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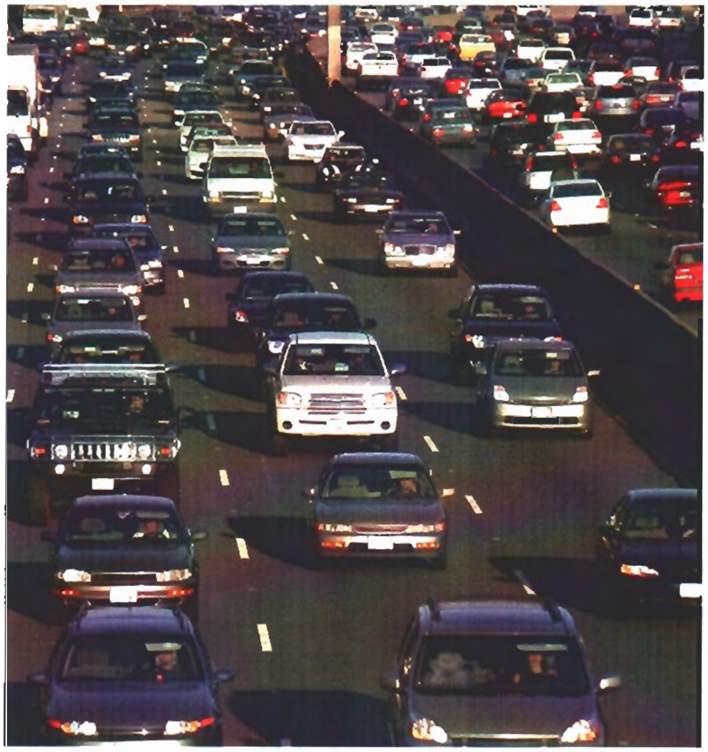

Consistency Certification No. CC-018-7

Response to Coastal Commission Staff Report Released September 2007

FOOTHILL TRANSPORTATION CORRIDOR SOUTH (FTC-S)

Transportation Corridor Agencies

January 9, 2008

San Joaquin Hills
Corridor Agency

Chairman:
Jim Dahl
San Clemente

TRANSPORTATION CORRIDOR AGENCIES

Foothill/Eastern
Corridor Agency

Chairman:
Lance MacLean
Mission Viejo

January 8, 2008

Mr. Mark Delaplaine
CALIFORNIA COASTAL COMMISSION
45 Fremont Street, Suite 2000
San Francisco, CA 94105-2219

Re: Consistency Certification No. CC-018-07
Foothill Transportation Corridor – South (SR-241 Toll Road)
TCA Response to Coastal Commission Staff Report

Dear Mr. Delaplaine:

The Foothill/Eastern Transportation Corridor Agency has reviewed the Staff Report released in September of 2007 and our formal response is attached herewith. As you know we have previously provided a hardcopy "redline" version of the Staff Report, however this submittal addresses not only factual errors, but includes discussion on the substantive issues raised in the Staff Report.

Please feel free to contact Valarie McFall, Acting Deputy Director of Environmental Planning at (949) 754-3475 if you have any questions.

Sincerely,

Tom Margro

Tom Margro
Chief Executive Officer

Cc: Larry Simon

Thomas E. Margro, Chief Executive Officer

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FOOTHILL/EASTERN TRANSPORTATION CORRIDOR AGENCY

CC No. CC-018-07

RESPONSE TO COASTAL COMMISSION STAFF REPORT RELEASED SEPTEMBER, 2007

SUBMITTED TO COASTAL COMMISSION JANUARY 9, 2007

TRANSPORTATION CORRIDOR AGENCIES

Valarie McFall

Acting Deputy Director

Environmental Planning

949/754-3475

TCA RESPONSE TO STAFF REPORT AND RECOMMENDATION ON CONSISTENCY CERTIFICATION EXECUTIVE SUMMARY

The Transportation Corridor Agencies (TCA) has carefully reviewed the Coastal Commission Staff Report and Recommendations on Consistency Certification No. CC-018-07 for construction of the portion of the extension of the 241Toll Road (SR-241) that crosses the California Coastal Zone.

Detailed responses to the Staff Report are included in the attached response document.

SUMMARY OF DETAILED RESPONSE TO STAFF REPORT

Our review of the Staff Report has discovered factual errors, misrepresentations, distortions, baseless conclusions, and egregiously misleading statements in such numbers and of such extraordinary proportions as to require our response to be stated with an unusual degree of candor. The staff's analysis is further undermined by reliance on zealous non-staff opponents for information. In addition, staff has cited faulty science and weak "engineering" studies that the preparers have acknowledged are flawed.

Faced with a wall of inconvenient truths, the Staff Report attempts to scale it with a hodgepodge of supposition, speculation, hypotheticals, urban legend and anecdotal observations. It is charitable to conclude that the Coastal Staff Report concerning the consistency certification for the completion of SR-241 (also called Foothill Transportation Corridor South, or "FTC-S") presents an inaccurate, one-sided analysis of the project and of the two decade-long federal/state environmental process that resulted in the adoption of the Green Alternative as the least environmentally damaging alternative.

The Staff Report, among other things:

- Mischaracterizes the project described in the consistency certification;
- Bases its analysis on impacts outside of the coastal zone (and thus beyond the Commission's jurisdiction under the federal Coastal Zone Management Act and Coastal Act);

- Grossly overstates habitat and species impacts by ignoring best available data, project features and other avoidance and minimization measures; and
- Ignores the considered professional judgment of the many state and federal transportation and environmental agencies that have studied and endorsed the Green Alternative.

Coastal Staff Admits That the Project is Needed But Staff Endorses I-5 Widening Alternatives That Would Have Devastating Natural and Human Environmental Impacts on Coastal Communities and on Affordable Coastal Access.

There is no dispute that the project is needed if the economy, environment and quality of life of the region are to be maintained. The regional transportation planning agency for Southern California, the Southern California Association of Governments, documents the challenges in stark language:

> *[T]he SCAG region is facing serious, unprecedented challenges. . . .The second-largest metropolitan area in the United States with over half of California's residents, the Southern California region is the most congested metropolitan area in the country. Over the past twenty years, traffic delays have nearly tripled in the region . . .*
>
> *. . .*
>
> *While California's population and total vehicle miles traveled have more than doubled since 1970, expenditures on this vital system have decreased significantly beginning in the early 1970s and have still not reached the level of investments made during the 1960s.* (SCAG, 2008 Regional Transportation Plan, p. 63)

Traffic forecasts for the year 2025 predict a 60 percent increase in traffic at the Orange/San Diego County line. A current commute of 25 minutes in South Orange County will take over an hour, adding 75,000 more vehicles, 500 percent as much congestion and nearly 600,000 pounds PER DAY (over 200 million pounds per year) of greenhouse gas emissions.

The 21 million people in the region who will benefit from the project are increasingly caught in a virtual prison of congestion – choking in a gridlock of delays. Inaction will result, fifteen years hence, in four additional hours of gridlock <u>each way</u> in the Orange County/San Diego corridor.

No one has made this point more eloquently than Governor Schwarzenegger: *"Our systems are at the breaking point now. We need more roads. [T]he people sit in gridlock…." (State of the State Address, January 5, 2006) [W]e all know that idling cars create a lot of greenhouse gas emissions."* (Press Release, Office of the Governor, October 16, 2007)

Even Coastal staff and the environmental groups who oppose the project acknowledge -- indeed, cannot escape – the fact that EXISTING and future congestion on Interstate-5 (I-5) requires the construction of a major new transportation facility in this corridor.

In what, by any measure, was a responsible and farsighted public policy response three decades ago, regional planners began planning for this inevitability. The TCA took over this responsibility and, 20 years ago, combined with other local, regional, state and federal transportation agencies and the federal environmental agencies to create a solution. ALL concluded that the Green Alternative discussed herein is the alternative that best accomplishes the regional transportation objectives of the project with the least amount of impact on the natural and human environment. In addition, Camp Pendleton continues to be an active participant in the Collaborative. The preferred alignment, traversing Camp Pendleton, would meet all the stipulations set forth by the U.S. Marine Corps, the most important of which is that the alignment does not impact Marine Corps tactical training or operational flexibility. The Marine Corps agrees that the current alignment meets their stipulations and conditions, however the Marine Corps has continued to stay "neutral" on the project, as they are required to do under federal law, until the EIS process is complete.

Coastal staff and other project opponents propose various alternatives that would require massive widening of I-5 and local streets which would forever alter the unique coastal community character of San Clemente and other coastal communities. Coastal staff and other project opponents summarily dismiss the enormous natural and human environmental impacts of the various I-5 widening alternatives documented in the state and federal environmental documents. Instead, they have chosen to rely upon cursory advocacy reports from a Vermont firm, Smart Mobility, which the opponents themselves admit are flawed and that do not comply with established engineering standards, resulting in an unsafe alignment not meeting Caltrans design and safety standards. Caltrans conducted an extensive analysis of the opponents' proposed I-5 "alternative" and concluded:

> *The [alignment proposed by SMI] does not meet Department standards, and in our view does not meet applicable engineering standards of care. Therefore, the Department cannot support the proposed design refinements or conclusions.* (Letter from Caltrans to FHWA, January 2008)

TCA's Engineering Manager with over 20 years of experience noted accurately that the Smart Mobility authors *"are not licensed in California. They don't know the area. They lack local experience. Their work looks like someone just drew highway designs on a Google Earth map."* Our full response to the Staff Report, and the Caltrans analysis, will prove that observation in detail.

Worse, in a stunningly cold and dismissive observation made in its Executive Summary (at page 6), the staff airily noted that the massive disruptions and human trauma of an I-5 widening should not be an impediment: *"Southern California highways are regularly implemented using condemnation procedures."* It appears that the staff views "condemnation" as merely a precise and painless incision across earth, stucco and lumber.

But such stark language would be small comfort to the families in 838 homes and the owners of 382 businesses which would be bulldozed to "implement" the staff's clinical view of progress. Such condemnation procedures (read: "forced takeovers") actually would expel nearly 2,000 citizens from their homes and sweep away the workplaces for 4,150 employees.

In real life, the I-5 widening alternative that Coastal staff believes is environmentally preferable – a 16-mile scar slicing through our neighborhoods -- would expand I-5 through the coastal communities of Dana Point, San Juan Capistrano and San Clemente from its existing 8 to 12 lanes to the future 14 to 18 lanes – resulting in the mass dislocation described above.

The unique coastal character of these communities would be forever altered – bisected by a massive new expanse of freeway carving through a 75-year history of California lore and community tradition. Yet, the Coastal Staff Report is devoid of any reasoned, objective analysis of the enormous destructive natural and human environmental costs of the I-5 widening alternatives.

Coastal staff should not be permitted to ignore the environmental impacts of the I-5 widening alternatives by claiming that they do not impact coastal resources or implicate coastal policies. The primary purpose of the Coastal Act is to protect and enhance coastal access – "maximum access" -- affordable by all Californians. The I-5 widening alternative embraced by Coastal staff would **WIPE OUT 16 coastal hotels and motels (including over 500 rooms) that provide affordable coastal visitor-serving facilities for a diverse cross-section of Californians**. A few of these hotels are shown below:

Yet the Staff Report is silent – and in our view insensitive -- about the impact of the I-5 widening alternative on coastal visitor-serving facilities. Coastal staff also ignores the undisputed fact that the I-5 widening alternatives are financially infeasible. As the Governor recently acknowledged, California has a $500 BILLION infrastructure deficit. No state or federal transportation funds are programmed for the widening of I-5 and Caltrans concurs that there is no foreseeable funding source to build a two to three billion dollar project to widen I-5. Thus, the Coastal staff's preferred alternatives are entirely illusory – a chimera premised in an analytical vacuum.

In contrast, the money saved by the taxpayers in the funding of SR-241 dovetails perfectly with the Governor's call for private financing. Speaking at a Monterey Town Hall on June 7, 2007, he made clear: "[W]e will miss out if we don't take private money and build public projects."

The Staff Report's Analysis of ESHAs Ignores Detailed Site Specific Data and Relies on Impacts Outside of the Coastal Zone.

The Staff Report reflects that its authors lack familiarity with the on-the-ground realities of the project site. Incredible as it may seem, the staff analysis of ESHA impacts defines the existing I-5, Old Highway 101, existing Cristianitos Road, and areas subject to several decades of intensive agriculture production as "environmentally sensitive habitat areas." A few are shown below:

Existing I-5: Included in Staff Report ESHA calculation

Existing Cristianitos Road: Included in Staff Report ESHA calculation

Existing Old Pacific Coast Highway, south of I-5: Included in Staff Report ESHA calculation

Existing I-5/Cristianitos Road Interchange: Included in Staff Report ESHA calculation

The Staff Report's treatment of claimed impacts to the Pacific pocket mouse (PPM) is illustrative of the Staff Report's inaccurate and misleading analysis and material misrepresentation of facts. The Staff Report claims that "the most significant adverse impacts [of the project] would be to the Pacific pocket mouse" and "would hasten the extinction of the entire species." Executive Summary pp. 2-3. In fact, a ten-year study of the pocket mouse (including 65,000 trap nights) DID NOT IDENTIFY A SINGLE POCKET MOUSE IN ANY PORTION OF THE PROJECT FOOTPRINT.

No pocket mice at all were found within the coastal zone. There is no mystery why pocket mice were not found in the coastal zone. There is only a very small amount of suitable habitat in the coastal zone. The Staff Report ignores detailed site-specific data to claim that the project will impact the 12 acres of "essential habitat" in the coastal zone, but ignores the best available data that indicates that only 0.6 (six tenths) of an acre of moderately suitable pocket mouse habitat exists in the coastal zone. And of course, the fact those ten years of study failed to identify a single pocket mouse in the coastal zone is itself dramatic evidence that the staff's claimed inconsistency with ESHA policies is incorrect. Indeed, the Commission made precisely this finding in its 1996 Coastal Commission Staff Report regarding the Marine Corps Officer Housing project at San Mateo Point (a 32-acre site immediately southwest of the I-5 off Cristianitos Road). The Commission found NO impacts to the PPM.

TCA has produced a solid analysis proving that the expert that staff relied upon, and therefore the Staff Report "deviate from the accepted norms of transparent scientific review." Given the stakes involved in the Commission's decision, TCA views the staff's inaccurate characterization of Pacific pocket mouse impacts as indefensible.

The Staff Report's treatment of arroyo toad ESHA issues is similarly flawed. The Staff Report claims that the project "would likely result in the loss of the only remaining coastal population of the arroyo toad." Executive Summary, p. 3. In fact, extensive surveys for the arroyo toad conducted over several years did not identify any arroyo toads within the coastal zone portion of the project. A member of the National Academy of Sciences rightly observes that the Staff Report "misinforms and misinterprets." The Staff Report incorrectly assumed that the connectors with I-5 would effectively be at grade (on the surface) when in fact the connectors are about 50 feet in the air at that location. Impacts to **potential** toad habitat in San Mateo Creek are limited to bridge columns that disturb 0.006 of an acre. This impact is less than the impact permitted (0.099 acre) by the Commission in its approval of Caltrans' repairs to similar bridge supports in the same location in San Mateo Creek (6-01-149). Still further, the Commission authorized impacts of this bridge repair project to be mitigated offsite and outside of the coastal zone.

Whether innocent or intentional, these egregious errors in the Staff Report are more than regrettable. The fact that misinformation and the failure of transparent scientific review can have the enormous consequence of destroying 20 years of planning is troubling. And these shortcomings raise additional doubts about the credibility of the staff's full analysis.

The Commission Has Consistently Rejected the Staff's Position Regarding Wetlands and the Use of the Balancing Provisions of the Coastal Act.

The Staff Report reflects the historic position of coastal staff that the Coastal Act does not allow impacts to wetlands for new transportation improvements – regardless of the small size of the impact and regardless of the magnitude of the mitigation measures to restore and enhance wetlands.

Thankfully, the Commission has rejected the staff's inflexible position on numerous occasions – using the Commission's authority under the "balancing" provisions of sections 30007.5 and 30200 of the Coastal Act including, but not limited to, the following:

RECENT COASTAL COMMISSION BALANCING DECISIONS

Decision	Year	Project Description	Sections Balanced
LCPA No. 2-06B (Carlsbad)	2006	Zone change for residential development	30240 (ESHA) and 30250 (concentration of development)
CDP No. 1-06-033 (Tilch)	2006	Replace failing onsite sewage wastewater disposal system for residence	30233 (wetlands) and 30231 (water quality)
UCSB LRDP Amendment 1-06, NOISE 1-06, and LDP No. 4-06-097	2006	Campus housing	30233 (wetlands) and 30250 (concentration of development)
CC-004-05 (North County Transit District)	2005	Construction of second railroad tracks	30233 (wetlands), 30240 (ESHA) and 30231 (water quality), 30252 (public access), and 30253 (air quality and energy conservation)
LCP No. 1-03 (Dana Point)	2004	Residential, commercial, visitor-serving development, parks, trail, and open space	30240 (ESHA) and 30210-31214 (public access), 30231 (water quality), 30250 (concentration of development)
LCPA No. 1-03B, CC-007-003 (Carlsbad)	2003	Habitat Management Plan	30240 (ESHA) and 30250 (concentration of development)
LCP Maj. Admt No. 3-01 (San Luis Obispo)	2002	Sewage Treatment Plant	30240 (ESHA) and 30231 (water quality)
LCPA OXN-MAJ-1-00 (Oxnard Northshore)	2002	Site remediation, residential development, and resource protection area	30233 (wetlands) and 30231 (water quality)
CDPM 9-98-127 (City of San Diego)	2000	Construction of freeway segment of SR-56	30233 (wetlands) and 30231 (water quality)
Appeal No. AS-IRC-99-301 (Irvine Community Development Co.)	2000	Mass grading and backbone infrastructure for future residential and recreational development	30233 (wetlands) and 30231 (water quality)
CPDM 1-98-103 (O'Neil)	1999	Construction of barn for dairy cows near stream	30233 (wetlands) and 30231 (water quality)
CC-64-92/5-92-232 (TCA)	1993	Construction of San Joaquin Hills Transportation Corridor Toll Road (SR 73)	30233 (wetlands) and 30210-30213, 30252 and 30253 (public access)

Time and time again the Commission has rejected the Coastal staff's position and has approved transportation and other public service facilities despite impacts to coastal wetlands. Indeed, the Commission approved the State Route 73 extension (financed and built by TCA) and the State Route 56 project in San Diego despite impacts to wetlands from those projects that were greater than the minor wetland impacts (0.16 – sixteen hundredths – of an acre) attributable to the project. These projects were approved due to the public access, habitat, and water quality benefits associated with the projects.

The precedent established by the Commission's approval of State Route 56 (6-98-127) is directly applicable to the project. As is the case here, State Route 56 involved the construction of a new highway interchange connecting to I-5 in the coastal zone. The similarities to the project are remarkable. The Staff Report on the SR 56 project stated:

> *The construction of the freeway segment is not one of the eight allowed uses in wetlands pursuant to section 30233 of the Coastal Act. The proposed project represents a major east-west highway linkage between two existing segments of SR 56. . . . 0.427 acres of existing riparian habitat will . . . be permanently impacted by the construction of the new highway. This development is not consistent with section 30233 of the Coastal Act, which does not allow fill of wetlands for new roadways. However, . . . the Commission finds that there is a conflict between the provisions of section 30233 and other Coastal Act policies and that the proposed development, on balance, provides a greater benefit to coastal resources than is provided by existing conditions.*
> (SR 56 Staff Report, April 25, 2000)

The project Staff Report attempts to distinguish the Commission's approval of SR 56 (and the other highway projects approved by the Commission despite wetland and ESHA impacts) and ignores the essential undisputed fact – the Commission has routinely used the balancing provisions of the Coastal Act to approve new highways with wetland impacts where the new highway improves water quality or coastal access.

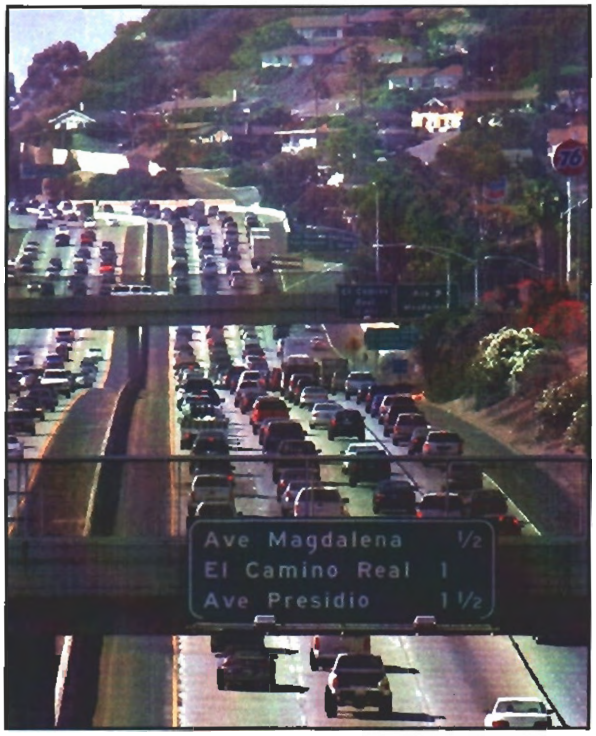
That is exactly the circumstance here. Like the SR 56 project, the completion of SR 241 will provide important water quality benefits by collecting and treating 5 million gallons per year of untreated runoff from EXISTING I-5 and will also provide dramatic coastal public access improvements by alleviating traffic on I-5 and by providing an alternative route for access to the coast from inland communities, in addition to providing funding for low and moderate cost visitor-serving uses through the addition of TCA's $100 million State Parks restoration and enhancement package.

In CC-64-92, the Commission approved a combined CDP and Consistency Certification for construction of a segment of the 17.5-mile toll road (San Joaquin Hills Transportation Corridor – SR-73) within the coastal zone. The Commission found that the project would fill 0.33 acre of wetland. However, it once again overruled its staff and further found that denial of the project would conflict with the public access policies of the Coastal Act. Finding approval of the project, on balance, to be most protective of coastal resources, the Commission explained:

> *. . .[T]he No Project Alternative would result in either a significant overload of the transportation system capacity of Pacific Coast Highway or significant adverse impacts to coastal communities and public recreational areas necessitated by future widenings of PCH. The City of Laguna Beach has already stated its opposition to the latter and has articulated a "planned deficiency" approach to PCH through Laguna Beach (in findings of approval for the Irvine Coast Development Agreement EIR). Consequently, the failure to approve the SJHTC would result in impacts contrary to Sections 30001.5, 30210, 30212, 30212.5, 30213, 30223, 30240, 30253.5 and 30254 of the Coastal Act either as a result of failing to provide for adequate transportation system access to coastal and upland support recreational areas or as a consequence of impelling the widening of PCH in a manner resulting in significant impacts both to coastal communities and to public recreational areas.*

Anyone who travels on I-5 every weekend would scoff at the staff's claim that the project will not provide important coastal access benefits. The photos below show typical WEEKEND traffic on this portion of I-5. Much of this traffic involves Californians driving to and from coastal locations – including travelers from inland Southern California (Riverside communities) to beaches in southern Orange County and San

Diego County. Many drivers seek to avoid the consistently clogged weekend congestion on I-5 by diverting to local streets -- mimicking the choked and clogged chaos of the freeway itself and resulting in additional barriers to coastal access.



The net effect of the existing severe traffic congestion is to prevent and discourage Californians from obtaining access to the coast. As the Commission recently said in its approval of the Consistency Certification for the North County Transit District's railroad passing track extension (CD-008-07):

> *The Commission finds that traffic congestion interferes with access to the coastal recreational opportunities within northern San Diego County (including travelers from Los Angeles and Orange Counties). As traffic congestion increases with expected growth of the region, these access impacts will worsen, and when congestion increases, non-essential trips such as those for recreational purposes tend to be among the first to be curtailed. Thus, as the traffic increases, the ability for the public to get to the coast will become more difficult, which would result in a condition that would be inconsistent with the access policies of the Coastal Act.*

The Project Will Have Limited Impacts on San Onofre State Beach (SOSB). TCA's $100 Million Parks Improvement Package Will Protect and Enhance Affordable Coastal Recreational Uses.

Staff claims that the project will have significant adverse effects on the San Mateo campground (within subunit 1) and related recreational resources. These impacts are almost entirely outside of the Coastal Zone (e.g., aesthetic impacts to the San Mateo Campground) and thus are not relevant to the Commission's consistency decision. The project REMAINS INLAND OF OLD HIGHWAY 101. Moreover, the project is located at a greater distance from the campsites at San Mateo Campground than I-5's distance is from State Park campsites located along the coastal bluffs of San Onofre State Beach (SOSB). The trail from the San Mateo Campground to the beach will be maintained throughout construction of the project. Importantly, the Staff Report fails to mention that:

- State Parks entered into the lease with the Department of the Navy with the express written understanding that the Navy reserved the exclusive right to grant additional road rights of way within the lease area;
- The general alignment for the project was established **8 YEARS before** the State Parks Department established the San Mateo Campground; and
- The Park's 1984 General Plan acknowledged that the project was planned to cross Subunit 1 of the lease area – **5 years before** establishment of the San Mateo Campground; and
- The closest campsite to the project will be 383 feet away (buffered by a 16-foot high sound wall) – with the average campsite more than two football fields away.

TCA has included within the project description an unprecedented commitment to provide $100 million dollars for major improvements to San Onofre State Beach, San Clemente State Beach and Crystal Cove State Park. This commitment represents the largest single contribution to improvement of the State Park system in its history. It is 25% of the State Park's operating budget for FY 2008. This money could be used by the State Park system to potentially fund the following:

- A 50-year extension of the San Onofre State Beach lease;

- Full funding for completion of the restoration of the cottages at Crystal Cove State Park;
- Funding for construction of camping facilities at the closed El Moro area within Crystal Cove State Park;
- The addition of at least 160 new campsites at San Onofre State Beach and San Clemente State Beach; **and**
- Restoration of 150 additional acres of coastal sage scrub habitat from the existing non-native grasslands at Crystal Cove State Park.

TCA's $100 million dollar commitment is NOT limited to the above uses. For example, if the State should elect not to seek to extend the lease at this time, approximately $70 million would be available for other additional improvements to enhance coastal recreational access.

The California Resources Agency has noted that the backlog in upkeep in California's state parks is well over $900 million. Even as the State Parks Department knows of our $100 million offer, and in light of its desperate need for funding, it is inexplicable why the State Parks Department continues to vocally oppose the project while also allowing its officers to make misleading and false claims about the project's impacts.

The Project Will Have No Impact On Trestles.

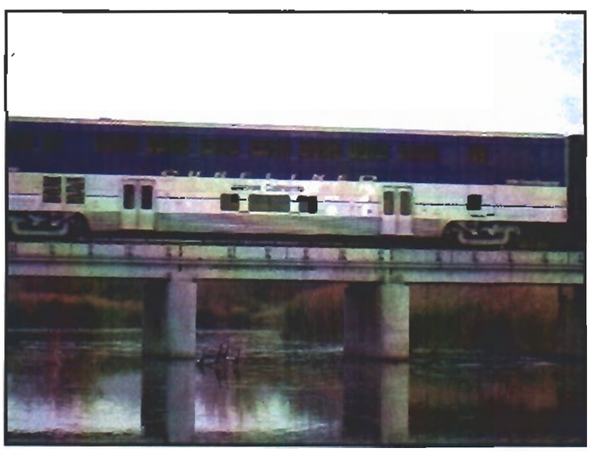
One of the most outrageous and objectionable claims in the Staff Report are the baseless assertions that the project would create detrimental impacts to the surfing at Trestles. The Staff Report says "[e]xperts disagree on whether alterations [to surfing resources] would occur." (Staff Report, p. 6).

We are pleased to commit this urban legend to its deserved demise. The undisputed facts are that:

- The surf conditions at Trestles are created by the cobble stones that create the hard bottom conditions for a stable surf break;
- The project bridges San Mateo Creek and, thus, does not interfere with the movement of the cobbles to the shore from San Mateo Creek;
- The project does not come any closer to Trestles than Old Highway 101;

- The project has been designed so that there is no net effect on the delivery of sediment to San Mateo Creek; and
- History shows that the good surfing conditions at Trestles have never been negatively impacted by construction of an at grade railroad crossing on Trestles beach, nor by the construction of highway bridges across San Mateo Creek for Old Highway 101, and Interstate 5 (I-5), nor for the repair to I-5 bridges in the creek recently approved by the Commission.

Put another way: Over the last 67 years there has been a combination of nearly five hundred supports, abutments, pier walls, footings, timber piles and upgraded foundations sunk into San Mateo Creek to support the railroad trestles, Old Highway 101, and eight lanes of Interstate 5. If hundreds of these supports are currently in San Mateo Creek and the surfing remains excellent, then how is it even conceivable that adding four supports for the toll road could "destroy" the world-class surf at Trestles? Indeed, it's not conceivable and renders repeated claims to the contrary ludicrous on their face.



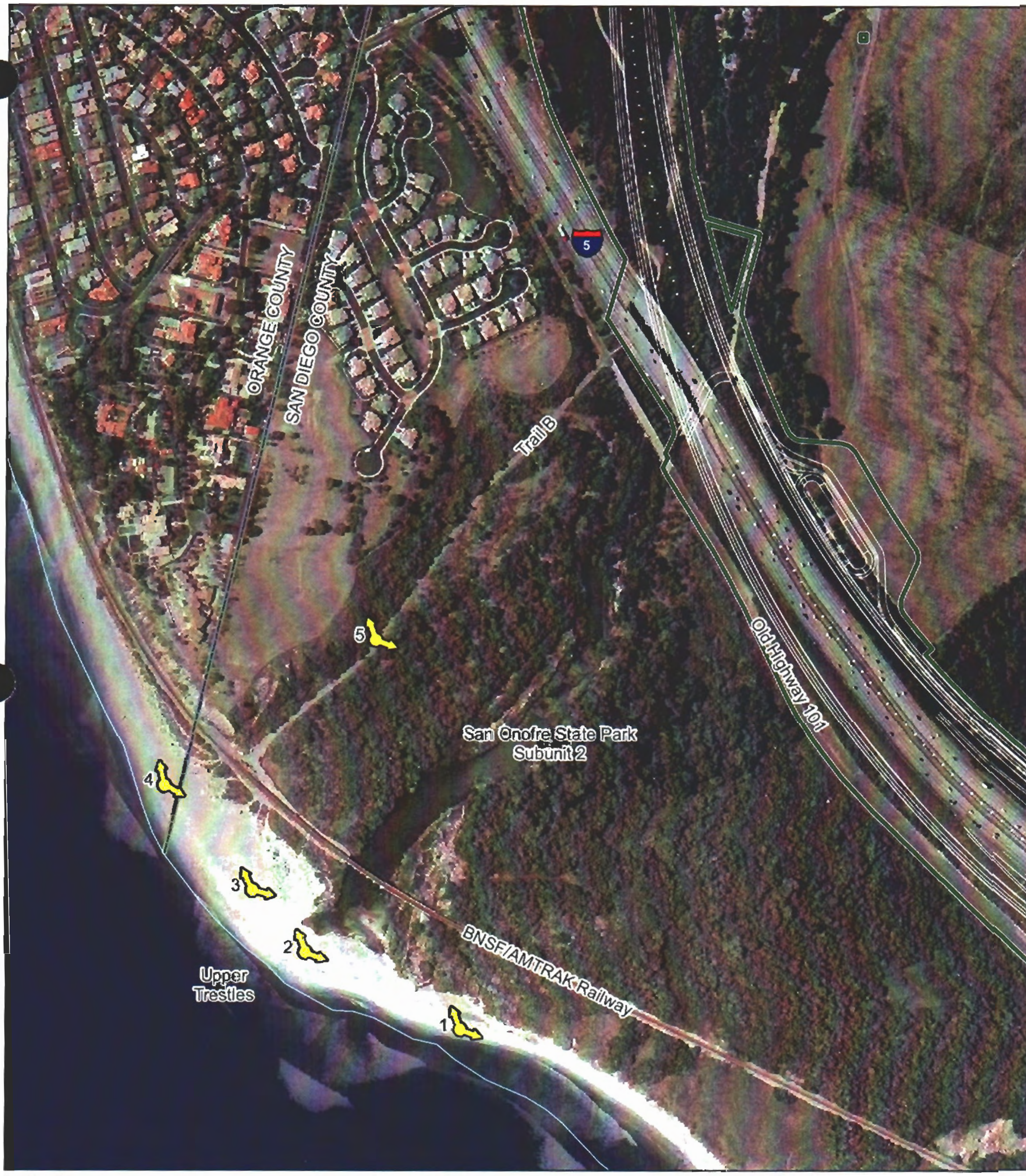
Railroad and railway trestles are between the project area and Trestles beach

Old Highway 101 bridges are between the project area and Trestles beach

I-5 bridges over San Mateo and San Onofre Creeks already exist

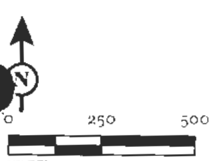
The "Trestles Experience" – still in effect with several existing structures in the watershed and creek beds

Despite the fact that the project comes no closer to Trestles than the existing Old Highway 101, the Staff Report claims that the project would "adversely affect the aesthetic and the natural setting of the surfing experience." (Staff Report, p. 6). The staff's opinion is contradicted by the detailed aesthetic evaluation of the project, including the view simulations of the views from the beach, with and without the project, shown on the following pages.



LSA

FIGURE 1



Legend

Photo Location Points (with ID)

Foothill Transportation Corridor - South Disturbance Limits

Foothill Transportation Carridor - South

Additional Photo View Points

SOURCE: EagleAerial (5/07)

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CONCLUSION

More than 20 years ago, public officials – citizens emerging from their neighborhoods and communities to serve the common good – embarked on a mission which exemplifies good public policy. They realized that the quality of life, the legacy of progress, and the solid and sustained economic hopes underpinning their towns and cities required that movement on their streets and highways be accommodated to the large population and visitor movements attracted to coastal California.

With a combination of funding shortages and other regional planning barriers, the toll roads became the best solution, complementing the state transportation system and someday becoming free public highways. Fifty-one miles of these roads have been completed, improving mobility throughout the region. And, now, 16 miles remain for completion.

The current alignment for which we seek the Coastal Commissioners vote is the result of over two decades of dedicated effort and labor. Yet, after two decades of rigorous study and re-study;

- The expenditure of more than $20 million;
- More than 50 meetings by a collaborative of six different state and federal agencies which reached consensus;
- Countless public hearings and meetings with fidelity to neighborhood concerns;
- The review of 38 different alternatives;
- Regard for the most profound environmental balancing; and
- The most sophisticated and professional scientific and technical studies followed by intensive peer review.

After all this, the Coastal Staff Report emerged as a disappointment of huge dimensions. Because of the sheer mass of staff error and misrepresentation and its reliance on the conjecture, wild charges, and claims of opponents who substitute volume for veracity, we believe they have transformed from neutral public servants to advocates who have suspended impartiality.

And while we regret the necessity for such direct observation, our full response -- centered in fact and solid analysis -- will prove that the staff recommendations should be rejected, and we respectfully request that the Commission concur in the TCA's consistency certification.

I. RESPONSE TO STAFF REPORT (9/07) PROJECT SUMMARY

A. Project Description

The Coastal Commission's jurisdiction is limited to those portions of the Foothill Transportation Corridor – South ("FTC-S") proposed in the coastal zone. Only a very small portion of the completion of FTC-S is within the coastal zone established by the California Coastal Act. The project is also the extension of the existing SR-241, and this response also references SR-241 as appropriate.

The Staff Report fundamentally misstates the impacts of the project within the coastal zone because the staff report relies on alleged impacts of the project that are outside the coastal zone, and thus outside of the Commission's jurisdiction. This erroneous project description is not consistent with the consistency certification and supporting documents that Transportation Corridor Agencies (TCA) provided to Coastal Commission staff. Moreover, it pervades the Staff Report, skews the analysis, and thus misleads both the Commission and the public.

The Staff Report erroneously asserts at the outset that the project *"would be approximately 16 miles long"* (pp.1, 12). In fact, only a very small portion of the SR-241 completion ("the project") is located within the coastal zone. The project crosses Marine Corps Base Camp Pendleton and intersects the coastal zone boundary approximately 0.25 mile northeast of and generally parallel to the existing Interstate (I-5). Thus, for purposes of this consistency certification and per the Commission's jurisdiction, the project is limited to approximately 2.2 miles of improvements, of which 1.7 miles are improvements along the existing I-5 (to provide the northbound and southbound connectors between SR-241 and the I-5). **The project includes only four lanes of traffic, two in each direction.**

The Staff Report project description also improperly includes elements not proposed to be built by TCA at this time, including the possibility of adding additional lanes at some point in the future. However, any additional lanes within the coastal zone would be subject to separate Coastal Commission review. Any additional lanes would be to provide a direct connector from future I-5 HOV lanes. It is expected such lanes would not be needed before some 10 or more years into the future. Those features are not a part of the project before the Commission, and cannot be considered in the analysis of the project.

Similarly, the project description in the Staff Report included incorrect earthwork numbers. The project includes approximately **1.4 million cubic yards of grading** (not 45 million stated in the Staff Report on page 152 or the 41 million stated on page 12) within the coastal zone. This includes 550,000 cubic yards of cut and 855,000 cubic yards of fill (as opposed to the 22 million cubic yards of cut and 19 million cubic yards of fill stated in the Staff Report on page 12). The correct grading numbers were provided to Coastal Staff in the report entitled *Roadway Description and Related Design Features*, submitted with the Consistency Analysis, on March 23, 2007.

The project description in the Staff Report also included incorrect project footprint numbers. **The total footprint of the project within the coastal zone is 138 acres (including 80 acres of existing I-5 and other existing transportation facilities).** This footprint includes all needed areas for grading, remedial grading, construction disturbance, paved roads, bridges, access roads, materials storage areas, utility relocations, etc. This is drastically smaller than the 1,194-acre project footprint identified in the Staff Report (pp. 1, 12, 152).

These errors are not merely suggestive of overreaching in the staff's recommendation, but fundamentally blur and confuse the exercise of the Commission's jurisdiction in reviewing and acting on this consistency matter.

II. RESPONSE TO STAFF PROCEDURES

A. Consistency with the California Coastal Management Plan (CCMP)

i. Alternative Measures

The Staff Report erroneously asserts that *"no measures exist that would enable the proposed alignment to be found consistent with the Coastal Act."* As discussed later in Section III: Response to Staff Findings and Declarations, **Staff's analysis pointedly ignores the extensive, detailed and binding mitigation measures included in the certified Final SEIR and included by TCA as part of the Project described in the consistency certification.** Those mitigation measures include effective procedures and Best Management Practices (BMPs), mandated by State and federal law to avoid or minimize environmental impacts, and that have proven to be successful in cases similar to the project. Because the Staff Report ignored or discounted the mitigation measures included in the project, the Staff Report fundamentally presents an inaccurate assessment of the project impacts. To illustrate, a few examples of measures the Staff Report ignored or substantially discounted are listed below:

- Project Biologist (Construction) (Measures TE-1, TE-2)
- Biological Resources Management Plan (Measure TE-3)
- Other biological measures, including wildlife bridges and culverts, design so there is no barrier to fish movement, invasive plan species management (Measures WV-15, 21, 27-29, TE-9)
- Arroyo Toad Resource Management Plan and construction measures for arroyo toad (TC 10-17)
- Final Design Noise Analysis (Measure N-7)

The Staff Report asserts erroneously that numerous alternative alignments are feasible and could be found consistent with the Coastal Act. Additionally, the Staff Report incorrectly implies that TCA acted alone in the selection of the preferred alternative. In fact, the preferred alternative was selected by "The Collaborative", consisting of local, state and federal transportation, regulatory, resource, and national security agencies that worked closely together to define the project's purpose and need, and to create, evaluate and screen alternatives throughout the planning process. Specifically, the Collaborative includes the following agencies: United States Environmental Protection Agency (EPA), United States Fish and Wildlife Service (USFWS), United States Army Corps of

Engineers (ACOE), Federal Highway Administration (FHWA), Caltrans, and the TCA. Marine Corps Base Camp Pendleton was an active participant in the "Collaborative" and had oversight to ensure that the preferred alternative did not impact the USMC Mission or operational flexibility. Over the course of more than 50 all-day meetings held over six years, the Collaborative evaluated each of the alternatives: 1) impacts to riparian ecosystems and ecosystems habitat; 2) traffic relief to I-5 and major local arterials, including percent of daily I-5 traffic congestion and hours of total vehicle travel time savings; 3) community impacts, including the number of impacted residences; 4) community disruption; 5) total costs; and 6) cost per hour of travel time savings.

The record demonstrates that these alternatives, including those suggested by the Staff Report, were properly eliminated as infeasible because they failed to adequately mitigate environmental or military impacts, or would result in enormous community and coastal resource impacts[1].

The EPA and ACOE have preliminarily determined that the preferred alternative is the Least Environmentally Damaging Practicable Alternative (LEDPA). The USFWS has preliminarily indicated that the preferred alternative will comply with applicable requirements of the Endangered Species Act. These determinations reflect the evaluations by these agencies in the Collaborative process conducted over six years. The LEDPA test administered by the Collaborative to choose the preferred alternative is equivalent to the test required by the Coastal Act to find the "least environmentally damaging feasible alternative".

Staff's suggestion that the chosen alignment cannot be made consistent with the Coastal Act ignores the lengthy process and evaluation completed by the Collaborative agencies, as well as the hard facts that demonstrate the infeasibility and enormous community and coastal resource impacts of the other alternatives suggested. The Staff Report is inconsistent with general planning principles that call for cooperation between state and federal agencies in the planning process and deferral to the agencies with the primary responsibility for various resources. Because the Staff Report flies in the face of the opinion

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[1] For a detailed discussion on the elimination of these alternatives, see Part H. Alternatives of Section III: Response to Staff Findings and Declarations of this document, and additionally, the report *Alternatives Analysis Summary* submitted to Coastal Commission staff on February 28, 2007.

reached by the other federal and state agencies and is completely belied by substantial evidence in the record, the Commission must consider the federal agencies' conclusions and agreement in the LEDPA.

Furthermore, a closer view of staff's determination that six other studied alternatives are feasible and consistent with the Coastal Act proves to be a meaningless analysis, for not only were they determined to be infeasible by the Collaborative, three are totally outside the coastal zone and so pose no consistency issues. The remaining three encroach only on a small portion of the coastal zone in areas of existing development, and therefore have limited resource impacts in the coastal zone. Nonetheless, none of the alternatives identified by staff achieves the congestion relief and coastal access benefits of the proposed project while also meeting Coastal Act least environmentally damaging feasible alternative criteria.

ii. Necessary Information

The Staff Report requested additional information from TCA in regards to wetlands, water quality, archaeology, and greenhouse gas emissions. TCA provided all of the requested information, as detailed in this Response document and summarized below.

Wetlands: Staff requested the following information pertaining to wetlands:

- *Wetlands Assessment of Project Area:* The TCA consistency certification documentation included a delineation of waters of the United States including wetlands, and water bodies subject to Fish and Game Code Section 1600 et. seq. TCA submitted supplemental information further delineating wetlands within the coastal zone to Coastal Commission staff on 12/19/07. Wetlands acreage did not change with this supplemental assessment.
- *Wetlands Assessment of Mitigation Area:* This was completed on 12/17/2007 and submitted to Coastal Commission staff on 12/19/07. It was found that the mitigation area is not a wetland.
- *Functional Assessment:* This was completed on 12/17/2007 and submitted to Coastal Commission staff on 12/19/07. An additional six functional capacity units will be created.

Water Quality: Staff requested the following information pertaining to water quality:

- *Adequate baseline data for San Mateo and San Onofre Creeks:* The available information has been provided to the RWQCB. In anticipation of a condition for the 401 certification, TCA has developed a baseline monitoring plan for RWQCB staff review. The baseline monitoring plan will be implemented by TCA following approval of the 401 certification.
- *Additional Information Requested by RWQCB:* All additional information requested by RWQCB was provided to RWQCB on 01/04/08 and included in this submittal to Coastal Commission staff, under a separate cover.

Archaeology: Staff requested the following information pertaining to archaeology and cultural resources:

- T*raditional Cultural Property Evaluation for Panhe:* The status of Panhe as a Traditional Cultural Property is not in question: it is recognized by the fact that the San Mateo Archaeological District (SMAD) has been determined eligible under both Criteria A and D. Since the eligibility of the District has been established, the impacts have been assessed in accordance with that status. (See previously submitted memorandum titled "The Need for Traditional Cultural Property Evaluations for *Panhe* and Trestles", submitted to staff on December 20, 2007, also provided here as Attachment 16).
- *Traditional Cultural Property Evaluation for Trestles:* A December 31, 2007 letter from the Federal Highway Administration (FHWA), in consultation with Caltrans, Marina Corps Base Camp Pendleton Environmental Security and the Advisory Council on Historic Preservation, established that the boundary of the surfing use area is well outside the study area for the project, and that other modern facilities (e.g., the train tracks/trestle bridge, Old Highway 101, and I-5) are present between the surfing use area and the project. Therefore, a TCP Evaluation to determine the status of the surfing use area is not necessary because FTC-S is not within the area of surfing use (see Attachments 16 and 17).

Greenhouse Gases: Staff requested the following information pertaining to greenhouse gases:

- *Evaluation of the Project's Contribution to Global Warming:* An assessment of construction and operational GHG effects was provided. This information is included in this document, in Section III: Response to Staff Findings and Declarations, Part E: Greenhouse Gases.
- *Mitigation for Construction and Operation Emissions:* An assessment of the operational effects of the project on greenhouse gas emissions was provided to Staff on April 30, 2007. In response to Staff's request, a revised study that also includes the construction impacts of the project on greenhouse gases was provided to Staff on December 20, 2007. Construction impacts will be offset by the carbon emissions savings produced by operation of the project in five years, as discussed in a summary discussion provided in Section III: Response to Staff Findings and Declarations, Part E: Greenhouse Gases of this document. TCA has included additional features that will further reduce greenhouse gas emissions. No mitigation is required because the project will have a net benefit.

III. RESPONSE TO STAFF FINDINGS AND DECLARATIONS

A. Environmentally Sensitive Habitat

The Staff Report states, "*the Commission must evaluate resource conditions as they exist at the time of the review, based on the best scientific information available*" (p. 26). However, at nearly every opportunity, the Staff Report ignores, omits, or distorts readily available scientific information and resources in its ESHA analysis. As an initial matter, the Staff Report fails to conduct the very kind of analysis and review it emphasizes is necessary in any ESHA determination. Specifically, the Staff Report in effect augments and therefore revises the statutory definition of ESHA and states that the determination of whether an area is an ESHA requires a "site-specific" analysis that takes into consideration such elements as *"community role, life-history, dispersal ability, distribution, abundance, population dynamics, and the nature of natural and human-induced impacts"* (p. 25).

Nonetheless, as discussed further below, even under the augmented and revised definition, the staff did not properly identify ESHA in the project area. The Staff Report is devoid of any site-specific analysis that considers the above elements. The following are a few examples of Staff's grossly inaccurate characterization of the value of the habitat within the coastal zone:

- The Coastal Commission staff grossly overestimates the potential arroyo toad habitat to be impacted by the proposed project. Staff's calculations of 66 acres (p. 43) includes approximately 32 acres of habitat types that cannot or do not support the arroyo toad such as existing transportation facilities (I-5 and other paved roadway surfaces) and other developed/disturbed areas containing non-native and ornamental vegetation (landscaped areas).

- The Staff Report claims that 12 acres of Pacific pocket mouse (PPM) "essential habitat" occurs within the coastal zone portion of the project disturbance limits based on a single habitat parameter (soil). This single parameter test grossly overestimates the amount of PPM habitat. A more robust analysis conducted by project biologists utilizing four parameters

> that are known to contribute to habitat suitability (soil, topography, historical disturbance, and vegetative cover) identified only 0.6 acre of habitat considered of moderate suitability within the coastal zone.

The Staff Report fails to include any documentation that the Coastal Commission ecologist visited the site and failed to document how much time was spent evaluating the resources in the field. Indeed, it is evident Commission staff is not familiar with the project site: it is not, as staff prefers to depict it, an unspoiled wilderness. It is clear upon visiting the site that many existing roads, trails, and other disturbed areas currently exist within the project impact area and would be utilized during construction to minimize additional impacts. Moreover, despite the fact that **over 50 professional biologists have been collecting and analyzing data from the project area for over 20 years, with thousands of hours spent in the field, staff chose not to contact any of these experts to discuss site conditions or research and data collection efforts.**

Dr. Dennis Murphy provides the following analysis of the Coastal Staff's evaluation of biological resource issues (see Attachment 1, *Letter from Dr. Dennis Murphy to California Coastal Commission, January 2008*). Dr. Murphy received his PhD from Stanford University and was chair of the Scientific Review Panel for the Southern California Natural Community Conservation Planning Program. He currently serves on the Board of Environmental Studies and Toxicology at the National Academy of Sciences:

> *The core of the staff report on sensitive species is a highly selective interpretation and reinterpretation of available observations and data, and is obviously designed to build a singular case against the toll road project – in essence, a categorical cherry picking from the standing base of information on the status and trends of species of concern, on species uses and reliance on specific habitat associations and resources, and on possible species and habitat responses to proposed and potential mitigation and management actions.*
>
> *...The staff report is neither a legitimate scientific (or technical) assessment of information provided by the applicant, nor is it a reliable appraisal of current knowledge pertinent to Coastal Commission deliberations.*

For the least Bell's vireo, the toll road Environmental Impact Report/Subsequent Environmental Impact Statement (EIR/SEIS) recognizes disturbance or permanent loss of portions of just two vireo "breeding" territories in the coastal zone- is a trivial impact on a species that is distributed along riparian strands throughout the San Mateo and San Onofre Creeks watersheds, as well several dozen additional watersheds across southern California.

In support of its negative finding on the impacts of the proposed project on this species, the staff report states that at the time of the bird's listing in 1986, it was known to inhabit just 291 territories in its range in California. The report then correctly notes that the species currently exists in more than 3000 occupied territories across that same range (having benefited from an ambitious and successful parasitic cowbird trapping program). The ten-fold increase in population numbers makes least Bell's vireo a top candidate for delisting by the U.S. Fish and Wildlife Service (FWS); nonetheless, the staff report describes the species' situation "as changed only slightly in the thirty-one years (sic) since listing," then returns to recounting that very few birds were found in certain southern California watersheds in the 1980s.

The salient fact is that today in the San Mateo and San Onofre watersheds alone there are nearly half as many vireos than existed statewide at the 46 known locations that were occupied when the bird was granted federal protection in 1986. While not yet formally designated as "recovered" by FWS, the least Bell's vireo has experienced one of the greatest reversals in population trend of any federally protected species in California. Given that the toll road project will directly impact just over one and a half percent of the current local "population" of least Bell's vireos, and substantially less than a tenth of one percent of current regional numbers of the species, an independent scientific assessment of impacts on the vireo would not agree with staff that the proposed project is "inconsistent with the environmentally sensitive habitat resource protection requirements" in the Coastal Act.

General planning principles call for all possible sources of information to be transparently considered. Any assessment in support of conservation *planning that less than rigorously strives to meet this obligation is likely to be biased. Given the supporting evidence cited in the staff report, it is clear that staff has chosen to present only those materials from the scientific literature and other sources that might support their conclusions – even where a preponderance of the evidence suggests that the conclusions that they present are incorrect.* (Attachment 1, pp. 1-3)

Under the subheading "Site Specific ESHA Analyses," Coastal Commission staff implies that the value now placed on these resources should influence the Commission's implementation of the law (p. 26). However, the Coastal Commission staff rejects the "values"--professional opinions--of those State and federal agencies that are mandated by law and whose expertise it is to protect sensitive species. As documented below, staff asserts, by implication, that its own opinion about species' status and habitat needs and project impacts deserve greater weight than that of these agencies. For example, the report defines as an ESHA any area within the coastal zone portion of the proposed project area that is currently or has previously been designated as critical habitat by the U.S. Fish and Wildlife Service (USFWS) (p. 26). The USFWS, the agency that regulates critical habitat designations for federally listed species, has in several instances determined that a critical habitat designation is no longer appropriate - based primarily on the determination that existing conservation planning actions provide protections to species at a level higher than that afforded by the designation of critical habitat - and has removed such designation. Yet staff fails to acknowledge that USFWS's regulations constitute the "best scientific information available," which the Coastal Commission states is the standard for their analysis (p. 26). **To meet its standard of basing ESHA determinations on the most current scientific information available, Coastal Commission staff should observe the expert agency's regulations, which are prepared by agency staff and subject to peer review and public notice and comment.**

Further compounding the Staff's distortion, the Staff Report identifies 66 acres of critical habitat within the coastal zone for gnatcatcher, but fails to disclose that approximately half of this area (32 acres) includes existing transportation facilities (I-5 and other roadway surfaces) and other developed/disturbed areas containing non-native and ornamental vegetation that are explicitly excluded from the designation of critical habitat by USFWS because they do not provide habitat for gnatcatcher (USFWS Final Rule Designating Critical Habitat for Coastal California Gnatcatcher, 65 Fed. Reg. 63,679, 63,685 [Oct. 24, 2000]).

In any event, in 2007 the USFWS excluded several areas, including the coastal zone portion of the project area, from critical habitat for coastal California gnatcatcher because it determined the area is subject to the Integrated Natural Resources Management Plan (INRMP) adopted by the U.S. Marine Corps (USMC) that provides a benefit to gnatcatcher and because of the protection provided by adopted habitat conservation plans, which include the mitigation provided by TCA for this project in Upper Chiquita Canyon (see Attachment 2, *Revised Designation of Critical Habitat for the Coastal California Gnatcatcher; Final Rule 50 CFR Part 17, December 2007*) (72 Fed. Reg. 72010, 72044 [Dec. 19, 2007])[2] (see later discussion of the Upper Chiquita area for more detail). The USFWS is certainly aware of plans to build the toll road in this area (see, e.g., 72 Fed. Reg. 72025).

Critical habitat is designated for **only one species** within the coastal zone in the area of the project: tidewater goby. A total of approximately 130 acres of critical habitat have been designated for the goby in San Mateo and San Onofre Creeks; however, due to significant avoidance measures by TCA and FHWA, the proposed project would only result in the permanent loss of 0.011 (0.006 in San Mateo Creek and 0.005 in San Onofre Creek) acre of this area (less than 0.008 percent [eight one thousandths] of the total critical habitat designated for this species in these watersheds.[3]

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2 The coastal California gnatcatcher benefits from current management practices under the 2007 INRMP through: (1) Nonnative vegetation control; (2) brownheaded cowbird management; (3) investigative research (e.g., to determine effects of wildfire on coastal California gnatcatcher habitat quality and distribution); (4) the establishment and management of coastal sage scrub mitigation areas, and (5) habitat enhancement by using native seed stock in restoration and recovery measures (MCBCP 2007, p. F–25). Also, according to the 2007 INRMP, California State Parks is required to conduct its natural resources management consistent with the philosophies and supportive of the objectives of the revised 2007 INRMP (MCBCP 2007, p. 2–31). 72 Fed. Reg. 72010, 72044 (Dec. 19, 2007).

3 The USFWS published a proposed critical habitat rule for tidewater goby on November 26, 2006 (71 FR 68914). Because MCBCP has an approved Integrated Natural Resources Management Plan that provides a benefit to the tidewater goby USFWS is proposing to exclude this area from the boundaries of designated critical habitat pursuant to 4(a)(3) of the ESA. However, currently designated critical habitat (November 20, 2000) will remain in place until the revised designation becomes final.

i. The Staff's Project Description Is Grossly Inaccurate.

The Staff Report fundamentally relies upon an incorrect and misleading characterization of the area within the coastal zone as largely undeveloped open space (see, e.g., p. 27). In fact, the majority of the area within the coastal zone that will be impacted by the project – approximately 80 acres of the 138 acres anticipated to be affected (or 58 percent) – are existing transportation facilities (I-5 and other roadway surfaces) and other developed/disturbed areas containing non-native and ornamental vegetation (Figure 4.11-1J, EIS/SEIR).

Perhaps most troubling is that the Staff Report reaches conclusions about project impacts without taking into account the extensive mitigation measures required by State and federal law that avoid, minimize, and compensate for impacts to biologically sensitive areas. As staff well knows, the project cannot be built without these measures. Because of this omission, the report mischaracterizes and vastly overstates project impacts. The project impacts cannot be evaluated in a vacuum without consideration of all project design features and mandatory mitigation measures. The mitigation requirements will be enforced by the California Department of Transportation (Caltrans), the Federal Highway Administration (FHWA), and TCA as mandated according to State and federal law and further regulated by the resource agencies with regulatory jurisdiction.

Finally, the Staff Report asserts *"the proposed project also has the potential to adversely affect and compromise the continued survival of at least six species with federal designations under the Endangered Species Act"* (p. 28), a conclusion unsupported by substantial evidence. **The USFWS and NMFS have specifically determined that the proposed project, with mitigation, will <u>not</u> jeopardize any individual species' survival** (see Attachment 3, *USFWS' Preliminary No Jeopardy/No Adverse Modification Conclusion, September 2005* and Attachment 4, *NOAA/NMFS Concurrence Letter, May 2007*). To reject the professional opinions of these agencies is an affront to the existing regulatory structure responsible for the protection of Threatened and Endangered species.

The following discussion addresses the assertions made in the Staff Report relative to the Threatened and Endangered species potentially present within the coastal zone portion of the project area. Topical issues (e.g., water quality, shading) common to several species are discussed at the end of this section.

ii. Pacific Pocket Mouse (PPM)

The Staff Report's conclusion that the coastal zone portion of the project is ESHA for PPM is not supported by the scientific evidence: Despite years of evaluation, with over 65,000 trap nights, no PPM have been documented in the coastal zone portion of the project site. The Staff Report relies on an incomplete evaluation of the habitat conditions for PPM in the coastal zone. The Staff Reports considers only one parameter of habitat suitability (soils) when more robust evaluations conducted by other biologists considered three additional parameters (vegetation, topography, and historical disturbance). The Staff Report ignores documented environmental factors that explain why this species does not utilize the coastal zone portion of the project. For example, a major portion of the project area within the coastal zone was converted into agriculture production several decades ago. As a result, the soil and habitat conditions in the area are extensively altered and do not contain the soil and vegetation conditions that would support the PPM.

The Staff Report cites the comments of Dr. Spencer that *"the proposed project would likely be the 'last nail in the coffin'"* for the San Mateo North population of PPM (p. 30). Dr. Spencer's hyperbole is notably without scientific support. Indeed, the project will enhance the likelihood of survival of the PPM by providing the necessary economic commitments to restore the pocket mouse habitat. The project includes an ambitious monitoring and adaptive management plan for PPM, consistent with the USFWS Recovery Plan for the pocket mouse (USFWS 2005). TCA developed the PPM management plan, submitted with this document to Coastal Staff under a separate cover, in coordination with the USFWS and key staff at the Marine Corps Base Camp Pendleton, to address the specific management needs of the San Mateo North population and to respond adaptively to changing conditions and new scientific information. Absent this substantial commitment to the population's long-term management needs this population will likely continue to decline from predation and competition.

As Dr. Ramey (See Attachment 5, *Letter from Dr. Roy Ramey to California Coastal Commission, January 2008*) has observed regarding the PPM resources management plan (PPMRMP):

> *The FTC-South will enhance rather than impede dispersal by providing habitat protection and enhancements, wildlife crossings,*

and contingencies for translocation. These same measures will enhance genetic diversity rather than contribute to its loss. A fully funded adaptive management plan described in the PPMRMP will also directly contribute to recovery of PPM through its prioritization and hypothesis testing approaches to the implementation of conservation actions. This will allow the management team to focus effort on conservation measures that have the greatest net benefit to PPM while winnowing out those that are ineffective. Thus, the adaptive management program will also benefit PPM populations elsewhere by increasing the knowledge base that can be applied to other populations. All told, the toll road with the proposed mitigation measures would enhance PPM recovery at San Mateo North. ...

Recognizing the importance of compatibility between the protection, minimization, and conservation measures proposed for the San Mateo North PPM population with the PPM Recovery Plan, the PPMRMP lists those Recovery Actions from the USFWS Recovery Plan that are compatible with or furthered by the Conservation Measure in the PPMRMP. In addition to the measures described above, the PPMRMP includes adaptive management and contingency planning that provides for population augmentation, captive propagation, plan updates, barrier curb modification, and additional measures to increase the use of undercrossings by PPM. The PPMRBP details how it contributes to the Down-listing and Delisting Criteria in the Recovery Plan. The goal here has been to achieve mutually compatible goals of constructing the FTC-South and contributing, to the maximum extent practicable, to PPM recovery at San Mateo North and elsewhere. (Attachment 5, pp. 11-12.)

<u>*No High Quality PPM Habitat in Coastal Zone*</u>

The Staff Report's claim that 12 acres of PPM "essential habitat" occurs within the coastal zone portion of the project disturbance limits (p. 30 and Exhibit 13 of the Staff Report) is belied by the site-specific characteristics of this area. The Coastal Commission staff ecologist's evaluation of PPM habitat is based on a single parameter (soil) for defining habitat suitability and, as a result, grossly overestimates the amount of PPM habitat. Recent analysis of PPM habitat by Dr. Rob Ramey and BonTerra Consulting reveals that no PPM habitat considered either high or very high in the PPM modeling program occurs within the coastal zone[4]. In fact, after taking into account the four parameters that are known to contribute to habitat suitability (soil, topography, historical disturbance, and vegetative cover), only 0.6 acre of habitat considered of moderate suitability occurs within the coastal zone for the San Mateo North population; the remainder is of poor or very poor suitability. Not surprisingly, no PPM has ever been trapped within the coastal zone portion of the project disturbance limits despite an extraordinary 65,900 trap nights conducted over ten years.

The Staff Report's statement that *"although the pocket mouse has not been directly observed during TCA's biological surveys within the coastal zone portion of the project area...the San Mateo North pocket mouse population site exists within an area contiguous with suitable, potentially occupied habitat within the coastal zone"* (p. 29) presents an incomplete and skewed picture of the survey efforts that have taken place, and implies that the species was not observed because TCA's biologists were conducting the survey. TCA's biological surveys were not only properly conducted and fully documented according to USFWS survey protocols, the San Mateo North population and surrounding areas were also independently surveyed by other qualified/permitted biologists, under the authority of the USFWS. Of the twelve separate trapping efforts conducted for the San Mateo North population, five were conducted for the proposed project, in full accordance with USFWS-approved survey protocols. Independent qualified/permitted biologists, under the authority of the USFWS and not associated with the project, conducted the remaining seven trapping efforts. Again, none of those independent trapping efforts revealed PPM within the coastal zone portion of the project disturbance limits. There simply is no evidence in the record to the contrary.

A determination based on the best available science entails, among other things, giving due weight to the results of the work of qualified biologists most familiar with the site and biological resources as they currently exist. While Staff can speculate on what might exist in the future or may have occurred in the past, the

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4 Ramey, R.R. and A.M. Johnston. 2007 (September). *Pacific Pocket Mouse Resource Management Plan For The San Mateo North Population* (draft) (Prepared for the Transportation Corridor Agencies). Costa Mesa, CA: BonTerra Consulting.

resource conditions must be evaluated, as the Staff Report states, *"as they exist at the time of the review, based on the best scientific information available"* (p. 26).

PPM has not been found in the coastal zone portion of the project for a reason: the habitat quality is not currently suitable to support the species.

Proposed Project Provides Plan/Funding for PPM Management/Recovery Plan

Realistically (and perhaps ironically), construction of the toll road is likely the San Mateo North population's remaining opportunity to reestablish and recover. As part of project approval under the federal ESA, TCA has prepared an ambitious and detailed Pacific Pocket Mouse Resources Management Plan ("Plan"), which provides for the implementation of long-term management, funding, and recovery initiatives on a 71-acre PPM reserve area (Sept. 2007). The San Mateo North population is not currently managed for the benefit of the species. TCA, through the Plan and other measures, has been proactive in designing specific minimization and mitigation measures that increase the likelihood of the San Mateo North population's persistence and viability as compared to the no project alternative.

The Plan builds upon the extensive avoidance and minimization measures in the EIS/SEIR that were identified during the project alignment selection. Significantly, the USFWS, Environmental Protection Agency (EPA), U.S. Army Corps of Engineers (USACE), Marine Corps Base Camp Pendleton, and FHWA agreed to these avoidance and minimization measures to eliminate project impacts during construction to habitat known to be occupied by the PPM and to individual PPM within the construction footprint. The Plan has been developed in compliance with the mitigation measures and conditions of approval for the EIS/SEIR and based on comments provided by key staff at Camp Pendleton and USFWS PPM specialists through the Section 7 ESA consultation process with the USFWS. The Plan is subject to final approval by the USFWS and Camp Pendleton.

The Plan uses the PPM Recovery Plan (USFWS 2005) as the basis for developing a long-term management program that will implement a robust, science-driven, adaptive management strategy. The Plan includes the following measures: (a) the requirement to establish a fully funded, non-wasting endowment and hire an independent entity to adaptively manage the PPM population at San Mateo North; (b) the construction of a barrier to prevent small mammal movement along the entire western edge of the roadway; (c) the minimization and shielding of all roadway lighting; (d) the minimization of potential fire ignitions; and (e) the development of a fire response plan. As such, implementation of the Plan will contribute to the species' recovery by providing scientifically valid management actions that will benefit the species by protecting and enhancing both natural and translocated PPM populations in permanently protected habitat. Through habitat enhancement, wildlife crossings and adaptive management (including contingencies for salvage), the Plan provides for the maintenance of genetic variation at San Mateo North.

A wildlife culvert will be constructed under Cristianitos Road in the vicinity of El Camino Real. Two additional wildlife culverts are proposed in small canyons adjacent to occupied PPM habitat, north of the San Mateo North population (Mitigation Measure TE-23). PPM from the San Mateo North population could proceed north along natural open space within the State Park and cross under the FTC-South and Cristianitos Road using the wildlife culverts.

Although ignored in the Staff Report, the USFWS, in a letter dated September 30, 2005, (see Attachment 3) stated that the increased vulnerability of the PPM posed by FTC-South can be addressed by adopting an adaptive management program for the San Mateo North population and incorporating minimization and conservation measures into the project. With the inclusion of these additional conservation measures in the Plan, the **USFWS has made a preliminary determination that construction of FTC-South will not jeopardize the continued existence of the PPM.** Indeed, additional analysis by TCA demonstrates that implementation of the PPM Resource Management Plan will contribute to the species' recovery.

iii. Tidewater Goby

The tidewater goby is a fish that is found in the San Mateo lagoon at the ocean end of San Mateo Creek. The project has no impacts on the lagoon. Without any supporting data, the Staff Report asserts that the project will impact approximately 24 acres of tidewater goby critical habitat (pp. 31–32). Coastal staff's assertion ignores the fact that the project design includes bridge spans at both the San Mateo and San Onofre Creek crossings to essentially avoid impacts in these areas. **The design of the bridges at San Onofre and San Mateo Creeks has significantly reduced the level of permanent impacts to just 0.011 acre. This represents less than 0.008 percent of the total critical habitat designated for this species in these watersheds.**[5] This fraction of a percentage cannot constitute *"obvious detrimental effects"*, as stated in the Staff Report. The Staff Report's grossly overstated impacts represent a total disregard for the facts.

Through the Collaborative process, TCA has invested substantial time and resources to the bridge designs at San Onofre and San Mateo creeks to reduce the level of permanent impacts to just 0.011 acre of potential habitat for the tidewater goby. This minimization of impacts by TCA is supported by the USFWS preliminary finding of "no jeopardy" and "no adverse modification of critical habitat" for this species (see Attachment 3).

The Staff Report attempts to justify its gross overstatements of project impacts by citing to the 2000 final rule designating critical habitat for goby which concluded that "construction of the CP alignment would likely result in the loss of [the San Mateo and San Onofre] populations and potentially preclude recovery for this species" (p. 35). That analysis is outdated; the project before the Commission is not the CP alignment (cf. p. 34). The proposed project has undergone significant revisions and refinement since the 2000 critical habitat rule. The Staff Report's claim of impact on the goby simply ignores the current project design, which was refined through 2005. As part of the refinements, bridge lengths were increased (to approximately 4,000 feet) at San Mateo Creek to limit impacts to surrounding sensitive habitat including wetlands and coastal sage scrub. The distance between bridge supports was also maximized, thus eliminating three bridge supports within wetlands in the coastal zone. Staff's apparent wonderment at the "conflicting" evaluations of project impacts by the USFWS between the 2000 critical habitat rule and the 2005 letter (p. 35) demonstrates a clear lack of understanding of the proposed project and its mitigation for impacts.

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[5] The USFWS published a proposed critical habitat rule on November 26, 2006 (71 FR 68914). Because MCBCP has an approved Integrated Natural Resources Management Plan that provides a benefit to the tidewater goby USFWS is proposing to eliminate this area from the boundaries of designated critical habitat pursuant to 4(a)(3) of the ESA. However, currently designated critical habitat (November 20, 2000) will remain in place until the revised designation becomes final.

The Staff Report ignores the fact that the main goby population is resident during most of the year in the lagoon located downstream of all of the permanent structures. The scientific literature indicates that in some streams juvenile and adult gobies move upstream from the lagoon during the summer and fall[6]. In the case of San Mateo Creek, the stream is typically dry during this period of the year and it is unlikely that fish would be present in the construction area. In any event, mitigation measures are proposed to provide for fish passage around the construction area at all times of the year.

The Staff Report also inaccurately describes the proposed woodland restoration area as providing potential habitat for the tidewater goby (p. 39). This statement again clearly demonstrates the Coastal Commission Staff's lack of familiarity with the proposed project and its on-site resources. The extended detention basin/sand filter where the woodland mitigation is proposed is located over 800 feet from San Mateo Creek and 1,700 feet from San Mateo Lagoon. The woodland restoration area will not receive water directly from San Mateo Creek, although it will drain to the creek. Therefore there would be no potential habitat for the goby within the basin or the surrounding riparian habitat because goby could not reach this area.

Finally, Coastal Commission Staff's conclusion that the area *"within tidewater goby critical habitat and [the] proposed construction activities would likely result in an adverse impact to this species"* (p. 39) is contrary to the expert agency's opinion. After reviewing the current status of the tidewater goby, the environmental baseline for the action area, the direct and indirect effects of the proposed action and the cumulative effects, **it is the USFWS's preliminary opinion that construction, operation, and maintenance of the toll road is not likely to jeopardize the continued existence of the goby, nor is it likely to destroy or adversely modify its designated critical habitat.** This preliminary opinion is supported by the following project facts:

(a) Very small direct impacts to tidewater goby are limited to bridge construction activities at San Mateo and San Onofre Creeks; construction may require temporary dewatering of small areas of these creeks, and the

[6] Worcester, K.R. and R.N. Lea. 1996. Observation on tidewater goby habitat utilization and laboratory maintenance during the California drought. Symposium on tidewater goby, Southern California Academy of Sciences Annual Meeting, Loyola Marymount University, May 3-4, 1996.

dewatering will likely occur outside the spawning season for goby to avoid and minimize impacts to goby reproduction;

(b) Gobies in the area of the potential dewatering activities will be captured by seining and released away from the construction footprint;

(c) Gobies are expected to remain in the creeks during and following construction and no appreciable reduction in the number of animals or distribution of the species is expected; and

(d) Gobies are most plentiful in the lagoons, which are over 700 feet from the impact area. These off-site lagoons are sufficient to support existing goby populations and to provide the necessary conservation function for this species.

iv. Arroyo Toad

Extensive surveys for arroyo toad did not identify any toads within the coastal zone portion of the project (1987 through 2001, EIS/SEIR Section 4.12.2.1). The construction of the bridge across San Mateo Creek would result in the permanent loss of 0.006 acre of potential habitat.

Without any scientific justification, Coastal Commission staff has *fabricated* a "coastal population" of arroyo toads upon which it has concluded that the project would have "substantial adverse impacts" (p. 52). There is absolutely no scientific data supporting the claim that the arroyo toads closer to the coast are genetically any different from the abundant toads further inland. And in any event, permanent project impacts within the coastal zone portion of the project would result in a minimal impact to potential arroyo toad breeding habitat (0.011 acre in San Onofre and San Mateo creeks) and would not result in significant constraints to upland aestivation habitat within the coastal zone.

As documented below, the Coastal Commission staff's conclusion that the proposed project is *"greatly increasing the likely occurrence of both short- and long-term adverse [e]ffects to the arroyo toad"* (p. 44) completely ignores the required mitigation measures for the project that have been approved by the USFWS for this and other Caltrans projects in the area (see, e.g., U.S. Fish and Wildlife Service Biological Opinion for the State Route 74 (SR 74) Safety Improvements Project in the County of Orange, California (1-6-05-F-1688.6).

Dr. Murphy concurs that the Coastal Staff report's analysis of impacts on the arroyo toad is fundamentally inaccurate and misleading:

> *The arroyo toad is widespread in the San Mateo and San Onofre watersheds; with nearly all of its extensive local distribution above the coastal zone, where an extraordinary ninety-plus percent of available habitat was occupied by the toad as recently as 2003. As is clear from maps at Tabs 15 and 16 in the staff report, the fate of the arroyo toad in the overall project area is very much a matter of its survival in areas inland (and largely well inland) of the coastal zone. And, as with the Pacific pocket mouse, surveys in support of the EIS/SEIR did not find the species in the coastal zone portion of the project area.*
>
> *While the report dedicates nearly a dozen pages to asserting that uncertainties accompany the avoidance and mitigation plan for the arroyo toad in the project plan, the report both ignores the extensive standing body of information on the species and the ongoing efforts to protect it. The toad has been the target of focused conservation attention in Camp Pendleton resource management efforts and in the [Orange County] Southern Subregion HCP, and it is currently benefiting from these ongoing management actions in areas adjacent to the proposed project and coastal zone.*
>
> *The arroyo toad has received rigorous scientific assessment in the MCB Camp Pendleton Arroyo Toad Monitoring Protocol (Atkinson et al., 27 August 2002, U.S.G.S. Western Ecological Research Center), and in a number of other pertinent technical documents generated from data from this coastal zone area and adjacent watersheds. Compelling distributional and other ecological data exist, which suggest that the effects of construction activities, as they manifest in such a circumscribed portion of the toad's range in the San Mateo and San Onofre watersheds, will have negligible impact. Combined with the very limited extent of toad habitat in the coastal zone, permanent losses of either toads or toad habitat seem very unlikely. Importantly, as with the vireo, staff avoided focusing on specific potential environmental impacts that might accompany the project*

and its construction phases in contexts that allow for realistic quantitative assessments of potential impacts to arroyo toads. (Attachment 1, p. 5)

TCA has committed to implement measures, as described in the EIS/SEIR and Biological Assessment (BA), to avoid and minimize impacts to toads during construction and operation of the proposed project. These measures include (1) implementation of Best Management Practices (BMPs) and Storm Water Pollution Prevention (SWPP) measures, and (2) implementation of an arroyo toad management plan. Specific methodologies for the toad plan will include the (a) use of exclusion fencing, (b) focused toad surveys, (c) capture and relocation of toads to outside of the impact area, (d) post-construction restoration of affected toad breeding habitat, and (e) implementation of an exotic predator and non-native plant removal program. These measures, frequently used in southern California, are endorsed by the USFWS and are currently being utilized on other projects[7] in the area.

In coordination with the USFWS, large diameter culverts have been incorporated into the project design under the road to provide for wildlife movement to upland areas west of the alignment. In addition, TCA has committed to installing a permanent mesh fence at the base of the chain-link fence along the roadway in areas near toad habitat. The fencing will act as a barrier, keeping toads off the road, and as a drift fence to funnel toads to culverts that cross under the road.

Based on the Staff Report comment that *"construction operations are proposed to occur for approximately 18 months without an active capture/relocation program in place"* (p. 48), **it appears that Coastal Commission staff are unfamiliar with accepted and USFWS-endorsed avoidance measures utilized by transportation projects in the area for several Caltrans projects,** including, but not limited to, the SR-74 project. The above quote is incorrect. Between March and June (breeding season), it is anticipated that the arroyo toads are likely to occur within or immediately adjacent to San Mateo Creek due to the presence of water in the creek needed for breeding. During this time period and prior to initiating any ground-disturbing activities in occupied/suitable habitats or in habitats proximate to suitable or occupied habitats for arroyo toad, exclusionary fencing shall be installed around the perimeter of the construction

[7] U.S. Fish and Wildlife Service Biological Opinion for the State Route 74 (SR 74) Safety Improvements Project in the County of Orange, California (1-6-05-F-1688.6).

area. The Project Biologist shall then conduct three focused arroyo toad surveys within the fenced construction site for a minimum of 14 nights prior to initiating project construction. If arroyo toads are found on the construction side of the exclusionary fencing, the Project Biologist will remove arroyo toads, relocate them from the construction impact area, and place them in suitable habitat either upstream or downstream of the construction area. Between July and February (aestivating season), the toad is expected to leave the creek area and burrow into upland habitat. However, because the exclusionary fence had been placed around the construction zone, no toads will be able to enter the zone. A Biologist will monitor the grubbing of vegetation on site and any toads found will be moved out of harm's way.

The report states that the project's proposed construction staging area *"within essential and well recognized arroyo toad habitat represents a significant threat to the species"* (p. 50). Of course, any large construction project of this nature will require a staging area. However, when considering the least environmentally damaging location for a staging area, the project engineers were directed by the project biologist to locate the staging area outside of the riparian breeding habitat. Upland habitats utilized for foraging and aestivation are plentiful (and not limiting) in the project area, making it the appropriate area in which to locate staging.

On page 50, the report states, *"the placement of 'grubbing spoils' and other grading debris within occupied arroyo toad habitat and the subsequent covering of these debris piles with plastic sheeting would impinge on those potentially important upland foraging habitats and movement corridors occupied by these debris piles"* (p. 50). These comments by staff again illustrate a total disregard of project construction practices and mitigation measures. Any temporary stockpile areas shall also be located within the construction footprint and in upland areas to protect the riparian resources. As with all construction areas, locations for proposed stockpiling would be subject to the same avoidance and minimization measures described above. Because the project is being built as a balanced cut/fill project, there is not expected to be substantial temporary stockpiling areas that would be large enough to impact foraging habitat or "movement areas."

Regarding the statement that *"daytime vehicle use in arroyo toad occupied habitat areas would still occur and would have the potential to adversely affect* *the species"* (p. 51), all created roads within the construction zone will be fenced, as described above. Therefore, toads would not be able to enter the zone and would not be subject to direct impacts from driving on construction roads.

In response to Measure TE-17 (arroyo toad predator removal), the Staff Report states, *"Because the specific details of this proposal have not been established or developed it is not possible to determine if the implementation of this measure would result in a net benefit to the species"* (p. 52). To the contrary, in the BO issued by the USFWS for the SR-74 project, Caltrans was required to conduct an invasive species removal program that focused on two species that were problematic, bullfrog (*Rana catesbeiana*) and crayfish (*Procambarus* spp.). The SR-74 project occurs along San Juan Creek, where arroyo toads are known to be present. The program was carried out during the spring and summer of 2007, and was very successful[8]. The methodologies utilized resulted in no losses of arroyo toads. A similar plan, building on this most recent work effort, will be utilized for FTC-S.

It is the USFWS's preliminary opinion that construction, operation, and maintenance of the toll road are not likely to jeopardize the continued existence of the arroyo toad. This preliminary opinion is supported by the following project facts:

(a) The breeding habitat will only be temporarily affected by construction or suffer a minor permanent loss and toad reproduction will only be minimally affected during bridge construction due to phasing of project impacts outside the toad breeding season;

(b) No permanent structures will be placed in creeks that could be a barrier to upstream or downstream movement;

(c) The loss of upland habitat will not significantly limit the distribution of the toad since substantial acreage of habitat will remain available to support this species;

(d) The number of toads killed will be minimized through trapping and relocation;

(e) Measures to reduce predators will have beneficial effects on toad numbers; and

[8] Personal Communications with Dr. Mike Robson, lead biologist for the SR-74 Project

(f) Impacts to water quality will be addressed through implementation of specific runoff management plans and project design features.

v. Coastal California Gnatcatcher

The Staff Report's evaluation of impacts to the coastal California gnatcatcher is similarly flawed. Dr. Murphy stated the following regarding the Staff Report's analysis:

> *The California gnatcatcher has long been the flagship species in southern California conservation planning. As chief architect of the approach taken in California's pilot NCCP effort in the coastal sage scrub vegetation community, I encouraged conservation planners to place emphasis on the protection of habitat for gnatcatchers in the remaining coastal portions of the bird's range, because of the unique species composition and other attributes of the ecological community there. It is gratifying to see the elevated attention paid to the species in all aspects of the toll road project design, both in the coastal zone and those densely inhabited areas inland that sustain the species.*
>
> *Staff greatly mischaracterizes the extent of potential impacts to the species. The project impacts to gnatcatcher habitat in the coastal zone are so limited that the report contorts the quantitative statements that it makes, with multiple confusing references to project impacts beyond the coastal zone, with out-of-context and out-of-date citations regarding the gnatcatcher's range wide status and trends, and avoids mentioning the proposed acquisition and management of Orange County's best existing habitat for the species (in upper Chiquita Canyon)--a central element that is part of the project's overall mitigation package.* (Attachment 1, p. 5)

The Staff Report overstates project impacts as "*directly removing and occupying [sic] 50 acres of gnatcatcher occupied coastal sage scrub ESHA during the construction phase of the proposed project*" (p. 60). However, multiple years of data collection documents that not all coastal sage scrub within the coastal zone is occupied by gnatcatchers.

Further confounding the evaluation of project impacts, the Staff Report ignores the conservation importance of the mitigation strategy for impacts to the coastal California gnatcatcher. **TCA implemented the USFWS-recommended mitigation measure of protecting over 1,182 acres within its Upper Chiquita Canyon Conservation Area.**

The USFWS has determined that the Orange County Southern Subregion HCP/NCCP will contribute to the survival and recovery of the California gnatcatcher on a range wide basis (Service, 2006). An important aspect of gnatcatcher recovery is the conservation of "key locations"[9] of gnatcatcher populations, including the Upper Chiquita Canyon Conservation Area population. These gnatcatchers represent the northern portion of the gnatcatcher population in a key location in the Chiquita Canyon, Western Gobernadora/Chiquadora Ridge, and Wagon Wheel area (Draft NCCP/HCP Planning Guidelines, April 2003). These areas are "integral to the overall function of the reserve for this species because they provide linkage to other populations, including Camp Pendleton (Draft NCCP/HCP Planning Guidelines, April 2003)."

In addition to the significant conservation benefits provided by the protection and restoration of Upper Chiquita Canyon Conservation Area, **TCA has identified an additional 150 acres of coastal sage scrub for restoration within Crystal Cove State Park**. Crystal Cove State Park includes an important component of the Orange County NCCP Reserve system. However, much of the coastal sage scrub habitat at Crystal Cove has converted to annual grasslands as a result of grazing activities over the last 150 years. TCA conducted a preliminary analysis of restoration opportunities at Crystal Cove and determined that the grassland areas (see Attachment 6, *Vegetation Types at Crystal Cove Canyon State Park*) are potentially suitable for restoration to coastal sage scrub.

Crystal Cove State Park currently supports approximately 1,400 acres of coastal sage scrub based on GIS files of the Orange County Central/Coastal NCCP. The restoration of 150 acres of coastal sage scrub at Crystal Cove would increase the coastal sage scrub to approximately 1,550 acres. The restoration of 150 acres would mitigate coastal sage scrub impacts within the coastal zone at a 3:1 ratio.

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9 The Draft Southern Planning Guidelines defines *key locations* as those locations that are deemed necessary for the conservation of the species in the subregion." (Service, 2006).

Coastal Commission staff underestimates the ability of coastal sage scrub to re-establish itself following disturbance, as demonstrated by their statement that *"permanent and temporary loss of these 49.75 acres has the potential to lower the overall carrying capacity of the greater habitat area"* (p. 57). The majority (approximately 30 acres) of the coastal sage scrub impacted within the coastal zone is re-growth on manufactured slopes from 1-5 construction or was previously subject to extensive agricultural operations based on reviews of historical (1941) aerial photographs of the area. In particular, the areas west of Cristianitos Road (the majority of which occurs outside the project footprint) contain a relatively high number of gnatcatchers compared to other coastal sage scrub in the area (EIS/SEIR Figure 4.11-4i). Given the ability of the coastal sage scrub in the area to respond to past disturbances and the proposed re-vegetation efforts, it is reasonable to assume that the coastal sage scrub will provide the required area of habitat to continue to support the gnatcatcher population at its current level.

Coastal Commission staff has ignored TCA's well-established record in successfully restoring coastal sage scrub as documented by appropriate vegetation parameters and other relevant ecological factors such as soil biosphere and wildlife, including breeding California gnatcatchers. Since the early 1990's, TCA has successfully restored and revegetated 395 of acres of coastal sage scrub habitat in the following areas:

- Bonita Canyon –21 acres
- Siphon Reservoir – 112 acres
- Coyote Canyon– 122 acres
- SR-73 Slopes– 140 acres

Additionally, TCA is dedicated to responsible mitigation and continues to actively manage 233 acres of coastal sage scrub on the SR-261 and SR-241 that is predicted to reach success criteria within three years.

TCA has also successfully restored and created approximately 72 acres of riparian, alluvial fan scrub and salt marsh habitats as mitigation for the SR-73 and SR-241 projects. The USFWS have determined that the areas along SR-73 have achieved the restoration goals established by the USFWS. The areas along

SR-241 and SR-261 are still being managed and are ultimately expected to achieve the goals established by the USFWS (see Attachment 7, *Past TCA Mitigation Report Letters*).

TCA's restoration activities have resulted in a net increase in the gnatcatcher population in the Central/Coastal NCCP area after the construction of the San Joaquin, Foothill-Eastern and Foothill-North projects.

On page 57, the report states that the *"TCA has not proposed mitigation for this use of coastal sage scrub ESHA and gnatcatcher critical habitat within the coastal zone."* However, this is because coastal sage scrub and gnatcatcher habitat conservation efforts are, in particular, addressed with on a region-wide basis, which is not necessarily confined to the coastal zone. Recognizing this, the Commission itself has previously approved mitigation for similar habitat impacts at locations outside the coastal zone. Three recent examples involve projects in the northern San Diego County area, including one in San Mateo Creek. In 6-01-149, the Commission approved a Caltrans project involving construction within San Mateo Creek to stabilize the existing I-5 freeway bridge piers. The Commission approved mitigation to riparian wetlands offsite at a parcel outside the coastal zone. In CC-004-05, the Commission recently approved a consistency certification for the North County Transit District double tracking project at Camp Pendleton, along with mitigation for CSS and wetland impacts outside the coastal zone at Foss Lake. Even more recently, at the December 2007 meeting, the Commission approved a consistency determination (CD-043-07) for the Army Corps of Engineers vegetation and sedimentation management project within the 7-mile long San Luis Rey River, a project that straddles the coastal zone boundary. The Commission required mitigation for removal of 233 acres of riparian habitat by 1:1 replacement with vireo and flycatcher habitat in the San Luis Rey River watershed or other locations in northern San Diego County.

Here, at the direction of and in consultation with the USFWS, TCA has developed a mitigation program that has been designed to minimize habitat loss and to provide substantial conservation value for the species within the region. Gnatcatcher conservation efforts are not directed at isolated areas, but rather at preserving relatively large, contiguous patches of coastal sage scrub suitable for gnatcatchers. Working through the regional conservation efforts of the Orange County Southern Subregion NCCP/HCP and INRMP adopted by MCB Camp Pendleton (which anticipates the project, including the segment in the coastal zone) project implementation will clearly produce a net benefit to gnatcatcher habitat/coastal sage scrub. In conjunction with the project, TCA acquired a 1,182-acre Conservation Area in Upper Chiquita Canyon. Of these 1,182 acres, 327 acres that were at risk of development have been preserved as mitigation for the coastal sage scrub and gnatcatcher impacts associated with the project. A critical aspect of the overall Southern Subregion NCCP/HCP is the preservation of this particular Conservation Area, which the USFWS has determined is a key location for coastal sage scrub and the gnatcatcher.

The Staff Report's exaggeration of impacts is based on reference to outdated statistics for the gnatcatcher. For example, on page 53, Coastal Commission staff use the 1980 Atwood estimate of between 1,000 and 1,500 gnatcatchers in the U.S. This reference is significantly out of date. The most current published USFWS population estimate is 2,899 pairs in the United States, a figure regarded by many as evidence that the gnatcatcher is recovered.[10]

LSA Associates recently conducted a thorough review of range wide gnatcatcher survey data based on electronic datasets maintained by the USFWS, the California Department of Fish and Game (CDFG), and the County of Riverside. The review reports an estimated 5,000 to 6,000 pairs in the United States.[11] (See Attachment 8, *Assessment of the Current Status in California, California Gnatcatcher Population Estimates and Conservation Status, 2007.*)

The statement by Coastal Commission staff that *"the potential success of surveys conducted by the project biologist to detect the occurrence of nests, nesting behavior or brood rearing activities remains uncertain and unproven"* (p. 59) is false. These standard measures are utilized on construction projects within coastal sage scrub occupied by gnatcatchers and the USFWS routinely approves and permits these measures in southern California (see, e.g., U.S. Fish and

10 U.S. Fish and Wildlife Service (USFWS), Carlsbad Field Office. 1996. *Reinitiation of the Biological Opinion on Implementation of the Special Rule for the Coastal California Gnatcatcher.* Carlsbad, CA: USFWS.

11 LSA Associates, Inc, May 2007. Assessment of the Current Status in California: California Gnatcatcher (*Polioptila californicus*) Population Estimates and Conservation Status.

Wildlife Service Biological Opinion for the Walnut Hills Development Project in the County of Los Angeles, California (FWS-LA-810.1).

On page 56, the report states, "the clearing of occupied territories, if conducted during the breeding season, may potentially result in the destruction and/or loss of gnatcatcher nests, eggs or nestlings." Coastal Commission staff ignores the fact that TCA will not clear occupied gnatcatcher territories during the breeding season (EIS/SEIR Measure TE 18).

It is the USFWS's preliminary opinion that construction, operation, and maintenance of the toll road are not likely to jeopardize the continued existence of the coastal California gnatcatcher. This preliminary opinion is supported by the following project facts:

(a) The overall distribution of the gnatcatcher south of Ventura County remains roughly the same since the listing in 1993, but today many of the largest gnatcatcher populations are conserved and managed in the regional NCCP/HCPs. Additionally, within and between Orange, San Diego, and Riverside counties, many of the gnatcatcher populations are interconnected with existing or planned linkages and corridors.

(b) For the entire 16-mile project, the number of birds expected to be impacted represents only a portion (1.6 percent) of the gnatcatcher's overall population.

(c) Hundreds of acres of habitat will remain in the project area to support the overall survival and recovery of the species and to maintain the important habitat linkage between San Diego and Orange counties.

(d) Three hundred and thirty three (333) acres of suitable habitat are proposed to be restored in the Upper Chiquita Canyon Conservation Area in support of overall species survival and recovery.

vi. Least Bell's Vireo

The Staff Report inflates project impacts to vireo by ignoring the species' current status (see reference to Dr. Murphy letter, above), grossly exaggerating the project's permanent impacts to vireo habitat, and downplaying the efficacy of avoidance and minimization measures.

The report's statement commenting on least Bell's vireo current population status that *"[t]his situation has changed only slightly in the thirty one years since listing and although the current population is estimated at approximately 3,000 territories, the known range remains restricted to southern California and Baja exclusively"* (p. 61) is false. The 2006 USFWS 5-Year Review Summary and Evaluation states that *"The vireo population in the U.S. has increased 10-fold since its listing in 1986, from 291 to 2,968 known territories . . . [with] tremendous growth of the vireo population in specific areas in San Diego and Riverside."*[12]

Coastal Commission staff implies that "68 vireos" are located in proximity to the proposed project (near San Mateo Creek) (p. 62), when in fact these locations occur up to, and over 8 miles inland along San Mateo and San Onofre Creeks. The project has the potential to result in only indirect impacts to at most two vireo territories.

Coastal Commission staff claims that San Mateo Creek, as it intersects with I-5, is a pristine location. This claim is patently false. The area of the project's connection with I-5 at San Mateo Creek is dominated by high volumes of traffic on I-5; truck and car traffic on Toby's Road (Military Base), Old Highway 101, and Cristianitos Road; and over 50 years of historic farming activities and now the current and planned tactical military readiness training and activities within the Northern Training area (old agricultural fields) immediately adjacent to the project site and San Mateo Creek.

On page 64, Coastal Commission staff expresses a concern that the vireo may be avoiding the habitat in proximity to the existing I-5 because of the noise generated by the highway. However, on page 61, Coastal Commission staff states that occupied vireo habitat exists within the riparian areas of San Mateo Creek. If staff believes that the vireo occupies the riparian habitat adjacent to I-5, and would be impacted by project implementation, then they also have to accept (a) that this species may be acclimated to noise and other disturbance factors or (b) that it is not the best habitat for the species and therefore does not qualify as an ESHA. The Coastal Commission staff cannot have it both ways.

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12 U.S. Fish and Wildlife Service, Carlsbad Field Office (USFWS). 2006 (September). *Least Bell's Vireo (Vireo Bellii pusillus) 5-Year Review Summary and Evaluation.* Carlsbad, CA: USFWS.

The Coastal Commission staff report states that Measure TE-20 *"provides no assurance that all suitable vireo habitat will be 'grubbed' outside of the breeding season"* (p. 66) and EIS/SEIR Mitigation Measures TE-20 and TE-21 *"do not provide a guarantee that construction activities, grading and vegetation clearance would not occur within vireo occupied areas during the breeding season. In addition, the potential success of surveys conducted by the project biologist to detect the occurrence of nests, nesting behavior or brood rearing activities remains uncertain and unproven"* (p. 67). These statements are inaccurate. **All projects that are required by the USFWS to implement such measures are also required to provide the USFWS with reports that documents the implementation of the mitigation measures and evaluates their results.** USFWS has received dozens of such monitoring reports documenting the relative success of these avoidance and minimization measures. The USFWS's continued recommendation to project proponents to implement such measures is clear acknowledgement of their success. The above statement by Coastal Commission staff does not take into consideration mitigation measures, specifically the requirements that Biological Monitors and Permitted Biologists must be present during such activities (see below). These are standard mitigation measures that are utilized on construction projects within vireo-occupied habitat and the USFWS routinely approves and permits these measures in southern California.

Page 68 of the Staff Report states, *"Re-vegetation would also require several years to be completed and the habitat would remain lost and unsuitable for <u>gnatcatcher</u> occupation during that interval"* (emphasis added). Coastal Commission staff obviously utilized the same impact discussion for both the vireo and gnatcatcher. An independent analysis would have been appropriate.

Page 68 states, *"[i]n addition, [TE-21] does not consider the operation of the proposed toll road that may subject large areas of vireo occupied and potentially occupied habitats to sound levels greater than 60 decibels as well."* As discussed in Mitigation Measure TE-21, during construction, no activity will occur within approximately 500 feet of active vireo nests. These are standard mitigation measures that are utilized on construction projects within vireo-occupied habitat and the USFWS routinely approves and permits these measures in southern California.

Coastal Commission staff inappropriately criticized the location of the proposed riparian habitat mitigation (p. 69) because it is located too close to both the I-5 and the proposed project. However, the Coastal Commission staff also wants the mitigation close to the impact area (which is at the I-5) and continuous with suitable habitat (again, in the vicinity of the I-5 and the proposed project). Coastal Commission staff initially states on one hand state that the project needs to mitigate habitat in the coastal zone and in the area of impact, and then also states that the mitigation is not valuable because a species may not use it because of its location. Again, the Coastal Commission staff cannot have it both ways.

It is the USFWS's preliminary opinion that construction, operation, and maintenance of the toll road are not likely to jeopardize the continued existence of the least Bell's vireo. This preliminary opinion is supported by the following project facts:

(a) The least Bell's vireo population in the U.S. has increased 10-fold since the species' listing in 1986, from 291 to 2,968 known territories, with significant population growth documented in southern California counties, including Orange County.[13]

(b) Only 5.7 acres of potentially occupied vireo habitat affecting an estimated two vireo territories will be removed at San Mateo Creek; while vireos occupying these territories may experience reduced productivity, suitable habitat will remain in proximity.

(c) Vireos supported by riparian habitat within 500 feet of the construction may be disturbed by construction activities and noise, but only two locations (within the coastal zone) will be affected, these impacts will be temporary, and minimization measures will be implemented.

(d) Increased noise due to toll road traffic could reduce the suitability of riparian habitats for two vireo locations; however, given the increasing population trend for vireo, the effect of reduced reproduction from toll road noise and other indirect effects is not likely to appreciably reduce the numbers, reproduction, or distribution of vireo in the action area or throughout the species' range.

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[13] USFWS 2006.

vii. Southern Steelhead

The Staff Report appears to base its evaluation of potential project impacts to steelhead by citing to reports, letters, and other analyses prepared by the National Oceanic and Atmospheric Administration -- National Marine Fisheries Service (NOAA/NMFS). However, the Staff Report ignores NOAA/NMFS' May 23, 2007 concurrence letter under Section 7 of the federal ESA in which it concluded the project was "**not likely to adversely affect**" the species (see Attachment 4). NOAA/NMFS is the federal agency responsible for the administration for the federal ESA relative to the steelhead. NMFS is also leading the recovery planning effort for this species in California and southern Oregon. It is inappropriate for the Coastal Commission staff to highlight some but ignore other evaluations of the federal agency mandated with the protection and recovery responsibility for this species.

The Staff Report characterizes the loss of 0.16 acre of riparian habitat within the San Mateo Creek area as *"obviously detrimental"* (p. 75). Yet, the entire San Mateo riparian system within the coastal zone includes approximately 90 acres of potential steelhead habitat. This 0.16-acre impact – a fraction of one percent (approximately 0.177 percent) of the larger San Mateo area —far from "obviously detrimental" has been determined by NOAA/NMFS not likely to adversely affect the San Mateo population.

The Staff Report states that *"substantial amounts of soil disturbance and earth moving as well as the temporary occupation of riparian and adjacent upland areas for construction equipment, material and personnel staging. ...have the potential to increase the amount of sediment entering the San Mateo Creek and its associated lagoon through the settlement of dust as well as potential increases in wind and waterborne erosion of sediments into the creek areas. Furthermore, the proposed project involves extensive use of construction equipment and heavy machinery that have the potential to release materials that could contaminate the air, water and sediment in and around the creek area"* (p. 75). The NOAA/NMFS letter to the FHWA states that the proposed project "would not likely adversely affect the Southern California Distinct Population Segment of the steelhead or critical habitat for this species." This finding was supported by specific reference to water quality as follows:

Best management practices will be implemented to minimize impacts during construction of the highway and bridges. These include a Storm Water Pollution Prevention Plan to minimize impacts from onsite runoff during construction, sediment control devices and measures to protect creek bed and banks during and after construction, enclosures for areas where concrete work will take place, restriction of fueling and maintenance of heavy machinery to areas away from the creek channel, and an emergency spill contingency plan.

Regarding the Staff Report conclusion on page 77, **NOAA/NMFS determined that construction of the project would not likely adversely affect the Southern California Distinct Population segment of the steelhead or critical habitat for this species.** These findings by NOAA/NMFS are supported by the following information:

No water diversions will be implemented for the proposed highway and relocation of steelhead will not be necessary. Additionally, the creek channels are expected to be dry for the majority of the construction period. During construction, temporary bridges will be constructed during the dry season so that when flow is present, interference with migrating steelhead is not expected. When construction is complete, the final bridges are not expected to decrease the functional value of steelhead migratory habitat within the San Mateo or San Juan Creek watersheds because the bridge piers will be spaced 200 feet apart. As a result, even if the final design locates the piers in the channel, NMFS does not expect that the piers will impede steelhead migration.

The proposed highway is not expected to reduce water quality within the San Mateo or San Juan Creek watersheds. As part of the Runoff Management Plan for the proposed project, runoff and pollutants from road surfaces will be filtered out within EDBs and bioswales, and untreated runoff will not be discharged into San Juan Creek, San Mateo Creek, or their tributaries. Additionally, untreated runoff from I-5 currently goes directly into lower San Mateo Creek and the estuary, but after project completion, runoff from Interstate 5 will be directed into EDBs and bioswales for the proposed highway, which is expected to eliminate *untreated highway runoff into lower San Mateo Creek and the San Mateo Creek estuary.*

Earthen areas disturbed by construction will be re-vegetated and hydro-seeded to minimize effects to riparian vegetation and to minimize sedimentation from disturbed banks and hillsides.

Because the highway will be located away from San Mateo and San Juan Creeks, and because the bridges will be supported by piers spaced sufficiently apart to reduce the risk of impairing flowing water, the project is not expected to affect floodplain development or connectivity in the San Mateo or San Juan Creek watersheds. (Attachment 4, pp. 2-3)

viii. Fairy Shrimp

The Staff Report alleges that *"[t]he deposition of dust and airborne pollution may also adversely affect the quality and suitability of fairy shrimp critical habitat"* (p. 80).

FTC-S will comply with all local and State dust and air pollution regulations. Any assertion by Coastal Commission staff that the project would exceed these measures and have a negative impact on fairy shrimp outside the impact area is speculative and not supported by science nor by substantial evidence. Indeed , in its September 30, 2005 letter, the USFWS made a preliminary "no jeopardy/no adverse modification" determination for the San Diego fairy shrimp (see Attachment 3).

ix. Topical Issues

The following discussions address topical issues raised in the Staff Report ESHA section for several species.

Water Quality and Sedimentation

Section D of this response document discusses in detail the water quality mitigation measures that will be required as a part of the project approvals. This section briefly addresses the water quality issues as the Staff Report recites in the ESHA section.

The Staff Report grossly exaggerates potential sedimentation issues in San Mateo and San Onofre Creeks (e.g., pg 33), ignoring the fact that **the proposed project has been designed and will be constructed and maintained by FHWA and Caltrans to meet or exceed the Clean Water Act and Porter-Cologne Act water quality standards** (see EIS/SEIR Mitigation Measures WQ-2 (construction BMPs), -3 (preparation of a storm water pollution prevention plan), -4 (spill contingency), -5 and -6 (post-construction and operations BMPs)).

These standards are consistent with the Coastal Act and require the protection, maintenance, enhancement, and restoration of marine resources by significantly improving coastal water quality from existing conditions without affecting sediment transport in coastal waters. Because of the incorporation of water treatment infrastructure into a segment of I-5 that currently drains untreated storm water runoff from I-5 into San Mateo and San Onofre Creeks, the project will greatly enhance the quality of the water from I-5 when storm water enters these creeks. This improvement to water quality has the potential to benefit the tidewater goby, southern steelhead, arroyo toad, and other species known to occur downstream of the existing I-5.

TCA commissioned a sediment transport analysis to evaluate whether there would be an impact to sediment delivery within San Onofre State Beach subunit 2 resulting from the proposed project, or a cumulative impact with other planned development (i.e., Rancho Mission Viejo) in the San Mateo Creek watershed. The Sediment Transport Study concluded that the supply of sediment from San Mateo Creek would be virtually unchanged in post-project conditions (see Attachment 8 in Volume VII of the Final SEIR).

As part of the analysis, qualitative and quantitative sediment transport analyses were performed for the lower San Mateo Creek channel to evaluate the sediment transport capacity and sediment delivery to the beach. The analysis found that with the project's alteration of approximately 0.3 percent of the San Mateo Creek watershed, only insignificant changes to hydrology and hydraulics of the channel would be present, thus resulting in insignificant changes to sediment transport. Therefore, **there is no support for the Coastal Commission staff's argument that arroyo toads or the fish species would be adversely affected by changes in hydrology** (see Part D: Recreation – Surfing for detailed discussion on the performed sediment analysis).

Shading

The Coastal Commission staff's assumptions of shading impacts on San Mateo and San Onofre Creeks and the resulting potential effects on species inhabiting these areas (e.g., p. 33) are based on assumptions, not the factual realities of the existing bridge heights, existing vegetation, or proposed bridge heights. The Staff Report ignores the San Mateo and San Onofre Creeks' shade impact analysis prepared by BonTerra Consulting for the project (BonTerra Consulting, August 7, 2007 (see Attachment 9, *Vegetation Shading Analysis, August 2007)*, which was partially based on the Marblehead Coastal project analysis, accepted by the Coastal Commission.

The August 7, 2007 shade impact analysis concluded that the proposed northbound connector would span approximately 920 feet in the portion of San Mateo Creek that contains southern riparian scrub and associated understory vegetation (similar to the existing I-5/San Mateo Creek Bridge). Based on the similarity of the height of the existing I-5/San Mateo Creek Bridge and the proposed northbound connector, **the shade impact analysis concluded that construction of the proposed project would not have a measurable impact on the existing riparian vegetation under the proposed northbound connector.** Further, when comparing the resources that would be bridged underneath the southbound connector and the existing vegetation of the I-5/San Mateo Bridge, it determined that the southbound connector would not have a measurable impact on the vegetation underneath it. The shade impact analysis, however, explained that there would be a small segment of the southbound connector that would ride over the existing bridge structure at I-5/San Mateo Creek, which would increase the shading in the San Mateo Creek beyond those conditions that currently exist. This area of 0.29 acre (42 feet wide, 300 feet long) would contribute to additional shading within the San Mateo Creek area. However, the analysis concluded that this small area is not substantial enough to result in significant changes to the vegetation community under the southbound connector, nor is it anticipated to have adverse impacts on the goby, arroyo toad, least Bell's vireo, or southern steelhead.

The proposed expansion of the bridge at San Onofre Creek will be similar to the existing I-5/San Onofre Creek Bridge. Based on the similarity of the height of the existing I-5/San Onofre Creek Bridge and the proposed expansion, the shade impact analysis also concluded that the construction of the proposed project would not have a measurable shading impact on the existing riparian vegetation under the proposed San Onofre Creek Bridge.

The Staff Report claims that shading from the San Mateo Creek bridge will impact the tidewater goby (pp. 33-34). There is no scientific basis in support the of staff's claim. **The riparian vegetation at San Mateo Lagoon where the gobies typically reside most of the year will not be shaded by the project.** There will be no water temperature effects and no impact on ecosystem productivity at the lagoon.

Gobies have a wide range of water temperature tolerance that ranges from 4.0 to 21.5 degrees Celsius (Worcester and Lea 1996). During the summer and fall when some gobies are more likely to be found in San Mateo Creek proper (assuming there is water present at all), additional shading may be minimally beneficial to the degree that water temperatures are slightly lower, and to the degree that shading provides gobies with additional camouflage from potential predators, e.g., herons.

There is no justifiable rationale to suggest that a benthic fish which often lives in turbid waters over ten feet in depth and where sunlight penetration is often low, would be affected by a marginal change in daily sunlight to the extent that feeding would be impaired. Most gobies are found in shallow water less than one meter in depth. Shading would have virtually no impact on a goby's ability to detect prey at such depths given that the species is adapted to detect prey in low light conditions. Perhaps most importantly, adult tidewater gobies feed primarily at night while juvenile gobies feed at all times during a 24-hour cycle (Swenson and McCray 1996). Clearly roadway shading does not affect goby feeding success.

<u>*Vibration and Noise*</u>

Staff also overstates vibration and noise impacts as a result of pile driving on fish and aquatic life (p. 34). As an initial matter, the Staff Report paints a picture of three years of constant pile driving. While it is true that pile driving will occur *over a three year period it will not be conducted for three years continuously;* pile driving activities will be episodic, occurring for days or at most weeks at a time. Moreover, their claim ignores the simple fact that pile driving for the bridge foundation would only occur when there is no or very low surface flows in San

Mateo and San Onofre Creeks. As is well documented, surface flows in this portion of the Creeks occurs very infrequently and only during significant storm events. Pile driving would not occur during or soon after periods of heavy rain when there is high surface water volume in the creeks. The piles would be installed when the water flows have receded and the creek beds are dry enough to allow the equipment into the area. There will be no pile-driving activities within San Mateo Lagoon. Therefore, **there would be no shock waves directly imparted to the water from the pile driving that could impact aquatic species (such as tidewater goby or steelhead) since pile-driving would occur only during flow conditions when the species would not be present.** The project will implement Caltrans' construction practices, which are designed to eliminate adverse vibration effects from pile driving.

BonTerra Consulting conducted an assessment of the vibration standards for Caltrans projects of this level and the potential harm to the tidewater goby. These standards are reported in the Transportation- and Construction-Induced Vibration Guidance Manual - California Department of Transportation Environmental Program, Environmental Engineering - Noise, Vibration, and Hazardous Waste Management Office (Caltrans 2004).

Although pile driving activities are expected to be the greatest potential source of construction vibration, the pile driving activities would occur at distances no closer than 700 feet from the edge of San Mateo Lagoon[14]. According to the Caltrans standards above, the vibrations generated by the pile-driving activities will have dissipated to negligible levels at the lagoon. Therefore, the tidewater goby and other aquatic species will not be subject to any vibrations as a result of project construction.

Similarly, staff's calculations greatly overstate the potential effects of noise levels on wildlife in adjacent habitat to the pile driving (e.g., p. 46). Pile driving will take place only in the area of the bridge supports and bridge falsework. The Staff Report makes an inaccurate assumption that the project will result in an impact to 565 acres of wildlife habitat in the vicinity of the pile driving activities. The generalization does not take into account that the majority of the 565-acre area includes non-sensitive resources such as the existing I-5, parking lots, fast food

[14] Note that the existing train tracks and trestles are located directly within the lagoon, and train traffic currently results in daily vibrations.

restaurants, agricultural fields, and the Marine Corps Base Camp Pendleton, northern training areas. The staff also ignores the fact that eight lanes of high volume traffic are immediately adjacent to the pile driving area.

Coastal staff speculates that because noise levels have been found to cause speech interference in humans, noise impacts to the arroyo toad and other upland species (vireo, gnatcatcher) would be similar--without citing any supporting scientific information (p. 46). The relevance of noise levels and the interference with human speech is not correlated to these species in this comment or any known literature. As the report correctly notes, the effects of these proposed noise levels on these species has never been subjected to scientific scrutiny. But that observation cuts both ways: there is no evidence suggesting that such noise levels have adverse impacts on arroyo toad, but in any event, the species appears to be doing quite well in the area despite the existing noise levels generated by the existing I-5, train tracks, and tactical military training activities at the Marine Base.

<u>Project Biologists</u>

The Staff Report states: *"These measure[s] do not describe the qualifications and experience necessary for the project biologist and do not establish the authority of this individual to halt project activities that may be inconsistent with mitigation measures, applicable law or the preservation of sensitive species and habitats. Accordingly, these measures can not be guaranteed to mitigate anticipated adverse project effects on sensitive resources and ESHA"* (p. 36). This is a strange statement because such measures are standard and are commonly employed on projects of this type, and especially projects in the coastal zone. **All monitoring biologists are subject to the approval of the USFWS, to ensure compliance with all avoidance/minimization measures during initial vegetation clearing/grubbing and project construction.** USFWS requires that these biologists be fully knowledgeable of the biology and ecology of the listed species and vegetation types. TCA will submit the biologist's name, address, telephone number, resume, at least three references, and work schedule on the project to the USFWS for approval at least seven days prior to initiating work. The biological monitors shall have the authority to halt/suspend all associated project activities that may be in violation of the terms and conditions of the regulatory permits for the project. Where necessary, individuals with 10(a)(1)(A) permits (scientific survey permit issued by the USFWS) shall be utilized in coordination with the USFWS.

The Biological Resources Management Plan (BRMP)

Staff suggests that because it has not reviewed and approved the BRMP, evaluation of project impacts is impossible (p. 37). As is standard within the State and federal permitting process, TCA is required under various project approvals to prepare a BRMP that provides specific design and implementation features of the biological resources mitigation measures outlined in the resource agency approval documents, including the USFWS Biological Opinion (BO), USACOE 404 permits, RWQCB certification, and CDFG 1602 agreement. It is not appropriate or advisable to prepare a BRMP in advance of project approvals because the purpose of a BRMP is to provide a level of detail that can only be accomplished when further design is completed. The Draft BRMP shall be submitted to the USFWS, NOAA/NMFS, CDFG, USACE, RWQCB, FHWA, California Coastal Commission, and Caltrans for review, to the extent required by permit and/or agreements from these agencies. The agencies with responsibilities over a particular geographic area or biological resource will be able to provide guidance, comments and, where appropriate, approval to the BRMP. It is anticipated that the Coastal Commission will provide input and approval for only those resource issues within the coastal zone.

Fire

Contrary to staff's conclusions (e.g., p. 58), the project will not substantially increase the risk of wildfire. The proposed project would provide increased public access to the study area; however, the entire alignment would be fenced, in part, to restrict access from adjacent land uses.

The Staff Report states that *"[t]he proposed placement of the toll road within an area of sage scrub habitat that is typically dry and fire-prone would drastically increase the human use of this area and the number of fire ignitions"* (p. 58). Coastal Commission staff ignores the fact that the proposed project enhances the ability of firefighters to move fire protection resources from one area to another using the corridor and the firebreak properties that the road provides in the event of a wildfire. These benefits were realized during the devastating Santiago Canyon Fire (2007) that burned nearly 30,000 acres in Orange County as well as in the Anaheim Hills fire in February 2006 and for the Coto de

Caza/Rancho Santa Margarita fire in May 2002. During these wild fires, the toll road served not only to provide emergency vehicle access to fire areas and evacuation routes for residents, but was also used effectively as a fire "break" for the control and containment of the fire.

Additional mitigation for fire protection that is ignored by Coastal Commission staff includes: (a) the installation of signs around construction sites warning of high fire risk and of area closings during the high fire season, as declared by Orange County Fire Authority (OCFA) or the MCB Camp Pendleton Fire Department; (b) the maintenance of access to the existing fire road grid for the OCFA and the MCB Camp Pendleton Fire Department for areas on MCB Camp Pendleton during and after construction; (c) the implementation of fuel modification techniques as required by the OCFA and the MCB Camp Pendleton Fire Department; (d) the installation of signs along the new or improved road segments in areas subject to wild land fires, as determined by the OCFA or the MCB Camp Pendleton Fire Department; and (e) the installation of emergency call boxes along the road in undeveloped areas of high and extreme fire hazard.

Mortality to Birds From Vehicle Strikes

The Staff Report overstates the potential of gnatcatchers and vireos to be struck by a vehicle and injured or killed during construction and operation of the project (p. 56). These findings are not substantiated by scientific literature, an understanding of common construction practices, or the experience of USFWS permitted biologists who have conducted surveys for this species during construction activities. It is anticipated that the vehicle strikes during operation of this (or any existing roadway adjacent to coastal sage scrub) represents a very low risk, and the situation would happen only infrequently, if at all. It should also be noted that I-5 is within the project footprint and crosses areas occupied by gnatcatcher and vireo, yet the USFWS has never identified impacts from vehicle strikes as a topic of concern for these species.

B. Wetlands

The project will impact 0.16 acre of wetlands, which will be mitigated at a ratio of 6.25:1, in other words 1 acre, in the coastal zone.

The Staff Report states *"TCA did not follow the standard jurisdictional delineation methodology"* (p. 104). TCA originally delineated wetlands using methodology approved by the U.S. Fish and Wildlife Service, U.S. EPA, U.S. Army Corps of Engineers and California Department of Fish and Game (Jurisdictional Delineation Report, submitted March 23, 2007).

TCA conducted an additional soil analysis in November 5, 2007 and examined historical aerials to determine whether wetland hydrology is currently or was historically present within the disturbance footprint. **No additional wetlands were identified based on supplemental soil or historical aerial analysis.** These analyses identified impacts to 0.16 acres (16 hundredths of an acre) of wetlands within the coastal zone. The CCC Delineation Report has been revised to include the results of this additional analysis.

Coastal Commission Staff requested that additional information be provided on personnel conducting the jurisdictional delineation, dates that fieldwork was conducted, existing conditions of the project site, sampling methods, and characteristics of the one-parameter wetlands identified in the report. Staff also requested the report include a site location map at 1:24,000 scale, site photographs, wetland delineation map and complete wetland delineation data sheets. The requested information was provided to Staff in December 2007.

i. Allowable Use Test

The Staff Report asserts on page 89 that the project is not an allowable use under Section 30233(a)(4), which authorizes wetland fill for "[i]ncidental public service purposes, including but not limited to, burying cables and pipes or inspection of piers and maintenance of existing intake and outfall lines."[15] The

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[15] The staff has failed to propose any findings that meet the Commission's obligation, implied in section 30512.2, subdivision (b) of the Public Resources Code, to specify whether compliance with the policies and requirements set forth in sections 30233 and 30240 is necessary to achieving the basic state goals described in Public Resources Code section 30001.5.The restrictions set forth in sections

Commission has considered expansions of existing roads, an airport runway (City of Santa Barbara, CC-058-02) and several past North County Transit District (NCTD) double tracking rail projects just east of I-5 on Camp Pendleton (including CC-55-05, CC 52-05, and CC-86-03) in certain situations to qualify as "incidental public service purposes," and thus allowable under Section 30233(a)(5) where no other alternative existed and where the expansion was deemed necessary to maintain existing traffic capacity.

30233 and 30240 are, according to the reasoning of the Legislature, "policies and requirements" that are subordinated to the basic goals identified in section 30001.5. Section to 30512.2, subdivision (b), states:

The Commission shall require conformance with the policies and requirements of Chapter 3 (commencing with Section 30200) ***only*** to the extent necessary to achieve the basic state goals specified in Section 30001.5. (Emphasis added.)

In other words, the Commission may ***not*** require conformance with the policies and requirements of sections 30233 and 30240 (including the land use restrictions set forth in section 30233), unless the enforcement of such policies and requirements is necessary to achieving the basic state goals specified in section 30001.5. Section 30001.5 reads, in its entirety, as follows:

> The Legislature further finds and declares that the basic goals for the state for the coastal zone are to:
>
> (a) Protect, maintain, and, where feasible, enhance and restore the ***overall*** quality of the coastal zone environment and its natural and artificial resources.
>
> (b) Assure orderly, ***balanced*** utilization and conservation of coastal zone resources ***taking into account the social and economic needs of the people of the state***.
>
> (c) ***Maximize public access*** to and along the coast and maximize public recreation opportunities in the coastal zone consistent with sound resources conservation principles and constitutionally protected right of private property owners.
>
> (d) Assure ***priority*** [as contrasted with exclusivity] for coastal-dependent and coastal-related development over other development on the coast.
>
> (e) Encourage state and local initiatives and cooperation in preparing procedures to implement coordinated planning and development for mutually beneficial uses, including educational uses, in the coastal zone. (Emphasis added.)

While section 30512.2 refers to LUPs, the LUP, like a general plan, stands atop the hierarchy of Coastal Act planning documents and permits. There is no reason in law or policy to subject consistency certifications or coastal development permits to a stricter standard.

If the Commission chooses to require conformance to the policies and requirements of Chapter 3, including sections 30233 and 30240, it ***must***, given the logic of section 30512.2, subdivision (b), demonstrate that conformity is necessary to achieving the basic state goals set forth in section 30001.5, and support its conclusion with substantial evidence. The staff-recommended findings fail to meet the Commission's burden.

The Staff Report claims that the project does not qualify as an "incidental public service because (a) the project is not a temporary disruption, (b) the project is not a limited expansion, and (c) the project will increase highway capacity. This imports three requirements to limit the application of Section 30233(a)(5) that plainly are not set forth in the provision.

The limitation of a "temporary disruption" is completely at odds with past Commission approval of permanent transportation projects, such as the Santa Barbara airport runway project, the Caltrans Devil's Slide project, and the several NCTD rail projects. The notion of a "limited expansion" or that the project "not increase highway capacity" is a fiction, again not found in the statute or its legislative history. Nonetheless, **the project here is no less a "limited expansion" than the other transportation projects approved as consistent with Section 30233(a)(4)**; in the coastal zone, it involves approximately 1.7 miles of ancillary improvements to the existing I-5 and 0.5 mile of connectors to I-5 and improvements along SR-241, for a total of 2.2 miles.

Finally, **there is no requirement in Section 30233(a)(4) that to qualify as permissible fill in a wetland, new development must maintain the status quo, or, in the case of a road, that the road not increase highway capacity.** Nonetheless, as explained in TCA's consistency certification but ignored by the Staff Report, the project is designed to maintain current levels of service by alleviating existing congestion. The existing population of the region has resulted in continuing traffic congestion in both weekday and weekend conditions. The major travel route, I-5 as it travels through south Orange County, experiences very poor levels of service during these periods. Under existing conditions, roadway deficiencies occur at three segments of I-5, 12 freeway/toll road ramps (nine I-5 ramps and three SR-241 ramps) and 10 intersections (six arterial-to-arterial and four arterial-to-freeway/toll road ramps). Additionally, a number of intersections on area roads are currently deficient, including the intersection of I-5 and Oso Parkway, I-5 and Crown Valley Parkway, I-5 and Ortega Highway, I-5 and Avenida Pico, Crown Valley Parkway and Marguerite Parkway, and Ortega Highway and Antonio Parkway (Final SEIR, § 3). Most of I-5 within the South County area operates at LOS F (failing conditions) during the peak hours (Orange County Congestion Management Plan, 2005).

Access to and along this portion of the coast is currently restricted because of severe traffic congestion on I-5. **In this area, I-5 is the only north-south route and thus the only regional facility available to handle inter-regional, local and recreational travel.** Access to the coast is particularly restricted during peak recreational periods such as weekends and holidays. Traffic on I-5 on weekends is higher than weekday traffic. (Final SEIR, ch. 3). Because of I-5 congestion, significant congestion is also occurring on local streets in San Clemente on the weekends as drivers attempt to avoid I-5 congestion. This results in additional barriers to coastal access. Coastal cities, including San Clemente, Dana Point and San Juan Capistrano expressed concerns with these issues in a 2003 letter included in the Final SEIR as Exhibit 1 to Section 3.

The plain language of Section 30233(a)(4) is not restricted to projects that maintain existing traffic capacity. But in any event there is substantial evidence that the project is necessary to maintain existing traffic capacity. The project qualifies as an "incidental public service purpose," and therefore is an allowable use under Section 30233(a)(4).

ii. Alternatives Test

The Staff Report erroneously concludes on pages 101-02 that the project is not the least damaging alternative. **The test used by the Collaborative to determine the 'least environmentally damaging practicable alternative' (LEDPA) is equivalent to the Coastal Act requirement that the chosen alternative be the 'least environmentally damaging feasible alternative'.** The process by which the Collaborative chose the preferred alternative is discussed at length in Part H: Alternatives, below.

iii. Mitigation Test

TCA has proposed mitigation within the coastal zone to offset permanent impacts to 0.16 acre of coastal wetlands. The proposed one-acre created wetland would provide a mitigation-to-impact ratio of 6.25:1, which would fully compensate for impacts to 0.16 acre of coastal wetland. The revised CCC delineation report includes a wetland delineation demonstrating that the proposed one-acre created wetland area is not currently wetlands using the Commission one-parameter wetland definition.

TCA will restore the temporarily impacted area to pre-project contours and revegetate the site within 12 months from initiation of impacts. Therefore, temporary impacts within the coastal zone will not exceed 12 months and qualify as "temporary."

Regarding the 1.0 acre of wetland mitigation proposed within the coastal zone, the following addresses the Staff Report concerns regarding the location of the newly created acre of willow: Following restoration of temporary impacts, the created wetland will be contiguous with San Mateo Marsh East of I-5 through an approximately 40-foot wide wetland with the exception of a single at-grade dirt road crossing. The proposed creation area will act as an intermediate refuge for species dispersing between the Creek and the Marsh. As such, it will improve connectivity between the creek and the existing isolated marsh and provide biological functions such as providing habitat for vertebrates, invertebrates and vascular plants (See Exhibit 6 of the revised CCC Delineation Report, submitted to Coastal Staff in December 2007).

Additionally, the minor impacts to coastal wetlands will occur in areas that are just as close to the existing I-5 as the proposed created wetland will be to the future toll road/I-5 connectors. In other words, **the impacted wetlands proximate to I-5 are already experiencing the same indirect impacts that the created wetland would presumably be exposed to** because of its proximity to the future road. Therefore, there is no anticipated net loss in function attributable to the location of the created wetland and no buffer is necessary to replicate existing conditions. There will no be polluted runoff or edge effects from the sand media filter basin on the southeast edge of the proposed mitigation site.

Further, while untreated runoff from the I-5 is currently discharging into the very small coastal wetlands that will be impacted, the created wetland will not receive untreated flows from the toll road. With implementation of the project, sand media filters will be constructed and sized accordingly to treat flows from the I-5 (currently untreated) and the future toll road.

Finally, TCA provided a functional capacity analysis as required under Section 30233(c) of the Coastal Act in December 2007.

The 0.16-acre of permanent impact consists of:

- Four bridge pilings in San Mateo Creek totaling 0.006 acre
- Extension of bridge bents in San Onofre Creek totaling 0.005 acre and
- Fill of 0.147 acre of San Mateo Marsh East resulting from the relocation of an existing dirt road.

The portions of San Mateo and San Onofre Creek proposed for permanent impact are primarily adjacent to the existing I-5. Construction of the bridge supports are not expected to significantly affect the hydrologic or biogeochemical functions of the two riverine features as explained in more detail in the Hybrid Functional Assessment. Similarly, as detailed above, the loss of such small patches of habitat (0.006 acre in San Mateo Creek and 0.005 acre in San Onofre Creek) within a matrix of a much larger patch (19.12 acre in San Mateo Creek and 2.18 acre in San Onofre Creek) of riverine habitat is not expected to significantly affect the carrying capacity of the habitat. The Hybrid Functional Assessment provided in Appendix E of the December 17, 2007 CCC Delineation Report provides a quantitative approach for analyzing impacts to aquatic function. Twenty-one metrics (including metrics affecting buffer functions, hydrologic functions, biogeochemical functions and habitat functions) are evaluated. Appendix E Table 1 indicates that San Mateo Creek provides approximately 20 Aquatic Functional Capacity Units (FCU) per acre and San Onofre Creek provides approximately 17 FCU per acre. San Mateo Creek totals approximately 9.78 acres within the CCC Study Area, therefore providing 195.6 total FCU. San Onofre Creek totals approximately 2.18 acres within the CCC Study Area, therefore providing 37.1 total FCU. Also as indicated in Appendix E Table 1, impacts to 0.011 acre result in overall loss of only 0.2 Functional Capacity Units, or 0.09% of the total function provided by CCC wetlands within the CCC Study Area. The lost functional units will be replaced and there will be an increase in function.

The impacts to San Mateo Marsh East, although greater in area, similarly have minimal impacts. The existing wetlands feature is isolated from San Mateo Marsh West by I-5 and separated from San Mateo Creek by approximately 900 feet. This wetland is supported by groundwater rather than surface water. Permanent impacts are limited to two locations: 1) the margin of the wetland characterized by a fill slope in which willows either overhang or have tapped into deeper groundwater and 2) a narrow linear band of one-parameter wetland vegetated with arroyo willow and mulefat but exhibiting no hydric soils or evidence of hydrology except for a very narrow agricultural ditch along the northern edge. The analysis shows that there will be no impacts to hydrologic function. The project permanently impacts only 0.6% of the overall wetland, therefore impacts to overall biogeochemical and habitat functions have been minimized. A Hybrid Functional Assessment was included as Appendix E of the Conceptual Habitat Mitigation and Monitoring Plan, dated August 31, 2007, which was submitted previously to the Commission. See Hybrid Functional Assessment, included as Appendix E of the revised CCC Delineation Report submitted to Coastal Staff in December 2007, and which has been refined to specifically address the coastal zone.

The consolidated 1.0 acre of created wetlands within the coastal zone will result in a net gain of functional capacity to coastal wetlands. TCA has met the Coastal Act Section 30233(c) requirement that the small wetlands fill enhance the functional capacity of wetlands in the impacted area. As described above, the 1.0 acre created wetland will act as intermediate refuge for species dispersing between the San Mateo Creek and San Mateo Marsh East. As such, it is expected to improve connectivity between the creek and existing isolated marsh and provide biological functions such as providing habitat for vertebrates, invertebrates and vascular plants. In contrast with the 0.16-acre of wetland to be impacted, the created wetland will not receive untreated flows from the I-5.

C. Public Access, Recreation, and Public Views

In its analysis of public access and recreation, the Staff Report attempts to extend Commission jurisdiction to features outside of the coastal zone. **For the purposes of this consistency certification, the project description includes approximately 2.2 miles of improvements, of which 1.7 miles are improvements along existing I-5**, not *"several miles of new construction and additions to I-5,"* as the Staff Report asserts (p. 112). The project includes only **four lanes of traffic**, two in each direction – not six lanes as claimed in the Staff Report.

The Staff Report claims, without documentation, that San Onofre State Beach (SOSB) received 2.4 million visitors in fiscal year 2005/2006 and that the San Mateo Campground (campground) received an annual number of 108,446 users during the 2006/2007 fiscal year (pp. 11, 114-115). To date, State Parks has refused to provide any records to substantiate these statistics. It is well known that the day use beaches are the primary use area of the Park. The project will have absolutely no impact on beach use. Despite repeated Public Records Act requests, State Parks has refused to provide any actual records of use of San Mateo and other campgrounds. State Parks claims that these public records are subject to a "privacy" exception to the Public Records Act. The California Supreme Court has expressly rejected the assertion that "privacy" claims of this sort excuse compliance with the Public Records Act. *International Fed'n of Prof'l and Technical Eng'rs v. Superior Court,* 42 Cal. 4th 319 (2007) (holding that disclosure of names and salaries of public employees not exempt under the Public Records Act); (*Commission on Peace Officer Standards and Training v. Superior Court*, 42 Cal. 4th 278 (2007) (holding name, employing departments, and hiring and termination dates of peace officers not exempt from disclosure under the Public Records Act). If State Parks claims are correct, why does it refuse to provide the documentation of uses of San Mateo and other campgrounds?

i. San Onofre State Beach (SOSB) Leasehold

The State Park lease expires in 2021. Any extension will require the agreement of the Department of the Navy (DoN) and will require the State to pay fair market value -- funds that will not be available to the State without the project.

The Lease between the DoN and Department of Parks and Recreation ("State Parks") dated September 1, 1971 is for a fifty (50) year term that expires in 14 years – on August 31, 2021 (see Attachment 10, *Lease Agreement*). The Staff Report states on page 120 that *"unless renewed [the existing SOSB lease] is set to expire in August 2021."* There is no indication that the lease will be renewed. Indeed, all recent indications by the USMC are that they may not be willing to extend the lease in subunit 1 (leased property on the east side of the I-5) because of the increased need for the use of Camp Pendleton for training activities since 9/11.

The Navy has repeatedly expressed concerns about encroachment and the impact of encroachment on the Base's ability to train Marines. For example, in Major General Bowdon's testimony to the United States House of Representatives Committee on Resources on May 6, 2003, Major General Bowdon described the manner in which "the ability of Camp Pendleton to provide the realistic training environment necessary to prepare Marines for combat has eroded significantly" due to encroachment (see Attachment 11, *Major General William G. Bowdon III Testimony, May 2003*). He summarized a study that found realistic training "is significantly degraded within prime maneuver corridors, training areas, and on the training beaches at Camp Pendleton due to encroachments." Regulatory restrictions, including endangered species, constitute the majority of encroachments. "Physical obstacles, such as I-5 and the nuclear power generation plant ... are not the leading encroachment factors." Major General Bowdon's testimony also addressed the requirement for beaches where realistic amphibious operations can be conducted.

There is also a need to train with new weapons systems and to absorb additional training demands (see Attachment 12, *Letter from L.D. Rannals, USMC to J. Kolb, FHWA, April 2001*). Due to training needs and encroachments, the DoN and the USMC have maintained that only a FTC-S alignment that closely adheres to Camp Pendleton's northern boundary would be acceptable to the Navy/Camp Pendleton. Additionally, the Navy has emphasized their need to protect their ability to *"develop new training areas and/or training support facilities within this most northern section of the Base."* Mr. Rannals letter to FHWA states that they cannot close out the option for additional training in the future, and the

USMC "must be able to maintain flexibility with respect to its land use options, so as to meet any future training requirements."

A recent article in Training & Simulation Journal (August/September 2007 Vol. 8 No. 4, www.TSJOnline.com) puts the issues further into perspective. The article describes the USMC efforts to seek *"new ways to improve training and simulations"* for infantrymen and an Infantry Immersive Trainer *"being developed in a 30,000-square-foot former tomato-packing warehouse near Camp Pendleton's northern infantry camp."* The article also mentions that about *"1,000 acres in the area would be developed into a larger training area so a platoon could get off a helicopter and assault or operate in the simulated town."*

In summary, the lease allows the USMC to train within the SOSB leasehold. **There is no guarantee that the lease will be renewed and USMC needs for additional training facilities and area are well documented.** In fact, due to USMC training needs, there is a distinct possibility that, even if the USMC renews the lease, it may not renew it in the same form, or include the same physical area, as presently in the lease.

It is common knowledge that the USMC has been granted approval by Congress to increase the manpower strength of their forces as our Country continues to fight the Global War on Terrorism (GWOT). This increase in strength will require the maximum use of all available training grounds at Camp Pendleton. Recent indications by the USMC are that, as they review their operational requirements, they may not be willing to extend the subunit 1 portion of the lease.

Even if the DoN and the USMC agree to extend the lease, the Staff Report fails to explain that the legislation passed after the lease was signed will require State Parks to pay fair market value for the lease (10 U.S.C. § 2667). **The fair market value of a 50-year extension of the lease may be as much as $70 million.** TCA's $100 million parks mitigation package (discussed below) that TCA has offered would provide the financial resources to allow CDPR to extend the SOSB lease with the increase to market value. In the absence of funding by TCA, it is unlikely that the State will have the necessary financial resources to extend the State Park lease – even if the DoN and the USMC agree to do so. The entire State Parks' operating budget for Fiscal Year 2008 is $383,495,000[16]. The

[16] Senate Bill No. 78, August 24, 2007. Page 22.

Legislature reduced the operating budget by approximately $40 million for 2008. Given, the estimated $14 billion state deficit, it is extremely likely that the State Park's budget will be cut in the future. State Parks has a backlog of deferred maintenance of over $ 1 billion. There is no foreseeable funding available to State Parks to pay the fair market value of a lease extension as required by federal law.

ii. The Lease Reserved to the Navy The Exclusive Right to Approve Roads Within the Lease Area

Contrary to the claims of the Staff Report, construction of the project as proposed is allowed under the lease. Indeed, the DoN, the lessor, has imposed stipulations that required the project to be located in this portion of Camp Pendleton. The lease reserves the right to the Navy to approve the construction of roads within the lease area:

> *This Lease is subject to all outstanding easements and rights of way for location of any type of facility over, across, in and upon the Leased Property, or any portion thereof, and to the right of the government, after consultation with State Parks as to location, to grant such additional easements and rights of way over, across, in and upon the Leased Property as it shall determine to be in the public interest; Provided, that any such additional easement or right of way shall be located so as not to unreasonably interfere with the use of the State Parks' improvements erected on the Leased Property (*Attachment 10, *Part II,C.)*

By its express terms, the Lease exclusively reserves to the Navy the right to approve easements within the Lease area. In addition, the limitation on "unreasonable interference", by its terms, only applies to improvements "erected" by State Parks. The project will not remove or unreasonably interfere with the use of any improvements erected by State Parks. At its closest point, the project is 380 feet from the nearest campsite at the San Mateo Campground (the average distance between the project and campsites is approximately 650 feet). The project includes noise and visual mitigation measures to reduce noise and visual impacts on the Campground (Mitigation Measures N1-N6 (Noise), and AS1-As4 (Visual), EIS/SEIR).

By the State Park's own admission, the campgrounds immediately adjacent to I-5 are very heavily used despite the fact that the coastal campgrounds are within 225 feet of I-5 and despite the fact that there are no noise or visual measures to reduce the effects of I-5. Thus, there is no evidence that the project will "unreasonably interfere" with the use of the San Mateo Campground.

The State Parks' Department knew the location of the Foothill South project several years before the construction of the San Mateo Campground in 1989 and with full knowledge that the State of California had no jurisdiction over the location of the project within Camp Pendleton. The General Plan, dated 1984, for San Onofre State Beach states the following:

> *San Onofre State Beach is leased from the U.S. Navy, and hence is not subject to land-use regulation by the county or the state.*
>
> *FTC-S and La Pata Avenue are shown in the Master Plan of Arterial Highways component of the Orange County General Plan adopted in 1983. The Foothill Transportation Corridor would have six to eight lanes, claiming a right-of-way of 300 to 400 feet wide. The final route of the FTC has not been selected, but the maps show it running along the east side of San Mateo Creek the full length of subunit 1, intersecting with the San Diego Freeway at the location of the Basilone Road Interchange. (California Department of Parks and Recreation, San Onofre State Beach Revised General Plan, p. 57, June 1984)*

Thus, **five years before** the construction of the San Mateo Campground, the State Parks Department understood that the project was planned to be located within the lease area east of San Mateo Creek. Nevertheless, State Parks proceeded to locate the Campground in this area. It did so while acknowledging that the Lease reserved to the federal government the exclusive right to approve the construction of a road in this area. Similarly, State Parks was aware of the future construction of the project when designating trails.

Under the terms of the Lease, the DoN/USMC have the right to grant TCA a permanent easement of right of way on the Leased Property that is superior to the rights of the State Parks. It is important to note that in accepting the grant from the DoN, **TCA will not be acquiring any interest of the State Parks**

under the Lease. Rather, TCA will be acquiring an interest in the reserved fee rights belonging solely to the DoN that were carved out of the Lease. As a result of the grant, TCA will stand in the shoes of the DoN with respect to its superior right of use of a portion of the Leased Property that is the subject of the easement. From a practical point of view, upon the acquisition of the easement, TCA's rights with respect to use of the easement within the Leased Property will effectively replace the rights of the State Parks with respect to that portion of the leasehold covered by the easement.

Had the parties intended to limit the scope of any easement or right of way, including an exclusion of uses on the leasehold or the size, the Lease would have specifically included restrictions on the scope, manner of exercise, the size and the location of any future easements or rights of way on the Leased Property. The fact that the reservation language is so broad indicates that the parties contemplated that the DoN would have tremendous discretion in determining the location and general manner of use of any future easement or right of way on the leasehold. More importantly, the broad terms of reservation used in the Lease evidences that a toll road extension would not be considered an increased burden on the operation of the Park.

iii. TCA Has Considered and Adopted All Feasible Mitigation Measures

The Staff Report fails to acknowledge the mitigation measures offered to offset impacts to recreational facilities. Throughout the document, the Staff Report falsely states that TCA is unwilling to provide substantial mitigation for impacts to existing recreational uses within San Onofre State Beach (SOSB). To the contrary, **TCA has offered $100 million to CDPR to improve and expand recreation resources at state parks and beaches. This extraordinary offer is above and beyond the required mitigation for the project.** The $100 million is available to fund all of the following protection and improvement measures as determined by the State Parks Department and the Navy:

- Extending the SOSB lease at market value (as required by federal law);
- New camp sites and other Improvements at San Onofre Bluffs campground within SOSB subunit 4;
- New campsites and/or improvements at nearby San Clemente State Beach to the north;

- Renovation and maintenance of Crystal Cove State Park cottages north of Laguna Beach;
- Improvements of additional coastal campsites, picnic facilities, and beach parking at Crystal Cove State Park's El Moro Campground; and
- Restoration of 150 acres of coastal sage scrub habitat at Crystal Cove State Park.

The $100 million could be used by CDPR to fund all or some of the above protections and improvements or any other improvements to recreational facilities in state parks and beaches. Thus, if the State and the Navy cannot agree on the terms for extension of the State Park Lease, all of the funds would still be available for any other state parks or beach projects, as determined by the California Department of State Parks and Recreation.

TCA has documented that the $100 million could easily add at least 120 campsites to the number of available campsites in the project vicinity.

The Staff Report asserts that TCA's extraordinary $100 million package is premature because CDPR has not yet determined whether or how to accept it. Contrary to this claim, TCA has fully documented the feasibility of using the funds as described. All that is left to do is for the State Parks Department to indicate that it is willing to accept the funds for the benefit of the people of California. Indeed, CDPR previously proposed that TCA commit to provide money and/or new recreational developments (*Mitigation Assessment of FTC-South Impacts on San Onofre State Beach,* August 1997).

The Staff Report cites an August 2004 letter from the Director of CDPR that states *"State Park staff has investigated the potential for recreating [the recreational opportunities provided by SOSB and impacted by the project] elsewhere and our knowledge of the region leads us to conclude that losses to the existing unit cannot be adequately mitigated"* (p. 123). While TCA disagrees with the Staff Report that the construction and operation of the project will have the impacts described (namely, render subunit 1 unusable), to say that no mitigation opportunities exist in the region is manifestly incorrect. TCA has readily identified opportunities to increase the number of coastal campsites and provide enhancements to camping facilities, including those described above.

The Staff Report's analysis of the State Park issue is fundamentally flawed because it:

- Ignores the fact that the DoN reserved the exclusive right to approve construction of roads within the Lease area;
- Ignores the fact that the Lease expires in 2021;
- Ignores the fact that federal law requires the State to pay fair market value to extend the lease; and
- Ignores the fact that the General Plan for the Park acknowledged the proposed location of the project five years before the construction of the San Mateo Campground.

iv. Project Will Not Impact Coastal Access

Contrary to the incorrect conclusions of the Staff Report, **at no time will project construction or operation remove the availability of coastal access to SOSB users, or require the permanent abandonment of <u>any</u> of the park's recreational facilities,** including the San Mateo Campground and Trails A and B[17] (see Attachment 13, *Trail References in SOSB*). The recreation and coastal access opportunities identified by the Staff Report as taking place at SOSB (*"beachcombing, sunbathing, swimming, surfing, camping, hiking, bicycling, horseback riding and wildlife and ocean viewing"* (p. 112) will all be available to park users during both construction and operation of the project.

The project has been a part of transportation planning documents since 1981, predating the construction of the majority of the park's facilities. CDPR has been informed of the project since this time. The project has also has been identified in the State Parks' San Onofre State Beach Management Plan since 1984. Because the project has been included in the guiding development document for the Park, this contradicts any claim that the project will require the abandonment of park facilities or will unreasonably interfere with recreational activities within the Park. As discussed above, CDPR entered into the Lease with the knowledge

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[17] Because the trail references in the Staff Report are not official trail names, the trail connecting the San Mateo Campground to Old Highway 101 (termed the "Panhe Trail" in the Staff Report) is referred to as **Trail A**. The trail connecting the day use parking area to the beach (referred to as the "Upper Trestles Trail" in the Staff Report) is referred to as **Trail B**.

and understanding that the DoN reserved the exclusive right to approve the construction of roads within the Lease area.

The Staff Report cites a 1997 Mitigation Assessment of FTC-S Impacts on San Onofre State Beach, which implies that the project will impede a *"potential for expanded recreational opportunities"* and that after construction of the project, *"potential activities such as environmental and equestrian camping may no longer be feasible uses"* (p. 122). However, no recent plan for SOSB identifies plans or locations for these uses and no supporting documents have ever been cited by CDPR or Coastal staff. It is, therefore, not reasonable to argue that the project renders these future "potential" uses as infeasible. CDPR also has no funding plan for these future potential uses, or for future market value extensions of the Lease.

v. The Project Will Not Impact SOSB Trails or Other SOSB Activities

The Staff Report also greatly exaggerates the effects of land acquisition on SOSB's trails, campground, and other recreational resources and activities.

SOSB Trails

The Staff Report indicates that Trail A would experience a *"substantial degradation"* (p. 128) by having to pass adjacent to, above, or below the proposed toll road. However, **this seems trivial in as much as staff recommended this same trail be eliminated in 2003 in favor of the existing trail crossing over I-5**, stating: *"The subject trail is dangerous and has adversely affected erosion control efforts under the bridges" and that "adequate access exists nearby"* (6-01-149, 2003).

Furthermore, this claim is belied by the Report's admission that the existing Trail B is heavily used despite the fact that it is located adjacent to a parking area, crosses over I-5, and follows the paved old Highway 101 route (See Staff Report, page 129). The Staff Report also describes the California Coastal Trail is described as *"a popular walking, jogging and bicycling route"* (p. 126) despite its being paved, its adjacency to the Cristianitos Road overcrossing, and its running *"parallel to I-5 through the entire Trestles Beach subunit of San Onofre State Beach"* (p. 129). Additionally, Trail A in its current configuration runs adjacent to Cristianitos Road for approximately 1,600 feet.

Temporary alternative trail routes will replace those portions of Trail A and Trail B that are temporarily impacted during construction. Portions of the trails that are permanently relocated will be established in locations that provide similar access routes to the beach. The existing Trail A, while realigned by the project, will not be removed. Significantly – although ignored by the Staff Report, other recreational facilities within SOSB, including the San Onofre Bluffs campground within subunit 4, Trail B within subunits 1 and 2, and the California Coastal Trail along Old Highway 101, have not been abandoned by State Parks for their even greater adjacency to I-5 or other existing roadways.

Therefore, because trail conditions after construction of the project will be similar to the conditions of popular and effective trails within SOSB currently, and because trail access to the beach will remain during construction of the project, the project clearly will not "unreasonably interfere" with any SOSB trails.

San Mateo Campground

Land acquisition for the construction and operation of the project does not preclude the use of any campsites within the San Mateo Campground. The closest of the project's travel lanes is located 380 feet from the nearest campsite, further separated by both elevation and a sound wall.

The Staff Report claims that if the project is routed through the Cristianitos subunit of SOSB as proposed, CDPR would abandon this portion of the park and that the San Mateo Campground would be closed. This claim is without foundation and is belied by CDPR's own acknowledgement that the Bluffs campsites in subunit 4 are extremely popular despite their location immediately adjacent to I-5 even without sound wall or other noise attenuation. Indeed, in its 1997 *Mitigation Assessment of FTC-S Impacts to San Onofre State Beach*, DPR explained that *"San Onofre State Beach would continue to be a popular park because of its location on the Southern California coastline and the coastal recreation opportunities it offers,"* and while FTC-S may have some impact on subunit 1, ***"FTC-S will provide greater access to the coast and substantially increase park visitation levels"*** (1997 *Mitigation Assessment of FTC-S Impacts to San Onofre State Beach*, pp. A-3 – 4).

By way of comparison, the campsites within CDPR's existing San Onofre Bluffs Campground (SOSB subunit 4) are about 200 feet from the existing I-5, have no sound wall, and lie adjacent to the very active BNSF/Amtrak railway. No sensationalist "park closure" statements have been made regarding the Bluffs Campground. A recent survey of State Parks demonstrates that there are State highways that run through or adjacent to 42 California State Parks. **State Parks has never closed any of those parks.** Indeed, it appears that the location of those parks was chosen despite their proximity to existing roads (see Attachment 14, *State Parks Adjacent To, On or Bisected By State Highways*).

In any case, TCA has committed up to $100 million to assist CDPR to protect and expand camping and other recreational uses at SOSB, San Clemente State Beach and Crystal Cove State Beach.

<u>*Other Recreational and National Security Activities and Resources*</u>

The Staff Report states that *"due to its close proximity to the beach and the Upper and Lower Trestles beach access trails, the Coastal Trail also provides special event parking during surf contests"* (p. 129). The Staff Report goes on to state that project impacts will impede the use of the Coastal Trail for special event parking. However, all project impacts to the Coastal Trail will be temporary. TCA will ensure adequate replacement parking for special events. If a special event were to take place during a time when temporary construction impacts impede the use of portions of the trail for special event parking, TCA will provide parking in the local area and shuttle people to and from the event.

The project includes the upgrade of an existing access road adjacent to I-5 for military tactical vehicles and training purposes. Coastal staff states *"the placement of a vehicular access road along a section of the California Coastal Trail that is currently closed to vehicle traffic has the potential to preclude or degrade the quality of the existing recreational uses"* (p. 131). However, **this road already exists and Camp Pendleton has full access of it for vehicular use.** The project is only proposing extending the existing road under I-5. This will allow access to the Northern Training Area (old agriculture field) without having to drive vehicles and equipment through the San Mateo Creek. Additionally, the military access improvement, included at the request of Camp Pendleton, will be used intermittently, similar to the use of old Highway 101 for access and parking surfing-related special events. Surfing special events draw thousands of spectators, as well as highly intrusive trucks, equipment and vehicles, but the events are not common occurrences. The Base military access road will be used intermittently, during special military training operations by Camp Pendleton Marines in support of their tactical training readiness. The DoN/Marine Corps Base Camp Pendleton lease includes a provision that the U.S. expressly reserves the right to use the property for conducting formal military training exercises, with notice. That right exists today, and the upgrade to the existing Base access road only serves to assist the DoN and Camp Pendleton Marines to exercise an existing right.

vi. The Project Will Not Have Significant Adverse Noise Impacts

As in the case of land acquisition, Coastal Staff greatly exaggerates the project's noise impacts to SOSB's trails, campground, and other recreational resources and activities. **Several comprehensive noise analyses that include existing, construction, and operation sound levels have been conducted throughout the project area. The reports document that noise impacts will be reduced below state and federal noise standards applicable to recreational areas** (Noise Assessment Technical Report, Mestre Greve Associates, 2003) and Supplemental Noise Assessment, Mestre Greve Associates, 2004). For example, the Final EIR concluded that, with the implementation of the noise mitigation measures, the noise levels within the San Mateo Campground would be reduced to 67 decibels (dBA). TCA has included several soundwalls throughout the project.

The Project Will Retain and Improve Existing SOSB Trails

The Staff Report claims that the project will have adverse construction noise impacts on trail users. This claim ignores the fact that trails will be rerouted or temporarily detoured outside of concentrated noise areas (but within the project disturbance limit). After construction staging and sequencing has been finalized, the details of temporary trail-rerouting plans will likewise be finalized and provided for Coastal Commission staff review.

The Staff Report states on page 133 that construction activities within the vicinity of SOSB Cristianitos subunit 1 (including San Mateo Campground) would generate noise levels of 65 dBA up to 2,800 feet from the centerline of the proposed toll road and that speech interference typically begins at 65 dBA. The construction noise level identified is the maximum noise level (Lmax) that would be generated by these activities. Noise at this level would only occur for a few minutes within any particular hour. Speech interference is evaluated using the average background noise level (Leq). The Leq generated by the construction activities are expected to be 10 to 15 dBA lower than the Lmax levels. Therefore, construction activities below 75 to 80 dBA Lmax would not result in any speech interference within the SOSB Cristianitos subunit 1.

The Staff Report states on page 135 *"It is very likely that the use of San Mateo Campground during the construction phase of the project would be substantially diminished and its ability to function as a coastal recreation and low cost coastal accommodation resource would be degraded."* When coming to this conclusion the Staff completely ignores the fact that construction activities will occur during daylight hours only not at night when low sound levels are most important to campground users. The staff also ignores the fact that the campground is located less than ¾-mile from the 8-lanes of I-5. If the traffic noise from I-5, which occurs during AM and PM hours, has not diminished the use of the campground it is not reasonable to assume that daytime construction activities would diminish the use.

The Staff Report states on page 135 to 136 *"Along those lines, it should be noted that SOSB includes an additional campground located in close proximity to I-5 that despite containing 10% more campsites than the San Mateo Campground, receives substantially fewer users. Specifically, the Bluffs Campground, adjacent to I-5 in SOSB subunit 4, hosted 60,079 overnight visitors between July of 2004 and July of 2005 while the San Mateo Campground hosted 43% more overnight visitors during the same period, 105,427. Although this difference may be attributed to a variety of factors, it can be assumed that the quieter, more natural setting of the San Mateo Campground was an important contributor."* By making this statement Staff completely misleads the reader by choosing to ignore the most obvious reason for the difference in attendance is the Bluffs Campground is only open from May 15th to October 2nd (4.5 months a year) while the San Mateo Campground is open year round. Using the attendance numbers provided above by the Coastal Commission staff indicates that the Bluffs campground is far more popular with 430 overnight visitors per day the park is open compared to the less popular San Mateo Campground which only averages 288 overnight visitors per day the park is open. This indicates that even though the Bluffs campground experiences significant traffic noise from the adjacent I-5, users still choose to camp there at a more frequent rate than the San Mateo campground when compared based on number of days available for use per year.

The Staff Report states *"CDPR has asserted on several occasions that if the toll road is routed through the Cristianitos subunit of SOSB, as proposed, CDPR would abandon this portion of the park and relinquish its lease to the underlying landowner, the Department of the Navy."* The fact is CDPR has not said definitively they would abandon this portion of the park. They have indicated they would consider abandoning it. **The Coastal Commission staff should also note that the 1984 General Plan for the park recognized the planned route for the toll road and the park still decided to build the campground in 1989 with knowledge of the roads proposed location.**

The Staff Report states on pages 136 and 137 that construction operations within the vicinity of Trail A would *"result in highly elevated and potentially unsafe sound levels for those pedestrians attempting to continue using the trail during the three year construction phase."* In addition, the report states that the peak noise levels of 90 to 105 dBA at a distance of 50 feet would expose the trail users to potentially dangerous sound levels. As stated above, the noise levels generated by the construction/pile driving activities represent the maximum noise levels (Lmax) that would only occur for a few minutes within any particular hour. The average noise levels (Leq) generated by these activities are expected to be 10 to 15 dBA lower than the Lmax levels.

The Staff Report contends on page 137 that the realigned Trail A would pass directly adjacent to the realigned Cristianitos Road over crossing, an area in which pile driving activities would occur for between eight and twelve weeks, thereby placing trail users within less than 50 feet of pile driving activities and subjecting them to sound levels in excess of 100 dBA and possibly as high as 105 dBA. Staff is incorrect in stating that trail users will be exposed to pile driving activities related to the Cristianitos Road Overcrossing. **No pile driving is proposed for the Cristianitos Road Overcrossing.** The bridge will be supported on cast in drilled hole piles not supported on pre-cast piles that are driven into the ground. Thus Staff's misinformed concerns about placing trail users within 50 feet of pile driving activities are unwarranted.

Table 1-1 of the *National Institute of Occupational Safety and Health's Publication No. 98-126*[18] shows that an individual would have to be exposed to

[18] See http://www.cdc.gov/niosh/docs/98-126/chap1.html

105 dBA for 4 minutes and 43 seconds for any potential damage to occur. At a Leq of 95 dBA the exposure increases to 47 minutes and 37 seconds. Pile driving activities would occur occasionally and for short durations of several minutes. An individual walking at 2 miles an hour would be exposed to 95 Leq for less than a minute. By about 1/2 mile away from the source, the noise would be reduced to 59 dB.

There are no circumstances where construction of the project would result in pile driving duration approaching the duration needed to result in hearing damage. During construction the trail will be temporarily rerouted and beach access will be provided along Cristianitos and down Highway 101. The trail users will not be in any danger of hearing loss.

San Mateo Campground

The Staff Report states on page 134 that sound levels within the San Mateo Campground would reach 75 dBA within 900 feet of the pile driving, 70 dBA within 550 feet of heavy grading, and 60 dBA during general construction activities. First, **no pile driving is proposed within 900 feet of the San Mateo Campground.** Second, these noise levels represent the maximum noise levels (Lmax) that would be generated by these activities and would only occur for a few minutes within any particular hour. The average noise levels (Leq) generated by these activities will be 10 to 15 dBA lower than the Lmax levels (based on the duration of the noise events during a one hour period). Therefore, the increase in noise levels within the campground would be 3 to 18 dBA over the existing sound level of 47 dBA, not 13 to 23 dBA as stated within the Staff Report.

Other Recreational Activities and Resources

The Staff Report states on page 139 that pile driving within 900 feet of San Onofre State Beach would generate noise levels upwards of 75 dBA, 9 dBA higher than the existing average noise level of 66 dBA. The noise levels generated by the pile driving activities at the San Onofre Creek Bridge Widening represent the maximum noise levels (Lmax) that would only occur for a few minutes within any particular hour. The average noise levels (Leq) generated by these activities are expected to be 10 to 15 dBA lower than the Lmax levels. Therefore, the 60 to 65 average noise level generated by the pile driving would not exceed the existing noise level at San Onofre State Beach subunit 2.

In fact, of the approximately 6,000 feet of beach frontage within subunit 2 only the southeastern most 450 feet is even within 1,000 feet of the proposed San Onofre Creek Bridge widening. Considering that prevailing winds blow inland, intervening topography and the constant sound from the crashing surf, it is difficult to understand how Staff concludes on page 140 that pile driving would substantially degrade the recreational opportunities and experiences provided by the beach at which they are received. It is even more difficult to reconcile the following statement made by Staff in which they contend that "similar sound levels may also be experienced by beaches within SOSB subunit 3 during construction." **The closest subunit 3 is to any proposed pile driving activities is over 3,000 feet.**

vii. The Project Will Not Adversely Impact Views

As in the case of land acquisition and noise, the Staff Report greatly exaggerated view impacts to SOSB's trails, campground, and other recreational resources and activities. It states that the project will radically alter and degrade the view shed from existing trails, the San Mateo Campground, and the I-5. However, **the Staff analysis fails to consider existing unnatural features of the landscape and future views from the project.**

The Staff Report incorrectly refers to the San Mateo Canyon as one of the few remaining rural coastal canyons within the Southern California region. Coastal recreation resources are, by definition, located within the coastal zone. There are no canyons located near Cristianitos or Trestles Beach or within the coastal zone. San Mateo Canyon is located in the mountains near State Route 74 (SR-74) between Camp Pendleton and Lake Elsinore and is not within the coastal zone. It is assumed that the Staff Report intended to refer to San Mateo Creek.

Within the coastal zone the San Mateo Creek area is not correctly depicted by Staff who state that the area is "characterized by an abundance of views of natural coastal and upland areas that are largely devoid of human development – a condition that is singularly unique throughout the region." By making this statement the Staff completely overlooks the abundance of unnatural features in this portion of the coastal zone including: Base housing and a commercial complex north of I-5, Camp Pendleton San Mateo Point Officer Housing south of I-5, a network of roads including Old Highway 101, Cristianitos Road, Basilone Road and unnamed paved roads to SONGS and SOSB subunits, San Onofre

Security Gate complex, Camp Pendleton training areas which were former agricultural fields, percolation ponds, paved parking lots, Green Beach and train tracks.

The Staff Report is incorrect in referring to an additional six-lane elevated freeway in the coastal zone. The project as proposed is four lanes, two in each direction.

The Staff Reports states that the proposed toll road would represent " a substantial transformation of this existing condition." The proposed project in the coastal zone is the connection between the proposed toll road and the existing I-5. There will be changes in the visual setting of the area in the coastal zone as a result of the project, primarily because of the vertical characteristics of the connectors; however, the project connectors will link to an existing major highway in the coastal zone, I-5.

Exhibit 31 of the Staff Report represents View Sims created by others. TCA was not asked by the California Department of Parks and Recreation (CDPR) to provide vertical and horizontal project design information; therefore, the basis of the View Sims provided in Staff Report Exhibit 31 is not known. Also, a view key map to indicate from where the photos were taken was not included, and the existing conditions photos are not dated.

Exhibit 31 of the Staff Report includes pre-project and post-construction views of the "campfire center" area at the San Mateo campground. This view simulation is not accurate as it depicts the toe of the proposed fill slope for Cristianitos Road immediately adjacent to the western edge of the "Campfire Center". The actual location of the toe of slope is approximately 175 feet west of where it is shown. It should also be noted that the San Mateo Campground is not in the coastal zone.
Exhibit 31-1 includes pre-project and post-construction views of the Trestles Beach Access Trail. The proximity of the proposed project is not correctly depicted in this simulation. The south-to-south connector is shown closer to the beach then is proposed. In actuality the connector will be between existing I-5 and Old Highway 101. Also the north-to-north connector is shown at a higher elevation then what is proposed. This connector will generally be at the same elevation as existing I-5. The existing trail from old Highway 101 to the existing railroad tracks at the beach is approximately 2,000 feet long. Additional view

simulations have been prepared at locations along the trail which demonstrate that existing topography and vegetation completely block the view of the proposed road for approximately 40 percent and obscure the view of the proposed road from almost every location along approximately 60 percent of the trail (see Attachment 15, *Additional View Simulations*).

Exhibit 31-2 of the Staff Report states that it includes pre-project and post-construction views from the northwest side of the Basilone Road/I-5 overcrossing looking northwest toward San Mateo Point. However, **either the location of the view or the direction of the view is incorrect because from this location or direction, the alignment would not be visible.** In addition, realigned Basilone Road would be at grade except for the bridge overcrossing at the I-5 and SR-241 northbound on-ramp and southbound off-ramp. The NN connector and the SS connector are at grade at the junction of the Basilone Road and I-5. No flyovers are proposed in this area.

Exhibit 31-3 of the Staff Report includes pre-project and post-construction views from the San Mateo campground. The San Mateo Campground is not located in the coastal zone. T**his view simulation is not accurate as it depicts the toe of the proposed fill slope for Cristianitos Road immediately adjacent to the western edge of the "Campfire Center". The actual location of the toe of slope is approximately 175 feet west of where it is shown.**

Exhibit 31-4 of the Staff Report states that it includes pre-project and post-construction views from water tank hill looking north along Cristianitios Road. However, this view scene is not located within the coastal zone. Coastal recreation resources are, by definition, located within the coastal zone. In addition, the quality of the view simulation is so poor that it is not possible to determine its accuracy. However, it appears the horizontal and vertical profiles of realigned Cristianitos Road and the project are not accurately depicted.

Additional view simulations are provided in Attachment 15, which characterize the potential visual effects of the proposed FTC-S alignment on the "Trestles Experience," including Trestles Beach and Trail B from old Highway 101 to the beach. A field visit was conducted on November 21, 2007. Photograph locations are noted on Figure 1. The existing topography in this area gently ascends to the northeast toward I-5 from Trestles Beach with some descending areas around

San Mateo Creek. Old Highway 101, south of Cristianitos Road, is located southwest of and parallel to I-5 and crosses over San Mateo Creek in this area. As shown in the view simulations 1 through 5, the proposed FTC-S connectors to existing I-5 will not be visible from Trestles Beach and are slightly visible from Trail B at a distance of approximately 1,000 feet (0.18 mile) from the shoreline. It is noted that beaches are dynamic in nature and vary in height, with storm events increasing or decreasing the height of the sand relative to the surrounding terrain. Typically, Trestles Beach sand is approximately +10 feet mean sea level (msl) and the highest elevation is approximately +13 feet msl. The precise sand elevation at the time of the existing conditions photographs were taken (November 21, 2007) is unknown. However, at the time, I-5 was not visible from Trestles Beach. Therefore, as documented in the attached view simulations under typical circumstances, existing I-5 and the future toll road connector to I-5 will not be visible from Trestles Beach.

Views: Trail A

The Staff Report incorrectly states that the proposed project would create a highly engineered, developed, and altered landscape in the area of Trail A. The Staff Report also states that the use of the trail and its natural setting are an important aspect of the overall experience of surfing at Trestles. Trail A extends from San Mateo Campground to Trestles for a distance of 1.5 miles. Only infrequently would a surfer would carry a surfboard from San Mateo Campground to the beach for 1.5 miles, or a visitor/camper who was attracted to the area for surfing choose the San Mateo (subunit 1) overnight camping rather than the San Onofre State Beach (subunit 3), which provides overnight camping and day use parking. It is disingenuous to imply that surfers are regularly using Trail A north of I-5.

By far the most common parking area for the regular day-use surfers is the free parking lot and on-street parking near the Carl's Junior fast food restaurant (3929 S. El Camino Real, San Clemente) just north of I-5. Therefore, the portion of the trail that can be fairly associated with the use of Trestles is the portion from just north of I-5 to the beach, or Trail B.

Views: Trail B

Along Trail B, existing I-5 is clearly visible at the northern end of the trail in current conditions; therefore, the proposed connector to I-5 will also be visible.

I-5 is not visible at the base of the trail adjacent to the sand, and the proposed connectors also will not be visible from the edge of the sand. In the intervening area along the trail between the beach and I-5, approximately 1,000 ft from the beach, existing I-5 is either not visible at all or barely visible. In general, the connectors are visible only when existing I-5 can be seen because the proposed connector road is, at its highest, 39 ft higher than existing I-5. Therefore, the connectors are only altering those views where existing I-5 is already visible from the trail.

Additional View Location 5 (Trail B). As shown on the key map included in Attachment 15, View Location 5 is located approximately 650 ft from the southern terminus of Trail B and approximately 1,400 ft from existing I-5. Existing and future conditions for View Location 5 are shown in Attachment 15. The existing conditions photo represents an approximate 180° view looking north toward existing I-5. View Location 5 is located near the midpoint of the trail between I-5 and Trestles Beach. The existing view is dominated by foreground and middle ground views of the existing vegetation on either side of the trail. The sky is visible in the distance. Existing I-5 is barely visible from this viewpoint. Because of the horizontal curvature of Trail B and the existing mature vegetation at the edge of Trail B, views of the proposed I-5 connector would be slightly visible from this portion of the trail.

As shown in View Location 5, the proposed alignment would be slightly visible from this location; however, because of the existing vegetation surrounding Trail B and the distance of the proposed alignment to the view location, **views of the proposed alignment would be almost entirely obstructed and would not substantially alter the Trestles Beach and Trail B experience.** In addition, existing I-5 would be approximately 30 feet below the future FTC-S connector, and Old Highway 101 would be approximately 200 feet southwest from the future FTC-S connector at this location. Therefore, as a trail user approaches the future FTC-S connector moving northeast on Trail B, existing I-5 and Old Highway 101 come into view. The FTC-S connector would be visible as well, but would not substantially alter the Trestles "experience" and surrounding atmosphere (the open space and the non-developed nature of the area) for a trail user.

Views: California Coastal Trail

The Staff Report describes the California Coastal Trail as passing through the Trestles Beach subunit of San Onofre State Beach (SOSB) and paralleling the I-5 corridor. It is assumed that the Staff Report is referring to the old Highway 101, which is a paved road, approximately three miles in length, connecting from Cristianitos Road to Basilone Road. Old Highway 101 is occasionally used as parking during surfing tournaments. Because the proposed alignment would not parallel the I-5 north of San Mateo Creek, views of the proposed alignment would not be visible from the portion of old Highway 101 north of San Mateo Creek.

Views: Trestles Beach

The Staff Report exaggerates the visual impacts of the proposed project on the views from Trestles Beach. As demonstrated in the additional view simulations 1 through 4 in Attachment 15, the proposed alignment would not be visible from Trestles Beach.

Additional View Location 1. As shown in the key map included in Attachment 15, View Location 1 is located on Trestles Beach approximately 500 ft southeast of the mouth of San Mateo Creek and approximately 300 ft south of the existing railroad tracks. Existing and future conditions for View Location 1 are shown in Attachment 15. The existing conditions photo is an approximately 180° view, with the view to the north at the left side of the photo; the view toward the existing train trestles, I-5, and project in the center of the view; and the view to the south along the beach at the right. A train moving south on the trestles is visible on the left side of the photo. As shown in View Location 1, existing views include sand in the foreground, vegetation growth from San Mateo Creek in the middle ground, and sky and distant mountains located on MCB Camp Pendleton in the background. Existing views from this location include approximately 174 passenger train trips per week and an additional number of freight trains traveling on the railroad trestles located approximately 375 ft from the shoreline.

As shown in Attachment 15, future views from View Location 1 would include the same features as the existing view. The elevation change of approximately 55 feet from the beach to existing I-5 where FTC-S would connect, combined with the density and height of the existing vegetation located in and along the San Mateo Creek and adjacent areas, would block any potential views of the proposed project alignment. Therefore, the proposed project would not be visible from this viewpoint.

Additional View Location 2. As shown in the key map included in Attachment 15, View Location 2 is located on the beach berm between the mouth of San Mateo Creek and the shoreline and approximately 300 ft southwest of the existing railroad tracks. Existing and future conditions for View Location 2 are shown in Attachment 15. The existing conditions photo is an approximate 180° view, with the view to the north at the left side of the photo; the view toward the mouth of San Mateo Creek, existing train trestles, I-5, and the project in the center; and view to the south along the beach at the right. As shown on Figure 3, existing views include sand in the foreground, San Mateo Creek, a railroad bridge and trestles crossing over San Mateo Creek, and a bluff to the north in the middle ground, and sky and distant mountains located on MCB Camp Pendleton in the background. Existing views from this location include the occasional train passing on the railroad trestles located approximately 500 ft from the shoreline.

As shown in Attachment 15, future views from View Location 2 would include the same features as the existing view. The elevation change from the beach to the existing I-5, where FTC-S would connect, combined with the density and height of the existing vegetation located in and along the San Mateo Creek and adjacent areas, would block any potential view of the proposed alignment. Therefore, the proposed project would not be visible from this viewpoint.

Additional View Location 3. As shown in the key map of Attachment 15, View Location 3 is located approximately 180 ft from the shoreline, on the beach, between the mouth of San Mateo Creek and Trail B, and approximately 280 ft southwest from the railroad. Existing and future conditions for View Location 3 are shown in Attachment 15. The existing conditions photo is an approximate 180° view, with the view to the north at the left side of the photo; the view toward existing train trestles, I-5, and the project in the center; and a view to the south along the beach at the right. As shown in Attachment 15, existing views include the sand in the foreground; the San Mateo Creek, the railroad trestles, and a bluff in the middle ground; and mountains located on MCB Camp Pendleton in the background. Existing views from this location include the occasional train passing on the railroad trestles located approximately 500 ft from the shoreline.

As shown in Attachment 15, the future views from View Location 3 would include the same features as the existing view. The elevation change from the beach to the existing I-5, where FTC-S would connect, combined with the density and height of the existing vegetation located in and along the San Mateo Creek and adjacent areas, would block any potential views of the proposed alignment. Therefore, the proposed project would not be visible from this viewpoint.

Additional View Location 4. As shown in the key map of Attachment 15, View Location 4 is located approximately 250 ft south-southwest of the southern terminus of Trail B and approximately 95 ft from the shoreline. Existing and future conditions for View Location 4 are shown in Attachment 15. The existing conditions photo is an approximate 180° view, with the view to the north at the left side of the photo; the view toward existing train trestles, I-5, and the project in the center; and the view to the south along the beach at the right. As shown on Figure 5, existing views include sand and a fire pit in the foreground; a bluff, the railroad tracks, and vegetation from San Mateo Creek in the middle ground; and mountains on MCB Camp Pendleton in the background. Existing views from this location include the occasional train passing on the railroad trestles located approximately 325 ft from the shoreline.

As shown in Attachment 15, the future views from View Location 4 would include the same features as the existing view. The elevation change from the beach to existing I-5, where FTC-S would connect, combined with the density and height of the existing vegetation located in and along the San Mateo Creek and adjacent areas, would block any potential views of the proposed alignment. Therefore, the proposed project would not be visible from this viewpoint.

As shown in Attachment 15, **these four additional view simulations from Trestles Beach provide substantial evidence that the Trestles Beach experience would not be adversely impacted by the proposed project** because, based on the beach sand elevation at the time of the view simulations, the proposed project would not be visible from the Trestles Beach area. The topography of San Mateo Creek and the vegetation growth within San Mateo Creek blocks or obscures any potential view of the proposed alignment from Trestles Beach. The alignment is proposed to be approximately 1,800 feet (0.3 mile to 2,500 feet (0.5 mile) from the nearest beach view. The view simulations show that the proposed project would not be visible from viewpoints 1 through 4.

However, even if the intervening topography and vegetation did not screen the view of the future project, the distance between the proposed project and the beach would not substantially impact the overall views of Trestles Beach because the distance is such that the I-5 connectors will be a relatively small component of a larger sweeping view of the topography and existing roadways. None of the existing landscape elements from the Trestles Beach view will be removed or changed as part of the project. The proposed project does not change the overall character of the view and is not out of scale with the existing topography and vegetation, or existing transportation facilities.

Views: San Mateo Campground

San Mateo campground is not in the coastal zone. The Coastal Commission's Staff Report speculates without evidence that visual impacts to San Mateo Campground would result in an eventual loss of San Mateo Campground. **None of the campground sites will be acquired to implement FTC-S.** It is uncontested that the impacts of I-5 on the Bluffs Campground are much more significant than the project impacts on the San Mateo Campground. Yet, the Bluffs Campground, by State Parks own admission, is extremely popular. The Staff Report fails to provide any rational explanation why the project would result in the closer of the San Mateo Campground when State Parks has continued to operate the Bluffs Campground adjacent to I-5.

Views: I-5 Scenic Highway Corridor

The proposed project would be visible from the I-5 located at the San Diego/Orange County border on the northernmost portion of the I-5 in San Diego County. This area is adjacent to the urbanized area of San Clemente in Orange County. Because the project would affect only a limited area of the referenced 21-mile stretch of I-5 between the City of Oceanside and the Orange County border, the project would not substantially change the views from the I-5 or impact its potential listing as a scenic highway.

The project will have no impact on views of the coast from travelers on I-5. The current inland views from I-5 are dominated by the USMC housing at San Mateo Point and above San Onofre Creek, Cristianitios and Basilone Roads and Interchanges, the Basilone Gate to Camp Pendleton, the Carl's Jr. fast food restaurant at Cristianitos Road, the Southern California Edison high voltage power lines, and by residential development above Cristianitos Road. The addition of a four-lane highway adjacent to Cristianitos Road will not materially alter these existing views.

Views: Night Lighting

Impacts resulting from night lighting within the coastal zone will be minimal. The majority of night lighting impacts would result from the northbound I-5 connector to the northbound SR-241 connector and the southbound I-5 connector to the southbound SR-241 connector. There will also be lighting at the Cristianitos interchange and at the Basilone interchange. Night lighting would be at the minimum required to conform to Caltrans lighting standards.

Views: Construction

The Staff Report states that 138 acres of the project area are within the coastal zone. While this is correct, it is also misleading. The 138 acres of the project area within the coastal zone are not undisturbed pristine areas. The 138 acres of the project disturbance area includes 41 acres of existing asphalt or concrete consisting of the I-5, or Old Highway 101 roads, which are not included within the project right-of-way. In addition to the 41 acres of existing pavement, the project will permanently disturb 39 acres (i.e., pavement, concrete), and 57 acres will be temporarily disturbed (i.e. falsework, grading and then revegetation of slope with coastal sage scrub [CSS]). The Staff Report also states that 45 million cubic yards of grading and fill would occur. Grading and fill of up to 45 million cubic yards of soil will not occur within the coastal zone. As presented on pages 5 and 20 of the Roadway Description Report provided to the Coastal Commission, earthwork in Section 1 of the project requires 250,000 cubic yards (cy) of cut and 850,000 cy of fill. The portion of Section 2 in the coastal zone requires 300,000 cy of cut and 5,000 cy of fill. Footnote 46 in the Staff Report on page 153 indicates that TCA did not provide earthwork quantities. This statement is not accurate, as the quantities were provided in the Roadway Description Report.

Construction impacts related to visual resources and views are overstated in the Coastal Commission Staff Report, and speculative. Impacts described as construction impacts with regard to visual resources would be temporary in nature. Furthermore, TCA is committed to participating in public outreach with regard to construction impacts to ensure that park users are not discouraged from using the park during construction through proper noticing and communication of the potential impacts to the public use areas. Public outreach efforts could and would include regular press releases; information signage at park entrances, along trails, and other appropriate locations; information posted on TCA Web site, and information posted on the State Parks Web site. These are the same kind of outreach methods that the State Parks Department currently uses for construction projects in State Parks.

Views: Landform Alteration and Alternatives

The Staff Report incorrectly states that the proposed alternative was not selected because it was sited and designed to minimize the alteration of natural landforms. In actuality, the specific alignment of the selected alternative was refined to reduce impacts to the natural environment and landforms, including biological resources. The continued refinement of the project alternatives has resulted in an alternative that is significantly superior to the CP alternative. Most notably, impacts to United States Army Corps of Engineers jurisdictional wetlands have been minimized to 0.82 acre from the previously delineated 17.0 acres of impact. Occupied Pacific pocket mouse habitat was avoided through refinement efforts to the preferred alternative. The total disturbance limits for the preferred alternative have been reduced by approximately 30 percent, resulting in significantly less impact to the natural environment.

Views: Mitigation

The Staff Report objects to the mitigation included in the Final SEIR, but fails to identify additional measures or specific recommendations that would reduce short- and long-term visual impacts of concern. TCA initiated park mitigation conversations with CDPR prior to SEIR certification and has continued the dialogue since certification. The conclusion of these efforts is the current proposal by TCA to contribute $100 million for several park protection and enhancement measures.

Views: Conclusion

The proposed project in the coastal zone will change the visual setting of the area, primarily because of the vertical characteristics of the connectors; however, the connectors are to an existing major highway. The selected alternative was refined in order to reduce impacts to the natural environment, including biological resources. **The project would not be visible from Trestles Beach because existing topography and vegetation would block all views of the proposed alignment from the Trestles Beach area and the alignment would not be close enough to be visible from the beach.**

D. Recreation – Surfing

The Staff Report states *"TCA has not adequately demonstrated that the surf break at Trestles would be protected if the toll road were built in this watershed"* (p. 6). TCA has modeled sediment transport at the watershed and subwatershed level, and provided this information as part of the updated Runoff Management Plan (RMP), which was submitted to Coastal Commission staff in September 2007 (*SEDIMENT CONTINUITY ANALYSIS Lower San Mateo Creek South Orange County Transportation Infrastructure Improvement Project, RBF Consulting, September, 2004).*

Commission staff elected to rely upon a letter provided by a consultant to the Surfrider Foundation (referred to as the "PWA letter"). **The consultant did <u>not</u> conduct any modeling to address whether sediment transport would negatively impact the beach or the surfing resources at Trestles.** Specific comments from the PWA letter are identified and refuted below.

The PWA letter fails to cite or to reference any 'key' technical reports discussing sediment transport and hydromodification mitigation. Thus it is apparent that PWA did not make use of all available pertinent information, including the modeling results, prior to making its assessments.

i. Subwatershed Analysis

PWA 'raises concern' that [eight] subwatersheds within San Mateo Creek are likely to be de-stabilized, resulting in increased fine sediment delivery to San Mateo Creek and the lagoon. **There is no basis for the concern that the subwatersheds will be destabilized.** The project Runoff Management Plan (RMP) (Saddleback Constructors, 2007) contains a detailed analysis of hydromodification impacts using continuous runoff simulation for subwatershed locations where runoff from the project is discharged. The results of this detailed investigation indicate that with the proposed design in place there will be virtually no change to the flow duration curves at the discharge points (Runoff Management Plan, Saddleback Constructors, 2007). Contrary to PWA's assertion, the subwatersheds will not be destabilized, and therefore, there will be no increase in fine sediment delivery. Further, potential local scour at culvert entrances and exits will be prevented through engineered energy dissipaters, a standard, accepted and effective BMP.

ii. Ecology and Morphology of San Mateo Creek

The PWA letter asserts that the proposed toll road junction with I-5 is located directly over San Mateo Creek and is likely to affect the ecology and morphology of the area during construction and possibly thereafter. TCA has conducted extensive studies and has carefully designed the project and the project construction strategy, to ensure that no such effects will occur. There is no basis for this statement in the letter and it is not based on an evaluation of the project plans. Construction of the viaducts (which span the Creek) connecting the Corridor with I-5 has been designed to avoid significant impact to the Creek. Aside from the impacts recognized during the construction (when BMPs would be used, etc) the installation of four additional columns in the creek will not result in any morphological change in the stream channel, as evidenced by the existing columns within the creek (including existing columns from I-5, Old Highway 101, and railroad train trestles). Consequently, given that there is no permanent impact to the form and function of the creek, there would be no ecological impact. Additionally, TCA has avoided impacts to riparian areas, including the mitigation site, to the greatest extent practicable. Impacts underneath the bridge are associated with pier construction and access; therefore, the majority of the impacts are temporary. All impacts have been accounted for in the Habitat Mitigation and Monitoring Plan. Based on the success of the current mitigation site, it is assumed that mitigation for impacts due to the proposed project will also be successful.

TCA has evaluated sediment transport in San Mateo Creek and has found that the creek is transport limited (as acknowledged by PWA [2006]). The roadway will be constructed primarily in upland areas that are not significant sources of bed material sediment. Further, a comprehensive hydromodification design and prevention program has been developed to ensure that the flow duration curves at the subwatershed discharge locations remain virtually unchanged in the after project condition. Finally, all culvert and other inlet and outlet locations will be designed with an appropriate energy dissipater to ensure that local scour does not occur. Therefore, insignificant changes in **sediment transport to San Mateo creek's lower reaches will result in insignificant changes in the amount of sediment transported to the mouth of the creek. Because the sediment delivery to the mouth will not appreciably change in the after project condition, there will be no impacts.**

The PWA further states that *"increased fine sediment delivery may accumulate in the lagoon at the creek mouth, changing its ecology over time and impacting the lagoon."* However, as indicated above, **there will be no appreciable change in the delivery of fine sediment in the after project condition.**

iii. Water Quality

The PWA letter states that since the watershed is largely undisturbed in the vicinity of the proposed project, water quality detention facilities would need to be extremely effective in trapping pollutants to avoid degrading water quality in the Creek. PWA questions, without factual reference, whether this is likely to be achieved, and therefore disagrees that water quality impacts are insignificant. TCA has proposed slow sand media filters, extended detention basins and vegetated swales in the San Mateo Watershed. The BMPs selected for the Corridor were the subject of a 5 year $15 million research program by the California Department of Transportation (Caltrans, 2004), the BMP Retrofit Pilot Program, conducted jointly by the Natural Resources Defense Council, Santa Monica Baykeeper, the San Diego Baykeeper, the U.S. Environmental Protection Agency, and California Department of Transportation (Caltrans, 2004), along with an extensive list of technical experts and other agencies. The purpose of the study was to assess the most effective treatment devices for freeway and highway environments. **The selected BMPs are among the most effective devices currently available for storm water quality mitigation and are extremely effective in removing constituents commonly found in highway storm water runoff.**

iv. Cobble and Sediment Transport

The PWA letter states that cobble transport can be greatly affected by the amount of finer sediment resident within the sediment deposit. Under wave action, increased porosity (absence of finer sediments) can result in cobbles moving onshore, while a lack of porosity resulting from the presence of smaller sediment can result in offshore movement (PWA, 2006). Additionally, the letter states that TCA's conclusion that cobble transport will not be affected because the project will be located in a silty part of the watershed (Geosoils, 2006) ignores the effect of finer sediments on coarse sediment transport and may be incorrect. The allegation that impacts to cobble transport are potentially significant and unmitigated is incorrect. As indicated above, **there will be no appreciable change in the delivery of fine sediment in the after project condition.** Storm water discharge rate, velocity and duration are virtually unchanged for local watersheds in the after project condition. Sources of bed material and fine sediments will not be significantly changed in the after project condition.

The PWA letter states that *"TCA studies of sediment delivery are based on the presumption that changes in water discharge are small because the paved area will be small relative to the total watershed area and that actual flow rates have not been measured, and the post-project flow rates have not been modeled."* This statement is incorrect. The flow rates both before and after project construction have been modeled for all of the subwatersheds along the Corridor. This analysis is contained in the project Runoff Management Plan (Saddleback Constructors, 2007). A detailed analysis, sufficient to understand the potential impacts of the project on the subwatersheds (using continuous simulation), has been completed, and the potential impacts will be prevented through the use of flow control.

The final comment provides anecdotal evidence that the surf break may be harmed through the interview of surfers who note that sediment supply impacts the surf break. As noted above, and in the report prepared by Geosoils (2006), because **the project will not significantly affect the delivery of sediment to the shoreline, it will not impact the surfing resource.**

PWA's September 17, 2007 letter to the Commission is equally in error. The letter states *"The construction of the Toll Road through the steep natural terrain of the San Mateo watershed will result in massive changes to the hydrology of the subwatershed drainages, causing stream destabilization and a significant increase in erosion and sediment production"* (p. 25).

Contrary to this claim, there will be no "massive changes" to the hydrology of the subwatershed drainages. **The project Runoff Management Plan (Saddleback, 2007) devoted extensive study to the analysis and prevention of potential changes to subwatershed hydrology as a part of the construction of the project.** Specifically, the discharge at subwatershed locations was compared between the pre- and post-project condition using continuous simulation for rainfall intensities up to an approximately 10-year storm event. For locations where there was a significant change in the computed flow duration curve, additional storm water detention was provided, and the detention volume designed to match the pre-project flow duration curve, ensuring no significant change to the watershed hydrology in the post-project condition. Therefore, the assertion that the project will cause stream destabilization and a significant increase in erosion and sediment production as a result of changes in subwatershed hydrology are simply wrong.

The PWA letter further asserts that there will be an increase in fine sediment delivery, *"because the proposed settling basins will be inadequate to control the amount of fine sediment runoff during flow events from these destabilized steep canyons..."* This statement misconceives the drainage system proposed for the project. The 'settling basins' [detention basins] and sand media filters will be constructed to exclusively serve the paved roadway surface as mitigation for storm water runoff quality and hydromodification from the paved roadway area. Areas adjacent to the roadway will drain to the existing creeks or roadway cross culverts discharging through engineered energy dissipators. The manufactured slopes adjacent to the roadway will be stabilized with native vegetation and monitored to ensure that they remain stable. **There will not be a new source of 'fine sediment' associated with the project.**

The letter also states: *"this approach masks the true impacts of the Project, which will have enormous impacts on the 20 subwatersheds within and just upstream of the coastal zone. The Project's disturbance (i.e., cut and fill) limits would occupy over 40% on average (and up to 100% in some cases) of the land areas of the eight subwatersheds closest to the creek mouth. Impermeable surfaces would cover up to 29% of the areas of individual subwatersheds. These are very large percentages. Impacts on this level are associated with destabilization of canyons, highly altered hydrology and severe erosion. Erosion and siltation impacts therefore could affect the ecology of the San Mateo Creek mouth and lagoon"* (p. 26). These statements are based on a report prepared by PWA, dated January 11, 2006. **Review of this report indicates that the results presented in Table 1 on page 18 are inaccurate.** For example, the two sub-watersheds that are indicated to be 100% occupied by the road prism (SM-04 and C-13) clearly are not. This can be seen on Figures 6 and 7 within the report. These figures show the portion of the road prism within sub-watersheds SM-04 and C-13 occupies only a very small area of the upper reaches of the subwatersheds. **How PWA can make the claim that 100% of these sub-watersheds are occupied is inexplicable.** The same holds true for the majority of the remaining sub-watersheds presented in Table 1 in which erroneously high values are given.

The percent sub-watershed area made impermeable by the toll road has also been inflated in Table 1. A simple way to confirm this is to look at the results for sub-watershed SM-01. The table shows 29% of the 443-acre sub-watershed will be made impermeable (taken as the footprint of the road pavement and shoulder). If this were true, 129 of the 443 acres will be made impermeable, just in this one sub-watershed alone. This value is unrealistically high considering TCA estimates the amount of area to be made impermeable within all 20 sub-watersheds, combined, is approximately 136 acres.

Another simple observation that can be made to confirm the values in Table 1 are inflated is by comparing, on Figure 6 and 7, the area of the sub-watershed to the area of the road footprint. Considering the impermeable area will be only a small ribbon within the middle of the overall road footprint, visually it can easily be seen that the impermeable road area could not possibly make up 29% of sub-watershed SM-01 or 24% of sub-watershed C-17.

The results presented in the PWA report are erroneous and should not be relied upon to base conclusions relating to destabilization of these sub-watersheds.

It also is important to note that the letter's author clearly has no familiarity with the project's design features, which specifically address the potential changes in subwatershed hydrology associated with the addition of impervious surfaces and improved drainage systems. These impacts have been analyzed and the design and facilities provided (see response to previous comment) ensure that erosion in the after-project condition is not changed as compared to the pre-project condition.

E. Water Quality

TCA submitted an updated Runoff Management Plan (RMP) to Commission staff in September 2007. This updated RMP provided detailed analyses of impacts to subwatersheds, as requested. The Staff Report states that this document was not reviewed and that a review of this plan will be included in an addendum to the Staff Report. No addendum reviewing the updated RMP has yet been released by Commission staff.

Regarding the updated RMP that staff has yet to review, staff incorrectly states that the Regional Water Quality Control Board (RWQCB) has *"raised a number of questions about the adequacy of this plan"* (p. 7). In fact, the RWQCB had asked for additional information and clarification to make the 401 Certification Application complete. TCA has followed up with RWQCB staff to provide this additional information, which has also been provided to Commission staff.

TCA and its consultants have reviewed the September 17, 2007 letter to the Commission from several environmental groups concerning comments on water quality.

The letter first erroneously states: *"TCA's proposed mitigation basically consists of design and treatment Best Management Practices (BMPs). As discussed earlier, the proposed settling basins are unlikely to control runoff during 2-year storm events, which contribute the majority of sediment in most watersheds. It is highly unlikely that the impacts of silt delivery to San Mateo Creek and lagoon can be mitigated with the proposed BMPs*" (p. 26). It is clear from this incorrect statement that the letter's author has not reviewed the project Runoff Management Plan (RMP) (Saddleback, 2007). The RMP describes a detailed analysis process for the project detention basins ('settling basins') for storm recurrence intervals from about 10% of the 2-year storm up to and including a 10-year storm. The flow duration curves at each subwatershed discharge point along the project were reviewed for a potential change in hydrology as a result of project. The project detention basins that provide appropriate design for hydromodification have been designed with a local gauge rainfall record of this range (10% of the 2-year storm to a 10-year storm). Therefore, the comment is incorrect and **there will be no impact to siltation processes in San Mateo Creek or San Mateo Lagoon.**

The letter also makes allegations about the existing and future water quality (p. 26). The existing lanes of I-5 cross San Mateo Creek and San Onofre Creek watersheds at sensitive locations (very near the estuaries) and in close proximity to the beach areas. TCA has completed a benefit analysis for the retrofit of I-5 as well as the project design features included for the portion of the Corridor within the San Onofre and San Mateo Watersheds. In the existing condition, about 96 acres of impervious area (from the freeway) discharges untreated runoff to the Trestles beach area. Once construction of the Corridor is complete, about 228 acres of impervious area (from the existing freeway and new toll road) will discharge and be treated through sand media filters. To argue that there would be no benefit because the watershed is "pristine" is contrary to the long established approach to protecting water quality. ignores the standards set by the Clean Water Act, Portor-Cologne Act and National Pollutant Discharge Elimination System (NPDES) permitting requirements, which are all based on pollutant discharge, not the relative impairment of receiving waters. Under the Coastal staff's logic, no measures would be undertaken to protect and improve water quality until a stream became impaired. Coastal Staff's approach to water quality reflects a regulatory approach rejected by the Stat of California and by the Clean Water Act over thirty years ago. Section 401 of the Clean Water Act gives the California Regional Boards the authority to regulate any proposed federally permitted activity that may affect water quality and requires certification of reasonable assurance that discharge into waters of the United States will not violate water quality standards. Similarly, the Porter-Cologne Act and the NPDES permit program regulate the discharge of waste substance and point sources of potential pollution, again, regardless of the impairment of receiving waters.

TCA proposes to use sand media filters at all locations within the San Mateo and San Onofre Creek watersheds to demonstrate a net project benefit for surface water quality within the coastal zone. Use of the sand media filters will produce a *net annual benefit* in terms of load reduction for constituents commonly found in highway runoff. Additionally, use of these facilities will act as a hazardous spill containment site in the event of an accidental hazardous material release along this segment of I-5, where currently there is none.

The following table shows the estimated constituent load for selected constituents for which data is available to compute an estimated average annual load before and after project implementation, for the area of the project tributary to the Trestles surfing area.

Comparison of Constituents Removal – No Project and Project Conditions (Average Annual)

Constituent	Typical Highway Concentration*	Expected Effluent Concentration (sand filter) **	Load (Current Conditions - No Treatment)	Load (Project Conditions with Filters)	Average Annual Watershed Benefit (kg)
Total Suspended Solids (TSS)	104. mg/L	7.8 mg/L	11752 kg	2091 kg	9661
Total Copper	58.0 ug/L	23.4 ug/L	6.6 kg	6.3 kg	0.3
Total Lead	68.0 ug/L	7.8 ug/L	7.7 kg	2.1 kg	5.6
Total Zinc	265.0 ug/L	39.3 ug/L	29.9 kg	10.5 kg	19.4

* from RVTS Study CTSW-RT-03-028 (edge of pavement at San Onofre Site)

** from CT BMP Retrofit Pilot Program Final Report CTSW-RT-01-050

The column labeled "Load, Current Conditions, No Treatment" indicates the average annual load of TSS and heavy metals that discharge from I-5 in the existing condition. The column labeled "Load, Project Conditions with Filters) shows the estimated annual load for the indicated constituents for the entire project within the San Onofre and San Mateo Creek watersheds. There is a net overall annual average benefit to the Trestles surfing area once the project is constructed because the selected BMPs are highly effective in targeting highway related pollutants.

The letter correctly notes that the project is not an exclusive vehicle for achieving the retrofit of I-5 with water quality treatment devices. However, I-5 has been operational in this location for about 50 years – the entire time without the benefit of any storm water treatment, and no strategy and funding source has been identified to make such improvements, other than the proposed project. Caltrans generally has two mechanisms to construct water quality improvements for existing freeways. The first is through the State Highway Operation Protection Program (SHOPP). A portion of SHOPP funds is earmarked for water quality retrofits within the state highway system. The 10-year look ahead for SHOPP 310 Mobility Projects does not include work on I-5 in the project area. The second mechanism for treatment control retrofit along I-5 is in association with a capital improvement project through the State Transportation Improvement Plan (STIP). No improvements to the I-5 corridor in this area are programmed in the District 11 2006 Anticipated Project Development Schedule (2006 Work Plan) and State Transportation Improvement Plan (2006).

The letter goes on to claim that the project will increase fine sediment in the creek system and the lagoon. As noted above, the assertion that the project will result in an increase in fine sediment production and reduce water quality is erroneous. The project's mitigation programs for storm water quality and hydromodifcation are specifically designed to meet the performance threshold of maintaining coastal resources described in the Coastal Act.

Finally, the letter references the lack of an existing water quality problem (p. 36). **As indicated above, the project will have a demonstrated water quality benefit within the coastal zone with the treatment of existing I-5 runoff.** This claim is incorrect. In 2005, Heal the Bay gave San Onofre Beach an "F" grade for water quality. The project will improve and restore these receiving waters.

F. Archaeological Resources

The Staff Report erroneously extends jurisdiction to archaeological resources outside of the coastal zone (see *Location and Significance of Resources*, page 205). Coastal Commission jurisdiction is limited to the coastal zone. The Staff Report improperly extends the Commission's jurisdiction. There is no nexus for such an extension of jurisdiction beyond what was legislatively defined in the California Coastal Act, and the California Supreme Court has recently held that the coastal zone is the boundary for the Commission's jurisdiction (*Sierra Club v. California Coastal Commission*, 2005) (35 Cal. 4th 839 2005).

Furthermore, Section 30244 of the Coastal Act requires reasonable mitigation for impacts to archaeological impacts. The extent of Coastal Act review is limited to whether reasonable mitigation is provided. **Reasonable mitigation is incorporated into the project and is further assured by the Section 106 process, which includes SHPO involvement.**

i. Panhe as a Traditional Cultural Property

The status of Panhe as a TCP is not in question; it is recognized by the fact that the San Mateo Archaeological District (SMAD) has been determined eligible under both Criteria A and D. The Criterion A eligibility of the SMAD *"reflects its status as the ethnographic village of Panhe, a Juaneño village occupied at the point of European contact. This element of the resource's eligibility also reflects its status as a Traditional Cultural Property that has been used for ceremony by living tribal members."*[19]

The Staff Report overstates the extent and significance of impacts from the Project to known cultural resources and claims there is not sufficient information to identify the full range of adverse impacts and whether reasonable mitigation is provided. As noted above, Coastal Commission jurisdiction is limited to the coastal zone. In addition, Exhibit 35 of the Staff Report is misleading because it shows wide swaths of archaeological resources that would be impacted by the project when in fact that is not the case.

[19] Transportation Corridor Agencies, *South Orange County Transportation Infrastructure Improvement Project (SOCTIIP): Final Subsequent Environmental Impact Report (December 2005)*, vol. III at 4.16-XXX

While the Project does cross the SMAD, it avoids the two sites within the SMAD that are listed on the Sacred Lands Files of the Native American Heritage Commission, and avoids the ceremonial use area that was designated by Camp Pendleton. One of the NAHC Sacred Lands areas and the ceremonial use area are both outside of the coastal zone. There is no evidence that any "sacred site artifacts and relics" have been identified within the boundaries of the project. Archaeological investigations on the SMAD have demonstrated that the majority of the site areas within the Project footprint are highly disturbed and retain minimal integrity. The Staff Report references work by Byrd (1997) (see footnotes 103 and 104). The cited Byrd work was conducted to assess the potential for expanding the boundaries of the existing SMAD to include archaeological resources that are present on the south side of San Mateo Creek (the 1981 SMAD description was restricted to the north bank of the Creek). Byrd did not re-assess the integrity of known sites within the SMAD, and did not address additional impacts that have occurred to sites within the original SMAD. At the same time, Romani et al. (1997) evaluated the integrity of archaeological resources within a previously studied alignment of the project (the CP alignment). Neither report (Romani et al. 1997, nor Byrd 1997) was finalized and the boundary of the SMAD was not expanded to include the additional sites as suggested by Byrd. Work by Romani and others (1997) demonstrated that only about ten percent of the SMAD archaeological resources exhibit intact midden. Romani concluded that those portions of the SMAD within the proposed ADI for the Project no longer retain sufficient integrity to be eligible for the National Register.

The Project Area of Direct Impact (ADI) has been designed to be on slope areas where there are little intact cultural resource deposits, and on deflating topographic high spots where the Miocene bedrock is exposed. This project design feature minimizes project impacts to archaeological resources. Further, reasonable mitigation measures to address potential impacts to archaeological resources within the Project Study Area are included in the project FSEIR and include controlled excavation of intact cultural resources within the project ADI.

In addition, the SMAD was created prior to the development of Discontinuous Districts as a concept within the National Register. As currently defined, the SMAD includes large areas that are totally devoid of archaeological resources. The SMAD is not significant because of physical linkages between the sites, but is identified to allow the resources within the drainage to be evaluated in relationship to one another. Separating the individual archaeological sites within the District by physical barriers, including a possible road, has no effect on the eligibility of the District.

Regarding the alleged increased potential for scavenging for artifacts, as a controlled-access highway, there is no potential for increased illegal collecting from the development of the project. State Park Rangers and Camp Pendleton Security would still patrol the intact site areas, and the right-of-way of the Project will be entirely fenced and patrolled by the California Highway Patrol.

Other potential build alternatives for the extension of the FTC-S were studied and were shown to impact other ethnographic village sites. Many of these villages have a higher percentage of intact archaeological deposits than those shown within the SMAD.

The project is consistent with the requirement in Section 30244 that "reasonable mitigation" be required through compliance with Section 106 of the National Historic Preservation Act of 1966 (as amended) and 36 CFR Part 800, and by identifying specific minimization, avoidance, monitoring, preservation, and recordation minimization measures. A Historic Property Treatment Plan is being prepared as part of the Section 106 compliance, and that treatment Plan will include implementation level details of the adopted mitigation.

ii. Trestles as a Traditional Cultural Property

Whether or not Trestles represents a historic resource, and potentially a TCP,[20] **the Trestles property lies entirely outside of the project area and will not be impacted directly or indirectly by the project.** Both the Old Highway 101 bridges and Amtrak rail line are between the proposed project connectors and the proposed Trestles historic district. In addition, the study referenced in the Staff Report[21] addresses the entire San Onofre surfing area, an area much larger

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[20] Although the Caltrans Standard Environmental Reference (Volume II, Chapter 4-4) states, "To date, no non Native American TCPs are known to have been identified in California, although some potential properties have been evaluated, and in consultation with the SHPO, determined to be not eligible for inclusion in the National Register.

[21] Alexander D. Bevil, Historian II, Southern Service Center, California Department of Parks and Recreation, *San Onofre State Beach Historical Significance*, letter to Mark Rauscher, Surfrider Foundation, August 31, 2007.

than the Trestles resource. The proposed project will have no impact on the Trestles (or San Onofre) Surfing Area (see Attachment 16, *Letter Memo From LSA to TCA Regarding Traditional Cultural Property Evaluations, December 2007* and Attachment 17, *Letter from FHWA to State Office of Historic Preservation, December 2007*).

G. Greenhouse Gases

The Staff Report incorrectly assumes that the project will increase greenhouse gases (GHGs) by increasing vehicle miles traveled (VMT). However, **this argument is not supported by the traffic and air quality modeling data.** As a threshold matter, staff bases its conclusion on the entire roadway, including the 13.8 miles <u>outside</u> of the coastal zone. The discussion below similarly reflects the entire roadway, but the benefit of the project would still occur if only that portion of the project within the coastal zone was analyzed.

Full project implementation (including the areas outside of the coastal zone) is projected to increase the daily VMT in the subregion by 1,586 miles per day. **This increase is less than a 0.0004 percent change in no-build daily VMT of 421,794,107 miles**. Therefore, the project would not result in any substantial growth in daily VMT; on the contrary, the increase in VMT is negligible. However, project implementation will reduce congestion on I-5 and arterial streets, resulting in better traffic flow and improved traffic speeds that would reduce the daily vehicle hours traveled (VHT) by 31,580 hours. **This reduction in VHT corresponds with a reduction in CO_2 emissions in the subregion by approximately 569,000 pounds per day (even with consideration of the slight increase in VMT).**

Please note that the Staff Report includes a quote from the Draft document, *The Role of Land Use in Meeting California's Energy and Climate Change Goals* (California Energy Commission Draft Staff Paper, June 2007). The final paragraph on page 15 of this draft paper includes the following sentence:

> *"It is imperative that land use planning and infrastructure investments place a high priority on reducing VMT."*

TCA has reviewed the <u>final</u> version of this CEC staff paper, which changes this sentence to:

> *"It is imperative that land use planning and infrastructure investments place a high priority on reducing VMT **<u>growth</u>**." [emphasis added]*

This change between the draft and final version of the document by CEC staff indicates that an actual reduction in VMT may not be feasible given existing land use and infrastructure patterns in the State of California. The CEC report instead supports a reduction in the rate of increase (growth) in VMT. The proposed FTC-S project results in a negligible increase in VMT, which for all intents and purposes holds VMT constant while reducing congestion and reducing CO_2 emissions.

i. Growth Inducement

The Staff Report also makes erroneous conclusions about growth inducement it suggests would be caused by FTC-S. Significantly and dispositive of this issue, the project clearly would not be even slightly growth-inducing in the coastal zone, and the Staff Report makes no argument to the contrary. Thus, the issue of growth-inducement is irrelevant here. In any event, FTC-S has been identified on local and regional plans for over 25 years. The development patterns of Orange County are well established, and the County and study area are largely built out. The Growth Section of the SOCTIIP Final SEIR explains that: (1) the majority of the study area not committed to permanent open space is already developed or in the process of developing and approaching the approved build out; (2) any growth facilitating effects of the project would occur within the overall distribution and intensity of development allowed under adopted General Plans, Specific Plans, and other regional forecasts; and (3) since the Ranch Plan was approved for development (in November 2004), it is highly unlikely that completion of SR-241 would influence the location and density of development, because development locations and intensity levels were set by the County and through a Settlement Agreement with groups opposed to the Ranch Plan (Endangered Habitats League, Natural Resources Defense Council, Sea and Sage Audubon Society, Laguna Greenbelt, Inc., and Sierra Club) . Thus, **the project would not influence the total amount of growth in the study area or induce growth beyond what would otherwise be expected under the adopted regional growth forecasts in the foreseeable future**, and would not be considered growth inducing. The Final EIR for the Ranch Plan concluded that the Ranch project could be built with or without implementation of the FTC-S project, but if SR-241 is not completed, then the Ranch Plan would need to implement additional roadway improvements.

In summary, the staff reference to the project encouraging continued growth is incorrect and contrary to the facts. There is no evidence that the project would be growth inducing within the coastal zone, or anywhere else.

ii. Construction Emissions: Paving

The Staff Report calculated the GHG emissions from road construction and concluded the proposed facility would generate 100,000 tons of CO_2. TCA has not determined at this time whether the road will be paved using asphaltic or portland cement concrete. Asphalt has been used in Southern California for the past 20 to 30 years, because it is less expensive and easier to maintain. However, since construction is not anticipated to begin until 2010, TCA will evaluate paving at that time. If, in fact, the road is paved using asphalt, the production of asphalt results in higher emissions of GHG than the production of cement. Production of the estimated 400,000 cubic yards of asphalt required to pave the facility and the additional 192,515 cubic yards of concrete required to construct bridge structures and other specific features would generate 268,470 tons of CO_2[22] over the course of the construction period. However, as discussed below, even if paved with asphalt, the carbon emission impacts of the project will be recovered within five years.

iii. Construction Emissions: Construction Equipment

The second source of GHG emissions during construction is the tail pipe emissions from construction equipment. The CO_2 emissions generated by the construction equipment were estimated using the emission rates from the URBEMIS2007 model. It is projected that the equipment required for the 42-month construction schedule would generate up to 58,200 tons of CO_2. When combined with asphalt-related emissions, project construction will generate 326,670 tons of CO_2. **After completion of the proposed project, the GHG emissions reductions from the operational improvements would offset the construction emissions in less than five years and would generate a net benefit thereafter.**

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[22] California Energy Commission, Optimization of Product Life Cycles to Reduce Greenhouse Gas Emissions in California, August 2005.

iv. Greenhouse Gas Project Reductions

In addition to the GHG emissions benefits resulting from the reduced congestion and improved travel speeds in the region, TCA has committed to implementing a number of measures in addition to those identified in the Final SEIR in order to further reduce GHG emissions. These commitments include:

- Install solar panels at toll plazas and booths.
- Utilization of green construction practices and materials when feasible
  - All diesel-powered construction equipment will have the latest emission control devices (e.g., diesel oxidation catalysts and diesel particulate filters verified by the Air Resources Board [ARB] to reduce emission of diesel soot and particulate matter, smog-forming nitrogen oxides, and GHGs).
  - Construction equipment operators will be required to turn off equipment engines when not in use to reduce emissions of particulates, nitrogen oxides, and GHGs released while engines are idling.
  - Construction equipment operators to be required to use cleaner diesel or diesel alternative fuels such as biodiesel, low sulfur diesel, ultra-low sulfur diesel, or emulsified diesel.
  - Any concrete or asphalt removed during project construction will be recycled.
  - Use of environmentally friendly concrete and asphalt alternatives and practices will be employed as feasible, such as:
    - Use of recycled tires as an asphalt component
    - Minimizing the use of Portland cement and maximizing the use of supplementary cementious materials
    - Minimizing the use of natural rocks and sand as aggregates
    - Maximizing the use of recycled and non-potable water as a concrete mix
    - Designing for a service life of 100 to 150 years

v. Conclusion

After completion of the proposed project, the GHG emissions reductions from the operational improvements would offset the construction emissions in less than 5 years. The project has been modified to include greenhouse gas reduction measures, and the benefits of the reduced congestion that will be realized by the project provide greenhouse gas emissions benefits over the long-term.

H. Alternatives

The test used by the Collaborative to determine the 'least environmentally damaging practicable alternative' (LEDPA) is equivalent to the Coastal Act requirement that the chosen alternative be the 'least environmentally damaging feasible alternative'.

The identification of the LEDPA was made by all of the state and federal agencies involved in the Collaborative process – and not TCA as suggested by the Staff Report. The preferred alternative was selected by "The Collaborative", which consists of local, state, and federal transportation, regulatory, resource and national security agencies, including: the EPA), USFWS, US ACOE, Caltrans, and TCA. In addition, the USMC, Camp Pendleton was an active member of the collaborative and had oversight to ensure that the preferred alternative, that traversed Marine Corps Base Camp Pendleton, did not impact the USMC Mission or Operational Flexibility. The USMC agrees that the current alignment meets their stipulations and conditions. **Together, these agencies created, evaluated, and screened project alternatives over the course of 50 meetings and six years.** Through a unique process that involved resource agencies at an early stage of planning, the Collaborative considered the EIS/SEIR, 20 technical studies, practicability criteria, and the generalized alignment of SR-241 as reflected in longstanding SANDAG and SCAG regional transportation plans.

Using several evaluation parameters, including 1) impacts to riparian ecosystems and ecosystems and habitats; 2) traffic relief in 2025, including percent of daily I-5 traffic congestion, hours of total vehicle travel time savings; 3) number of impacted residences; 4) community disruption; 5) total costs; 6) cost per hour of travel time savings; 7) severe operational or safety problems; 8) unsuitable demographics (for transit alternatives); and 9) logistical or technical constraints. Together, the members of the Collaborative narrowed their chosen alternatives from 24 to 10 and then to 1 preferred alternative. **After the lengthy and rigorous process described above, the Collaborative's unanimous decision was that the preferred alternative was the LEDPA.**

Despite the long and rigorous process undertaken to choose the preferred alternative, the Staff Report nonetheless now asserts that six feasible alternatives to the project exist, and that each could be found consistent with the Coastal Act. The Staff Report is wrong. The record demonstrates that each of these six alternatives is infeasible. The Staff Report's assertion that the preferred alternative is inconsistent with the Coastal Act, while the six other identified alternatives could be made consistent, is a fiction, contrary to the record and the conclusion reached by these several federal and state agencies.

Five of the alternatives identified in the Staff Report were considered, evaluated, and eventually eliminated by the Collaborative in the process described above. These alternatives were eliminated because each failed to meet the basic purpose of the project, had environmental or military impacts that were infeasible to mitigate, or because it would displace several hundred homes and businesses. Detailed information on the infeasibility of these five alternatives is presented below, as well as discussed in detail in the Final EIR, and the report *Alternatives Analysis Summary* submitted to Coastal Staff on February 28, 2007.

A sixth alternative identified in the Staff Report was recently presented in a document entitled *An Alternative to the Proposed Foothill South Toll Road: The Refined AIP Alternative,* prepared by Smart Mobility, Inc. As discussed below, this alternative is fraught with fundamental problems and badly mistaken assumptions, and likewise is an infeasible alternative to the proposed project.

i. The Central Corridor (CC) Alternative

The Staff Report does not give specific or detailed reasons for preferring the CC alternative to the project other than *"the weight given to community disruption"* in this alternatives rejection was too great. Indeed, one reason that this alternative was eliminated was its severe community disruption within the coastal community of San Clemente – estimated to displace 763 homes with 1,914 residents[23] and 106 businesses with 1,100 employees[24] (many or which are important existing visitor-serving uses, including 10 displaced low and moderate-cost overnight visitor accommodations in the coastal community of San

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[23] The number and type of displaced residents was estimated using 2000 U.S. Census data applied to the number of displaced residential units.

[24] The number of displaced employees was estimated using standard occupancy factors applied to displaced non-residential structures.

Clemente). However, the Staff Report ignores the several identified environmental impacts of this alternative.

The CC alternative (formerly the BX alignment) was evaluated beginning in August 1999 to determine its optimal alignment. However, because this alternative would create significant biological resource impacts in the upper and middle Chiquita areas, a significant habitat area inland of the coastal zone, and impacted important wetlands areas at the confluence of Cañada Chiquita and San Juan Creek and at the Segunda Deshecha wetlands complex (approximately 53.7 acres of wetlands total), it was determined to be one of the most environmentally damaging alternatives proposed.

Therefore, in addition to its severe impacts on southern Orange County communities and the socioeconomics of the area and the coastal zone, **the CC alternative would also seriously impact acres of existing riparian systems and endangered species habitat, causing habitat loss and fragmentation.**

ii. The Central Corridor – Avenida La Pata (CC-ALPV) Alternative

The Staff Report also does not give specific or detailed reasons for preferring the CC-ALPV alternative to the project other than *"the weight given to community disruption"* was too great. Like the CC Alternative discussed above, community disruption was only <u>one</u> reason that this alternative was eliminated. Although estimated to displace 172 homes and 541 residents, the CC-ALPV Alternative also was eliminated because of its poor performance on improving traffic conditions, only resulting in benefiting 14 total intersections, freeway segments and ramps at peak traffic hours in 2025 (the proposed project improves a total of 21). Additionally, after construction of the CC-ALPV Alternative, 7.8% of daily traffic on I-5 would still be congested in 2025, more than twice the amount of traffic that would experience congested conditions with the proposed project.

Additionally, like the CC alternative described above, the initial build out of **the CC-ALPV alternative was estimated to impact a substantially larger area of Army Corps jurisdiction (12.38 acres, 11.41 acres of which are Corps wetlands) than the preferred.**

iii. The Alignment 7 Corridor – Avenida La Pata (A7C-ALPV) Alternative

The Staff Report also does not give specific or detailed reasons for preferring the A7C-ALPV alternative to the project other than *"the weight given to community disruption"* was too great. While this was one reason that the alternative was eliminated (the alternative would displace 112 homes and 358 residents), it was also eliminated for poor performance in reducing traffic congestion. **After construction of the A7C-ALPV alternative, 7.8% of daily traffic on I-5 would still be congested in 2025, more than twice the amount of traffic that would experience congested conditions with the proposed project.**

iv. The Arterial Improvements Only (AIO) Alternative

The Staff Report claims that the AIO alternative was eliminated due to lack of funding. While this was one reason this alternative was determined to be infeasible (no established funding or potential future funding exists for this alternative) the Staff Report ignores the other reasons for its elimination: namely its poor performance on reducing traffic congestion, and its severe community disruption.

Of all the alternatives evaluated during the collaborative process, the AIO Alternative performs the worst in regards to improving traffic. After construction of the AIO Alternative, 11.3% of daily traffic on I-5 would still experience congested conditions in 2025 (compared to 3.2% with the proposed project). Only 6 intersections, freeway segments and/or ramps would benefit at peak traffic hours in 2025 from construction of this alternative.

Additionally, the AIO alternative would displace 263 homes with 827 residents and 17 businesses with an estimated 200 employees.

v. The I-5 Widening Alternative

As with the AIO alternative, the Staff Report claims that the I-5 Widening alternative was eliminated due to lack of funding and because *"the weight given to community disruption"* was too great. It is true that no established funding or potential future funding exists for the widening of I-5. However, the Staff Report belittles the extremely severe community and socioeconomic impacts that this alternative would create, including the portion of the I-5 within the coastal zone.

In fact, **construction of the I-5 Widening Alternative would devastate coastal communities** as hundreds of residences, institutions, and businesses (including dozens of low-cost visitor serving uses) would be condemned.

Approximately 838 homes and 1,970 residents, as well as 382 businesses and 4,150 employees, would be displaced by the I-5 widening alternative, the vast majority of which are located within the coastal communities of San Clemente and Dana Point. In discussion relating to recreation and surfing impacts, the Staff Report states that potential impacts to surfing resources could impact tourism in the coastal community of San Clemente. However, **the displacement of several hundred homes and businesses that would take place were the I-5 alternative constructed would have impacts on the San Clemente tourism industry several magnitudes greater.** Specifically, low-cost visitor serving uses, including scores of hotels and motels, restaurants, surf shops, and visitor-serving convenience stores are concentrated along the I-5 corridor within San Clemente and Dana Point to serve the tourists and surfers visiting this coastal area[25]. For example, approximately 16 low- and moderate-cost motels and hotels would be displaced by construction of the I-5 Widening Alternative. This would remove approximately 539 hotel rooms, an estimated 212 of which are rooms with rates of less than $100.00 per night. The balance (327 rooms) is rooms with moderate rates (less than $179 per night and greater than $100 per night) (see Attachment 18, *Low- and Moderate-Cost Lodging Facilities Displaced by I-5 Widening*) Additionally, the City of San Clemente has stated that the I-5 Widening would *"have devastating impacts on the City, long term and short term during construction"* (see Attachment 19, *Letter from City of San Clemente on I-5 Widening Alternative, March 2000*).

Project opponents and Coastal staff claim that I-5 can be widened to meet project objectives without the level of community disruption indicated by the project Final SEIR. However, their analysis is based on a flawed and unsafe, smaller suite of I-5 improvements that would not alleviate congestion enough to meet project need. In short, all I-5 improvements identified by project opponents so far do not include the same number of lanes, and propose deficient interchanges not consistent with Caltrans design and safety standards. **Caltrans**

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[25] Approximately 16 hotels, inns, and motels would be displaced by the I-5 Widening Alternative, in addition to 25 bars and restaurants, and 4 surf shops.

agrees that to meet the purpose and need of the project, the final I-5 condition must be up to 6 general purpose and 2 HOV lanes in each direction (up to 16 lanes total) a massive widening that would drastically alter the character of San Clemente (see Attachment 20, *Letter from Caltrans to FHWA, June 2006*).

vi. The Arterial Improvements Plus – Refined (AIP-R) Improvements

Project opponents evaluated another form of improvement to I-5, which was more comparable to the AIP alternative evaluated in TCA's environmental documents than the I-5 Widening alternative. The AIP-R alternative was submitted by project opponents in a document prepared by Smart Mobility, Inc (SMI) of Norwich, Vermont entitled, "*An Alternative to the Proposed Foothill South Toll Road: The Refined AIP Alternative*" (SMI Report). The Vermont Company that prepared this analysis based its conclusions on deeply flawed assumptions, demonstrating both a superficial and highly inaccurate analysis. SMI has since been forced to concede that it made fundamental errors in the report[26]. The report's primary preparers are not licensed to practice civil engineering in the State of California and review of their work experience indicates that they have no previous work experience in the State of California working on Caltrans projects.

This "AIP-R" improvement would not have nearly the same traffic benefits as the I-5 because it proposes fewer lanes and deficient interchanges. Even more importantly, it would be unsafe and does not meet Caltrans design and safety standards. Both the Orange County Board of Supervisors and Caltrans have written letters to Coastal Commission opposing the AIP-R Alternative. **Caltrans states:**

> ***The [AIP-R alternative] does not meet Department standards, and in our view does not meet applicable engineering standards of care. Therefore, the Department cannot support the proposed design refinements or conclusions.*** (See Attachment 21, *Letter from Caltrans to FHWA, January 2008*).

[26] In an LA *Times* article dated 10/15/07, SMI admitted they underestimated the required width of widening and Dan Silver, with the Endangered Habitats League stated "Factual errors were made."

Caltrans went on to identify a large number of deficiencies and inaccuracies in the SMI Report. The following is a **partial** list of the deficiencies identified by Caltrans:

- Report used incorrect number of I-5 improvements.
- Elimination of I-5 off- and onramps violates mandatory design standards.
- Interchange design did not consider geometric constraints, operational and safety impacts.
- Right turn onramps alignments from El Toro Road do not merge safely with the main segment of the onramps.
- Minimum distance between ramp intersections and local road intersections are not met.
- Interchange horizontal and vertical geometric data is not provided.
- Crown Valley Parkway right turn onramp alignments do not merge safety and are not in conformance with design standards.
- Crown Valley Parkway required auxiliary, merge and storage lanes, and shoulders are missing.
- Crown Valley Parkway interchange offramp merge conflicts with signalized interchange.
- Access control is not attainable without removal of adjacent intersection.
- Site distance restrictions are not addressed.
- Length of southbound offramp requires a second passing lane
- Ortega Highway right turn onramp alignments do not merge with the main segment of the onramps.
- Pico Interchange onramp alignments do not merge safely.
- Report does not provide any Single Point Interchange level of service analysis.
- Single Point Interchanges would not provide similar levels of service as TCA's interchange designs.
- Pico ramp design results in Level of Service F.

- Interchange details do not reflect any additional widening required for ramp storage capacity – leading to incorrect assessment of right-of-way impacts.
- Proposed design will not provide the required storage capacity needed for safe and effective operation of ramp meters.
- There is no technical analysis that shows interchange level of service.
- The purported advantage of the Single Point Interchange will often not materialize where the local street system is not compatible.
- Proposed interchange design may take a pedestrian as many as four cycles to cross.
- I-5 structures will require reconstruction.
- Extended detention basins do not meet applicable guidelines.
- Data for business and residence acquisition costs are unrealistic.

Additionally, the Orange County Board of Supervisors states that the AIP-R alternative "is **not** substantiated by any technical engineering or traffic analysis" (see Attachment 22, *Letter from Orange County Board of Supervisors to California Coastal Commission, December 2007*).

The SMI Report purports to show that a refined series of arterial and I-5 improvements could practically and cost-effectively meet future traffic demand without construction of the toll road. In truth, the findings of the report are based on deeply flawed assumptions, including:

- Minimized improvements do not provide traffic benefit similar to the AIP or I-5 Widening Alternatives analyzed in the Final SEIR;
- Lane configurations do not meet Caltrans design and safety standards;
- Deficient interchanges that will not function the same as interchanges proposed as part of the I-5 Widening Alternative or AIP Alternative;
- Underestimated displacements, based in part on reducing the width of city frontage roads inconsistent with OCTA and City standards (and would result in major local street congestion); and

- Unsafe design including (but not limited to) decreased emergency access, interchanges configurations not in context with their surroundings, and free right turns at intersections that pose risk to pedestrians (and are inconsistent with Caltrans policy).

A detailed analysis of the flaws in the SMI Report is included as Attachment 23, *Response to the Smart Mobility Report – Refined AIP Alternative* of this document. In summary, there are several flaws in the Refined AIP (AIP-R) alternative as presented by SMI. They can be categorized into 1) flaws in freeway design; 2) flaws in arterial design; and 3) flaws in overall design.

Flaws in Freeway Design

Flaws in the freeway design of the AIP-R alternative as presented by SMI include flaws in lane configurations, interchanges, frontage roads, storm water facilities, context sensitive interchange design, and single-point interchanges:

- **Lane Configurations:** The SMI report[27] states: *"The (AIP-R) mainline, interchange and arterial improvements are functionally identical to the (SOCTIIP) AIP Alternative but include(s) basic design refinements that maintain the (SOCTIIP) AIP Traffic Performance…"* (Emphasis added)

  IN FACT: Several "Final Lane Configurations" shown in Table 1 "Existing Lanes and Proposed Improvements by Segment for (SOCTIIP) AIP and AIP-R" on page 11 of the SMI Report are different than those in the SOCTIIP AIP. The SMI report is missing lanes which are included in the SOCTIIP AIP for over 40% of the project length. Specific locations where this occurs include:

  - Segment H (SMI Cross Section H) – SR-73 to J. Serra in San Juan Capistrano. There are 6 existing general purpose lanes northbound – not 4 as used in the AIP-R. The final lane configuration should be six general purpose lanes and two HOV lanes in each direction.

[27] (4th paragraph, page 4) An Alternative to the Proposed Foothill South Toll Road, The Refined AIP Alternative, Smart Mobility Inc, (AIP-R, SMI) September 2007

- Segments L, M and N – Pacific Coast Highway to Avenida Pico in Dana Point and San Clemente (See Cross Section L Existing and Proposed of Attachment 23). The RTP has 1 HOV lane in each direction programmed and the SOCTIIP AIP proposed an additional HOV lane NB and SB that the AIP-R did not include. This results in a 15-lane roadway in Segment L, a 12-lane roadway in Section M and a 14-lane roadway in Segment N through Dana Point and San Clemente with a final lane configuration of four general purpose lanes, two HOV lanes and auxiliary lanes, as necessary, in each direction. See Exhibit B of Attachment 23 for a visual example of a 14-lane roadway (photo of existing I-5 south of El Toro Road).
- Segment O – Avenida Pico to Palizada in San Clemente. The SOCTIIP AIP proposed a second auxiliary lane in addition to the existing auxiliary lane southbound which the AIP-R does not include. The final lane configuration should be two auxiliary lanes southbound, one auxiliary land northbound, and four general purpose lanes and one HOV lane in each direction.

Since the AIP-R does not use the same lane configurations as the SOCTIIP AIP, the claim that the AIP-R provides "the same superior traffic benefits associated with the (SOCTIIP) alternative"[28] is unsubstantiated and, without adequate traffic analysis in the SMI report, the entire premise of the AIP-R is negated.

- **Interchanges:** The AIP-R does not include two interchanges that were required to be included in the SOCTIIP AIP. Proposed southbound exit and entrance ramps at Laguna Hills Mall (south of El Toro Road) and a southbound exit ramp at Stonehill Drive (north of SR-1) were under study by Caltrans and were included in the SOCTIIP AIP as additional capacity improvements.

[28] (3rd paragraph, page 1), AIP-R, SMI

- **Frontage Roads:** the SMI report states[29] : *"As demonstrated in this report, even minor refinements to the design of the (SOCTIIP) AIP can greatly reduce or even eliminate displacement, such as... narrowing frontage roads with low traffic demand to allow mainline freeway widening."*

  IN FACT: The definition of the SOCTIIP AIP Alternative is the "**Arterial Improvement** Plus I-5 HOV and Spot Auxiliary Lanes". The "frontage roads" cited to be narrowed in the report are actually primary and secondary arterials as described on the County of Orange Master Plan of Arterial Highways (MPAH) and are a part of the local cities' critical arterial network. Narrowing of "frontage roads" is actually narrowing of arterial roadways, is not a minor refinement and, in fact, reduces arterial capacity rather than improving the county arterial system. The SMI proposal to narrow the arterial roadways ("frontage roads") would result in the increase of congestion on the local streets in direct conflict with the purpose of the SOCTIIP AIP Alternative.

  The County of Orange standard for primary arterials as set forth in Topics 101 and 301 of the Orange County Highway Design Manual is a 4-lane roadway with median, parking and sidewalks in a 100' right-of-way. The narrowing of these arterials as proposed by SMI violates the County arterial design standards and would not be acceptable to local agencies because of concerns such as public safety (including fire and police response), local traffic mobility requirements and commercial access concerns. Specific examples of narrowed frontage road include:

  - ***Avenida de la Carlota*** (see Cross Sections A and B, Exhibit E and Refined Plan Sheet 1 in Attachment 23) serves major commercial areas including a regional shopping mall. North of El Toro Road (see Cross Section A in Attachment 23) the existing roadway is designated a Secondary Arterial and generally consists of 4 lanes with a median, no shoulders, and sidewalk on the west side only. The median varies from 6' (where there is no sidewalk) to 14'

[29] (2nd paragraph, page 4), AIP-R, SMI

where there are left turn movements. The existing/forecast traffic in this segment is 16,000 (2007) / 20,000 (2030) ADT (Average Daily Traffic). The Secondary Arterial designation requires 4 lanes (without median) with 8' shoulders for a 64' pavement width plus sidewalks in an 80' right of way. The SMI Report reduces this Secondary Arterial to two lanes with a median for left turn movements in a 62' right-of-way, which does not conform to County MPAH standards.

- ***Avenida de la Carlota south of El Toro Road*** (see Cross Section B of Attachment 23) is designated a Secondary Arterial and generally consists of 4 lanes with a median, no shoulders and a sidewalk on the west side only. The existing/forecast traffic in this segment is 13,000 (2007) / 23,000 (2030) ADT. The Secondary Arterial designation requires four lanes (without median) with 8' shoulders for a 64' pavement width plus sidewalks in an 80' right of way. The SMI Report reduces this Secondary Arterial to two lanes with a median for left turn movements and reduces the right-of-way width by 12', which does not conform to County standards for MPAH. In addition the 2030 traffic volumes will require four lanes plus a median.

- ***Rancho Viejo Road north of Junipero Serra Road*** (see Cross Section H and Refined Plan Sheet 5 in SMI report) is designated a Secondary Arterial and generally consists of 4 lanes with a median, no shoulders and a sidewalk on the east side only. The existing/forecast traffic in this segment is 10,000 (2003) / 12,000 (2025) ADT. The Secondary Arterial designation requires 4 lanes (without median) with 8' shoulders for a 64' pavement width plus sidewalks in an 80' right of way. The SMI Report reduces this Secondary Arterial to two lanes with a median for left turn movements and reduces the right-of-way width by 8' which does not conform to County MPAH standards.

- ***Camino Capistrano north of Stonehill Drive*** (See Cross Section K and Refined Plan Sheet 6 of Attachment 23) serves a major commercial/industrial area with multiple commercial entrances, requiring right and left turns as well as street parking. Camino Capistrano is designated a Primary Arterial and generally consists of 4 lanes with a median with a shoulder (for parking) and a sidewalk on the west side only. The existing/forecast traffic in this segment is 24,000 (2003) / 30,000 (2025) ADT. The Primary Arterial designation requires four lanes (with median) with 8' shoulders for an 80' pavement width plus sidewalks in a 100' right of way. The SMI Report reduces this Primary Arterial to two lanes with a median for left turn movements and reduces the right-of-way width by 28' which does not conform to County MPAH standards. In addition the 2025 traffic volumes indicate the need for a six lane divided roadway.

- ***El Camino Real south of the I-5 exit*** (See Cross Section S Existing and Proposed of Attachment 23) is the ONLY continuous alternative route to I-5 and the only emergency access from the county line through San Clemente to Pacific Coast Highway (SR-1). El Camino Real is designated a Secondary Arterial and generally consists of four lanes with no median, 6' shoulders and a sidewalk on the northeast side only. The existing/forecast traffic in this segment is 17,000 (2004) / 17,000 (2030) (ADT). The existing roadway does not meet the Secondary Arterial designation requirements of four lanes (without median) with 8' shoulders for a 64' pavement width plus sidewalks in an 80' right of way. The SMI Report reduces this Secondary Arterial to two lanes with no median and 4' shoulders and reduces the right-of-way by 23' which does not conform to County MPAH standards.

- **Storm Water Facilities:** The SMI Report states[30]: *"As demonstrated in this report, even minor refinements to the design of the (SOCTIIP) AIP can greatly reduce or even eliminate displacement, such as …design and siting of stormwater facilities to avoid developed property."*

[30] (2nd paragraph, page 4), AIP-R, SMI

IN FACT: The AIP-R siting of many EDBs would not only be exceedingly costly but several would require exceptional engineering/construction solutions and some are just not practical nor do they conform to accepted engineering practice. Specific examples of this include:

- ***EDB 3F*** is located on a steep slope above the existing ramp and arterial which border the site. See Exhibit D of Attachment 23, which is a photo of the site showing the existing church located immediately at the top of the slope which exceeds 140 feet high and is underlain by the Capistrano formation which is known locally to be geotechnically unstable. This location is not practical.

- ***EDB 3E*** is located below I-5 on a steep slope at the bottom of which is the primary access road to a hotel/convention facility and a commercial parking area. This EDB would require a full take of the hotel/convention facility. It would therefore not be feasible.

- ***EDB 7B*** is proposed on a hillside which is on the far side of a drainage way and over 20 feet above the roadway. (See Exhibit C of Attachment 23 which is a photo of the actual hillside location of EDB 7B. This site has recently been filled to build the office buildings shown in the photo. Not only is this location not practical, it would require at least a partial take of the new office building.

- ***EDBs 13A and 11*** are sited in commercial mall/shopping area parking lots which have no adjacent land available for replacement parking. Provision for Caltrans to have title and access to maintain the EDBs would require construction of multi-level replacement parking structures for private entities.

- The AIP-R plan has two areas where no EDBs are shown – from north of SR-1 (EDB 7B) to Vista Hermosa, a distance of over 3 miles which has several drainage points which require some type of storm water runoff treatment. Also, the AIP-R shows no EDBs from south of Presidio to Cristianitos Road, a distance of almost two miles with two distinct drainage points requiring storm water runoff treatment.

The existing I-5 is located in an area of significantly variable topography. There are many areas where the land next to I-5 differs in elevation by over 50 feet. Because of the variable topography, there are substantial areas of open space directly adjacent to the I-5 roadway both within the right-of-way and outside the right-of-way that are sloped due to hills and canyons. The location of EDBs cannot be based solely on the availability of "open space" as seen from an aerial photograph because the location of the EDBs must account for topography and related constraints such as hydrology.

- **Context Sensitive Interchange Design:** AIP-R[31] text states: *"As demonstrated in this report, even minor refinements to the design of the (SOCTIIP) AIP can greatly reduce or even eliminate displacement, such as …context-sensitive interchange design."*

  IN FACT: Context Sensitive Design is not a process in which a single entity advances their design ideas without consideration from other parties, as SMI has done in their report. Rather, Context Sensitive Design *"is a collaborative approach to developing and redesigning transportation facilities that fit into their physical and human environment while preserving the aesthetic, historic, community, and natural environmental values. CSD contributes to community, safety, and mobility."*[32] FHWA also notes that the *"ultimate decision on the use of existing flexibility rests with the State design team and project managers."*[33] The Collaborative's approach to selecting the preferred alternative therefore IS an example of Context Sensitive Design, as several federal, state, regional and local agencies participated in the selection. As noted by FHWA, for *"each potential project, designers are faced with the task of balancing the need for the highway improvement*

[31] (2nd paragraph, page 4), AIP-R, SMI
[32] Context Sensitive Design, FHWA http://www.fhwa.dot.gov/environment/csd.htm
[33] See http://www.fhwa.dot.gov/environmentl/flex/intro.htm

with the need to safely integrate the design into the surrounding natural and human environments."[34]

Several interchange configurations proposed in the SMI report are not in context with the significant planning studies which have been conducted by Caltrans in conjunction with local agencies and with extensive public input. These include Interstate 5 interchanges at Ortega Highway in San Juan Capistrano, Avenida Pico in San Clemente and El Toro Road in Laguna Hills. These planning studies were conducted according to the Caltrans Project Development Procedures Manual (PDPM) and resulted in the elimination of consideration of the single point interchanges proposed by SMI at these locations. The studies represent the appropriate Context Sensitive Interchange Design evaluation because they were conducted by the local agencies with extensive public input. The SMI report is inconsistent with the conclusions of the local agencies which implemented a Context Sensitive Interchange Design process for these interchanges.

- **Single Point Interchanges:** The Single Point Interchange (SPI) is a concept which essentially combines two separate diamond ramp intersections into one large at-grade intersection. The traffic capacity of the SPI can exceed that of a compact diamond if long signal times can be provided (not possible in many of the SMI proposed locations) and left turning volumes are balanced. This additional capacity may be offset if nearby intersection queues interfere with weaving and storage between intersections - which is true at most of the proposed locations.

Two disadvantages of the SPI are: 1) future expansion of the interchange is extremely difficult; 2) they create poor bicycle and pedestrian circulation – this is particularly important at El Toro Road and Avenida Pico interchanges which have high pedestrian traffic.

The SPI incorporates free-right turns. **Recent Caltrans policy [see Caltrans Highway Design Manual (HDM) Topic 405.3(3)] has been to remove free-right turns, as they pose a safety risk to pedestrians.** If

[34] Ibid.

free-right turns are permitted, they must have a dedicated lane where they connect with the arterial. Serious conflicts occur when the right turning vehicle must weave across multiple lanes on the local street in order to turn left at a major cross street close to the ramp terminal which is the usual case with the intersecting arterials along I-5. Free-right turns should generally be avoided unless there is room for a generous acceleration lane or a lane addition on the local street which produces additional property takes – usually businesses in the vicinity of I-5.

Additionally, although the SMI Report includes very little information on which to base any comments about the design work, based on comparison with the other ramps that are shown in the interchange concepts, the ramps for the Single Point Interchanges look very short – they look shorter than the ramps for the existing interchanges. In fact, ramps for SPI's tend to be longer to provide adequate sight distance. Lengthening the ramps will require additional right-of-way acquisition and/or retaining walls. See Exhibit F of Attachment 23 for an example of a Single Point Interchange that meets Caltrans Highway Design Manual Criteria.

Flaws in Arterial Design

Flaws in the arterial designs of the AIP-R alternative as presented by SMI include infeasible widening within the right-of-way. The SMI Report states[35]: *"Most of these (improvements to several arterial corridors) can be accommodated within the publicly owned right-of-way, and therefore do not result in property impacts."*

IN FACT: The arterial right-of-way is typically set at the back of sidewalk. Therefore, unlike the I-5 where the right-of-way includes slopes, ANY widening of the arterial roadway will require property acquisition along the entire length of the arterial improvement (over 8 miles along Antonio/LaPata) as well as at all improved intersections (see Exhibit A of Attachment 23).

Therefore, the SMI report greatly underestimates the property impacts of the arterial component. If the AIP-R design were implemented, the property takes

[35] (last paragraph, page 20), AIP-R, SMI

would be substantially higher than those stated by SMI. Therefore, the SMI statement is incorrect.

Flaws in Overall Design

The SMI report generally assumes that the area in which the widening is to occur is flat and, therefore, does not take into account topography. **The cross sections that are included in the report are very deceiving – they imply the corridor is flat.**

INFACT: There is a significant elevation difference between I-5 and the surrounding ground at almost all locations between El Toro Road and the San Diego County line (see Exhibits B, C and D of Attachment 23 for examples) as well as along the arterial widenings. The reason this is significant is that the cross sections make it appear that there is no need to take adjacent private land and buildings to accommodate the required slopes (See Exhibit A and Cross Section P Existing and Proposed of Attachment 23). To accomplish freeway and arterial widening and stay within the existing roadway right-of-way, retaining walls would be needed along almost the entire corridor (in many areas retaining walls already exist). Retaining walls carry a very significant capital construction cost, and they also have significant on-going maintenance cost (graffiti removal, structural inspection).

The SMI report states that the conceptual design plans are consistent with all applicable Caltrans guidelines. We cannot verify this statement because horizontal and vertical sight distance standards would need to be verified and without vertical profiles this cannot be determined. Although we do not have the information to either verify or determine this is an inaccurate statement, our engineering review of the AIP-R concludes that it is highly unlikely that the AIP-R is consistent with all applicable Caltrans guidelines.

Additional Comments

Traffic Analysis/Lane Configuration: The design of the Arterial Improvements Plus HOV and Spot Mixed-Flow Lanes on I-5 (SOCTIIP AIP) was based on Caltrans standard preliminary design procedures to establish the roadway widening improvements necessary to meet the lane criteria established/confirmed by the Collaborative traffic consultant's analysis.

The Caltrans Highway Design Manual (HDM) Topic 102 states "freeways should be designed to accommodate design year peak hour (PH) traffic volumes". The number of lanes required on a multi-lane urban freeway is based on PH volume per lane at level of service between C and E. In other words, the Caltrans "metric" or standard for "minimum capacity requirement" is Level of Service E for project/expenditure planning of widening projects. The addition of one HOV lane (required by AQMD) for the AIP, plus the addition of auxiliary lanes where possible, still did not bring the capacity up to LOS E in all areas. Therefore, the Caltrans "metric" for further study of the AIP was not met.

Consequently, the SMI claim that the AIP-R provides "the same superior traffic benefits associated with the (SOCTIIP) alternative"[36] is inappropriate.

Roadway Design: Topic 82.1.2 Application of Standards of the HDM states Mandatory Design Standards are those considered most essential to achievement of overall design objectives. Many pertain to requirements of law or regulations such as those embodied in the FHWA's 13 controlling criteria. As has been demonstrated with the widening of I-5 throughout Orange County from El Toro Road north to the Los Angeles County line, the widening and reconstruction of the I-5 to provide a roadway sufficient for the next 20 years is classified as "new construction" and, as such, the roadway design for the SOCTIIP AIP was based on the Caltrans requirement that new facilities shall be designed to full HDM standards.

As an example of geometric changes proposed in the SOCTIIP AIP to meet the HDM standards, the existing I-5 alignment immediately north of State Route 1 in Segment K has a substandard curve which would be exacerbated with the proposed AIP-R widening. The SOCTIIP AIP design proposed a realignment of I-5 through the SR-1 interchange and northerly through the long curve in order to meet current standards for safety and, thus, improve capacity on I-5.

[36] (3rd paragraph, page 1), AIP-R, SMI

Consequently, our engineering review of the AIP-R concludes that it is highly unlikely that the AIP-R is consistent with all applicable Caltrans guidelines, especially the FHWA's 13 controlling criteria.

Interchange Redesigns: Following Caltrans practice to comply with state and national standards used for implementation of projects addressing future needs, the SOCTIIP AIP design evaluated existing interchanges and, where necessary, new interchange designs were developed to meet minimum Caltrans HDM criteria for the ramp configurations, horizontal alignments and arterial interface. Examples of this include:

- ***El Camino Real/Magdalena Interchange:*** The SMI proposal for the El Camino Real Interchange on page 19 includes "*closing the northbound ramp at the El Camino Real interchange, and replacing with the existing ramp, just to the south, also exiting to El Camino Real. These interchanges are more closely spaced than desirable, and this change will improve safety.*"

  The SMI design does not consider the Caltrans practice to comply with state and national standards for implementation of projects addressing future needs. The SMI design does not address either the existing non-standard geometry or the access control issues at all the existing ramp intersections with El Camino Real (see Exhibit X-1 of Attachment 23). The closing of the NB ramps at El Camino Real and the use of the trumpet ramps to the south at Avenida Magdalena creates two issues. First, this violates the Caltrans advisory policy in HDM Topic 502.2 Local Street Interchanges: *"The use of isolated off ramps or partial interchanges should be avoided because of the potential for wrong-way movements and added driver confusion."* The second issue is safety related in that the existing ramps at Magdalena have substandard curve radii and the NB exit ramp does not meet the current stopping sight distance standard. The SMI ramps would make the curve radii more substandard and exacerbate the deficient stopping sight distance that would make the ramps even more dangerous than they are currently.

The SOCTIIP AIP design evaluated the existing El Camino Real interchange and a new interchange design was developed to meet minimum Caltrans HDM criteria for the ramp configurations, horizontal alignments and arterial interface (see Exhibit X-2 of Attachment 23). In order to create ramp configurations that meet minimum capacity needs and HDM design standards, the SOCTIIP AIP design started with the realignment of El Camino Real itself (approximately 0.6 mile) and, consequently, all the ramp intersections with El Camino Real had to be relocated. Then, the existing substandard weaving distance from the adjacent SB entrance ramp to the north (entrance from Avenida Presidio) required that the SB El Camino Real exit ramp be "braided" with the Avenida Presidio ramp. This "braiding" moved the SB El Camino Real ramp exit from I-5 to north of Avenida Presidio with the addition of structures to carry the SB El Camino Real ramp over Avenida Presidio and the Avenida Presidio entrance ramp. Thus, the SB El Camino Real exit ramp would be over 0.7 mile long and require the taking of at least 8 blocks of commercial buildings fronting on El Camino Real.

The SB El Camino Real entrance ramp intersection with El Camino Real was moved northerly to intersect El Camino Real north of its crossing with I-5 to provide minimum geometric standards for the turning movements from NB and SB El Camino Real onto the ramp. The loop ramp for SB El Camino Real to NB I-5 traffic was provided to meet safety and capacity requirements. The reconfiguration of the NB El Camino Real exit ramp also required that the NB exit and entrance ramps at Avenida Magdalena be eliminated due to their substandard separation from the NB El Camino Real ramp and, then, the traffic from these ramps had to be reallocated to the El Camino Real ramps.

The realignment of El Camino Real and the Caltrans requirement for access control along El Camino Real through and beyond the I-5 ramp intersections with El Camino Real also necessitated the realignment and extension of Calle Alcazar to the east of I-5 from Avenida Cordoba on the north to Avenida San Gabriel on the south (approximately 0.5 mile). These street relocations, which would be required to provide local access to the adjacent residential areas, result in significant commercial and residential takes.

- ***Avenida Pico:*** The SMI AIP-R report proposes replacing the current tight diamond interchange at Avenida Pico with an SPI, with only a minor realignment of Avenida Pico to the east of I-5. Also, minor modifications to the ramps are shown with minimal right-of-way impacts. While the design may appear to be a workable solution to the traffic issues here, there are many flaws in the design proposed by SMI which severely affect the safety and operation of the interchange (see Exhibit Y-1 of Attachment 23). First, placing an SPI where the intersecting arterial is on a curve makes it difficult for drivers to determine the proper lane to enter when making left turns from the off ramps. There are also several places on the ramps, at the approaches to Avenida Pico and where lanes merge, where adequate stopping and decision sight distances are not provided. Another safety issue occurs as the on ramps enter the mainline I-5 where substandard geometry does not provide for safe merging of the ramp traffic with mainline traffic which would also cause safety and traffic issues on I-5. While it is difficult to verify based on the sketch in the report, it appears that the opposing left turn movements of the northbound and southbound exit ramps conflict and do not line up with the lanes on Avenida Pico they are supposed to join.

  Another major issue is the fact that the right turn lanes do not maintain tangency to Avenida Pico or the ramps they tie into. This is both a traffic capacity issue and safety hazard, as vehicles would be joining lanes with higher speed traffic with no space to merge and would be required to make abrupt direction changes to stay within the proper lane. Also, since this is an urban area with San Clemente High School and many retail and commercial businesses, pedestrian traffic is expected to be high, creating safety concerns at the free-right turns.

  Aside from the extremely unsafe conditions resulting from the proposed SMI design, there are several other constructability and right of way issues which are not addressed. The SMI report does note that the mainline I-5 structure would need to be replaced; however, the report fails to mention the associated major reconstruction of the approaches to the structure to provide adequate vertical clearance for vehicles traveling under the structure. As shown on the proposed SMI exhibit, the bridge does not appear to be long enough to clear to northbound exit and entrance ramps. Regardless, placing a single-span structure with a length that exceeds typical dimensions would require specialized design and an exceptionally large depth (thickness) for the proposed structure, if such a structure is even feasible. As a result of the increased depth, the approaches to I-5 and/or Avenida Pico would need to be revised vertically to account for this.

There is also the issue of the EDBs, which are mentioned in the SMI report, but generally glossed over without much thought on feasibility or practicality. It is noted that Basin 3-E is located on a slope adjacent to a parking lot and results in partial displacement and even discusses the option of constructing Basin 3-E under the privately owned parking lot. Caltrans policy would not allow for such a condition. Basin 3-F is described as being at the foot of a hillside when, in fact, it is in the middle of the hillside. Aside from the obvious constructability issues with providing a basin with sufficient capacity at this location, there is also the issue with conveying runoff to a basin that is substantially higher than the freeway (water does not flow uphill).

In contrast to the proposed SMI design, the SOCTIIP AIP proposed a design that meets Caltrans Design Criteria, providing a safe, operationally superior and feasible solution (see Exhibit Y-2 of Attachment 23). The realignment of Avenida Pico (approximately 0.5 mile) is necessary to accommodate the needed storage capacity of the ramps and allow for typical intersection designs at the ramp termini. This realignment requires the mainline structure to be reconstructed at the new crossing location. The existing tight diamond interchange was replaced with a partial cloverleaf interchange to reduce signal times and provide two entrance ramps for each direction of mainline traffic, thus adding ramp capacity and reducing congestion on the ramps and Avenida Pico. The exit ramps have been realigned to accommodate the new loop ramps and intersect Avenida Pico at nearly right angles. All entrance ramps have been realigned to a partial clover interchange design. All ramps have been redesigned to meet current HDM standards to tie into the widened mainline. With the ramp realignments, properties in the northwest, southwest and southeast quadrants of the interchange would need to be acquired, resulting in several business relocations.

With the realignment of Avenida Pico, Via Pico Plaza was realigned to intersect Calle de Los Molinos (0.2 mile) and a cul-de-sac was placed at the end of Calle de Industrias closest to Avenida Pico, removing the intersection with Avenida Pico completely. These changes were necessary to provide the Caltrans required access control along Avenida Pico adjacent to the interchange in order to improve traffic capacity. Also, the northern end of Calle de Los Molinos was terminated with a cul-de-sac and Avenida Navarro was eliminated, as the properties along the east side of the street were part of the proposed right of way to accommodate the southbound exit ramp and southbound loop entrance ramp.

In order to provide the traveling public with an interchange configuration that accommodates present and future traffic demands, significant right of way impacts are unavoidable.

- ***Ortega Highway/SR-74 Interchange:*** The Ortega Highway/State Route 74 interchange with I-5 is currently a tight diamond configuration that the SMI report proposes replacing with an SPI. Some widening of Ortega Highway is proposed with right-of-way impacts along the south side of Ortega Highway. The ramps have been modified with only minimal right-of-way impacts. The SMI Ortega Highway design appears to address traffic issues, but several operational and safety issues result from the flawed design proposal (see Exhibit Z-1 of Attachment 23). Adequate stopping and decision sight distances are not provided at several locations on the ramps, including at the approaches to Ortega Highway and where the right and left turn lanes merge. The substandard geometry where the ramps enter mainline I-5 produces another safety and operational issue, as ramp traffic cannot safely merge with mainline traffic, affecting traffic flow on both mainline I-5 and on the ramps. The operation of the interchange would also be adversely affected by the large distance between opposing left turns and the ramps, increasing the distance vehicles must travel to clear the intersection. This increased distance adversely affects signal times, reducing overall capacity of the interchange. Additionally, the turn lanes on Ortega Highway do not appear tangent to their respective lanes nor do they line up properly with the entrance ramps.

Another serious safety issue is the fact that the right turn lanes do not maintain tangency to Ortega Highway or the ramps they tie into. This is a serious hazard, as vehicles would be joining lanes with higher speed traffic with no space to merge and would be required to make abrupt direction changes to stay within the proper lane. Also, as this is an urban area with a YMCA facility and several retail and commercial businesses, pedestrian traffic is expected to be high, creating safety concerns at the free-right turns.

The SOCTIIP AIP proposed a partial cloverleaf design which meets Caltrans Design Criteria providing a safe, operationally superior and feasible solution (see Exhibit Z-2 of Attachment 23). By introducing new loop ramps, realigning the existing ramps to accommodate them and allowing for only right turn access onto the ramps, the signals at the off ramps are spaced further apart with fewer signal phases. This eliminates the need for left turn lanes and storage space along Ortega Highway, providing for additional through lane capacity within the existing Ortega Highway roadway width. The result is the need for only minor widening of the existing structure approaching the southbound entrance ramp to I-5. With the realignments, all ramps meet current HDM standards and to tie into the widened mainline. Properties in the northwest, southwest and southeast quadrants of the interchange are impacted by the realignments and would necessitate acquisition of right of way and the relocation of portions of the YMCA facility and several businesses.

With the realignment of the southbound exit ramp, a portion of Del Obispo Street (0.1 miles) has been realigned to intersect Ortega Highway at the same location, combining two previously signalized intersections into one and further enhancing the capacity of Ortega Highway.

- ***Crown Valley Parkway:*** Page 16 of the SMI report describes the construction of a "flyover ramp" for the southbound exiting left turns at the Crown Valley Parkway Interchange. This alternate design is very impractical for this location for many reasons.

  First, the design shows the ramp crossing under Crown Valley Parkway; then crossing I-5. There is not sufficient horizontal or vertical clearance between Crown Valley Parkway and I-5 to accommodate this ramp without complete vertical realignment of Crown Valley Parkway which would have significant impact on the other ramp terminals.

  Second, the ramp, which would be two lanes wide, connects to Crown Valley Parkway east of the existing northbound exit ramp and the required access control would necessitate the taking of all of the businesses between the existing ramp and the entrance to the regional mall which is approximately 1000 feet to the east.

  Third, the distance from where the ramp crosses the northbound exit ramp to where it connects to Crown Valley Parkway does not appear to provide sufficient length to allow an acceptable vertical alignment of the ramp as it connects to Crown Valley Parkway.

  Fourth, the run out of the 2 lane ramp connection to Crown Valley Parkway would require all traffic that now turns left into the major commercial/business area along Puerto Real to be rerouted further east which would further congest that portion of Crown Valley Parkway.

vii. Conclusion

The Staff Report claim that there are 6 alternatives to the project that could be made consistent with the Coastal Act (while the preferred alternative could not be made consistent) is unfounded. Each of the 6 alternatives identified by staff 1) have severe environmental, wetlands, and/or community impacts; 2) have unsafe operational features, or 3) are technical infeasible, or 4) simply do not alleviate traffic congestion enough to justify the significant cost.

I. Conflict Between Coastal Act Policies and Use of Balancing

The Staff Report acknowledges, as it must, that the Commission has approved transportation and other projects under the "balancing" provision in Section 30007.5. Indeed, it has repeatedly approved such projects (especially for important regional transportation infrastructure) under precisely the same circumstances that are presented by FTC-S. In the case of FTC-S, balancing is perfectly appropriate to resolve conflicts between the wetland and ESHA protection policies of the Coastal Act (Sections 30233 and 30240) and the policies of the Act which promote improved water quality (Section 30231), public access (Section 30210), encouragement of lower cost visitor-serving and recreational facilities (Section 30213), and public safety (Section 30253). On balance, the latter provide a greater level of consistency with the Coastal Act.

The Staff Report presents only a partial list of recent Commission balancing decisions. The Commission has employed "balancing" judiciously, but has not been reluctant to do so when, as here, resolution of conflicting coastal policies produces a result that is most protective of coastal resources. A more complete table than that presented in the Staff Report includes, but is not limited to, the following:

Recent Coastal Commission Balancing Decisions

Decision	Year	Project Description	Sections Balanced
LCPA No. 2-06B (Carlsbad)	2006	Zone change for residential development	30240 (ESHA) and 30250 (concentration of development)
CDP No. 1-06-033 (Tilch)	2006	Replace failing onsite sewage wastewater disposal system for residence	30233 (wetlands) and 30231 (water quality)
UCSB LRDP Amendment 1-06, NOISE 1-06, and LDP No. 4-06-097	2006	Campus housing	30233 (wetlands) and 30250 (concentration of development)
CC-004-05 (North County Transit District)	2005	Construction of second railroad tracks	30233 (wetlands), 30240 (ESHA) and 30231 (water quality), 30252 (public access), and 30253 (air quality and energy conservation)
LCP No. 1-03 (Dana Point)	2004	Residential, commercial, visitor-serving development, parks, trail, and open space	30240 (ESHA) and 30210-31214 (public access), 30231 (water quality), 30250 (concentration of development)
LCPA No. 1-03B, CC-007-003 (Carlsbad)	2003	Habitat Management Plan	30240 (ESHA) and 30250 (concentration of development)
LCP Maj. Admt No. 3-01 (San Luis Obispo)	2002	Sewage Treatment Plant	30240 (ESHA) and 30231 (water quality)
LCPA OXN-MAJ-1-00 (Oxnard Northshore)	2002	Site remediation, residential development, and resource protection area	30233 (wetlands) and 30231 (water quality)
CDPM 9-98-127 (City of San Diego)	2000	Construction of freeway segment of SR-56	30233 (wetlands) and 30231 (water quality)
Appeal No. AS-IRC-99-301 (Irvine Community Development Co.)	2000	Mass grading and backbone infrastructure for future residential and recreational development	30233 (wetlands) and 30231 (water quality)
CPDM 1-98-103 (O'Neil)	1999	Construction of barn for dairy cows near stream	30233 (wetlands) and 30231 (water quality)
CC-64-92/5-92-232 (TCA)	1993	Construction of San Joaquin Hills Transportation Corridor Toll Road (SR-73)	30233 (wetlands) and 30210-30213, 30252 and 30253 (public access)

Two previous Commission decisions, in particular, bear specific mention because they are directly parallel to the FTC-S project, involving two important routes in the State Highway system, including a previously approved toll road.

- **State Route 56:** In Application No. 6-98-127, the Commission approved the coastal zone portion of the middle segment of State Route 56 to complete an east-west freeway connection between I-5 and I-15. The Commission first found that the project would result in permanent impacts to 0.427 acres of wetlands (in contrast to 0.16 acre here) and two acres of sensitive upland plants. Nonetheless, the Commission employed "balancing," finding wetland protection outweighed by state-of-the art water quality improvements that, as here, would reduce contaminants and thereby enhance the use of downstream resources by wildlife and humans. The Commission further found wetland protection outweighed by the fact that "completion of this east-west highway connector, identified in many regional planning documents for decades, will enhance public access to the coast by reducing required travel times from these developing inland communities to the shorelines of Del Mar and Torrey Pines. Without the construction of the middle segment of SR-56, the mandate of Section 30210 of the Coastal Act to maximize public access to the coast will not be fully realized." Thus, the Commission concluded that this major transportation project, on balance, would be most protective of coastal resources.

- **State Route 73 Toll Road:** In CC-63-92, the Commission approved a combined CDP and Consistency Certification for construction of a small segment of the 17.5-mile toll road (San Joaquin Hills Transportation Corridor) within the coastal zone. The Commission found that the project would fill 0.33 acre of wetland. However, it further found that denial of the project would conflict with the public access policies of the Coastal Act: Finding approval of the project, on balance, to be most protective of coastal resources, the Commission explained:

  ". . .[T]he No Project Alternative would result in either a significant overload of the transportation system capacity of Pacific Coast Highway or significant adverse impacts to coastal communities and public recreational areas necessitated by future widenings of PCH. The City of Laguna

Beach has already stated its opposition to the latter and has articulated a "planned deficiency" approach to PCH through Laguna Beach (in findings of approval for the Irvine Coast Development Agreement EIR). Consequently, the failure to approve the SJHTC would result in impacts contrary to Sections 30001.5, 30210, 30212, 30212.5, 30213, 30223, 30240, 30253.5 and 30254 of the Coastal Act either as a result of failing to provide for adequate transportation system access to coastal and upland support recreational; areas or as a consequence of impelling the widening of PCH in a manner resulting in significant impacts both to coastal communities and to public recreational areas."

The Staff Report nonetheless states on page 23 that "it strongly disagrees with the argument that any of these situations [including SR-56] are comparable to the situation raised by the proposed road . . .." However, this supposed disagreement is 180 degrees the opposite of this Commission's decisions on comparable projects.

First, as part of regional transportation plans that have been developed over the course of decades, the project will complete the connection between SR-91 and I-5, thus facilitating significant new and more direct and convenient public access from inland areas to coastal recreational areas in southern Orange County and northern San Diego County. Access to and along this portion of the coast is currently restricted because of severe traffic congestion on I-5. Because of this congestion, significant congestion is also occurring on local streets in the coastal community of San Clemente on the weekends as drivers attempt to avoid I-5 congestion. This results in additional significant barriers to coastal access. Without construction of the remaining segment of the toll road, the mandate of Sections 30210 through 30214 of the Coastal Act to maximize public access to the coast will not be fully realized. The project's benefit to, and consistency with the Act's public access policies, is obvious.

The Staff Report disingenuously states on page 29 that TCA has not "quantified" its stated benefit of bringing additional visitors to the coast, and that TCA has not provided evidence that significant numbers of recreational travelers, as opposed to commuters, will be willing to pay tolls to reduce travel times. The Staff Report agrees that I-5 weekend traffic is heavy; but states that nevertheless existing toll road use on weekends remains low.

Yet, the exact same benefit to public coastal access, without more, was transparently obvious to Commission staff and the Commission in connection with the toll road approval (SR-73) discussed above and again not less than six months ago, when the Commission approved the consistency certification for the North County Transit District's 1.2-mile railroad passing track extension and briefs in Oceanside. The Commission "balanced" impacts to wetlands, explaining:

> *"The Commission finds that traffic congestion interferes with access to the coastal recreational opportunities within northern San Diego County (including travelers from Los Angeles and Orange Counties). As traffic congestion increases with expected growth of the region, these access impacts will worsen, and when congestion increases, non-essential trips such as those for recreational purposes tend to be among the first to be curtailed. Thus, as the traffic increases, the ability for the public to get to the coast will become more difficult, which would result in a condition that would be inconsistent with the access policies of the Coastal Act." (CD-008-07)*

Public access to the beach and other coastal recreational amenities in northern San Diego County and southern Orange County are presently severely constrained by traffic congestion, especially on the weekends and holidays. Weekday traffic is projected to increase 60% by 2025, and weekend traffic is projected to be higher still. The high weekend traffic on I-5 has a spillover impact on local roads in San Clemente, Dana Point and San Juan Capistrano and creates further barriers to coastal access.

Beachgoers from the inland areas will either pay the toll or use SR-241 because it is quicker or will use the I-5 because it is less congested and because completion of SR-241 has greatly reduced travel times. Either way, the project will significantly benefit public access, exactly as the Commission found in the recent North County Transit District railway extension and bridge project and also in the SR-56 decision, as noted above.

On the issue of public access, project opponents ignore that the project will greatly benefit public access overall to the many coastal access destination points in northern San Diego County and southern Orange County. (See letter from project opponents to the Commission, dated September 24, 2007.) These include: San Clemente State Beach, Doheney State Beach, Dana Point Harbor, Salt Creek Beach, and Crystal Cove State Beach. Instead, they focus only on San Onofre State Beach. First, the project opponents erroneously argue that San Mateo Campground will be abandoned as a consequence of the FTC-S. This is discussed above in Section III: Response to Staff Findings and Declarations, Part C: Public Access, Recreation and Public Views.

Even DPR in its 1997 *Mitigation Assessment of FTC-S Impacts to San Onofre State Beach*, candidly explained that *"San Onofre State Beach would continue to be a popular park because of its location on the Southern California coastline and the coastal recreation opportunities it offers,"* and while FTC-S may have some impact on subunit 1, ***"FTC-S will provide greater access to the coast and substantially increase park visitation levels."*** (pp. A-3 and 4). Second, the project opponents also incorrectly assert that there is no evidence that this park's visitors have access problems due to traffic congestion. A more candid assessment was provided in a recent Christmas Day article in the local Orange County Register, where a San Clemente surfer explained, as to his trips to San Onofre State Beach: *"Like many in Southern California, I'd spent hours in my car in the Summer waiting in the heat to simply get into the State Beach, only to wait again in the lineup to secure my own wave."*[37] (See Attachment 24, *Santa Safari, Orange County Register, December 2007*)

Second and still further in terms of public access and additionally the promotion of lower cost visitor-serving and recreation facilities, the Staff Report ignores the public access and recreation benefits afforded by TCA's extraordinary $100 million State Parks package. On October 4, 2007, TCA amended the project description to its consistency certification to provide as follows:

> *"At the time of grant of the easement to TCA by the U.S. Department of Navy, TCA will record an irrevocable offer to provide, from the proceeds of the construction financing of the project:*
>
> - *To the Secretary of the Navy up to 70 million dollars, in cash or in*

[37] "Santa Safari – A family's Christmas tradition includes presents and, with luck, a decent break." *Orange County Register*(December 25, 2007).

kind consideration, for extension of the current lease for SOSB under terms agreed to by the Secretary and the State of California;

- *To the State of California, 20 million dollars for improvements to recreational facilities at SOSB and Crystal Cove State Park; and*
- *To the State of California, 10 million dollars for coastal sage scrub restoration within Crystal Cove State Park."*

Alternatively, the entire $100 million could be reallocated solely for improvements to SOSB and Crystal Cove State Park or other coastal projects. This package is particularly key to funding state park access and recreation projects in light of the 10% reduction that the Governor has ordered in the budgets of every State agency, including State Parks. But for the funding provided to extend the SOSB lease, that lease will expire in 2021 unless State Parks can come up with the funding, at full fair market value, which federal law now requires. The funding enables State Parks to complete the improvements at Crystal Cove State Park, and it provides $10 million in funding for coastal sage scrub restoration within that Park. Each element of TCA's funding package undeniably provides significant coastal resource benefits, which far outweigh any impact on wetlands or ESHA that the project may create.

Third, as demonstrated by the above table, the Commission has repeatedly employed "balancing" where a project, as here, will significantly improve water quality. The Staff Report's discussion of each of the precedents cited demonstrates the obvious: the improvement of water quality along the coast is a serious and important issue to the Commission.

FTC-S will significantly improve water quality by treating approximately five million gallons of runoff from the I-5 each year that currently flow untreated into San Onofre and San Mateo Creeks and to Trestles Beach. It will do so, employing a state-of-the-art water quality treatment system that includes vegetated swales and vegetated strips, media filters in the coastal zone and outside the coastal zone up to Ortega Highway (approximately 12 miles), native vegetation, and design pollution prevention BMPs. **The result will be arguably the best roadway runoff water quality treatment system in the country.**

The Staff Report attempts to dismiss this by saying that neither creek has been formally judged "impaired." This overlooks that in 2005, Heal the Bay gave San

Onofre State Beach at San Mateo Creek an "F" grade in terms of water quality. More important, the benefits of these water quality improvements will be substantial and cannot be dismissed because, just as in the Commission's decision on the SR-56 project, the reduction in contaminants here will clearly enhance the use of downstream resources by both wildlife and humans. Although these two streams are not listed as impaired, this treatment system will enhance water quality within the coastal zone over existing baseline conditions, help ensure that this project will not contribute to any future designation of these watersheds as impaired, and will improve water quality for the species within the coastal zone that utilize San Mateo and San Onofre Creeks and the ocean near shore area. Importantly, **the project will result in a net benefit to water quality within the coastal zone, and specifically the Trestles surfing area.**

The project opponents also argue in their September 24, 2007 letter to the Commission that Caltrans would be required to install these improvements anyway. However, this is clearly not so, as discussed at length in Part E: Water Quality, above. **Caltrans has no strategy and no funding source identified or possible to make water quality improvements to I-5, other than the proposed project.**

Finally, the project provides several public safety benefits, including the provision of an alternate major evacuation route for the San Onofre Nuclear Generating Station (SONGS) and for local area residents, the public, and coastal recreation users during a wild fire or flooding by tsunami. Further, it provides enhanced fire protection benefits and increases accessibility for emergency vehicles. All of these are addressed directly by the policy in Section 30253 of the Coastal Act, which requires that new development "minimize risk to life and property in areas of high geologic, flood, and fire hazard."

The Staff Report addresses the emergency evacuation benefit associated with SONGS, which it downplays, despite the fact that SONGS, as well as the project, are located within a designated high fire hazard area (See California Department of Forestry and Fire Protection, FRAP Map for San Diego County dated 9/25/07), and despite the obvious and uncontested fact that weekday traffic, which is already congested, will increase by 60% in 2025, and weekend traffic is projected to be even higher. As to SONGS emergency access, it defies common sense to state that there is no problem when it is obvious that traffic generation of that sort would cause both chaos and gridlock, without the alternative access that this project would provide. Currently, should an emergency evacuation of SONGS be required, it is anticipated to take vehicles 9 ½ hours to completely vacate the 10-mile radius from SONGS. An incident on I-5 could increase evacuation time by nearly two hours, and an earthquake could increase evacuation to up to 18 hours[38]. Southern California Edison's (SCE) evacuation time evaluation report concludes, "*Evacuation time is a function of available roadway capacity.*"[39] The importance of maintaining I-5 as accessible as possible has not escaped the Commission. As the Commission itself stated in approving Caltrans' project requiring construction within San Mateo Creek to stabilize the I-5 freeway bridge piers (Appl. No. 6-01-149):

> *". . . I-5 is a major coastal access route and provides the major vehicular access into San Diego County from the north. Disruption of service on I-5 would have a significant impact on coastal access."*

Section 30253 requires the Commission to minimize risks to life and property in areas of high flood and fire hazard. In their September 24, 2007 letter, the project opponents assert incorrectly that Section 30253 requires that coastal projects be designed "to minimize their own safety risks." This misreads the coastal policy, which requires that new development "minimize risks to life and property" in high hazard areas, which FTC-S clearly does. As noted, the project would be located in a high fire hazard area, and would provide enhanced fire protection benefits that are not presently available, as well an additional evacuation route in the case of flooding by tsunami. The Staff Report simply ignores these additional emergency access and evacuation benefits, despite the provisions of Section 30253. In short, the impacts on coastal resources from not constructing the project would be more significant and adverse than the project's ESHA and wetland impacts.

Consistent with numerous past actions of the Commission that have approved transportation projects like this one, FTC-S is, on balance, most protective of coastal resources. The Commission can and should apply the "balancing" provision in Section 30007.5 here in approving TCA's consistency certification[40].

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38 Wilbur Smith Associates. "Evacuation Time Evaluation for the San Onofre Nuclear Generating Station" (2007). Prepared for SCE.

39 Ibid.

40 In the spirit of cooperation, TCA has submitted this Consistency Certification for FTC-S however, it reserves the argument that the Commission lacks jurisdiction over the small part of the project located within the coastal zone, because it is excluded from the definition of "coastal zone" under the Coastal

Zone Management Act (CZMA) and because Camp Pendleton is a "federal enclave" subject to exclusive federal jurisdiction. Notably, the CZMA excludes from the coastal zone "lands the use of which is by law subject solely to the discretion of or which is held in trust by the Federal Government, its officers or agents." (16 U.S.C. 1452(1).) This language squarely applies to Camp Pendleton and to the Navy's reserved rights to approve roads, including the project, under its lease with State Parks (which, as noted herein, is set to terminate in 2021). See also, discussion of Lease in Section III: Response to Staff Findings and Declarations, Part C: Public Access, Recreation and Public Views.

ATTACHMENTS

Environmentally Sensitive Habitat

1. Letter from Dr. Dennis Murphy to California Coastal Commission, January 2008
2. Revised Designation of Critical Habitat for the Coastal California Gnatcatcher; Final Rule 50 CFR Part 17, December 2007
3. USFWS' Preliminary No Jeopardy/No Adverse Modification Conclusion, September 2005
4. NOAA/NMFS Concurrence Letter, May 2007
5. Letter from Dr. Roy Ramey to California Coastal Commission, January 2008
6. Vegetation Types at Crystal Cove Canyon State Park
7. Past TCA Mitigation Report Letters
8. Assessment of the Current Status in California, California Gnatcatcher Population Estimates and Conservation Status
9. Vegetation Shading Analysis, August 2007

Public Access, Recreation, and Public Views

10. Lease Agreement
11. Major General William G. Bowdon III Testimony, May 2003
12. Letter from L.D. Rannals, USMC to J. Kolb, FHWA, April 2001
13. Trail References in SOSB
14. State Parks Adjacent To, On or Bisected By State Highways
15. Additional View Simulations

Archaeological Resources

16. Letter Memo From LSA to TCA Regarding Traditional Cultural Property Evaluations, December 2007
17. Letter from FHWA to State Office of Historic Preservations, December 2007

Alternatives

18. Low- and Moderate-Cost Lodging Facilities Displaced by I-5 Widening
19. Letter from City of San Clemente on I-5 Widening Alternative, March 2000
20. Letter from Caltrans to FHWA, June 2006
21. Letter from Caltrans to FHWA, January 2008
22. Letter from Orange County Board of Supervisors to California Coastal Commission, December 2007
23. Response to the Smart Mobility Report – Refined AIP Alternative

Conflict Between Coastal Act Policies and Balancing

24. Santa Safari, Orange County Register, December 2007

Date: 07 January 2008

To: California Coastal Commission
45 Fremont Street, Suite 2000
San Francisco, CA 94105

From: Dennis D. Murphy, PhD.
Professor
Biology Department
University of Nevada, Reno

Re: The staff report and recommendations on the Foothill/Eastern Transportation Corridor Agency toll road project

I have taken the opportunity to read the *Staff Report and Recommendations on Consistency Certification* in reference to the Foothill/Eastern Transportation Corridor Agency "toll road" project and its potential impacts on resources in the coastal zone. Here I comment on Coastal Commission staff assessment statements and recommendations specifically related to the status of those wildlife and fish species of conservation concern in the coastal zone that will be subject to some level of potential "take" or disturbance to their habitats.

As background I offer several of my credentials pertinent to this review of the staff report. Among many other activities, I served as chief architect of the first conservation guidelines to California's Natural Community Conservation Planning (NCCP) effort for the state's coastal sage scrub community and the dozens of at-risk species that reside there (for which I received the Governor's Leadership Award in Environment and Economics in 1994). I subsequently led the interdisciplinary science team that produced the Lake Tahoe Watershed Assessment, a deliverable to President Clinton in 2000 that was intended to guide management and restoration of the lake basin's resources in the new century. In addition, I currently serve on the Board of Environmental Studies and Toxicology at the National Academy of Sciences. I have testified before U.S. Senate and House committees and subcommittees on issues pertaining to the federal Endangered Species Act on eight separate occasions. Most relevant to conservation planning in coastal Orange and northern San Diego counties, I have also provided direction in science and adaptive management to more than two-dozen Habitat Conservation Plans (HCPs) and NCCPs, including several of the largest in southern California; and I have contributed to both the Orange County Central/Coastal Subregion NCCP/HCP, and the recently certified Orange County Southern Subregion HCP.

The staff's report (with recommendations) is only in part a critique of the documentation, including the biological information that was provided by the Transportation Corridor Agency (TCA) in support of its submittal for a Coastal Consistency Certification. The report attempts as well to provide contextual background on species of concern and their habitats; but to that task it does not provide an adequate overview of available information that pertains to species survival and recovery in and adjacent to coastal areas on the Orange and San Diego county line. The core of the staff report on sensitive species is a highly selective interpretation and reinterpretation of available observations and data, and is obviously designed to build a singular case against the toll road project – in essence, a categorical cherry picking from the standing base of information on the status and trends of species of concern, on species uses and reliance on specific habitat associations and resources, and on possible species and habitat responses to proposed and potential mitigation and management actions. To that end the staff report is neither a legitimate scientific (or technical) assessment of information provided by the applicant, nor is it a reliable appraisal of current knowledge pertinent to Coastal Commission deliberations and it cannot serve as the basis for an informed decision on the proposed project.

For the least Bell's vireo the toll road Environmental Impact Report/Subsequent Environmental Impact Statement (EIR/SEIS) recognizes disturbance or permanent loss of portions of just two vireo "breeding" territories in the coastal zone-- a trivial impact on a species that is distributed along riparian strands throughout the San Mateo and San Onofre creeks watersheds, as well several dozen additional watersheds across southern California. In support of its negative finding on the impacts of the proposed project on this species, the staff report states that at the time of the bird's listing in 1986, it was known to inhabit just 291 territories in its range in California. The report then correctly notes that the species currently exists in more than 3000 occupied territories across that same range (having benefited from an ambitious and successful parasitic cowbird trapping program). The greater than ten-fold increase in population numbers makes least Bell's vireo a top candidate for delisting by the U.S. Fish and Wildlife Service (FWS); nonetheless, the staff report describes the species' situation "as changed only slightly in the thirty-one years (*sic*) since listing," and then returns to recounting that very few birds that were found in certain southern California watersheds in the 1980s.

The salient fact is that today in the San Mateo and San Onofre watersheds alone there are nearly half as many vireos than existed *statewide* at the 46 known locations that were occupied when the bird was granted federal protection in 1986. While not yet formally designated as "recovered" by FWS, the least Bell's vireo has experienced one of the greatest reversals in population trend of any federally protected species in California. Given that the toll road project will directly impact just over one and a half percent of the current local "population" of least Bell's vireos, and substantially less than a tenth of one percent of current regional numbers of the species, an independent scientific assessment of impacts on the vireo would not agree with staff that the proposed project is "inconsistent with the environmentally sensitive habitat resource protection requirements" in the Coastal Act.

General planning principles call for *all* possible sources of information to be transparently considered. Any assessment in support of conservation planning that less than rigorously strives to meet this obligation is likely to be biased. Given the supporting evidence cited in the staff report, it is clear that staff has chosen to present only those materials from the scientific literature and other sources that might support their conclusions – even where a preponderance of the evidence suggests that the conclusions that staff present are incorrect.

Similar misinformation accompanies all of the report's species assessments. Among those species, the one of most immediate conservation concern is the Pacific pocket mouse. The biology of the Pacific pocket mouse is reasonably well documented in the report, notwithstanding the fact that one cannot find in the report a rather important detail -- *that the Pacific pocket mouse has not actually been detected in the coastal zone portion of the proposed project area despite over 65,000 trap nights.*

What is true is that the subspecies has a very few extant populations -- just three, those populations are very small, and probably no natural dispersal of pocket mice exists among the tiny habitat patches that support them; the natural circumstances that long provided for the Pacific pocket mouse in Orange and San Diego counties have drastically diminished, making the subspecies greatly imperiled by any measure. The staff report uses these facts to conclude that the development action is unjustified and could hamper attempts to save the subspecies. As tempting as it might be to declare the tiny surviving demographic units of Pacific pocket mouse in the greater area of the toll road alignment as untouchable and off limits of any sort; in fact, the status and circumstances of the known populations are sufficiently dire that the only conservation response that can be effective is based on direct management intervention.

A salient fact largely ignored in the staff report is that the San Mateo North population of pocket mouse that is adjacent to (not on) the toll road alignment inhabits a highly disturbed and fragmented landscape, including areas long dedicated to and disturbed by agricultural activities. Pocket mouse survival in those locations is utterly dependent on a land management scheme that can contribute to reversing those conditions, and providing more natural physical circumstances subject to a more natural disturbance regime, through restoration, enhancement, and management practices. Such management is not currently being carried out, and in its absence the pocket mouse, which appears to be at desperately low population numbers, could vanish entirely in short order. The TCA proposal to rectify the current situation -- where Cristianitos Road isolates the San Mateo North population from the San Mateo South population (approximately two miles south of the proposed project) -- with an effective landscape linkage for pocket mice, as well as active management measures, such as predator and competitor control, and an adaptive management program, constitutes the only affirmative action proposed to conserve the San Mateo North population. To that end the summary statement on page nine of Tab 13 of the report that "the toll road will reduce the size of the occupied area, prevent natural range expansions, impede dispersal, and contribute to loss of genetic diversity" is wrong in each of its assertions.

The status of and the conservation challenge posed by the arroyo toad are completely different, but the staff report again misinforms and misinterprets. The arroyo toad is widespread in the San Mateo and San Onofre watersheds; with nearly all of its extensive local distribution above the coastal zone, where an extraordinary ninety-plus percent of available habitat was occupied by the toad as recently as 2003. As is clear from maps at Tabs 15 and 16 in the staff report, the fate of the arroyo toad in the overall project area is very much a matter of its survival in areas inland (and largely well inland) of the coastal zone. And, as with the Pacific pocket mouse, surveys in support of the EIR/SEIS did not find the species in the coastal zone portion of the project area.

While the report dedicates nearly a dozen pages to asserting that uncertainties accompany the avoidance and mitigation plan for the arroyo toad in the project plan, the report both ignores the extensive standing body of information on the species and the ongoing efforts to protect it. The toad has been the target of focused conservation attention in Camp Pendleton resource management efforts and in the Southern Subregion HCP, and it is currently benefiting from these ongoing management actions in areas adjacent to the proposed project and coastal zone.

The arroyo toad has received rigorous scientific assessment in the *MCB Camp Pendleton Arroyo Toad Monitoring Protocol* (Atkinson et al., 27 August 2002, U.S.G.S. Western Ecological Research Center), and in a number of other pertinent technical documents generated from data from this coastal zone area and adjacent watersheds. Compelling distributional and other ecological data exist, which suggest that the effects of construction activities, as they manifest in such a circumscribed portion of the toad's range in the San Mateo and San Onofre watersheds, will have negligible impact. Combined with the very limited extent of toad habitat in the coastal zone, permanent losses of either toads or toad habitat seem extremely unlikely. Importantly, as with the vireo, staff avoided focusing on specific potential environmental impacts that might accompany the project and its construction phases in the spatial or temporal contexts that allow for realistic quantitative assessments of potential impacts to arroyo toads.

The California gnatcatcher has long been the flagship species in southern California conservation planning. As chief architect of the approach taken in California's pilot NCCP effort in the coastal sage scrub vegetation community, I encouraged conservation planners to place emphasis on the protection of habitat for gnatcatchers in the remaining coastal portions of the bird's range, because of the unique species composition and other attributes of the ecological community there. It is gratifying to see the elevated attention paid to the species in all aspects of the toll road project design, both in the coastal zone and those densely inhabited areas inland that sustain the species.

Staff, however, greatly mischaracterizes the extent of potential impacts to the California gnatcatcher. The project impacts to gnatcatcher habitat in the coastal zone are so limited that the report contorts the quantitative statements that it makes, with multiple confusing references to project impacts beyond the coastal zone, with out-of-context and out-of-date citations regarding the gnatcatcher's range-wide status and trends, and avoids mentioning the proposed acquisition and management of Orange County's best existing habitat for the species (in upper Chiquita Canyon)--a central element that is part of the project's overall mitigation package.

The facts are these. "Critical habitat" for the California gnatcatcher in southern California includes approximately 500,000 acres. Fifty acres (one ten thousandth) of that is in the coastal zone portion of this project's impact area. Those fifty acres of coastal sage scrub include a substantial portion that were previously used in agriculture, hence are currently in degraded condition. Because of that and the proximity of those coastal sage scrub acres to existing Interstate-5, a significant portion of the existing sage scrub in the project area is not occupied by gnatcatchers. In addition, as can be surmised from the fact that much of that sage scrub has recently recolonized (on its own) the portion of the fifty acres that was previously in agriculture, essentially all areas that will be temporary disturbed during project construction are fully restorable, and are likely to produce habitat conditions much superior to those that currently exist. Those facts noted, staff's emphatic assertion that the project is "clearly inconsistent" with Coastal Act policy in regards to California gnatcatcher is itself inconsistent with the facts.

The two fishes of conservation concern in the planning area, the tidewater goby and the steelhead trout, have unique life history strategies and depend on functioning coastal zone ecosystems. Potential deleterious impacts to the tidewater goby from the project have been intensively analyzed and presented in the EIR/SEIS, with findings that a minute fraction of goby habitat (0.011 acre) will be lost, and with presentation of avoidance and mitigation activities that will, according to a letter dated 30 September 2005 from the FWS, adequately mitigate impacts to gobies in the lagoon below the project area.

Potential impacts of the project to the steelhead trout have been formally analyzed and considered by biologists at the National Marine Fisheries Service (NMFS) in a 2007 "not likely to adversely affect" concurrence letter. The NMFS determination acknowledged the important steelhead habitats exist above and below the project area, but determined that the project was "not likely to adversely affect the species or its critical habitat" based on, among other things, the limited footprint of bridge column supports where the elevated toll road structure crosses San Mateo Creek. This NMFS determination and the FWS assessment are telling in that virtually none of the concerns elevated in the Coastal Commission staff report are shared by the federal resource agencies that have explicit jurisdiction over -- and expertise on -- the species of concern.

Perhaps the most exaggerated statement in the staff report is found in its executive summary, which states that the toll road project will cause "disturbance and destruction of untold numbers of these six species and potentially irreparable harm to their local, regional, and global populations, populations which have been consistently recognized as both vitally important and gravely threatened." In fact the numbers are "told." The numbers are told in the TCA's environmental documents, and provide the Commission with an actual quantitative appraisal of the potential impacts of the proposed project in the coastal zone. An appraisal that the staff report has obfuscated and distorted.

Because the staff report falls short of the mark in its evaluation of project impacts, it will be incumbent upon the Commission to reach beyond the report to form a conclusion that is based on a transparent evaluation of the facts.

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degrees

Bachelors of Science	University of California at Berkeley	1974
Doctor of Philosophy	Stanford University	1981

professional positions

Post-Doctoral Fellow	Stanford University	1981-1983
Director	Center for Conservation Biology, Stanford	1983-1995
President	Center for Conservation Biology, Stanford	1995-1997
Research Professor	University of Nevada, Reno	1997-Present

organizational ands society affiliations

Board of Directors	The Xerces Society	1987-1997
Board of Directors	Society for Conservation Biology	1993-2001
President	Society for Conservation Biology	1995-1997

memberships have included

Ecological Society of America, Society for Conservation Biology, Society of Ecological Restoration and Management, Society for the Study of Evolution, The Lepidopterist's Society, The Xerces Society

board of editors service

Journal for Research on the Lepidoptera	1982-1992
Wings (Xerces Society)	1988-1998
Conservation Biology	1991-1998

awards and commendations

Chevron Conservation Award	1988
Team Award - Wildlife Society	1990
Publication of the Year Award - Wildlife Society	1990
Publication of the Year Award - U.S. Forest Service	1992
Pew Scholars Award in Conservation and the Environment	1992
California's Governor's Leadership Award in Economics and the Environment	1994
Commendation - Intermountain Regional Director, U.S. Forest Service	1996

Professional Biographical Statement

Dennis D. Murphy is Research Professor in the Biology Department and formerly director of the graduate program in Ecology, Evolution, and Conservation Biology at the University of Nevada, Reno. He received a Bachelors of Science at the University of California at Berkeley and his doctorate from Stanford University. He previously served as Director, then as President of the Center for Conservation Biology at Stanford. Author of more than 180 published papers and book chapters on the biology of butterflies and on key issues in the conservation of imperiled species, Dr. Murphy has worked in conflict resolution in land-use planning on private property since the first federal Habitat Conservation Plan on San Bruno Mountain. He won the industry's oldest and most respected prize in conservation, the Chevron Conservation Award, has been named a Pew Scholar in Conservation and the

Environment, and received the California Governor's Leadership Award in Economics and the Environment.

Dr. Murphy has served a number of scientific societies and environmental organizations, and is Past President of the Society for Conservation Biology. He serves currently on the Board on Environmental Studies and Toxicology at the National Research Council (of the National Academy of Sciences). His professional activities outside of academia include service on the Interagency Spotted Owl Scientific Advisory Committee, enjoined by Congress to develop a solution to that planning crisis in the Pacific Northwest, as chair of the National Park Service's Scientific Advisory Committee on Bighorn Sheep, as co-chair of the State Department's American-Russian Young Investigators Program in Biodiversity and Ecology, as co-director of the statewide Nevada Biodiversity Initiative based at the University of Nevada at Reno, and as chair of the Scientific Review Panel to the first Natural Community Conservation Planning Program in southern California's coastal sage scrub ecosystem. He served the National Academy of Sciences on its Committee on Scientific Issues in the Endangered Species Act, on the Committee on Threatened and Endangered Species on the Platte River, and on the Committee on Hydrology, Ecology, and the Fishes of the Klamath River Basin.

Dr. Murphy's ongoing and recent activities in the area of conservation planning and adaptive management include service on the Science Board to the CalFed Ecosystem Restoration Planning Program for the Sacramento and San Joaquin river systems, development of a conservation strategy for the imperiled Tahoe yellow cress for the U.S. Fish and Wildlife Service, development of a watershed-based ecosystem management framework for the Truckee, Carson, and Walker hydrological units in the Humboldt-Toiyabe National Forest, and science design for the nation's largest Habitat Conservation Plan under the Endangered Species Act, in Clark County, Nevada, and several other major HCP efforts in southern California and southern Nevada. Dr. Murphy also has served as team leader for the committee of scientists carrying out the Lake Tahoe Watershed Assessment, a Presidential deliverable to the Tahoe Federal Interagency Partnership via the U.S. Forest Service, and now sits with the science committee of the Tahoe Science Consortium. He also has chaired a number commissions and committees for NGOs, currently including the Commission on Performance Measures for State Wildlife Conservation Strategies at the Heinz Center in Washington, D.C. Dr. Murphy has testified more than a dozen times before Senate and House committees and subcommittees on issues mostly pertaining to implementation of the federal Endangered Species Act.

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Federal Register

Wednesday,
December 19, 2007

Part II

Department of the Interior

Fish and Wildlife Service

50 CFR Part 17

Endangered and Threatened Wildlife and Plants; Revised Designation of Critical Habitat for the Coastal California Gnatcatcher (Polioptila californica californica); Final Rule

DEPARTMENT OF THE INTERIOR

Fish and Wildlife Service

50 CFR Part 17

RIN 1018–AV38

Endangered and Threatened Wildlife and Plants; Revised Designation of Critical Habitat for the Coastal California Gnatcatcher (Polioptila californica californica)

AGENCY: Fish and Wildlife Service, Interior.

ACTION: Final rule.

SUMMARY: We, the U.S. Fish and Wildlife Service (Service), are designating revised final critical habitat for the coastal California gnatcatcher (*Polioptila californica californica*) under the Endangered Species Act of 1973, as amended (Act). In total, approximately 197,303 acres (ac) (79,846 hectares (ha)) of habitat in San Diego, Orange, Riverside, San Bernardino, Los Angeles, and Ventura Counties, California, are being designated as critical habitat for the coastal California gnatcatcher. This revised final designation constitutes a reduction of 298,492 ac (120,795 ha) from the 2003 revised proposed rule. We are continuing our review of whether the current listing of the coastal California gnatcatcher as a subspecies should be retained or changed, as discussed in the 2003 proposed rule to revise critical habitat, and we will publish our determination separately at a later date.

DATES: This final rule is effective January 18, 2008.

ADDRESSES: Comments and materials received, as well as supporting documentation used in the preparation of this final rule, will be available for public inspection, by appointment, during normal business hours, at the Carlsbad Fish and Wildlife Office, U.S. Fish and Wildlife Service, 6010 Hidden Valley Road, Carlsbad, CA 92011 (telephone: 760/431–9440). The final rule, draft economic analysis and associated addendum (dated September 14, 2007), and maps are available on our Web site at *http://www.fws.gov/Carlsbad*.

FOR FURTHER INFORMATION CONTACT: Field Supervisor, Carlsbad Fish and Wildlife Office, at the above address (telephone: 760/431–9440; facsimile 760/431–5901). For information about Ventura and northwestern Los Angeles Counties, contact Field Supervisor, Ventura Fish and Wildlife Office, U.S. Fish and Wildlife Service, 2493 Portola Road, Suite B, Ventura, CA 93003 (telephone: 805/644–1766; facsimile 805/644–3958). If you use a telecommunications device for the deaf (TDD), call the Federal Information Relay Service (FIRS) at 800–877–8339.

SUPPLEMENTARY INFORMATION:

Background

It is our intent to discuss only those topics directly relevant to the revised designation of critical habitat for the coastal California gnatcatcher (*Polioptila californica californica*) in this final rule. For more information on the taxonomy, biology, and ecology of the coastal California gnatcatcher, refer to the final rule listing this species as threatened published in the **Federal Register** on March 30, 1993 (58 FR 16742), the original proposed and final critical habitat rules published in the **Federal Register** on February 7, 2000 (65 FR 5946) and October 24, 2000 (65 FR 63680), respectively, and the revised proposed rule published in the **Federal Register** on April 24, 2003 (68 FR 20228).

Species Distribution

The coastal California gnatcatcher (*Polioptila californica californica*) is a member of the old-world warbler and gnatcatcher family Sylviidae (AOU 1998. p. 3). This species occurs primarily in or near vegetation categorized as sage scrub. Within the United States, this species is restricted to coastal southern California from Ventura and San Bernardino Counties, south to the Mexican border (AOU 1957, p. 451; Atwood 1991, pp. 130–131; Garrett and Dunn 1981, p. 292). An evaluation of the historic range of the coastal California gnatcatcher indicates that about 41 percent of its latitudinal distribution is within the United States and about 59 percent is within Baja California, Mexico (Atwood 1990, p. 6). An analysis based on elevational limits associated with coastal California gnatcatcher locality records found that a significant portion (65 to 70 percent) of the species' historic range may have been located in southern California rather than Baja California, Mexico (Atwood and Bolsinger 1992, p. 159). Please see "Primary Constituent Elements" section below for a detailed discussion of the habitat requirements of the coastal California gnatcatcher.

The species was listed as threatened on March 30, 1993, because of habitat loss and fragmentation resulting from urban and agricultural development (58 FR 16742). Aside from habitat loss and fragmentation, other management issues concern fire, nonnative plants, and predation (Mock 2004, pp. 7–8).

Previous Federal Actions

On October 24, 2000, we published a final rule designating approximately 513,650 ac (207,890 ha) of land in portions of Los Angeles, Orange, Riverside, San Bernardino, and San Diego Counties as critical habitat for the coastal California gnatcatcher (65 FR 63680). Following the publication of the final rule, several lawsuits were filed against the Service by multiple parties (collectively referred to as Plaintiffs), including the Natural Resources Defense Council (NRDC); Building Industry Association of Southern California; National Association of Home Builders; Foothill/Eastern Transportation Corridor; and Rancho Mission Viejo, L.L.C. (*NRDC* v. *U.S. Dept. of Interior*, CV–99–2496 (C.D.Cal., filed 12/20/00); *Building Industry Association of Southern California et al.* v. *Norton*, CV 01–7028 (D.C.C., filed 1/17/01), and *Rancho Mission Viejo L.L.C.* v. *Babbitt*, CV 01–8412 (D.D.C. filed 12/28/00)), challenging the critical habitat designation for the coastal California gnatcatcher. On June 11, 2002, the U.S. District Court for the Central District of California granted our request for a remand of the coastal California gnatcatcher critical habitat designation so that we could reconsider the economic impact of designating any particular area as critical habitat. The Court ordered us to submit a new proposed rule to the **Federal Register** by April 11, 2003.

We published a proposed rule to revise critical habitat for the coastal California gnatcatcher in the **Federal Register** on April 24, 2003, that included approximately 495,795 ac (200,595 ha) of land in Ventura, Los Angeles, Orange, Riverside, San Bernardino, and San Diego Counties (68 FR 20228). As part of the April 24, 2003 proposed rule, we also announced and sought comment on our review of the current listing classification of the coastal California gnatcatcher as a subspecies under the Act and its potential reclassification as a distinct population segment (DPS). We accepted public comments on the proposed revision of critical habitat and the listing classification until June 23, 2003.

On April 8, 2004 (69 FR 18516), we published a notice in the **Federal Register** announcing: (1) The availability of the draft economic analysis (DEA) of the proposed revised designation for public review (dated February 24, 2004); (2) the reopening of the public comment period on the revised proposed rule; and (3) the scheduling of public hearings on the proposed revised critical habitat the first year after designation (Chapter V of the DEA, p. 131). To the degree that water infrastructure project modifications are captured by the DEA's analysis of real estate development, water infrastructure delay costs are also captured.

The DEA addresses the consultation cost expected to be associated with the HCPs covering water operations. The DEA cost estimate includes the expected cost to the Service of an internal consultation on these HCPs. Furthermore, third-party HCP proponents may bear administrative costs associated with section 7 consultations on HCPs (See our response to Comment 31 above).

The water replacement costs and capital costs cited in some comments are potential costs that the DEA does not address. Additional analysis would be needed to quantify these costs. Specifically, the Service would need to evaluate whether coastal California gnatcatcher conservation efforts are likely to affect specific water systems. In addition, this analysis might require a model of water system operations to quantify changes in water supply in some cases.

Comment 43: The DEA ignores the economic impacts of critical habitat proposed on important regional transportation facilities. Dr. Sunding's report documents costs of $450 million to the existing Transportation Corridor Agency (TCA) projects (not including the pending Foothill (South) Transportation Corridor) attributable to regulatory delays, including those attributable to the Act.

Our Response: The DEA discusses potential impacts of revised proposed critical habitat on regional transportation facilities starting on page 110 of Chapter IV. Future transportation projects include road construction by California Department of Transportation (Caltrans) Districts 7, 8, 11, and 12, and the Transportation Corridor Agency (TCA). Total costs for the four Caltrans districts are estimated at approximately $45 million, or roughly 5 percent of total costs. This analysis estimates that all Caltrans districts combined will participate in 191 formal consultations resulting in project modification costs, though construction in Riverside and San Bernardino counties is expected to result in significantly higher section 7 costs than in any other district. The TCA's proposed SR–241 Foothill-South toll road is estimated to result in an estimated section 7 cost of approximately $35 million, based on an average of two potential development scenarios.

Comment 44: The CRMI study estimates higher critical habitat designation costs associated with local infrastructure (including water infrastructure) than the DEA.

Our Response: The DEA estimates $63 million in project modification and administrative costs for local infrastructure projects (this figure excludes TCA costs so as to provide a more comparable estimate to the CRMI study which also estimates these costs separately). The CRMI study reports an increase in compliance cost to local public infrastructure from the coastal California gnatcatcher critical habitat designation equal to $1,000 per housing unit constructed, roughly $124 million in total.

The CRMI study relies on an average local infrastructure cost of $33,000 per new housing unit and an incremental impact of the critical habitat designation on local public infrastructure of 3 percent. The DEA applies a cost estimate based on anticipated project modification costs associated with planned or proposed projects identified primarily through interviews with potential public project proponents. The DEA discounts estimates at 7 percent while it appears the CRMI study does not discount public infrastructure costs. The Service believes that applying a positive discount rate to future costs provides a better estimate of the present value of these costs since this methodology accounts for the time value of money.

Comment 45: One commenter stated that the DEA does not account for additional costs related to review of Federal documents (e.g., review and preparation of comments on the DEA of the critical habitat designation for the coastal California gnatcatcher) and costs related to legal challenges (e.g., whether the MSCP Subarea plans may result in adverse modification). Another commenter stated that the analysis considers permitting cost and land prices only, and ignores factors like reduction in output, delay costs, indirect costs and other real costs that Dr. Sunding analyzed. According to the commenter, when all costs are applied, the costs are profound. For example, the CRMI study states that if a designation reduces a 1,000-unit subdivision by just 200 units, the economic impact is $33 million, and that impact falls most heavily on consumers. The commenter asserts that home and land costs are higher today in southern California than they were in 2004, so that even with the recent downturn, greater economic impact would be expected.

Our Response: Potentially affected parties likely incurred administrative costs related to review of Federal documents, such as the proposed rule for example, to ensure their activities were appropriately considered in the DEA or to request exemption from the rulemaking. The DEA appropriately considers only the direct and indirect costs associated with compliance with the final designation since the purpose of the economic analysis is to determine what the economic costs resulting from designation would be on a particular area, so that the benefits of including the area in critical habitat can be weighed against the benefits of excluding the area. The DEA does, however, include administrative costs of compliance with the rulemaking where appropriate, for example the administrative costs of section 7 consultation, which may similarly include review of Federal documents. In addition, the DEA focuses on activities that are considered reasonably foreseeable. The number, scope, and timing of potential legal challenges associated with the rulemaking are speculative and impossible to quantify.

Comment 46: According to one commenter, development areas proposed for designation provide critically needed housing to the region, create new sources of employment, and provide tax revenues for local jurisdictions. The commenter stated that the DEA fails to capture the opportunity cost of lost benefits from real estate development.

Our Response: The DEA concludes that the reduction in real estate development is unlikely to substantially affect regional housing markets. Therefore, it is unlikely that the coastal California gnatcatcher critical habitat designation will alter job growth. In addition, while it is true that future tax revenue may be lower than projected due to a potentially reduced level of real estate development, corresponding public expenditures on public services and infrastructure related to new development would also be lower. The net affect of these two factors is difficult to determine and the Service considers such an estimate as speculative.

Comment 47: One commenter stated that the critical habitat designation would create delays in the processing of various proposed development projects. These delays may result in lost employment benefits, lost tax revenue, delayed mitigation measures that may benefit the species, and lost benefits from decreased housing availability.

Our Response: The DEA estimates that project delay lasts 6 months and occurs only in the first year after the critical habitat designation (Chapter V of the DEA, p. 131). It is possible that in scrub habitat (MCAS Miramar 2006, pp. 7–14, 7–15).

Based on the above considerations, and consistent with the direction provided in section 4(a)(3)(B) of the Act, we have determined that conservation efforts on MCAS Miramar identified in the Revised 2006 INRMP provide benefits to the coastal California gnatcatcher and the features essential to its conservation. Therefore, MCAS Miramar is exempt from inclusion in this revised designation of critical habitat for the coastal California gnatcatcher pursuant to section 4(a)(3)(B) of the Act.

Marine Corps Base (MCB) Camp Pendleton

MCB Camp Pendleton occupies over 125,000 ac (50,586 ha) of land in the northwest corner of San Diego County. Among the plant communities that characterize MCB Camp Pendleton are oak woodlands, a range of chaparral and sage scrub communities (including the largest remaining contiguous Diegan coastal sage scrub, coastal bluff scrub), native and nonnative grasslands, coastal dunes, riparian communities, and wetlands (including isolated ephemeral wetlands or vernal pools unique to this region) (MCBCP 2007, p. ES–3). As stated in the 2003 revised proposed rule, MCB Camp Pendleton contains a coastal corridor of coastal California gnatcatcher-occupied sage scrub that provides the primary linkage between San Diego populations and those in southern Orange County.

Since the publication of the 2003 revised proposed critical habitat designation for the coastal California gnatcatcher, MCB Camp Pendleton has revised and updated its 2001 INRMP to address conservation and management recommendations within the scope of the installation's military mission. The coastal California gnatcatcher benefits from current management practices under the 2007 INRMP through: (1) Nonnative vegetation control; (2) brown-headed cowbird management; (3) investigative research (e.g., to determine effects of wildfire on coastal California gnatcatcher habitat quality and distribution); (4) the establishment and management of coastal sage scrub mitigation areas, and (5) habitat enhancement by using native seed stock in restoration and recovery measures (MCBCP 2007, p. F–25). Also, according to the 2007 INRMP, California State Parks is required to conduct its natural resources management consistent with the philosophies and supportive of the objectives of the revised 2007 INRMP (MCBCP 2007, p. 2–31).

Based on the above considerations, and consistent with the direction provided in section 4(a)(3)(B)(i) of the Act, we have determined that conservation efforts identified in the revised 2007 INRMP will provide benefits to the coastal California gnatcatcher and the features essential to the species' conservation occurring on MCB Camp Pendleton and lands leased to California State Parks (San Onofre State Beach). As discussed above, these conservation measures include managing habitat for the coastal California gnatcatcher on MCAS Pendleton; conducting baseline surveys; and monitoring and management activities to enhance and or create coastal sage scrub and minimize threats to the PCEs required by the species. Therefore, MCB Camp Pendleton (including San Onofre State Beach) is exempt from the revised final designation of critical habitat for the coastal California gnatcatcher.

Naval Weapons Station Seal Beach, Detachment Fallbrook

Naval Weapons Station Seal Beach, Detachment Fallbrook (Detachment Fallbrook) occupies approximately 8,852 ac (3,582 ha) in San Diego County and is bound to the north, west, and much of the south by MCB Camp Pendleton. Among the plant communities that characterize Detachment Fallbrook are coastal sage scrub, mixed chaparral, chamise chaparral, valley foothill riparian, annual grasslands, fresh emergent wetlands, and eucalyptus (Navy 2006, p. 3–37).

Since the publication of the 2003 proposed rule to revise critical habitat for the coastal California gnatcatcher, Detachment Fallbrook has revised its 1996 INRMP to address conservation and management recommendations within the scope of the installation's military mission. According to the 2006 revised INRMP (Navy 2006, pp. 3–124 to 3–126), conservation measures for the coastal California gnatcatcher include: (1) Avoidance and minimization measures to protect the species as part of normal project site approval process (NEPA); (2) maintenance of a minimum of 2,000 ac (809 ha) of coastal sage scrub suitable for the species; (3) establishment of three coastal sage scrub priority management areas, each with specific fire suppression and prescribed fire guidelines based on level of occupation, proximity to MCB Camp Pendleton coastal California gnatcatcher populations, and habitat type; (4) monitoring coastal California gnatcatcher populations every 5 years; (5) establishment of a ledger system to provide for net gains in coastal California gnatcatcher habitat to protect against future encroachment on the military mission; (6) monitoring and managing of grazing livestock to avoid or minimize impacts to the species' habitat; (7) conducting weed eradication in coastal sage scrub; and (8) monitoring different coastal sage types in relation to fire, grazing, and site factors to improve understanding of how to manage for a range of conditions over time using fire and grazing.

The conservation measures listed above provide management and protection of the features essential to the conservation of the coastal California gnatcatcher. Based on the above considerations, and consistent with the direction provided in section 4(a)(3)(B) of the Act, we have determined that conservation efforts identified in the Revised 2006 INRMP provide benefits to the coastal California gnatcatcher and the features essential to the species' conservation. As discussed above, these conservation measures include managing habitat for the coastal California gnatcatcher on Detachment Fallbrook; conducting baseline surveys; and monitoring and management activities to enhance and/or create coastal sage scrub and minimize threats to the PCEs required by the species. Therefore, Detachment Fallbrook is exempt from inclusion in this designation of critical habitat for the coastal California gnatcatcher pursuant to section 4(a)(3)(B) of the Act.

Application of Section 4(b)(2) of the Act

Section 4(b)(2) of the Act states that the Secretary must designate and revise critical habitat on the basis of the best available scientific data after taking into consideration the economic impact, national security impact, and any other relevant impact of specifying any particular area as critical habitat. The Secretary may exclude an area from critical habitat if he determines that the benefits of such exclusion outweigh the benefits of specifying such area as part of the critical habitat, unless he determines, based on the best scientific data available, that the failure to designate such area as critical habitat will result in the extinction of the species. In making that determination, the legislative history is clear that the Secretary has broad discretion regarding which factor(s) to use and how much weight to give to any factor.

Under section 4(b)(2) of the Act, in considering whether to exclude a particular area from the designation, we must identify the benefits of including the area in the designation, identify the benefits of excluding the area from the designation, and determine whether the benefits of exclusion outweigh the benefits of inclusion. If we consider excluding an area, then we must determine whether excluding the area would result in the extinction of the species. In the following sections, we address a number of general issues that are relevant to the exclusions we have considered. In addition, we conducted a draft economic analysis (DEA) of the impacts of the proposed revised critical habitat designation and completed an addendum to the DEA dated September 14, 2007, which identifies the incremental impacts of designation (see "Economic Analysis" section below for more details about the addendum). The DEA (dated February 24, 2004) was made available for public review and comment from April 8, 2004, to May 10, 2004 (69 FR 18516) and April 3, 2007, to May 3, 2007 (72 FR 15857). Substantive comments and information received on the DEA are summarized above in the Public Comment section. After considering the DEA and public comment thereon, the addendum to the DEA, the proposed revision to critical habitat, and the information in this revised final designation of critical habitat, we have excluded areas from critical habitat under the provisions of section 4(b)(2) of the Act. This is provided for in the Act and in our implementing regulations at 50 CFR 424.19.

Benefits of Designating Critical Habitat

The process of designating critical habitat as described in the Act requires that the Service identify those lands on which are found the physical or biological features essential to the conservation of the species that may require special management considerations or protection, and those areas outside the geographical area occupied by the species at the time of listing that are essential to the conservation of the species. In identifying those lands, the Service must consider the recovery needs of the species, such that, on the basis of the best scientific and commercial data available at the time of designation, the habitat that is identified, if managed, could provide for the survival and recovery of the species.

The identification of those areas that are essential for the conservation of the species and can, if managed, provide for the recovery of a species is beneficial. The process of proposing and finalizing a critical habitat rule provides the Service with the opportunity to determine the features or PCEs essential for conservation of the species within the geographical area occupied by the species at the time of listing, as well as to determine other areas essential to the conservation of the species. The designation process includes peer review and public comment on the identified features and areas. This process is valuable to land owners and managers in developing conservation management plans for identified areas, as well as any other occupied habitat or suitable habitat that may not have been included in the Service's determination of essential habitat.

The consultation provisions under section 7(a) of the Act constitute the regulatory benefits of critical habitat. As discussed above, Federal agencies must consult with us on actions that may affect critical habitat and must avoid destroying or adversely modifying critical habitat. Federal agencies must also consult with us on actions that may affect a listed species and refrain from undertaking actions that are likely to jeopardize the continued existence of such species. The analysis of effects to critical habitat is a separate and different analysis from that of the effects to the species. Therefore, the difference in outcomes of these two analyses represents the regulatory benefit of critical habitat. For some species, and in some locations, the outcome of these analyses will be similar, because effects on habitat will often result in effects on the species. However, the regulatory standard is different: the jeopardy analysis looks at the action's impact on survival and recovery of the species, while the adverse modification analysis looks at the action's effects on the designated habitat's contribution to the species' conservation. This will, in many instances, lead to different results and different regulatory requirements.

For 30 years prior to the Ninth Circuit's decision in *Gifford Pinchot*, consistent with the 1986 regulations, we essentially combined the jeopardy standard with the standard for destruction or adverse modification of critical habitat when evaluating Federal actions that affected currently occupied critical habitat. However, the court of appeals ruled that the two standards are distinct and that adverse modification evaluations require consideration of impacts on species recovery. Thus, critical habitat designations may provide greater regulatory benefits to the recovery of a species than would listing alone.

There are two limitations to the regulatory effect of critical habitat. First, a section 7(a)(2) consultation is required only where there is a Federal nexus (an action authorized, funded, or carried out by any Federal agency)—if there is no Federal nexus, the critical habitat designation of private lands itself does not restrict any actions that destroy or adversely modify critical habitat. Second, the designation only limits destruction or adverse modification. By its nature, the prohibition on adverse modification is designed to ensure that the conservation role and function of those areas that contain the physical and biological features essential to the conservation of the species or of unoccupied areas that are essential to the conservation of the species is not appreciably reduced. Critical habitat designation alone, however, does not require property owners to undertake specific steps toward recovery of the species.

Once an agency determines that consultation under section 7(a)(2) of the Act is necessary, the process may conclude informally when we concur in writing that the proposed Federal action is not likely to adversely affect critical habitat. However, if we determine through informal consultation that adverse impacts are likely to occur, then we would initiate formal consultation, which would conclude when we issue a biological opinion on whether the proposed Federal action is likely to result in destruction or adverse modification of critical habitat.

For critical habitat, a biological opinion that concludes in a determination of no destruction or adverse modification may contain discretionary conservation recommendations to minimize adverse effects to primary constituent elements, but it would not suggest the implementation of any reasonable and prudent alternative. We suggest reasonable and prudent alternatives to the proposed Federal action only when our biological opinion results in an adverse modification conclusion.

As stated above, the designation of critical habitat does not require that any management or recovery actions take place on the lands included in the designation. Even in cases where consultation has been initiated under section 7(a)(2) of the Act, the end result of consultation is to avoid jeopardy to the species and/or adverse modification of its critical habitat, but not specifically to manage remaining lands or institute recovery actions on remaining lands. Conversely, voluntary conservation efforts implemented through management plans institute proactive actions over the lands they encompass and are put in place to remove or reduce known threats to a species or its habitat; therefore, implementing recovery actions. We believe that in many instances the benefit to a species and/or its habitat realized through the

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Ecological Services
Carlsbad Fish and Wildlife Office
6010 Hidden Valley Road
Carlsbad, California 92011

In Reply Refer To:
FWS-OR-1041.22

SEP 30 2005

Mr. Gene K. Fong, Division Administrator
U.S. Department of Transportation
Federal Highway Administration, California Division
650 Capitol Mall, Suite 4-100
Sacramento, California 95814

Attention: Mary Gray and Stephanie Stoermer

Subject: Preliminary Conclusions for the South Orange County Transportation Infrastructure Improvement Project (SOCTIIP), A7C-FEC-M Initial Alignment, Orange and San Diego Counties, California

Dear Mr. Fong:

In our letter dated August 17, 2005 (FWS-OR-1041.20), regarding our formal consultation and conference in accordance with section 7 of the Endangered Species Act of 1973 (Act), as amended (16 U.S.C. 1531 *et seq.*), on the referenced project, we indicated we would provide you with preliminary conclusions for listed species and identify any outstanding issues by September 30, 2005. You had specifically requested that we provide a "preliminary" jeopardy/non-jeopardy determination on the endangered Pacific pocket mouse (*Perognathus longimembris pacificus*, "PPM") to further the National Environmental Policy Act process for the project.

Based on our draft analyses, we have determined in our preliminary conclusions that the construction and maintenance of the SOCTIIP A7C-FEC-M Initial Alignment (the "proposed action") will not jeopardize the continued existence of the Riverside fairy shrimp (*Streptocephalus woottoni*), San Diego fairy shrimp (*Branchinecta sandiegonensis*), tidewater goby (*Eucyclogobius newberryi*), southwestern willow flycatcher (*Empidonax traillii extimus*), least Bell's vireo (*Vireo bellii pusillus*), or thread-leaved brodiaea (*Brodiaea filifolia*). Our preliminary conclusions also support a no adverse modification determination for designated critical habitat for the San Diego fairy shrimp and tidewater goby and proposed critical habitat for the thread-leaved brodiaea.

Our draft analyses for the arroyo toad (*Bufo californicus*, "toad"), coastal California gnatcatcher (*Polioptila californica californica*, "gnatcatcher") and its designated and proposed critical habitats, and PPM identify significant project-related impacts to individuals, populations and habitat for these species. Regarding the toad and gnatcatcher, conservation measures identified by the Transportation Corridor Agencies ("TCA") in the April 2004 draft Environmental Impact

Statement/Subsequent Environmental Impact Report ("DEIS") to avoid and minimize impacts to these species will provide the basis for no jeopardy/no adverse modification determinations. However, because of impacts that are not fully offset, we believe that our overall analyses and final no jeopardy/no adverse modification determinations would be further supported by implementation of additional conservation measures. We will discuss our recommendations for additional conservation and other measures in an upcoming consultation meeting.

Regarding PPM, the San Mateo North population is necessary for the survival and recovery of the PPM because it is one of only four populations known for the species. The PPM recovery plan calls for stabilizing and protecting all existing populations and establishing 10 populations within its historic range. Based on our analysis, we have determined that the proposed action as described in the Biological Assessment likely would increase mortality factors at the San Mateo North site during construction and in association with the direct and indirect effects of toll road operation. The proposed action would also reduce the area of suitable habitat available to PPM at San Mateo North. This loss of suitable habitat likely would reduce the ability of the site to support large population fluctuations that are characteristic of this species. Absent the adoption of the measures described below, this loss would effectively "cap" the size of the San Mateo North population during population expansions. Population expansions during favorable conditions likely are essential for sustaining this isolated population through periods of environmental adversity when individuals may forego reproduction and population persistence relies on adult survivorship. Coupled with increased mortality factors likely associated with animals entering the roadway, roadway lighting, predator concentrating effects, and increased fire frequency, the proposed action further increases the vulnerability of the San Mateo North population.

This increased vulnerability can be addressed by the adoption of an adaptive management program for the San Mateo North population and the incorporation of the following minimization and conservation measures into the project:

A. With the approval of and coordination with Marine Corps Base Camp Pendleton (MCBCP), establish an endowment and hire an entity to adaptively manage the PPM population at San Mateo North. The amount of the endowment must be supported through a property analysis record ("PAR") or another similar cost calculation method that is indexed for inflation and incorporates funding for; 1) invasive species control, 2) habitat management and enhancement, 3) predator control, 4) control of public access, 5) PPM population monitoring and augmentation, and 6) contingencies.
B. Construction of a barrier to small mammal movement along the entire western edge of the roadway alignment in the San Mateo North area to prevent PPM from entering the roadway and getting killed.
C. Minimization and shielding of all roadway lighting, including light cast by vehicle head and taillights, from adjoining habitat areas. This measure may require the construction of a block wall or other solid shielding to prevent light from entering adjoining habitat. All

walls constructed adjoining PPM habitat shall be constructed to minimize perching opportunities of owls and other avian predators.

D. Minimizing the potential for fire ignitions associated with toll road construction and usage to travel into adjoining habitat. This measure should minimize the width of any fire break by means of engineering (e.g., block or crib walls adjoining habitat).

E. Development of a fire response plan in coordination with the local fire agencies to minimize the detrimental effects of fire suppression activities in the habitat should a fire occur.

We understand that TCA is willing to implement these additional conservation measures and to work with MCBCP and our agency to assure the long-term conservation of the San Mateo North population of the PPM. Based on this commitment, we have made a preliminary determination that the proposed action will not jeopardize the continued existence of the PPM.

We anticipate further discussions with your agency, TCA and the California Department of Transportation (Caltrans) regarding the issues in this letter prior to providing our final conclusions and a draft biological opinion for your review and comment. If you have any questions regarding this letter, please contact Jill Terp of my staff at (760) 431-9440, extension 221.

Sincerely,

Karen A. Goebel

Karen A. Goebel
Assistant Field Supervisor

cc:
Macie Cleary-Milan, TCA
Sylvia Vega, Caltrans

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Southwest Region
501 West Ocean Boulevard, Suite 4200
Long Beach, California 90802- 4213

In response refer to:
I/SWR/2005/05890:SCG

MAY 23 2007

Gene K. Fong
U. S. Department of Transportation
Federal Highway Administration
California Division
650 Capitol Mall, Suite 4-100
Sacramento, California 95814

Dear Mr. Fong:

NOAA's National Marine Fisheries Service (NMFS) has reviewed the Federal Highway Administration's (FHWA) proposed South Orange County Transportation Infrastructure Improvement Project (SOCTIIP), located in southern Orange County, California. The project consists of creating a 16 mile-long toll road, which will connect Highway 241 with Interstate 5 (I-5) near the cities of Rancho Santa Margarita and San Clemente. The highway connector is designed to alleviate traffic congestion in southern Orange County. The proposed preferred alternative alignment (alignment A7C-FEC-M) will cross San Mateo Creek and San Juan Creek, both of which are within the Distinct Population Segment (DPS) of endangered Southern California Steelhead (*Oncorhynchus mykiss*), and designated critical habitat for this species.

At its southern terminus, the proposed highway will connect with I-5 about 1000 feet upstream of the mouth of San Mateo Creek. A large span bridge with connector lanes will be built directly adjacent to the existing I-5 span bridge to facilitate the connection of the two highways. The bridge will be a cast-in-place pre-stressed box-girder superstructure supported by large deep-pile foundations and bridge piers. Some bridge piers will be located within the San Mateo Creek channel, but will be placed approximately 200 feet apart. As the proposed highway proceeds north it will veer away from San Mateo Creek, and will head north toward San Juan Creek. The proposed highway will have a second span bridge, which would be built over San Juan Creek within Rancho Mission Viejo property, about 6 miles upstream of the ocean. The second bridge will also be a cast-in-place pre-stressed box girder superstructure supported by large deep-pile foundations and bridge piers. Some bridge piers will be within the San Juan Creek channel, but will be distanced approximately 200 feet apart. Additionally, in 15 locations along the proposed highway within the San Mateo and San Juan Creek watersheds, extended detention basins (EDBs) and bioswales will be incorporated into the highway infrastructure. The purpose of the

EDBs will be to contain and detoxify road surface runoff, by facilitating removal of oils, heavy metals, and fine sediments from the runoff prior to it being discharged into any stream. The construction of the bridges and related highway infrastructure is estimated to take 18 to 24 months to complete. The FHWA determined that construction of the SOCTIIP was not likely to adversely affect the Southern California DPS of steelhead or critical habitat for this species, and requested NMFS' concurrence with this determination.

After reviewing the proposed action, the draft environmental impact statement, the biological assessment dated April 14, 2005, additional information provided by letter dated January 5 2007, discussions with FHWA, and a site visit in June of 2005, NMFS concurs with the FHWA's determination for the following reasons.

1. No water diversions will be implemented for the proposed highway and relocation of steelhead will not be necessary. Additionally, the creek channels are expected to be dry for the majority of the construction period. During construction, temporary bridges will be constructed during the dry season so that when flow is present, interference with migrating steelhead is not expected. When construction is complete, the final bridges are not expected to decrease the functional value of steelhead migratory habitat within the San Mateo or San Juan Creek Watersheds because the bridge piers will be spaced 200 feet apart. As a result, even if the final design locates the piers in the channel, NMFS does not expect that the piers will impede steelhead migration.

2. The proposed highway is not expected to reduce water quality within the San Mateo or San Juan Creek watersheds. As part of the Runoff Management Plan for the proposed project, runoff and pollutants from road surfaces will be filtered out within EDBs and bioswales, and untreated runoff will not be discharged into San Juan Creek, San Mateo Creek, or their tributaries. Additionally, untreated runoff from I-5 currently goes directly into lower San Mateo Creek and the estuary, but after project completion, runoff from Interstate 5 will be directed into EDBs and bioswales for the proposed highway, which is expected to eliminate untreated highway runoff into lower San Mateo Creek and the San Mateo Creek estuary.

3. Best management practices will be implemented to minimize impacts during construction of the highway and bridges. These include a Storm Water Pollution Prevention Plan to minimize impacts from onsite runoff during construction, sediment control devices and measures to protect creek bed and banks during and after construction, enclosures for areas where concrete work will take place, restriction of fueling and maintenance of heavy machinery to areas away from the creek channel, and an emergency spill contingency plan.

4. Earthen areas disturbed by construction will be re-vegetated and hydro-seeded to minimize effects to riparian vegetation and to minimize sedimentation from disturbed banks and hillsides.

5. Because the highway will be located away from San Mateo and San Juan Creeks, and because the bridges will be supported by piers spaced sufficiently apart to reduce the risk of impairing flowing water, the project is not expected to affect floodplain development or connectivity in the San Mateo or San Juan Creek watersheds.

This concludes section 7 consultation for this proposed action. Consultation must be reinitiated where discretionary Federal agency involvement or control over the action has been retained (or is authorized by law) and: (1) if new information becomes available revealing effects of the action on listed species in a manner or to an extent not previously considered, (2) if project plans change, and if the agency action is subsequently modified in a manner that causes an effect to listed species that was not considered, or (3) if a new species or critical habitat is designated that may be affected by this action. Please contact Stan Glowacki at (562) 980-4061 or via email at Stan.Glowacki@noaa.gov if you have any questions concerning this letter, or if you require additional information.

Sincerely,

Anthony G. Morton

for Rodney R. McInnis
Regional Administrator

cc: Jae Chung, Corps of Engineers
Mary Larson, CDFG
Jill Terp, USFWS

December 7, 2007

California Coastal Commission
45 Fremont Street, Suite 2000
San Francisco, CA 94105

Dear Commissioners,

I am writing in response to Coastal Commission Staff Report on the Coastal Consistency Determination for the Foothill Transportation Corridor South. In particular, I address that section of the report that discusses the potential impacts to Pacific Pocket Mouse (PPM) of the proposed toll road project.

In its evaluation, Coastal Commission staff relied extensively on a report prepared by Dr. Jonna Engel, *Impacts of proposed toll road corridor on the Pacific pocket mouse, Perognathis longimembris pacificus*, dated September 26, 2007. The stated purpose of Engel's report is: *"to lay out the biological basis for why I have determined that the toll road, as sited and designed, is incompatible with the survival and recovery of the Pacific pocket mouse."* However, for the reasons detailed below, Engel's evaluation and staff's reliance on that evaluation presents an inaccurate representation of the facts based on an apparently selective and calculated citation of information, used in turn to justify a predetermined dire conclusion about the proposed project impacts on PPM. In fact, the proposed project includes an active monitoring and adaptive management program necessary for the affected population's long-term survival, one that would not exist without the project.

The population of PPM adjacent to the FTC-South, the "San Mateo North Population," currently exists at an extremely low level and in a very limited area. The population is small, primarily because there is little potential high quality habitat, vegetation is overgrown, other mouse species out-compete PPM, and feral cats are not controlled. Additionally, the currently occupied habitat is entirely west of FTC-South and surrounded by former agricultural areas, and steep slopes, as well as a two lane highway (Cristianitos Road). These conditions make the habitat largely of marginal suitability for PPM.

It is because the San Mateo North Population is extremely small, isolated, and threats to it are currently not managed or addressed, that it is unlikely to survive without protection and intensive management. Practically speaking, the best chance for protection and management of the San Mateo North Population will be if the toll road project is approved and the *Pacific Pocket Mouse Resource Management Plan* (PPM RMP) is implemented. However, staff's portrayal of the situation is contrary to these facts and not supported by an objective analysis of this and other information provided to the Commission.

As noted above, the staff report relies heavily on the report prepared by Dr. Engel, a marine ecologist who specializes on mussels. Unfortunately, rather than provide the basis for a well-researched and well-reasoned evaluation of the project's impacts, Engel attempts to support her conclusions through a selective citation of limited references. Not only limited, Engel's choice of references are largely outdated, inaccurate, or speculative interpretations based on limited data (Appendix 1). Two cited references are letters by an activist writing in the capacity of a project opponent who paints the project in the worst possible light. Engel's selective citation of information means that information contrary to her conclusion was ignored. This includes any discussion of actions that the Foothill/Eastern Transportation Corridor Agency (TCA) has undertaken to ensure PPM recovery at San Mateo North and elsewhere.

For these and other reasons detailed below, it is clear that Engel's evaluation, and therefore the staff report, deviate from the accepted norms of transparent scientific review. These norms require consideration of <u>all</u> information in which alternative outcomes can be evaluated. Engel's report considers only a worst-case scenario and ignores the tangible conservation benefits of active management of this population proposed by TCA. When a measured review of all available information is conducted, including up-to-date information and research, then a very different set of conclusions emerge: (1) the Foothill Transportation Corridor-South (FTC-South) will not negatively impact PPM because it would not disturb occupied habitat, and (2) the FTC-South will contribute to PPM recovery at San Mateo North because it provides a fully funded intensive management program that would not take place otherwise.

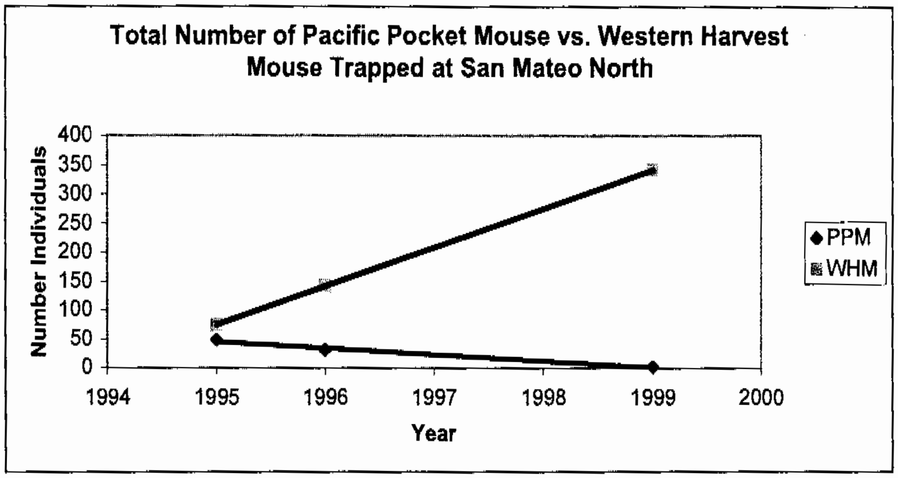
My Qualifications

I earned a Bachelor's degree in Biology and Natural History from the University of California Santa Cruz, a Master's degree in Wildlife Ecology from Yale University, and a Ph.D. in Ecology and Evolutionary Biology from Cornell University. My postdoctoral experience included research at University of Colorado, Boulder and the Center for Reproduction of Endangered Species at the San Diego Zoo. I was Curator of Vertebrate Zoology at the Denver Museum of Nature & Science and served as a consulting Science Advisor to the Office of the Assistant Secretary of the Interior in Washington, D.C., working on endangered species scientific issues. As an evolutionary biologist and conservation geneticist, I have 26 years of field and laboratory experience, as well as hands-on management experience with the conservation of threatened and endangered wildlife in North America, Africa, and Asia. Much of that experience is directly relevant to issues raised in this review, including issues regarding the conservation of genetic diversity in small isolated populations and metapopulations, captive breeding and reintroductions.

My research over the past 20 years has revolved around questions of genetics of small-isolated populations and metapopulations of bighorn sheep in the Sierra and Mojave Desert (Ramey 1993; Jessup and Ramey 1995; Ramey 1995; Bleich et al. 1996; Boyce et al. 1997; Boyce et al. 1999; Ramey et al. 2000), argali of central Asia (Tserenbatta et al. 2004), tropical rainforest birds (Brown et al. 2004), meadow jumping mice (Ramey et al., 2005, 2006, 2007), and African elephants (Charif et al 2000). Combined with that, I have hands-on experience in the live-capture, salvage, and/or captive breeding of endangered wildlife, including bighorn sheep, argali sheep, peregrine falcons, and California condors. I have also researched questions regarding the quantification of critical habitat for bighorn sheep (Turner et al. 2004, 2006), California condor nest site characteristics (Snyder et al. 1986) and off-road vehicle impacts on desert-rodents and birds (Luckenbach and Bury 1983). I have researched aspects of population genetics of scabies mites (Ramey et al. 2000), respiratory bacteria, (Safaee et al., 2006); and HIV (Young et al. 2000). I have also published on taxonomic revision (Wehausen and Ramey 1993; Wehausen and Ramey 2000; Ramey et al. 2005; Timm et al. 2005). I currently conduct research in Africa on elephant metapopulations and conservation. I am also a member of the Caprinae Specialist Group at the International Union for the Conservation of Nature (IUCN).

Distribution of the Pacific Pocket Mouse Subspecies

The Pacific pocket mouse subspecies has always had a limited distribution, for reasons other than Engel suggests. This subspecies is a peripheral population, at the western edge of the species range for little pocket mouse (*Perognathus longemembris*), and was first described from specimens taken from one location in 1898 (Mearns 1898). It is one of 19 subspecies of the little pocket mouse that are found across much the southwestern U.S. and northern Baja (Appendix 2). The coastal habitat that is thought to make this subspecies different is actually marginal habitat for two reasons. First, the small body size of PPM (and other little pocket mouse subspecies in general) necessitates that it dig burrows in sandy soils, rather than more compact soils. Because this soil type is uncommon in the region, it naturally limits the distribution of PPM. Second, PPM must compete with more abundant and aggressive species, including the western harvest mouse, which is larger but overlaps with PPM in body size and food habits (primarily seeds), making it PPM's closest competitor. In such cases, natural selection leads to the exclusion of the less competitive species when two species are competing for the same "niche" in the ecosystem; in this case, PPM. As shown in the figure below as western harvest mouse numbers have increased at San Mateo North, PPM numbers have steadily declined.



Engel's report makes liberal interpretation of the historical trapping data and implies an abundant and broad distribution along the southern California coast. For example, Engel states: *"Historically, the Pacific pocket mouse occurred up to 2.5 miles inland from Marina del Rey and El Segundo in Los Angles south to the Mexican border."* However, trapping data have shown that the distribution of PPM was always patchy between these locations. Pacific pocket mice were first described by Mearns (1898) on the basis of three specimens trapped from the Tijuana River near the United States-Mexico border in 1894. A single individual was later trapped at San Onofre in 1903 by Frank Stephans (von Bloeker 1931). And it took repeated effort, including *"at least a thousand trap nights at the type locality without success"* and multiple traplines before they were "rediscovered" along the Tijuana River and at San Onofre by von Bloeker (1931a,b). As von Bloeker was making the 135-mile drive back to Los Angeles in 1931 his search identified only two locations where he later trapped Pacific pocket mice (near San Onofre and the Santa Margarita River). Based on these early survey efforts that occurred before extensive development (listed above), as well as subsequent trapping efforts (IUCN 2007), it is clear that PPM has always had a very patchy distribution along the coast, and was never common.

Historic Habitat Loss

Relying on Engel, the staff report overstates the extent of historic habitat loss for PPM by using the loss of coastal sage scrub as a proxy for habitat loss for PPM. However, coastal sage scrub (the habitat used by the coastal California gnatcatcher) is not the same as that used by the PPM; therefore estimates of loss of coastal sage scrub or gnatcatcher habitat are not equivalent to the loss of acreage for PPM. Although analysis of PPM trapping data has shown that soil type is the primary determining factor in PPM distribution, with sandy soils and sandy loams being preferred (Bornyasz 2003), it is not the only factor that determines presence or absence: PPM are not found on steep slopes or former agricultural

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areas while gnatcatchers are found in these areas. Therefore, PPM simply cannot occupy all of the same habitat as gnatcatchers because PPM are restricted to sandy soils-- found in a fraction of coastal sage scrub--whereas gnatcatcher distribution is determined by the presence of coastal sage scrub vegetation, which is not restricted to sandy soils, slope, or former agricultural areas but is influenced by factors independent of soil type (Franklin 1998).

Engel's report cites a lack of success in trapping PPM at several small mammal study sites in Orange County to suggest that PPM have been lost from these areas. However, such a speculative conclusion is not supported by the historical data because PPM were never trapped in these locations in the first place. According to the IUCN Red List: *"P. l. pacificus has a recorded distribution from the vicinity of Marina del Rey in Los Angeles, extending south along the coastal areas to the Mexican border. <u>The known distribution of populations has always been patchy: over 97% of all records of the subspecies have come from only five localities, with around 77% of these being recorded in 1931 and 1932</u>"* (IUCN 2007).

Based on Engel's review, the staff report advises that the proposed project raises a number of significant issues for PPM, including: (1) impacts to and loss of habitat; (2) concomitant problems associated with the genetics of small populations; and (3) the disruption of metapopulation dynamics. Each of these issues has been evaluated in the FTC-South Environmental Impact Statement /Subsequent Environmental Impact Report (EIS/SEIR) and, based upon peer-reviewed publications, available data, and best professional judgment, not found to be a demonstrable threat to PPM.

(1) Impacts Upon, and Loss of, Habitat

The staff report concludes that construction of the FTC-South will result in both "impacts upon" PPM and the "loss of habitat" for PPM. This conclusion is based on Engel's statement that, *"the toll road area of impact has been determined to encompass the entire San Mateo North population..."* The trapping data, however, clearly show that all PPM captures, and therefore occupied habitat, is west of the disturbance footprint of the proposed FTC-South. As a result, the FTC-South will have no direct impact on occupied PPM habitat.

Almost all of the area outside of the San Mateo North Population's currently occupied habitat is classified as "low to no value" to PPM. The reasons are several: (i) it is a former agricultural area; (ii) it includes developed areas such as the Cristianitos Road corridor; and (iii) it has steep slopes, unsuitable soils, and/or unsuitable vegetation. (See 2007 draft PPM RMP.)

The TCA has proposed a number of measures aimed at protecting and benefiting the San Mateo North Population and its habitat. The proposed habitat protection (e.g. fencing, patrols, and fire planning) and proposed habitat enhancements (e.g. removing cats, soil enhancements, vegetation management, and post-fire planning), have far greater potential to benefit the San Mateo North Population and expand it beyond its current range than the current situation of *no* habitat protection and *no* enhancement activities. It is clear that the status quo is not benefiting PPM at San Mateo North; the trapping data show that since 1993, the number of PPM captured at San Mateo North has declined: (48 in 1993, 31 in 1995, 2 in 1999, 3 in 2001, and 4 in 2003).

Former Agricultural Areas and Their Influence on PPM Distribution

Important to the evaluation of impacts on PPM is the fact that PPM are distinctly absent from former agricultural areas. To date, there has been no documented permanent PPM occupancy of former agricultural areas (Ogden 1997; Service 2007, Ramey and Johnston 2007). Historic aerial photographs of San Mateo North Population and vicinity were used to map areas of former agricultural use. As these photographs show, the majority of the area south and east of occupied PPM habitat at San Mateo North is former agricultural land, or contains disturbed and compacted soil from roads, trails, or other activities. When PPM trapping locations are plotted on historic aerial photographs, all but two PPM captures are located in or immediately adjacent to an area (within 20m) that has no historic agricultural use. Only a handful of PPM captures occur along the edge of former agricultural areas (Exhibit 8). While it is possible that PPM may temporarily forage in former agricultural areas at San Mateo North, it is also possible that these trapping locations, plotted during the mid 1990's when GIS technology was in its infancy, were in error. It is also possible that the locations, particularly those from 2003, may be alongside former roads or untilled areas along the edge of fields, rather than in former agricultural areas that were tilled.

In any event, despite intensive survey efforts, PPM have not been found to permanently occupy former agricultural areas (where tillage has occurred) at San Mateo North or elsewhere (Ogden 1997; Service 2007; Ramey and Johnston 2007). Tillage appears to alter of soil heterogeneity (e.g. loss of sandy-loam inclusions), increase soil structure, and increase soil compaction such that PPM may not burrow in previously tilled soils (Horn et al. 1995; Webb 2002; Munkholm and Schjønning 2004; Mari et al. 2006; Standish et al. 2006).

One goal of TCA's PPMRMP is to reestablish PPM in areas of unoccupied habitat, including former agricultural areas, that otherwise have suitable vegetation and are contiguous with occupied PPM habitat. Consequently, soil augmentation i.e., creating sandy-loam patches that PPM can use for burrowing, in former agricultural areas of the PPM Management Area at San Mateo North is identified as one of the top priorities in the PPMRMP adaptive management program. Using proper scientific experimental design, the adaptive management program will employ soil amendment techniques will be designed and evaluated for habitat enhancement and reestablishment of PPM in currently marginal and unsuitable habitat. If successful, this experimental approach could greatly benefit the overall recovery the San Mateo North Population and contribute valuable information about management options that could be used for other PPM populations.

(2) Problems Associated With the Genetics of Small Populations and (3) the Disruption of Metapopulation Dynamics

The loss of genetic variation and potential for inbreeding depression are a real threat to the San Mateo North Population. This population is extremely small (with approximately 90 percent decline in the number of mice captured from 1993 to 2003) and is effectively isolated from other populations by development, Cristianitos Road, and agricultural fields. The problem is exacerbated by the fact that the most immediate and plausible threats to PPM at San Mateo North are not currently managed (e.g. cat predation, competing species, and vegetation succession). The San Mateo North Population cannot recover unless all of these threats are addressed in a systematic manner. The trapping data indicate that San Mateo North is currently a population *sink*. The greatest risk to PPM at San Mateo North is simply *inaction*.

Metapopulations are clusters of populations that are connected by the ongoing dispersal of animals among them. This results in genetic exchange among populations, which is important to maintenance of genetic variation and the potential natural recolonization of populations that die out. Therefore, if there is to be a "metapopulation dynamic" there must be dispersal and interbreeding. However, contrary to the staff report's assertions that the toll road would bisect the San Mateo North and South populations, there is no data that indicate that dispersal is taking place between the San Mateo North and San Mateo South populations. Trapping data reveal that no PPM have been captured east of Cristianitos Road, and no PPM have been found to permanently occupy former agricultural areas that have undergone cultivation. The available data clearly show that these populations have been bisected for decades by Cristianitos Road, agricultural fields, and unsuitable habitat.

Nor is staff's conclusion supported by genetic research. Engel's report cites a limited mitochondrial DNA survey from Swei et al. (2003) to suggest that *"these populations are the most recently connected by gene flow."* However, this is an overstatement of the facts. While it is possible that these populations were connected prior to human development, they are not currently. The fact that the two San Mateo populations appear to be closely related (in terms of mitochondrial DNA) is not surprising. Countless studies of other organisms reveal a similar pattern: populations that are in close geographic proximity tend to also be closely related genetically. This reflects a general tendency for populations that were once connected to share genetic similarity, even though these are now separated by artificial barriers. I have studied this phenomenon extensively in bighorn sheep inhabiting the Mojave Desert (Ramey 1993; 1995; Epps et al. 2006); meadow jumping mice separated by urban development (Ramey et al. 2005; 2006; 2007); and in rainforest birds affected by forest fragmentation in the jungles of central America (Brown et al. 2004). In the case of PPM, the limited analysis of mitochondrial DNA show that two of the four North San Mateo mitochondrial DNA types are also found in South San Mateo (where ten mtDNA types are found). The other two North San Mateo mtDNA types are closely related to the mtDNA types that are shared between populations (Figure 2 in Swei et al. 2003). Engel's conclusions drawn about current genetic exchange based on such limited data are purely speculative.[1]

Staff's report suggests that there is still "connectivity" between San Mateo North and San Mateo South. However, the probability of a mouse currently making the move in either direction from San Mateo North to San Mateo South is close to zero under current conditions. Briefly consider the fact that mice would have to somehow make all of the turns in the proper direction at every critical junction. Yet it is unreasonable to assume that mice are capable of planning extensive or intricate migratory maneuvers, so movements would be much more random. It is even more unlikely that a mouse could traverse the entire distance between these populations in its lifetime. The distance between San Mateo North and San Mateo South exceeds the maximum lifetime dispersal distance of PPM at least 20-30 times, thus a single dispersal event would take many generations to accomplish. And any dispersing mice would have to avoid being struck by cars on Cristianitos Road and avoid predation by feral cats, foxes, and owls along the way.

In response to assertions that the connection between these populations would be broken by construction of the FTC-South, I previously calculated the probability of successful dispersal of PPM in 2005 (Ramey 2005). Even under favorable circumstances, the chance of a mouse making it from one population to another is vanishingly small: approximately one in five thousand. That does not include the probability of being eaten along the way, or surviving long enough to find a mate and successfully breed after it arrives. Even if 40 mice per generation attempted the crossing (20 from each direction), the number of migrants would not exceed 0.008 individuals per generation. That number is over three orders of magnitude too small to make any difference in the genetics of these populations. The assertion that mice move between these populations is belied by the facts; the proposed toll road would not cause the isolation of the two populations because they are already effectively isolated.

In lieu of natural migration, the only present option available to establish connectivity between these populations is intensive management through the use of translocations. This technique has been used in countless wildlife conservation programs to reintroduce species to former ranges and to prevent inbreeding in small isolated populations. For

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[1] Similarly, Engel's assertion that the Toll Road will seriously jeopardize the metapopulation dynamics of PPM based on the "*blipping on and off of small populations*" from the "*bad synergy of environment and genetics*" or "*good synergy of environment and genetics*" is without scientific justification as these terms have no definition in the field of conservation genetics.

translocations to be successful there must be: (1) suitable habitat available in which to introduce animals, and (2) provisions for natural connectivity in the future (Ramey et al. 2000). In the case of PPM, both of these will be provided for by the TCA and are discussed in the PPMRMP (e.g. avoidance, minimization, and mitigation measures). In brief, suitable habitat will be made available through habitat protection and enhancements, while opportunity for future connectivity will be offered through wildlife culverts and crossings under the FTC-South and Cristianitos Road.

Evidence of TCA's Long-Term Commitment to PPM Recovery

The TCA has a history of commitment to PPM recovery at San Mateo North since the discovery of PPM there in 1993. This commitment has been demonstrated through funding of PPM surveys and research; project redesign; development of an adaptive management program to protect and enhance habitat for PPM; and long term funding for this adaptive management program. Yet in its effort to provide the Commission with a report upon which it can make a fair and well-reasoned determination, the staff report makes almost no mention of these actions or the contribution that each makes to PPM recovery.

I discuss each of these actions briefly:

(1) The TCA has funded studies on the feasibility of using translocations to reestablish and expand Pacific pocket mouse range (Spencer et al. 2000a), including the identification of potential receiver sites where PPM could potentially be reestablished (Spencer 2000b). The TCA also funded laboratory and field research on a common subspecies of little pocket mouse to study ecology, and to experiment with techniques for radio tracking and captive breeding (Spencer et al. 2001).

(2) The TCA has provided support for four PPM surveys since 1993 to determine distribution and abundance of this subspecies at San Mateo North. These extensive surveys have identified areas of occupied PPM habitat, as well as uninhabited areas. Those uninhabited areas include the disturbance footprint of the FTC-South; the areas between the proposed toll road and San Mateo Creek; and former agricultural areas between occupied habitat and the parking lot for San Onofre State Park.

(3) During the process to identify the FTC-South alternatives and the environmental review process conducted in concert with the USFWS, the FTC-South alignment was moved to the east to avoid occupied PPM habitat (referred to as the "Green Alignment"). This avoidance measure was discussed in detail in the Final EIR/EIS for FTC-South. This was also previously discussed in the USFWS Recovery Plan for the PPM as follows: the TCA "is redesigning the proposed project to avoid direct impacts to the local Pacific pocket mouse occupied habitat as it was defined in the last survey effort" (USFWS 1998). This realignment of FTC-South is consistent with PPM Recovery Plan defined

Recovery Actions: protect and secure extant populations and protect essential habitats and sites.

(4) To better understand ecological conditions at San Mateo North, TCA conducted detailed studies of vegetation, soil, and slope to quantify habitat quality - all of which are important variables for predicting PPM occupancy. Results from initial surveys were presented in the SOCTIIP Biological Assessment. New information, including a quantitative analysis of PPM habitat quality is presented in the draft PPMRMP (Ramey and Johnston 2007). This includes an analysis of historic aerial photographs to determine past land use, including areas of former agricultural use at San Mateo North. When combined with data on slope, soil, and vegetation, this information proved crucial to a quantitative and objective analysis of PPM habitat quality. It was then used to prioritize habitat enhancement strategies for the San Mateo North Population in the PPMRMP.

(5) As part of the required mitigation for FTC-South an adaptive management plan for PPM was developed. The approach to the development of the PPMRMP is to identify potential threats, rank them in order of priority, and implement specific management actions in an adaptive management framework. Briefly, a problem analysis approach and a Popperian hypothesis testing approach (Popper 1953) was used to identify and prioritize the problems facing PPM at San Mateo North and deal with the them in an efficient and effective manner. The TCA has committed to funding the implementation of the PPMRMP.

Taken together, these TCA-funded studies, along with preparation of and endowment for a science-based adaptive management plan for PPM at San Mateo North, represents a level of commitment to recovery of this subspecies that is without equal. Not only does the staff report misrepresent the biological situation at San Mateo North, it ignores the positive effects these TCA-funded actions will have on PPM.

Wildlife Undercrossings

The staff report's dismissal of the proposed wildlife undercrossings is unfounded and contrary to recently published research. This research clearly shows that many species of rodents use culverts and undercrossings similar to those proposed by the TCA and detailed in the PPMRMP. For example, Donald and St. Clair (2004) tested the efficacy with which mice and voles used crossing structures placed under, or over, the four-lane Trans-Canada Highway. They reported that that small, covered culverts (0.3 m in diameter, 64-73 m in length), which offer protection from predators, were more attractive to rodents than larger undercrossings (wider than 3 m). Similarly, Mata et al. (2003) reported that crossing structure use was linked to animal size, with the narrowest structures (e.g. circular culverts) having the highest use by small mammals. The extent of use they documented and the relatively high frequency of drainage culverts under most roads, led these authors to comment that culverts play a "noteworthy role" in the restoration of connectivity for small and mid-sized mammal population otherwise dissected by roads.

Enhancements to undercrossings that increase their use have also been identified. Foresman, K. R. (2003) found that shelves placed in culverts allowed small mammals to use these when water would otherwise prevent movement. Additionally, Donald and St. Clair (2004) reported that vegetation cover at the entrances to culverts enhanced their use by rodents.

This is but a sampling of the papers on this subject that are contrary to Engel's assertions and absent from her evaluation upon which staff relied to prepare the report.

Other Threats

Engel lists other potential impacts that are associated with the FTC-South but does not substantiate her claim that these: *"present serious threats to the survival and recovery of the Pacific pocket mouse and that are covered elsewhere."* All of the sources of information cited by Engel only speculate about these potential threats. Two of those sources are activist letters.

Documented below for each potential threat identified in the staff report (including Engel's report specifically) is evidence—not speculation—showing that PPM are so threatened or PPM status would be improved by construction of FTC-South:

(1) Contrary to assertions that highway noise is deleterious to PPM, McGregor et al. (2007) found that small mammals avoid the road itself, and not emissions such as noise from the traffic on the roads. They also report that the overall barrier effect of roads cannot be mitigated by measures aimed at reducing overall traffic, but that other measures such as wildlife culverts and crossings are needed (such as those proposed for FTC-South).

(2) The potential for PPM road strikes on FTC-South is virtually eliminated by a barrier curb to prevent PPM from entering the roadway. There is currently no strike protection for PPM on Cristianitos Road, which will also be made inaccessible to PPM by the barrier curb.

(3) To address a potential concern over light spillage into PPM habitat, the TCA has developed a Lighting Plan PPMRMP Exhibit 7. The illumination plan is minimal; illumination is downcast; and most importantly because the FTC-South is below grade, all illumination occurs outside the PPM Management Area.

(4) The TCA proposes a 7-foot tall fence with overhang and an intensive trapping program to eliminate feral and domestic cats from the PPM Management Area. Gates will be locked, access restricted, and the fence regularly inspected. Two additional feet

of chain-link fence would be buried below ground level to prevent burrowing under the fence. San Mateo North is currently unfenced and without protection.

(5) Although there is no data supporting the concern that there is increased potential for wildfire from the FTC-South (as compared to Cristianitos Road)), TCA proposes to develop a fire response plan in coordination with local firefighting agencies. This plan would emphasize the use of minimum impact suppression tactics that are used in the fire service for environmentally sensitive areas. A fire restoration plan provides for mitigating effects of a wildfire to PPM. In contrast, there is currently no fire response plan or fire restoration plan for San Mateo North.

The *Pacific Pocket Mouse Resource Management Plan* (PPMRMP)

Engel states that the PPMRMP *"has yet to be developed and submitted to Commission Staff for Review."* However, this assertion is not supported by the facts. The first draft of the PPMRMP was released in July 2006 and was provided to the Commission. The second draft was released on 20 September 2007 and is provided here as an appendix for the Commission's informed decision making process. This document includes a scientifically based and well-funded adaptive management plan and is being further refined in consultations with the U.S. Marine Corps at Camp Pendleton and U.S. Fish and Wildlife Service.

Consistency with PPM Recovery Plan

Engel's blanket condemnation: *"the toll Road is simply inconsistent with the recovery strategy laid out for the Pacific pocket mouse in the recovery plan (Brylski 1998)"* and *"[c]onstruction of the road is directly counter to all recovery criteria for the species and therefore would preclude its recovery"* is clearly refuted by the available information, most of which was ignored or misrepresented in Engel's report. As shown above and in accompanying maps in the PPMRMP, the FTC-South does not reduce the size of occupied habitat because PPM occur outside of disturbance limits and west of them. The FTC-South will *enhance* rather than impede dispersal by providing habitat protection and enhancements, wildlife crossings, and contingencies for translocation. These same measures will enhance genetic diversity rather than contribute to its loss. A fully funded adaptive management plan described in the PPMRMP will also directly contribute to recovery of PPM through its prioritization and hypothesis testing approaches to the implementation of conservation actions. This will allow the management team to focus effort on conservation measures that have the greatest net benefit to PPM while winnowing out those that are ineffective. Thus, the adaptive management program will also benefit PPM populations elsewhere by increasing the knowledge base that can be applied to other populations. All told, the toll road with the proposed mitigation measures would enhance PPM recovery at San Mateo North.

Recovery Plans are guidance documents intended to provide a synthesis of information and potential conservation goals and actions to achieve recovery of the listed species. Recognizing the importance of compatibility between the protection, minimization, and conservation measures proposed for the San Mateo North PPM population with the PPM Recovery Plan, the PPMRMP lists those Recovery Actions from the USFWS Recovery Plan that are compatible with or furthered by the Conservation Measure in the PPMRMP. In addition to the measures described above, the PPMRMP includes adaptive management and contingency planning that provides for population augmentation, captive propagation, plan updates, barrier curb modification, and additional measures to increase the use of undercrossings by PPM. The PPMPRM details how it contributes to the Down-listing and Delisting Criteria in the Recovery Plan. The goal here has been to achieve mutually compatible goals of constructing the FTC-South and contributing, to the maximum extent practicable, to PPM recovery at San Mateo North and elsewhere.

Conclusion

The staff report predicts a *"virtual death sentence"* to the San Mateo North population because the FTC-South would cut off movement between it and San Mateo South. However, the report fails to acknowledge the factors that already isolate this population, including Cristianitos Road, former agricultural areas, and other human development. The staff report fails to acknowledge the publicly available trapping data that show that no PPM have been captured in the FTC-South disturbance corridor, or that this area is of "low to no" habitat value to PPM. No mention is made of the population decline at San Mateo North that has occurred as a result of continued isolation and inaction in the face of threats. Such omissions illustrate a selective presentation of information in the staff report.

Engel's assertion about potential for the toll road to disrupt "metapopulation dynamics" of PPM does not accurately reflect the reality of the situation. Based on experience and the published literature, the only practical way to reestablish connectivity between populations is to do so artificially through translocation, and to provide highway undercrossings for natural movements that could result in PPM reestablishing in former agricultural areas that have undergone mitigation.

Staff's reliance on Engel's selective use of information conceals the fact that TCA has taken extensive measures to provide for the recovery of PPM at San Mateo North, from adjusting the road alignment to developing and funding a bona-fide adaptive management program to aid PPM recovery in the long term. This population, and PPM in general, will be recovered only through intensive management. In practical terms, that intensive management and eventual recovery will come about only as a result of conservation actions for the San Mateo North Population that are but one component of the FTC-South project mitigation package. Experience with other taxa (e.g. California condors and peregrine falcons) has proven the necessity of taking such actions when decades of inaction have failed to produce results. Here is an opportunity for a well-funded program that will not adversely affect PPM but will enhance its chances survival and recovery in the future.

Sincerely,

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Appendix 1

The Engel report cites to a number of outdated sources of information, most notably: an unpublished report whose treatment of PPM is a page and a half in length (Williams 1986); an unpublished manuscript dating from 1993 (Erickson 1993); and the USFWS listing document (USFWS 1994) used several sweeping generalizations to estimate PPM habitat that had been lost to human activities and development. These three primary sources of information are reviewed below:

Williams (1986)

This is a brief, one and a half page summary of information on PPM using sources up until 1976. At that time no systematic surveys for PPM had been undertaken, and all previous fieldwork had shown this subspecies *"to be scarce"* (Williams 1986). Soil and habitat preferences were unknown, and according to Williams: *"Information on areas of present occurrence and estimates of population densities are needed."* Due to this lack of information, Williams (1986) speculated where PPM might be found in the future and where PPM might be extirpated due to development. A list of historic distribution records, where PPM had been trapped (either using snap traps and live traps), was included.

Erickson (1993)

In the 1993 manuscript draft Erickson noted that: "*One can only speculate on the current status of the Pacific Pocket Mouse. A systematic survey has never been conducted...*" Although a systematic survey was not conducted between 1993 and 1995, an expanded survey effort resulted in a total of four populations being discovered during that period. Yet, Erickson stated in this 1995 version of this unpublished manuscript: "*Using the best available information, the status of the Pacific pocket mouse qualifies as "critical" under the Mace-Lande system (Mace and Lande 1991).*" However, Erickson did not present any quantitative analysis to support his conclusion.

The Mace-Lande scheme (no longer in use) defined "Critical" as having a 50% probability of extinction within 5 years or 2 generations (one year in the case of PPM), whichever is longer. Or, a population was classified as "Critical" if its population number fell below 250, or had fewer than 2 populations. However, more recent data show that Erickson's (1995) speculation to be incorrect and overly pessimistic. PPM have been found in four populations and the subspecies has persisted for over 12 years. While populations naturally fluctuate, the trapping results at Camp Pendleton Oscar One population in 2003 (USFWS 2004) show 418 unique individual PPM were captured on a single 3.4 acre trapping grid.

To this day, neither of Erickson's draft manuscripts (Erickson 1993, 1995) have undergone peer-review and publication. In the Final Rule to list the PPM as endangered, Erickson's unpublished manuscript was cited 22 times.

Appendix 1

USFWS (1994)

Although the Final Rule to list the PPM as endangered sought to make use of all available information on PPM, much of this document is now known to be based on questionable assumptions. Most notably, loss of habitat was greatly overestimated and potential threats to PPM are speculative. For example, the USFWS thought that less than one percent of historic PPM habitat was thought to exist in Los Angeles County, however PPM had only been historically found at three locations in that county (Marina del Rey/El Segundo, Cliffton, and Wilmington). As discussed elsewhere in this review, PPM habitat was equated with coastal sage scrub, an assumption that is unsupported by data.

Appendix 2

The Pacific Pocket Mouse (*Perognathus longimembrius pacificus*) is a *subspecies*; and one of no fewer than 19 that have been described for the little pocket mouse (*Perognathus longimembrius*). Referring to the Pacific pocket mouse subspecies as if it were a full species is technically incorrect and perpetuates a false impression that this is an extremely rare, (full) species. This *subspecies* was listed as endangered under the Endangered Species Act in 1994.

A close reading of the original description of PPM as a species and then a subspecies, an examination of mtDNA results (Swei et al. 2003), and a reanalysis of Huey's (1939) measurement data, show that the PPM specimens not reliably distinguishable from other subspecies. The PPM was first described qualitatively as a separate species (*Perognathus pacificus*) by Mearns (1898) on the basis of three specimens from one location near the United States-Mexico border in San Diego County. Additional occupied locations were described by von Blocker (1931a,b). The species was then reclassified into two subspecies by von Bloeker (1932): *Perognathus longimembrius pacificus* and *P. longimembrius cantwelli.* Subsequently, these two putative subspecies were recombined into a single subspecies (*P. longimemebrius pacificus*), and characterized as being the smallest of the little pocket mice by Huey (1939). All of these taxonomic classifications and reclassifications were based entirely on qualitative comparisons.

The Federal Register listing notice for the Pacific pocket mouse stated that Huey (1939) used a "biometric analysis" of 331 specimens in its description; however, to label that work a "biometric analysis" is not accurate -- it involved nothing more than a qualitative description from a table of minimal body and skull measurements, no statistical analyses were conducted. While the 16 PPM in the table are smaller *on average* than other *Perognathus longimembris*, substantial overlap in size is apparent among these individuals and individuals of other subspecies. Analyzing Huey's (1939) data set with stepwise linear discriminant analysis, one finds weak discrimination of PPM specimens, with only 62.5% correctly classified at a posterior probability of >0.95. One can only conclude that the Pacific pocket mouse cannot be reliably distinguished from other populations of little pocket mice.

Pacific pocket mice are ostensibly unique because they are the smallest of the little pocket mice. But a slightly smaller average size among PPM could simply be due to ecophenotypic variation among populations, rather than due to underlying genetic differences. A parsimonious explanation is that pocket mice living in coastal situations do not grow as large as others because environmental conditions are marginal for pocket mice -- rather than the presumption that slightly smaller size among coastal mice is a genetic adaptation to life in marginal coastal habitat. As noted by Huey (1939), smaller size is also typical of coastal populations of *Perognathus longimembris*, along the Gulf of California. All of these coastal populations (including PPM) are at the edge of the range of the nominant species, where population densities tend to be lower than in inland situations. *In evolutionary biology, body size alone is not considered to be a reliable indicator of distinctive genetic differences among populations.*

Appendix 2

Huey is known to have split a wide variety of taxa into large numbers of vaguely defined subspecies. He qualitatively described at least 51 new mammal subspecies (including five pocket mice and 23 pocket gophers), and 9 new bird subspecies, without any rigorous statistical analysis of morphology or convincing evidence of distinguishing adaptations. The ostensible uniqueness of the Pacific pocket mouse rests on these qualitative descriptions; descriptions that were widely employed sixty years ago, but viewed as wholly inadequate today. Admitting the uncertainty of his conclusions, Huey stated that:

> *"These facts may only be coincidental, and further study of material from other sections within the range of* Perognathus longimembris *may upset the findings of this study. This problem for the ultimate revision of the group and such work is, owing to the considerable amount of material yet to be gathered, still in the distant future."*

Mammal authorities, including Hall (1981) and Williams et al. (1993), have taken these qualitative descriptions at face value without any additional data analysis, simply restating the conclusions of previous authors. For example, the subspecies description for Pacific pocket mouse presented by Williams et al. (1993) runs less than a third of a page, and over half of this description simply recapitulates the measurement data from a single individual (the holotype specimen) measured in 1898.

PPM is considered by the USFWS to be an extreme habitat specialist because the range of this putative subspecies is purportedly exclusively within 4 kilometers (km) of the coastline. It is assumed that this subspecies is uniquely adapted to ecological conditions that occur along this narrow section of the coast. But that assumption has no quantitative basis, nor has there been any discussion of specific adaptations that could potentially be quantified. The continued recognition of this putative subspecies is based entirely upon the unsupported opinion that ecological differences are strong enough between this and other putative subspecies that there *must* be adaptive differences (see page 511 in Swei et al. 2003). An alternative view -- that diagnosable adaptive differences do not exist -- is not considered by the USFWS.

The mtDNA parsimony network published by Swei et al. (2003) indicates that PPM populations are derived from little pocket mouse populations to the east. PPM is not reciprocally monophyletic from these other populations with respect to mtDNA, *or even close to being so*. In other words, PPM is not on a separate evolutionary lineage. The amount of molecular variance (23.7%) found across the entire species range of *Perognathus longimembris* is less than that found within or among populations within subspecies of related mammals. Furthermore, there is complete absence of quantifiable adaptive differences between PPM and other nearby subspecies. Together, these lines of evidence fail to support the recognition of PPM as a valid subspecies.

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Cornell University, Ph.D. in Ecology and Evolutionary Biology, 1993.

Yale University, School of Forestry & Environmental Studies. M.F.S. in Wildlife Ecology, 1986.

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Areas of Expertise:
Endangered species conservation (26 years of experience with scientific research and hands-on management aiding endangered species reintroduction and recovery in the U.S. and abroad.)
Animal behavior
Evolutionary biology
Emerging environmental problems

Research and Professional experience:
President, Wildlife Science International, Nederland, CO (2007 - present).

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Curator of Vertebrate Zoology, Denver Museum of Nature and Science. (2000 - 2005).

Research Scientist, University of California, San Diego (1999 - 2000).

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USDA Postdoctoral Research Fellow, University of Colorado, Boulder (1994 - 1997).

Postdoctoral Research Associate, University of Colorado, Boulder (1994 - 1999).

Research Associate, University of California, White Mountain Research Station, (1986 - 1994).

Wildlife Biologist, U.S.D.A. Forest Service, Mt. Whitney Ranger District, CA (1987).

Research Assistant, Yale University, Department of Biology, New Haven, CT (1985).

Field biologist, Condor Research Center, Ventura, CA. (1983 - 1984).

Field Biologist, The Peregrine Fund, Inc., Santa Cruz, CA. (1980 - 1983).

Teaching experience:

Continuing Legal Education International and American Law Institute - invited faculty to lecture on the Endangered Species Act (2004-present)
University of Colorado, Boulder. Instructor of Genetics. (1998-1999).
University of Colorado, Boulder - Hughes Undergraduate Research Initiative, (1996–1999).
Cornell University, teaching assistant for Evolutionary Biology. (1988–1992).

Academic Awards, Fellowships, Memberships, and Affiliations:

International Union for the Conservation of Nature, Caprinae Specialist Group
University of Colorado, Denver, Department of Environmental Science – Adjunct Faculty (2002-2006)
University of Denver, Department of Biology - Adjunct Faculty (2002-2004)
U.S. Department of Agriculture, Postdoctoral Research Fellowship (1994– 1996)
Cornell University, Outstanding Graduate Student Teaching Award, (1992)

Community Service:

Nederland Fire Protection District: volunteer firefighter (1996-present)

Avocations:

Rock climbing, backcountry telemark skiing, river rafting, and travel to remote locations.

Peer Review Publications:

Wehausen, J.D., S.T. Kelley, and R.R. Ramey (submitted) A brief review of respiratory disease interactions between domestic sheep and bighorn sheep.

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Congressional testimony:

28 April 2004, Legislative Hearing on: *"H.R. 2933, To amend the Endangered Species Act of 1973 to reform the process for designating critical habitat under that Act."*

31 July 2007, Legislative Hearing on: *"Crisis of Confidence: The Political Influence of the Bush Administration on Agency Science and Decision-Making."* Written testimony may be found at http://lamborn.house.gov/UploadedFiles/07%2007%20Ramey_Testimony.pdf

Ad hoc reviewer for the following journals and agencies:

Animal Conservation
Conservation Genetics
Frontiers in Ecology and Environment
Journal of Wildlife Disease
Journal of Wildlife Management
Molecular Ecology
National Science Foundation
Royal Society of London
Systematic Zoology
Southwestern Naturalist
U.S. Department of Agriculture

Leanne,
Here is my list of attachments. You will have a copy of the Pacific Pocket Mouse Resource Management Plan. The rest are attached as PDFs. Thank you, Rob R.

Pacific Pocket Mouse Resource Management Plan:

Ramey, R.R., and A.M. Johnston (2007), Pacific Pocket Mouse Resource Management Plan for the San Mateo North Population. Wildlife Science International, Nederland, CO and Bonterra Consulting, Costa Mesa, CA. dated September 20, 2007.

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 doi: 10.1111/j.1365-2664.2007.01403.x

Do small mammals avoid roads because of the traffic?

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Summary

1. Roads can act as barriers to animal movement, which may reduce population persistence by reducing recolonization of empty habitats and limiting immigration. Appropriate mitigation of this barrier effect (e.g. seasonal road closures, location and design of wildlife over- or underpasses) depends upon whether the animals avoid the road itself or the traffic on the road. Empirical studies of road avoidance to date do not generally differentiate between these.

2. We conducted short- and long-distance translocations and trapping studies of white-footed mice (*Peromyscus leucopus*) and eastern chipmunks (*Tamias striatus*) near two-lane paved roads, which differed widely in traffic amount, from 47 to 15 433 vehicles per day.

3. In the trapping study (13 sites) only five animals moved across a road, in comparison to 36 animals that moved the same distance without an intervening road ($P < 0{\cdot}0001$). In the short-distance translocations (15 sites), 51% of the small mammals that were translocated across roads returned, in comparison to a return rate of 77% of animals that were translocated a similar distance with no intervening road ($P = 0{\cdot}009$).

4. In the long-distance translocation study (24 sites) we found that each intervening road reduced the probability of successful return by about 50%.

5. We found no significant effects of traffic amount on return rates in either the short-distance or the long-distance translocations studies.

6. Small mammal densities were not lower near roads and we found no evidence for a decrease in density near roads with increasing traffic amount.

7. *Synthesis and applications.* Our results suggest that small mammals avoid the road itself, and not emissions such as noise from the traffic on the roads. Our results imply that the barrier effect of roads on these species cannot be mitigated by measures aimed at reducing traffic amount; other measures such as wildlife passages would be needed.

Key-words: animal movement, barrier, dispersal, habitat fragmentation, permeability, *Peromyscus leucopus*, road avoidance, *Tamias striatus*, traffic, translocation

Introduction

Roads are a large threat to some wildlife populations (Forman *et al.* 2003). Most studies of the effects of roads on wildlife focus upon animal–vehicle collisions (called 'traffic mortality'; reviewed in Forman *et al.* (2003: 114–122). However, it has also been suggested that roads act as complete or partial barriers to movement for some species (e.g. Oxley *et al.* 1974; Mader 1984; Swihart & Slade 1984; Brody & Pelton 1989; Burnett 1992; Rondinini & Doncaster 2002; Shine *et al.* 2004; Whittington *et al.* 2004). Such a barrier effect could fragment habitat and reduce population persistence by reducing recolonization of empty habitats and/or limiting immigration.

That roads act as barriers to movement for some species implies that these species avoid roads (i.e. they are reluctant to cross them). Jaeger *et al.* (2005) discussed three types of possible road avoidance and argued that the type of avoidance largely determines the mechanism and strength of road effects on a population. The three types of avoidance behaviour are: (i) animals may avoid the road itself as it is a hostile environment onto which they will not venture (called 'road surface avoidance'); (ii) animals may avoid emissions from traffic such as fumes or noise, keeping them some distance away from the road [we call this 'general traffic avoidance'; Jaeger *et al.* (2005) call it 'noise avoidance']; or (iii) animals may avoid individual vehicles, waiting for a break in traffic before attempting to cross the road (called 'car avoidance'). In the case of road surface avoidance alone, all roads of similar

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type and size would have the same degree of barrier effect (i.e. the same permeability) to movement, irrespective of traffic amount. In the case of general traffic avoidance alone, the degree of barrier effect would be minimal for low-traffic roads, and would increase with increasing traffic amount. Car avoidance should reduce the degree of barrier effect for low- and medium-traffic roads, where breaks in traffic would be long enough for individual animals to cross successfully. When traffic is very high, such as on freeways, animals with car avoidance would never or rarely attempt to cross, so the barrier effect would be strong. These avoidance behaviours are not mutually exclusive; particular species could exhibit more than one (or none) of them.

Past empirical studies of road avoidance have not generally differentiated among types of road avoidance. Several studies were conducted on only one road (e.g. Swihart & Slade 1984; Burnett 1992; McDonald & St Clair 2004a; Shine *et al.* 2004), and studies conducted on more than one road (i.e. with different traffic amounts) confounded road type/width with traffic amount: dirt and gravel roads had lower traffic amounts than paved roads, and two-lane paved roads had lower traffic amounts than four-lane highways (e.g. Oxley *et al.* 1974; Mader 1984; Brody & Pelton 1989; Mader *et al.* 1990; Lovallo & Anderson 1996; Rondinini & Doncaster 2002; Whittington *et al.* 2004). Thus, the effects of traffic amount on road-crossing responses of animals cannot be distinguished from the effects of road type or width.

Differentiation among these types of road avoidance is of practical importance for the mitigation of the barrier effect of roads. For example, if animals show general traffic avoidance, mitigation may be necessary only for high-traffic roads. An appropriate measure might be road closures during migration periods. If wildlife passages are built, they would need to be designed such that traffic noise and other emissions are reduced or eliminated on and near the passages (Reijnen *et al.* 1995; Clevenger *et al.* 2001). In contrast, if the animal avoids the road itself, irrespective of the amount of traffic on it, then road closures will not reduce the barrier effect of the road. Wildlife passages will be necessary. For such species, passages may be necessary even on roads with very low traffic if these roads bisect areas containing required resources.

The purpose of this study was to determine which type(s) of road avoidance are responsible for road avoidance by small mammals. We conducted short- and long-distance translocations and trapping studies at different road sites of similar road type and width, but which differed widely in their traffic amounts. This allowed us to differentiate between the influences of the road surface itself and the traffic on the road. If small mammals avoid the road surface but are insensitive to traffic noise or individual cars, we predicted that small mammals should reduce their movements across roads relative to their movements in continuous habitat, and there should be no effect of traffic amount on across-road movement rate. Also, in this case small mammal densities should not be reduced near the road. In contrast, if small mammals avoid traffic noise but not the road surface itself, we predicted that the frequency of small mammal movements across roads should decrease with increasing traffic amount. General traffic avoidance should also result in lower small mammal densities near roads than further from roads. Finally, if small mammals avoid individual cars, we predict reduced across-road movement at very high traffic amounts but, unlike general traffic avoidance, a decrease in small mammal densities near roads should not occur.

The two small-mammal species studied, white-footed mice (*Peromyscus leucopus*) and eastern chipmunks (*Tamias striatus*), are sufficiently abundant for the translocation study. They also represent two different time-periods of activity relative to the peaks of traffic on the roads in our area. In our area, traffic amounts are highest from 7.00 a.m. to 9.00 a.m. and from 4.00 p.m. to 6.00 p.m. We expected that traffic amount would have a larger effect on cross-road movement by the eastern chipmunk than by the white-footed mouse, because the former is diurnal while the latter is nocturnal.

Materials and methods

TRAPPING STUDY

A trapping study was undertaken to survey the densities of small mammals, and to quantify small mammal movement. The goal of the trapping study was to determine whether (i) small mammals show a lower tendency to spontaneously move across roads than a similar distance where no road intervenes; (ii) the tendency for small mammals to move across roads decreases with increasing traffic; (iii) small mammal densities are lower near roads than further from roads; and (iv) densities of small mammals near roads decrease with increasing traffic on the road.

We established 13 trapping sites. Each site included a 100 m length of two-lane paved road with shoulders and ditches but without approaches, driveways, culverts, streetlights or sidewalks. At each site there was forest on both sides of the road. We obtained traffic estimates (average number of vehicles per day) from the City of Ottawa (May–June counts) and selected road segments to cover a large range of traffic values, from 47 to 15 433 vehicles per day.

Each trapping site consisted of three square trapping grids containing 36 traps at 10 m spacing (Fig. 1). Two of the grids were

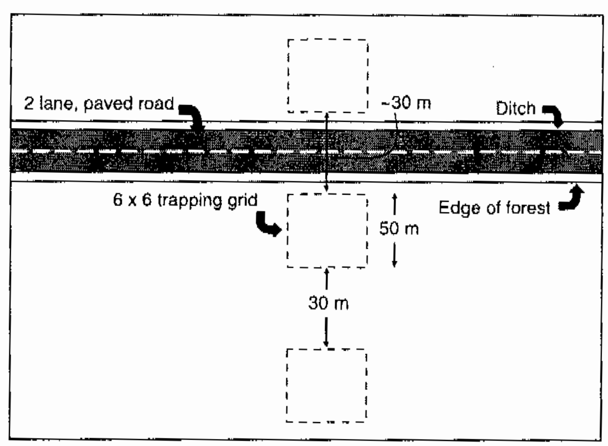

Fig. 1. Illustration of one trapping site for the trapping study (see Methods). Trapping was conducted at 13 similar sites, varying in traffic amount from 47 to 15 433 vehicles per day.

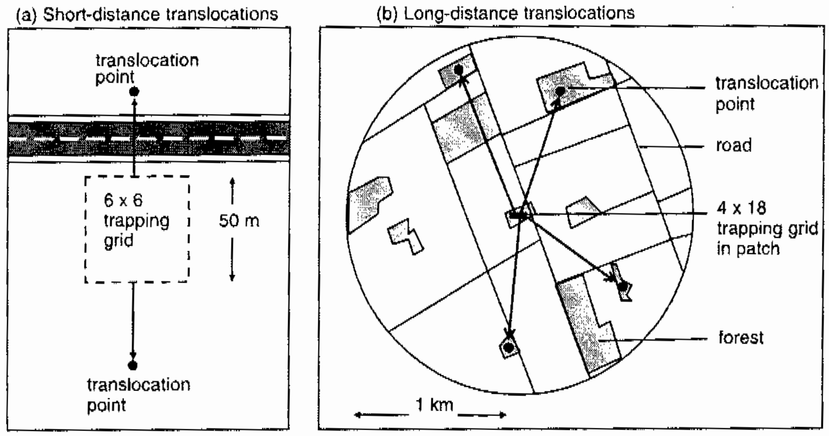

Fig. 2. Illustration of translocation experiments. (a) Short-distance translocations: animals were trapped and translocated 35 m from the edge of the trapping grid, either across the road or further into the forest. Fifteen sites were used, ranging in traffic amount from 47 to 15 433 vehicles per day. (b) Animals were trapped and translocated to another forest patch within 1.25 km of the trapping site. Twenty-four sites were used, with animals translocated across zero to four roads, with total traffic amounts of zero to 15 433 vehicles per day.

on either side of the road ('roadside grids') beginning 10 m from the road edge, so that all traps were in forest. The third grid ('interior grid') was further into the forest on one side of the road, with 30 m between the roadside grid and the interior grid, to match the distance approximately between the two roadside grids. We used Sherman™ non-folding aluminium traps baited with peanut butter and sunflower seeds to trap white-footed mice and eastern chipmunks. We trapped each site for 6 consecutive days, and checked traps each morning (8–10 a.m.) and late afternoon (4–5 p.m.). Captured animals were ear-tagged and released at point of capture.

A movement was recorded when an individual that was trapped and tagged at one grid was trapped later in another grid. We used a χ^2 contingency test to compare the number of small mammals that moved between the two roadside trapping grids (i.e. crossed the road) relative to the number that moved between the nearest roadside grid and the interior grid (i.e. moved a similar distance without an intervening road). We compared the number of animals trapped (index of density) near the road vs. numbers trapped further into the forest using a pairwise t-test, comparing the mean number of animals trapped at the two roadside grids to the number trapped at the forest interior grid for each site (Fig. 1). To determine whether traffic decreased the number of animals near roads, we performed a simple linear regression comparing the number of individual animals found in the roadside grids at each site to the traffic amount, for both species combined and for each species separately.

TRANSLOCATION STUDIES

From the trapping study (above), we determined that small mammals are unlikely to cross roads during their regular movements. However, even if small mammals are unlikely to cross roads during their regular movements, their motivation and tendency to cross roads may increase during particular movement events, e.g. during dispersal. To simulate such high-motivation situations, we performed translocation experiments in which we moved animals across roads and determined the probability that they returned to the point of capture. We performed these translocations in both the immediate neighbourhood of the road ('short-distance translocations'), to evaluate the effects of varying traffic amount while holding road type and size approximately constant, and over much longer distances ('long-distance translocations') to simulate dispersal movements more accurately. The translocation studies provided information on whether (i) small mammals translocated across a road are less likely to return than animals translocated a similar distance without an intervening road; (ii) the probability of animals returning across a road decreases with increasing traffic amount on the road; and (iii) the probability of small mammals returning following long-distance translocations decreases with increasing number of intervening roads and/or increasing traffic amount on the intervening road(s).

SHORT-DISTANCE TRANSLOCATIONS

We established 15 sites for the short-distance translocations. These sites were selected using the same criteria as in the trapping study, and they varied in traffic amount from 47 to 15 433 vehicles per day. With three exceptions, the short-distance translocation study sites were on the same road segments as in the trapping study, but displaced by about 200 m along the road. Each site consisted of one trapping grid of 36 traps (Fig. 2a). Captured white-footed mice and eastern chipmunks were ear-tagged and translocated in mesh bags 35 m from the edges of the grid, either across the road or further away from the road into the forest (Fig. 2a). At the two release points, the releaser stood between the released animals and the trapping grid from which they were removed. After releasing the animals, the releaser returned directly to the trapping grid. We trapped and conducted translocations at each site for 6 consecutive days, each morning (8–10 a.m.) and late afternoon (4–5 p.m.). Marked animals that were recaptured within the trapping session for each site were recorded as returned successfully.

We compared the returns of small mammals translocated across the road to those translocated on the same side of the road using a G-test of independence. We determined whether the probability of an animal returning from across the road decreased with increasing traffic amount using logistic regression analysis with traffic amount and species as predictor variables.

LONG-DISTANCE TRANSLOCATIONS

For the long-distance translocations, we trapped animals in 24 forest patches around the Ottawa region. In each patch, we used a rectangular grid of four transects at 10 m spacing, each containing 18 traps, with 5 m spacing between traps within transects. Each patch was trapped for 6 consecutive days. On initial capture, all white-footed mice and eastern chipmunks were marked with an ear tag and then translocated to another forest patch within 1·25 km of the trapping site (Fig. 2b). Tagged mice or chipmunks that returned within the trapping session were recorded as returning successfully.

We determined whether the probability of return of each species decreased with number of intervening roads (between the capture site and the translocation site) and total traffic amount on those roads, using stepwise multiple logistic regression analyses. We included distance between capture and release sites as a covariate in the analysis to control for the negative effect of translocation distance on small mammal return rates (Bender & Fahrig 2005).

Results

Although the roads and associated forest sites selected were as similar as possible (with the exception of traffic amount), it was not possible to control completely for variation in road width, canopy cover, canopy type and ground cover type. Road widths varied from 6·8 to 14·4 m for the pavement width only, and from 6·8 to 17·8 m for the pavement plus gravel shoulders. Mean canopy cover ranged from 20 to 55%. In six sites the dominant canopy trees were mainly coniferous, in five sites they were mainly deciduous and in five sites they were mixed. In eight of the sites the ground cover was mainly herbaceous vegetation, while in the other eight sites litter was the dominant ground cover.

However, these differences among sites were not correlated with traffic amount. The correlation between traffic amount and pavement width was $r = 0{\cdot}17$ ($P = 0{\cdot}53$, $n = 16$), between traffic amount and the width of pavement plus gravel shoulders was $r = 0{\cdot}37$ ($P = 0{\cdot}15$, $n = 16$) and between traffic amount and mean canopy cover was $r = -0{\cdot}23$ ($P = 0{\cdot}39$, $n = 16$). There was no significant relationship between traffic amount and dominant canopy tree composition [analysis of variance (ANOVA) $R^2 = 0{\cdot}04$, $P = 0{\cdot}75$, d.f. = 2,13], or between traffic volume and dominant ground cover (ANOVA $R^2 = 0{\cdot}002$, $P = 0{\cdot}86$, d.f. = 1,14). Because there was no association between site characteristics and traffic amount, site characteristics are unlikely to have confounded our results (below).

TRAPPING STUDY

We captured 136 white-footed mice and 104 eastern chipmunks in 8424 trap nights. Sixty-eight mice and 54 chipmunks were recaptured at least once after their initial capture (50% and 52% recaptured, respectively). Forty-one small mammals moved among grids; 36 (17 mice and 19 chipmunks) moved between roadside and forest interior grids, whereas only five (four chipmunks and one mouse) moved between roadside grids. This difference was statistically significant ($\chi^2 = 24{\cdot}4$, $n = 41$, $P < 0{\cdot}0001$). Due to the small number of animals crossing roads, we could not evaluate the effect of traffic amount on the probability of across-road movement.

There was no significant difference between the number of mice captured in roadside and interior grids (Fig. 3; paired-$t = 0{\cdot}24$, d.f. = 12, $P = 0{\cdot}82$). Roadside grids had significantly more chipmunks than interior grids (Fig. 3; paired-$t = 2{\cdot}9$, d.f. = 12, $P = 0{\cdot}014$). There was no significant effect of traffic amount on the number of animals trapped in the sites (Fig. 4; for mice: $F = 0{\cdot}02$, d.f. = 1,11, $P = 0{\cdot}88$; for chipmunks: $F = 2{\cdot}2$, d.f. = 1,11, $P = 0{\cdot}17$).

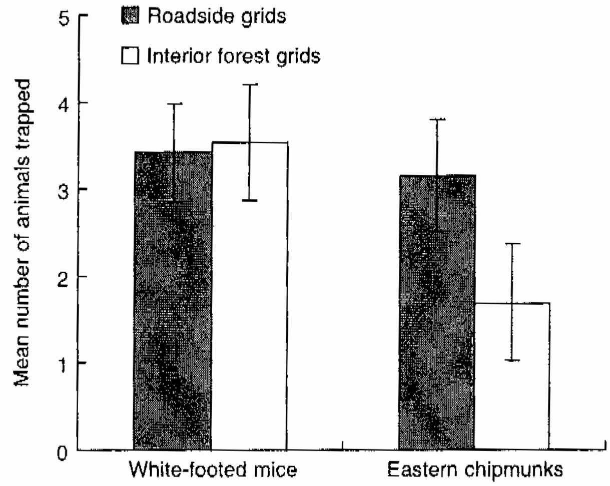

Fig. 3. Mean numbers (± SE) of white-footed mice and eastern chipmunks trapped in roadside trapping grids and interior forest trapping grids. There was no significant difference for white-footed mice (paired-$t = 0.24$, d.f. = 12, $P = 0.82$); the number of chipmunks trapped in roadside grids was significantly higher than the number trapped in interior forest grids (paired-$t = 2.9$, d.f. = 12, $P = 0.014$).

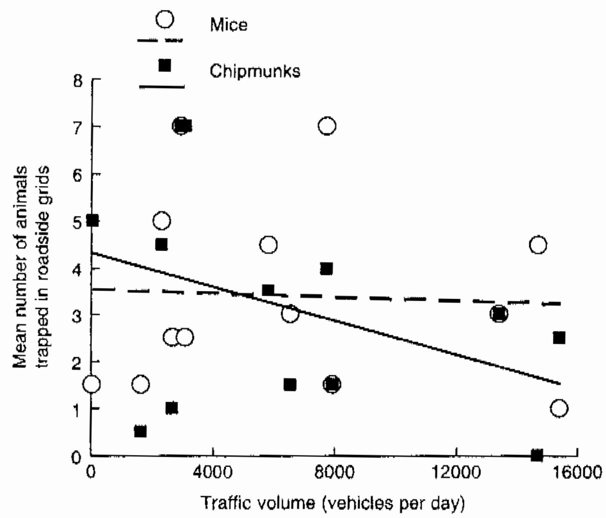

Fig. 4. Mean number of animals trapped in roadside grids vs. traffic amount; means were calculated for the two roadside grids at each site. Linear regression lines are shown, although both are non-significant at $\alpha = 0.05$ (white-footed mice: $F = 0.02$, $P = 0.88$; eastern chipmunks: $F = 2.2$, $P = 0.17$).

TRANSLOCATION STUDIES

Of the 91 small mammals translocated during the short-distance translocation study, 58 were recaptured. Of the 47 animals (22 white-footed mice, 25 eastern chipmunks) translocated across roads, 24 returned (13 mice, 11 chipmunks). Of the 44 small mammals (25 mice, 19 chipmunks) that were translocated on the same side of the road, 34 returned (18 mice, 16 chipmunks). Significantly more of the animals translocated on the same side of the road returned than for animals translocated across the road (Fig. 5; $G = 6{\cdot}9$, $n = 91$, $P = 0{\cdot}009$). Analysed separately, this result was due mainly to a significant reluctance of

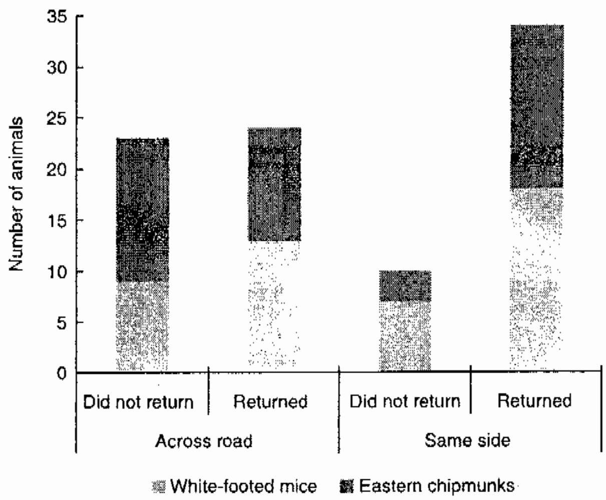

Fig. 5. Number of white-footed mice and eastern chipmunks returning to their capture sites after being translocated either across a road or the same distance further into the forest on the same side of the road as the capture site (see Fig. 2a). Fifteen sites were used, ranging in traffic amount from 47 to 15 433 vehicles per day. There was a significantly higher rate of return for animals translocated on the same side of the road than for animals translocated across the road ($G = 6.9$, $P = 0.009$), which was due mainly to a response by chipmunks (mice: $G = 0.87$, $P = 0.35$; chipmunks: $G = 7.8$, $P = 0.005$).

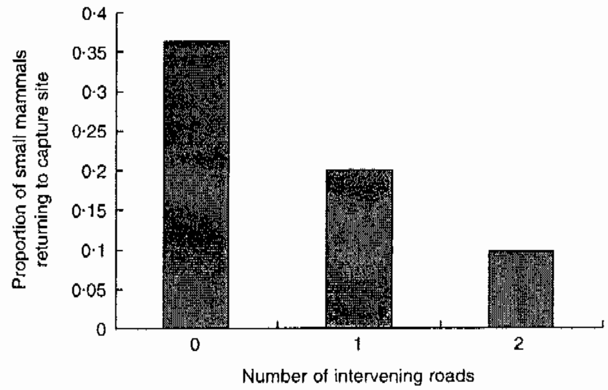

Fig. 6. Proportion of small mammals returning from long-distance translocations (see Methods), when translocated across zero, one or two roads (Table 1: Wald $\chi^2 = 16.1$, $P < 0.0001$). The number of animals translocated was 77, 170 and 62, respectively. In addition, two animals were translocated across three roads, and one animal was translocated across four roads; none of these three animals returned to its capture site.

chipmunks to return across the road (mice: $G = 0{\cdot}87$, $n = 47$, $P = 0{\cdot}35$; chipmunks: $G = 7{\cdot}8$, $n = 44$, $P = 0{\cdot}005$). For the 47 animals translocated across the roads, we found no significant effects of traffic amount (Wald $\chi^2 = 1{\cdot}5$, $P = 0{\cdot}22$), species (Wald $\chi^2 = 1{\cdot}7$, $P = 0{\cdot}2$) or the interaction between species and traffic amount (Wald $\chi^2 = 0{\cdot}63$, $P = 0{\cdot}43$) on the probability of small mammals returning to their initial capture site following translocation across roads.

In the long-distance translocation study, we marked and translocated 312 individuals (197 white-footed mice and 115 eastern chipmunks) from 24 patches over 10 368 trap nights. After controlling for a strong negative effect of distance between capture and translocation sites, we found that the number of intervening roads significantly negatively affected the probability of return of both white-footed mice (Wald $\chi^2 = 9{\cdot}1$, $n = 197$, $P = 0{\cdot}0025$; Table 1a) and eastern chipmunks (Wald $\chi^2 = 7{\cdot}2$, $n = 115$, $P = 0{\cdot}0072$; Table 1b). The probability of return decreased by about 50% with the addition of each intervening road (Fig. 6). The probability of return of white-footed mice was marginally significantly negatively affected by total traffic amount on the intervening roads ($\chi^2 = 2{\cdot}8$, $P = 0{\cdot}095$; Table 1a).

Table 1. Multiple logistic regression analysis results of the probability of small mammals returning to the site where they were captured following long-distance translocations on translocation distance, traffic amount, and number of intervening roads (see Methods; n = 197 white-footed mice and 115 eastern chipmunks)

Parameter	Estimate	Wald χ^2	P
(a) *Peromyscus leucopus* (white-footed mouse)			
Intercept	0·71	3·3	0·069
Translocation distance	−0·0033	16·7	< 0·0001
Number of roads	−0·85	9·1	0·0025
Traffic	−0·00011	2·8	0·095
(b) *Tamias striatus* (eastern chipmunk)			
Intercept	1·02	2·6	0·11
Translocation distance	−0·0046	9·3	0·0023
Number of roads	−1·4	7·2	0·0072
Traffic	−0·00006	0·45	0·50

Discussion

Taken together, our results suggest that small mammals avoid the road surface itself rather than traffic noise or other emissions. There are three lines of evidence that support this conclusion. First, we predicted that if small mammals avoid the road surface, they should show reduced movement across roads relative to movements on the same side of the roads. Both the trapping study and the translocation studies supported this prediction. Very few animals moved across roads in the trapping study. In the short-distance translocations, 51% of the small mammals that were translocated across roads returned, in comparison to 77% of the animals that were translocated a similar distance within the forest. Kozel & Fleharty (1979) also found that over half of all rodents (including *P. maniculatus*, a close relative of *P. leucopus*) translocated across roads did not return. Bakowski & Kozakiewicz (1988) found that bank voles translocated into continuous forest returned to the trapping grid faster and in greater numbers than those translocated to the other side of a road. Our long-distance translocation study was consistent with the short-distance translocation results; each intervening road reduced the probability of successful return by about 50%. Of course, the fate of the animals that did not return is unknown. We do not know whether they avoided the roads or were killed on them. However, if it was mortality, the return rate should have decreased with increasing intervening traffic amount, which it did not.

Secondly, we predicted that if small mammals only avoid the road surface and not traffic noise or other emissions, the probability of movement across roads should not change with increasing traffic amount. On the other hand, if they are repelled strongly by traffic noise (or suffer from direct traffic mortality), the probability of movement across roads should decrease with increasing traffic amount. We found no significant effects of traffic amount on return rates in either the short-distance or the long-distance translocation studies, even though our study sites varied widely in traffic amounts. Note that these results do not preclude the possibility that small mammals show a weak negative response to traffic. There are several possible sources of noise in the data, including variations in habitat type, between-individual capturability and possible tag losses, which could obscure a weak response to traffic.

Thirdly, we predicted that if small mammals only avoid the road surface, their densities should not be reduced near roads. In contrast, if they avoid traffic noise, the densities should be lower near roads, and the densities near roads should decrease with increasing traffic amount. Small mammal densities were not reduced near roads; in fact, densities of eastern chipmunks were actually higher near the roads. This increase may have resulted from the combined effects of the road acting as a barrier to movement and the habitat edge along the road funnelling movement along it (e.g. Doncaster *et al.* 2001). Garland & Bradley (1984) found no relationship between proximity to a road and home range size or life span of desert rodents. We also found no evidence for a decrease in density near roads with increasing traffic amount (with the same caveat as above). These results suggest that small mammals mainly avoid the road surface itself, rather than emissions such as noise from the traffic on the roads.

Our results are equivocal on the issue of whether small mammals avoid individual cars, waiting for a break in traffic before attempting to cross a road (car avoidance). For car avoidance we predicted that across-road movements would decrease with very high traffic amounts, with no decrease in small mammal density near roads. We found a small, marginally significant decrease in return rates with increasing traffic amount for white-footed mice in the long-distance translocation experiment. For car avoidance, one might not expect a strong statistical effect, because even on busy roads there are time-periods when traffic is lighter and when car-avoiding animals might find sufficient breaks in traffic to cross the road. We found no decrease in small mammal density near roads, even high-traffic roads, which is consistent with car avoidance. Although we did not search systematically for carcasses, we did not observe any dead mice or chipmunks in over 600 h of field work. Therefore, we cannot rule out the possibility that mice and chipmunks avoid individual cars. Further research is needed to test this conclusively.

We had expected a stronger effect of traffic on eastern chipmunks than on white-footed mice, because eastern chipmunks are diurnal and therefore more exposed to traffic than white-footed mice, which are nocturnal. Although our results suggest that eastern chipmunks may avoid roads more strongly than white-footed mice (Fig. 5), there was no evidence to suggest a difference between the two species in their responses to traffic amount. The fact that we did not find a stronger effect of traffic amount on eastern chipmunks than on white-footed mice further supports our conclusion that small mammals avoid the road itself rather than the traffic on it. A road is present and creating a barrier to movement at all times, whether the animal approaches it during the day (eastern chipmunks) or night (white-footed mice), and whether or not there is traffic on it.

Our results were not confounded by associations between traffic and site characteristics. Dominant canopy type (coniferous, deciduous or mixed), percentage of canopy cover and dominant ground cover type (litter or vegetated) were not related to traffic. The roads were selected purposefully to be as similar in width as possible. Unavoidably, there was a weak (although not statistically significant) positive correlation between total road width (pavement plus gravel shoulder) and traffic ($r = 0{\cdot}37$, $P = 0{\cdot}15$, $n = 16$). We might have expected this weak correlation to result in a spurious negative effect of traffic amount on movement across roads. As we did not find a relationship between traffic amount and movement across roads, our conclusion that small mammals avoid the road surface itself rather than traffic noise or other emissions is robust.

This study is the first to show, over a wide range of traffic amounts, that traffic amount plays little or no role in road avoidance by white-footed mice and eastern chipmunks. Goosem (2002) studied the effect of traffic amount on road crossing by small mammals on narrow, dirt, rainforest roads that ranged in traffic amounts. As in our study, she found little or no effect of traffic amount on small mammal road-crossing. However, the traffic amounts on the roads in Goosem (2002) were all very low (less than a few hundred cars per day). Our study extends this by showing that small mammals do not respond to a very large range in traffic amount, from less than 50 to over 15 000 vehicles per day.

Jaeger *et al.* (2005) argue that the type of avoidance, i.e. avoidance of the road itself or the traffic on the road, is critical for predicting the probable effects of roads on population persistence. Small mammals in the Ottawa area are known to suffer frequent local extinctions (about 5–15%) due to high overwintering mortality (Merriam & Wegner 1992). If roads create partial barriers to movement, this could reduce the likelihood and/or the speed of recolonization of empty forest patches in the spring and summer. According to the model proposed by Jaeger *et al.* (2005), animals that show road surface avoidance should be highly vulnerable to these effects. Therefore, our results imply that small mammal population sizes should be lower in landscapes with higher road densities. On the other hand, if small mammals do avoid cars, as hinted at by our data, the predicted effect of road density on small mammal populations would be lessened (Jaeger *et al.* 2005). We are not aware of any data available to evaluate the effect of road density on small mammal populations; this will require further research.

Although our results and those of Goosem (2002) suggest that small mammals do not show general traffic avoidance, there is some evidence that larger animals may avoid traffic.

Results of radiotelemetry studies on black bears (Brody & Pelton 1989; Beringer *et al.* 1990) and bobcats (Lovallo & Anderson 1996) have been interpreted as evidence of traffic avoidance, although a radiotelemetry study of grizzly bears indicated that road avoidance was independent of traffic amount (McLellan & Shackleton 1988). Seiler (2005) found that the traffic mortality of moose in Sweden increased with increasing traffic amount up to about 5000 vehicles per day, but then decreased at higher traffic amounts. He interpreted this to mean that moose avoid high-traffic roads. Similarly, an analysis of badger traffic mortality in Britain showed that badger deaths increased asymptotically with traffic amount; again the authors interpreted this to mean that badgers showed avoidance of high traffic roads (Clarke *et al.* 1998). In these studies, traffic amount was confounded with road size and/or type, so the conclusions regarding traffic amount are not definitive. A recent study of elk response to off-road all-terrain vehicles provides the strongest evidence of animals moving to avoid vehicles (Preisler *et al.* 2006).

Finally, our study has implications for the effectiveness of different possible mitigation strategies aimed at reducing the barrier effect of roads on small mammal movement. Measures aimed at reducing traffic amount or traffic speed or altering the timing of traffic seasonally or daily would not mitigate effectively the effects of roads on small mammal movement. More effective measures might be construction of suitable wildlife passages (Clevenger *et al.* 2001; McDonald & St. Clair 2004b), reduction of the width of the road and/or the road right-of-way, and in extreme cases (e.g. mitigation for endangered species), removal of the road itself. Our results also support the suggestion that conservation of large roadless areas should be a priority (Crist *et al.* 2005).

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Elements that promote highway crossing structure use by small mammals in Banff National Park

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Summary

1. Corridors provide important structural connectivity in habitats that have been fragmented by human activities, but more empirical work is needed to identify the attributes of effective corridor design under a broad range of ecological conditions.
2. We tested the efficacy with which murid rodents in Banff National Park, Alberta, Canada, used crossing structures constructed across the Trans-Canada Highway. We studied the effects of size, vegetative cover at entrances, and distance from home ranges as determinants of crossing structure use with potential relevance to other corridor types.
3. We translocated animals across underpasses and overpasses, coated them with fluorescent dye, released them at standardized distances, and followed them to obtain detailed information on two scale-dependent movement parameters, return success and tortuosity (or complexity) of movement paths, as well as a scale-independent metric of movement, the fractal dimension.
4. Translocated animals returned with higher success across smaller crossing structures than across larger ones, perhaps because these structures afforded more overhead cover from predators.
5. Adding overhead cover to crossing structure entrances further improved return success and correlated with more tortuous movement of translocated animals.
6. Animals translocated further (60 m) from crossing structures returned with lower success than those translocated closer to them (20 and 40 m). Among the three species studied (deer mice *Peromyscus maniculatus*, meadow voles *Microtus pennsylvanicus* and red-backed voles *Clethrionomys gapperi*), deer mice had significantly higher return success at 60 m, perhaps owing to their larger home range sizes and willingness to cross the road directly.
7. *Synthesis and applications*. Ideal crossing structure characteristics will often be species-specific, even within guilds of animals. Our results imply that wildlife corridors, more generally, need to offer sufficient cover and be placed with a frequency that corresponds to the spatial scale over which targeted species move.

Key-words: barriers, habitat connectivity, habitat fragmentation, mammals, road ecology, rodents, wildlife corridors.

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Introduction

Corridors have been widely advocated as essential components of reserve design because they can connect isolated areas of suitable habitat and thus minimize the harmful effects of habitat fragmentation on animal movement (Noss 1987; Bennett 1990; Saunders, Hobbs & Margules 1991). A lack of movement in fragmented landscapes can reduce visitation and immigration rates, alter patterns of gene flow (Andrén 1994), affect the persistence of the inherently smaller populations (Wilcox & Murphy 1985; Rosenberg, Noon & Meslow 1997) and alter ecological interactions (Tewksbury *et al.* 2002). Despite the intuitive logic of corridors, there has been much discussion about whether corridors actually facilitate animal movement (Noss 1987; Simberloff & Cox 1987; Simberloff *et al.* 1992; Beier & Noss 1998),

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mainly due to a lack of empirical evidence (Rosenberg, Noon & Meslow 1997). Enduring uncertainty stems from the fact that structural corridors do not necessarily function as movement corridors (Hess & Fischer 2001) and that the functional connectivity of landscapes more generally is likely to be species-specific (Beier & Noss 1998; Haddad *et al.* 2003).

Although much of the support for the role of corridors in species conservation has been conceptual or theoretical (Simberloff & Cox 1987; Simberloff *et al.* 1992; Meffe & Carroll 1994), recent empirical evidence from microcosm studies demonstrates increased population persistence in the presence of corridors (Gilbert, Gonzalez & Evans-Freke 1998; Coffman, Nichols & Pollock 2001). Recent field studies have also shown that corridors increase population density within patches (Haddad & Baum 1999), interbreeding among patches (Mech & Hallett 2001) and interpatch movement (Haddad 1999). Yet other empirical studies have reported that corridors did little or nothing to enhance animal movement (Mabry & Barrett 2002; Haddad *et al.* 2003) or abundance (Hannon & Schmiegelow 2002). Unfortunately, in each of these studies movement in corridors was inferred from patterns of population redistribution, which makes it difficult to identify the variety of factors that influence corridor use (Simberloff & Cox 1987; Andreassen, Halle & Ims 1996). To assess accurately whether or not corridors provide functional connectivity between isolated patches, more direct measures of corridor efficacy should be employed, such as the precise trajectories of moving animals while they are travelling to find and use corridors (Haddad 1999; Berggren, Birath & Kindvall 2002). Examination of specific movement patterns may also reveal the particular corridor configurations that are most attractive to moving animals. Configuration variables of potential importance include dimensions (Clevenger, Chrusz & Gunson 2001), amount of vegetative cover (Yanes, Velasco & Suarez 1995) and the distance between corridors and the home ranges of resident animals (Rosenberg, Noon & Meslow 1997). Corridor use may also change with species-specific perceptions of landscape elements (Haddad 1999), which may stem from differences in a variety of natural-history characteristics (*sensu* Ims 1995), ranging from activity pattern to habitat selection.

Corridor function may change predictably with landscape context, for example with increases in road networks. Roads can act as severe impediments to animal movement (Forman 1998), potentially causing genetic differentiation among fragmented populations (Aars & Ims 1999; Gerlach & Musolf 2000). The Trans-Canada Highway (TCH), which bisects limited montane habitat to parallel the Bow River in Banff National Park, Alberta, Canada, is reported to be a severe barrier to the movement of a variety of large mammal species (Clevenger, Chrusz & Gunson 2001). To facilitate movement across the TCH, crossing structures have been constructed comprising two wildlife overpasses and 22 wildlife underpasses of various sizes. Together with drainage culverts, these crossing structures have been shown by descriptive and correlative study to function as movement corridors for a wide variety of animals (Clevenger & Waltho 2000; Clevenger, Chrusz & Gunson 2001). The constancy of the road barrier and the replication of crossing structures also provide an opportunity for replicated, experimental study of some of the characteristics of crossing structures, which may provide some insights for corridor design more generally.

Such studies are difficult with rare and wide-ranging animals, which have often been the focus of study in natural corridor-containing landscapes (Beier & Noss 1998) and have also been emphasized in Banff (Gloyne & Clevenger 2001). We examined crossing structure features using three species of murid rodents (meadow voles *Microtus pennsylvanicus*, deer mice *Peromyscus maniculatus* and red-backed voles *Clethrionomys gapperi*), which exhibited differences in preferred habitat (open grasslands for meadow voles, forested habitats for red-backed voles and a mix of the two for deer mice), diel activity patterns (meadow voles are primarily diurnal whereas the other two species are active mainly at night) and home range size (deer mice *c.* 1·2 ha, red-backed voles *c.* 0·7 ha, meadow voles *c.* 0·1 ha; reviewed by Banfield 1981). Although we could not manipulate or replicate variation in life-history traits, we discuss the ways that they may have influenced differences among our three species in their responses to crossing structure attributes.

Our objectives were to assess how small mammals used crossing structures in response to three kinds of characteristics: crossing structure size, vegetative cover at crossing structure entrances, and the distance between crossing structures and the home ranges of target individuals. We assessed small mammal use of these crossing structure characteristics by translocating territorial individuals (*sensu* With 1994; Zollner & Lima 1999; Bélisle & St. Clair 2001) across the TCH adjacent to different wildlife crossing structures, and monitoring the success and path characteristics with which they returned to their home ranges. For the latter, we measured tortuosity (Nams 1996; indicating the degree to which a path twists) and fractal dimension, a scale-independent measure of path convolution (With 1994; Nams 1996).

Methods

STUDY AREA AND TRANSLOCATIONS

Field data were collected from 1 July to 15 October 1999 and 2000 in the Bow River Valley along the TCH, a major transportation corridor that carries as many as 5·4 million vehicles year^{-1} (Clevenger & Waltho 2000) through Banff National Park. More than half the length of the TCH within the park comprises four lanes, which are bordered on both sides by a 2·4-m high wildlife exclusion fence that limits the cross-valley movement of large mammals. Meadow voles, red-backed voles and deer mice were captured using Longworth live-traps baited with sunflower seeds, and individuals were permanently marked using numbered metal ear tags (National Band and Tag Company, Newport, KY). The sex of each captured animal was determined via examination of anogenital distance. Individuals were inspected to determine their reproductive condition and weighed with a Pesola™ spring scale to determine age classes (adult or juvenile). Translocations directly across the TCH were conducted to ensure that each individual had a similar motivation to return to its home territory across different crossing structure conditions. Individuals were first captured three times within 50 m of one or the other end of wildlife crossing structure entrances to establish their residency, and then moved across the TCH to the desired release points in areas adjacent to crossing structures. Animals were translocated to both the up-drainage ($n = 118$) and down-drainage ($n = 138$) sides of the crossing structures. We did not control for drainage direction because we considered it unlikely that animals would be affected by the small elevation gained or lost over these short distances (typically *c.* 60 m).

The translocations were used to assess small mammal responses to variation in crossing structure size, vegetative cover at crossing structure entrances, and the distance between crossing structures and the home ranges of target individuals. To assess preferences in crossing structure type, individuals were translocated to within 2 m of the entrances to two 15-m wide wildlife overpasses, which were covered with sparse trees and shrubs amid patches of bare ground and had a length of either 75 m or 79 m; nine 3-m diameter soft-bottomed, arch-shaped underpasses, which contained no vegetative cover inside or at the entrances and had a mean length/range of 68 m/64–73 m; and nine 0·3-m diameter metal drainage culverts, which contained introduced grasses near their entrances and had a mean length/range of 65 m/63–72 m. To determine the role of ground cover in improving the function of crossing structures, we translocated individuals across two wildlife overpasses ($n = 13$) and nine 3-m diameter wildlife underpasses ($n = 26$) and released them within 2 m of real or hypothetical brush piles. Prior to all translocations, the amount of cover (heavy, medium or none) was varied at both of the entrances to crossing structures using freshly cut spruce boughs to represent natural cover. The brush piles across the entrances to the overpasses extended for the full width of each overpass entrance. In the heavy, medium and no cover treatments, approximately 100%, 50% and 0%, respectively, of the ground area 2 m inside and outside of the entrances to the wildlife crossing structures was covered with spruce boughs. As a final experiment to quantify the distance that displaced individuals would travel to their home ranges via crossing structures, we captured individuals adjacent to the TCH and translocated them directly across the road to similar habitat in the vicinity of 3-m diameter wildlife underpasses. Animals were captured and released at distances of 20 m, 40 m and 60 m from the underpasses (Fig. 1) so that individuals were always released at a constant (approximately 80 m) distance from their capture locations, but at varying distances from the nearest culvert. Each individual was translocated only once and we used approximately equal numbers of each species at each crossing type.

Prior to their release, all animals were marked with a small quantity of fluorescent powder (Radiant™ fluorescent pigment, Radiant Color Inc., Richmond, CA), which fell off as animals moved along the ground, permitting the fine-scale monitoring of movement paths (Leman & Freeman 1985). Individuals created a pigment trail that we were able to track for a mean of 4·5 days (SD 1·2 days, range 4·1–5·3 days). Movement responses were quantified as the return success and path characteristics of individuals as they encountered crossing structures. We monitored traps at each individual's original capture location for 4 days following its translocation to determine the proportion of translocated animals that returned successfully. Each animal that failed to return within 4 days was captured at or near its release location and returned manually.

MOVEMENT METRICS

Mice and voles were released 2 m from the entrances to crossing structures at the beginning of their active periods; early morning for the diurnal meadow voles and early evening for the nocturnal deer mice and red-backed voles. The path of each translocated individual was followed the next evening with a hand-held ultraviolet light, which caused the pigment in the dye to fluoresce, revealing a bright trail representing each animal's precise trajectory. Wire pin flags were placed along the trails at each turn where the compass bearing differed by at least 20 degrees from the previous bearing (after Turchin 1998). By subtracting the compass bearing of each step (the straight-line distance between sequential turns) from the bearing of the subsequent step, we converted the bearings to turning angles for subsequent analysis.

To calculate the squared net displacement of the path (the square of the total distance that an animal had travelled from the release point to the end of the path; Turchin 1998) in a given habitat, step lengths and turning angles were converted into x–y coordinates. Dividing the total path length by the net displacement squared yielded an estimate of the overall path tortuosity.

STATISTICAL ANALYSES

We analysed the binary dependent variable, return success, with logistic regression using a model-building strategy described by Hosmer & Lemeshow (1989). To allow for the inclusion of biologically important variables in the model, univariate tests (which were effectively G-tests for the categorical independent variables) were conducted with an alpha level set liberally at 0·25 to identify significant main effects from all candidate

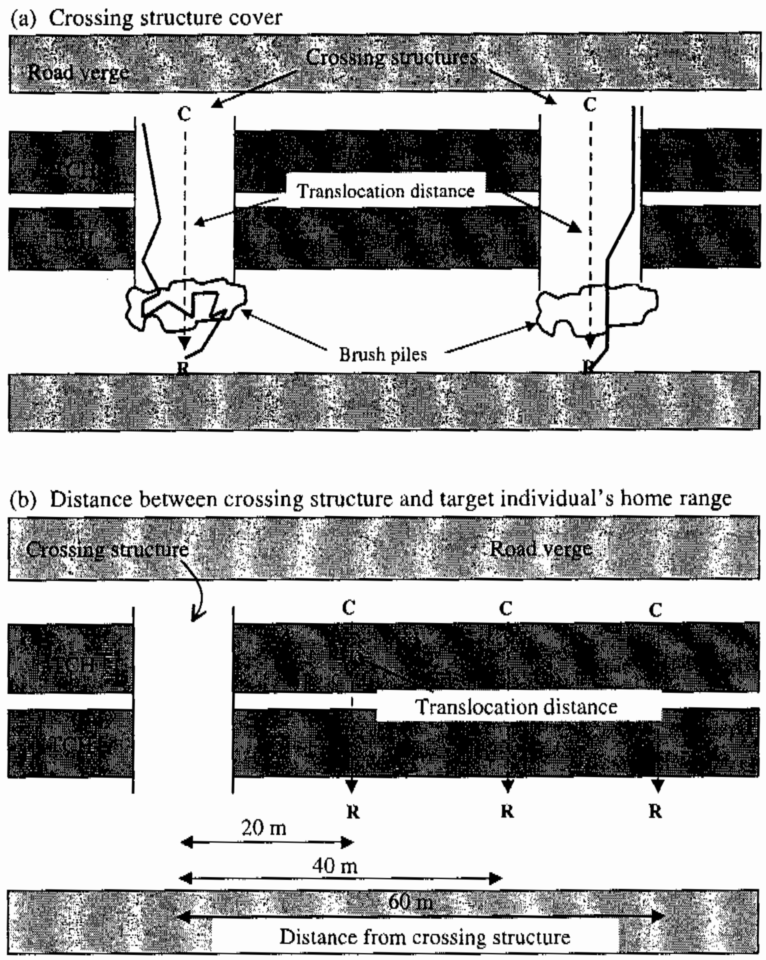

Fig. 1. (a) Small mammals were translocated directly across crossing structures with brush piles at the entrances, showing a typically tortuous path (left) and a non-tortuous path (right). (b) Small mammal translocations conducted at crossing structure distances of 20 m, 40 m and 60 m from nearby culverts. Original capture (C) and release locations (R) along the TCH are depicted. Translocation distance refers to the distance animals were moved across the TCH between the original capture location and release sites.

variables. Each of the three experiments had four independent variables: species (deer mice, meadow voles and red-backed voles), treatment (see below), translocation distance (the distance animals were moved across the TCH between the original capture location and release point; mean/range = 70 m/63–79 m) and sex. The treatment in the first experiment examined crossing structure preference by comparing overpasses, 3-m diameter underpasses and 0·3-m diameter culverts. The treatment variable for the second experiment compared cover manipulations that provided heavy, medium and no cover. In the third experiment, treatment described crossing structure distance, the distance from each target individual's home range to the nearest crossing structure within categories of 20, 40 and 60 m.

All variables that the univariate tests identified as significant were fitted into a combined model, and those that remained significant (using a likelihood ratio test) were retained in a reduced model. To assess the effect of variables that were removed, but confounded with the remaining variables, changes in the beta coefficients of the remaining variables with and without the non-significant variables were examined. Linearity of the continuous variables was tested using a likelihood ratio test comparing a model containing only the linear term to a model with the addition of the quadratic term. Two-way interaction terms with plausible biological meaning were entered, one term at a time, into the reduced main-effects model (species by treatment, species by sex, and sex by treatment). The significance of these interaction terms was verified with a likelihood ratio test examining changes in deviance between the models with and without the interaction term. Finally, a reduced model with the significant main effects and interaction terms was constructed and its fit to the data was assessed using the Nagelkerke's r^2, which provides an approximate measure of the strength of association between the dependent and independent variables. The Hosmer and Lemeshow test statistic was also used to assess the fit of models produced by the logistic regression model (Hosmer & Lemeshow 1989). Hosmer and Lemeshow probability values approaching 1·0 indicate that the candidate model fits the data quite well.

We used multivariate ANOVAS to analyse path elements of tortuosity and fractal dimension. No path data were collected for the crossing structure preference experiment because they could not be collected within the small crossing structures used for this component. We adopted a model-building strategy similar to the one above, identifying significant main effects in a reduced model and then testing interaction terms one at a time. Post-hoc analyses via Tukey's honestly significant difference (HSD) tests were used to determine the significance of pairwise comparisons among several means (Zar 1996). We assessed the model's fit to the data using the adjusted r^2 and we followed each negative result with a power analysis revealing the probabilities of both type I (P_a) and type II error (P_b). Tortuosity and fractal dimension measures did not meet assumptions of normality, so log transformations were performed to normalize the data.

Fractal geometry was used to generalize movement effects across spatial scales (Wiens & Milne 1989; Sugihara & May 1990). We conducted fractal analysis using the FRACTALS program (Nams 1996), which estimates the fractal dimension (D) of a movement path that is assumed to be scale-independent. Thus D measured for a movement trail at a scale of centimetres long would be the same as D measured at a scale of metres or kilometres long (Turchin 1996). Although there is some question as to whether fractal analysis represents a truly scale-independent metric of movement (Turchin 1996), fractals have been used to assess differences in movement patterns for different species and across a range of spatial scales in a scale-independent manner (With 1994; Nams 1996).

Results

Because no experimental subjects disappeared or were killed on the highway (n = 166), we were able to categorize every translocated animal as having either succeeded (n = 90) or failed (n = 76) to return. Those animals that failed to return had moved on average 19·49 m in a relatively straight line away from the TCH. The number of translocated animals that successfully returned to their original capture locations in the crossing structure preference experiment was affected by crossing structure type [logistic regression (LR): χ^2 = 13·5, d.f. = 2, P = 0·004] and species (χ^2 = 8·9, d.f. = 2, P = 0·011), but not by sex (χ^2 = 0·56, d.f. = 1, P = 0·45) or translocation distance (χ^2 = 0·98, d.f. = 1, P = 0·32). The overall model (χ^2 = 30·67, d.f. = 8, P < 0·001) provided a good fit to the data [Nagelkerke's r^2 = 0·56; Hosmer & Lemeshow (H&L) test: χ^2 = 3·8, d.f. = 8, P = 0·87; percentage correctly classified in 0 and 1 categories, 68% and 86%, respectively]. All species were more successful returning through 0·3-m diameter culverts than through 3-m diameter underpasses, and least successful returning across overpasses. Deer mice had a higher return success than the other two species through all crossing structures, while meadow voles exhibited the lowest return success across all structures or were unable to return altogether (Fig. 2). The mean time to return for animals in the crossing structure preference experiment was 1·6 days (SD 0·5 days, range 1–3 days). No animals returned successfully without using crossing structures in this experiment.

When investigating the role of vegetative cover in crossing structure attractiveness, we found that return success was affected by the amount of cover provided (χ^2 = 6·88, d.f. = 2, P = 0·032) and by species (χ^2 = 7·15, d.f. = 2, P = 0·028), but not by sex (χ^2 = 0·033, d.f. = 1, P = 0·86) or translocation distance (χ^2 = 0·005, d.f. = 1, P = 0·94). The overall model (χ^2 = 15·5, d.f. = 4, P = 0·004) again provided a good fit to the data (Nagelkerke's r^2 = 0·50; H&L test: χ^2 = 1·1, d.f. = 7, P = 0·88; percentage correctly classified in 0 and 1 categories, 75% and 79%, respectively). Individuals were much more

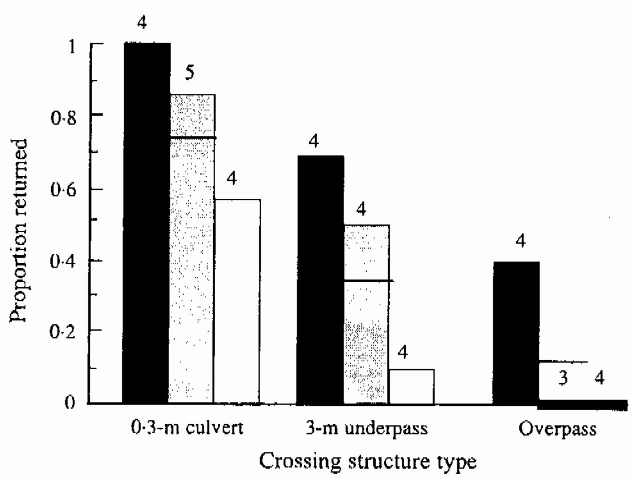

Fig. 2. Proportion of small mammals that successfully returned following translocations across 0·3-m diameter underpasses, 3-m diameter underpasses, and overpasses. Black columns represent deer mice, white columns meadow voles and grey columns red-backed voles. Black lines represent the adjusted means for each treatment and a heavy black line on the x axis indicates that no animals returned. Sample sizes (n) are above each bar.

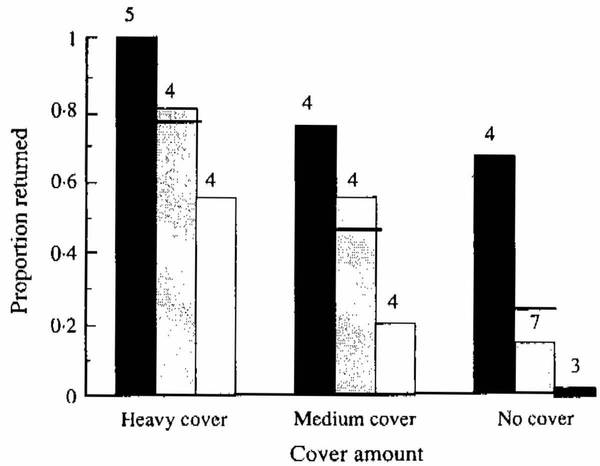

Fig. 3. Proportion of small mammals that successfully returned following translocations under three cover treatments; heavy, medium and no cover. Black columns represent deer mice, white columns meadow voles and grey columns red-backed voles. Black lines represent the adjusted means for each treatment and a heavy black line on the x axis indicates that no animals returned. Sample sizes (n) are above each bar.

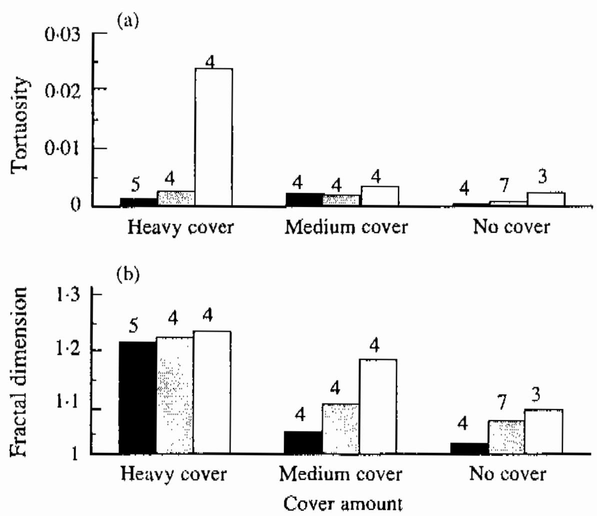

Fig. 4. (a) Tortuosity values and (b) fractal dimensions of translocated small mammals encountering three cover treatments, heavy, medium and no cover. Black columns represent deer mice, white columns meadow voles and grey columns red-backed voles. Sample sizes (n) are above each bar.

successful returning through crossing structures with heavy cover provided at the entrances than through structures with medium or no cover provided. Again, meadow voles experienced much lower return success through all crossing structures than either deer mice or red-backed voles (Fig. 3). The mean time to return for animals in the crossing structure cover experiment was 2·9 days (SD 1·6 days, range 1–4 days). As above, no animals crossed the highway without using crossing structures.

Path tortuosity also changed when different amounts of cover were provided (ANOVA $F_{2,39} = 7·49$, $P = 0·003$, adjusted $r^2 = 0·59$; Fig. 4a). Individuals exhibited more tortuous movement paths when heavy cover was provided than in either the medium (Tukey's HSD, mean difference = 0·22, $P = 0·031$) or no cover treatments (Tukey's HSD, mean difference = 0·68, $P < 0·001$). Paths were also more tortuous in the medium cover treatment than when no cover was present (Tukey's HSD, mean difference = 0·45, $P < 0·001$). There were further tortuosity differences among species ($F_{2,39} = 11·29$, $P < 0·001$). Deer mice moved in a significantly less tortuous manner for all cover treatments than red-backed voles (Tukey's HSD, mean difference = −0·29, $P = 0·004$) and meadow voles (Tukey's HSD, mean difference = −0·79, $P < 0·001$). Red-backed voles, in turn, exhibited less tortuous paths than meadow voles (Tukey's HSD, mean difference = −0·50, $P < 0·001$). The sexes did not differ in the tortuosity of their paths ($F_{1,39} = 0·46$, $P_a = 0·50$), but this test had very low power to detect potential differences ($P_b = 0·61$). A significant interaction between cover amount and species in the degree of tortuosity exhibited for each path revealed that meadow voles showed disproportionately high tortuosity under heavy cover, a habitat least similar to their preferred open meadow, relative to the medium and no cover treatments

($F_{4,39} = 7.09$, $P = 0.001$). There were no significant interactions between sex and cover amount ($F_{2,39} = 0.061$, $P = 0.94$) or species and sex ($F_{2,39} = 0.32$, $P = 0.73$).

Fractal geometry was used as a complementary, but scale-independent, measure of movement responses to different cover amounts. Fractal dimensions of individual paths differed significantly among the different cover amounts ($F_{2,39} = 156$, $P < 0.001$, adjusted $r^2 = 0.82$; Fig. 4b). As with the scale-dependent tortuosity measurement, mice and voles had significantly higher fractal values, indicating that they moved with more complex paths in the heavy cover treatment than in the medium (Tukey's HSD, mean difference = 0·11, $P < 0.001$) and no cover treatments (Tukey's HSD, mean difference = 0·16, $P < 0.001$). Like the pattern observed for path tortuosity, individuals moving through medium cover had significantly higher fractal dimensions than when no cover was present (Tukey's HSD, mean difference = −0·052, $P < 0.001$) and these differences were consistent among species. Although the qualitative response to different cover amounts was similar among species, absolute fractal dimensions differed ($F_{2,39} = 28.8$, $P < 0.001$). Again, like the pattern observed for return success and tortuosity, deer mice paths had lower fractal D estimates than either red-backed voles (Tukey's HSD, mean difference = −0·064, $P < 0.001$) or meadow voles (Tukey's HSD, mean difference = −0·087, $P < 0.001$), and red-backed voles showed marginally lower fractal values than meadow voles (Tukey's HSD, mean difference = −0·023, $P = 0.053$). Sex had no effect on the fractal values of translocated animals in a test with moderate statistical power ($F_{1,39} = 3.12$, $P_a = 0.099$, $P_b = 0.22$), although there was a slight trend for females to have higher values than males. Among the three interaction terms we investigated, only cover amount by species was significant and indicated proportionately more complex paths displayed by meadow voles in medium cover and deer mice in heavy cover ($F_{4,39} = 5.25$, $P = 0.004$).

The final experiment showed that the return success of individuals was affected by crossing structure distance, the distance animals had to travel back to their home ranges using wildlife crossing structures ($\chi^2 = 9.16$, d.f. = 2, $P = 0.010$), and species ($\chi^2 = 23.8$, d.f. = 2, $P < 0.001$), but not by sex ($\chi^2 = 1.26$, d.f. = 1, $P = 0.262$) or translocation distance ($\chi^2 = 0.57$, d.f. = 1, $P = 0.449$). The overall model (LR: $\chi^2 = 38.2$, d.f. = 4, $P < 0.001$) provided a good fit to the data (Nagelkerke's $r^2 = 0.53$; H&L test: $\chi^2 = 1.69$, d.f. = 6, $P = 0.95$; percentage correctly classified in 0 and 1 categories, 81% and 80%, respectively). For this, and each previous logistic regression the qualitative results of the analysis were unchanged when backward stepwise logistic regression was performed as an alternative to the model building procedure we described above. Individuals were less successful returning to home ranges as crossing structure distance increased. It appeared that this effect was driven mainly by the very low return success exhibited by animals translocated 60 m from crossing structures because there was no significant difference in return success between animals translocated 20 m and 40 m from crossing structures. Meadow voles had the lowest return success across all distances, while deer mice tended to return most often (Fig. 5). In this experiment, animals that succeeded in returning did so within an average of 3·4 days (SD 2·3 days, range 1–4 days) and all the animals that returned across the highway when released at distances of 20 and 40 m used the crossing structures. However, four of six deer mice that failed to return when released 60 m from wildlife underpasses and overpasses returned across the highway without using the crossing structures.

To corroborate the return success results, we once again compared the tortuosity of paths using ANOVA. The distance that animals had to travel from their home territories to crossing structures influenced path tortuosity ($F_{2,91} = 18.1$, $P < 0.001$, adjusted $r^2 = 0.68$; Fig. 6a).

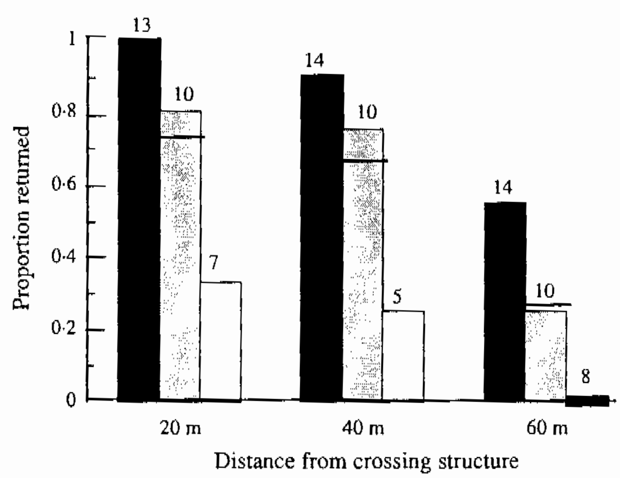

Fig. 5. Proportion of small mammals that successfully returned following translocations at three crossing structure distance classes of 20, 40 and 60 m. Black columns represent deer mice, white columns meadow voles and grey columns red-backed voles. Black lines represent the adjusted means for each treatment and a heavy black line on the x axis indicates that no animals returned. Sample sizes (n) are above each bar.

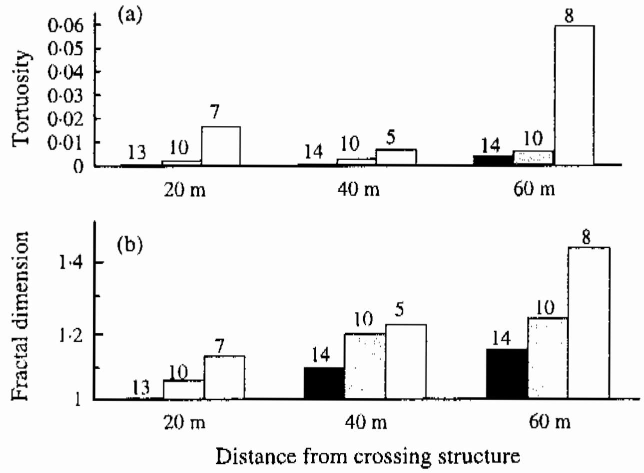

Fig. 6. (a) Tortuosity values and (b) fractal dimensions of translocated small mammals returning from three crossing structure distance classes of 20, 40 and 60 m. Black columns represent deer mice, white columns meadow voles and grey columns red-backed voles. Sample sizes (n) are above each bar.

Animals translocated 60 m from crossing structures moved in a more tortuous manner than those that only had to move 40 m (Tukey's HSD, mean difference = 0·44, $P < 0·001$) or 20 m (Tukey's HSD, mean difference = 0·59, $P < 0·001$) to find crossing structures. As for return success, no difference in tortuosity existed between paths at 20 m and 40 m (Tukey's HSD, mean difference = −0·15, $F_{2,91} = 18·1$, $P_a = 0·34$, $P_b = 0·14$). There were also significant tortuosity differences among species ($F_{2,91} = 7·18$, $P = 0·017$). Meadow voles moved in a much more tortuous manner when attempting to return to crossing structures than red-backed voles (Tukey's HSD, mean difference = 0·87, $P < 0·001$) or deer mice (Tukey's HSD, mean difference = 1·34, $P < 0·001$). Deer mice exhibited less tortuous paths than red-backed voles (Tukey's HSD, mean difference = −0·47, $P < 0·001$). Sex had no impact on path tortuosity, but with low power to detect potential differences ($F_{1,91} = 0·50$, $P_a = 0·48$, $P_b = 0·58$). A significant interaction between the distance travelled to crossing structures and species was driven mainly by disproportionately higher than expected tortuosity by meadow voles at 20 m and 60 m ($F_{4,91} = 4·74$, $P = 0·003$). There were no significant interactions between sex and cover amount ($F_{2,91} = 1·18$, $P = 0·33$) or species and sex ($F_{2,91} = 0·79$, $P = 0·46$).

As before, we calculated scale-independent fractal dimensions and compared them with an ANOVA to determine if the observed movement responses were due to natural-history characteristics or to differences in spatial scale. Unlike the pattern observed in path tortuosity, fractal dimensions of individual paths did not differ significantly based on the distance between crossing structures and target individual's home ranges, but, once more, with low power (Fig. 6b; $F_{2,91} = 0·79$, adjusted $r^2 = 0·21$, $P_a = 0·46$, $P_b = 0·67$), which suggests that the apparent tortuosity differences with different distance treatments above may be an artefact of different spatial scales. Animals captured 60 m away from crossing structures had similar fractal values to paths at 40 m (Tukey's HSD, mean difference = 0·037, $P = 0·43$) and at 20 m (Tukey's HSD, mean difference = 0·021, $P = 0·75$), indicating that they interacted with the landscape with comparable complexity. Like the pattern observed for path tortuosity, there were no significant differences between the fractal dimensions of individuals travelling from 20 m and 40 m away from crossing structures (Tukey's HSD, mean difference = 0·016, $P = 0·86$). Fractal dimensions did not differ among species ($F_{2,91} = 1·66$, $P_a = 0·20$, $P_b = 0·47$). Again, sex had no measurable effect on the fractal values of translocated animals ($F_{1,91} = 1·5$, $P_a = 0·22$, $P_b = 0·51$). None of the three interaction terms was significant.

Discussion

Using the crossing structures on the TCH through Banff, we conducted replicated translocation experiments using three species of murids. We investigated three factors describing crossing structure type, cover and distance that may influence the efficacy of highway crossing structures. We examined our results in terms of both the success with which translocated animals returned to their home territories and the path characteristics (tortuosity and fractal dimension) with which they did so. We found that deer mice, meadow voles and red-backed voles all preferred small crossing structures to those with larger diameters. These murids were more successful returning through 0·3-m diameter drainage culverts than through 3-m diameter underpasses, and least successful returning across the 15-m wide overpasses. For small mammals, the presence of denser and more proximate overhead cover, which these animals generally prefer (Diffendorfer, Gaines & Holt 1995), may have made the smaller structures seem safer. It is also possible that the smaller crossing structures, like smaller vegetated corridors, were less likely to house territorial conspecifics (*sensu* Andreassen, Halle & Ims

1996; Rosenberg, Noon & Meslow 1997) or predators that might serve as deterrents. Small mammals were least likely to cross the wildlife overpasses, possibly because the overpasses had very sparse tree and shrub cover and included a 3-m height gain from the entrance of the structure to the centre, which may have increased both energy demands and the perceived predation risk for the translocated small mammals (Diffendorfer, Gaines & Holt 1995). Whatever the reason, the preference these animals exhibited for small crossing structure size contrasts with the preference for larger sizes exhibited by other animals (Hunt, Dickens & Whelan 1987; Yanes, Velasco & Suarez 1995; Rodriguez, Crema & Delibes 1996; Clevenger, Chrusz & Gunson 2001). The high return success of nocturnal deer mice through all crossing structures was potentially linked to lower traffic volume at night (when they are active), which has been found to affect crossing structure use in a variety of small and medium-sized animals in the same study area (Clevenger & Waltho 2000).

The preference for small drainage culverts exhibited by small mammals in this study suggests that the movement of these animals across the TCH may be substantially enhanced by existing below-road passages such as drainage culverts (Clevenger & Waltho 2000; Clevenger, Chrusz & Gunson 2001). Such structures may be a very cost-effective way of increasing the movement of small animals across roads, particularly in areas with high road densities where movement is constrained enough to cause genetic differentiation even in small, common animals (Gerlach & Musolf 2000). It is possible, but unlikely, that our results overemphasize the importance of crossing structures in small mammal movement because previous use of these structures by resident animals artificially heightened the return success we measured. In contrast, small mammals tend to align their territories along, rather than across, linear features such as roads (Stamps, Buechner & Krishnan 1987), making it unlikely that animals were released in familiar territory (i.e. their home range) or that crossing structures contained attractive conspecific cues (Reed & Dobson 1993; Andreassen, Halle & Ims 1996).

A second main result of our study was that enhancing the cover at crossing structure entrances increased the return success of animals that were translocated adjacent to them. This result suggests that greater cover increases the attractiveness to animals of crossing structures and is consistent with other studies (Hunt, Dickens & Whelan 1987; Rodriguez, Crema & Delibes 1996; Rosell *et al.* 1997). Meadow voles exhibited much lower return success than the other species for all cover treatments and were unable to return at all when no cover was provided. This response may be due to their diurnal activity and the corresponding high traffic volumes along the TCH (peak values = 20 000 vehicles day^{-1}) relative to night (peak values = 5000 vehicles day^{-1}; Clevenger & Waltho 2000). Consequently, meadow voles encountered higher vehicle noise, vibration and movement when attempting to return through crossing structures compared with the two nocturnal species. An alternative explanation for the reluctance of meadow voles to use crossing structures may be their relative lack of mobility compared with deer mice (Banfield 1981). This species may lack awareness of the patchiness of the environment (Carpenter 1987) or may have limited perceptual range (Zollner & Lima 1999) and, as a consequence, individuals may not know in which direction to travel to reach their home territories.

Path characteristics potentially explain the mechanisms responsible for differences in mice and vole return success, as more complex paths could decrease return success through increased energy demands (Stamps, Buechner & Krishnan 1987). Yet it is also possible that higher tortuosity was associated with higher quality habitat (Stapp & Van Horne 1997). The fact that deer mice exhibited lower path tortuosity (and hence more direct paths) and higher return success in all cover amounts supports the first interpretation because this species naturally occupies a broader range of habitat types and travels easily both on ground and arboreal substrates (Stapp & Van Horne 1997). Furthermore, the more tortuous paths of meadow voles, especially under heavy cover, may reflect their discomfort on non-grassy substrates or their lower perceptual range. Despite these plausible mechanistic relationships, our results caution against a simplistic translation between tortuosity and return success because all individuals exhibited more tortuous movement paths under heavy cover, even though return success was highest for that treatment. This may be because animals move more quickly and directly under opposing conditions, when travel is easy and homing directions are easily perceived, or when the complete lack of overhead cover conveys extreme predation risk (Stapp & Van Horne 1997; Berggren, Birath & Kindvall 2002) causing animals to dart away from the immediate area. Our tortuosity results were qualitatively unchanged by measurements of fractal dimension, indicating that the movement responses of deer mice, meadow voles and red-backed voles to different amounts of cover were not influenced by spatial scale over the range of scales we studied.

By showing that any amount of cover substantially improved crossing structure use for all species (although heavy cover allowed for the highest return success), our results suggest an inexpensive way to increase the effectiveness of crossing structures. Even artificial cover like our spruce boughs appears to confer greater freedom of movement, presumably because it provides vulnerable small mammals with protection from predation (Hunt, Dickens & Whelan 1987; Rosell *et al.* 1997) while crossing the typically exposed verge habitat. Provision of vegetative cover as part of wildlife crossing structures may substantially increase their value to some wildlife.

As a third experiment in this study, we measured the distance animals would travel to use a crossing structure as a means of returning to their home territories (Rosenberg, Noon & Meslow 1997). The probability with which an animal uses a given crossing structure will obviously depend partly on its ability to find it (Simberloff *et al.* 1992). In our experiment, all species were more likely to return when they were captured and then translocated 20 or 40 m from an associated crossing structure than when they were captured 60 m from it. This suggests that they were similarly limited in their ability to detect distant crossing structures, despite differences in their home range sizes. However, the lower return success of animals translocated further from the crossing structure may also be an artefact of having to travel a much longer net distance to reach their home territory. Almost one-third (4/14) of deer mice released 60 m from crossing structures crossed the highway without using crossing structures, perhaps suggesting that they can cross the road if they must, but use crossing structures when they are available. In support of this, W. McDonald & C.C. St Clair (unpublished) showed that deer mice translocated directly across the TCH in the absence of crossing structures were able to return successfully 87% of the time. As with crossing structure type and cover, there were marked differences among species. Once more, diurnal meadow voles had the lowest return success and nocturnal deer mice had the highest. Tortuosity values reinforced these return success results; meadow voles exhibited the most tortuous paths across all distances, while deer mice returned in relatively straight lines. All three species moved more tortuously when they were translocated 60 m from crossing structures. These path characteristics suggest that animals move in more convoluted paths when they are farther from home, possibly because they cannot initially perceive its direction (*sensu* Lima & Zollner 1996). The flexibility in habitat use shown by deer mice may allow them to employ more direct paths regardless of distance, and this may be true of other habitat generalists (Mabry & Barrett 2002). However, unlike the cover analysis, fractal dimensions revealed scale-dependency of these path characteristics, which provides an alternative interpretation. When controlled for scale, animals at all three distances exhibited paths with almost identical complexity, perhaps indicating that territory size is more important than species habitat preferences or activity patterns in determining how far animals will travel to use a crossing structure. Bowman, Jaeger & Fahrig (2002) similarly concluded that both dispersal distances and translocation return success are best predicted by home range size.

The decline in animal use of wildlife crossing structures as the distance to the structure increases may have important implications for the future placement of wildlife crossing structures in fragmented landscapes. Previous studies concerning crossing structure density in Banff have not benefited from knowledge of how far marked individuals will travel to use these corridors (Clevenger & Waltho 2000). Our results for murid rodents indicated that animals were more likely to use crossing structures that were near their home ranges. Elsewhere, the addition of vegetated corridors has improved movement rates and population demography for small mammals (Coffman, Nichols & Pollock 2001). For these, and potentially for other guilds, home range size or maximum dispersal distance (Bowman, Jaeger & Fahrig 2002) may be relevant variables for determining the optimum density of crossing structures and other corridors.

In summary, we have established the importance of three attributes to the efficacy of highway crossing structures as corridors for small mammals. For this guild, crossing structures best facilitated movement of translocated animals if they were relatively small, if their entrances provided good cover from predators, and if the distance between a crossing structure and the home ranges of animals that used them was less than 60 m. In this study, crossing structure use dropped off precipitously for wide uncovered structures (i.e. overpasses), when no cover was present, and at 60 m from capture locations, even for the relatively vagile and robust deer mouse. Together, these results support the conclusions from previous studies that bigger corridors are not necessarily better for small fauna (Saunders & Hobbs 1991; Andreassen, Halle & Ims 1996). For this group, several small structures might improve crossing success markedly relative to fewer larger structures, particularly if structures are designed to minimize perceived predation risk at their entrances. The similar (prey species) guild of our study species, and the relative similarity of their home range sizes, restricts the generality of our results to other crossing structures and to other corridor contexts. Thus, profitable lines for future work would be to test the responses to other kinds of corridors for animals that incorporate a greater range of territory sizes and life-history traits.

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Structural vulnerability of a sandy loam exposed to intensive tillage and traffic in wet conditions

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Abstract

Sustainable soil management requires that the structural degradation is balanced or exceeded by regeneration. Our objective was to investigate the vulnerability of topsoil structure to stress exerted by intensive tillage or traffic. The study addressed the short-term stability to disturbance as well as the recovery (resilience) within a year. A field experiment was conducted in a randomised block design on a humid sandy loam in 1997–1999. Each year, either compaction from a heavy tractor (PAC) or puddling by intensive rotary cultivation (PUD) produced a severe impact on topsoil structure. The PAC and PUD treatments were carried out on wet soil in early spring. The mechanical treatments were referenced by plots (REF), which were left undisturbed until the soil had dried to a friable condition and ready for seedbed preparation. The PAC and PUD treatments were prepared for sowing at the same time as the reference plots. Penetration resistance was recorded in the spring of 1998 and 1999 to a depth of 200 mm. Soil was sampled from the 0–40 mm layer in May 1998 and in March, May and November 1999. The soil was air-dried and separated into four aggregate size fractions. The aggregates were subjected to tensile strength and density measurements. The penetration resistance in the 0–200 mm layer ranked in the order PAC $\gg$ PUD $>$ REF. Both mechanical treatments significantly increased the density of 4–8 mm aggregates. One or 2 months after the mechanical treatments, they had increased tensile strength relative to REF by 44 and 33% in 1998 and by 13 and 33% in 1999 for the PAC and PUD treatments, respectively. Thus, our result showed substantial topsoil degradation when exposed to the PAC and PUD treatments, i.e. the sandy loam showed low stability. In November 1999, the PUD-treated aggregates were still markedly stronger than those found in the REF soil. Hence, the PUD-treated soil showed little resilience within a 6-month summer period. There was no significant difference in aggregate tensile strength between the treatments in March 1999 after a winter with cycles of freezing and thawing and a mouldboard ploughing operation in early spring. Our results thus imply that soil degradation induced by soil compaction or intensive rotary cultivation early spring may reduce the ease of tillage in the following autumn, whereas little residual effect can be expected in the following spring.

Keywords: Seedbed; Soil compaction; Intensive tillage; Tensile strength; Aggregate; Vulnerability; Stability; Resilience

1. Introduction

Sustainable management of soil requires that structural degradation is balanced or exceeded by regeneration. It is well known that intensive tillage and traffic on wet soil may result in severe degradation of the

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topsoil structure. Although the conditions for regeneration are better in the topsoil than in the subsoil, the question is whether regeneration is able to balance degradation before the next tillage or traffic event. Otherwise, a gradual increase in degradation may occur. The tensile strength of soil aggregates and soil friability are important expressions of the ease of seedbed preparation, i.e. soil workability (Dexter, 1988).

Soil compaction is a major and increasing problem in modern agriculture. Especially traffic related to harvest operations in late autumn and slurry applications in early spring is responsible for harmful compaction in Danish agricultural soils. Soil compaction may result in cloddy soils (Watts and Dexter, 1994) with strong aggregates and a poor friability (Watts and Dexter, 1998).

Increased tractor power and improved tyres have enabled tillage to take place under wetter conditions and with higher intensity than formerly. This has led to concern, particularly in northwestern Europe about the impact on soil structure (Ehlers and Claupein, 1994; Schjønning et al., 1997; Watts and Dexter, 1997). A high energy input in the secondary tillage process is potentially damaging for soil structure—especially when the soil is wet. One of the consequences can be a decreased wet aggregate stability, which increases the risk of surface crusting and erosion (Bullock et al., 1988; Schjønning et al., 1997). In addition, Watts et al. (1996) and Watts and Dexter (1997) showed that aggregate tensile strength increased significantly after rotary cultivation, indicating decreased workability.

Kay (1990) introduced the term structural vulnerability to characterise the inability of soils to cope with stress. A soil may be vulnerable due to a low stability or a low resilience. Stability is thus the ability of the soil to resist the immediate structural degradation when stress is applied (e.g. tillage). Resilience is the ability of the soil to recover from structural degradation, i.e. the ability to regain its original structure. A large number of studies have addressed soil structural stability while only few have investigated structural resiliency. Results presented by Håkansson and Reeder (1994) and Arvidsson and Håkansson (1996) indicate that many soils have a low resilience to topsoil compaction as yield levels require 3–4 years to stabilise to the original level after exposure to severe topsoil compaction. The objective of our study was to evaluate the structural stability when exposed to soil compaction and puddling through intensive tillage, and the ability of soil to regenerate soil structure (resilience) after treatments.

2. Materials and methods

2.1. Soil type and field trial

A field experiment located at Rugballegård Experimental Farm for Organic Farming, Denmark, was conducted on a sandy loam developed on till plains from the Weichselian glacial stage and classified as a Glossic Phaeozem according to the FAO system of classification. Some basic soil characteristics are given in Table 1. Severe impact on topsoil structure produced by either heavy compaction (PAC) or puddling by intensive rotary cultivation (PUD) was compared with a reference treatment (REF). The experiment was established in 1997 and the treatments were applied every year to plots in a randomised block design with three blocks. In 1997, the PAC and PUD treatments were applied in early spring to a soil grown with winter wheat (Table 2). Subsequently, spring barley was established in the PUD-treated soil. In 1998 and 1999, the soil was mouldboard ploughed to 20 cm depth in early spring. The PAC and PUD treatments were applied immediately after ploughing. Our intention was to conduct the PAC and PUD treatments when the soil was too wet for optimal tillage. The water content immediately after performing the mechanical treatments was 21.9, 19.1 and 22.4 g (per 100 g) in 1997, 1998 and 1999, respectively. In comparison, the water content at -100 hPa metric potential was 21.8 g (per 100 g) for PAC in May 1999 (Munkholm

Table 1
Basic soil characteristics for the soil under investigation (from Munkholm et al. (2002))

Soil parameter	
Organic matter (g per 100 g)	3.1
Clay (<2 μm) (g per 100 g)	13
Silt (2–20 μm) (g per 100 g)	14
Fine sand (20–200 μm) (g per 100 g)	39
Coarse sand (200–2000 μm) (g per 100 g)	31
pH($CaCl_2$)	5.9
CEC ($mmol_c\ kg^{-1}$)[a]	111

[a] CEC = cation exchange capacity.

Table 2
Timetable for field operations and sampling

	1997	1998	1999
Crop	Winter wheat	Oats	Spring barley/pea mixture undersown with grass-clover
PAC and PUD treatment	24 March[a]	15 April	25 March
Seedbed preparation and sowing[b]		23 April	29 April
Sampling 1		18 May	23 March
Sampling 2			18 May
Sampling 3			1 November

PAC: compacted; PUD: intensive rotary cultivation; REF: reference.
[a] The PAC and PUD treatments were carried out in an established winter wheat crop. Spring barley was subsequently established in the PUD treated soil.
[b] For all treatments (PAC, PUD and REF).

et al., 2002). The PAC treatment was obtained by creating adjacent wheel tracks using a 6–8 tonne tractor (inflation pressure 125 kPa). The puddling in the PUD treatment was performed by a rotary harrow at high rotary speed (205 rounds min^{-1}) compared to the forward tractor speed (4 km h^{-1}). Secondary tillage and sowing was carried out later in the spring in all treatments using a rotary harrow and a traditional drill at moisture contents around field capacity. Small grain cereals were grown in 1997 and 1998, whereas a mixture of spring barley and pea was grown in 1999 (Table 2).

2.2. Sampling and soil preparation

Soil sampling took place in May 1998 and on three occasions in 1999 (Table 2). The sampling on 23 March 1999 was carried out immediately after ploughing and before the PAC and PUD treatments. The sampling on 18 May 1998 and 18 May 1999 took place shortly after plant emergence at a water content slightly lower than field capacity. The sampling on 1 November 1999 took place in the grass-clover catch crop that was undersown into the spring barley/pea crop that was harvested in August 1999. From crop establishment until sampling in November, the soil had not been tilled and only received traffic during the harvest of the spring barley/pea crop. At all sampling occasions, three sub-samples were taken from the 0–40 mm layer of each plot and mixed. A gentle soil separation procedure was followed that involved air-drying, gentle crushing of air-dry large clods and separation by sieves to obtain four aggregate size classes: 8–16, 4–8, 2–4 and 1–2 mm (Munkholm et al., 2002).

2.3. Tensile strength

The aggregates were crushed individually between two flat parallel plates using the indirect tension test described by Dexter and Watts (2000). All of the tests were performed at a constant rate of displacement of 2 mm min^{-1}. The compressive force was measured 30 times s^{-1} by a load cell (0–100 ± 0.03 N) and recorded automatically on an adapted computer. Fifteen aggregates of each size class from each treatment and block were crushed (i.e. 45 aggregates per size class and treatment).

The aggregate tensile strength (Y, kPa) was calculated from the equation (Dexter and Watts, 2000):

$$Y = 0.576\frac{F}{d^2} \quad (1)$$

where F (N) is the polar force required to fracture the aggregate and d (m) is the mean aggregate diameter. In this study, d was estimated according to Dexter and Watts (2000):

$$d = \frac{1}{2}(s_1 + s_2) \quad (2)$$

where s_1 and s_2 are the openings of the upper and lower sieves.

Friability was estimated from the equation (Dexter and Watts, 2000):

$$\log Y = -k \log V + A \quad (3)$$

where k is friability, A (kPa) is the normalised strength of 1 m^3 soil and V (m^3) the aggregate volume.

2.4. Penetration resistance

Soil penetration resistance was measured to a depth of 200 mm with an automated cone penetrometer (Olsen, 1988), using an ASAE R313.1-recommended 20.27 mm diameter/30° semi-angle cone. These measurements were carried out in May 1998 and 1999 at plant emergence and at a water content near field capacity. Twenty measurements were performed in each plot (i.e. 60 replicates per treatment).

2.5. Aggregate density

Dry 4–8 mm aggregates were weighed and coated with Saran resin (Brasher et al., 1966). The coated aggregates were then weighed in air and then re-weighed immersed in water at 20 °C. The weight loss gives the volume of water displaced, which is equal to the volume of coated aggregate. The measurements were adjusted for the weight and volume of the Saran resin according to Munkholm et al. (2002). Thirteen aggregates per plot were tested (i.e. 39 aggregates per treatment).

2.6. Statistical analysis

The penetration resistance and tensile strength data were log-transformed to yield normality. Averages were calculated for each plot and used in the F-tests, taking the treatment × block interaction as the residual error.

3. Results

3.1. Density and penetration resistance

In both experimental years, a markedly higher penetration resistance was found in the topsoil of the PAC-treated soil in comparison with the REF and PUD soils (Fig. 1). In the 50–100 mm layer, the PAC soil exhibited a penetration resistance about twice that of the REF and PUD treatments. The intensive cultivation in the PUD treatment produced a slightly higher penetration resistance than the REF treatment. The PUD

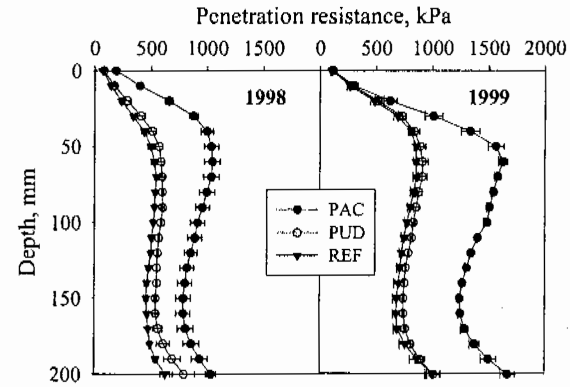

Fig. 1. Penetration resistance measured shortly after tillage operations in May 1998 and 1999. PAC: compacted; PUD: intensive rotary cultivation; REF: reference. Horizontal bars indicate ±1 S.E.M.

effects were statistically significant in soil layers 30–200 and 100–170 mm for 1998 and 1999, respectively.

In the seedbed, the PAC and PUD treatments significantly impacted the density of 4–8 mm aggregates, being 1.68, 1.68 and 1.63 g cm^{-3} for PAC, PUD and REF treatments, respectively. That is, puddling through intensive tillage had a similar effect on the density of aggregates to soil compaction.

3.2. Aggregate tensile strength and friability

In May 1998, about 4 weeks after applying the mechanical treatments (Table 2), significantly higher aggregate tensile strengths were observed for the PAC and PUD treatments than for the REF treatment when averaged over size classes (Table 3). For individual size fractions there was only a significant difference for the 8–16 mm aggregates. Similar effects were measured a few weeks after the mechanical treatments in 1999 (Table 3). However, here the PUD soil displayed aggregate tensile strength that was significantly higher than even the PAC soil. For the individual size fractions, significant differences were found for both 1–2 and 4–8 mm aggregates with 2–4 and 8–16 mm aggregates showing the same trend.

In November 1999, about 7 months after the mechanical treatments, the PUD soil still had significantly stronger aggregates than the REF soil, whereas the PAC aggregates reacted similarly to the REF aggregates. Following the winter period 1998–1999 and the

Table 3
Geometric mean values of tensile strength, Y (kPa) and friability indices, k

Aggregate size	May 1998			March 1999			May 1999			November 1999		
	PAC	PUD	REF	PAC	PUD	REF	PAC	PUD	REF	PAC	PUD	REF
1–2 mm	252 a[a]	255 a	230 a	184 a	184 a	157 a	176 a	195 a	149 b	175 b	262 a	165 b
2–4 mm	161 a	155 a	99 a	127 a	164 a	131 a	123 a	149 a	107 a	137 a	166 a	141 a
4–8 mm	70 a	63 a	48 a	92 a	91 a	85 a	74 b	101 a	71 b	84 a	97 a	79 a
8–16 mm	45 a	39 a	28 b	43 a	43 a	49 a	47 a	50 a	41 a	46 a	55 a	38 a
Geometric mean[b]	107 a	99 a	74 b	98 a	105 a	96 a	93 b	110 a	83 c	98 b	124 a	91 b
k	0.29 a	0.31 a	0.34 a	0.23 a	0.24 a	0.19 a	0.22 a	0.22 a	0.21 a	0.22 a	0.25 a	0.24 a

PAC: compacted, PUD: intensive rotary cultivation, REF: reference
[a] Values followed by the same letter for a given aggregate size and sampling date are not significantly different at the $P < 0.05$ level.
[b] Geometric mean of data from the four aggregate sizes.

ploughing operation in March, no significant differences between the accumulated effect of the 1997 and 1998 treatments were found (Table 3). Soil friability in terms of the friability index was not significantly affected by treatments at any of the sampling occasions and there was no clear trend in data.

4. Discussion

4.1. Structural stability

In both experimental years, the PAC and PUD treatments clearly increased aggregate tensile strength as measured in May, 1–2 months after the treatments were applied. The mechanical impact increased tensile strength relative to REF by 44 and 33% in 1998 and by 13 and 33% in 1999 for the PAC and PUD treatments, respectively (Fig. 2). The clear effect of compaction is consistent with results obtained in 1999 in the same experiment (Munkholm and Kay, 2002). They showed that the PAC treatment gave a 25% increase in average tensile aggregate strength for soil sampled just below the seedbed (6–13 cm). An increase in aggregate tensile strength after compaction agrees with results presented by Watts and Dexter (1998) and Arvidsson and Håkansson (1996). Results by Macks et al. (1996) and Rogowski and Kirkham (1976) also indicated that soil compaction increased aggregate tensile strength. The latter authors found a positive correlation between tensile strength and bulk density.

The increase in aggregate tensile strength after intensive rotary cultivation is consistent with results by Watts et al. (1996) and Watts and Dexter (1997). They showed that aggregate tensile strength increased immediately after rotary cultivation on a silt loam. Two to four passes with the rotary cultivator yielded aggregates (16–19 mm) with more than twice the strength of reference aggregates (Watts and Dexter, 1997). The increase in aggregate tensile strength was associated with a marked increase in dispersible clay.

4.2. Structural resilience

4.2.1. Within season effects

This study shows that the soil did not recover from the degrading effect of the PUD treatment within the

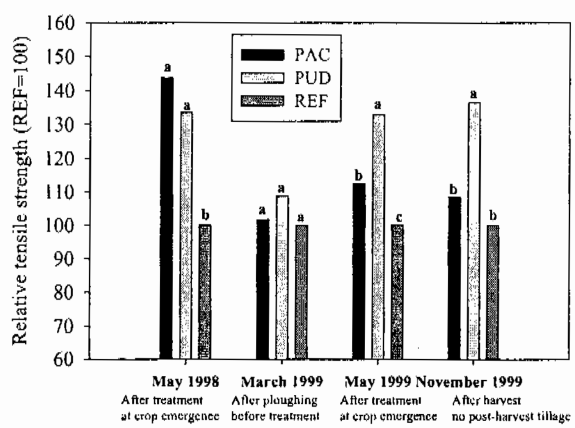

Fig. 2. Relative tensile strength (REF = 100) of air-dry aggregates (average of the four size fractions) at the different times of sampling. PAC: compacted; PUD: intensive rotary cultivation; REF: reference. Figures with the same letter within sampling time are not significantly different at the $P = 0.05$ level.

growing season. In November, PUD aggregates were still markedly stronger than the REF aggregates. As a matter of fact, the increase relative to the REF soil was of the same magnitude (36%) as in May (33%). Also for the PAC treatment our study indicated that the soil did not fully recover within the growing season. The increase in tensile strength for the PAC treatment relative to the REF soil was 13% in May and 8% in November. However, in November the difference between PAC and REF was not significant.

Watts and Dexter (1997) showed that the differences between cultivated and uncultivated soil were most evident immediately after tillage, but there was still a significant difference 20 days after tillage. A persistent negative effect of soil compaction was also found in the study of Watts and Dexter (1998). They found that the friability from February to July constantly remained lowest for the soil sampled from wheelways than for soil sampled in ordinary arable and zero trafficked soil.

The higher strength of aggregates from the PUD treatment in the autumn suggests increased difficulty in preparing a proper seedbed for winter crops. Higher energy inputs may be needed to fragment the soil. Fortunately, a fine seedbed is not so critical in the autumn in Scandinavia, due to predominantly wet weather at the time of seeding winter crops (Håkansson et al., 2002).

4.2.2. Over-winter effects

The results from March 1999 suggest that the soil had recovered from the effect of the PAC and PUD treatments carried out early spring 1997 and 1998. That is, there were no clear differences between treatments in March 1999 after the soil had been ploughed. Ploughing was expected to more or less erase the effect of the 1998 PUD treatment because minimally affected soil was brought to the soil surface by ploughing. However, it was expected that a residual effect of the compaction treatments in 1997 and 1998 was found after ploughing in spring 1999. The PAC treatment produced higher penetration resistance in the whole topsoil (Fig. 1). Hence, even after ploughing in March 1999 higher aggregate strength was anticipated for the PAC treatment. Unfortunately, we cannot separate the effects of winter and spring ploughing in our study. However, a Swedish study has shown a marked recovering effect of winter. Arvidsson and Håkansson (1996) showed substantial recovery of soil structure over winter for a Swedish clay soil compacted in the autumn. Compaction in the autumn substantially increased dry aggregate strength but after a winter and before spring tillage, the relative difference between compacted and control was small. Alleviation of the compaction effect during the winter may be related to an extensive disruption of aggregates caused by cycles of freezing and thawing during the winter (Bullock et al., 1988). Our results are furthermore in accordance with Boizard et al. (2002), who showed that the proportion of severely compacted soil (so-called Δ zones) fluctuated greatly from year to year for a northern French silt loam regularly exposed to severe soil compaction. They concluded that a silt loam soil exhibited a strong resistance to cumulative compaction, although soil structure could be affected for several years after a compaction incidence.

5. Conclusions

The sandy loam topsoil displayed low structural stability when exposed to soil compaction and intensive rotary cultivation in wet conditions. The topsoil showed very little recovery of structure within season but our results indicated a relatively high resilience after a winter and a spring ploughing. The poor within season resilience has practical implications under Danish conditions where the establishment of winter crops in the autumn shortly after the harvest of summer crops is very common.

Further studies are needed to elucidate especially the effects of intensive cultivation, which is less well described than compaction. There is reason to believe that problems associated with intensive cultivation on wet soil are increasing. In modern agriculture, the combined use of tractors with increased traction power and low-pressure tyres has enabled tillage at wetter conditions and with higher intensity than ever before.

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Legacy of land-use evident in soils of Western Australia's wheatbelt

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Key words: land abandonment, old-fields, phosphorus, secondary succession, soil nutrients, spatial variation

Abstract

Native regeneration of old-fields in the wheat-growing region of Western Australia is slow to non-existent. We compared the physio-chemical properties of three old-fields and three woodland remnants adjacent to each old-field to determine if current soil conditions are a barrier to regeneration. Of the variation in soil properties, 17.4% was described by spatial structure, 5.4% by land use (cultivation time and time since abandonment), 3.9% by soil type and 2.6% by vegetation and leaf litter cover. There were differences in individual soil properties between old-field and remnant soils at two sites. Soil compaction, probable erosion as evident by a higher percentage of coarse fragments, increased Colwell phosphate that we interpret as fertiliser residue and reduced organic carbon were evident in one old field, after 60 years of cultivation and 14 years abandonment. Increased Colwell phosphate was evident at the second old field, despite only 1 year in cultivation and 45 years in recovery. The third site showed no evidence of its 4 year period in cultivation 43 years ago despite similar farming practices and soil type to the second. Phosphate fertiliser residues could account for the dominance of non-native annual grasses in the re-assembly of wheatbelt old-fields.

Introduction

Cultivation of previously forested land can have lasting impacts on the physical and chemical properties of the soil. This legacy can be evident decades and even centuries after cultivated lands are taken out of agricultural production (e.g., Compton and Boone, 2000; Dupouey et al., 2002; Foster et al., 2003; Koerner et al., 1999) and is likely to affect natural forest regeneration (Dupouey et al., 2002; Foster, 1992; Foster et al., 2003). In general, studies of old-field succession indicate that whether or not soils recover is likely to be determined by land-use history i.e. intensity and length of cultivation (Dupouey et al., 2002; Martin, 2004; Robertson et al., 1993); the resilience of soils to disturbances resulting from clearing and cultivation, such as erosion (Kalisz, 1986; Pardini et al., 2003; Read and Hill, 1983); and the plant species which invade, as these will affect the amounts and availabilities of nutrients (Bradshaw, 2004; Ehrenfeld, 2003; Hobbie, 1992).

Old-fields in the wheat-growing region of Western Australia tend to be dominated by non-native annual grasses (Hobbs and Atkins, 1991; Yates and Hobbs, 1997). The slow to non-existent return of the native species-rich eucalypt woodland could be related, in whole or part, to the inability of these ancient and highly weathered soils to recover from the effects of extensive clearing and intense cultivation that has occurred since the 1890s. During this period

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there has been widespread deterioration in soil structure; soil compaction, acidification and salinisation; as well as nutrient and soil loss by wind and water erosion (Nulsen, 1993). The rapidity of this land degradation is unparalleled in the Northern Hemisphere but has parallels in the tropics (Hobbs and Saunders, 1993). It is not known for how long these effects persist once land is taken out of agricultural production.

Plant production is generally limited by P on ancient soils (Vitousek and Farrington, 1997; Walker and Syers, 1976). In south-western Australia, native plant communities are adapted to the nutrient-poor soils; but crop production only became possible with the use of phosphate fertiliser (Beard, 1990; Nulsen, 1993). The residual effect of phosphate fertilisers (Barrow, 1980; Burvill, 1979) could promote the invasion of non-native competitive grasses (Hobbs, 1989) and so prevent the return of native species. The residual effect can persist for up to 24 years after a single application to newly cleared soils in south-west Western Australia (Bolland and Allen, 2003) but is likely to vary according to soil type and land-use history (Arnold et al., 1999; Barrow, 1980; Burvill, 1979). In turn, the non-native grasses themselves are likely to affect soil properties. For example, their short and fibrous roots deplete soil water and probably reduce the water holding capacity of the sub-soil to the detriment of native woody seedlings (D'Antonio and Vitousek, 1992; Eliason and Allen, 1997). Grasses also have the capacity to affect the amounts and availabilities of soil nutrients (D'Antonio and Vitousek, 1992).

We compare soil properties of three old-fields and woodland remnants adjacent to each old-field to determine the legacy, if any, of past land use. Despite the homogenising effect of cultivation, the legacies of land use can be masked by the spatial variation that results from the differential interactions of parent material, climate and topography (Bradshaw, 2004; Fraterrigo et al., 2005). Therefore, we include it, along with soil type and vegetation, in a multivariate multiple regression (McArdle and Anderson, 2001) that simultaneously models these effects. The ultimate aim is to determine if there are alterations to soil properties that may act as a barrier to natural regeneration of wheatbelt old-fields.

Methods

Geology, climate and soils

The study sites were north of Kellerberrin in the central wheat and sheep farming district of Western Australia known as the wheatbelt. The hard ancient (2500–2900 million years old) granitic and gneissic rocks intruded by dolerite dykes (540 to 2500 million years old, McArthur, 1992) that form the substrate for the soils of this region are part of the inert and rigid Yilgarn Craton. This massive craton of low relief has weathered over geological time to produce a gently undulating landscape (i.e. catena) with a mantle of sandy and lateritic (gravely ironstone) soil underlain by mottled and pallid zones of weathered material (McArthur, 1993). Differential erosion has produced a range of soil types that are linked to position within the catenary sequence, and together with climate (predominantly rainfall), largely determines vegetation type (Beard, 1990; McArthur, 1993).

The climate of the region is extra-dry Mediterranean (i.e. seven to eight hot dry months; Beard, 1990). Mean annual rainfall at the Kellerberrin climate station (31°37′ S, 117°43′ E) is 330 mm, though actual rainfall varies considerably from year to year (refer Hobbs, 1993 Figure 1). Mean monthly maximum temperature ranges from 16.3 °C (July) to 33.9 °C (January) and mean monthly minimum temperature ranges from 5.6 °C (August) to 16.9 °C (January and February) (Bureau of Meteorology, 2004).

Our study sites are located on one or more of three landform-soil units described by Bettenay and Hingston (1964) and mapped by McArthur (1992, 1993). The Booraan unit is located on the slope of the catena where shallow (30–40 cm) sands or sandy loams have developed over the weathered mottled and pallid zone material (Natric Haploxeralf; Plinthic Lixisol). There are also areas of exposed underlying granitic rock (i.e. rock outcrop) within the mapped Booraan unit. The Danberrin unit is characterised by low hilly terrain where shallow brown gritty sands and sandy loams have developed directly over the rock substrate (Typic Haploxeralf; Albic Luvisol). The Rock Outcrop unit is generally associated with the Danberrin unit. It is dominated by areas of bare rock and some shallow brown gritty loamy soil over rock. These landform-soil units support *Acacia acuminata*-eucalyptus woodland (predominantly *Eucalyptus loxophleba* in association with *E. capillosa* or *E. salmonophloia*) (Beard, 1983, 1990; Hobbs et al., 1989; Muir, 1978; see also summary by Yates et al., 1999).

Land-use history

During early periods of clearing (i.e. from 1890s), large trees were ringbarked and smaller trees were generally chopped down during autumn, winter and spring, using an axe, and shrubs were cleared with horse-drawn handmade metal rollers (Greble, 1979; Main, 1993). Piles of vegetation stacked about the cut stumps were then burnt during the summer (Greble, 1979). From the 1950s onwards, woodland was typically cleared using two tractors or bull-dozers connected by a ground-level steel cable or chain (Beresford et al., 2001; Main, 1993) and then burnt as before. Farming also became mechanised during this period – horses were replaced with heavy tractors (Main, 1993).

The introduction of phosphate fertiliser (i.e. superphosphate) in the 1890s (Beard, 1990) spurred extensive clearing of woodland vegetation for wheat production (Terry, 1907 cited by Main, 1993) resulting in a highly fragmented landscape (Hobbs, 1992, 1994; Hobbs and Saunders, 1993). Superphosphate was applied liberally until 1975 when it became too expensive to apply excessive amounts (Bolland et al., 2003). Superphosphate application also increased soil sulphur levels – superphosphate contains about 12% sulphur (Burvill, 1979).

There were further modifications to the soil during cultivation. Widespread European rabbit (*Oryctolagus cuniculus*) burrows were fumigated from the 1920s until 1952 and the spread of myxomatosis (Main, 1993). Insecticides, including DDT, and herbicides for weed control were introduced in 1948, with a peak in herbicide use in the 1980s (Couper, 1993). Compound fertilisers (N–P–K) were introduced in 1960s, which together with the discovery that crop production increased with the addition of trace elements (i.e. Cu, Mo and Zn), lead to more clearing of native vegetation and a concomitant increase in salinity (Main, 1993; Nulsen, 1993). Although this increase in salinity (i.e. secondary salinity) is linked to agricultural development, the processes leading to its occurrence are complex and covered in detail by McFarlane et al. (1993). The ecological consequences for native remnant woodland vegetation are considered by Cramer and Hobbs (2002).

Land abandonment is not widespread in the region but is predicted to increase with further soil degradation as a consequence of salinisation of soil and water, erosion, water logging and changing soil structure (Hobbs and Saunders, 1993). It may also increase as policies made necessary by escalating soil degradation are implemented, or as terms of trade decline (Allison and Hobbs, 2004; Aplin et al., 1999; Pannell, 2001).

Study sites

The study sites were three abandoned paddocks (i.e. old-fields). These sites were selected because of the presence of adjacent eucalypt woodland remnants for comparison and information on their land-use histories was available from previous studies (Hobbs, 1993; Hobbs and Saunders, 1993; Saunders et al., 1993). In addition, the sites were not obviously affected by secondary salinity (i.e. lack of accumulated salt at the soil surface).

While the woodland remnants we selected were relatively intact, all three were subject to grazing by sheep from the mid-1860s to the early 1900s (Main, 1993). The presence of poisonous *Gastrolobium parviflorum* (Benth.) Crisp afforded some protection from grazing to one remnant (Woolering, see below). While there has been an absence of domestic animals at all three sites since cultivation began, there has been an overall reduction in the abundance of native mammal herbivores except perhaps kangaroos (*Macropus* spp.) (Hobbs et al., 1993). Kangaroos and European rabbits continue to graze old-fields and woodland remnants (Arnold et al., 1991; Hobbs et al., 1993). Finally, the effects of the selective removal of sandalwood (*Santalum spicatum*) and eucalypt trees during the early to mid-1900s (Hobbs et al., 1993; Main, 1993) may be evident in some places.

The old-field on Letchford Road (7.3 ha; 31°18′ S, 117°43′ E; Rock Outcrop landform-soil unit) was cleared of native vegetation in the late

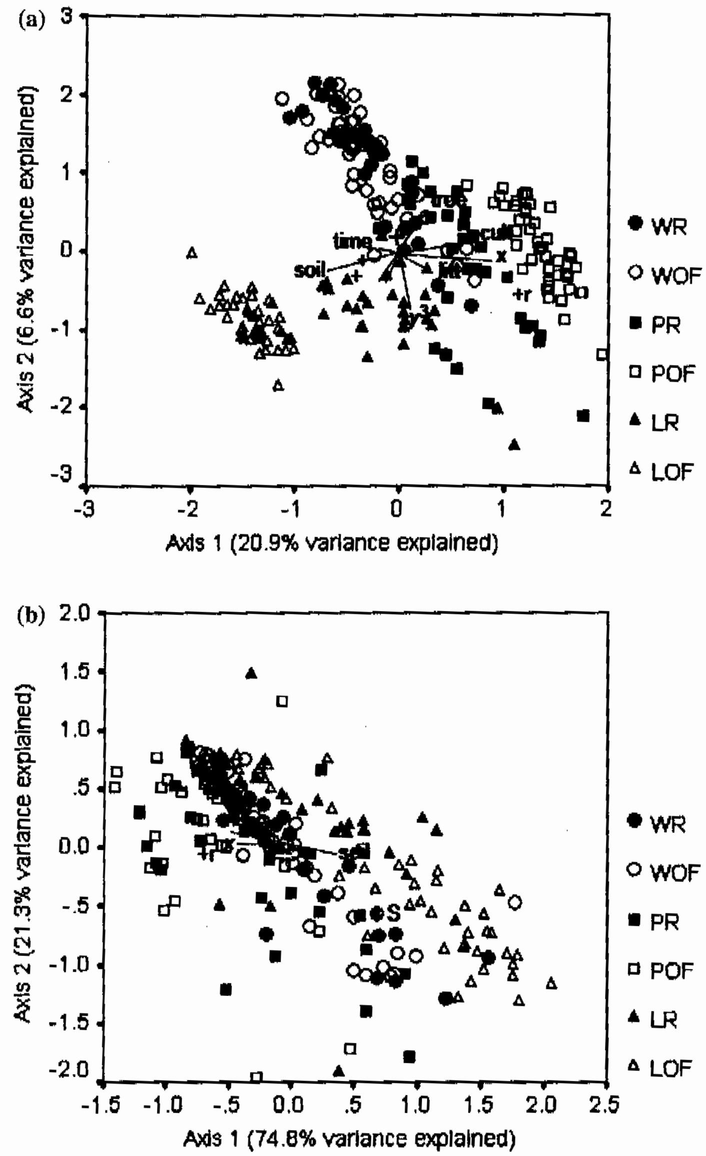

Figure 1. (a) CCA ordination of soil properties for 225 samples taken from three old-fields (LOF, POF and WOF) and the adjacent woodland remnants (LR, PR and WR) constrained by 16 explanatory variables. The biplot (black lines) includes variables retained in the final DISTLM *forward* model; lines of x (easting) and x^2 are superimposed, and the two unlabelled lines are of ground cover biomass and percentage shrub cover respectively. + = weighted averages for soil variables, r = water repellency, two small unlabelled averages (+) are for S and NO_3-N respectively, larger + represents the cluster of remaining variables. (b) NMS ordination of soil properties for 225 samples taken from three old-fields (LOF, POF and WOF) and the adjacent woodland remnants (LR, PR and WR). The joint plot (black lines) includes variables whose correlations with either ordination axes were greater than $R^2 = 0.175$. The unlabelled lines are for cultivation time and superimposed lines for x (easting) and x^2 respectively. + = weighted averages for soil variables, r = water repellency, S = sulphur and the unlabelled white + represents the cluster of remaining variables. % variance explained = coefficients of determination for the correlations between ordination distances and distances in the original n-dimensional space.

1950s and yielded one wheat crop before being abandoned (M. Barnes, pers. comm. 2003). The current owner claims that it is too stony to farm (J. Anderson, pers. comm., 2005) and this is probably the reason for its initial abandonment. The old-field is bordered by Letchford Road along one length, a road reserve along another side, and by woodland on the other two sides. Vegetative cover includes non-native annual grasses (*Avena* spp., *Pentaschistis airoides* (Nees) Stapf) and native grasses (*Aristida holathera* Domin, *Austrostipa eremophila* (Reader) S.W.L. Jacobs and J. Everett). The native shrubs *Hakea recurva* Meisn. and *Acacia acuaria* W. Fitzg. also occur. The adjacent remnant (also on Rock Outcrop) is a York gum (*E. loxophleba* Benth.)–wandoo (*Eucalyptus capillosa* Brooker & Hopper)– mallee (*E. subangusta*? (Blakey) Brooker & Hopper) woodland. The shrub layer includes *Allocasuarina campestris* (Diels) L.A.S. Johnson, *Acacia* spp., *Melaleuca* spp. and *Santalum acuminatum* (R.Br.) A.DC. The ground cover is predominantly *Borya sphaerocephala* R.Br., with some leaf and twig litter; and *Waitzia acuminata* Steetz and *Podolepsis lessonii* (Cass.) Benth. appear in spring.

The old-field on Pullen Road (22.3 ha; 31°20′ S, 117°44′ E; Booraan landform-soil unit) was cleared of native vegetation in 1930 and then cropped until 1990 when it was abandoned, because it was no longer economical to cultivate, partly because of exposed rock, and the presence of poisonous *Gastrolobium parviflorum* prevented it from being used for grazing (F. Langford, pers. comm. 2005). The old-field supported an annual crop of wheat most years except for the occasional fallow year, and lupin (*Lupinus* spp.) was trialled towards the end of the farming period (F. Langford pers. comm. 2005). Lupins increase soil nitrogen and organic matter, but also increase soil acidity and water repellence (Nulsen, 1993). Superphosphate was applied yearly during cultivation. It is likely that an N and K fertiliser was applied during the last 20 yrs of cultivation (F. Langford, pers. comm., 2005).

The old-field is bordered by Pullen Road, woodland, and on opposite sides, two cultivated paddocks. It is dominated by non-native annual grasses (*Avena* spp.) with scattered *Acacia acuminata* Benth. The adjacent remnant is a York gum-wandoo-salmon gum (*E. salmonophloia* F. Muell.) woodland (Rock Outcrop landform-soil unit). The shrub layer is predominantly *Acacia acuminata* and *Melaleuca uncinata* R.Br. Leaf and twig litter is the dominant ground cover, except in spring when there is a flush of annual vegetation (e.g., *Ursinia anthemoides* (L.) Poir., *Schoenia cassiniana* (Gaudich.) Steetz, *Podolepis canescens* DC.).

The old-field adjacent to Woolering Reserve (23.3 ha; 31°32′ S, 117°43′ E; Rock Outcrop landform-soil unit) was cleared in 1957, cropped until 1961 and then abandoned as it was too stony. Superphosphate was added at a rate of 90 kg/ha/yr during cultivation (F. Morley, pers. comm., 2005). It was burnt in 1963 and a stand of trees that had recruited blew over during a cyclone in 1978. The old-field is bordered by Woolering Reserve on one side, bush that is open to grazing domestic animals on another, and a cultivated paddock. Native vegetation, including *Eucalyptus loxophleba* (to 15 m), and *Acacia acuminata*, *A. acuaria*, *Hakea recurva* and *Gastrolobium parviflorum* in the shrub layer, has recolonised this old-field. *Acacia acuminata* litter is the dominant ground cover, except for a sward of *Avena barbata* Link in the northern section. There is a flush of native Asteraceae in spring (predominantly *Waitzia acuminata*). The adjacent remnant is wandoo-York gum woodland (Rock Outcrop/Danberrin landform-soil unit). The species that dominate the shrub layer are the same as those in the old-field. Leaf and twig litter is the dominant ground cover; *Borya sphaerocephala* is also common and there is a flush of native Asteraceae in spring (predominantly *Waitzia acuminata*). Part of the remnant was burnt in 1964.

Soil sampling and analyses

Five transects were set out at each site, 65–80 m apart and perpendicular to the boundaries of the old-field and remnant. The boundaries between the remnant and old-field at each site were separated by a track. Each transect started 50 m into the remnant and finished 100 m into the old-field. Reference points were placed at the ends and at intervals along each transect corresponding to 50 m into the old-field and at the boundaries of the two habitats. Sampling points were arranged in a stratified (by the central reference point) random cluster design (Nusser et al., 1998; Urban, 2002) determined by generating three paired sets of distance and angle measurements around each reference point. This design provides samples covering the entire study area and a wide range of between-sample distances, which are required to estimate spatial structure (Urban, 2002). Distance measurements were between 0–25 m and three angle measurements were each between 0–120°, 120–240° and 240–360° respectively. Sampling points at the boundaries were forced within the old-field or remnant at least 30° from adjacent sampling points.

The geographical position (easting and northing) of each reference point was determined in the field using a hand-held global positioning system accurate to within 2 m (GPS II^+unit manufactured by Garmin Corporation, Olathe, Kansas USA). The geographical positions of the sampling points were calculated using the Pythagorus Theorem $\sin^2\theta+\cos^2\theta=1$.

Three soil cores were collected during October 2003 at each sampling point to a depth of 5 cm using a 3.5 cm diameter metal corer. The soil surface layer is the most relevant as it was directly modified by cultivation; impacts tend to decrease with depth (Ellert and Bettany, 1995; Guo and Gifford, 2002). Individual soil cores were placed in airtight bags and kept cool enroute to the laboratory. In the laboratory, one soil core was oven-dried at 105° C and the bulk density was calculated. Soil texture (sand, loam etc.), percentage coarse fragments and water repellency (classed as non-repellent, slightly repellent, repellent and very repellent) were also measured. Two soil cores were thoroughly mixed and air-dried, then sent to CSBP Soil and Plant Laboratories (Bibra Lake, Perth) for analyses. Samples were passed through a 2 mm sieve before analyses.

Organic carbon was determined by wet oxidation with a dichromate-sulphuric acid mixture (Walkley and Black, 1934) and measured colourimetrically at 600 nm. Total nitrogen was determined by the LECO combustion method (Sweeney and Rexroad, 1987). Nitrate nitrogen and ammonium nitrogen were extracted simultaneously using a Lachat Flow Injection Analyser following the method of Searle (1984). Soils are mixed with 2 M potassium chloride in a soil: solution ratio of 1:5 for 1 h at 25 °C. The concentration of ammonium is measured colourimetically at 420 nm using the indo-phenol blue reaction, whereas the concentration of nitrate is calculated after reduction and colourimetric measurement of nitrite at 520 nm.

Available phosphorus and potassium were extracted using the Colwell method (Colwell, 1965) and the concentrations were determined using the methods of Rayment and Higginson (1992). Sulphur (sulphate) was measured by inductively coupled plasma atomic emission spectrometry after extraction at 40 °C for 3 h with 0.25 M potassium chloride (Blair et al., 1991). To measure reactive iron, soils were mixed with an oxalic acid/ammonium oxalate solution (1:33 soil to solution ratio) for 1 h after which the concentration of iron was determined using a flame atomic absorption spectrophotometer at 248.3 nm. Reactive iron is a conservative soil property and therefore not expected to be affected by land-use, but reflects soil type. We use it as an indication of the validity of the paired (old-field/woodland remnant) comparisons.

Electrical conductivity is a measure of soil salinity and was completed only as a check on the field-based assumption that these soils were unaffected by secondary salinity. Electrical conductivity was determined after soils were mixed with deionised water for 1 h at 25 °C using a soil: solution ratio of 1:5 (Rayment and Higginson, 1992). Using these extracts, soil pH was determined after the addition of calcium chloride solution to a concentration of 0.01 M (Rayment and Higginson, 1992). Volume-based concentrations for organic carbon, total nitrogen, nitrate nitrogen, ammonium nitrogen, available phosphate, potassium, sulphur and reactive iron were converted to weight-based values (i.e. element concentration (%)$\times$bulk density (g/cm^3).

Vegetation survey

Percentage cover of all plant species was estimated visually in two height classes, trees greater than or equal to 5 m in 20×20 m quadrats and shrubs 2–5 m in 5×5 m quadrats at one of the three sampling points associated with each reference point ($n=25$ quadrats of each size per site). The ground cover within the central 0.1 m^2 portion of a 1×1 m quadrat placed at all three sampling points associated with each reference point was collected in October (spring) 2003 and the dry weight determined ($n = 75$ quadrats per site). We use ground cover biomass rather than percentage cover as it better reflects soil nutrient availability for plants. Percentage leaf litter cover within the 1×1 m quadrats was estimated also. These vegetation parameters (summarised in Table 1) were used in the statistical analyses of the variation in soil properties (refer Statistical analyses).

Statistical analyses

Multivariate analyses

Multivariate multiple regression (Anderson, 2001a; McArdle and Anderson, 2001) was used to partition the variation in the soils data set according to that explained by: (i) soil type ($n = 2$), (ii) vegetation variables ($n = 4$), (iii) variables describing the spatial structure in the data ($n = 9$) and (iv) variables describing land-use history ($n = 2$). Soil type was assigned according to the parent material (i.e. 1 = Booraan unit and 2 = Danberrin and Rock Outcrop units). The vegetation variables included percentage cover of trees, shrubs and leaf litter, as well as ground cover biomass. The spatial variables were calculated using the geographical coordinates of the sampling points, i.e. x = easting and y = northing, and the equation for a cubic trend surface regression (Borcard et al., 1992; Legendre, 1990), such that the final terms were x, y, x^2, xy, y^2, x^3, x^2y, xy^2 and y^3. These nine terms allow for the explanation of spatial patterns in linear gradients as well as those in patches or gaps (Borcard et al., 1992). The land-use history variables were cultivation time (i.e. 1, 60 and 4 years for Letchford, Pullen and Woolering old-fields respectively) and time since abandonment (i.e. 45, 14 and 43 years for Letchford, Pullen and Woolering old-fields respectively). A variable of 0 years for cultivation time and a dummy variable of 100 years for time since abandonment were assigned to woodland remnants at each site.

Individual variables ($n = 15$ total) were assessed for their relationship to the multivariate soils data, and then subject to a forward selection procedure which makes redundant variables that do not explain more variation than chance alone. Forward selection is by sequential testing – a multivariate extension of the stepwise regression procedure (Borcard et al., 1992). Forward selection resulted in the elimination of six spatial variables, so that the final analysis, completed on sets of variables, included the vegetation and land-use variables; and the spatial variables x, x^2 and y^3. Before analysis, soil texture (a qualitative measure) was converted into percentage clay content using the approximations in McDonald et al. (1990). Square root, log and Napierian (log $(y+1)$) transformations were used where necessary to normalise individual variables (Quinn and Keough, 2002). Water repellence classes were converted into semi-quantitative ranks of zero to three that were skewed towards zero (untransformed). Electrical conductivity and reactive iron variables were not included.

All tests used the chord distance measure (Orlóci, 1967) (= relative Euclidean) which normalises data of different scales so that they are comparable (Legendre and Legendre, 1998), and fits a linear relationship between the response and explanatory variables. P values for the marginal tests (examining a single variable or group of variables) were obtained using 999 permutations of the raw data, while conditional tests

Table 1. The percentage cover of trees ≥5 m and shrubs 2–5 m, the ground cover biomass and percentage cover of leaf litter, at the old-fields (OF) and adjacent woodland remnants (R)

	Letchford		Pullen		Woolering	
	OF	R	OF	R	OF	R
	$n = 15, 45$	$n = 10, 30$	$n = 15, 45$	$n = 10, 30$	$n = 15, 45$	$n = 10, 30$
Trees	0.06 ± 0.06	11.8 ± 3.7	5.4 ± 2.3	28.4 ± 3.2	24.5 ± 3.7	27.3 ± 3.2
Shrubs	4 ± 1.9	34.8 ± 6.4	2.7 ± 1.8	13.5 ± 8.0	5 ± 2.2	10 ± 2.7
Ground cover	29.6 ± 2.3	19.2 ± 3.0	20.5 ± 1.7	10.2 ± 2.9	10.7 ± 1.1	13.1 ± 2.8
Leaf litter	0 ± 0	12 ± 5	3.9 ± 1.6	36.7 ± 7	30.2 ± 6.2	23.8 ± 7

Data are means ± SE; larger sample sizes are for ground cover biomass and percentage cover of leaf litter values.

(used in forward selection) were done using 999 permutations of residuals under the reduced model (Anderson, 2001b). All multivariate multiple regressions were done using DISTLM and DISTLM *forward* (Anderson, 2003; 2004).

To visualise the preceding analyses, an ordination of the (transformed) soils data set, constrained by a multiple regression on the same explanatory variables, was produced using canonical correspondence analysis (CCA; ter Braak, 1986). CCA does not calculate a distance matrix, but is implicitly based on the chi-squared distance measure, which is similar to the chord distance measure except that more weighting is given to response variables whose sums contribute a relatively small portion to the total sum of response variables (McCune and Mefford, 1999). A biplot was drawn on the ordination to display the relationship between the explanatory variables and the ordination axes, where the angle and length of the line indicate the direction and strength of the relationship.

For comparison, we produced a non-metric multi-dimensional scaling (NMS) ordination using chord distances. In contrast to the CCA, the NMS is unconstrained by the explanatory variables. Its use is appropriate given the high level of unexplained variation and consistent with our ultimate aim to determine the differences, if any, between old-field and remnant soils. Then a joint plot was imposed onto the ordination to display the relationship between the explanatory variables and the NMS ordination scores. As for a biplot, the angle and length of the line indicate the direction and strength of the relationship (McCune and Mefford, 1999). Ordinations were done using PC-ORD (McCune and Mefford, 1999).

Univariate analyses

Two-factor ANOVA was used to test for differences between the old-fields and remnants for each soil property (factors = old-field/remnant and site, both fixed) using SPSS (SPSS Inc., 2002). We calculated the Type III Sums of Squares recommended for unbalanced designs ($n = 45$ old-field and 30 remnant samples per site) (Quinn and Keough, 2002). Data were transformed prior to analysis, and outliers were retained, as for the multivariate analyses.

Results

Multivariate analyses

Multivariate multiple regression showed that 16 soil type, vegetation, spatial and land-use variables together explained 29.9% of the variance in the soils data, which was statistically significant (pseudo-$F_{16,224} = 5.53$, $P = 0.001$). The variables that explained most of the variation (equal highest) were x (easting), x^2 and x^3 (Table 2a). The percentage of variation explained by these variables is reduced in the sequential model, which accounts for the correlation between pair-wise combinations of these variables ($R^2 = 1$; Table 2b). Soil type was negatively correlated with cultivation time (i.e. Booraan soils at Pullen were cultivated for the longest period; $R^2 = -0.99$) but nonetheless explained a significant amount of variation after taking cultivation time into account (i.e. 2.5% after removing effect due to cultivation time; Table 2b). Similarly, time since abandonment and cultivation time were correlated (i.e. Pullen was abandoned more recently and had the longest period in cultivation; $R^2 = -0.71$), as were time since abandonment and soil type (i.e. again, Booraan soils at Pullen were abandoned more recently; $R^2 = -0.68$), but all three variables were retained in the sequential model (Table 2b). Overall, six of the 16 variables considered explained significant amounts of variation in the sequential model; these were x (easting), y^3 (northing^3), cultivation time, time since abandonment, soil type and percentage shrub cover (Table 2b).

The results of the multivariate analyses of sets containing variables that explain more than 1×10^{-6} (program default for redundancy) of the total variation when fitted sequentially are shown in Table 3. The set of variables with the greatest explanatory power was the set of spatial variables, which explained 17.4% of the variation in the soils data (Table 3). Once the spatial set of variables was fitted, the next most important set was land-use (5.4% of variation explained), followed by soil type and the set of habitat variables (Table 3b). All four sets of variables explained significant amounts of variation (Table 3b).

Table 2. Results of multivariate multiple regression of soils data on variables for (a) each variable taken individually (ignoring other variables) and (b) forward selection of variables, where amount of variation explained by each variable added to the model is conditional on variables already in the model

Variable	%Var.	Pseudo-F	P	Cum. %Var.
(a) Variables individually				
x	10.27	25.53	0.001	
x^2	10.27	25.53	0.001	
x^3	10.27	25.53	0.001	
Cultivation time	10.15	25.20	0.001	
Soil type	10.07	24.98	0.001	
x^2y	5.45	12.85	0.001	
xy	3.21	7.39	0.001	
y^3	2.84	6.51	0.004	
y^2	2.83	6.51	0.004	
y	2.83	6.50	0.004	
Percentage tree cover	2.72	6.24	0.007	
xy^2	2.01	4.57	0.009	
Ground cover biomass	1.95	4.43	0.018	
Percentage litter cover	1.41	3.20	0.040	
Time since abandonment	0.95	2.14	0.100	
Percentage shrub cover	0.91	2.06	0.115	
(b) Variables fitted sequentially				
x	10.27	25.53	0.001	10.27
y^3	6.80	18.20	0.001	17.07
Cultivation time	4.43	13.20	0.001	21.50
Time since abandonment	2.47	6.95	0.001	23.97
Soil type	2.47	6.78	0.003	26.44
Percentage shrub cover	1.16	3.50	0.036	27.6
Percentage litter cover	0.79	2.39	0.091	28.39
x^2	0.73	2.24	0.086	29.12
Ground cover biomass	0.19	0.58	0.561	29.31
Percentage tree cover	0.19	0.58	0.569	29.50

%Var. = percentage of variance in soils data explained by that variable, Cum. % Var. = cumulative percentage of variance explained. Variables missing from (b) explained $< 1 \times 10^{-6}$ % of total variation (i.e. redundant).

Table 3. Results of multivariate multiple regression of soils data on sets of variables for (a) each set of variables taken individually (ignoring other sets) and (b) forward-selection of sets of variables, where amounts explained by each set is conditional on sets of variables already in the model. %Var. = percentage of variance in soils data explained by that set, Cum. % Var. = cumulative percentage of variance explained

Set	%Var.	Pseudo-F	P	Cum. %Var.
(a) Sets individually				
Spatial	17.36	15.47	0.001	
Land-use	14.83	19.33	0.001	
Soil type	10.07	24.98	0.001	
Habitat	5.37	3.12	0.004	
(b) Sets fitted sequentially				
Spatial	17.36	15.47	0.001	17.36
Land-use	5.42	7.68	0.001	22.78
Soil type	3.88	11.52	0.001	26.66
Habitat	2.62	1.99	0.044	29.28

Sets do not contain variables made redundant in previous analysis (i.e. 6 spatial variables, refer Table 2).

The total variance explained by the CCA ordination (including axis 3) was 29.9% (Figure 1a) which is the same as that explained by the multiple regression. Letchford old-field soils and Pullen old-field soils were separated from each other and from the other soils along axis one, which correlated most strongly with soil type, cultivation time as well as x (easting) and x^2. The unique soil type and lengthy cultivation period of the Pullen old-field relative to the other old-fields resulted in their being distinct. Also, Pullen soils (old-field and remnant) were more water repellent than soils at the other two sites (refer to Univariate results) and this contributed to Pullen old-field soils being distinct (Figure 1a). Similarly, high sulphur levels in Letchford old-field soils contribute to their distinctiveness (Figure 1a). Woolering soils (old-field and remnant) were mostly separated from the other soils along axis two, which correlated most strongly with percentage tree cover and y^3. Woolering old-field had greater percentage tree cover than the other old-fields (Table 1). Pullen remnant soils appeared the most variable of the six groups, particularly along axis two. The strength of the relationship between the ordination axes and the explanatory variables (length of black lines; Figure 1a) reflects the percentage of variance explained by the variables in the individual regression model rather than in the sequential model as CCA does not account for correlation between variables (Table 2, Figure 1a).

The total variation explained by the NMS ordination was 96.1% (the two-dimensional minimal stress solution; Figure 1b). There is much less structure to the NMS ordination than the ordination produced using CCA. However, there are some similarities between the two. There is (incomplete) separation of Letchford old-field soils and Pullen old-field soils (Figure 1b), which is also correlated with x (easting), x^2, soil type and cultivation time (R^2 0.175–0.20; Figure 1b). This reflects the unique soil type and lengthy cultivation period of the Pullen old-field relative to the Letchford old-field. Again, water repellency has contributed to some of the Pullen old-fields and Pullen remnant soils being distinct (Figure 1b) and high sulphur levels in Letchford old-field soils contribute to their distinctiveness (Figure 1b). Last, the variability among Pullen remnant soils is also apparent on the NMS ordination.

Univariate analyses

The means and 95% confidence intervals for each soil property are plotted in Figure 2. Despite large amounts of variation within soils taken from the same site, particularly the Pullen remnant, there are several soil properties which differ between old-field and remnant sites (Table 4). Specifically, bulk density was increased for Pullen old-field soils compared with Pullen remnant soils, though both values were lower than for the Letchford soils (Figure 2a, Table 4). There were significant differences in the percentage clay content of old-field and remnant soils within each site, but no consistent difference as indicated by the significant interaction term (Figure 2b, Table 4). There were more cases of water repellent soils at Pullen than at the other two sites (29 cases spread between old-field and remnant, compared with six at Letchford and one at Woolering; (χ^2-value = 53.18, df = 11, $P < 0.005$). Old-field soils at Pullen and Letchford were less acidic than the adjacent remnant soils (Figure 2d, Table 4). There was no difference between old-field and remnant soil pH at Woolering, and these levels were generally lower than pH levels at the other sites.

Organic C was higher in Pullen remnant soils than in the other soils (Figure 2e, Table 4) and total N was higher in Letchford old-field soils than in Letchford remnant soils, but similar for the other old-field/remnant comparisons (Figure 2e, Table 4). Colwell P was significantly higher in old-field soils at Pullen and Letchford than in the adjacent remnant soils, but similar between old-field and remnant soils at Woolering (Figure 2i, Table 4, Figure 3). Potassium levels were much higher in Letchford old-field soils than in any other soils (Figure 2k, Table 4). The electrical conductivity values indicate that the soils were not saline (< 0.2 dS/m; Figure 2m).

Discussion

A legacy of clearing and cultivation was evident in two of the three old fields despite high levels of spatial and unexplained variation in the soil properties. At Pullen, these legacies include soil

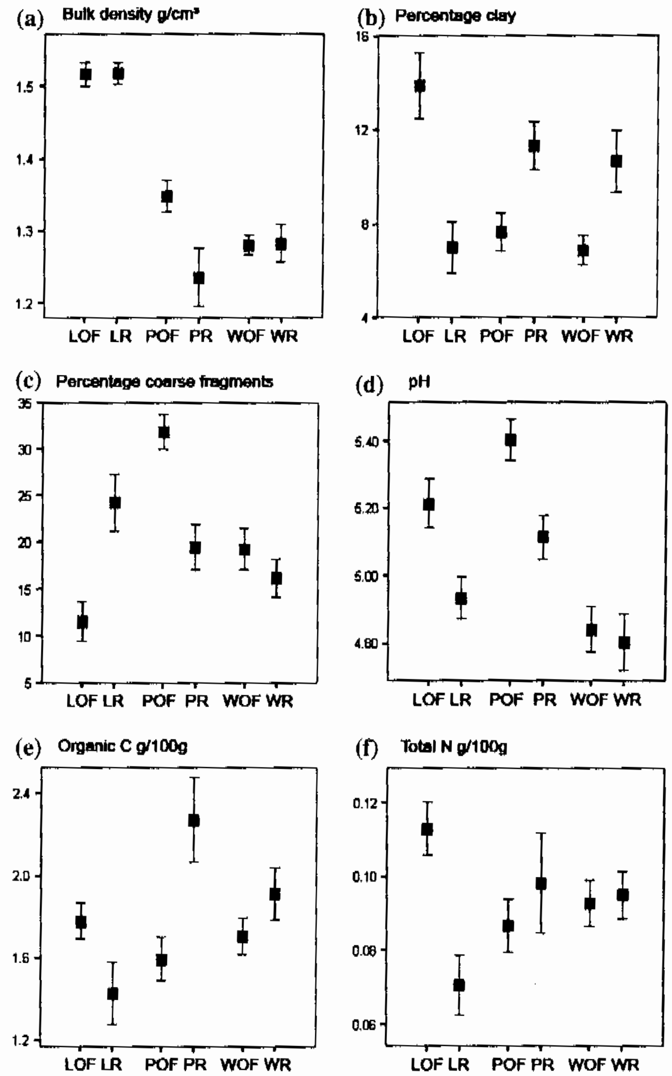

Figure 2. Soil physical and chemical properties (mean ± SE) within old-field (OF) and adjacent woodland remnants (R) at three sites (L = Letchford, P = Pullen and W = Woolering). Soil nutrient data are weight-based values.

compaction, probable erosion as evident by a higher percentage of coarse fragments, increased Colwell phosphate that we interpret as fertiliser residue, and reduced organic carbon in the old-field compared with the remnant. This legacy is not surprising given that this site had the longest cultivation period and the least time to recover. More surprising was the apparent legacy of cultivation at Letchford after only 1 year in cultivation and 45 years in recovery. There was increased Colwell phosphate that could be due in part to fertiliser residue in old-field soils compared with remnant soils at Letchford. In contrast, the Woolering old-field showed no evidence of its 4 year period in cultivation 43 years ago despite similar farming practices and soil type to Letchford.

Pullen and Letchford remnants were on soils associated with rocky outcrop – left intact because they were too stony, which is the same rea-

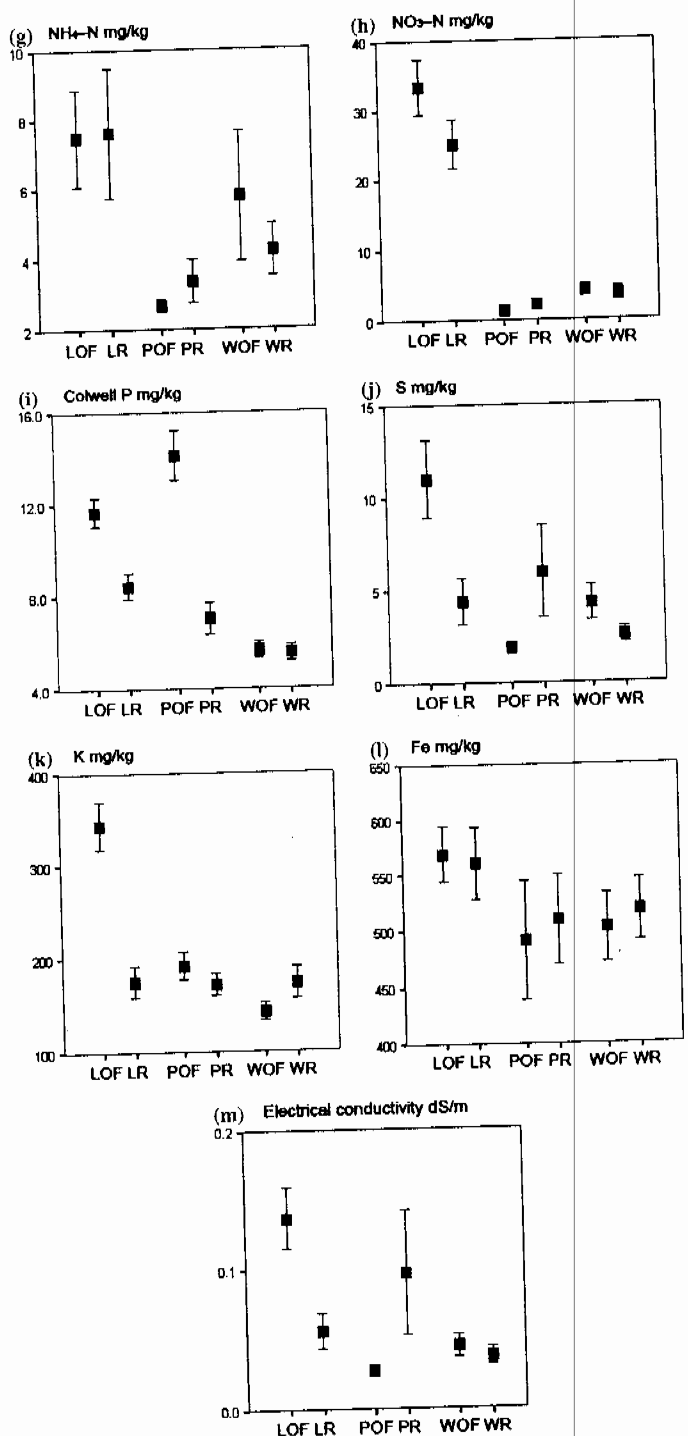

Figure 2. Continued.

Table 4. Results of 2-factor ANOVA on individual soil variables

Variable	Mean square values and P-values			
	Site	Old-field/remnant	Interaction	Residual
Bulk density	1.27	0.07	0.08	0.02
	< 0.001	0.05	0.02	
Percentage clay	0.08	0.10	1.52	0.09
	0.44	0.30	< 0.001	
Percentage coarse fragments	22.13	0.003	40.76	2.51
	< 0.001	0.97	< 0.001	
pH	0.03	0.02	0.002	0.001
	< 0.001	0.001	0.16	
Organic C	0.20	0.15	0.72	0.07
	0.07	0.16	< 0.001	
Total N	0.003	0.022	0.041	0.006
	0.59	0.06	0.002	
NH_4-N	Invalid test – variance increases with mean			
NO_3-N	Invalid test – variance increases with mean			
P	1.50	1.15	0.44	0.04
	< 0.001	< 0.001	< 0.001	
S	Invalid test – variance increases with mean.			
K	0.64	0.32	0.61	0.04
	< 0.001	0.005	< 0.001	
Fe	Invalid test – variances heterogeneous.			
Electrical conductivity	Invalid test – variance increases with mean.			

Degrees of freedom associated with each factor are 2 (site), 1 (old-field or remnant), 2 (interaction) and 219 (residual).

son the Letchford and Woolering old-fields were abandoned after a relatively short period in cultivation. It follows that the old-field that was cultivated for the longest period had less exposed rock. An advantage of the forward selection procedure is that it enabled us to determine separately the effects of soil type and land-use history despite them being confounded. Cultivation time, time since abandonment and soil type were all retained in the final sequentially fitted multiple regression model despite multicollinearity.

The level of unexplained variation (70.7%) is high but not unusual. Borcard et al. (1992) report 63.3% unexplained variation after partitioning the variation due to space and environmental factors for a forest community data set, and 68.6% for a model of factors influencing the growth of marine bacteria. Whether the large amount of unexplained variation is due to factors that were not included in our model (e.g., species composition of the vegetation) or stochastic variation is not clear. However, it is logical to assume that the unexplained variation is not due to factors that are spatially structured at the scale of 5 m (minimum distance between sampling points) to 408 m (maximum distance within sites) up to 24.5 km (maximum distance between sites), as this space was adequately described by the terms used in the model.

Therefore if the unexplained variation does contain deterministic components, these are likely to be at the local scale (i.e. < 5 m) and not spatially structured within and among sites. Examples of processes that would operate at that scale include nutrient cycling under individual plants (Farley and Fitter, 1999; Zinke, 1962). In a New Mexico desert grassland, 35–76% of variation in soil N was on a scale of < 20 cm and was linked to accumulation under individual grasses; and on a scale of 1–3 m in adjacent shrubland reflecting shrub size (Schlesinger et al., 1996). Some of the local scale (i.e. 4–6 m) variation within the Letchford remnant could be attributed to N and P accumulation underneath *Santalum spicatum* (Hobbs and Atkins, 1991). Other local processes which might influence the

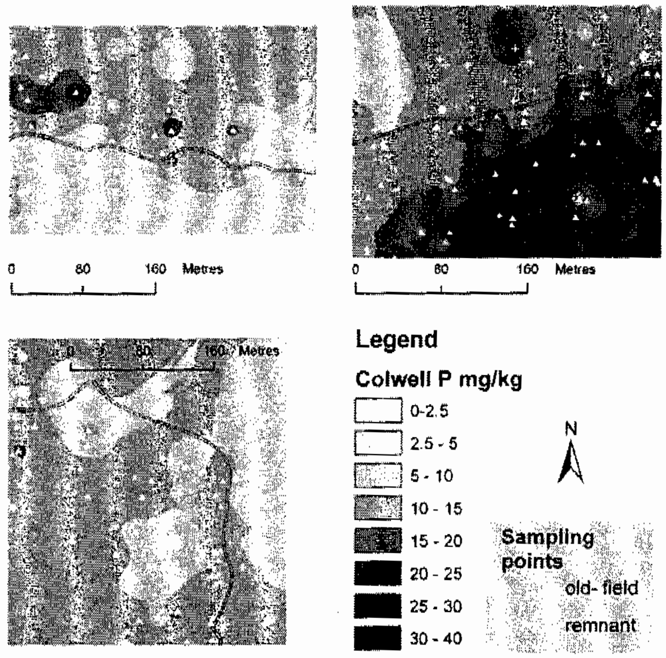

Figure 3. Maps of Colwell P at Letchford (top left), Pullen (top right) and Woolering (bottom left) produced by interpolation to grid from point data using an inverse distance weighed algorithm (variable search radius and power of two).

distribution of soil nutrients include patchy mycorrhiza infection (Allen and Allen, 1990 and references within) and the burrowing activity of soil fauna (Hobbs et al., 1993).

As we predicted, spatial structure is evident in the old-field soils despite the homogenising effects of clearing; and for the Pullen old-field the effects of continued tillage, cultivation of a monoculture and currently, invasion of a persistent annual grass (*Avena* spp). Other than differential nutrient leaching or accumulation (Bradshaw, 2004), additional processes that might determine this spatial structure include nutrient cycling beneath scattered *Acacia acuminata*. However, there is some evidence of homogenisation of Pullen old-field soils – we found consistently more variation in soil properties among remnant soils than among old-fields soils at Pullen. A similar finding is reported for northern hemisphere old-fields (Fraterrigo et al., 2005; Lane and BassiriRad, 2005; Robertson et al., 1988, 1993). Low resource heterogeneity may favour species that are able to withstand uniformly high levels of competition (Day et al., 2003; Hutchings et al., 2003). Nutrient-poor patches within heterogeneous habitats could be refuges from intense competition (Facelli and Facelli, 2002); therefore homogeneous soils may prevent the colonisation of new species because there are few such refuges (Day et al., 2003; Hutchings et al., 2003). Therefore, homogeneous soils could contribute to the dominance of the Pullen old-field by non-native annuals.

For soils of this region, cultivation is likely to increase soil acidity rather than decrease it (Nulsen, 1993). It is estimated that ~10 million ha (> 65% of agricultural land in Western Australia) could acidify over the next 100 years (Nulsen, 1993). Soil acidification occurs in poorly buffered soils when N that is added via nitrogenous fertiliser (i.e. $(NH_4)_2SO_4$ or NH_4NO_3) or leguminous crops undergoes nitrification resulting in the accumulation of free H^+ ions (Nulsen, 1993). It has not occurred in the old-fields we studied. Therefore it is probable that the pH differences between the old-fields and remnants at Pullen and Letchford are due to differences in current vegetation rather than land-use history. The increase in pH may reflect increased base cation concentrations in the grass litter (Ehrenfeld, 2003). The elevated potassium levels in the Letchford old-field are consistent with this explanation, though they are more likely a result of the relatively high percentage clay content of this soil (Bettenay and Hingston, 1964). Altered pH can affect plant species diversity (Roem and Berendse, 2000) though the values for the Letchford old-field are within the range expected for uncultivated soils of that soil type and depth (i.e. pH 4.5 to 6.7; McArthur, 1992).

The reduced levels of organic carbon at Pullen old-field compared with the Pullen remnant are consistent with its land-use history and vegetation cover given the general predictions regarding the recovery of soils after clearing and cultivation (Guo and Gifford, 2002). In particular, the removal of tree stumps has prevented resprouting (e.g., mallee eucalypts) and therefore a more rapid recovery of soil carbon (Hooker and Compton, 2003). However, the soil carbon content *per se* is unlikely to prevent natural regeneration – the Woolering old-field has a similar amount of carbon to the Woolering remnant and supports native vegetation. The results for total nitrogen, ammonium and nitrate are highly variable and more difficult to interpret; there are however, no consistent land-use effects.

The reduction in water infiltration associated with soil compaction (Yates et al., 2000) is likely to be a barrier to the establishment of native species as it will intensify the competition with non-native annuals for limited water. Furthermore, high phosphorus availability is likely to favour non-native annuals, including *Avena* spp. (Cale and Hobbs, 1991; Hester and Hobbs, 1992; Hobbs and Atkins, 1988, 1991). This phenomenon – the paradox of enrichment (Rosenweig, 1987) – predicts that high soil P will favour some species to the exclusion of most others resulting in a reduction of species richness (e.g., Gough and Marrs, 1990). Those at risk in the wheatbelt include species adapted to derive their nutrition from mycorrhiza that typically form in low-nutrient soils (Bougher and Tommerup, 1996; Brundrett, 1991).

So it is significant, and potentially ecologically catastrophic, that phosphate fertiliser residue can persist long after agricultural land is taken out of production. Greater levels of P in the old-fields soils of Pullen and Letchford may not only reflect the residue of phosphate fertiliser: soil P concentrations may be maintained by the invasive annual grasses that dominate these sites (Ehrenfeld, 2003). The idea that the non-native annual grasses could enhance their invasibility to the detriment of the native species is intriguing and worthy of further research. It may be possible to reduce available P in these soils by continuous cropping with soil amendments to increase crop yield thereby stripping the soil of P (Gough and Marrs, 1990; Marrs, 1985). An alternative approach would be to match the vegetation to the nutrient regime (Whisenant, 1999) – that is to try and initiate autogenic restoration by seeding native species that are able to compete in the P-enriched conditions.

This study is one of only four to have considered the role of soils in the natural regeneration of old-fields in Australia (Arnold et al., 1999; Liangzhong and Whelan, 1993; Read and Hill, 1983). This study has generated a set of testable hypotheses regarding the legacy of land-use evident in some wheatbelt old-fields. Our current research focuses on two of these: the effect of P-enrichment both on the ability of a selection of native species to compete against *Avena barbata* and on the formation of mycorrhiza, in two separate pot studies.

In conclusion, the soil could act as a barrier to native regeneration in old-fields at Pullen and Letchford but not at Woolering. Is it coincidental then that the Woolering old-field supports a diversity of native species whereas the other old-fields do not? Although cultivation leaves a legacy in soils, the location of the old-field within the fragmented landscape and disturbance events after abandonment are likely to have a major influence on community assembly. Specifically, the Woolering old-field is better connected to remnant vegetation than the other sites, which will increase the likelihood of seed arrival. Further, the Woolering old-field has undergone two large disturbance events that may have reset the assembly trajectory, thus altering both soil conditions and vegetation development. The fire of 1963 is likely to have stimulated native seed germination (Bell et al., 1993), while the 1978 cyclone delivered substantial summer precipitation, an important factor in the establishment of shrubs and trees as drought limits recruitment (Yates et al., 1994; Yates and Ladd, 2005). Therefore, while the legacy of land-use is undoubtedly an important factor explaining current soil conditions and vegetation communities in old-fields, the presence of seeds and conditions favourable for establishment are also important. Knowledge of these and other factors is essential to understanding the barriers to the regeneration of native vegetation on wheatbelt old-fields.

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Predicting the distribution of shrub species in southern California from climate and terrain-derived variables

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Abstract. Generalized additive, generalized linear, and classification tree models were developed to predict the distribution of 20 species of chaparral and coastal sage shrubs within the southwest ecoregion of California. Mapped explanatory variables included bioclimatic attributes related to primary environmental regimes: averages of annual precipitation, minimum temperature of the coldest month, maximum temperature of the warmest month, and topographically-distributed potential solar insolation of the wettest quarter (winter) and of the growing season (spring). Also tested for significance were slope angle (related to soil depth) and the geographic coordinates of each observation. Models were parameterized and evaluated based on species presence/absence data from 906 plots surveyed on National Forest lands. Although all variables were significant in at least one of the species' models, those models based only on the bioclimatic variables predicted species presence with 3 - 26 % error. While error would undoubtedly be greater if the models were evaluated using independent data, results indicate that these models are useful for predictive mapping – for interpolating species distribution data within the ecoregion. All three methods produced models with similar accuracy for a given species; GAMs were useful for exploring the shape of the response functions, GLMs allowed those response functions to be parameterized and their significance tested, and classification trees, while sometimes difficult to interpret, yielded the lowest prediction errors (lower by 3 - 5 %).

Keywords: Chaparral; Classification tree; Coastal sage scrub; Direct gradient analysis; Digital terrain model; Generalized additive model; Generalized linear model; Species response curve; Vegetation modeling.

Abbreviations: ATM = Atmospheric and Topographic Model; CT = Classification Tree; DEM = Digital Elevation Model; GIS = Geographic Information System; GLM = Generalized Linear Model; GAM = Generalized Additive Model; IPW = Image Processing Workbench; USDA = United States Department of Agriculture; USGS = United States Geological Survey; UTM = Universal Trans-Mercator.

Nomenclature: Hickman (1993).

Introduction

Models that predictively map (Franklin 1995) the distribution of plant species or functional types can be used to interpolate data from costly vegetation field surveys (Austin & Heyligers 1989; Nicholls 1989; Lees & Ritman 1991; Le Duc et al. 1992; Mackey 1994; Cherrill et al. 1995). When they are based on climate variables, these models can be used to make first-order predictions of distribution changes in response to climate change (Austin 1992; Leathwick 1995, 1998; Brzeziecki et al. 1995; Huntley et al. 1995; Kienast et al. 1996; Diaz & Cabido 1997; Guisan et al. 1998; and reviewed by Franklin 1995). Further, these estimates of species' response surfaces (Austin 1985) can also be useful in models of transient ecosystem responses to environmental change when those models require information about the probability of species' occurrence on the landscape or in environmental space. This includes gap models of forest succession (as discussed by Austin et al. 1994a, p. 30), landscape simulation models (for example, He & Mladenoff in press) and dynamic global vegetation models (Steffen et al. 1996).

In order to map predicted plant distributions, spatially-interpolated environmental variables are required (Franklin 1995). It is when those variables are related to direct gradients (*sensu* Austin & Smith 1989) or primary environmental regimes (thermal, radiation, moisture, mineral nutrients; Mackey 1993), and chosen based on functional relationships derived from ecophysiological studies (Box 1981; Woodward 1987), that the response surface models can best be used to address environmental change.

I have developed statistical and decision-tree models predicting the probability of species presence for 20 shrub species that are commonly found in the chaparral and coastal sage scrub communities of southern California. Climate variables (temperature and precipitation) interpolated from climate station data, potential solar radiation estimated across a topographic grid, and a terrain variable related to potential soil moisture, were tested as explanatory variables.

Chaparral, characterized by a continuous canopy of evergreen sclerophyllous shrubs, and coastal sage scrub, characterized by a more discontinuous cover of drought-deciduous malacophyllous shrubs and subshrubs, are found in the coastal and lower montane regions of southern California, which experience a Mediterranean-type climate regime with wet cool winters and dry warm to hot summers (Hanes 1977; Mooney 1977; Keeley & Keeley 1988). The distribution of the various shrub species has been related to indirect gradients such as (1) elevation (related to both precipitation and winter minimum temperatures); (2) slope aspect (related to solar insolation, and hence potential evapotranspiration); (3) slope angle or topographic position (related to soil depth or texture, and thus potential soil moisture); and (4) substrate and lithology (related to nutrient and moisture availability) (Wells 1962; Kirkpatrick & Hutchinson 1980; Poole & Miller 1981; Westman 1981; Miller et al. 1983; Keeley & Keeley 1988; Davis & Goetz 1990; Gordon & White 1994; previously reviewed in Franklin et al. in press). Westman (1991) modeled the range of several chaparral and coastal sage shrub species in relation to climate variables derived from small-scale climate maps.

Materials and Methods

Data on species distributions

Visual estimates of the cover of plant species at 906 locations in three National Forests within California's 'southwest ecoregion' (defined and delineated in Hickman 1993 and Davis et al. 1994; Fig. 1) were available from the USDA Forest Service. Note that these 'forests' are actually dominated by shrub formations covering 50 - 80 % of their land area, and the 10 - 30 % of the land area covered by forest and woodland is not managed for timber production due to its limited extent and slow growth (Franklin 1996; Franklin & Woodcock 1997). The data were collected in 10-m radius circular plots between 1990 and 1994 for the purpose of defining shrub vegetation types or 'series' (Gordon & White 1994). Of 1215 plots originally collected, these 906 had their locations recorded as points on 1:24 000 topographic maps, and were digitized. While the accuracy with which plots were located on maps is not known, I would estimate it to be within 50 m. The plot locations were subjectively chosen. Sampling was both purposive (to sample different chaparral associations throughout the study area and elevation range) and opportunistic (locations were chosen based on ease of access and are clustered near roads). Species were not necessarily sampled evenly throughout geographical or gradient space. Also, all of these species have ranges that extend beyond the ecoregion, at least into northern Baja California (see Westman 1991; Hickman 1993). This implies that the models described below can be used to interpolate species distributions within the study area, but not to predict range changes nor to examine the shape of the response function describing the realized species niche (Austin et al. 1990).

Data for the 104 most frequently occurring species (of the 330 taxa of flowering plants sampled) were made available to me. Preliminary examination of patterns of

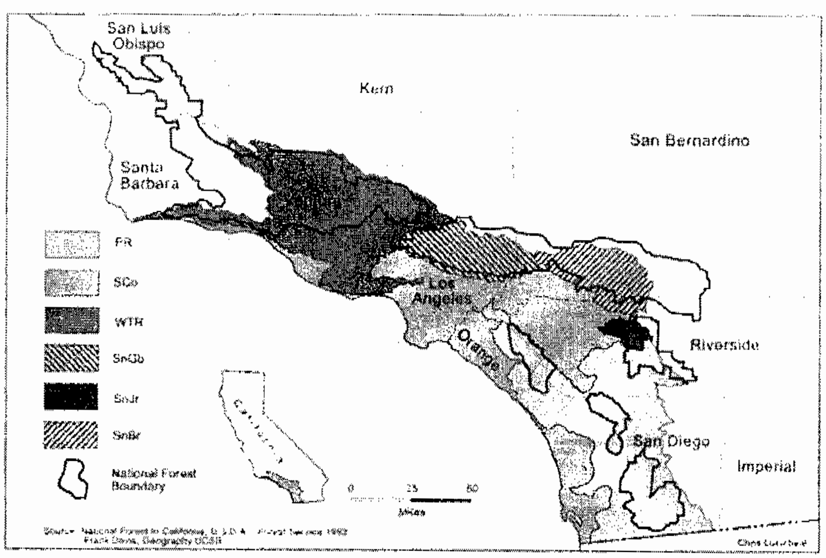

Fig. 1. Study area: plots were located within the southernmost National Forests in California (outlined); terrain data were available for the National Forest lands, climate variables (see Fig. 2) for the southwest ecoregion as defined in Hickman (1993) and Davis et al. (1994). Subdivisions of the ecoregion include: WTR = Western Transverse Ranges; SnGb = San Gabriel Mountains; SnBr = San Bernardino Mountains; SnJt = San Jacinto Mountains; PR = Peninsular Ranges; Sco = South Coast.

species abundance (cover) in relation to the environmental variables showed a great amount of scatter, and therefore I converted the data to species presence/absence for modeling. The 20 species modeled were chosen based on their high frequency of occurrence in the sample, their importance as indicators of certain vegetation types defined by Gordon & White (1994) (*Ceanothus tomentosus, Xylococcus bicolor, Adenostoma sparsifolium, Artemisia californica*), or their having been the subject of previous modeling efforts (*Ceanothus greggii, Malosma laurina*; Westman 1991).

Mapping the environmental variables

Climate variables and derived bioclimatic indices represent primary environmental regimes related to the physiological tolerances of organisms (Box 1981, 1996; Woodward 1987; Woodward & Williams 1987; Mackey & Sims 1993; Mackey 1993, 1994). They are measures of, or surrogates for, energy and water inputs, seasonal extreme conditions, and conditions during growing and dormant seasons and have been used to model and predictively map biotic distributions (reviewed in Austin et al. 1994a, p. 11; Franklin 1995; and see also Leathwick 1995, 1998; Brzeziecki et al. 1995; Beerling et al. 1995; Huntley et al. 1995; Guisan et al. 1998). Several approaches to interpolating climate variables on a geographic and topographic grid have been developed and tested (Hutchinson 1984, 1987; Daly et al. 1994; Hutchinson et al. 1996).

J. Michaelsen (unpubl.) provided 1-km gridded estimates of 28 climate variables for the southwest ecoregion: mean minimum and maximum monthly temperature for each month, and annual and trimesterly mean precipitation. The surfaces were interpolated from climate station data using elevation from a digital elevation model. Universal kriging (Cressie 1991) was the interpolation method used in a two-component model. Ordinary kriging was used to model the spatial dependence of residuals from regression models predicting the climate variables from up to four variables: location (latitude, longitude), elevation, and a topographic barrier index to capture the rainshadow effect. Then the regression model was re-estimated using the variogram model of spatial dependence, and this was repeated until the estimates converged (as suggested by Bailey & Gatrell 1995; Michaelsen pers. comm.).

These interpolated values of the climate variables at the vegetation plot locations are estimated with error (0.5 - 2.0 °C for the temperature variables), and this will add unexplained variance to the models described below. Further, the climate variables are interpolated to a resolution (1 km × 1 km) which is much larger than the vegetation plot (0.03 ha). However, because climate is slowly-varying in space, relative to individual plants, or topography, this scale problem should not introduce additional noise.

Because there is a body of literature and theory linking bioclimatic gradients to plant distributions, and because the models are intended to be predictive rather than exploratory, explanatory variables were chosen *a priori* (Judge et al. 1985, p. 869). Three of the climate variables were selected for modeling: annual precipitation (strongly related to growing season precipitation in this Mediterranean-type climate – precipitation in the dormant season is near zero): 'ppt.yr'; mean minimum temperature of the coldest month (December): 'dec.mint'; and mean maximum temperature of the warmest month (July): 'jul.maxt' (Fig. 2). The deviation of the coldest temperature from the annual mean (suggested by Leathwick 1995) was also examined, but was strongly correlated with jul.maxt for this data set (Pearson's $r = -0.72$).

Potential solar radiation (insolation) was estimated using the Atmospheric and Topographic Model (ATM) of solar radiation (Dozier 1980, 1989; Dozier & Frew 1990; Dubayah 1992; Dubayah & Rich 1995) implemented in the Image Processing Workbench (IPW; Frew 1990). This approach has sufficient physical realism to simulate the terrain-distributed surface energy balance, and has been validated using field data (Dubayah 1992; Dubayah & Rich 1995). However, for the purpose of modeling species response surfaces I was primarily interested in the relative radiation balance of different landscape positions (related to potential evapotranspiration; Dubayah 1994). Therefore, I estimated only clear-sky potential incoming shortwave radiation using a number of simplifying assumptions (uniform land surface albedo, constant uniform atmospheric optical properties for the entire model year). Topographic variables (elevation, slope and aspect) used in radiation modeling were derived from USGS 7.5' 30 m × 30 m resolution DEMs. Incoming solar radiation was calculated for each grid cell in the DEM, for a single day each month, and then multiplied by the number of days as an estimate of monthly potential radiation. These values were summed to estimate quarterly and annual solar radiation.

Quarterly estimates of solar radiation for the growing season (spring: Mar-May), and driest quarter (summer: Jun-Aug) were highly correlated ($r = 0.88$), and therefore only winter (Dec-Feb) and spring values were used in modeling ('psi.win', 'psi.spr'). In southern California, the difference in energy balance and potential evapotranspiration between north- and south-facing slopes is greatest during the spring and summer (Miller et al. 1983). However, winter potential insolation showed a strong empirical correlation with vegetation patterns, probably because illumination differences between north- and south-facing slopes are most pronounced due to low sun angle (Davis & Goetz 1990; McCullough 1995; Franklin et al. in press).

Errors commonly found in DEMs (related to the method used to derive the elevation grid) are amplified when first- and second-order difference operations are applied to derive slope, aspect and other terrain variables (Zevenberger & Thorne 1987; Skidmore 1989; Weibel & Heller 1991; Brown & Bara 1994; reviewed in Franklin et al. in press). In this dataset, the correlation between elevation recorded with the field data (from topographic maps) and the DEM-derived elevation for the plot locations was $r = 0.99$, while the correlations for field- versus DEM-estimated slope (angle or gradient; $r = 0.48$) and aspect ($r = 0.46$) were much lower (see also Davis & Goetz 1990). This had an unknown effect on the estimates of potential solar radiation. However, differences between the values may be due to scale differences in the measurements (discussed by Franklin et al. in press).

Additional mapped variables, related to environmental gradients, have been found important in vegetation modeling (reviewed by Franklin 1995) including soil type, landform, geology, and terrain variables related to soil depth and texture (slope angle, slope curvature, hillslope position) and potential soil moisture (drainage

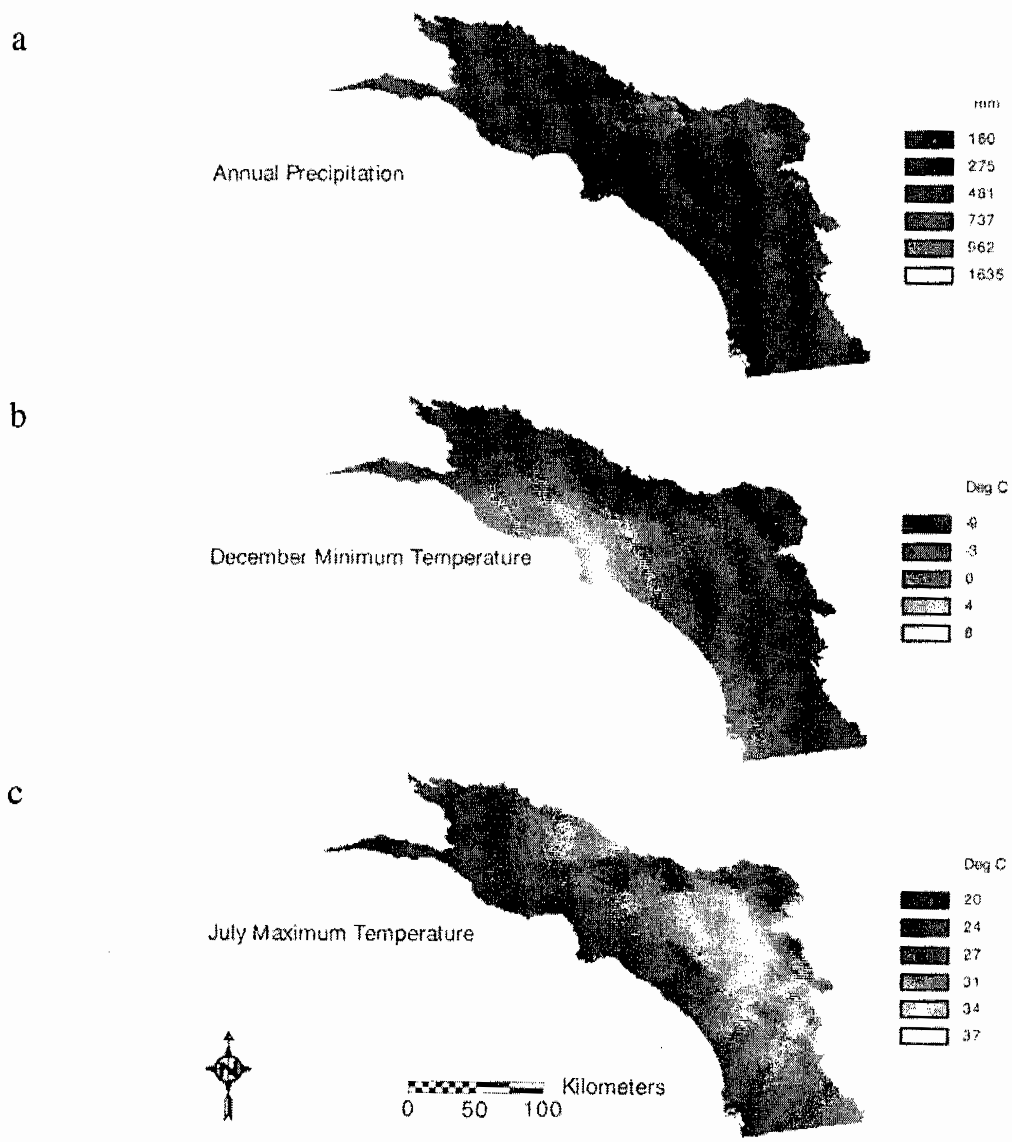

Fig. 2. Climate variables used in the models: **a.** Mean annual precipitation; **b.** Mean minimum temperature of the coldest month (December); **c.** Mean maximum temperature of the warmest month (July).

Table 1. Bioclimatic, topographic and spatial variables used as explanatory environmental variables in the models.

Variable name	Units	Description
ppt.yr	mm	average annual precipitation
dec.mint	°C	average minimum daily temperature of the coldest month (December)
jul.maxt	°C	average maximum daily temperature of the warmest month (July)
psi.spr	Wm^{-2}	topographically-distributed potential solar insolation for the spring quarter (Mar-May)
psi.win	Wm^{-2}	topographically-distributed potential solar insolation for the winter quarter (Dec-Feb)
slope.deg	°	slope angle or gradient
utm.n	m	geographic coordinate — UTM northing
utm.e	m	geographic coordinate — UTM easting

basin position, the topographic moisture index or TMI described by Moore et al. 1991). Digital maps of substrate or lithology were not available for the entire study area at an appropriate scale. Slope aspect is strongly related to, and was used to model, potential solar radiation (Dubayah 1994) and therefore was not included separately. Other terrain variables such as slope curvature and TMI were evaluated but not used, due to the errors the DEM described above. The only additional variable that was tested was slope which was calculated using the IPW software and a second order finite difference method (Skidmore 1989; Frew 1990). Explanatory variables used in the vegetation models are summarized in Table 1.

Finally, many statistical models of species response surfaces have ignored the potential for untreated spatial dependence (autocorrelation) in the response variable to inflate the estimated explanatory power of these models. Some studies have tested for spatial autocorrelation in the explanatory variables, and then used systematic sampling at a distance interval for which spatial randomness could be assumed, to generate a sample that met the independence assumption of a generalized linear model (Davis & Goetz 1990). If the spatial patterning of species distributions is caused entirely by spatial patterning of the explanatory environmental variables, then it may not be necessary to parameterize the spatial structure of the dependent variable in the model (Smith 1994). However, if there is spatial structure in the species data that is not shared by the environmental data, it may reflect biotic processes such as dispersal, predation and competition, as has been discussed at length in the literature (Pielou 1977; Ripley 1981). While characterizing the spatial structure of the species distribution may produce more accurate predictions of its distribution within the study area, removing spatial structure from the model may make it sufficiently general to extrapolate outside the study area (Harvey 1996).

A technique that has been used is to generate a trend surface model for the dependent variable, predicting its response using a quadratic or cubic trend surface regression based on the geographic coordinates (x, y) of the observations, and combine this with a model based on environmental variables using Bayesian or other techniques (Pereira & Itami 1991; Le Duc et al. 1992; see also Bocard et al. 1992). Another approach is to use an estimate of clustering as an additional explanatory variable in a statistical model (Smith 1994; Leathwick 1998). I developed models both with and without geographic coordinates as explanatory variables. This addresses geographic patterning but not spatial dependence or clustering in the dataset.

Methods of analysis

Three modeling frameworks being used with increasing frequency to describe species' response surfaces are generalized linear models (GLM, McCullagh & Nelder 1989; Crawley 1993), generalized additive models (GAM, Hastie & Tibshirani 1990; Yee & Mitchell 1991) and decision trees or classification and regression trees (Breiman et al. 1984; Clark & Pregibon 1992). These modeling approaches were reviewed in Franklin (1995) and Austin et al. (1994a; see also Leathwick 1995, 1998; Bio et al. 1998). Austin & Meyers (1995), and Austin et al. (1995) compared these and several other modeling approaches. In the present study, I used species presence/absence as the dependent variable, and so the logistic link function and binomial error term were used in the GAMs and GLMs, and classification trees (CT) were developed to predict species presence or absence.

GAMs were first parameterized using all environmental and spatial variables, and smoothing splines, to assess the validity of the linear model for each bivariate relationship, and to explore the shape of the response curve and strength of the relationship between each species and explanatory variable. Then, GLMs were parameterized using all variables and using response functions suggested by the GAM. The following restrictions were imposed: all response functions were modeled as either linear, quadratic (approximating a unimodal or symmetric Gaussian response curve), or a higher-order polynomial. For simplicity, and because the sample did not span the entire species ranges, skewed quadratic responses were not parameterized, although they are frequently cited in the literature (Minchin 1987; Austin et al 1994b; but see Oksanen 1997 and Austin & Nicholls

1997), nor were piecewise linear (monotonic) relationships (Bayes & Mackey 1991; Mackey 1993). Interaction terms were initially evaluated for significance in the GLMs, and although they were occasionally significant, they were not included in the models presented below. Variables in the GLMs were tested for significance, and deleted if not significant (backward elimination), and the remaining variables again tested for significance.

Finally, classification trees were developed for each species. A cut-off of five observations per terminal node was used, beyond which no splitting of the dataset occurred. Cross-validation was used to determine the optimum tree size yielding the most robust predictions (Clark & Pregibon 1992; Venables & Ripley 1994; Michaelsen et al. 1994). Cross-validation suggested that deviance was minimized at about 10 - 24 terminal nodes for many of the species models; therefore, for expediency, all trees were pruned to the 22 'best' nodes based on a cost-complexity measure (deleting those 'branches' that reduce deviance the least). Then the tree was pruned interactively to the smallest size possible without increasing model error (by aggregating terminal nodes that gave the same prediction). This generally resulted in models that used a subset of the explanatory variables. Statistical analyses were carried out using the S-Plus software version 3.3 for Windows (Anon. 1995).

It has been noted that when observations from outside the biogeographic range of the species are used to develop a model, this can inflate the amount of deviance explained by the model (Austin et al. 1995, p. 18; see also Guisan et al. 1998). Austin et al. (1995) have recommended that these 'structural zeroes' or 'naughty noughts' (Austin & McKenzie 1988) be removed from the dataset. They suggest deleting observations that are beyond the last positive observation by greater than 1% of the sample, sorted by an important environmental variable. I included the last positive observation +/–10% of the sample, and so the fit of my models may still be overestimated somewhat. For example, there were roughly 1000 observations (906), and if they are sorted by mean minimum temperature of the coldest month, and the first occurrence of a species is in the 200th observation and the last in the 500th, I selected the 100th-600th observations, sorted thus, and use that subset of the data to develop models for that species. I sorted, iteratively, for up to three climatic variables.

Model evaluation

In all three of these modeling frameworks, the model fit and significance of the variables are evaluated using the residual deviance (analogous to the residual sum of

Table 2. Summary of the shape of response functions for each environmental variable (Table 1), interpreted from smoothing functions fit in GAMs, and functions used to parameterize GLMs. Number of species (from among 15 chaparral or five coastal sage species) showing each type of response curve for GAMs, and number of species for which the variable was significant in GLMs ($p < 0.05$).

Response function	ppt.yr	dec.mint	jul.maxt	psi.spr	psi.win	slope.deg	utm.n	utm.e
Chaparral (n = 15)								
GAMs								
Linear	0	0	1	1	1	0	0	1
Piecewise linear	6	6	8	7	7	3	7	6
Skewed quadratic	5	9	2	0	2	0	1	2
Bimodal	0	0	1	1	1	3	2	2
Higher-order polynomial	1	0	3	0	1	1	4	3
No apparent relationship	3	0	0	6	3	8	1	1
GLMs								
Significant	9	13	11	7	9	2	13	8
Linear	4	5	3	7	9	2	7	3
Quadratic	5	8	7	0	0	0	3	4
Higher-order polynomial	0	0	1	0	0	0	3	1
Coastal sage (n = 5)								
GAMs								
Linear	0	0	0	0	2	0	0	0
Piecewise linear	3	5	1	4	3	1	4	2
Skewed quadratic	0	0	3	0	0	2	0	1
Bimodal	2	0	0	0	0	0	0	0
Higher-order polynomial	0	0	1	0	0	0	1	1
No apparent relationship	0	0	0	1	0	2	0	1
GLMs								
Significant	5	5	3	2	4	3	3	2
Linear	2	5	0	2	3	1	1	0
Quadratic	3	0	3	0	1	2	1	1
Higher-order polynomial	0	0	0	0	0	0	1	1

squares in the linear model). This is not as intuitively meaningful as the 'proportion of variance explained' from a linear model, but residual deviances can be compared with analysis of variance using a χ^2-test. However, because the CT-model is restricted to a normal error function (Austin et al. 1995, p. 74), rather than one more appropriate for binary data, comparisons of residual deviance between trees and the other types of models are invalid. The models were also assessed by examining the number of observations (presence/absence) correctly predicted by each model, as well as the proportion of omission (type I) and commission (type II) errors – predicting the species to be absent when it is present, and *vice versa*. Both can be important types of error in species distribution models. Further, because these models predict the probability, p, of the response variable being true, in this case of the species being present – which I will refer to as p(P) – commission and omission errors should be examined as a function of p for each model. An optimum threshold value of p should be chosen that minimizes omission and commission errors (Pereira & Itami 1991; Guisan et al. 1998 used the Cohen's k for calibrating this threshold probability value). This is important because when a species is rare in the sample, a 'model' that predicted it to be absent everywhere would have high overall accuracy (but high omission error), and vice versa. Although the data used to estimate model fit and prediction accuracy are the same as those used to develop the models, the diagnostics are still useful for comparisons among models.

Results

GAMs and GLMs: Variable selection and response curves

GAMs parameterized for the 20 species suggested skewed quadratic or piecewise linear responses to annual precipitation (ppt.yr) and winter monthly minimum temperature (dec.mint) for the chaparral species (Table 2, Fig. 3), but mainly piecewise linear responses for the coastal sage species (Table 2, Fig. 4). The latter are reaching their upper elevational limit within the study area (the National Forest lands do not extend to the coast, Fig. 1). The pattern of response to summer monthly maximum temperature (jul.maxt) was reversed – usually piecewise linear for chaparral species and skewed quadratic for coastal sage species (Table 2). This may be because highest jul.maxt occurs in the interior valleys and middle elevations of the study area, where coastal sage species are found (Fig. 2). The response functions for geographic coordinates ranged from linear to fourth-order polynomial. Plots of the smoothing functions for the GAMs suggested no apparent relationship to spring potential solar insolation (psi.spr) for about a third of the species, or to winter insolation (psi.win) in about a quarter of the cases (Table 2). These plots usually suggested a stronger relationship for psi.win than for psi.spr (Figs. 3, 4). Slope angle (slope.deg) had no apparent relationship to species response for half of the species (Table 2, Fig. 3).

GLMs parameterized using linear terms and second-order polynomials (higher-order polynomials only for geographic coordinates) showed that the precipitation, temperature and geographic variables, especially dec.mint, were retained in the models most frequently (significant at $p < 0.05$, Table 2). These first five variables, when significant, always explained the most deviance in the GLMs, although the exact magnitude and order of importance of the variables varied greatly among the species. Potential winter insolation (psi.win) was also significant in more than half of the chaparral models and most of the coastal sage models, but always explained less deviance than the previous five variables. Spring potential insolation (psi.spr) was significant in less than half of the models. Slope (slope.deg) was significant for only five of the species (Table 2, Fig. 4).

Table 3. Frequency with which the five bioclimatic and two spatial variables (Table 1) were selected in the tree model for the chaparral species (n = 15) and coastal sage scrub species (n = 5). The ranking indicates where in the tree model the variable was first selected, e.g., a variable ranked 1 - 3 was used in splits 1 - 3 of the tree (explained the highest amount of deviance).

Species	ppt.yr	dec.mint	jul.maxt	psi.spr	psi.win	utm.n	utm.e
Chaparral (n = 15)							
Frequency	9	14	13	10	13	13	14
Frequency ranked 1-3	4	11	8	1	5	7	9
Frequency ranked 4-5	4	2	4	7	6	4	2
Frequency ranked 6-7	1	1	1	2	2	2	3
Coastal sage scrub (n = 5)							
Frequency	4	5	5	4	5	4	5
Frequency ranked 1-3	2	4	3	1	1	0	4
Frequency ranked 4-5	1	1	2	1	3	3	0
Frequency ranked 6-7	1	0	0	2	1	1	1

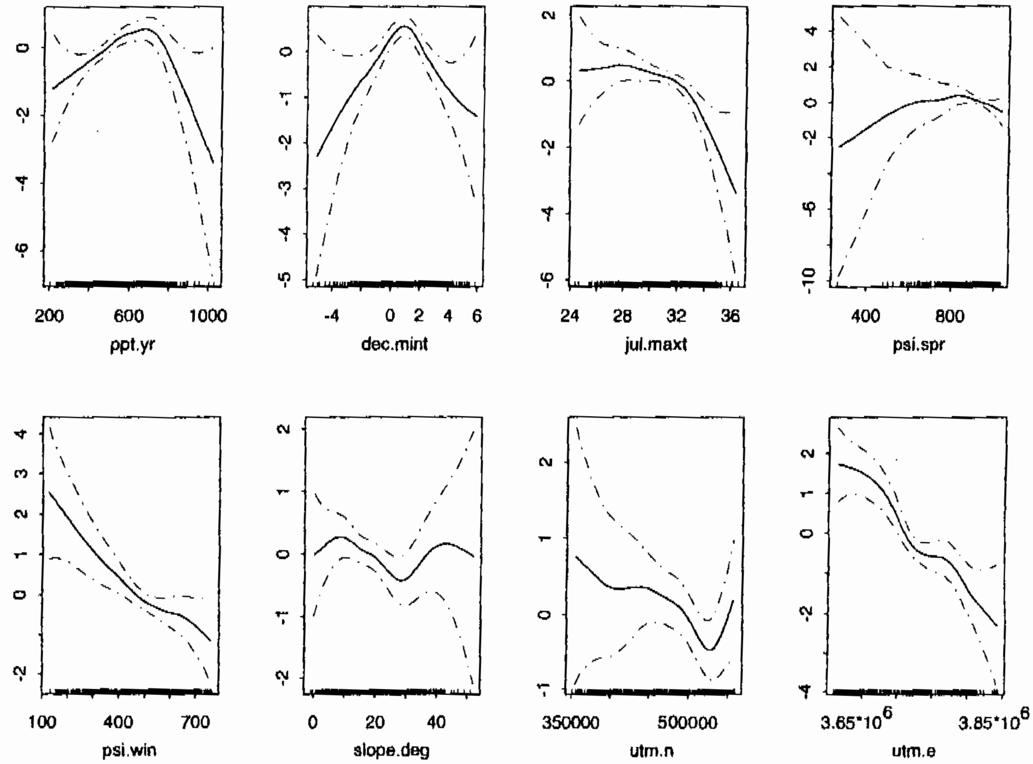

Fig. 3. GAM smoothing functions with 95% confidence intervals (dashed lines) for the eight environmental variables described in Table 1, for *Quercus berberidifolia*. The y-axis in each plot is the smoothing function applied to the variable.

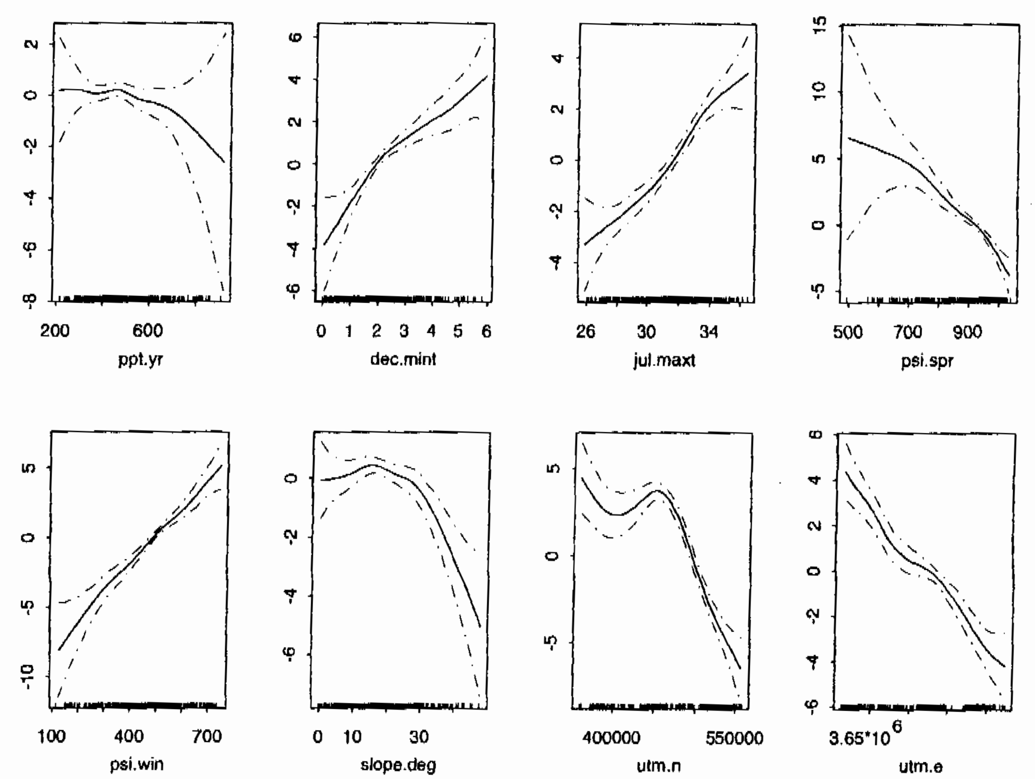

Fig. 4. GAM smoothing functions with 95% confidence intervals (dashed lines) for the eight environmental variables described in Table 1, for *Artemisia californica*. See caption Fig. 3.

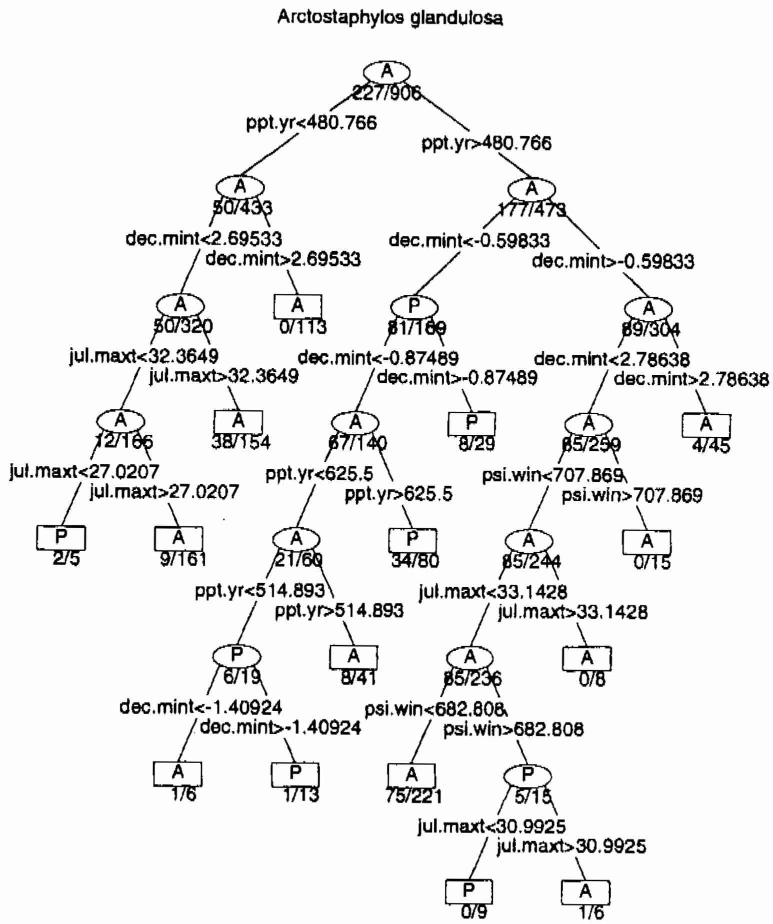

Fig. 5. Classification tree model for *Arctostaphylos glandulosa* based on bioclimatic variables (see Table 6). Abbreviations used for variables are given in Table 1. The ellipses represent internal nodes and rectangles terminal nodes of the pruned tree. Symbols P = Present, A = Absent are the models' prediction of the species' presence/absence at each node. The ratio below each node is the proportion of observations misclassified at that node.

Classification trees: Variable selection

Based on the variable selection for the GLMs, and preliminary testing of classification tree models, slope was not included as a variable in the tree models presented here. CT-models developed using the remaining seven variables, and pruned as described above (number of terminal nodes ranged from 9 - 18), selected the temperature and geographical variables and psi.win for almost all species, while ppt.yr and psi.spr were selected in about two thirds of the cases (Table 3). Further, variables are selected in a CT-model in order of how much deviance they explain; dec.mint, jul.maxt and utm.e (related to distance from the coast) were most frequently selected first, second or third, while psi.spr and psi.win were most frequently selected fourth or fifth (Table 3). This not only mirrors the pattern found in the GLMs, it suggests that the tree model may be capturing a hierarchical interaction between the climatic and topographically-distributed insolation variables that was not captured in the GLMs where insolation variables were significant less frequently. For example, the CT-model based on bioclimatic variables for *Arctostaphylos glandulosa* (Fig. 5) can be interpreted as follows: when precipitation is low (left main branch), the species is present only if summer maximum temperature is also low. If precipitation is not so low (right main branch), and if winter minimum temperature is not too high, and if psi.win is high (but not too high), and if summer maximum temperature is moderate, then the species is present. In the CT-model for *Ceanothus tomentosus* based on five bioclimatic variables (tree not shown), the species is predicted to be present at lower psi.win (< 489 W/m^2) if summer maximum temperature is high (29 - 32 °C), while it is predicted to be present at higher psi.win (up to 536 W/m^2) if summer maximum temperature is lower (< 27 °C).

CT-models were then developed excluding the geographic variables. The number of nodes ranged from 9 - 21. The five remaining variables were retained more frequently in the models. The temperature variables were most frequently selected first or second, ppt.yr and psi.win third or fourth, and psi.spr last (Table 4).

Further, the 'response functions' as they are approximated in the tree models by the selection of threshold

Table 4. Frequency with which the five bioclimatic variables only were selected in the tree model for the chaparral species (n = 15) and coastal sage scrub species (n = 5). See Table 3 caption.

Species	ppt.yr	dec.mint	jul.maxt	psi.spr	psi.win
Chaparral (n = 15)					
Frequency	15	15	15	12	14
Frequency ranked 1 - 2	6	10	11	0	3
Frequency ranked 3 - 4	9	4	3	4	10
Frequency ranked 5	0	1	1	8	1
Coastal sage scrub (n = 5)					
Frequency	5	5	5	3	5
Frequency ranked 1- 2	2	4	2	0	2
Frequency ranked 3 - 4	3	1	3	1	1
Frequency ranked 5	0	0	0	2	2

values of variables, were generally ecologically rational (*sensu* Austin et al. 1995, p. 77) based on observations of the species' abundance versus environmental variables (not shown). However, interactions between variables modeled by their nested selection within the tree are admittedly difficult to evaluate for their ecological rationality, even for these relatively simple or parsimonious trees (discussed in Austin et al. 1995).

All models: Predictions and error

When GAMs developed using all (eight) variables are compared to the GLMs that only retain significant variables (three-seven), the GAMs are almost always significantly better ($p < 0.01$) based on the χ^2-test (Table 5) – they explain more deviance relative to the number of degrees of freedom lost to estimate the smoothing functions. The GAMs and GLMs appeared to explain a modest proportion of the deviance (high residual deviance; Table 5), but this is typical for this type of study and is related to the binary nature of the dependent variable (discussed in Bio et al. 1998). Perhaps a more easily understood measure of their fit is the prediction error (proportion of observations incorrectly predicted present and absent, Table 5). This ranges from 2% to 27% for the GAMs and 5% to 30% for the GLMs. On average the GLM had 2% higher prediction error than the GAM for the same species for reasons discussed above (range 0.02%-5%). Prediction accuracy was generally higher for those species that were relatively rare in the sample and which tended to be restricted to certain portions of the environmental gradients (for example, *Xylococcus bicolor, Malosma laurina, Ceanothus tomentosus*). Recall that these prediction errors may mask very high omission or commission errors (as shown below) and should be mainly used for comparisons among the models.

Table 5. Summary of generalized additive models and generalized linear models for the 20 species analyzed. n obs = number of observation (plots) used in species' model; n pres = number of those plots in which the species was present; Null Dev = null deviance; Resid Dev = residual deviance (unexplained by model); Resid DF = residual degrees of freedom; n var = number of variables used in the model (Table 2) – note that the number of variables in the GAMs is always 8; Error = proportion of observations incorrectly predicted when probability threshold, p(P), = 0.5; pr χ^2 = probability that the GAM and GLM are not significantly different based on the χ^2-test.

				GAM				GLM				
Species	n obs	n Pres	Null Dev	Resid Dev	Resid DF	n var	Error	Resid Dev	Resid DF	n var	Error	pr χ^2
Chaparral												
Adenostoma fasciculatum	906	856	1087.97	905.32	873.31	8	0.23	953.22	896	5	0.25	0.0015
Adenostoma sparsifolium	535	100	515.44	173.89	503.57	8	0.07	291.98	528	6	0.12	0.0000
Arctostaphylos glandulosa	906	296	1020.05	807.74	873.72	8	0.22	885.91	900	3	0.26	0.0000
Arctostaphylos glauca	906	295	997.54	737.04	873.64	8	0.19	765.03	892	7	0.20	0.0695
Ceanothus crassifolius	906	194	803.41	461.15	873.99	8	0.11	556.76	896	5	0.15	0.0000
Ceanothus greggii-perplexans	841	200	883.67	461.62	808.99	8	0.13	528.21	830	6	0.15	0.0000
Ceanothus leucodermis	906	230	826.00	591.85	873.94	8	0.15	649.77	892	7	0.16	0.0000
Ceanothus tomentosus	375	43	263.00	89.24	342.71	8	0.05	146.09	368	5	0.07	0.0003
Cercocarpus betuloides	906	301	1039.30	848.28	873.53	8	0.24	892.27	897	5	0.26	0.0063
Heteromeles arbutifolia	868	122	599.50	439.55	835.30	8	0.10	493.95	859	6	0.11	0.0003
Quercus berberidifolia	906	417	1149.16	835.88	873.86	8	0.22	904.90	894	7	0.25	0.0000
Quercus wislizenii	906	193	612.43	380.20	873.76	8	0.09	418.96	899	5	0.09	0.0426
Rhus ovata	906	170	806.69	678.28	873.85	8	0.15	738.67	899	5	0.16	0.0000
Xylococcus bicolor	322	25	175.79	42.36	290.02	8	0.02	87.15	314	5	0.05	0.0060
Yucca whipplei	906	328	1091.56	992.91	873.19	8	0.27	1053.68	899	4	0.29	0.0001
Coastal sage scrub												
Artemisia californica	575	127	572.70	265.87	542.74	8	0.09	358.04	566	5	0.14	0.0000
Eriogonum fasciculatum	906	387	1176.72	990.40	873.29	8	0.27	1025.7	895	7	0.30	0.0330
Malosma laurina	575	47	279.90	134.73	542.55	8	0.05	175.17	566	5	0.07	0.0159
Salvia apiana	906	185	838.56	649.05	873.43	8	0.16	710.46	899	5	0.18	0.0000
Salvia mellifera	806	175	705.55	416.27	773.67	8	0.13	467.88	796	6	0.13	0.0004

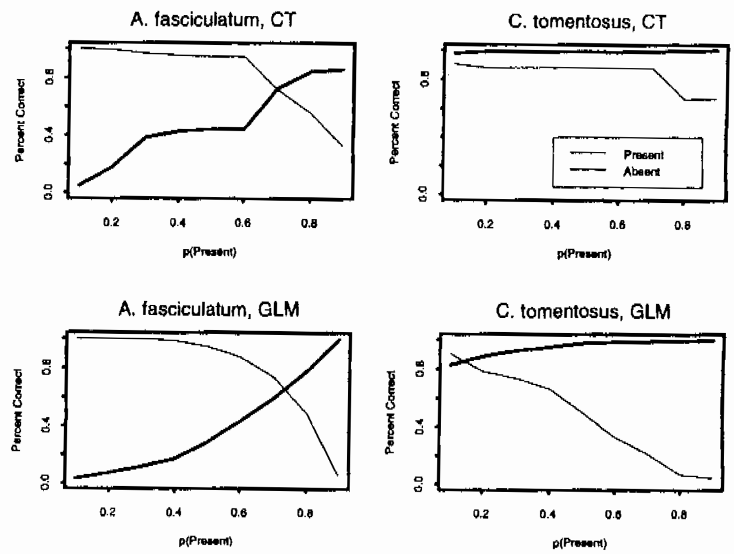

Fig. 6. Prediction accuracy for species presence and absence, as a function of the *p*-value (probability of species presence) of the GLM (Tables 2 and 5) and CT models (based on all seven variables, Tables 3 and 6), for *Adenostoma fasciculatum* and *Ceanothus tomentosus*.

The CT-models based on up to seven bioclimatic and spatial variables explained more deviance than the GAMs or on the GLMs based on all eight original variables (Table 6). Tree models based on the five bioclimatic variables only also explained more deviance than almost all of the GLMs which included spatial variables (19 of 20), and many of the GAMs which included all eight variables (11 of 20). Recall, it is not possible to test the significance of these differences. Prediction error was 2 - 25 % for the tree models with spatial variables, and 3 - 25 % for those without spatial variables – on average 4.5 % lower than for the GLMs (range 0.03 - 8 %).

Recall that each of these models predicts a probability of the binary dependent variable (based on the logit link function, or the proportion of class membership in the terminal node in the case of CTs). When omission and commission error are calculated for the models as a

Table 6. Summary of classification tree models for each species based seven variables (Table 3), versus five bioclimatic variables only (Table 4); node = the number of terminal nodes in the final model (pruned from 22 nodes as described in the text); other columns are as described in Table 5.

	All Variables (7)					Bioclimatic variables (5)				
Species	node	Resid Dev	Resid DF	n var	Error	node	Resid Dev	Resid DF	n var	Error
Chaparral										
Adenostoma fasciculatum	15	839.4	891	6	0.20	16	847.4	890	5	0.21
Adenostoma sparsifolium	14	120.0	521	6	0.04	14	217.3	521	4	0.07
Arctostaphylos glandulosa	16	724.0	890	7	0.22	15	760.0	890	4	0.20
Arctostaphylos glauca	16	669.7	890	5	0.15	17	699.6	889	5	0.18
Ceanothus crassifolius	18	373.4	888	6	0.09	19	455.1	887	5	0.13
Ceanothus greggii perplexans	18	334.3	823	5	0.10	12	596.4	829	4	0.15
Ceanothus leucodermis	17	512.3	889	6	0.11	17	565.0	889	5	0.13
Ceanothus tomentosus	11	46.59	364	4	0.02	16	71.5	359	5	0.04
Cercocarpus betuloides	17	743.5	889	6	0.18	18	791.7	888	5	0.18
Heteromeles arbutifolia	17	356.2	851	6	0.08	16	397.7	852	4	0.09
Quercus berberidifolia	18	766.0	888	6	0.19	21	846.0	885	5	0.21
Quercus wislizenii	13	373.9	893	6	0.09	13	386.4	893	5	0.08
Rhus ovata	17	588.0	889	6	0.13	18	604.0	888	5	0.13
Xylococcus bicolor	9	41.8	313	5	0.03	15	53.0	307	5	0.03
Yucca whipplei	14	927.0	892	6	0.25	16	927.0	892	5	0.24
Coastal sage scrub										
Artemisia californica	16	238.5	559	7	0.07	13	291.6	562	5	0.09
Eriogonum fasciculatum	17	907.9	889	7	0.23	14	957.7	892	5	0.25
Malosma laurina	13	143.7	562	6	0.04	13	150.0	562	5	0.04
Salvia apiana	14	616.7	892	6	0.14	9	691.0	897	4	0.16
Salvia mellifera	13	390.0	793	5	0.10	17	393.8	789	4	0.12

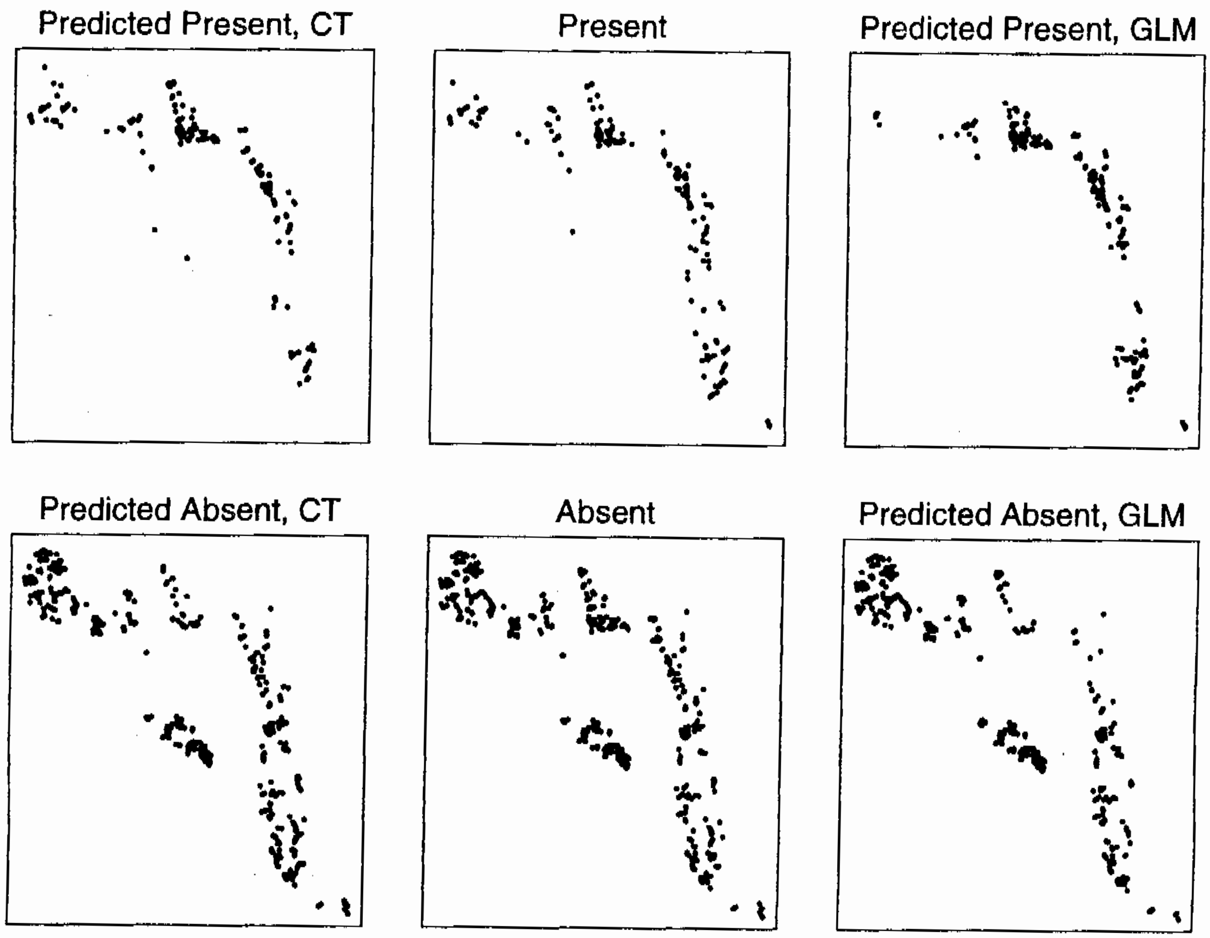

Fig. 7. Spatial pattern of predicted and observed species presence/absence for *Arctostaphylos glauca*, for sample plot locations. Top row: species presence predicted from the CT model, observed, and predicted from the GLM; bottom row: species absence, as above.

function of the predicted probability of species presence, p(P), the overall prediction error at the 'optimum' threshold value of p(P), when omission and commission errors are both minimized, is always higher than those reported above which are for p(P) = 0.5 (compare Fig. 6 with Tables 5, 6). CT-models based on five variables had overall errors of 5 - 31 % at the optimum value of p(P), 0-15% higher than for p(P) = 0.5, and GLMs had errors of 12-39%, 0-18% higher. Further, the optimum value of p(P) was roughly equal to how frequently the species occurred in the sample used to develop the model. For example, *Xylococcus bicolor, Ceanothus tomentosus, Quercus berberidifolia* and *Adenostoma fasciculatum* occurred in 8%, 11%, 46% and 95% of the sample and the optimum p(P) was 0.1, 0.3, 0.4 and 0.7, respectively.

A simple way to view the spatial distribution of model predictions, prior to mapping them in a GIS (geographic information system), is to plot the locations of observations from the sample that were predicted present and absent, and compare this to the actual presence/absence of the species in the sample (Fig. 7). In the example shown, the predictions from the classification tree based only on the bioclimatic variables for *Arctostaphylos glauca* are compared to the predictions from the GLM, using the optimum value of p(P). The CT-model is more accurate (20% vs. 26% total error); however it shows a pattern of omission errors in the southeast corner of the study area, while the GLM shows even more marked omission errors in the northwest corner (Fig. 7). This is in spite of the fact that the GLM included both spatial variables (utm.n explained the most deviance and utm.e was the fourth-most important), while the CT-model shown here did not include the spatial variables. The information could be used to help identify important additional explanatory variables.

Discussion

GAMs were useful for examining the shape of the response functions and evaluating them for ecological rationality. These models explained slightly more deviance than GLMs when all variables were included and smoothed. GLMs provided a useful modeling framework for testing alternative hypotheses about the shape of response functions and significance of variables describing environmental gradients. As has been previously noted (McCullough 1995; Austin et al. 1995), even simple tree models (4 - 7 variables, 10 - 20 terminal nodes) can be difficult to interpret in terms of the ecological response functions they approximate and hierarchical interactions they describe.

Many of the models presented here appear to be sufficiently accurate to be used for prediction of species distributions – interpolation within the study area – although they should be evaluated using independent data. All three modeling frameworks, because they predict a probability of class membership – species presence, p(P) – can be used to map probability surfaces which can be interpreted as an index of habitat suitability (Aspinall & Veitch 1993), or probability of species establishment or occurrence at the site. Presence is more informative than absence in a sample of plant locations (because plants do not occupy every site that they potentially could). However, it is unwise to choose a p(P) value that minimizes errors of omission, and assume that omission errors simply indicate additional sites where the species could exist but is absent in the sample. This would result in a model that predicts an abundant species to occur everywhere and a rare species almost nowhere (Fig. 6).

Mean minimum temperature of the coldest month was generally the most important climatic variable, followed by mean maximum temperature of the warmest month, and/or annual precipitation. While there is precedent for using these climate variables directly in species response models (Westman 1991; Mackey 1993 for example), bioclimatic indices with a physiological basis may yield results that are more interpretable or comparable to other studies. These include moisture balance (based on precipitation and potential evapotranspiration; cf. Leathwick 1998), growing season warmth (growing degree days) and absolute minimum temperature (Box 1996). This will be addressed in future research.

Previous work suggests that topographic and topohydrologic variables related to soil moisture and nutrient status (slope, hillslope position, upslope catchment area, topographic moisture index, topographically-modeled soil moisture) are also related to plant species distributions and useful in predictive models (reviewed in Franklin 1995). Only slope was explored in this study, and its poor predictive power may be related to its inaccurate estimation from the USGS DEMs, discussed above. In a previous study using some of the same DEMs but smoothing them using a linear low-pass filter, slope, slope curvature and the topographic moisture index were found to be significant predictors of chaparral species assemblages (McCullough 1995; Franklin et al. in press). Future research will address the accuracy and resolution requirements for digital terrain data used to estimate the variables cited above, in order to thoroughly test their significance in predictive models for these species.

Species response functions can be evaluated not just by their fit, but by their ecological rationality (Austin et al. 1995, p. 77). Climatic variables were frequently modeled using a quadratic response function (see also Westman 1991), although a linear response was not surprising for species sampled over a subset of their biogeographical range. Potential solar insolation was modeled using a linear response function, or, in the case of CT-models, was found at lower levels in the tree, showing a nested hierarchical relationship with the climatic variables (see Michaelsen et al. 1994 for discussion). Spatial variables (geographic position) often showed complex (third and fourth order polynomial) response functions, which may reflect the pattern of the subjectively located plots as much as the spatial distribution of the species, or any biotic clustering or patchiness (Bocard et al. 1992). It may also be related to the spatial patterning in the explanatory variables (Fig. 2) although this remains to be tested. Because of strong clustering of some species among the sample plots, spatial variables accounted for large proportions of the explained deviance in some GAMs and GLMs. However, CT-models that included spatial variables only accounted for a small increase in prediction accuracy over those that did not. While it was noted previously that these models should be used primarily for interpolation within the study area, use of geographic coordinates as explanatory variables would preclude the use of the models for any extrapolation beyond the ecoregion.

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Small mammal use of modified culverts on the Lolo South project of Western Montana - an update

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Small mammal use of modified culverts on the Lolo South project of Western Montana - an update

Abstract

A highway reconstruction project, termed the Lolo South Project, is currently underway in west-central Montana to expand Highway 93 from two lanes to four over a distance of approximately 45 miles from the town of Lolo to that of Hamilton. Portions of this highway bisect a series of wetlands which currently support a variety and abundance of wildlife. As one wildlife mitigation approach, several three- and four-foot-diameter culverts have been placed at these sites to encourage animal movement between the fragmented wetlands. Metal shelves serviced by ramps were installed in three of the culverts to allow animal movement during periods of high water. The current research project continued and expanded upon the initial pilot study which was begun in January 2001 (and reported at the ICOET 2001 meetings). In particular, additional culverts were added to the original study to increase the sample size, and modifications of the shelf design were made based upon early results, and these refinements were rigorously tested. A total of 10 culverts spaced over a distance of approximately six miles along a series of wetlands along Highway 93 are now being studied, five with 25inch-wide shelves (experimentals) and five without (controls). Besides the 3 to 4-foot-diameter culverts originally employed, larger culverts have been added (ranging up to 10-foot-wide squash culverts). An additional four culverts along Interstate 90 through Missoula (ranging from 3- to 10-foot widths) are also being studied. This phase of the study was initiated in October 2001 and will continue through December 2003. Remote sensing TrailMaster cameras, which are triggered by a combination of heat and motion, were mounted on the roof of each culvert, approximately 15 meters from one entrance. These cameras were positioned so that any mammals traversing the culvert either on the floor of experimental or control culverts or on the ramps in the experimental culverts would be photographed. Cameras are being checked once each week, and film is replaced as needed. Once each month (March - October) the small mammal populations which exist along the wetlands adjacent to the original six culverts are being censussed. For this purpose, 25 Sherman live traps baited with rolled oats are placed in single transect lines approximately 10 meters from each entrance, with a trap spacing of five meters. Traps are checked twice per day at 6:00 am and 6:00 pm for a total of three days. All animals captured are identified to species, sexed, weighed, their reproductive status noted, aged (immature/juvenile/mature), and marked before being released at the point of capture. Environmental data loggers, which record temperature,

light, and humidity levels at 30-second intervals 24 hours/day, were placed at three sites; information from each data logger is downloaded each week. Finally, habitat characteristics adjacent to each culvert entrance are being described. Given this experimental design we are able to determine which small mammal species are present adjacent to the culverts and which of these are actually using the culverts to move between wetland sites on each side of the highway. Seasonal use of the culverts and use of the shelves during periods of high water are being assessed. Activity patterns of those animals traversing the culverts is determined from date and time information imprinted on each photograph. Activity patterns are also being correlated with prevailing environmental conditions. Trapping data to date have identified seven small mammal species living adjacent to the culverts: meadow voles (Microtus pennsylvanicus), deer mice (Peromyscus maniculatus), vagrant shrews (Sorex vagrans) short-tailed weasels (Mustela erminea), House mice (Mus musculus), Columbian ground squirrels (Spermophilus columbianus), and striped skunks (Mephitis mephitis). Other species surely reside here as well, though they are too large for the traps employed. Since the original pilot study the floor of the original shelves has been modified to provide a better surface for small mammals and a "vole tube" has been incorporated to address apparent shyness to enter culverts by meadow voles. Photographic evidence has so far demonstrated culvert use by a total of 23 species including the species listed above (with the exception of the house mouse), and muskrats (Ondatra zibethicus), raccoons (Procyon lotor), coyotes (Canis latrans), red foxes (Vulpes vulpes), and white-tailed deer (Odocoileus virginianus) among others. During periods in which water has covered the floor of the culverts, deer mice, short-tailed weasels, striped skunks, raccoons, and domestic cats have used the shelves in the experimental culverts. Meadow voles, the most abundant small mammal species adjacent to the culverts, have now been observed freely moving through the culverts equipped with tubes. These tubes are also heavily used by weasels. ICOET 2003 Proceedings 343 Making Connections From these data several conclusions can be drawn. Most importantly, several species of small mammals appear to readily use the shelves when water in the culvert would otherwise prevent movement; thus, these devices seem to be very effective. Behavioral differences in some species, notably the meadow vole which will not expose itself to an open environment, have been overcome with the development of a protective tube. Further refinements are continuing to be made. The application of these devices for retrofitting small culverts, as well as their utility in large culverts with permanent water flow were examined. Biographical Sketch: Kerry Foresman received his B.A. degree in zoology from the University of Montana in 1971. He then went on to receive an M.S. degree in zoology from the University of Idaho in 1973. In 1977 he earned his Ph.D in physiology from the University of Idaho. Kerry is currently a professor of biology and wildlife biology in the Division of Biological Sciences at the University of Montana. He is a Mammalian ecologist primarily working on sensitive and threatened species. Much of his research focuses on reintroduction of threatened species. He is also studying the effects of habitat fragmentation on wildlife populations and ways to mitigate such effects.

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SMALL MAMMAL USE OF MODIFIED CULVERTS ON THE LOLO SOUTH PROJECT OF WESTERN MONTANA - AN UPDATE

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Abstract

A highway reconstruction project, termed the Lolo South Project, is currently underway in west-central Montana to expand Highway 93 from two lanes to four over a distance of approximately 45 miles from the town of Lolo to that of Hamilton. Portions of this highway bisect a series of wetlands which currently support a variety and abundance of wildlife. As one wildlife mitigation approach, several three- and four-foot-diameter culverts have been placed at these sites to encourage animal movement between the fragmented wetlands. Metal shelves serviced by ramps were installed in three of the culverts to allow animal movement during periods of high water. The current research project continued and expanded upon the initial pilot study which was begun in January 2001 (and reported at the ICOET 2001 meetings). In particular, additional culverts were added to the original study to increase the sample size, and modifications of the shelf design were made based upon early results, and these refinements were rigorously tested.

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Recovery of Severely Compacted Soils in the Mojave Desert, California, USA

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Often as a result of large-scale military maneuvers in the past, many soils in the Mojave Desert are highly vulnerable to soil compaction, particularly when wet. Previous studies indicate that natural recovery of severely compacted desert soils is extremely slow, and some researchers have suggested that subsurface compaction may not recover. Poorly sorted soils, particularly those with a loamy sand texture, are most vulnerable to soil compaction, and these soils are the most common in alluvial fans of the Mojave Desert. Recovery of compacted soil is expected to vary as a function of precipitation amounts, wetting-and-drying cycles, freeze-thaw cycles, and bioturbation, particularly root growth. Compaction recovery, as estimated using penetration depth and bulk density, was measured at 19 sites with 32 site-time combinations, including the former World War II Army sites of Camps Ibis, Granite, Iron Mountain, Clipper, and Essex. Although compaction at these sites was caused by a wide variety of forces, ranging from human trampling to tank traffic, the data do not allow segregation of differences in recovery rates for different compaction forces. The recovery rate appears to be logarithmic, with the highest rate of change occurring in the first few decades following abandonment. Some higher-elevation sites have completely recovered from soil compaction after 70 years. Using a linear model of recovery, the full recovery time ranges from 92 to 100 years; using a logarithmic model, which asymptotically approaches full recovery, the time required for 85% recovery ranges from 105–124 years.

Keywords desert soils, disturbance recovery, military effects, soil bulk density, penetration resistance

Severe soil compaction results from various land uses in the Mojave Desert (Lovich & Bainbridge, 1999), particularly military exercises involving widespread vehicle use (Prose & Wilshire, 2000). Training exercises cause considerable ecosystem disruption (Krzysik, 1985), and management of military lands is a major concern of the U.S. Department of Defense. The disturbance legacy of military exercises during World War II and in 1964 is still evident in the Mojave Desert (Prose, 1985; Prose & Metzger, 1985; Steiger & Webb, 2000), with individual tank tracks still visible 50–60 years after the original disturbance (Prose & Wilshire, 2000; Belnap & Warren, 2002). Active rehabilitation of severely compacted soils is expensive and usually

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requires ripping with heavy equipment. As a result, most sites with severely compacted soils typically are abandoned without active restoration.

Other land uses that may significantly compact desert soils include off-road vehicle (ORV) use, livestock grazing, and construction of utility corridors. Off-road vehicles cause significant compaction with as few as 1 to 10 passes (Davidson & Fox, 1974; Vollmer et al., 1976; Wilshire & Nakata, 1976; Webb, 1982, 1983). As noted by Prose & Wilshire (2000), compaction under recreational vehicles may be greater than under tracked vehicles, such as tanks, owing to the higher ground pressures under conventional tires. Grazing by domestic livestock causes severe compaction, which can be especially high near watering areas (Webb & Stielstra, 1979). Heavy vehicles compact soils in right-of-ways and access roads during the construction of utility corridors (Vasek et al., 1975a,b).

Abandoned military camps and mining towns with minimal subsequent disturbance provide evidence documenting the recovery rates of severely compacted soils in the Mojave Desert (Webb & Wilshire, 1980; Prose & Metzger, 1985; Webb et al., 1988; Knapp, 1992; Prose & Wilshire, 2000). This study examines compaction recovery in military training camps, built during World War II in the Mojave and Sonoran Deserts in response to anticipated desert warfare in North Africa and then abandoned in 1944, and ghost towns, built in the late nineteenth and early twentieth century in response to discovery of precious-metal ore bodies, and abandoned when ores could not be profitably mined or production ceased in the early 1900s. The purpose of this study is to provide quantitative estimates of the natural recovery of severely compacted soils in the Mojave Desert, updating and expanding on the work of Webb et al. (1986) and Webb & Thomas (in press). The results provide land managers with information to make a choice between expensive restoration measures and a "leave-alone" strategy of ecosystem restoration.

The Compaction Process

Effects of Soil Compaction

Soil compaction has significant effects on ecosystem restoration following severe disturbances. Roads are a major source of fugitive dust (Campbell, 1972), and water erosion can be 10–20 times higher on slopes (Iverson, 1980; Iverson et al., 1981). Because soil compaction significantly reduces infiltration rates, recovery of compacted soil is of primary concern to erosion control. Soil compaction may retard the establishment of desert plants (Adams et al., 1982; Prose et al., 1987; Webb et al., 1988; Prose & Wilshire, 2000). Revegetation of abandoned sites is slow (Webb & Wilshire, 1980; Webb et al., 1988), but significant recovery can occur in as little as a half century, and the role of residual compaction in the recovery of perennial vegetation is unclear (Webb et al., 1988).

Vulnerability of Soils to Compaction

Soil compaction is, by definition, the decrease in pore volume within a soil mass, resulting in an increase in bulk density (Johnson & Sallberg, 1960). The density increase caused by soil compaction changes other soil properties, most notably the size distribution and continuity of pores and strength characteristics. Decreases in the sizes of pores, particularly macropores, decreases infiltration rates but may increase water-holding capacity, depending on the amount of compaction and the soil particle-size distribution. Increases in soil strength affect root elongation and propagation into compacted soils, which may affect seedling establishment and restoration of vegetation cover. Subsequent growth rates of plants may also be limited because the compaction may limit access to both water and nutrients. In seasonally inundated soils (e.g., playas), compaction can also affect plant growth by reducing oxygen availability to roots.

In its simplest sense, compaction results from the application of normal stress to the soil surface. In reality, vehicles impart a complex, three-dimensional stress field on soil, resulting in a normal stress that compacts soil but also in shear stresses that cause dilation of soil (Webb, 1982). Depending upon the magnitude of the normal stress, compaction typically occurs between 0.05 and 0.30 m depth, with dilation occurring at very shallow depths. Most heavily-used dirt roads have a thin, loose layer of soil over a densely compacted layer, which complicates measurement of the amount of compaction. Most laboratory compaction tests, which attempt to eliminate shear while applying normal stress, cannot account for this complexity, creating a dichotomy in the interpretation of some analyses.

The amount of compaction that a soil can sustain is a function of particle-size distribution, structure, and water content at the time of compaction (Webb, 1983). Poorly sorted soils, such as loamy sands and sandy loams, compact more readily than well sorted soils, such as eolian sand or playa surfaces. Gravel may increase compaction over what would occur with the <2 mm fraction alone (Webb, 1983); large amounts of gravel may inhibit compaction, as particle-to-particle contacts in gravel may absorb stress that might otherwise decrease soil unit volume. Soils compact the most when stresses are applied at water contents slightly less than field capacity, the water content that a soil drains to about 24 hours after rainfall (Webb, unpublished data). At low water contents, pore-water pressures are high, increasing the resistance to applied pressure (Greacen, 1960). At water contents near saturation, volume decreases can be attained only by removal of water, and, therefore, the rate of drainage while pressure is applied is an over-riding consideration. Poorly drained soils are seldom present in desert areas, except in some playas and riparian areas.

Bulk density is difficult to measure in gravelly soils typical of the Mojave Desert. Infiltration rates and soil strength are sensitive indicators of soil compaction, prompting some researchers (Prose, 1985) to prefer these measurements to the more fundamental property of bulk density. Soil strength, typically measured with a penetrometer, is strongly dependent on water content (Greacen, 1960), and water content should be reported for all penetration-resistance data to allow comparability with other studies.

Processes of Recovery from Soil Compaction

Amelioration of soil compaction is a complex process, and several factors affect the recovery rate. Water erosion, which may accelerate in compacted soils on slopes, greatly increases the ecosystem recovery time because rates of soil formation in arid regions are extremely slow; however, compacted zones are partially or totally removed from the soil. In contrast, deposition of new eolian or alluvial sediments over a compacted soil, which has occurred in the Patton encampments (Prose & Metzger, 1985), may effectively eliminate compacted soil as a problem for reestablishing plants. The following discussion applies to relatively stable surfaces that are relatively unaffected by accelerated soil erosion or subsequent deposition.

The most important soil factor affecting compaction recovery rates is the magnitude of the increase in bulk density as a function of depth. The magnitude of compaction is very important because some lightly compacted soils may not recover (Heinonen, 1977) or may recover at an imperceptible rate. Highly compacted soils loosen after disturbance ceases, and the recovery rates are faster at the surface than in the subsurface (Thorud & Frissel, 1976) because the surface receives the greatest weathering and environmental extremes. Webb (1982) notes that most compaction occurs at 0.0–0.1 m depths in desert soils.

Compaction amelioration results from clay-mineral expansion during wetting-and-drying, freeze-thaw heaving, and bioturbation. Clay-mineral expansion, or shrink-swell, is most prevalent in soils containing expansive clays such as smectite. The rate of loosening is dependent on the clay content, clay mineralogy, the depth of water penetration, the frequency of wetting and drying cycles, and the depth of the compaction in the soil. In areas with winter-dominated precipitation and cool weather, the frequency of wetting-and-drying cycles is relatively low because the soil tends to remain moist throughout the winter and early spring. However, soils in areas with a summer-dominated rainfall have frequent wetting-and-drying cycles as a result of recurring thunderstorms and subsequent hot weather.

Freeze-thaw cycles reduce compaction in regions where severe freezing occurs (Orr, 1975), although the loosening may occur only above 0.2 m (Blake et al., 1976; Larson & Allmaras, 1971; van Ouwerkerk, 1968). The effectiveness of freeze-thaw loosening depends on soil-water content, texture, rate of frost penetration, and depth of compaction. Frost-heaving effects are inseparable from wetting and drying because the freezing of water in the soil includes a desiccation of clay minerals (Larson & Allmaras, 1971). Freeze-thaw loosening may be most effective in deserts with cold winters (e.g., Great Basin Desert), as opposed to deserts that experience only periodic frost (e.g., Sonoran Desert).

In a laboratory experiment, Akram & Kemper (1979) applied both wetting-and-drying and freeze-thaw cycles to compacted soils with textures ranging from silty clay to loamy sand. They found that most of the change in infiltration rate, which is indicative of soil compaction, occurred during the first three cycles although the resulting infiltration rates were still below the undisturbed rates. The data of Akram & Kemper (1979) indicate that an exponential-decay model may be appropriate in empirically describing compaction amelioration. Both freeze-thaw and wetting-and-drying cycles were most effective in clay-rich soils; compacted loamy sand changed little during four cycles.

Bioturbation may be more important than physical processes in loosening compacted, coarse-grained desert soils. Rodent-burrowing activity is very important, especially at depth, although reestablishment of animal populations may be dependent on the rate of plant succession. Roots penetrating the soil cause volume expansion near the soil surface (Larson & Allmaras, 1971), and small channels left in the soil after the root dies create macroporosity. Soil loosening is most effective by plants with diffuse root systems, as opposed to plants with central taproots, because the small diffuse roots displace less of the high-strength, compacted soil per root while penetrating the soil with more roots per unit volume. Agricultural studies that indicate monocots, usually annuals and perennial grasses, may have a greater ability to colonize compacted soils than dicots (Lathrop & Rowlands, 1983). Annuals with diffuse root systems would loosen soil only over a small depth range, however, without affecting compaction at depths greater than 0.1 m. Annual monocots are usually the first to colonize compacted soils in the Mojave Desert (Lathrop & Rowlands, 1983; Prose & Wilshire, 2000).

In regions of greater than 500 mm yr^{-1} of rainfall and frequent freeze-thaw cycling, estimates of recovery time range from less than 10 years to 84 years, depending on the various factors that affect compaction recovery (Webb & Thomas, 2001). In the Mojave Desert, one study suggests a high variability in the recovery times for compacted soils, positing that recovery below a depth of 0.3 m may be much slower than at shallower depths (Prose & Wilshire, 2000), if at all. Bolling & Walker (2000) concluded that spatial heterogeneity in abandoned roads in southern Nevada obscured any significant recovery trends, but their study site included lumped measurements over a complicated array of geomorphic surfaces, which may respond differently to both the initial disturbance and subsequent recovery. Webb et al. (1986) concluded that compaction recovery in the Mojave Desert requires 80–140 years. Knapp (1992) similarly concluded that complete recovery from compaction requires 100–130 years in ghost towns in the northern Great Basin Desert. Both studies assumed that a linear-recovery model is an appropriate empirical description of compaction recovery and concluded that compaction amelioration is faster at higher-elevation sites where freeze-thaw and wetting-and-drying cycles are frequent.

Methods

Measurements of compaction recovery were made in 19 sites in the Mojave Desert with 32 site-time combinations (Figure 1, Table 1). The sites included the five abandoned World War II sites of Camps Ibis, Granite, Iron Mountain, Clipper, and Essex described by Howard (1985) and Bischoff (2000). Soil compaction in these sites was originally measured by Prose & Metzger (1985). In addition, soil compaction was measured in seven ghost towns and another more recently

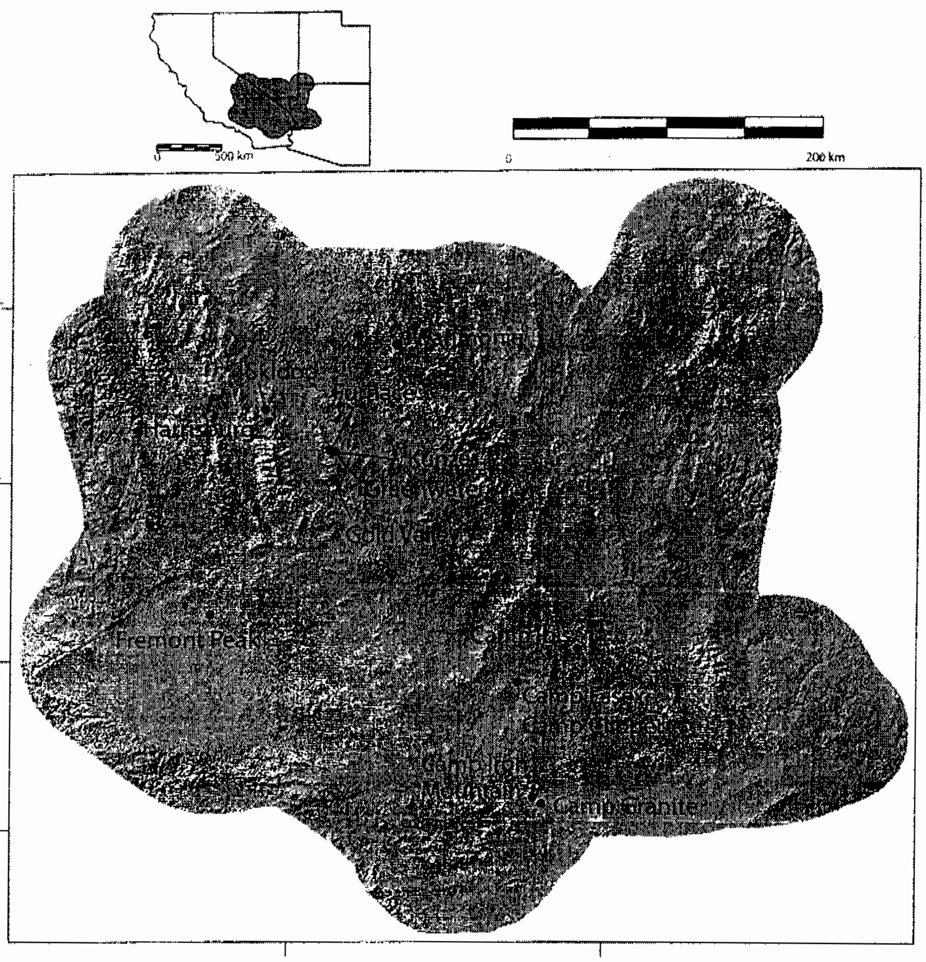

FIGURE 1 Shaded relief map of the Mojave Desert showing the locations of compaction-recovery sites.

TABLE 1 Characteristics of Disturbed Sites Reported in this Study

Site	Subsite	Elevation (m)	Age of geomorphic surface[1]	Year abandoned	Year(s) compaction measured
Fremont Peak	200 pass	893	Holocene	1979	1980, 1999
Camp Iron Mountain[2]	parking lot	388	Holocene	1944	1984, 2000
Camp Granite[2]	parking lot	367	Holocene	1944	1984
Camp Clipper[3]	parking lot	571	Holocene	1944	1984
Camp Essex[3]	parking lot	571	late Holocene	1944	1984, 2000
Camp Ibis[2]	parking lot	550	late Pleistocene	1944	1984
Gold Valley	west	1310	latest Pleistocene	1908	1982, 1999
Wahmonie	old road	1320	latest Pleistocene	1960	1978, 1999
Wahmonie	townsite	1320	latest Pleistocene	1928	1978, 1999
Greenwater	Road	1340	Holocene	1907	1981, 1998
Greenwater	site C	1340	late Pleistocene	1907	1981, 1998
Greenwater	site G	1340	late Pleistocene	1907	1981, 1998
Furnace	Road	1430	latest Pleistocene	1985?	1998
Furnace	Main Street	1430	latest Pleistocene	1907	1981, 1998
Kunze	townsite	1430	Holocene	1906	1998
Harrisburg	townsite	1640	middle Holocene	1907	1985, 1999
Skidoo	Downtown	1730	early Holocene	1916	1981, 1999
Skidoo	Montgomery Street	1730	early Holocene	1907	1981, 1999
Skidoo	Old road	1740	early Holocene	1916	1981, 1999

[1]Ages of geomorphic surfaces from Webb and others (1988) or inferred from a combination of Prose and Metzger (1985) soil data and site inspection.
[2]Desert Training Center – Patton encampment originally studied by Prose and Metzger (1985).
[3]Bishoff (2000). Prose and Metzger (1985) refer to these camps variously as "Camp Clipper old" (=Camp Clipper) and "Camp new Clipper" and "Camp Clipper new" (=Camp Essex).

abandoned site with known dates of abandonment (Table 1). The townsites are Harrisburg and Skidoo in the Panamint Mountains of Death Valley National Park; Gold Valley, Furnace, Kunze, and Greenwater in the Black Mountains of Death Valley National Park; and Wahmonie on the Nevada Test Site in southern Nevada (Webb & Wilshire, 1980; Webb et al., 1988). The Fremont Peak site in the western Mojave Desert was originally used to study compaction under motorcycle traffic (Webb, 1982).

Dates of abandonment and other site-specific information are given in Webb & Wilshire (1980), Webb et al. (1983, 1988), and Prose & Metzger (1985) and are repeated in Table 1. The recovery times, or the elapsed time between abandonment and measurement, ranged from 1 to 91 years. Visitation to these sites is light, with the highest visitation at the World War II encampments owing to roadside markers. None of the camps or townsites were recently grazed by domestic livestock; although sheep herds once grazed seasonally near Fremont Peak, no evidence of livestock use during the 20 years of abandonment was observed. Feral burros grazed lightly at Skidoo and Harrisburg before their removal in the mid-1980s. Although wild horse herds roam parts of the Nevada Test Site, no evidence remains of their presence at Wahmonie.

Annual precipitation at the World War II encampments probably ranges from 100 to 150 mm with less than five days yr^{-1} with freezing temperatures. Annual precipitation at the ghost towns ranges from about 150 to 185 mm, with mean January temperatures ranging from 3.9°C at low elevations to 1.1°C at high elevations (Webb et al., 1986). The number of days yr^{-1} with freezing temperatures is difficult to estimate for these sites, but nearby climate stations at about the same elevations have 50 to 75 freezing days yr^{-1}. Therefore, comparison of compaction recovery in the World War II encampments with ghost towns may yield information on the efficacy of wetting-and-drying and freeze-thaw loosening.

All of the soils studied were Entisols or Aridisols, depending upon age of geomorphic surface (Table 1), in the suborders Torrifluvents and Orthids (Soil Survey Staff, 1975). Ages of geomorphic surfaces are presented in Webb and Colleagues (1988) or were inferred from descriptions given in Prose & Metzger (1985). None of the undisturbed soils studied had significant desert pavements or A_v horizons. Soil textures at depths of 0 to 0.1 m varied from sandy loam in granitic soils, to gravelly loamy sand, to sandy loam on volcanic substrate. The gravel content ranges from 4 to 32%, and sand contents ranged from 52 to 86%, indicating that these soils are poorly sorted and typical of common Mojave Desert soils. Clay content is between 3 and 6% in all soils studied (Table 2).

Laboratory Measurements

Bulk soil samples were collected from 0–6 cm depth at all sites except Camp Clipper, which was on the same geomorphic surface as Camp Essex. Proctor compaction curves (Felt, 1965) were run on each sample using the standard method as specified in the ASTM standards (ASTM D 698-91). A minimum of four water contents were analyzed, with some samples requiring 6–8 points for adequate representation of the relation between water content and maximum bulk density.

Field Measurements

Subsites were selected to represent highly compacted areas abandoned and allowed to recover naturally with little subsequent disturbance (Table 1). At all subsites, undisturbed (control), abandoned, and active road sites were chosen for measurement to allow estimation of an indexed recovery percentage.

TABLE 2 Physical Properties of Sites Reported in this Study

Site	Particle size distribution[1]				Undisturbed bulk density[3] ($Mg\,m^{-3}$)	Maximum bulk density[4] ($Mg\,m^{-3}$)	Bulk density in active road ($Mg\,m^{-3}$)	Water content[5] ($kg\,kg^{-1}$)
	Gravel (%)	Sand (%)	Silt (%)	Clay (%)				
Camp Clipper[2]	4	82	8	6	1.55	1.88	1.81	0.008
Camp Iron Mountain	22.2	71.8	4.2	1.8	1.68	1.98	1.93	0.003
Camp Granite[6]	26.8	52.1	18.9	2.2	1.54	1.87	n.m.	0.004
Camp Essex	10.0	76.6	7.9	5.5	1.57	1.88	1.81	0.007
Camp Ibis[6]	8.8	86.3	4.0	0.9	1.65	2.12	n.m.	0.011
Fremont Peak	8.7	65.3	21.2	4.7	1.46	2.07	1.79	0.065
Furnace	26.8	63.9	7.9	1.3	n.m.	1.85	n.m.	0.023
Gold Valley	23.1	62.7	13.0	1.2	1.29	1.95	1.49	0.074
Greenwater	31.8	60.0	7.0	1.3	n.m.	1.89	n.m.	0.047
Harrisburg	13.6	65.3	18.8	2.2	1.43	1.99	1.71	0.023
Kunze	24.2	66.7	7.6	1.6	n.m.	1.90	n.m.	0.039
Skidoo	8.1	65.1	24.5	2.3	1.54	1.97	1.72	0.022
Wahmonie	8.0	79.6	10.7	1.7	1.40	1.96	1.60	0.064

[1]Determined using sieve analyses for gravel and sand and hydrometer analyses for silt and clay.
[2]Particle size from Prose and Metzger (1985, p. 66).
[3]For 0–30 mm soil depth.
[4]Determined using laboratory Proctor compaction tests.
[5]Moisture content at the time of penetrometer measurements.
[6]For 0–10 mm soil depth.
n.m., not measured because of high gravel contents.

Penetration depth, a common index of compaction, is the mean depth to which an operator (weight = 85 kg) can push a 30°, 920-mm^2 cone into the soil surface (Wilshire & Nakata, 1976). The normal force exerted on the penetrometer at insertion beyond the cone is 910 kN m^{-2}. Penetration depth is the measurement of compaction that is least sensitive to soil gravel content (Webb, 1983; Webb et al., 1986), and indexing penetration depth to the active road minimizes the variables of operator weight and water content. For each treatment, 70 penetration depths were averaged. Penetration depth was measured in townsites, undisturbed soil, and active roads at 19 sites over several years to form 31 estimates of compaction recovery.

Soil bulk density in the 0–60 mm depth was measured using a 57-mm diameter coring device designed to collect intact samples. The recovered soil was dried in a drying oven at about 60°C for 48 h; the lower temperatures were used to minimize "baking" of clay minerals and a loss of structural water from clay minerals. At each site, 10 bulk density samples each were collected from active roads, the abandoned areas, and undisturbed areas. I include bulk density measurements taken by Prose and Metzger (1985), who sampled a slightly deeper depth range of 0–100 mm. Because Prose and Metzger (1985) did not collect samples from active roads, the maximum bulk density measured using the Proctor test was substituted for this value at camps not measured in 2000, and the active road bulk density measured in 2000 was substituted for the active road bulk density in 1984 for sites measured in common (Table 1).

We assumed soils were compacted fully and abandoned with no subsequent disturbance. The index of recovery, I_R, is:

$$I_R = (P_d - P_a)/(P_u - P_a), \quad (1)$$

where P = mean soil parameter (density or penetration depth), P_d = historically disturbed soils, P_u = undisturbed soils, and P_a = soil in active roads (representing high current compaction). The amount of time estimated for full recovery, T_F, is calculated by:

$$T_F = T_R/I_R, \quad (2)$$

where T_R = recovery time (yrs). Indexing of soil properties using Eq. (1) removes the influence of soil-water content at the time of measurement, which is particularly important for penetration depth and allows comparison among sites.

Results

Proctor Compaction Curves

The Proctor compaction analysis indicates that the soils in the World War II camps and ghost towns are highly vulnerable to soil compaction. Maximum bulk densities ranged from 1.85 to 2.12 Mg m^{-3}, and the average difference between the undisturbed bulk densities measured in the field and the maximum densities was 0.456 Mg fm^{-3}. Similarly, the difference between maximum Proctor bulk density and the bulk density in active roads was 0.23 Mg m^{-3}, due at least in part to the zone of dilation on the surface of active roads.

The compaction curves for the World War II encampments (Figure 2a) have important differences from the curves for the ghost towns (Figure 2b). The peak in the compaction curves for the World War II encampments is relatively sharp, and most curves fall off at a water content of about 0.15 kg kg^{-1}, suggesting that the

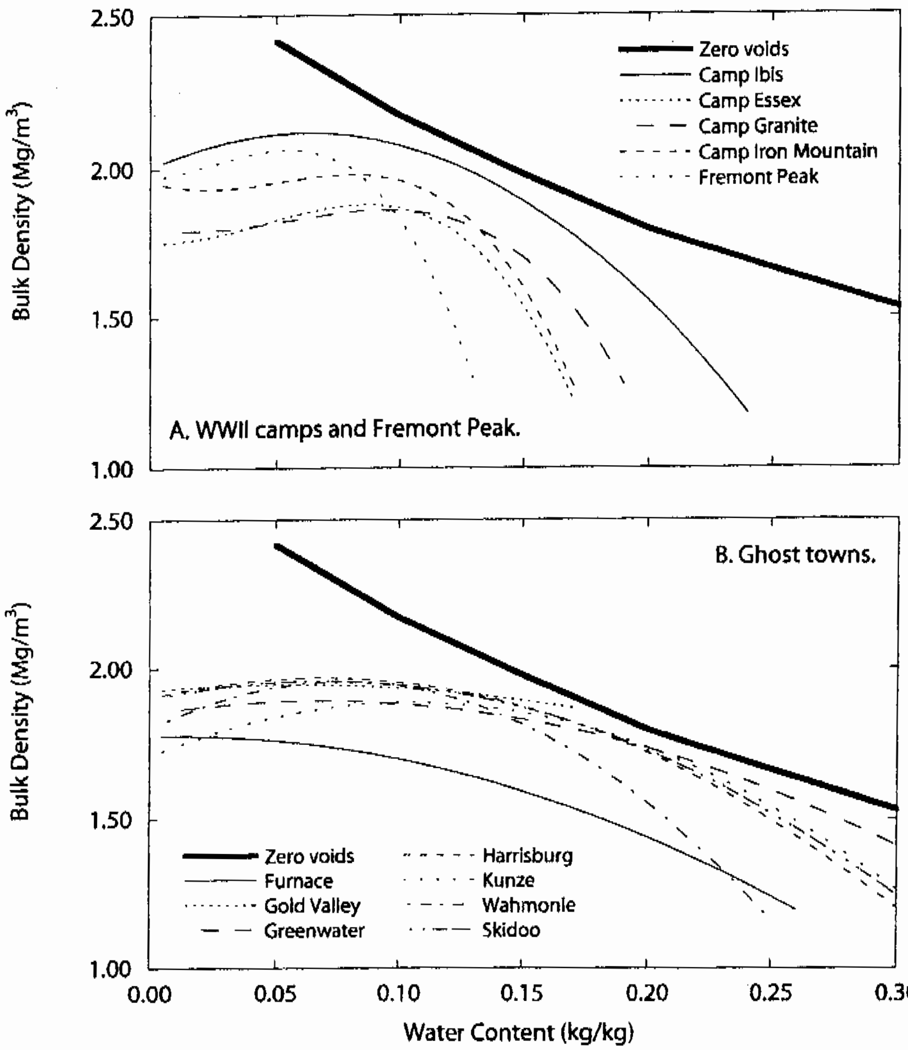

FIGURE 2 Proctor compaction curves for soils at compaction-recovery sites. (A. World War II encampments and the Fremont Peak site. B. Ghost towns.)

water-holding capacity of these soils is relatively low. The compaction curves for the ghost towns are flatter, indicating that compaction vulnerability remains high at higher water contents than for the encampments. The difference may be related to the fact that the soils in the World War II camps are better sorted than the soils in the ghost towns, particularly with respect to the amount of gravel versus sand (Table 2). For the World War II camps, the maximum bulk density occurred at a water content of $0.74\,\mathrm{kg\,kg^{-1}}$; for the ghost towns, the water content was $0.072\,\mathrm{kg\,kg^{-1}}$.

Compaction Recovery: Penetration Depth

Most compacted soils have not recovered, even after recovery periods of up to 91 years since abandonment. Compacted soils, as measured with penetration depth, had fully recovered in only 2 of 31 comparisons, in both cases after 70 years of abandonment. The average penetration depths were 35 mm for active roads, 88 mm for recovering site, and 111 mm for undisturbed soil; water content at the time of the penetration depth measurements ranged from 0.3 to 7.4% (Table 2). Using eq. (2), the full recovery time ranged from $27 \leq T_F \leq 154$ for the 31 measurements. Using linear regression, force-fit to $I_R = 0$ at $T_A = 0$, yields an estimated index of recovery, I_{Re}, as

$$I_{Re} = 1.001 \cdot T_R \quad (r = 0.578). \tag{3}$$

This linear model predicts complete recovery in 100 years. The data suggest that a linear model of recovery is inappropriate; indeed, such a model force-fit to recovery of 0% at $T_R = 0$ falls under the data points for abandonment times of $T_R < 40$ years (Figure 3a).

A better representation of compaction recovery is a logarithmic function of the form:

$$I_{Rc} = -36.39 + 59.65 \cdot (\log(T_R + 4)), \quad (r = 0.652). \tag{4}$$

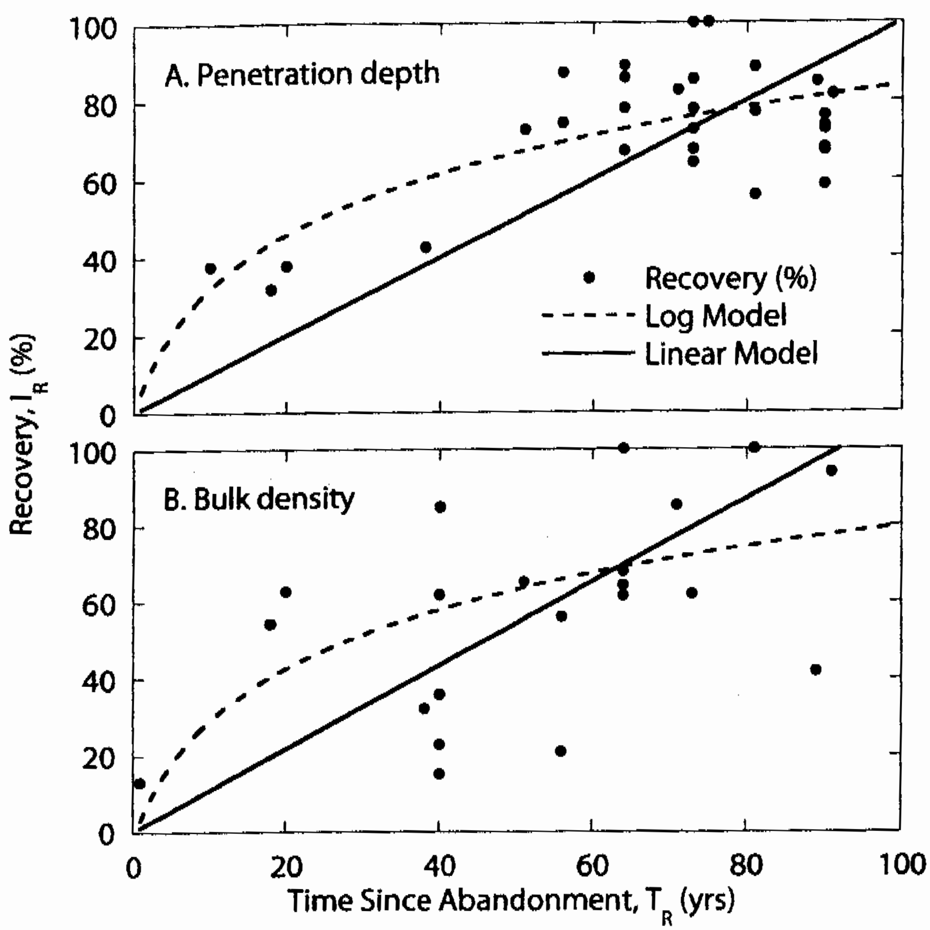

FIGURE 3 Compaction recovery for abandoned sites in the Mojave Desert. (A. Penetration depth. B. Bulk density.)

Because of its logarithmic form, Eq. (4) has the disadvantage of being unrealistically asymptotic at large T_R (Figure 3a). Eq. (2) does not reach $I_{Rc} = 100\%$ until $T_R = 190$ yrs. Partial recovery times provide more realistic measures of recovery (Webb & Wilshire, 1980). Using this approach, $T_R = 105$ years for $I_{Rc} = 85\%$ recovery. From the linear and logarithmic models, severe soil compaction as measured with penetration depth requires about 70–105 years for recovery in the Mojave Desert.

Compaction Recovery: Bulk Density

Using bulk density, compacted soils had fully recovered in 3 of 22 measurements, all with $T_R > 64$ years. Using Eq. (2), the full recovery time ranged from $8 \leq T_F \leq 269$ years, reflecting the large amount of variability in the data. Using linear regression, force-fit to $R = 0$ at $T_A = 0$, yields:

$$I_{Re} = 1.087 \cdot T_R \quad (r = 0.566). \tag{5}$$

This linear model predicts complete recovery in 92 years (Figure 3b). The logarithmic function is:

$$I_{Rc} = -38.01 + 58.41 \cdot (\log(T_R + 4)), \quad (r = 0.509). \tag{6}$$

The logarithmic relation (Eq. 6) does not reach $I_{Rc} = 100\%$ until $T_R = 227$ years, and $T_R = 124$ years for $I_{Rc} = 85\%$ recovery. Neither model appears clearly better than the other, and for $T_R < 50$, five points are above each curve and four points are beneath. Of the four lower points, three were measured by Prose & Metzger (1985) at the lower elevation sites. From the linear and logarithmic models, recovery measured in terms of bulk density requires 92–124 years.

Compaction Recovery: Effect of Elevation

Site elevation is a proxy for the amount of wetting-and-drying and freeze-thaw loosening that a site might undergo in the Mojave Desert, owing to the strong vertical precipitation and thermal gradients in this region. Using either penetration depth or bulk density, the recovery times are significantly related to elevation. Using multiple linear regression, with $I_{Re} = 0$ at $T_R = 0$, the recovery relation for penetration depth is:

$$I_{Rc} = 0.018 \cdot E + 0.659 \cdot T_R (r = 0.974), \tag{7}$$

where E = elevation (m). For bulk density, the recovery relation is:

$$I_{Re} = 0.026 \cdot E + 0.578 \cdot T_R (r = 0.936). \tag{8}$$

The coefficients for E and T_R are significant at $P < 0.05$.

Compaction Recovery: Other Factors

Other factors that might affect amelioration of soil compaction did not significantly explain any of the variability in recovery as shown in Figure 3. The recovery time of individual sites was highly variable and did not discriminate among young versus old geomorphic surfaces (e.g., Holocene versus Pleistocene surfaces). Gravel content explained more variance ($r = 0.269$) than did sand, silt, or clay content, and none of the results were statistically significant at $P < 0.05$. Given the specific sites that are available for measurement in the Mojave Desert, elevation of the site appears to be the only variable that explains a significant amount of variance in compaction recovery.

Discussion and Conclusions

Recovery of severely disturbed desert soils and vegetation, as measured with penetration resistance and bulk density, requires approximately a century in the Mojave Desert. Full recovery times range from 100–190 years and 92–227 years on the basis of full recovery times estimated from penetration-depth and bulk-density measurements, respectively. By using the linear-model estimates of full recovery and the logarithmic-model estimates of 85% recovery (more realistic), I conclude that soil compaction at 0–6 cm requires 92–124 years to recover in the Mojave Desert. These results are in agreement with previous studies (Webb et al., 1986; Knapp, 1992).

Owing to the large variability in recovery (Figure 3), it is difficult to conclude whether the path of recovery is linear or logarithmic. The difference is crucial to land management. A logarithmic recovery path would indicate that initial recovery is fast, and the potential recovery might be the difference between initiating artificial reclamation or allowing natural recovery. For penetration depth, the logarithmic curve appears to best represent the early course of recovery (Figure 3a). For bulk density, the more fundamental soil property, the results are more equivocal, with five points above and four points below both curves (Figure 3b). However, three of the four lower points are from the World War II encampments, and the low recovery rate may be due in large part to the use of Prose & Metzger's (1985) data.

Prose & Metzger (1985) did not index recovery to nearby active roads, and I either used values I measured in active roads, or in two cases (Camps Clipper and Granite), I substituted the maximum bulk density obtained from the Proctor compaction tests for the bulk density in an active road as part of my analysis. Because the average difference between the Proctor maximum bulk density and the density in the active roads was 0.23 $Mg\,m^{-3}$, this procedure increased the amount of recovery estimated using Eq. (1). In addition, the lowest points at $T_R = 40$ and 56 years were measured at Camp Essex, suggesting the possibility of additional disturbance after abandonment, as originally discussed by Prose & Metzger (1985).

Recovery of soil compaction is significantly related to elevation, indicating that a complex interaction among the recovery mechanisms of wetting-and-drying cycles, freeze-thaw cycles, and bioturbation is responsible. Both wetting-and-drying and freeze-thaw cycles increase with elevation, and the importance of each variable cannot be quantitatively separated in this empirical study. Freeze-thaw loosening may be the more important process in Harrisburg and Skidoo than in the lower elevation townsites, and particularly the World War II encampments. The frequency of wetting-and-drying cycles is probably not very different among the townsites, despite differences in mean annual precipitation, whereas the frequency of freeze-thaw cycles probably is greater at higher elevations. Laboratory compaction-recovery tests will be required to separate out the efficacy of these two processes.

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Soil compaction processes and their effects on the structure of arable soils and the environment

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Abstract

Soils are three-phase systems which undergo changes as soon as the external stresses exceed the internal soil strength, defined by the precompression stress value. The three-dimensional stress propagation induces corresponding volumetric soil strain. Soil compaction can result either in a higher bulk density or, when soil loading is attended with retarded water fluxes and high dynamic forces, in a completely homogenised soil characterised by a lower bulk density and a predominance of fine pores. While in natural soils the structure can be described as macroscopically homogeneous, less careful mechanical treatment or reduced addition of organic substances results in less favourable types of soil aggregates. As a result of applied external stresses, physical and chemical processes, such as mass flow and diffusion of water, ions and gases, are at least retarded or even completely altered. Both increased bulk density and homogenisation cause decreased aeration and increased penetration resistance, which results in impeded root development. Reduced water permeability may result in soil erosion, with serious negative effects on the environment. Compacted soil may also contribute to global atmospheric warming due to increased emission of CO_2, CH_4 and N_2O from such soils. Anthropogenic changes in soil structure and soil functions remain constant for extended periods of time and efforts to restore deteriorated soil structure very often fail because of excessive loosening and homogenisation, cultivation of too wet soil or, afterwards, ill-adapted soil management practices, resulting in even worse soil properties. The present paper gives a summary of relevant work performed by the authors.

Keywords: Soil compaction; Soil physical properties; Environment

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1. Introduction

One hundred years ago, Wollny (1898) described the positive effect of a favourable soil structure on root growth, water availability, gas transport and soil strength. He stressed that the mechanisms involved in the relationships between soil structure, plant growth and crop yield should be investigated, not only to achieve higher crop yields but also to further improve relevant soil properties. At that time, scientists generally were concerned with research aimed at the optimisation of crop yields and they were not obliged to care about environmental problems. However, even in 1898, it was well known that, under given environmental conditions, a favourable soil structure results in consistent crop yields and it was recognised that, under the same conditions, soil compaction usually will have negative effects on crop growth and/or yield. Throughout the decades, this knowledge has repeatedly been confirmed by the results of field experiments on the effects of soil compaction and, sometimes, also causes and effects of compactive processes were established (e.g. Blank, 1932–1936; Dexter, 1988; Håkansson et al., 1988; Kay, 1990; Domżał et al., 1991, 1993; Soane and Van Ouwerkerk, 1994).

Besides having intended positive effects, the interference of man with the natural environment also causes changes which may unfavourably affect both the farm economy and the environment. These phenomena are recognised as an effect of industrial production but they are also considered to be related to agricultural practices, which embrace incomparably larger areas. At present, increasing attention is being paid to the factors causing degradation of agricultural areas, including the agricultural activity itself as a soil degrading factor. The importance of this factor depends mainly on the type of farming and the intensity of agricultural production, including the level of fertilisation, degree of mechanisation, the soil water status during field operations, tillage and harvesting technologies, etc. (Domżał and Hodara, 1990a; Domżał et al., 1991). According to Miller (1990), the maintenance of soil productivity is particularly hampered by water erosion, soil structure degradation and compaction, phosphorus losses due to runoff from agricultural areas and the leaching of nitrate compounds and pesticides to the ground water.

Soil compaction caused by traffic of heavy vehicles and machinery results in soil structure deterioration, both in the topsoil and in the subsoil (Słowińska-Jurkiewicz and Domżał, 1988, 1991a,b). In soil compaction, not only pure static stresses, but also dynamic forces play a role, caused by vibration of the engine and the attached implements and by wheelslip. Owing to dynamic loading, soil physical properties such as pore size distribution and pore continuity are negatively affected, which entails decreases in air and water permeability and results in increased soil strength or, in the presence of excess soil water, decreased soil strength due to kneading. These changes may have a negative effect on the soil biota, on physical–chemical equilibria and redox potential, on the soil's filtering and buffering capacity, on ground water recharge and, finally, on crop yield (Domżał and Hodara, 1990b, 1991, 1992; Domżał et al., 1992; Horn et al., 1994).

In central Europe, during the last 3–4 decades, both the mass of agricultural machinery and the number of wheeling events have increased by over 300%. In Europe, as a result of the use of farm machinery that is too heavy, degraded soils cover an area of about 33 Mha, which is approximately 50% of the physically degraded area of the world (Oldeman, 1992). Meanwhile, agricultural engineers developed much site-specific machinery but until now they were not very successful in the prevention or long-lasting repair of compaction-induced soil degradation.

In order to analyse soil degradation due to soil compaction in detail, the relationships between internal soil strength and applied stress, the kind and intensity of stress application and relevant soil parameters must be considered (Horn, 1988).

The present paper summarises relevant work carried out by the authors. Based on the fundamental concept of stresses and strains, the corresponding processes in soils will be described and the ecological consequences discussed.

2. Soil compaction processes

Soil strength can be quantified by stress–strain measurements, from which, for example, the value of the precompression stress (i.e. a measure for the internal soil strength) may be derived (Horn, 1988). If the applied stress does not exceed this value, the soil reacts elastically, while exceeding it results in a further, plastic deformation. Under the same climatic conditions and soil use, the precompression stress values vary owing to differences in soil texture, degree of aggregation and matric potential. Fig. 1 shows the results of measurements of the precompression stress at a matric potential of −6 kPa for three soil types. In the Luvisol, clay migration from the Al horizon resulted in decreased internal soil strength, while in the Bt horizon clay enrichment caused an improvement in soil structure, which resulted in an increase in internal soil strength. In the Mollisol, calcium carbonate precipitation in the Cca horizon caused increased precompression stress values. The Vertisol, derived from mesozoic clayey parent material, clearly showed mottles and Fe and Mn concretions, which indicates that the soil remains wet throughout the greater part of the year. Consequently, even the precompression stress values of the well aggregated Bga

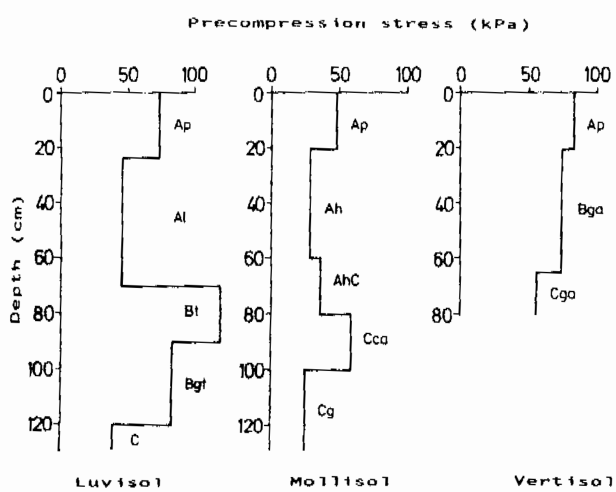

Fig. 1. Precompression stress values in different horizons of three soil types at a matric potential of −6 kPa (Horn, 1988).

horizon did not exceed 100 kPa. In all three soil types, the parent material (C, Cg, Cga horizons) were always weakest.

As soon as the applied stresses greatly exceed the internal soil strength, soil structure deterioration occurs in two consecutive stages: (1) deterioration of the secondary, coarse inter-aggregate pores while the intra-aggregate pore system remains stable; (2) deterioration of the aggregates, for example by wheeling 'at the wrong time' (i.e. at an unsuitable soil water content or matric potential), which causes pronounced soil homogenisation (Horn, 1989).

2.1. Effect of wheeling intensity on soil strength

Soil wheeling can cause serious disturbance of the pore system, both with respect to the pore size distribution, the mean pore diameter, the total number of pores and/or their function. If, throughout the years, arable soils are repeatedly wheeled, the site-specific internal soil strength will be either increased or decreased, depending on the external stress/internal strength ratio and the current soil water status (Semmel, 1993).

The precompression stress values found after a number of wheeling events with various loading intensities during a period of 6 years, expressed as the mean internal strength, are shown in Fig. 2. Treatments 2 and 4, with three wheeling events per year at 1.7 Mg and 3.4 Mg, respectively, did not cause statistically significant greater precompression stresses. However, increasing the external stress to 4.0 Mg and the frequency to seven wheelings per year (Treatment 7), which were performed even in wet periods in spring, resulted in a considerable increase in the precompression stress values. Within the soil profile, the plough pan (at 40 cm depth) showed the largest precompression stresses, while at 60 cm depth they were intermediate. The greatest wheeling intensity resulted in the largest precompression stress values at all depths.

It should be noted that these results always include the effect of seasonal drying, which results in increased soil strength. Therefore, the similar results of Treatments 2 and 4 may

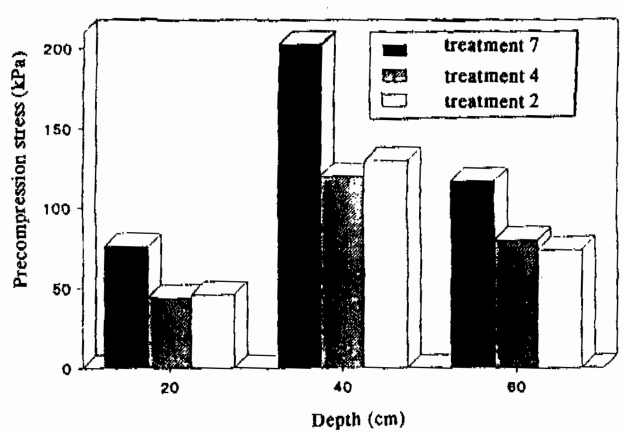

Fig. 2. Precompression stress values at a matric potential of −6 kPa in different horizons of a Luvisol derived from loess, as a function of wheeling treatments with different frequency and loading intensity during 6 subsequent years. Treatment 2, three wheelings per year with 1.7 Mg; Treatment 4, three wheelings per year with 3.4 Mg; Treatment 7, seven wheelings per year with up to 4.0 Mg (Semmel, 1993).

be explained by the effect of matric suction (i.e. negative pore water pressure), which exceeds by far the mechanical stresses.

2.2. Stress propagation in the soil profile

The propagation of vertical stresses in the soil profile at three intensities of external loading and the effect of matric potential on the precompression stress values, is shown in Fig. 3. At all depths, down to 60 cm, the greatest loading intensity resulted in the largest vertical stress. If the soil is wheeled under favourable conditions (i.e. at a matric potential of between -10 and -30 kPa), the deeper soil layers are strong enough to withstand all applied stresses; only the top 30 cm will be further deformed. However, if the soil becomes slightly wetter (i.e. at a matric potential of -6 kPa), the applied stresses can equal or exceed the internal soil strength down to greater depths. Thus, a considerable additional increase in soil compactness will occur. It should be noted that, again, the precompression stress is greatest in the plough pan.

Changes in soil strength as a function of the number of wheeling events result in changes in both internal soil strength and measured internal soil stresses (Fig. 4). With increasing wheeling frequency the measured vertical stresses in the upper soil horizons clearly become smaller because, due to soil strain, repeated external loadings induce a pronounced increase in bulk density, elasticity and shear strength. These stronger soil horizons on the one hand attenuate the external stresses more completely, on the other hand their increased elasticity and stress-dependent deflection results in a further deformation of the deeper and still weaker soil horizons. Thus, additional soil loadings induce a further increase in the precompression stress values of the deeper soil horizons. Owing to progressive stress attenuation, this effect fades out at greater depths.

A load applied to the soil will always be transmitted three-dimensionally, whereby not only principal stresses but also mean normal and octahedral shear stresses play a role (Bailey et al., 1988). These stresses affect soil particle displacement, volumetric strain and particle

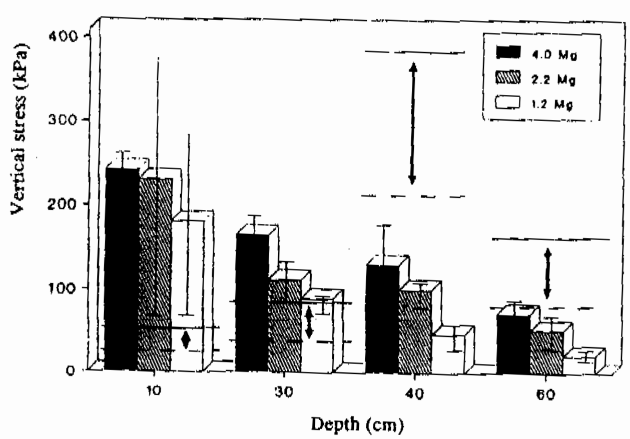

Fig. 3. Vertical stresses and site-specific precompression stresses in a Luvisol derived from loess at three intensities of external loading and two matric potentials. Solid line, precompression stress at a matric potential between -10 and -30 kPa; dashed line, precompression stress at a matric potential of -6 kPa (Semmel, 1993).

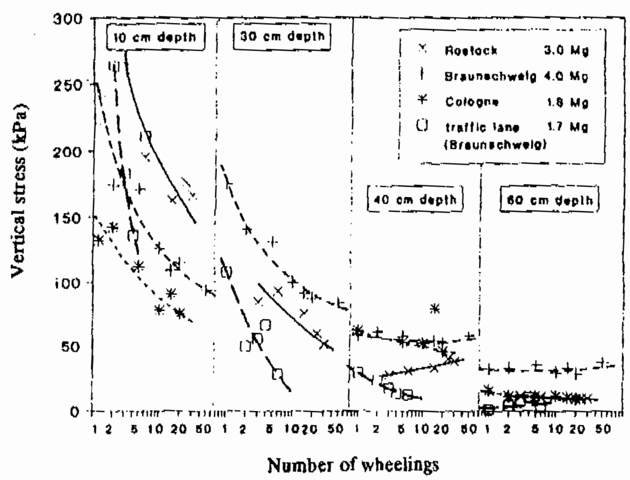

Fig. 4. Effect of repeated wheeling on measured vertical stresses at different depths in a Luvisol derived from loess (Semmel, 1993).

rearrangement. Thus, soil strength can be either increased due to compaction or decreased because of destruction of existing aggregation due to shearing. During soil wheeling the stress components in the soil vary, depending on the relative position of the wheel and on the internal shear resistance. Repeated wheeling at constant water content during a single day induces a relative increase in the vertical principal stress, S1, compared with the two horizontal stress components, S2 and S3 (Fig. 5). Thus, the intensive stress concentration in the vertical direction resembles an increased concentration factor value, which again points to weaker soil.

The extent to which the stresses induced by loading exceed the internal soil strength, can be derived by comparing the Mohr–Coulomb failure line (determined by means of a frame

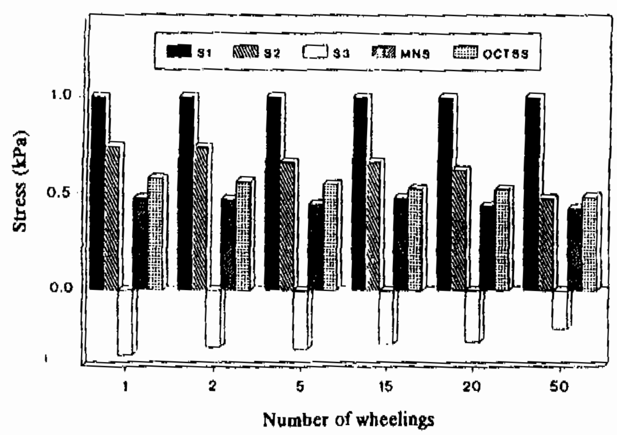

Fig. 5. Effect of repeated wheeling (wheel load 4.0 Mg) on changes in the ratio of the stress components at 30 cm depth in a Luvisol derived from loess, at a matric potential of −30 kPa. S1, vertical principal stress; S2, S3, horizontal stresses; MNS, mean normal stress; OCTSS, octahedral shear stress. For comparison, the value of S1 was set at 1.0 (Semmel and Horn, 1994).

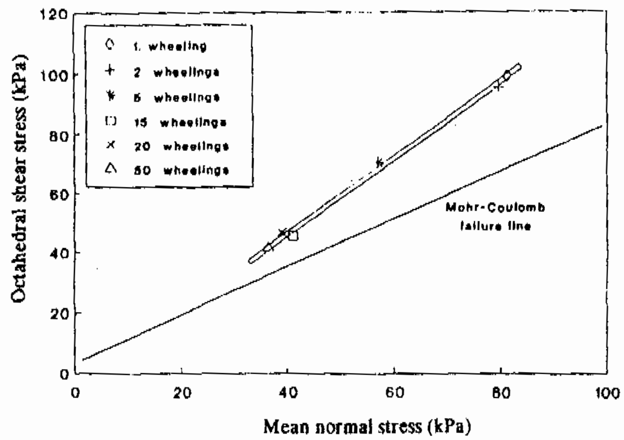

Fig. 6. Comparison of the Mohr–Coulomb failure line with the corresponding in-situ measured octahedral shear stress at the same water content in a Luvisol derived from loess (Semmel and Horn, 1994).

shear test at constant speed and controlled load) with the results of in-situ tests of the octahedral shear stress at corresponding mean normal stresses (Fig. 6). Especially during the first few wheeling events, the most pronounced shear failure occurs, while repeated wheeling results in much smaller effects. Soil loading can affect both the pore size distribution and the pore continuity. However, also the shape of the water menisci will be altered due to changes in hydraulic conductivity (Richards, 1974). If during loading the excess pore water cannot be drained off immediately, further compaction will be temporarily prevented by the creation of positive pore water pressure. However, if dynamic forces (vibration, wheel slip) simultaneously cause a rearrangement of the soil particles, accompanied by an improved accessibility of the particle surfaces to the compressed soil water, the soil will be completely kneaded and homogenised (Horn, 1976).

3. Physical soil structure deterioration

To characterise the various stages of structure deformation and site deterioration, applied stress/soil strength relationships and alterations in soil functions must be discussed both on the macroscopic and microscopic scale.

In general, three stages of stress-induced changes in the pore system can be distinguished, which also affect the environmental aspects (i.e. the function of soils in ecosystems).

(1) Under natural conditions, the soil aggregation process will eventually reach a steady state, where aggregate formation, favourably influenced by swelling and shrinkage and by biological activity, has created a homogeneous, very strong pore system with a considerable proportion of macropores. At this stage, pore size distribution and pore continuity have reached a site-specific steady state, in which more or less spherical aggregates, such as crumbs, predominate. This can be demonstrated in photographs of opaque blocks of soil, made from undisturbed samples (8 cm × 9 cm × 4 cm) in the vertical plane, by means of drying, hardening with a solution of Polimal-109 polyester resin, cutting into 1-cm-thick slices, grinding and polishing (Fig. 7, top).

Fig. 7. Photographs showing the structure of a Haplic Phaeozem developed from loess. Top, Ah horizon from a forest soil, depth 0–5 cm, bulk density 0.87 Mg m^{-3} (Słowińska-Jurkiewicz, 1989). Bottom, Ap horizon from a cultivated soil, depth 0–5 cm, bulk density 1.46 Mg m^{-3} (Słowińska-Jurkiewicz, unpublished data). Solid phase, black; voids, white.

Fig. 8. Photograph of a massive structure. Orthic Luvisol developed from loess, depth 0–8 cm (Słowińska-Jurkiewicz, unpublished data). Solid phase, white; voids, black.

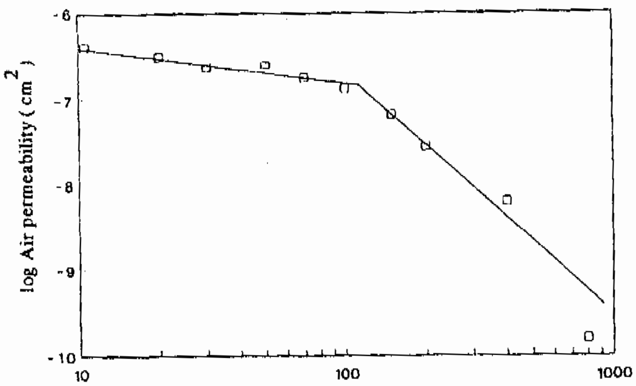

Fig. 9. Stress-dependent change in air permeability of soil samples from 40 cm depth in a Luvisol derived from loess, at a matric potential of −6 kPa. As soon as, during additional loading, the precompression stress value (100 kPa) is exceeded, the air permeability declines sharply (Semmel, 1993).

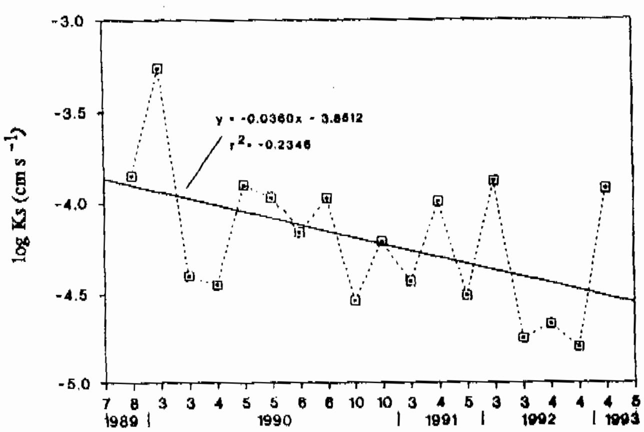

Fig. 10. Saturated hydraulic conductivity, K_s, at 40 cm depth in a Luvisol derived from loess, as affected by long-term wheeling with various loads and wheel slip percentages, at various matric potentials (Semmel, 1993).

(2) Long-term mechanised soil cultivation for crop-growing and the application of fertilisers and pesticides drastically decreases the humus content (Słowińska-Jurkiewicz, 1989; Shikula and Nazarenko, 1990) and the natural internal soil strength (Kay, 1990) and results in soil structure deterioration. This is expressed in the formation of bigger, less porous but weaker aggregates (Fig. 7, bottom).

Generally, the structure of the non-compacted arable layer is heterogeneous and characterised by an aggregated fragment structure where aggregates varying in diameter from about 1 to 20–30 mm predominate. Between the aggregates, large free spaces, even >20 mm occur. If the pressure exerted by tractor wheels or other machinery exceeds the maximum internal soil strength, firstly the inter-aggregate pore space will be destroyed, while the intra-aggregate pore space remains constant (Fig. 8). As a result, the precompression stress value and physical properties, such as air permeability and hydraulic conductivity, are reduced (Figs. 9 and 10). Usually, the most compacted zones are observed under the

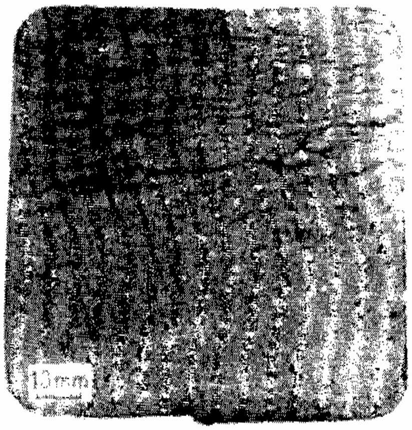

Fig. 11. Photograph of a soil structure with horizontal fissures. Orthic Luvisol developed from loamy silt, depth 0–8 cm (Słowińska-Jurkiewicz and Domżał, 1991a). Solid phase, white; voids, black.

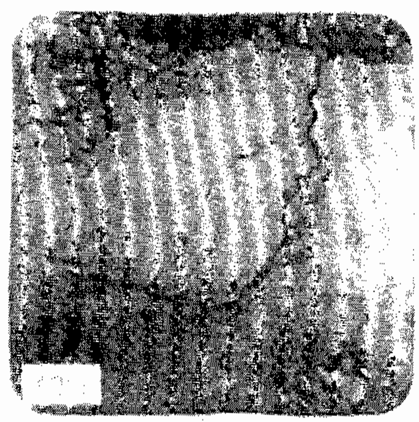

Fig. 12. Photograph of a soil structure exhibiting a combination of horizontal and vertical fissures. Haplic Phaeozem developed from loess, depth 0–8 cm (Domżał et al., 1993). Solid phase, white; voids, black.

rear tractor wheels between about 3 and 8 cm below the surface of the rut. A characteristic feature of the structure in this layer is the total absence of pores >20 μm. At about 8 cm depth, the soil is still very compact but here some pores of 20–50 μm diameter occur. In the 9–17 cm layer the soil is less compact and even some pores >100 μm may be found.

(3) Repeated wheeling induces a still denser rearrangement of the soil aggregates and the formation of a platy structure with highly regular horizontal fissures (Fig. 11) or a massive structure characterised by a combination of horizontal and vertical cracks and fissures (Fig. 12). These types of soil structure occur especially after repeated wheeling of silty or loamy soils and loess soils, which can be explained primarily by normal redrying and shrinkage processes following soil kneading. On sandy soils, excessive compaction results in a structure with intergranular pores only and, rarely, short or narrow cracks (Fig. 13).

4. Environmental consequences of physical soil degradation

The effect of compaction on soil structure deterioration depends on the internal strength of the soil concerned, the frequency and intensity of the applied loading and on the soil

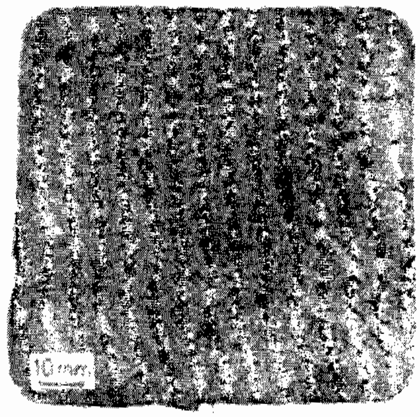

Fig. 13. Photograph of a soil structure with intergranular pores and short and narrow cracks. Leptic Podzol developed from sand, depth 0–8 cm (Słowińska-Jurkiewicz and Domżał, 1991a). Solid phase, white; voids, black.

water status during field operations. The various types and degrees of alterations in soil structure may result in unsatisfactory ecological properties, such as excessive mechanical impedance, lack of oxygen, plant-available water and nutrients, and deteriorated physical–chemical processes (Medvedev, 1991).

With respect to their susceptibility to compaction, three groups of soils can be distinguished.

(A) Sandy soils with a single-grain structure are only slightly susceptible to soil compaction and, although a relatively high degree of compactness may result, this does not lead to significant deterioration of soil physical properties. Cultivation easily restores the original soil structure.

(B) Soils derived from silt, such as silty loams, with a low colloid content and a weak structure, are easily compacted by external forces.

(C) Medium- and fine-textured loam and clay soils are resistant to mechanical pressure at low water contents but they are highly susceptible to severe compaction at high water contents.

Soil compaction, and especially subsoil compaction is a stealthy evil because its effect is cumulative (Semmel, 1993). Serious compaction, even in the arable layer, cannot be alleviated by one or two tillage operations. The soil may be reloosened but the resulting structure is inferior to that of uncompacted soil: it is less stable than non-compacted, well-structured, naturally strong soil, which makes the soil more prone to wind and water erosion and less resistant to subsequent wheeling. According to Semmel (1993), neither swelling and shrinking or freezing and thawing cycles, nor relatively high earthworm activity could safeguard the hydraulic conductivity values from a decrease induced by repeated, well defined wheeling during 6 subsequent years. As a result, water fluxes were further reduced to ever greater depths.

Silt and clay soils in particular are highly susceptible to long-lasting changes, whereby a reduction in water fluxes is accompanied by a reduction in soil aeration, the dominance of CO_2, CH_4 and N_2O in the soil atmosphere and impeded root development (Grath, 1993). Currently, it is hypothesised that compacted soils could contribute to global atmospheric warming due to increased emission of CO_2, CH_4 and N_2O from such soils. It seems worthwhile to check this hypothesis.

The dominant plastic soil deformation caused by soil compaction results in an anisotropic pore system, in which water infiltration is impeded (Horn, 1994). The platy structure of seriously compacted soil layers, in which, in the vertical plane finer and therefore less permeable pores predominate, and in the horizontal plane coarser pores are dominant, is characterised by a hydraulic conductivity which is many orders of magnitude greater in the horizontal than in the vertical direction. Therefore, on flat areas, water ponding may become a serious problem (as is well known from silage maize plots after harvesting), which causes considerable delay in field operations in spring. The problems of stagnant water at the soil surface are aggravated by subsoil compaction, which is accompanied by decreased internal drainage. Even on slightly sloping terrain (2–4% slope), water runoff from compacted topsoils may induce pronounced soil erosion (i.e. exceeding 20 Mg ha^{-1} $year^{-1}$ and sometimes even >100 Mg ha^{-1} $year^{-1}$; R.P.C. Morgan, personal communication). This loss of soil from the most fertile A horizon, sometimes to the full depth of the plough layer, is accompanied by the transport of nutrients, chemicals and sometimes even plant seeds. The soil may be deposited downhill or transported to surface waters. Downhill deposition results in artificial soil profiles. These colluvisols may be chemically very fertile, but their agricultural productivity is inferior because they have worse physical properties, such as strongly reduced air and water permeability, and are very susceptible to further soil compaction. Transportation of soil, nutrients and chemicals to surface waters may entail silting of water courses and (artificial) lakes, reduction in water quality and, consequently, in aquatic life. On the way, considerable damage may be done to roads and buildings.

In compacted soils, the gas exchange and associated redox processes are inferior to those in uncompacted soils. These processes may affect the uptake of nutrients, adsorption and desorption processes, ion fixation and immobilisation. Therefore, mismanaged soils, such as Stagnosols or Pseudogley soils derived from originally highly productive Luvisols or even Mollisols originated from loess, must be graded as financially less valuable. From the point of view of food and fibre production, the filter and buffer functions of the soil, and high-quality drinking water production, it would be of utmost importance to have available satisfactory quantitative data on the effects of soil compaction. However, these data are still greatly lacking.

Improving the physical properties of compacted soil is not easy because only part of the soil deformation is reversible. Moreover, amelioration is very costly as it requires much fossil fuel in relevant tillage operations and huge amounts of organic matter to be applied to increase the humus content or at least to prevent a further decrease in this all-important soil structure stabilising factor. Nevertheless, usually the greater part of the aggregates produced by cultivation is 'artificial' (i.e. they are less porous and more blocky, which gives a less favourable seedbed quality). After loosening compacted subsoils, they recompact quickly owing to their lower stability: usually, after 3–5 years they are even denser than before loosening.

5. Conclusions

Soil compaction processes and the corresponding changes in soil physical properties may be described by the value of the precompression stress, the type and intensity of stress application and the resulting changes in soil strength.

Repeated wheeling causes the consecutive destruction of the inter- and intra-aggregate pores, which results in the formation of a massive, dense pore system and/or in a loss of soil strength. It further results in reduced aeration, water infiltration and root development, and in a drastic decline in soil strength and worsening of pore functions, such as filtering and buffering capacities. The formation of dense, platy aggregates due to repeated wheeling, may induce a more pronounced horizontal flux of water, which may cause soil erosion. The vertical fluxes are many orders of magnitude smaller, which may enhance the formation of N_2O in the soil and impede the gas exchange with the atmosphere.

Compaction-induced soil degradation is still more severe if, due to dynamic forces influencing the matric potential, additional soil swelling occurs. This does not only result in a complete loss of soil strength but it also worsens the ecological parameters. These phenomena occur especially in silt and clay soils, which are most susceptible to compaction processes.

Only if the soil aggregates and the total soil structure are strong enough to withstand applied soil stresses, will soil physical properties remain unchanged. Therefore, soil loading should be limited in accordance with the internal strength of the weakest horizon of the soil profile.

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Effect of Tillage Machinery Traffic on Soil Properties, Corn Root Development and Plant Growth

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ABSTRACT

Tillage traffic is one of the major problems facing modern agriculture. Overuse of machinery, intensive cropping, and short crop rotations, intensive grazing and inappropriate soil management leads to soil compaction. This experiment was conducted on a clay loam soil to study the effect of tillage machinery traffic (TMT) on soil properties, corn root development and plant growth. Tillage machinery (TM) used in experiment was wheel tractor (TW), crawler tractor (TC), and a no compaction (C).

The results showed highly significant differences between treatments. The data on final emergence count did not show significant differences between treatment means when tested at $P \leq 0.05$ levels. However, plant height showed significant differences at $P \leq 0.05$ and $P \leq 0.01$ levels when they were measured at 2, 4, 6, 8 and 10 weeks and at the time of harvest. The TW1, TW2, and TW3 produced taller plants than TC1, TC2 and TC3. The data on root length and density showed significant differences between treatment means at $P \leq 0.05$ and $P \leq 0.01$ levels, with TW1 and TW2 produced the best results while TC3 showed the lowest results.

The machinery passes (MP) significantly influenced growth parameters and gave lower dry matter yield and the other yield components. The soil bulk density, soil resistance, and soil moisture generally increased under machinery passes except under TC3 and TW3 treatments which showed the lowest performance.

Keywords: Corn production, bulk density, tillage traffic, root development, plant growth.

1. INTRODUCTION

Frequent traffic of machinery and equipment, in irrigated field causes a breakdown of soil structure in the topsoil layer, and considerable compaction of the lo wer layers. As a result, it is difficult to prepare a good seedbed which affects germination and consequently irregular stands are obtained. Through the years, the intensive use of the agricultural machinery without moisture control has been causing dissem ination of the soil compaction (Hill and Meza - Montalvo, 1990; Muller et al., 1990), consequently productivity of land in such areas is significantly affected (Barnes et al., 1971; Gupta et al., 1985; Larson et al., 1989; Dias Junior and Miranda, 2000; Hor n et al., 2000). Due to soil compaction root penetration and development becomes pretentious. The root torpor pressure is insufficient to overcome the mechanical resistance of the soil (Gysi, 2001; Smucker and Erickson, 1989; Bicki and Siemens, 1991; Durr and Aubertot, 2000, Arvidsson, 2001; Ishaq et al., 2001) (Arvidsson, 2001; Dauda and Samari, 2002), which result in poor plant emergence and growth ultimately crop yields are decreased. In tropical conditions, the soil compaction process occurs due to till age and harvest operations carried under wetter than the optimal conditions required for wheel movement; in pasture areas, due to the excessive trampling of the cattle (Kondo and Dias Junior, 1999) and in forest areas, due to the traffic of the harvest operations and wood transport under inadequate soil water conditions (Dias Junior et al., 1999). . Thus, in agriculture, application of stress greater than the pre -compression stress should be avoided (Gupta et al., 1989; Lebert and Horn, 1991; Dias Junior, e t al, 1995; Defossez and Richard, 2002). Corn yields are undoubtedly affected by field characteristics and operations such as soil strength, compaction, soil water, tillage and residue practices, time of field operations and soil fertility, which altogether influence emergence, root development and nutrient availability. Residues from the previous year left on the soil surface can influence subsequent yields. Therefore, changes in soil physical properties as a function of agricultural machinery traffic is important for root growth and also to assess the load support capacity of the soil.

2. MATERIALS AND METHODS

2.1. Site Description

Study was carried out on a 2.0 ha area during the growing season of 2006. The site is located at the Jiangpu experimental farm of Nanjing Agricultural University, Jiangsu Province of China which is located at Latitude of 32° 3' 4.96" N, and Longitude of 118° 36' 38.78" W). Prior to establishment of this experiment, the site has remained under continuous corn (*Zea mays* L.), since 2002. Surface drains were installed during 2000 within each plot. The soil's organic C, total N, available P, exchangeable K, were 11.34 g kg^{-1}, 27.88 mg kg^{-1}, 13.57 mg kg^{-1} and 31.4 mg kg^{-1}, respectively. The monthly meteorological data was collect ed and is shown in Table 1.

Table1. Meteorological data for the period January to July 2006.

	January	February	March	April	May	June	July
Total rainfall (mm)	117.3	60.2	10.6	113.4	96.9	112.1	191.1

Average temperature(°C)	3.5	4.1	11.2	16.7	20.9	26.2	28.3
Average relative humidity (%)	81	76	65	70	69	73	81
Wind Velocity (m/s)	2.6	3.0	2.7	2.8	2.8	2.3	2.5

Source: Meteorological Station Jiangpu Nanjing Jiangsu Province of China.

Six treatments that included; Crawler TC1 (one pass), TC2 (two passes), and TC3 (four passes); Wheel tractor TW1 (one pass), TW2 (two passes), and TW3 (four passes) were replicated three times in a randomized complete block design (RCBD). The parameters such as; soil structure, bulk density, soil moisture content, and soil strength were studied.

2.2 Instruments and Machines Used

A two wheel driven (2D) Tractor Model 1995 (power 35.3 kW, weight 2500 kg) and a Crawler Tractor Model 1982 (power 50 kW, weight 4500 kg) Manufactured by Shanghai Tractor International Combustion engine Corporation, R,P. China (Fig.1 & 2) were used in this study. The other equipment included core soil sampler, soil sample containe rs, balance, penetrometer and an oven were used.

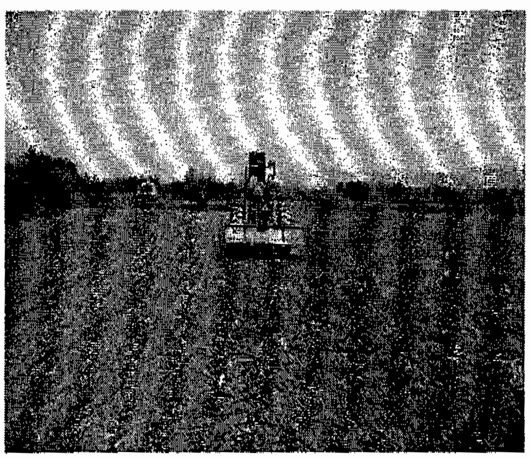

Fig.1 wheel tractor TW

Fig.2 crawler tractor TC

2.3. Experimental Design and Treatment Applications

The experiment was laid out in a randomized co mplete block design with a factorial arrangement of treatments consisting of (a two wheel driven tractor and crawler tractor) and three pass levels (one pass, two passes, and four passes), replicated in three blocks, resulting in a total of 18 plots. Each plot measured 4 m X 120 m. The plots were separated by 1 m wide buffer strips. Wheel tractor (TW) with rubber tires and Crawler tractor (TC) with chain were used after rotary tillers operation before planting.

Corn seed (Baiyu109 variety) was planted usi ng a planter (double-disk seed and fertilizer opener) with a density of 141751 seeds ha^{-1} (45 kg^{-ha}). A compound fertilizer (N 8%, P 8%, and K 9%) at a rate of 750 kg ha^{-1} was applied with the seed at planting. N, P and K application rates were selected on the basis of soil tests (for plant extractable K and P) using the Melich III test, whi ch is the standard fertilizer test in Jiangsu Province of China. Nitrogen 46 (urea only 450 kg ha^{-1}) was applied 2–5 weeks later, and at the 8th week of sowing second dose at 300 kg ha^{-1} was applied.

2.4 Herbicide

After three weeks of planting a commonl y used herbicide Thifensul Furon-methyl was applied at a rate of 1350 g^{-ha}.

2.5 Soil Sampling

The core samples were randomly taken at each sampling location to determine the bulk density using a core sampler (0.5 cm diameter by 0.5 cm height). Three s ub-samples were taken, from wheel tracked and three from chain tracked plots. The soil cores were taken at 0 –5 cm, 5–10 cm, and 10 – 15 cm depths. The bulk density measurements were made at different times during the growing season depending on the objecti ves, convenience and climatic conditions.

2.6 Crop Data Collection

Emerging seedlings were counted at 10 randomly selected rows in each plot in 1 -m long sections. The seedlings were counted between 2 and 4 weeks following planting. Plant significant difference were obtained after 2, 4, 6 and 8 weeks and at the time of harvest., The dry matter yield was determined by hand harvesting six randomly selected corn plants in an experimental plot. Since there wasn't any differentiation between treatments at the time of harvest hence, the maturity differences between corn treatments was beyond the scope of this study. During harvest, the stalks and cobs were collected and counted, and stored to be dried later. After drying at 70 °C for a period of 2 to 3 days, the Stover (stalks, leaves and husks) from each sample location were weighed and a sub-sample was collected and kept for drying at 70 °C at least for 48 hours. Once the Stover sub-sample was dried it was reweighed and the Stover yield was determined. Dry matter yield was determined by adding both Stover and grain yield.

2.7 Statistical Analyses

The analysis of variance (ANOVA) was done using depth as a repetition factor to evaluate effects of depth on bulk density. For each depth, treatment differences w ere evaluated using the Student–Newman–Kuels (SNK) test at a 0.05 level of probability.

Corn emergence data and dry matter yields were analyzed for each sampling period using the general linear model Analysis of Variance. The SNK test at 0.05 level of pr obability was used to determine treatment differences. The entire analyses were performed using a SAS Statistical Software.

3. RESULTS

3.1. Bulk Density

Dry bulk density values mostly varied at the 0–15 cm depth and fluctuated between 1.28 and 1.67 g cm^{-3} (Table 2). Bulk densities varied at the deeper depth, bulk density values ranged between 1.48 and 1.57g cm^{-3}. Some variations were likely due to different timings of soil sampling.

Average bulk density was lower at 0–5 cm than in the underlying layer. Differences in bulk density between the shallow and deeper depths were quite clear, with higher bulk density values in the deeper layer. A significant depth–compaction interaction was found in (TW) and (TC), which is attributed to the tillage operations which predominately take place in the top soil layers (Table 3).

Table 2. Dry bulk density (ρ_b) prior to experiment. (g/cm^3)

Observation	0-5 cm depth	5-10 cm depth	10-15 cm depth
1	1.31	1.38	1.68
2	1.38	1.68	1.49
3	1.77	1.65	1.55
Average	1.48	1.57	1.57

Table 3. Average dry bulk density (ρ_b) after compaction operations. (g/cm^3)

Depth (cm)	C*	TW1	TC1	TW2	TC2	TW3	TC3
0-5	1.28	1.40	1.44	1.38	1.42	1.50	1.54
5-10	1.41	1.43	1.51	1.44	1.65	1.51	1.53
10-15	1.49	1.52	1.52	1.51	1.61	1.643	1.67

TW = Wheel tractor
TC = Crawler tractor
C* = no compaction

3.2. Corn Emergence Rates

Emergence showed significant interaction between treatments. Generally, TW3 and TC3 showed slower emergence percent than the other treatments. TW2 had the highest emergence rate (Table 4) while, TC3 had the lowest emergence rate per square meter. TW treatments had a higher emergence than TC, which was again attributed to compaction Table 5.

Table 4. Plant emergent rate (%)

Dated	TW1	TC1	TW2	TC2	TW3	TC3	C*
2006.4.20	47.85	42.14	54.28	45.71	35.71	32.86	72.14

TW = Wheel tractor
TC = Crawler tractor
C* = no compaction

Table 5. Number of plants emerged / m^2

S.No.	C*	TW1	TC1	TW2	TC2	TW3	TC3
1	11	8	6	7	7	10	9
2	12	8	9	10	9	5	6
3	11	7	8	10	10	6	6
4	10	9	9	9	5	3	4
5	8	7	7	6	4	4	3
6	9	6	5	7	3	2	4
7	7	5	3	8	5	6	2
8	12	6	4	6	4	4	3
9	11	5	3	6	6	7	4
10	10	4	5	7	7	3	5
Average	10.1	6.7	5.9	7.6	6.4	5	4.6

3.3 Plant Status

3.3.1 Effect on final emergence count: The treatments did not show any high significant differences when tested at $P \leq 0.05$ level as shown in Table 6.

3.3.2 Effect on plant height: Differences were obtained between plant heights measured during 4, 6,8,10 weeks and at the time of harvest time. The TW1, TW2, and TW3 produced taller plants as compared to than TC1, TC2 and TC3; however, plant heights were shorter under TW3 and as compared to rest of the treatments (Table 7). Figure 3 and 4 shows the corn crop grown in the field both under wheel (TW) and crawler (TC) tractors.

3.3.3 Effect on root length and root density: Differences were obtained between plant root measured during 4, 6,8,10 weeks and at the time of harvest time. TW1 and TW2 showed the best results while, TC2 showed the lowest results (Table 7). The differences in root development are shown in Figure 5 and 6. The data were taken during 8th week of sowing.

Table 6. Field traffic effects on plant emergent rate

ANOVA

Treatments	Source of Variation	SS	DF	MS	F Value	P Value
C VsTW1	Between Groups	64.8	1	64.8	24.60759	0.000101
	Within Groups	47.4	18	2.633333		
C Vs TC1	Between Groups	88.2	1	88.2	22.11142	0.000178
	Within Groups	71.8	18	3.988889		
C Vs TW2	Between Groups	31.25	1	31.25	11.89218	0.002866
	Within Groups	47.3	18	2.627778		
C Vs TC2	Between Groups	84.05	1	84.05	21.3385	0.000213
	Within Groups	70.9	18	3.938889		
C Vs TW3	Between Groups	130.05	1	130.05	31.25367	2.63E-05
	Within Groups	74.9	18	4.161111		
C Vs TC3	Between Groups	151.25	1	151.25	44.41272	2.98E-06
	Within Groups	61.3	18	3.405556		

Fig.3 Crop planted under TW2

Fig.4 Crop planted under TC2

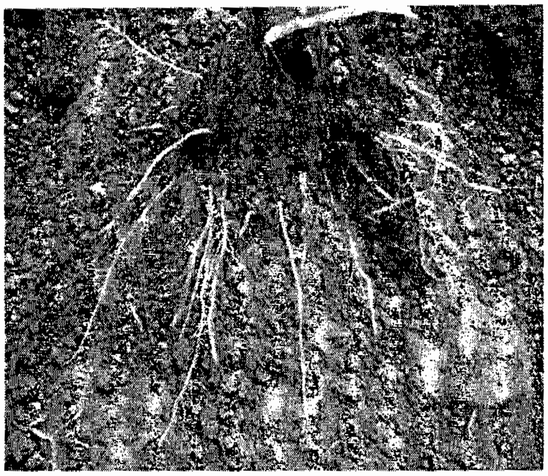

Fig.5 Root development in TW2

Fig.6 Root development TC2

Table 7. Average Plant height and root development (cm)

S.NO	TW1		TC1		TW2		TC2	
WEEK	R.L	P.H	R.L	P.H	R.L	P.H	R.L	P.H
2	2.7	14.3	3.5	12.4	2.4	8.5	2.4	10.3
4	14.2	17.3	13.7	16.3	11.6	15.3	13.2	14.3
6	15.3	58.1	14.6	50.6	12.1	48.3	13.1	47.6
8	17.4	114.2	16.8	113.9	13.3	114.8	13.6	111.3
10	18.0	188.1	17.6	165.8	14.1	166.7	13.2	173.5
Harvest	22.65	215.67	18.98	211.67	24.30	230	20.29	210

S.NO	TW3		TC3		C	
WEEK	R.L (cm)	P.H (cm)	R.L (cm)	P.H (cm)	R.L (cm)	P.H (cm)
2	2.31	11.5	1.73	8.2	2.3	12.4

4	11.13	10.6	10.5	13.0	13.8	14.9
6	13.92	47.9	12.7	45.0	16.0	64.3
8	14.3	100.0	14.2	92.3	19.4	118.5
10	12.6	126.3	11.4	115.0	21.0	200.3
Harvest	27.79	209	25.05	203.33	26.40	249.33

R.L = Average Root length (cm)

P.H = Average Plant height (cm)

3.3.4 Dry matter: Average dry matter yields were affected by traffic compaction. The lowest yields (14.208 tones ha^{-1}) were observed at TW3 while the highest yields (34.399 tones ha^{-1}) were recorded at C treatment (Table 8). The combination of two passes under TW2 and TC2 treatments had comparably higher dry matter yields than TW1, TC1, TW3 and TC3 treatments. The soil texture and soil drainage characteristics were consistent within individual plots.
Lower emergence rates did not translate into lower yields in TW3 and TC3. There was a significant tractor × passes interaction, where TW3 and TC3 had a significantly lower total dry matter yield than TW1, TC1, TW2, and TC2 (Table 8). The climatic conditions of 2006 were wetter than normal; thus, less warming and evaporation of water from these sites may have contributed to their lower yield. TC has a smaller total dry matter yield than other treatments. This was attributed to difficulty in seeding through residue from the previous years and the large amount of precipitation received 2–3 days before planting that created a poor seedbed conditions.

Table 8. Average dry matter yield (tones^{-ha})

S.No.	C*	TW1	TC1	TW2	TC2	TW3	TC3
1	40.444	24.707	23.307	34.399	31.387	14.208	19.074

C*= no compaction

4. DISCUSSION

Results of this study reveal that tillage had a greater influence on bulk density of the sandy loam soil. Similar results have been reported in other studies ; for example, (Kushwaha et al. 2001), compared the effects of no-till, conventional tillage and residue practices, found that CTNR had a significantly lower bulk density (1.27 g cm^{-3}) than NTR (1.40 g cm^{-3}) on a sandy loam site. Da Silva et al. (2001) found a significantly higher bulk density in TC; the bulk density varied from 0.96 to 1.71 Mg m^{-3} on a loam soil. Kushwaha et al. (2001) observed that tillage practices had the largest impact on bulk density. The tillage practices have also affected the emergence, growth and the dry matter yield. In a study conducted in Northern New York Cox et al. (1990) slow emergence of corn plants. They further pointed that the emergence differences did not necessarily translate into lower total dry matter yield, but climatic conditions over the entire season could have affected the total yield. Under drier than average conditions during a 20-year study, noticed that corn yields were greater, probably because of the higher amount of soil moisture held in plots where compaction is reasonable.

Kelvin et al., (2001) conducted research in sandy soil by rubber tracked and tired vehicles and found that heavy vehicle effects penetration resistance after more discriminating indistinguishing soil physical changes among the trafficked and un trafficked treatments than bulk density.

Ruijun Qin et al. (2004) compared the results of root length, density, length, and mean root diameter under different tillage systems and found that under no tillage and conventional tillage the root length, diameter was higher in upper soil layer (0-5 cm), similar from (5-10 cm) and lower from (10-30 cm).

Chaudhry and Sandhu (1983) studied the impacts of compaction and observed that the compacted soil restricts the root development which effects the yield.

Tsimba et al., (2002) compared tillage practices and partial tillage disrupts root restricting consolidated soil zones and improve rooting capacity-disruption tillage increase costs of farm operations because of need for more powerful tractors and greater fuel use.

Chan (1992) observed that soil compaction significantly affects crop quality and the yield. Soil compaction affects plant growth by causing increased resistance to root penetration and decreased uptake of water, Muhammad Saqib et al., (2004).

5. CONCLUSIONS

The following conclusions were drawn from this study:

I. Bulk density was affected by tillage practices, but only within the first 10 cm both under TW and TC treatments.
II. Tractor × passes interactions affected corn emergence. Poor emergence was found under TW3 and TC3 treatments.
III. There was long-term tillage effect on dry matter yields, and differences were attributed to climatic variation over plant growth and root development.
IV. Higher bulk density in some treatments (TW2 and TC2) may have increased the ability of the soil to retain water during seasons with less than average precipitation, which may have contributed to higher dry matter yields.
V. Plant height was found better in slight compacted plots. Thus TW2 is recommended as a sustainable tillage practice on a clay loam, loam and sandy loam soil in a temperate climate.

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United States Department of the Interior

FISH AND WILDLIFE SERVICE
Ecological Services
Carlsbad Fish and Wildlife Office
2730 Loker Avenue West
Carlsbad, California 92008

In Reply Refer To:
FWS-OR-2950.1

Valarie McFall
Transportation Corridor Agencies
125 Pacifica, Suite 100
Irvine, California 92618-3304

Re: Satisfaction of Term and Condition Numbers 2 and 4 of Biological Opinion 1-6-93-F-98R for the San Joaquin Hills Transportation Corridor: Coastal Sage Scrub Revegetation at the Coyote Canyon Landfill, Orange County, California

Dear Ms. McFall:

This letter responds to your May 29, 2002, request for concurrence that coastal sage scrub revegetation requirements have been met pursuant to Term and Condition Nos. 2 and 4 of biological opinion 1-6-93-F-98R for the San Joaquin Hills Transportation Corridor (SJHTC). Term and Condition No. 4 specifies that the Federal Highway Administration (FHWA) or its agents (hereafter, Transportation Corridor Agencies or TCA) shall revegetate a minimum of 122 acres of "acceptable" coastal sage scrub on or adjacent to the closed Coyote Canyon Landfill, and Term and Condition No. 2 lists performance standards that must be met in association with that revegetation effort. On January 12, 2000, we provided concurrence that the performance standards had been met for 91 acres of coastal sage scrub revegetation on the landfill cap. At issue is the remaining 31 acres of revegetation that is comprised of 18 acres between the landfill and the SJHTC, 8 acres in East Canyon and 5 acres in South Canyon.

According to the biological opinion, Coyote Canyon Landfill revegetation efforts shall be deemed acceptable if: 1) the habitat is occupied by breeding pairs of coastal California gnatcatchers (*Polioptila californica californica*), 2) the revegetation area has a total cover by native coastal sage scrub species of at least 70 percent and the vegetation is not being artificially sustained, and/or 3) the U.S. Fish and Wildlife Service and FHWA or TCA agree that the habitat has the structure and composition of naturally-occurring gnatcatcher habitat or fully functional coastal sage scrub. Based on our review of the *2001 Coyote Canyon Coastal Sage Scrub Mitigation Performance Monitoring Report*, the *2000 Avifauna Monitoring Report for the San Joaquin Hills Transportation Corridor Revegetation and Restoration Areas*, our visit to the site on March 12, 2002, and supplemental accounting and figures of restoration areas provided by Margot Griswold of Earthworks Construction and Design on August 21, 2002, we concur that the 18 acres between the landfill and the SJHTC and the 5 acres of revegetation in South Canyon meet the above performance standards. However, because the 8-acre East Canyon site does not satisfy the vegetation cover standards, does not support breeding gnatcatchers, and the vegetation is dominated by annual grasses and weeds (sweet clover and bur clover), we do not concur that East Canyon fulfills the performance standards called for in Term and Condition Nos. 2 and 4.

In anticipation that the East Canyon revegetation area would have difficulty meeting the performance standards, we recommended during a May 10, 1999, site visit that TCA identify alternative revegetation areas that could substitute for the acreage called for in this location. The *2001 San Joaquin Hills Toll Road Coastal Sage Scrub Slope Mitigation Performance Monitoring Report* and the supplemental accounting and figures of restoration areas provided by Margot Griswold of Earthworks Construction and Design on August 21, 2002, document that TCA has exceeded the revegetation requirement for Term and Condition No. 5 of biological opinion 1-6-93-F-98R by approximately 13 acres. We agreed during a May 21, 2002, meeting among our agencies that 8 acres of the excess revegetation along the SJHTC side slopes should be credited towards the Coyote Canyon Landfill revegetation commitment. Therefore, by taking this area into consideration we concur that all 122 acres of coastal sage scrub revegetation on or adjacent to the Coyote Canyon Landfill have met the performance standards.

Due to the unique circumstances of this revegetation effort having been implemented on a landfill cap, gas recovery operations and ongoing maintenance to protect the integrity of the cap result in periodic disturbance to the revegetated areas. As management responsibilities of the landfill are transferred to the Orange County Integrated Waste Management Department (IWMD), it is appropriate for IWMD, Gas Recovery Systems/The Irvine Company (GRS/TIC) and the Nature Reserve of Orange County (NROC) to develop a long-term management program to deal programmatically with the Existing Use Policies outlined in Section 5.11 of the Orange County Natural Community Conservation Plan/Habitat Conservation Plan (NCCP/HCP). These policies are intended to minimize the impacts of existing uses within the NCCP/HCP Reserve System to the maximum extent practicable consistent with cost-effective operation of the particular facility.

It is our understanding that TCA has worked with the revegetation monitor to develop a cost-effective erosion control mix that has been applied to areas disturbed by gas recovery and cap repairs during the initial revegetation effort, and these areas have been addressed as part of the overall revegetation monitoring program. Along with procedural steps to minimize impacts to the resident gnatcatchers, we envision that a long-term management program would adopt similar procedures to help ensure the continued success of the revegetation program. We would appreciate any assistance that TCA can provide IWMD, GRS/TIC and NROC in developing such a program based on TCA's experience at this site.

In conclusion, we concur that TCA has satisfied Term and Condition No. 4 of biological opinion 1-6-93-F-98R that calls for 122 acres of coastal sage scrub revegetation on or adjacent to the closed Coyote Canyon Landfill. It is our hope that the long-term success of this revegetation effort will be ensured through appropriate management of this site by IWMD, GRS/TIC and the NROC. Should you have questions or wish to discuss any of the above, please do not hesitate to contact William Miller of our office at (760) 431-9440, extension 206.

Sincerely,

Karen A. Evans
Assistant Field Supervisor

cc: Jeffrey Kolb, FHWA
Steve Letterly, TIC
Lyndine McAfee, NROC
Thomas Halter, GRS
Suzanne McClanahan, IWMD

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Ecological Services
Carlsbad Fish and Wildlife Office
2730 Loker Avenue West
Carlsbad, California 92008

In Reply Refer To:
FWS-OR-2950.4

JUN 19 2003

Macie Cleary-Milan
Transportation Corridor Agencies
125 Pacifica, Suite 100
Irvine, California 92618-3304

Re: Satisfaction of Term and Condition Number 3 of Biological Opinion 1-6-93-F-98R for the San Joaquin Hills Transportation Corridor (SJHTC), Orange County, California

Dear Ms. Cleary-Milan:

This letter responds to your January 22, 2003, request for concurrence that Term and Condition Number 3 of the San Joaquin Hills Transportion Corridor Biological Opinion (1-6-93-F-98R) has been satisfied. Term and Condition Number 3 calls for the restoration of 6 acres of "acceptable" coastal sage scrub within the University of California, Irvine (UCI) Open Space Preserve.

The precise acreage and performance standards were to be defined in a restoration plan prepared by the Federal Highway Administration and approved by UCI. That plan called for habitat created along the West Campus to emulate a reference site in Buck Gully. Although statistical comparisons with the Buck Gully site were not made, the *Final Report for the Transportation Corridor Agencies Award TCA-2101 to the School of Biological Sciences, University of California, Irvine* (December 2002) documents that 18 acres were selected within UCI open space for experimental restoration treatments. Additionally artichoke thistle abatement efforts were implemented over 64 acres of the Open Space Preserve (focusing on 40 acres over several years starting in 1996, and over 64 acres in 2001).

Cumulatively, these efforts have created in excess of 6 acres of functional coastal sage scrub that have been documented to be within several threatened California gnatcatcher territories, and have improved the overall biological integrity of the UCI Open Space preserve. Importantly, published results of the experimental efforts have also advanced our knowledge about coastal sage scrub restoration techniques, particularly with regards to the use of transplantation as a viable restoration method. We, therefore, concur that 6 acres of "acceptable" coastal sage scrub has been created to satisfy Term and Condition Number 3 of the SJHTC Biological Opinion.

Thank you for your ongoing diligence in carrying out the conservation measures of the SJHTC Biological Opinion. Should you have questions or comments please contact William Miller at (760) 431-9440 *206.

Sincerely,

for Karen A. Goebel
Assistant Field Supervisor

cc:
Margot Griswold, Earthworks Construction & Design
Jeffrey Kolb, FHWA
Peter Bowler, UCI

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Ecological Services
Carlsbad Fish and Wildlife Office
2730 Loker Avenue West
Carlsbad, California 92008

In Reply Refer To:
FWS-OR-2950.2

SEP 10 2002

Valarie McFall
Transportation Corridor Agencies
125 Pacifica, Suite 100
Irvine, California 92618-3304

Re: Satisfaction of Coastal Sage Scrub Revegetation Terms and Conditions of Biological Opinion 1-6-93-F-98R for the San Joaquin Hills Transportation Corridor (SJHTC), Orange County, California

Dear Ms. McFall:

This letter responds to your May 29, 2002, request for concurrence that "all terms and conditions" have been met for Biological Opinion 1-6-93-F-98R for the SJHTC. Because of the large number of terms and conditions contained in that biological opinion and the focus of your May 29 letter on coastal sage scrub (CSS) revegetation commitments, we are addressing this response to the satisfaction of terms and conditions pertaining to CSS revegetation/restoration. Our analysis is based on our review of the *2001 San Joaquin Hills Toll Road Coastal Sage Scrub Slope Mitigation Performance Monitoring Report*, the *2000 Avifauna Monitoring Report for the San Joaquin Hills Transportation Corridor Revegetation and Restoration Areas*, supplemental accounting and figures of restoration areas provided by Margot Griswold of Earthworks Construction and Design on August 21, 2002, and our visits to the revegetation areas on March 12 and August 21, 2002.

Table 1 provides a summary of the terms and conditions that involve CSS revegetation, restoration and preservation, lists the relevant performance standards for each, briefly describes the status of the associated revegetation efforts, and notes, where appropriate, if the subject revegetation effort is intended to fulfill other restoration/revegetation obligations. As is indicated in Table 1, a number of the terms and conditions specify unique performance standards for the identified restoration/revegetation commitment. We have determined that the performance standards have been met for Term and Condition Nos. 4 through 7, but we would like further documentation or evidence to demonstrate that the standards have been met for Term and Condition No. 3. We address the attainment of the performance standards for each of the subject terms and conditions below.

Term and Condition Number 3 calls for the restoration of 6 acres of coastal sage scrub within the U.C. Irvine (UCI) Open Space Preserve. This restoration commitment is the responsibility of Transportation Corridors Agencies (TCA)/Federal Highway Administration (FHWA) but was handed over to UCI for implementation. The latest correspondence in our files pertaining to this effort is the "Third Annual Report: Transportation Corridor Agencies Grant to the School of Biological Sciences, University of California, Irvine, September 1, 1999". While this report states that 9 acres of weed abatement and supplemental plantings were implemented to satisfy this term and condition, it lacks information regarding the specific location and attainment of performance standards for those efforts. Therefore, we request further documentation that the performance standards have been met before we can concur that this term and condition has been satisfied.

Term and Condition Number 4 calls for the revegetation of a minimum of 122 acres on or adjacent to the the Coyote Canyon Landfill. Per your request, we have addressed satisfaction of this term and condition separately in a September 4, 2002 letter to you. We determined that 114 of 122 acres of the revegetation had met the performance standards. The remaining 8 acres at East Canyon did not meet the performance standards. However, by mutual agreement with TCA, we have accepted 8-acres of excess revegetation planted on the SJHTC side slopes (see below) to fulfill the overall 122-acre revegetation commitment.

Term and Condition Number 5 calls for the revegetation of 113 acres of slopes graded for SJHTC construction. Based on acreages assigned to revegetation areas in figures provided by Margot Griswold on August 21, 2002, 131.98 acres of revegetation were installed within the right-of-way along SJHTC side slopes (i.e. within areas under the control of TCA/FHWA). Because some roadway cuts exposed bare bedrock resulting in bare ground cover values higher than typical for most sage scrub plant communities, 6 acres have been discounted from this total. The side slopes meet the performance standards if; 1) they are occupied by breeding pairs of coastal California gnatcatchers (Polioptila californica californica, "gnatcatcher"), 2) the total cover by native coastal sage scrub species is at least 70 percent and the vegetation is not being artificially sustained, or 3) the U.S, Fish and Wildlife Service (Service) and TCA agree that the habitat has the structure and composition of naturally occurring gnatcatcher habitat or fully functional coastal sage scrub. The *2001 San Joaquin Hills Toll Road Coastal Sage Scrub Slope Mitigation Performance Monitoring Report* demonstrates that coastal sage scrub cover values meet or exceed the 70 percent requirement. Additionally, this report documents nesting of three pairs of gnatcatchers within a portion of the slope areas and sightings of nine additional gnatcatcher pairs and several juveniles within the revegetated areas. Of potential concern relative to the self sustainability of side slope revegetation areas is the high cover values of non-native weedy species (predominantly sweet clover and bur clover, Margot Griswold pers. comm.) reported for north facing fill slopes in 2001 (37% for slopes planted in 1995/96, and 72% for slopes planted in 1996/97). However, during our August 21, 2002, field tour of these areas, high weed cover was not evident and it appeared that native grasses are establishing successfully in the shrub understory. Thus, we are satisfied that Term and Condition 5 has been satisfied.

Term and Condition No. 6 calls for the revegetation of 15 acres on the slopes in the vicinity of Bonita Creek channel. Based on acreages assigned to revegetation areas in figures provided by Margot Griswold on August 21, 2002, 17.94 acres were installed in the vicinity of the Bonita channel. Two of these acres are proposed to fulfill Term and Condition 5 of Biological Opinion 1-6-94-F-26 for the widening of MacArthur Boulevard and extension of Bison Avenue. The Bonita channel revegetation areas meet the performance standards if; 1) they are occupied by breeding pairs of gnatcatchers, 2) the habitat is insignificantly different (statistically) from naturally-occurring gnatcatcher habitats or fully functional coastal sage scrub in the San Joaquin Hills, or 3) the Service and TCA agree that the habitat has the structure and composition of naturally occurring gnatcatcher habitat or fully functional coastal sage scrub. The *2001 San Joaquin Hills Toll Road Coastal Sage Scrub Slope Mitigation Performance Monitoring Report* documents that there is 116 percent absolute cover of native sage scrub species on the Bonita Channel slopes, but does not make statistical comparisons with CSS in the San Joaquin Hills. Nevertheless, 2000, 2001 and 2002 avian surveys by TCA consultants and ourselves have documented the presence of breeding gnatcatchers in these areas. Thus, Term and Condition No. 6 has been satisfied.

Term and Condition No. 7 requires that 2 acres of CSS be restored and 4 acres be preserved in the vicinity of Bonita Reservoir. The August 21, 2002 "San Joaquin Hills Transportation Corridor Bonita Channel Mitigation Plan Sheets" identify 8.53 acres adjoining Bonita Reservoir as having been "preserved and restored." Two of these acres are proposed to fulfill Term and Condition 6 of Biological Opinion 1-6-94-F-26. The restoration areas meet the performance standards if; 1) they are occupied by breeding pairs of gnatcatchers, 2) the total cover by native coastal sage scrub species is at least 70 percent and the vegetation is not being artificially sustained, or 3) the Service and TCA agree that the habitat has the structure and composition of naturally occurring gnatcatcher habitat or fully functional coastal sage scrub. The *2001 San Joaquin Hills Toll Road Coastal Sage Scrub Slope Mitigation Performance Monitoring Report* documents that the restoration area has only 48 percent absolute cover by native vegetation and 79 percent cover by exotic species, comprised mostly of non-native European annual grasses. However, the *2000 Avifauna Monitoring Report for the San Joaquin Hills Transportation Corridor Revegetation and Restoration Areas* and recent observations by Service biologists document that these areas support breeding gnatcatchers. Thus, while the cover standards for vegetation have not been attained, the performance standards have been met with regards to the presence of breeding gnatcatchers.

Occupancy of the Bonita Reservoir restoration area and the SJHTC side slopes by gnatcatchers demonstrate that the revegetation and restoration efforts have been successful in creating important habitat attributes necessary to support this species. However, the continued high cover of non-native exotic species in these areas suggest that some long-term management may be necessary to ensure that they continue to progress towards truly self-sustainable coastal sage scrub. As long-term management of this area was envisioned to be carried out through the Conservation Fund established under B.O. 1-6-93-F-98R (since transferred to the Nature Reserve of Orange County), we would welcome TCA and/or the Restoration Ecologist to propose to

NROC those measures that could be taken over by NROC to help ensure the ongoing success of these revegetation/restoration efforts.

In association with Term and Condition No. 5, your May 29, 2002, correspondence to us requests to "hold in surplus" acreage that was planted in excess of that required to satisfy that condition (approximately 5 acres when bare rock and areas credited towards the satisfaction of Term and Condition No. 4 are debited from the total). However, it is our understanding that it is not feasible at this time for TCA to identify this area in a geographically distinct manner (e.g. by means of a legal description or creation of a parcel). In essence, this is a proposal to create a small informal "conservation bank" that can be debited for future project impacts. Because TCA cannot identify a specific geographic area that would be held in surplus or a project that it would like to apply this "credit" towards, we are unable to properly consider the effects associated with such an agreement. However, we agree to take this acreage into consideration when evaluating future operations and maintenance impacts to passively and actively created habitat in the SJHTC right-of-way.

In conclusion, we concur that Term and Condition Nos. 4 through 7 have been met for B.O. 1-6-93-F-98R, but we would like further documentation or evidence to demonstrate that the performance standards have been met for Term and Condition No. 3. We appreciate the diligence that TCA has paid towards complying with the Terms and Conditions of this biological opinion and hope through continued involvement in the NROC that we can work together to ensure the long term success of TCA's efforts. Should you have questions or comments, please contact William Miller at (760) 431-9440 *206.

Sincerely,

KSA Karen A. Evans
Assistant Field Supervisor

cc: Lyndine McAffee, NROC
Margot Griswold, Earthworks Construction & Design
Jeffrey Kolb, FHWA

Table 1
Status of Implementation of Coastal Sage Scrub Terms and Conditions

Term and Condition	CSS Requirement-type/location	Implementation	Actions/Status	Comments	Performance Standards[1]
2	FHWA/TCA shall revegetate a minimum of 256 acres, preserve 4 acres and restore 2 acres of CSS. Locations of these efforts are specified in the Terms and Conditions listed below.	See below	See below	Summarizes all SJHTC CSS commitments and some of the associated performance standards. Specific locations and performance standards are detailed in Terms and Conditions 3 through 7.	
3	Restore 6 acres on the U.C. Irvine Open Space Preserve.	Installed 9 acres at U.C. Irvine but specific locations not identified.	Yet to demonstrate that performance standards have been met.	FWS has requested updated monitoring information for this effort.	a or b or c
4	Revegetate a minimum of 122 acres on or adjacent to the the Coyote Canyon Landfill	Installed 91 acres at Coyote Canyon, 8 acres in East Canyon, 5 acres in South Canyon, and 18 acres between the SJHTC and the Landfill.	On January 12, 2000, FWS concurred that 91 acres on the landfill cap met performance standards. On September 4, 2002, FWS concurred that 23 of the remaining 31 acres met the performance standards, and accepted 8 acres of excess revegetation along the SJHTC side slopes for the outstanding balance.	Eight acres of revegetation within East Canyon have not met performance standards.	a or b or d
5	Revegetate 113 acres of slopes graded for SJHTC construction.	Installed 131.98 acres within right-of-way along SJHTC side slopes.	TCA requests concurrence that performance standards have been met.	Acreage planted exceeds minimum required to satisfy this term and condition. However, 6 acres of unvegetated bare rock are proposed to be discounted from the gross revegetation acreage. Additionally, 8 acres of excess revegetation has been credited towards satisfaction of Term and Condition No. 4 (see above).	a or b or d
6	Revegetate 15 acres on the slopes in the vicinity of Bonita Creek channel.	Installed 17.94 acres along Bonita Channel.	TCA requests concurrence that performance standards have been met.	Acreage planted exceeds minimum required to satisfy this term and condition. However, TCA proposes that 2 acres of this area fulfill Term and Condition No. 5 of Biological Opinion 1-6-94-F-26.	a or b or e
7	Restore 2 acres and preserve 4 acres of CSS in the vicinity of Bonita Reservoir.	Preserved and restored 8.53 acres adjoining Bonita Reservoir.	TCA requests concurrence that performance standards have been met.	Acreage exceeds minimum required to satisfy this term and condition. However, TCA proposes that 2 acres of this area fulfill Term and Condition No. 6 of Biological Opinion 1-6-94-F-26.	a or b or d

[1]a. Habitat is occupied by breeding pairs of gnatcatchers.
b. Service and TCA agree that habitat has the structure and composition of naturally occurring gnatcatcher habitat or fully functional coastal sage scrub.
c. Perfomance standard identified in restoration plan.
d. Total cover by native coastal sage scrub species is at least 70 percent and the vegetation is not being artificially sustained.
e. Habitat is insignificantly different (statistically) from naturally-occurring gnatcatcher habitats or fully functional coastal sage scrub in the San Joaquin Hills.

United States Department of the Interior
Fish and Wildlife Service
Ecological Services
Carlsbad Fish and Wildlife Office
2730 Loker Avenue West
Carlsbad, California 92008

MAR 28 2001

In Reply
Refer To: FWS-OR-1368.2

Macy Cleary-Milan, Deputy Director
Environmental and Planning
Transportation Corridor Agencies
125 Pacifica
P.O. Box 53770
Irvine, California 92619-3770

Re: Transportation Corridor Agencies' (TCA) Ford Road Coastal Sage Scrub Mitigation, Biological Opinion 1-6-93-F-19, Orange County, California

Dear Ms. Milan:

This letter is provided in response to your December 13, 2000, correspondence requesting our concurrence that the TCA has completed coastal sage scrub restoration efforts committed to in association with the extension of Ford Road (presently Bonita Canyon Road). On October 22, 1998, we concurred that one of the components of the restoration program, 0.6-acre Restoration Site B, had met its performance standards. Of interest to TCA is our concurrence regarding the remaining areas being restored, Restoration Site A and the revegetation areas along the side slopes of Bonita Canyon Road.

Subsequent to initiation of TCA's coastal sage scrub restoration efforts, Restoration Site A and revegetation areas south of Bonita Canyon Road have been impacted by placement of a storm drain and a sidewalk in association with development of Newport Beach Planning Area 22. To mitigate for these impacts, The Irvine Company has agreed to restore coastal sage scrub in the temporary impact area and vicinity, provide additional land to the Orange County Natural Community Conservation Plan (NCCP) Reserve System, and debit its Take Authorization. These efforts adequately compensate for the Planning Area 22 impacts, and TCA is not responsible for continuing restoration efforts in these impact areas.

On March 14, 2001, we met on site with TCA and Earthworks Construction & Design to assess achievement of the performance standards for the remaining portions of Restoration Site A and the revegetation areas on the side slopes of Bonita Canyon Road. Based upon the information contained in the 1999 performance monitoring report and our site visit, we concur that Restoration Site A and the revegetation area has successfully met the criteria of the biological opinion. Our concurrence is based on similar native species cover values and diversity of the restoration sites to a reference coastal sage scrub site, previously documented use of Restoration

Site A by a breeding pair of gnatcatchers (LSA 1999), seedling recruitment of sage scrub species within the restoration areas, and our opinion that this area will continue to provide suitable habitat for breeding gnatcatchers.

We appreciate your ongoing efforts to implement the terms and conditions of the Ford Road biological opinion. Should you have any questions please contact William Miller of our office at (760) 431-9440.

Sincerely,

Karen A. Evans

Karen A. Evans
Acting Assistant Field Supervisor

cc: Mark Durham, ACOE

United States Department of the Interior
Fish and Wildlife Service
Ecological Services
Carlsbad Fish and Wildlife Office
2730 Loker Avenue West
Carlsbad, California 92008

In Reply
Refer To: FWS-OR-1610.1

APR 4 2001

Macy Cleary-Milan, Deputy Director
Environmental and Planning
Transportation Corridor Agencies
125 Pacifica
P.O. Box 53770
Irvine, California 92619-3770

Re: Eastern Transportation Corridor Coastal Sage Scrub Restoration at Siphon Reservoir, Orange County, California.

Dear Ms. Milan:

This letter is provided in response to your December 13, 2000, correspondence informing us that performance standards have been met for the 112-acre coastal sage scrub restoration site surrounding Siphon Reservoir implemented in association with the Eastern Transportation Corridor (ETC). Term and condition number two of our biological opinion addressing the ETC (1-6-94-F-17) states that "[C]oastal sage scrub habitat shall be deemed to be 'acceptable' if:

a. the habitat is occupied by breeding gnatcatchers; or

b. the Service and the Federal Highway Administration or its agents unanimously agree that the habitat has the structure and composition of naturally-occurring gnatcatcher habitat or fully functional coastal sage scrub; or

c. the Federal Highway Administration or its agents can demonstrate, to the satisfaction of the Service, that the habitat is insignificantly different (statistically) from naturally-occurring gnatcatcher habitats or fully functional coastal sage scrub in the Lomas de Santiago."

On March 14, 2001, we met on site with Transportation Corridor Agencies' (TCA) and Earthworks Construction & Design to view the restoration area and review the performance standards.

Coastal California gnatcatcher (*Polioptila californica californica*, "gnatcatcher") monitoring from mid-March to August 2000 documented 15 pairs of gnatcatchers within the restoration site (LSA Associates, Inc., 2000a). Eleven to 12 of those pairs successfully bred and fledged young.

Vegetation monitoring indicates high cover values for native sage scrub shrubs in Phases I & II of the restoration site (86 percent and 91 percent absolute cover, respectively) (LSA Associates, Inc., 2000b). Also, there appears to be recruitment of coastal sage scrub shrub seedlings within the restoration areas, suggesting that the site is moving towards self sustainability.

Based on these factors, we concur that the performance standards for the Siphon Reservoir coastal sage scrub restoration area have been met. As with the Coyote Canyon coastal sage scrub restoration area, we are concerned about the persistence of a small amount of non-native weedy species on the site (e.g. *Centaurea* sp., *Brassica nigra*) and the need for weed management during 1999/2000. It is possible that, as the site continues to mature, weedy species will be held in check by competition with the native shrubs. But this is difficult to predict.

We are satisfied that long term management of weeds within the Siphon Reservoir site was accommodated by TCA's contributions towards a conservation fund for the management and enhancement of habitat within the Nature Reserve of Orange County (NROC). We trust that TCA, as a member of the NROC Board of Directors, will advocate continued management of its restoration sites.

We appreciate your ongoing efforts to implement the terms and conditions of the ETC biological opinion. Should you have any questions, please contact William Miller of our office at (760) 431-9440.

Sincerely,

Karen A. Evans

Karen A. Evans
Acting Assistant Field Supervisor

cc: Mark Durham, ACOE
Glenn Clinton, FHWA

Citations:

LSA Associates, Inc., 2000. *Annual report on California gnatcatcher nesting studies on the Eastern Transportation Corridor-2000.* Unpublished report prepared for Eastern Transportation Corridor Agency, Irvine, California.

LSA Associates, Inc., 2000. *2000 Eastern Transportation Corridor Siphon Reservoir coastal sage scrub performance monitoring report.* Unpublished report prepared for Eastern Transportation Corridor Agency, Irvine, California.

United States Department of the Interior
Fish and Wildlife Service
Ecological Services
Carlsbad Fish and Wildlife Office
2730 Loker Avenue West
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JAN 1 2 2000

Glenn Clinton
Program Delivery Team Leader
Federal Highways Administration
980 Ninth Street, Suite 400
Sacramento, California 95814-2724

Re: San Joaquin Hills Transportation Corridor Monitoring Reports, Orange County, California (1-6-00-FTA-11)

Dear Mr. Clinton:

We have received a letter dated October 6, 1999, from the Transportation Corridor Agencies (TCA) pursuant to biological opinion 1-6-93-F-98R for the San Joaquin Hills Transportation Corridor in Orange County, California. This biological opinion was issued to Federal Highways Administration on January 28, 1994. Monitoring reports attached to the letter included the; 1) *1999 Coyote Canyon Coastal Sage Scrub Mitigation Performance Monitoring Report* dated September 1999, 2) *1999 Avifauna Monitoring Report for the San Joaquin Hills Transportation Corridor Revegetation and Restoration Areas* dated August 1999, and 3) *San Joaquin Hills Toll Road Coastal Sage Scrub Slope Mitigation Performance Monitoring Report* dated September 1999.

The Coyote Canyon monitoring report evaluated the establishment of coastal sage scrub at Coyote Canyon Landfill after 5 years. The TCA has requested our concurrence that the 91-acre, coastal sage scrub, mitigation site in Coyote Canyon has achieved the performance criteria set forth in Term and Condition # 2 and #4 of the subject biological opinion. On May 5, 1999, representatives from our office met with the TCA to evaluate the Coyote Canyon mitigation site. As outlined on page 24 our opinion, the coastal sage scrub revegetation site shall be considered acceptable if the "habitat is occupied by breeding gnatcatchers." In 1998, 2 pairs of gnatcatchers successfully fledged eight young on the mitigation site. In 1999, the number of breeding gnatcatcher pairs on the mitigation site increased to 12 breeding pairs and a total of 40 fledglings. Based on the above survey information and our site visit, the 91-acre Coyote Canyon Landfill site achieves the criteria of being occupied by breeding gnatcatchers.

Despite the successful breeding of gnatcatchers on site, we remain concerned about the long-term viability of the mitigation site. The average percent cover of alien species at Coyote Canyon Landfill consists of 41 percent of non-native annual grasses and 35 percent of *Melilotus indicus*. Maintenance of the site in 1999 included target weeding of *M. indicus* and *Medicago polymorpha* over approximately 40 acres. We are concern that the site may be overtaken by alien weeds once monitoring and maintenance of the site lapses. The site is bordered by the transportation corridor to the east and ongoing residential development to the west. As a result, the site likely is susceptible to a continuing invasion of alien plants associated with the adjacent roadway and residential development. In addition, we are concerned about the degradation of habitat from future gas collecting activities (e.g., relocation of gas wells) that are likely to occur given the nature of a settling landfill. Though we understand that habitat disturbed by gas collection activities will be revegetated by landowner pursuant to the measures set forth in the Orange County Central/Coastal Natural Community Conservation Plan, we remain concerned about the long-term integrity of the landfill site as gnatcatcher breeding habitat.

To maintain the current value of the site and promote the long-term viability and function of the created coastal sage scrub in the future, we expect that the Coyote Canyon Landfill will receive perpetual management as outlined in Term and Condition #1 of the our biological opinion. Per this term and condition, a conservation fund was established to guarantee the perpetual management of the gnatcatcher and cactus wren in the "action area" of the transportation corridor. As described on page 24 of the biological opinion, the conservation fund shall be used for management measures or additional habitat restoration/enhancement measures. Because the Coyote Canyon Landfill is within the action area of the transportation corridor, we maintain that the allocation of funds for the perpetual management of the site is appropriate. Remedial measures (e.g., weeding, replanting) shall be implemented as needed. Though we concur that the 91 acres on Coyote Canyon Landfill has successfully met the criteria of our the biological opinion, this concurrence is based on our understanding that the conservation values of the site will be protected in perpetuity per Term and Condition #1.

Thank you for your continued cooperation regarding this biological opinion. If you have any questions, please contact Annie Hoecker at (760) 431-9440.

Sincerely,

Jim A. Bartel
Assistant Field Supervisor

cc: Laura Coley-Eisenberg, TCA
Tim Neely, NROC
Tom Halter, GRS

4/26 Lisa Fup JF

United States Department of the Interior
Fish and Wildlife Service
Ecological Services
Carlsbad Fish and Wildlife Office
2730 Loker Avenue West
Carlsbad, California 92008

OCT 22 1998

Laura Coley Eisenberg
Principal Environmental Analyst
Transportation Corridor Agencies
201 E. Sandpointe Avenue, Suite 200
Santa Ana, California 92799-8870

Subject: Ford Road Coastal Sage Scrub Mitigation Performance Monitoring Report, Orange County, California (1-6-98-TA-141)

Dear Ms. Eisenberg:

This letter confirms our receipt of the third annual performance monitoring report for the Ford Road coastal sage scrub (CSS) mitigation sites dated August 1998. This report evaluated the progress of two restoration sites, both of which cover 0.6 acres. After 3 years of monitoring, the Transportation Corridor Agencies (TCA) have requested our concurrence that Restoration Site B has successfully achieved the performance criteria as outlined in the biological opinion, 1-6-93-F-19.

On October 7, 1998, representatives from our agencies met to evaluate the Ford Road CSS restoration sites. Based upon the information in the report and our site visit, we concur that Restoration Site B has successfully met the criteria of the biological opinion. This conclusion is based on the following:

1. The cover and species diversity on-site compares to high-quality CSS in the project vicinity.

2. A pair of coastal California gnatcatchers nested in the vegetation in 1998.

3. The site demonstrates the ability to be self-sustaining because it has not received significant maintenance since 1996.

We are pleased with the successful restoration of Site B. If you have any questions, please contact Annie Hoecker of my office at (760) 431-9440.

Sincerely,

Jim A. Bartel
Assistant Field Supervisor

cc: Fari Tabatabai, ACOE

ASSESSMENT OF THE CURRENT STATUS IN CALIFORNIA

CALIFORNIA GNATCATCHER *(POLIOPTILA CALIFORNICA)*

POPULATION ESTIMATES AND CONSERVATION STATUS

Submitted to:

Nossaman, Guthner, Knox and Elliott, LLP

Prepared by:

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LSA Project No. NGK230

LSA

May 2007

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TABLES

EXECUTIVE SUMMARY

In 2004 LSA Associates, Inc. (LSA) first compiled information concerning nesting California gnatcatcher numbers and distribution in California, and the conservation status of lands occupied by gnatcatchers. This information was entered in a Geographic Information System that was used to help estimate the Statewide population of gnatcatchers and to summarize the species' conservation status. This effort was repeated in 2007 to refine county estimates and to reaffirm the Statewide estimate of 5,000 to 6,000 pairs. In 2007, approximately 60 to 69 percent of the gnatcatchers are in areas that are conserved or very likely to be conserved, with an additional 9 to 11 percent in areas that are still subject to planning under the Habitat Conservation Plan/Natural Communities Conservation Plan (HCP/NCCP) process. Assuming that at least half of the gnatcatchers in the pending HCP/NCCP planning areas are ultimately conserved, the total conserved portion of the California population would range from 66 to 73 percent.

INTRODUCTION

In 2004 LSA Associates, Inc. (LSA) attempted to compile as much information as available about the distribution of nesting California gnatcatchers *(Polioptila californica)* in California. That information was installed in a Geographic Information System (GIS) to compare land use data and vegetation distribution to produce an estimate of the average number of birds residing in the State. That estimate was compared to various Statewide estimates made previously. In addition, LSA compiled available information on the conservation status of the locations where these birds occurred. LSA repeated those exercises with information current to early 2007. This paper discusses the methodology and findings for these assessments.

METHODOLOGY

POPULATION ESTIMATES

Sources of Information

GIS. Three electronic data sets formed the core of LSA's database. These are maintained by the United States Fish and Wildlife Service (USFWS), the California Department of Fish and Game (CDFG), and the County of Riverside.

Foremost of these data sets was the GIS maintained by Tony McKinney and others at the Carlsbad office of the USFWS (occurrence information for multiple species within jurisdiction of the Carlsbad Fish and Wildlife Office, accessed in May 2004 and April 2007). The great majority of information included was gleaned from protocol survey reports submitted to the USFWS since 2000 and is mapped at the scale of individual bird or pair locations or territories. All of the California gnatcatcher's range in California is under the jurisdiction of the Carlsbad office with the exception of Ventura County.

The CDFG in Sacramento maintains the *California Natural Diversity Database* (CNDDB; commercial version, May 2, 2004). Ultimately, all of the information in the USFWS GIS should be included in the CNDDB as well, often in a more generalized manner. At present, though, the CNDDB lags far behind in this most current information. However, the CNDDB is much more complete in terms of historical information.

As part of the Western Riverside County Multiple Species Habitat Conservation Plan (MSHCP), Dudek Associates developed a database of California gnatcatcher locations in Riverside County (County of Riverside, February 15, 2002) that largely overlaps the other two data sets. Nevertheless, a considerable amount of information was added to LSA's pool of information from this source.

Our 2007 GIS update was based only on the USFWS database. To our knowledge the MSHCP database has not been updated and the CNDDB should not have received any new information not also received by USFWS.

Unpublished Reports. In 2004 LSA reviewed all of the gnatcatcher survey reports from 1994 to 2003 that were provided for examination at the Carlsbad field office by Doug Miles and the USFWS support staff. With few exceptions, these were protocol survey reports. Certain reports in use by USFWS personnel or others were not available. According to Mr. McKinney, at the time of LSA's 2007 analysis the USFWS database included data from all protocol reports received through about February 2007.

A number of reports more general in nature—usually wider in geographic scope—that are possessed by LSA were also examined. Most important among these were the monitoring reports prepared by Robert A. Hamilton for the Nature Reserve of Orange County (Target Bird Monitoring Studies, 1999–2001, 2002, and 2003). These included five annual population estimates for the entire Central and Coastal subregions of the 37,350+-acre Nature Reserve of Orange County.

Personal Communication and Professional LSA Knowledge. LSA consulted with many individuals in compiling its GIS and analyzing the information therein. Ventura County information was provided by USFWS biologist Rick Farris; Dr. Walter Wehtje of California State University, Northridge; and Forma Design, Inc., working on behalf of Newhall Ranch. Kimball L. Garrett of the Natural History Museum of Los Angeles County discussed gnatcatcher populations in the county of his expertise, as did Robert L. McKernan, director of the San Bernardino County Museum. Mr. McKernan also commented on the gnatcatcher situation in Riverside County. Mr. Hamilton discussed the particulars of his Orange County work. LSA's understanding of San Diego County gnatcatchers benefited from input from Philip Unitt, bird collections manager of the San Diego Museum of Natural History and compiler of the San Diego Bird Atlas and USFWS biologist Peter Beck. More general discussions concerning gnatcatcher populations involved USFWS biologists Clark Winchell and Kevin Clark. The input from the above individuals was critical in LSA's analysis, but none of the results should be considered the opinion of any of those listed here, unless specifically cited as such.

LSA's database also incorporated gnatcatcher location information known by LSA biologists, primarily in coastal Orange County and southwestern San Diego County.

Scientific Literature. Published scientific literature was also consulted in LSA's analysis, but most of the published literature concerning gnatcatcher locations was already included in the three GIS sources. One exception was the San Diego County Bird Atlas (Unitt 2004, see Table A), published after LSA's 2004 analysis and not yet incorporated in the USFWS database.

Condensation of Information

Combining the information from all of the data sources resulted in a data set including many more localities than were eventually used in the final estimates. The original combined data set of approximately 5,300 entries in 2004 (many representing multiple pairs of gnatcatchers) was reduced in the following ways.

Duplicate and Overlapping Data. A single gnatcatcher territory (a better term to use than "pair" when discussing points on the ground over time) might be represented by several GIS entries. Territories were sometimes represented in each of the three original GIS data sets. Within the three data sets, a single territory might be entered multiple times if surveys were done in the same area over multiple years. Surveys often overlapped in coverage, occasionally even in the same year.

In 2004 LSA examined all of the data to eliminate what were considered to be multiple entries for the same territories. In so doing, LSA generally used the most recent data but always used what were considered to be the most complete, or accurate, data. See under *Annual Variation* below for an explanation of which data were used when multiple years of equally valid surveys were available. Data from 2004–2007 were not used for any sites already covered in the 2004 analysis.

In several areas, individual territory counts were superseded by counts of much larger areas (e.g., Camp Pendleton, Fallbrook Naval Weapons Station) or estimates for large areas based on extensive surveys as part of a specific study design (i.e., Nature Reserve of Orange County).

Accuracy of Information. Geographic information insufficiently precise was excluded from LSA's mapping process. In the USFWS GIS, this information included sites identified with PCODE values of 3 or higher (i.e., location information accuracy exceeding 500 meters).

In a few cases, LSA was not convinced of the validity of gnatcatcher reports from areas where others have not confirmed their presence. These sites were primarily on the fringe of the bird's range in Los Angeles County.

Urbanization. In 2004 the map of existing territories was further reduced when overlaid with a U.S. Forest Service map of urbanization and vegetation types in Southern California (California Resources Agency Legacy Project, June 2002). This was LSA's attempt to discount known gnatcatcher territories in recently developed areas. This information was double-checked in areas familiar to LSA, because gnatcatchers often occur in close proximity to developed land, and territories were occasionally incorrectly flagged as being in urban zones. In some other cases, aerial photographs were consulted to confirm the results of this exercise, but this was not possible in most areas.

High quality aerial photographs taken in 2006 were available for review in 2007. Many gnatcatcher territories counted in 2004 were on land now found to be cleared or developed. When comparing aerial photos, gnatcatcher point data often fell on the edges of developed areas. When considering whether to include or delete such points, the pattern of points in the immediate area was important to consider. Often it was clear that points were slightly misplaced. Lacking a pattern of points nearby, consideration was made of the fact that gnatcatcher territories are larger in inland areas than near the coast. Also, points were more likely to be removed when large disturbances were involved rather than small ones. Points on the edges of small or isolated patches of habitat were more likely to be removed than points on the edges of large blocks of habitat.

Historical Sites. Historical gnatcatcher locations are included in the CNDDB and western Riverside County GIS. Without exception, LSA did not include these locations in the final map unless there was confirmation since about 1990, when conservation interest in the species expanded greatly and most parts of the bird's range came under scrutiny.

Interpretation of Information

Number of Birds/Territories. Much of the raw information accumulated by LSA included counts of birds. Unless specified as adults or pairs, counts in the nesting season were generally divided by five or six, the typical size of family groups involving one pair. In a few cases, information obtained late in the season, when young of the year wander widely, was so imprecise that large numbers of birds had to be disregarded for mapping purposes. For the same reason, reports of single birds—or multiple birds actually identified as young of the year—at far-flung locations in the latter half of the year were not included for mapping purposes.

Many reports listed only one member of a pair. Nevertheless, LSA considered these as pairs (or territories) because unmated adults are very rare, especially on territory. In almost all cases, LSA believes that the other member of the pair was simply not detected.

Annual Variation. California gnatcatchers are known to vary widely in population density. (Atwood, J. L. and D. R. Bontrager 2001. California gnatcatcher *Polioptila californica*. The Birds of North America 574:1–32.) This is believed to result from a complex interaction of productivity and mortality driven primarily by weather conditions, especially rainfall. A conservative estimate is that twice as many birds are present in "good" years as in "bad." When multiple years of survey data of equal quality were available, LSA avoided using numbers from "good" or "bad" years, instead using numbers from "average" years whenever possible. Otherwise, LSA made no attempt to disregard data from any year, believing that the overall numbers would average out in an analysis as large as LSA's.

Extrapolation of Information

Once numbers were provided for each county by GIS, LSA used best professional judgment in a final interpretive exercise. In 2004 a comparison of the gnatcatcher location map to the U.S. Forest Service map for coastal scrub (California Resources Agency Legacy Project, June 2002) was useful. Although historical location data had not been used previously, those data were then taken into account. For our 2007 analysis, gains and losses in the number of gnatcatcher territories in the GIS were noted in reconsidering our 2004 estimates. The estimate for each county is of the number of pairs LSA believes are present during years of average population density. The 2004 process for each county is explained in more detail below, followed by a discussion of our 2007 adjustments.

Ventura County. This represents the northwestern extent of the species' range, and there is relatively little information available. Although there is a large amount of potentially suitable habitat available, much of it is under private ownership, and little is known about it. Gnatcatchers are clearly not as common or widespread as to the southeast. Gnatcatchers are now known only from the Moorpark area and points eastward, because they have not been found recently at several other historical locations. LSA's 2004 estimate of more than double the known population was probably conservative given the amount of similar habitat that has not been surveyed.

Los Angeles County. Los Angeles is the one county where our 2004 population estimate did not exceed the number actually recorded. This is because of a long history of investigation coupled with a limited amount of suitable habitat. Seemingly suitable habitat is present in the Santa Monica Mountains and the Santa Clarita area, but only recently have individuals been detected in the latter area, and the species remains unconfirmed in the former.

San Bernardino County. California gnatcatchers have been recorded at numerous locations in the southwestern portion of the County, but the species is at the periphery of its range there and is clearly rare and local. Many records away from the Jurupa Hills appear to have been temporary in nature. LSA's 2004 estimate for the County may have been conservative but was based on the extent of scrub available and the widely dispersed pattern of recorded pairs.

Orange County. In contrast to the highly urbanized northwestern half of the County, many gnatcatchers inhabit the southeastern half. LSA identified hundreds of gnatcatcher locations in the County, but more than half of LSA's 2004 County estimate was based on the population estimates made for the 37,350-acre Nature Reserve of Orange County every year from 1999 to 2003. Reanalysis of those estimates to account for partial territories may reduce the outcomes by approximately 15–20 percent (R. A. Hamilton pers. comm., May 2004). Because this information is relatively imprecise, LSA was conservative in its estimate, despite the large expanse of potentially suitable, but unsurveyed habitat in the southernmost portion of the county.

Riverside County. In western Riverside County, numerous gnatcatcher surveys have been conducted in connection with planning activities. As a result, nearly 900 gnatcatcher territories were identified in our 2004 analysis. When estimating the County total, LSA attempted to account for the amount of unsurveyed suitable habitat remaining, primarily northeast of the Murrieta/Temecula area.

San Diego County. The San Diego Bird Atlas project, gnatcatcher surveys of military lands, ongoing HCP/NCCP planning activities, and gnatcatcher surveys conducted for other development projects had resulted in a good understanding of gnatcatcher distribution in the County by 2004. LSA's population estimate took into account the amount of unsurveyed scrub remaining, primarily along the base of the mountains in the less developed portions of the County and an undisclosed number of pairs at Miramar Naval Air Station.

California. LSA's 2004 estimate of the average number of gnatcatchers Statewide was generalized and reduced from the total obtained by adding all of the County estimates. This was in keeping with what LSA believed was a conservative—but realistic—analysis.

2007 Adjustments. Most of the changes in our GIS numbers were small enough to fall within the buffer of uncertainty in our 2004 estimates. Our population estimates were reduced only in San Bernardino and Riverside Counties, in no counties were they increased.

We made no changes for Ventura County in the GIS, but added two territories in Los Angeles County. Therefore we left our 2004 population estimates for those counties unchanged. The July 2006 observation of a wayward individual near Gorman in extreme northwestern Los Angeles County suggests there is more to know about gnatcatcher distribution at the northern extent of the range.

In the GIS we added one territory and removed three in San Bernardino County. Nevertheless, our 2007 estimate is down 10 pairs from 2004 based on the amount of habitat lost, primarily in the Rancho Cucamonga/Fontana area.

We left our Orange County population estimate unchanged based on GIS additions of 38 territories and removal of 20. (Note that we discovered a 57-territory double count in our 2004 analysis).

Riverside County showed the most habitat loss (158 GIS deletions, 37 additions), prompting a 200 pair reduction in our 2007 County estimate.

San Diego County received the most GIS additions (168), but we also deleted 87 territories. Both figures are relatively minor compared to the number of pairs estimated in 2004. Our estimate for 2007 remains the same.

Despite the 210 pair reductions described above (based on 256 GIS additions and 278 deletions), we made no change to our 2004 Statewide population estimate. This was because of the necessary imprecision in our estimates, based largely on the dynamic nature of gnatcatcher populations.

CONSERVATION STATUS

The conservation status of various lands within the range of the California gnatcatcher was compiled from the following GIS data base sources:

- State of California: CASIL, 2002
- Department of Fish and Game: CASIL, 1984, 2004
- County of San Diego: SanGIS, 1996, 2001
- County of Riverside: MSHCP, 2004
- County of Orange, 1998, 2007
- USFWS Proposed Critical Habitat, 2003
- USFWS Carlsbad Fish and Wildlife Office, 2007
- Puente Hills Landfill Native Habitat Preservation Authority, 2003

These lands were then divided into a matrix of conservation status and HCP/NCCP status, in order to provide perspective on the conservation status of the estimated California gnatcatcher population. The following conservation categories were used in this matrix:

- *Conserved*: This category includes approved and permitted HCP/NCCP planning areas designated for conservation and government owned lands designated for conservation. Pending HCP/NCCP areas are included under a separate 4(d) special rule category as described below. The conserved category includes the following;
  - Identified HCP/NCCP habitat reserves that have been acquired by government agencies or are otherwise secure through an HCP/NCCP Implementation Agreement, such as the Nature Reserve of Orange County in the Central/Coastal Orange County HCP/NCCP
  - Land controlled by nongovernmental conservation organization (e.g., The Nature Conservancy, Santa Monica Mountains Conservancy) either through ownership or easement
  - Military bases, which have a natural resources management plan
  - Other government land designated for conservation, such as local regional parks, State Parks, National Forest, Bureau of Land Management (BLM) conservation areas, etc.
- *Identified Criteria/Conservation Areas*: These areas are targeted for conservation by the approved multispecies HCP/NCCPs that will be implemented over time through the acquisition of habitat in conjunction with future development in authorized areas. While these areas are not currently as

secure as the previous category, there is a reasonable expectation by local agencies and the USFWS that high percentages of these areas will be permanently conserved over time, in conjunction with development of less valuable habitat. For purposes of this analysis, the total numbers of gnatcatcher pairs expected to be conserved were adjusted to reflect the percentages of conservation that can be estimated from the respective plans. That is, for the San Diego MSCP, it was estimated that overall, 65 percent of known California gnatcatcher localities would be preserved. For the Southern Orange County HCP/NCCP, it was estimated that 83 percent of known California gnatcatcher localities would be preserved in the Rancho Mission Viejo area (Subarea 1). For the Western Riverside County MSHCP, there is no statement of likely percentage of gnatcatcher localities that would be preserved. Instead, a range of likely preservation was calculated based on the following two approaches: (1) all of the identified conserved areas, plus approximately 67 percent of the coastal sage scrub habitat in Criteria areas would be preserved; or (2) a total of 55 percent of primary habitats for the species would be preserved. For example, the MSCP and MSHCP were estimated in this study to contain 336 pairs and 366 pairs, respectively, in areas that are targeted for conservation but not yet conserved. Since only a portion of these conservation areas will actually be conserved, these totals were decreased to correspond with the overall conservation goals of the multispecies plans. In both cases, this is a conservative assumption, because it is likely that coastal sage scrub with gnatcatchers is more likely to be conserved than unoccupied coastal sage scrub.

- *Existing Use/Section 9 Protection*: These areas can be divided further into the following two subcategories:
  - Within the central/coastal Orange County HCP/NCCP, there are identified "Existing Use" areas, which are neither conserved nor authorized for development. These primarily are on land owned by nonparticipants in the HCP/NCCP process. Take of California gnatcatcher in these areas is only authorized pursuant to Section 7 or Section 10, in conjunction with additional conservation measures for the species.
  - All areas outside of HCP/NCCP planning areas are also placed in this category, unless they are in the "Conserved" category above.
- 4(d) Special Rule: This category includes all land that is in the HCP/NCCP subregions for which final HCP/NCCP plans are in preparation. Take of California gnatcatcher in these areas is authorized only to the extent that it is in conformance with the 4(d) Rule for the HCP/NCCP Interim Habitat Loss process Conservation Guidelines:
  - The loss of coastal sage scrub habitat will not cumulatively exceed five percent of the coastal sage scrub in the subregion, and the proposed.
  - The habitat loss will not preclude connectivity between areas of high habitat values.
  - The habitat loss will not preclude or prevent preparation of the subregional HCP/NCCP.
  - The habitat loss has been minimized and mitigated to the maximum extent practicable.
- *Authorized Development*: For purposes of this analysis, authorized development is assumed to be all areas in approved HCP/NCCP plans that are not in one of the first three categories above. In the central/coastal Orange County, this includes both authorized development by participating landowners and land outside the HCP/NCCP Reserve that is owned by nonparticipating landowners. In the latter case, a mitigation fee must be paid to obtain authorization for take. In the San Diego MSCP and Western Riverside County MSHCP and South Orange County

HCP/NCCP, it is assumed for this analysis that all areas outside of the Conserved or identified Criteria/Conservation areas will ultimately be developed. Of course, this development would require compensatory mitigation, i.e., conservation of other areas. Therefore, this is a conservative assumption, since it likely that some of this land will never be developed. In addition, it is assumed that the portions of the identified Criteria/Conservation areas that are not ultimately conserved, as described above, will ultimately be developed. Consequently, the numbers of gnatcatchers that actually occur outside of Criteria/Conservation areas were adjusted upward in amounts corresponding to the downward adjustments in the Criteria/Conservation areas.

Using GIS software, the California gnatcatcher locations assembled for the population estimate were overlain with the above conservation status categories and HCP/NCCP status map to derive a summary of the conservation status of the mapped gnatcatchers. The numbers of gnatcatcher pairs in Conservation/Criteria areas and authorized development areas were adjusted downward and upward, respectively, as described above. This analysis was then used to derive estimated percentage ranges for various categories of conservation, which can be extrapolated to the generalized population estimates. In addition to the conservatism built into the analysis of mapped localities, the overall extrapolation of conserved gnatcatchers would also be conservative, because the portions of the population estimates that are not represented by mapped California gnatcatcher locations are likely to be in more remote areas that have not been surveyed and are less likely to be developed.

RESULTS

POPULATION ESTIMATES

Table A shows LSA's 2004 and 2007 estimates for the average number of California gnatcatcher pairs nesting in California and each of the six occupied Counties. Also shown are the raw numbers from LSA's GIS analyses, the number from which the extrapolations were made. In addition, previous estimates of California gnatcatcher numbers in California are shown. Population estimates for California have almost consistently risen since Jonathan Atwood attempted the first in 1980. Further studies and more surveys have significantly increased LSA's knowledge of the species and its distribution. Many birds are present at mitigation sites that did not exist 12–15 years ago, and more will occupy additional new and planned mitigation sites as well as preserved areas where habitat enhancement is occurring.

CONSERVATION STATUS

The current conservation status of the mapped California gnatcatchers represented in LSA's GIS analysis, as described above, is divided by category and HCP/NCCP status in Table B. Since 2004, the following changes to HCP/NCCP status occurred;

- The Western Riverside County MSHCP was approved at the State and federal level (previously only locally approved).
- The Southern Orange County HCP/NCCP was approved at the local and federal level (previously pending). The South Orange County HCP/NCCP was not approved by the State (CDFG).
- The North San Diego Subarea Plan was locally approved (formerly pending) and is pending State and federal approval.
- The Palos Verdes Peninsula HCP/NCCP was locally approved (previously pending) and is pending State and federal permits.

In summary, in 2007, approximately 60 to 69 percent of the total estimated population of California gnatcatchers occurs in areas that are already conserved or highly likely to be conserved. Another 9 to 11 percent occurs in pending HCP/NCCP areas, and a high percentage of these will ultimately be conserved permanently. If only half of the gnatcatchers in the pending HCP/NCCP planning areas are ultimately conserved, the total conserved portion of the California population would range from 66 to 73 percent. Approximately 8 to 10 percent of the known gnatcatchers occur in areas for which no take authorization or permanent conservation has occurred. Approximately 15 to 18 percent of the population occurs in areas that are likely to be developed.

Table A: Coastal California Gnatcatcher Population Estimates (pairs)

	Atwood 1980	Atwood 1990	MBA 1991	Atwood 1992	USFWS 1993	USFWS 1996, including birds authorized for take	USFWS 1996, excluding birds authorized for take	USFWS 1999 updates	Atwood and Bontrager 2001	Others	Raw data, this study [2004 in brackets]	Est. averages, this study, [2004 in brackets]
California	1,000–1,500	1,200–2,000 (reduced from 1819–2262)	1,645–1,880	1,811–2,291	2,562	3,430	2,899		3,035	URS 2001: nearly 5,000[3]	4,156–5,466 [4,402–5,712]	5,000–6,000 [no change] (5,300±1,105) [(5,510±1,165)]
Ventura	30					2	2	4	4		21–23 [no change]	40±20 [no change]
Los Angeles	130	54–67	20–30	24–30	30	60	59	120–148[1]	144		98–126 [96–124]	120±25 [no change]
San Bernardino	50					10	10	27[2]	27		35 [37]	40±15 [50±20]
Orange	325	240–298	325–350	224–284	757	908	643		643	Hamilton 2003, NROC reserve only: 717–1,435	1,432–2,197 [1,414–2,179]	1,800±400 [no change]
Riverside	400	755–939	300–400	724–916	261	344	268	300	300	Dudek: ~290 data points	763 [884]	900±250 [1,100±300]
San Diego	400	770–958	1,000–1,100	839–1,061	1,514	2,106	1,917		1,917	Mock 2004: 2000+	1,974–2,489 [1,893–2,408]	2,400±400 [no change]

1 Based on Palos Verdes Peninsula numbers varying naturally from 31 to 59 pairs in the latest surveys.
2 Includes 13 individuals (not pairs) authorized for take.
3 URS cited USFWS (2000; two references listed) for this31–59 number, but LSA has been unable to confirm this report.

SOURCES

Atwood, J. L. 1980. The United States distribution of the California black-tailed gnatcatcher. Western Birds 11:65–78.

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Table B: Distribution of Estimated California Gnatcatcher Population (pairs) by Jurisdiction and Conservation Status

Conservation Status	Jurisdiction, HCP/NCCP Status							
	Approved HCP/NCCPs				Locally Approved HCP/NCCP			
	Orange County Central/ Coastal	San Diego MSCP	Western Riverside MSHCP	Southern Orange County	San Diego North and MSCP North	Palos Verdes Peninsula	Non-HCP/ NCCP Areas	TOTALS [2004 in brackets]
Conserved[1]	767–1,532	321	148	154	7	–	703–1,218	2,100-3,380 [1,940–3,220]
Identified Criteria/ Conservation Area	–	220	231–320	–	–	–	–	451-540 [452–541]
Subtotal Conservation	767–1,532	541	379–468[2]	154[3]	7	-	703–1218	2,551-3,920 [2,392–3,761]
Existing Use/Section 9 Protection	79	-	-	97	-	-	267–269	443-445 [346–348]
4(d) Special Rule Protection	–	22	–	-	433	31–59	–	486-514 [783–811]
Authorized Development[4]	118	287	295–384	54	–	–	–	754-843 [792–881]
Total [2004 in brackets]	964-1729 [969–1,734]	850 [777]	674 -852 [884]	305 [339]	440 [430]	31–59 [no change]	970-1,487 [972–1,489]	4,234-5,722 [4,402–5,712]

1 Includes implemented HCP/NCCP conservation areas, conservation organization ownership or easements (e.g., The Nature Conservancy), military bases, and other government-owned land designated for conservation.

2 There is no specific estimate of percentages of gnatcatchers that would be preserved under the MSHCP. The range estimated here is based on the following two approaches: (1) conservation of 55 percent of the primary habitats for the species within the entire plan area (MSHCP Volume II-B, Coastal California Gnatcatcher Species Account, Table 1); and (2) conservation of 67 percent of the Criteria Areas. Both approaches assume that preservation of gnatcatchers will be directly proportional to preservation of habitat, which is a conservative assumption (i.e., in practice occupied habitat will likely be conserved at a higher rate than unoccupied habitat).

3 Specific data regarding pairs of gnatcatchers that would be preserved under the Southern Orange County HCP/NCCP are not available. Conservation status is based on percentage estimates in the Southern Orange County HCP. The estimate here is based on the following assumptions (1) 83% of pairs would be conserved in Rancho Mission Viejo (Subarea 1), (2) 100% of pairs in Coto de Caza (Subarea 3) would be in areas of permitted development, (3) All other areas in the South Orange County HCP/NCCP are not permitted for take and would be protected under Section 9 of the ESA.

4 Identified non-conservation areas and estimated non-conservation areas (per footnote 2, above) in approved HCP/NCCP areas.

LSA

FIGURE 1

Legend

- Proposed USFWS California Gnatcatcher Critical Habitat
- Habitat Conservation Plan Areas
- California Gnatcatcher Pair Locations
  - 1 to 17 Pairs
  - 18 to 48 Pairs
  - 49 to 79 Pairs
  - 80 to 1,135 Pairs

Conservation Ranking

Highest to Lowest

- Conserved (Includes implemented NCCP and Conservation Easements)
- Military Integrated Natural Resources Management Plan
- Identified Criteria / Conservation Areas
- Existing Use / Section 9 Protection
- 4(d) Special Rule Protection
- Authorized Development

California Gnatcatcher

Conservation Status Map

BonTerra
CONSULTING
An Environmental Planning/Resource Management Corporation

151 Kalmus Drive
Suite E-200
Costa Mesa
California 92626
(714) 444-9199
(714) 444-9599 fax
www.bonterraconsulting.com

August 7, 2007

Ms. Maria Levario
Acting Director, Environmental and Planning
Transportation Corridor Agencies
125 Pacifica
Irvine, CA 92618

VIA EMAIL AND MAIL
levario@sjhtca.com

Subject: Vegetation Shading Analysis for the Proposed San Mateo, San Onofre, and San Juan Creek Bridge Structures for the Foothill Transportation Corridor-South Project

Dear Ms. Levario:

This analysis of the potential shading impacts from the preferred alternative is based on the engineering plans of the proposed bridge structures over San Mateo, San Onofre, and San Juan creeks, and previous analysis of shading impacts at two of the bridge locations. Coincidentally, the existing bridges at San Mateo and San Onofre Creeks were evaluated in the "Revised Shading Study Associated with Two Proposed Bridges, Spanning Existing Wetlands on the Marblehead Coastal Site, San Clemente, California", prepared by Glenn Lukos Associates (GLA December 4, 2001). The findings in the GLA document were utilized in support of the California Coastal Commission Coastal Development Permit for the Marblehead Coastal project currently under construction. The following table outlines the existing bridge conditions and the proposed bridge expansions.

The GLA report concluded, based on transect data collected along the southern edge of the creek directly beneath the north-bound bridge and immediately upstream, that the vegetation beneath of the San Mateo Bridge exhibited similar canopy cover compared to those areas outside the shaded areas of the San Mateo Bridge. Resources adjacent, and under, the existing San Onofre Bridge include southern riparian scrub and associated hydrophytic vegetation. In summary, there was no distinguishable difference between areas that were shaded by the bridge structure, or not shaded by the bridge structure. The GLA report did not analyze San Juan Creek; however, findings from the other bridges have been applied to potential impacts at San Juan Creek.

EXISTING BRIDGE CONDITIONS AND THE PROPOSED BRIDGE EXPANSIONS

Creek Crossing	Existing Bridge Length (approx.)	Existing Bridge Width (approx.)	Existing Bridge Height Above Grade (approx.)	Proposed Bridge Length Over USACE Ordinary High Water Mark (approx.)	Proposed Bridge Width (approx.)	Proposed Bridge Height Above Grade (approx.)
San Mateo	500 feet	165 feet (including 30 feet gap between the two separate bridge spans)	55 feet	Southbound Connector – 300 feet, (615 will occur above the existing I-5/San Mateo Creek bridge) Northbound Connector – 920 feet, none of which occurs over the existing I-5/ San Mateo Creek bridge	Southbound Connector – 42 feet wide Northbound Connector – 42 feet	Southbound Connector 82 feet above existing grade, and 28 feet above the I-5 Northbound Connector 43 feet above grade
San Onofre	354 feet	165 feet (including 30 feet gap between the two separate bridge spans)	30 feet	90 feet on both the northbound and southbound lanes	40 feet on both the northbound and southbound lanes	30 feet
San Juan	N/A[1]	N/A	N/A	2,100 feet	91 feet	Maximum/Minimum Height above existing ground = 49.3/41.6 feet

The proposed northbound connector will span San Mateo Creek. At the crossing location, the creek vegetation consists of southern riparian scrub and associated understory vegetation, similar to the vegetation at the existing I-5/San Mateo Creek Bridge. Based on the similarity of the height of the existing I-5/San Mateo Creek Bridge and the proposed northbound connector, it is expected that the construction of the proposed project would not have a measurable impact on the existing riparian vegetation under the proposed northbound connector.

Approximately 960 feet of the southbound connector will similarly not have a measurable impact on the vegetation underneath the connecter based on the comparison of the existing vegetation of the I-5/San Mateo Creek Bridge and those resources that will be bridged by the southbound connector. However, a small segment of the southbound connector will be constructed over the existing bridge structure at the I-5/San Mateo Creek, which would increase the shading in the San Mateo Creek beyond the current conditions. This area of 0.38 acre (42 feet wide, 400 long) would contribute to additional shading within the San Mateo Creek area. However, this is not a substantial increase and therefore, no significant changes to the vegetation community under the southbound connector are expected.

The proposed expansion of the bridge at San Onofre Creek will be similar to the existing I-5/San Onofre Creek Bridge. Based on the similarity of the height of the existing I-5/San Onofre Creek Bridge and the proposed expansion, the construction of the proposed project would not have a measurable impact on the existing riparian vegetation under the proposed San Onofre Creek Bridge.

[1] N/A = not applicable. Bridge does not currently exist.

No bridge currently exists across San Juan Creek in the vicinity of the preferred alternative. The proposed bridge will be approximately 2,100 feet long, and 91 feet wide, and over 49 feet above natural grade at its maximum height. Since the height of the proposed bridge is similar to the existing 1-5 bridge height at San Mateo Creek, there would not be a substantial amount of shading and the minimal amount of shading would not significantly alter the vegetative resources under the bridge.

If you have any comments or questions, please contact me at (714) 444-9199.

Sincerely,

BONTERRA CONSULTING

Ann M. Johnston

Ann M. Johnston
Principal, Biological Services

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~~NF(R)-13233~~
N 6247401RP03233

AGREEMENT OF LEASE

between

STATE OF CALIFORNIA

DEPARTMENT OF PARKS AND RECREATION

and

UNITED STATES OF AMERICA

(Consisting of Part I and Part II)

NF(R)-13233

AGREEMENT OF LEASE

NO. ______________

PART I

INDEX

NF(R)- 1323

AGREEMENT OF LEASE

PART I

THIS NEGOTIATED LEASE between the STATE OF CALIFORNIA, DEPARTMENT OF PARKS AND RECREATION (hereinafter referred to as "Lessee"), whose address is 1416 Ninth Street, Sacramento, California 95811, and the UNITED STATES OF AMERICA (hereinafter referred to as "Government"), consisting of this PART I, and of PART II containing "General Provisions" which is attached hereto and made a part hereof.

WITNESSETH:

WHEREAS, the Government owns and the Department of the Navy has jurisdiction, administration, custody, and control of that certain property known and identified as the U. S. Marine Corps Base, Camp Pendleton, California (hereinafter referred to as "Base"); and

WHEREAS, the Secretary of the Navy has determined that portions of the Base, more particularly described in Article 1 of this Lease, are not excess property, are not for the time being required for continuous military use or for purposes of providing security for the President of the United States, and are available for the use by Lessee for the purposes hereinafter set forth; and

WHEREAS, both parties recognize that all the land comprising Camp Pendleton is vital to the National Security and, with the exception of the "Leased Property" described in Article 1 of this Lease and certain security zones, must be retained exclusively for military training so long as Camp Pendleton is required for the National Defense as a training base for the Marine Corps; and

WHEREAS, this Lease is made under the authority of Section 2667 of Title 10 of the U. S. Code;

NOW THEREFORE, in consideration of the promises and of the terms and conditions hereinafter set forth, the Government and Lessee hereby agree as follows:

ARTICLE I. LEASED PROPERTY

The Government hereby leases to the Lessee certain portions of the Base, Camp Pendleton, California, consisting of three parcels hereinafter called the "Leased Property," said three parcels of land in the County of Orange and the County of San Diego, State of California being portions of fractional Section 25, Township 8 South, Range 7 West San Bernardino Base and Meridian, and portions of Sections 25, 26, 35 and 36, Township 8 South, Range 7 West; Sections 1, 2, 10, 11, 12, 14, 23 and 24, Township 9 South, Range 7 West; Sections 29, 30, 31, 32 and 33, Township 9 South, Range 6 West, Sections 3 and 4, Township 10 South, Range 6 West of Rancho Santa Margarita, according to Record of Survey Map 794, filed January 17, 1940, in the Office of the County Recorder of said San Diego County, more particularly described in Exhibit A and delineated on the map marked Exhibit B bearing the legend "Proposed Lease to State of California, C.F. 8/29/71," both exhibits which are attached hereto and incorporated by reference herein.

(Provided, however, that this Lease shall not be effective as to that area known as the Enlisted Men's Beach and the supporting inland area thereto located in Parcel 2 of Exhibit "A" and specially delineated in Exhibit "B" hereto, and the Government shall have exclusive use of that area and all facilities thereon, unless and until such time as an alternative site mutually acceptable to the Government and Lessee is located; comparable facilities are installed thereon, and relocation to the alternative site is accomplished. Lessee agrees that it shall bear all costs in connection with preparation of and relocation to such alternative site, and all costs incurred in the installation of comparable facilities.)

Provided, ~~further,~~ however, that this Lease shall not be effective as to any portion of the Leased Property which is presently out-leased by the Government for agricultural purposes until such time as such agricultural lease terminates, notice of which will be promptly given in writing by the Local Government Representative to this Lessee in each instance. It is further agreed between the Government and Lessee that upon termination of any existing agricultural lease the Government shall have the right to enter into further agricultural leasing of the area involved, subject to the consent of the Lessee herein in each instance.

ARTICLE 2. TERM

The term of this Lease shall be for a period of fifty (50) years and shall begin on September 1, 1971 and end on August 31, 2021 unless sooner terminated in accordance with the provisions of Article D, or E of PART II of this Lease.

ARTICLE 3. USE

The Leased Property shall be used, maintained, protected and preserved by the Lessee in accordance with good management practices as a public park and not otherwise, such use to include any incidental uses that arise out of or are related to public recreation.

Provided, however, that the operation of all facilities on the Leased Property shall be conducted without regard to race, color, religion, or national origin, and any form of segregation or discrimination on the basis of race, color, religion, or national origin, in the operation of any of said facilities shall be deemed good and sufficient grounds upon which to effect a termination of this Lease.

ARTICLE 4. RENT

The Lessee shall pay to the Government as rent for the use of the Leased Property the sum of One Dollar ($1.00) for the term of this Lease, receipt of which is hereby acknowledged.

ARTICLE 5. LOCAL GOVERNMENT REPRESENTATIVE

The Commanding Officer, Western Division, Naval Facilities Engineering Command, San Bruno, California 94066 (or his successor) is hereby designated as Local Government Representative, and shall,

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under the direction of the Commander, Naval Facilities Engineering Command, acting under the direction of the Secretary of the Navy, Washington, D. C., be responsible for the administration of this Lease, and shall exercise general supervision thereof insofar as the interests of the government are concerned, provided, however, that the Lessee agrees to consult with, and obtain the approval of, the Commanding General, Marine Corps Base, in any and all matters affecting the administration, mission or security of the Marine Corps Base, Camp Pendleton, including, but not limited to, the matters set forth in Part II of this Lease.

ARTICLE 6. PRIOR LEASE

This Lease supersedes the Lease between the same parties hereto dated March 30, 1971 and designated NF(R)-11681.

ARTICLE 7. EXECUTION

IN WITNESS WHEREOF, the parties hereto have duly executed this Lease, effective as of 1 September 1971.

WITNESS:

DATE 31 August 1971

UNITED STATES OF AMERICA

By

W. S. Spangler
Captain, CEC, USN
Deputy Commander for Facilities Management
Naval Facilities Engineering Com

APPROVED
DEPARTMENT OF GENERAL SERVICES

By

NF(R)- 13233

WITNESS:
APPROVED AS TO FORM

DEPARTMENTAL COUNSEL

STATE OF CALIFORNIA
DEPARTMENT OF PARKS
AND RECREATION

By

DEPUTY DIRECTOR

Contract #4-999-929

Appropriation Ch. 266/71, Item 207 FY 1971/72

Function or Fund General, Support

Line Item Allotment 4-72 999999 226.01

Amount of Estimate $1.00

Unencumbered Remainder $25,645.00

I Hereby Certify upon my own personal knowledge that budgeted funds are available for the period and purpose of the expenditure state above. (After T. B. A. No. ______ or B. R. No. ______)

Accounting Officer

NF(R)-13233

AGREEMENT OF LEAS

NO. ____________

PART II

GENERAL PROVISIONS

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ARTICLES PAGE

AGREEMENT OF LEASE

NF(R)-13233

between

STATE OF CALIFORNIA

DEPARTMENT OF PARKS AND RECREATION

and

UNITED STATES OF AMERICA

PART II

GENERAL PROVISIONS

A. GENERAL MAINTENANCE OBLIGATION

Lessee, at its own expense, shall so protect, preserve, maintain, and repair the Leased Property and any and all improvements constructed or installed thereon that the same will at all times be kept in good condition and repair.

B. REPRESENTATIONS

Lessee has examined, knows and accepts the condition and state of repair of the Leased Property and the Base of which it forms a part, and acknowledges that the Government has made no representation concerning such condition and state of repair, nor any agreement or promise to alter, improve, adapt, repair, or keep in repair the same, or any item thereof, which has not been fully set forth in this Lease which contains all of the agreements made and entered into between the Lessee and the Government.

C. SUBJECTION TO EXISTING AND FUTURE EASEMENTS AND RIGHTS OF WAY

This Lease is subject to all outstanding easements and rights of way for location of any type of facility over, across, in and upon the Leased Property, or any portion thereof, and to the right of the government, after consultation with Lessee as to location, to grant such additional easements and rights of way over, across, in and upon the Leased Property as it shall determine to be in the public interest; Provided, that any such additional easement or right of way shall be located so as not to unreasonably interfere with the use of the Lessee's improvements erected on the Leased Property; and Provided, further, that any such additional easement or right of way shall be conditioned on the assumption by the Grantee thereof of liability to Lessee for such damages as Lessee shall suffer for property destroyed or property rendered unusable on account of Grantee's exercise of its rights thereunder. There is hereby reserved to the holders of such easements and rights of way as are presently outstanding or which may hereafter be granted, to any workers officially engaged in the construction, installation, maintenance, operation, repair, or replacement of facilities located thereon, and to any Federal, State, or local official engaged in the official inspection thereof, such reasonable rights of ingress and egress over the Leased Property as shall be necessary for the performance of their duties with regard to such facilities.

D. TERMINATION BY GOVERNMENT

This Lease may be terminated by the Government at any time: (1) during any mobilization or any national emergency, present or future, declared by the President or Congress, (2) in the interest of national defense, (3) upon closure of the Base, (4) in the event the Leased Property or a major part thereof becomes excess, or (5) upon a determination by the Local Government Representative that: (a) the Leased Property is no longer used for the purpose set forth in Article 3 of Part I hereof, or (b) if after 30 days' notice of default in any of the obligations under this Lease, the Lessee has failed to cure such default.

E. TERMINATION BY LESSEE

Lessee shall have the right to terminate this Lease upon ninety (90) days' written notice to the Local Government Representative.

F. SURRENDER

Upon the expiration of this Lease or its prior termination provided herein, Lessee shall quietly and peacefully remove itself and its property from the Leased Property and surrender the possession of the Leased Property to the Government; Provided, in the event the Government shall terminate this Lease, Lessee shall be allowed a reasonable period of time, as determined by the Local Government Representative in accordance with the circumstances surrounding the termination, in which to remove all of its property from and terminate its operations on the Leased Property. During such period prior to surrender, all obligations assumed by Lessee under this Lease shall remain in full force and effect.

G. INSTALLATION OF IMPROVEMENTS - REMOVAL AND RESTORATION

Lessee shall have the right hereunder to make and install on the Leased Property such improvements as shall be required in connection with the uses permitted under Article 3 of Part I hereof, including buildings, trails, roadways, utility lines, campsites, picnic grounds, and the like; Provided, however, that agreement shall be reached between Lessee and the government as to the location and plans for any proposed improvements prior to the commencement of any installation thereof.

Title to any and all improvements made or installed on the Leased Property by Lessee hereunder shall remain in Lessee during the term of this Lease, and Lessee may, at its option, remove all or part of the

the improvements made or installed on the Leased Property by it; Provided, however, such right of removal shall be exercised either:

(a) prior to expiration of the Lease term; or

(b) prior to the effective date of any termination of the Lease by the Government, pursuant to the provisions of this Lease governing such termination, when the Government shall have given Lessee sufficient notice of such termination to permit the effecting of such removal; or

(c) within a reasonable time after the effective date of the termination by the Government, when the advance notice thereof given by the Government is insufficient to permit such removal to be accomplished prior to said effective date; and

Provided, further, that following any such removal Lessee shall, to the extent the Government shall require and direct, restore the Leased Property to the same or as good condition as existed when this Lease became effective.

If Lessee shall fail to exercise the aforesaid rights of removal of improvements within the time prescribed, such improvements shall be deemed to have been abandoned by Lessee and may be used or disposed of by the Government in any manner whatsoever, without any liability to account to Lessee therefor.

H. RESERVATIONS BY THE GOVERNMENT

The Government specifically reserves and excepts from this Lease the following: (1) all rights to water and to minerals or other non-renewable natural resources, located on or underlying the Leased Property, (2) rights of ingress and egress and the use of such portion of the Leased Property as may be necessary to extract or develop the aforesaid water and natural resources, (3) existing and such other rights of way as may be necessary for access to and maintenance of existing water and sewer lines, power lines, water wells and telephone lines, (4) such rights of way as may be necessary in the future for the establishment of uses similar to those mentioned in the preceding item, provided the location thereof does not unreasonably interfere with the use of Lessee's improvements erected on the leased property.

The reservation respecting water and natural resources is intended to include the prohibition against any use thereof by the Lessee. However, water on the leased property may be made available to the Lessee to the extent and upon such terms and conditions as are approved by the Government from time to time.

I. INDEMNIFICATION BY LESSEE/GOVERNMENT NON-LIABILITY

Except for occurrences during or resulting from a formal military exercise as provided for under paragraph L, the Lessee, insofar as it is legally able to do so, covenants that it will indemnify, save, and hold harmless the Government, its officers, agents, and employees for and from any and all liability or claims for loss of or damage to any property owned by or in the custody of Lessee, its officers, agents, servants, employees, subtenants, licensees, or invitees, or for the death of or injury to any of the same which may arise out of or be attributable to the condition, state of repair, or Lessee's use and occupancy of the Leased Property, whether or not the same shall be occasioned by the negligence or lack of diligence of Government, its officers, agents, servants, or employees.

J. UTILITIES AND SERVICES

It is expressly understood and agreed that utilities and services will not be furnished the Lessee from Government sources at the Base. Lessee shall, at its sole cost and expense, obtain all utilities and services which it may require in connection with its use of the Leased

Lessee shall have the right to make necessary utility connections and install and maintain transmission lines upon or adjacent to the Leased Property at such locations within the Base as are approved by the Commanding General of the Base.

K. LIENS

Lessee shall promptly discharge or cause to be discharged any valid lien, right in rem, claim or demand of any kind, except one in favor of the Government which at any time may arise or exist with respect to the Leased Property or materials or equipment furnished therefor, or any part thereof, and if the same shall not be promptly discharged by Lessee, the Government may discharge, or cause to be discharged, the same at the expense of Lessee.

L. ACCESS

The Government shall have access to the Leased Property at all reasonable times for any purposes not inconsistent with the use thereof by Lessee, including but not limited to, the purpose of inspection, and in addition thereto, the Government expressly reserves the right to use all or any part of the Leased Property, upon such notice as shall hereafter be specified, for the purpose of conducting formal military training exercises. In the event the Government shall schedule a formal military training exercise requiring the use of all or a substantial portion of the Leased Property, the Government shall give the Lessee five (5) days' notice except where military necessity requires a shorter clearance period in which case not less than forty-eight (48) hours' notice may be given. Upon receipt of such notice, and prior to the beginning of said scheduled training exercise, the Lessee shall cause the Leased Property to be cleared of all persons occupying the Leased Property under the said authorization of the Lessee, together with their personal property, and

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Leased Property during the said training exercise. Recognizing that the availability for training purposes of the land comprising Camp Pendleton (including the Leased Property) is vital to the National Security, to the extent it can legally do so, the Lessee further agrees to indemnify, save and hold harmless the Government, its officers, agents, and employees, for and from any liability or claims for loss of or damage to any property owned by or in the custody of Lessee, its officers, agents, subtenants, servants, employees, contractors, licensees or invitees, or for the death of or injury to any of the same which may arise from or be attributable to the conduct, after notice as provided herein, of a formal military training exercise

M. DISPUTES

Any dispute concerning a question of fact which is not disposed of by agreement shall be decided by the Commander, Naval Facilities Engineering Command, who shall reduce his decision to writing and mail or furnish a copy thereof to Lessee. Within thirty (30) days from the receipt of such copy Lessee may appeal by mailing or otherwise furnishing the Commander, Naval Facilities Engineering Command, Washington, D. C. 20390, via the Local Government Representative, a written appeal addressed to the Secretary of the Navy, and the decision of the Secretary or his duly authorized representative for the hearing of such appeals shall, unless determined by a court of competent jurisdiction to have been fraudulent or capricious or arbitrary or so grossly erroneous as necessarily to imply bad faith, or not supported by substantial evidence, be final and conclusive; Provided, that if no such appeal is taken, the decision of the Commander, Naval Facilities with any appeal pending under this clause, the Lessee shall be afforded an opportunity to be heard and to offer evidence in support of its appeal. Pending final decision of a dispute hereunder, Lessee shall proceed diligently with the performance of its obligations under this Lease and in accordance with the decision of the Commander, Naval Facilities Engineering Command. The term, "Commander, Naval Facilities Engineering Command," as used herein, shall include his duly appointed successor or his representative specifically designated for this purpose.

N. COVENANT AGAINST FEES

Lessee warrants that no person or agency has been employed or retained to solicit or secure this Lease upon an agreement or understanding for a commission, percentage, brokerage, or contingent fee, excepting bona fide employees or bona fide established commercial agencies maintained by Lessee for the purpose of securing business. For breach or violation of this warranty, the Government shall have the right to annul this Lease without liability or in its discretion to require Lessee to pay, in addition to the rental or consideration, the full amount of such commission, percentage, brokerage, or contingent fee.

O. OFFICIALS NOT TO BENEFIT

No Member of or Delegate to Congress, or Resident Commissioner shall be admitted to any share or part of this Lease, or to any benefit to arise therefrom.

P. FAILURE OF GOVERNMENT TO INSIST ON COMPLIANCE

The failure of the Government to insist, in any one or more instances, upon performance of any of the terms, covenants or conditions of this Lease shall not be construed as a waiver or relinquishment of the

Government's right to the future performance of any such terms, covenants or conditions of this Lease shall not be construed as a waiver or relinquishment of the Government's right to the future performance of any such terms, covenants or conditions, and Lessee's obligations in respect to such future performance shall continue in full force and effect.

Q. ASSIGNMENT OR SUBLETTING

Lessee shall not transfer or assign this Lease or any interest therein nor sublet to any third party or parties any portion of the Leased Property or rights therein without the prior written consent of the Government. Under any assignment made, with or without consent, the assignee shall be deemed to have assumed all of the obligations of Lessee hereunder, but no assignment shall relieve the assignor of any of Lessee's obligations hereunder except for an extension of the Lease term beginning after such assignment, and then only if the Government shall have consented thereto. Nothing herein contained shall prohibit the sale of food and camping supplied or the furnishing of services by the Lessee or its concessionaires incidental to use of the Leased Property for recreational purposes.

R. GOVERNMENT RULES AND REGULATIONS

The existence of the military camps, helicopter landing areas, and security zones indicated on Exhibit "B" hereto and located on or near the boundaries of the Leased Property require restrictions on the use of the adjacent Leased Property, in such manner and to such extent as may be directed by the Government.

Lessee shall also comply with such rules and regulations regarding Base safety, security, ingress, and egress as may be prescribed from time to time by the Commanding General of the Base; and Lessee shall make every reasonable effort, including the installation of suitable fencing and identification markers, to prevent trespassing by unauthorized persons from the Leased Property to adjacent portions of the Base. Lessee shall not undertake any project requiring modification of the terrain without prior approval of the Commanding General of the Base.

S. NOTICES

No notice, order, direction, determination, requirement, consent, or approval under this Lease shall be of any effect unless in writing. All notices required under this Lease shall be addressed to Lessee, 1416 Ninth Street, Sacramento, California 95811, or to the Local Government Representative at the address specified in Article 5 of Part I of this Lease, or to the Commanding General, U. S. Marine Corps Base, Camp Pendleton, California 92055, as may be appropriate, or at such other address as may from time to time be agreed upon by the parties hereto.

NF(R)-13233

The Government hereby leases to the Lessee the following described portions of the U. S. Marine Corps Base, Camp Pendleton, California, consisting of three parcels hereinafter called the "Leased Property", said three parcels of land in the County of Orange and the County of San Diego, State of California being portions of fractional Section 25, Township 8 South, Range 7 West San Bernardino Base and Meridian, and portions of Sections 25, 26, 35 and 36, Township 8 South, Range 7 West; Sections 1, 2, 10, 11, 12, 14, 23 and 24, Township 9 South, Range 7 West; Sections 29, 30, 31, 32 and 33, Township 9 South, Range 6 West, Sections 3 and 4, Township 10 South, Range 6 West of Rancho Santa Margarita, according to Record of Survey Map 794, filed January 17, 1940, in the Office of the County Recorder of said San Diego County more particularly described as follows:

Parcel 1 Inland Area

For point of reference, commence at the intersection of the Westerly line of said Rancho Santa Margarita with the Northeasterly right of way line of Highway Interstate 5, said Westerly line of Rancho Santa Margarita being also the line common to the Counties of Orange and San Diego; thence northeasterly along said Rancho boundary line 4,434 feet to the true point of BEGINNING; thence continuing with the Westerly line of Rancho Santa Margarita 16,315.43 feet to an angle point therein; thence southeasterly along said boundary 1,700 feet more or less to an intersection with the westerly line of fractional Section 25, Township 8 South, Range 7 West, San Bernardino Meridian; thence northerly along the West line of said Section 25, 550 feet more or less to the Northwest corner thereof; thence easterly along the North line of said Section 25, 1,600 feet; thence southerly in a straight line along the easterly bank of Cristianitos Creek, but staying west of Cristianitos Road, 4,400 feet; thence westerly, at right angles, 250 feet; thence southerly, at right angles, 400 feet; thence southwesterly 1,000 feet; thence southerly, along the toe of the slope on the west side of Cristianitos Creek, 4,600 feet; thence southeasterly 800 feet to point on the southwesterly side of Cristianitos Road; thence northeasterly in a straight line, parallel with said road 1,300 feet; thence southerly, staying to the west of the service road to the Sewage Disposal Ponds, 3,000 feet; thence westerly 1,000 feet; thence southeasterly 850 feet; thence easterly, along the south side of the Sewage Disposal Ponds, 900 feet more or less to the toe of the slope on the easterly side of San Mateo Valley; thence, generally following the toe of the slope on the easterly side of San Mateo Valley, southerly 3,500 feet; southwesterly 6,600 feet; more southwesterly, 1,100 feet; southerly 1,300 feet more or less to an intersection with the northeasterly right-of-way line of said Highway Interstate 5 at point along the northerly approach lane of Basilone Road Interchange; thence along the northwesterly right-of-way line of Highway Interstate 5, 3,370 feet, more or less, to a point; thence in a northerly direction, leaving said Highway Interstate 5, North 26° 0' 56" West; 762.95 feet; thence North 820 feet; thence North 34° 0' 0" East 1,770 feet; thence North 19° 0' 0" East, 1,990 feet; thence North 61° 02' 39" West, 1,250 feet; thence North 73° 09' 09" West, 530.24 feet to the northwesterly boundary of said Rancho Santa Margarita Y Las Flores, the true point of beginning, containing 2,380 acres, more or less.

NF(R)-13233

Parcel 2 Beach Area North of Nuclear Plant

BEGINNING at the intersection of the Northwesterly line of an easement for construction and operation of a nuclear generating station, granted to Southern California Edison Company and San Diego Gas and Electric Company, with the Mean High Tide line of the Pacific Ocean, said point of intersection being the most Westerly corner of said easement; thence northeasterly along said northwesterly line of said easement, 1,400 feet more or less to an intersection with the Southwesterly right-of-way line of Highway Interstate 5; thence northwesterly along said Southwesterly right-of-way line 6,500 feet more or less to the Westerly bank of San Onofre Creek; thence southwesterly along said Westerly Bank of said creek, 900 feet more or less to the Northeasterly right-of-way line of the Atchison Topeka and Santa Fe Rail way Company line; thence southerly to the Mean High Tide line of the Pacific Ocean; thence along said Mean High Tide line to the point of BEGINNING, containing 160 acres more or less.

Parcel 3 Beach Area South of Nuclear Plant

BEGINNING at the intersection of the Southeasterly line of an easement for construction and operation of a nuclear generating station, granted to Southern California Edison Company and San Diego Gas and Electric Company, with the Mean High Tide line of the Pacific Ocean, said point of intersection being the most Southerly corner of said easement; thence northeasterly 1,000 feet more or less to an intersection with the Southwesterly right-of-way line of Highway Interstate 5; thence southeasterly along said Southwesterly right-of-way line of said Interstate 5 to an intersection with a line lying 18,220 feet southeasterly from said Southeasterly line of said nuclear generating station; thence southwesterly at right angles to said highway right-of-way line 1,500 feet more or less to the Mean High Tide line of the Pacific Ocean; thence northwesterly along said Mean High Tide line to the point of BEGINNING, containing 405 acres more or less.

TOGETHER WITH the right of ingress and egress between Parcels 2 and 3 across that portion of the easement for construction and operation of a nuclear generating station granted to Southern California Edison Company and San Diego Gas and Electric Company lying between the Quay Wall of said station and the Mean High Tide line.

FIRST AMENDMENT TO AGREEMENT OF LEASE NF(R)-13233
between
STATE OF CALIFORNIA, DEPARTMENT OF PARKS & RECREATION
and
UNITED STATES OF AMERICA

This Amendatory Agreement, effective the 28th day of July, 1977, by and between the United States of America, represented by the Commanding Officer, Western Division, Naval Facilities Engineering Command acting under the direction of the Secretary of the Navy hereinafter referred to as Government and the State of California, Department of Parks and Recreation hereinafter referred to as Lessee:

WITNESSETH:

WHEREAS, Government leases to Lessee under Contract NF(R)-13233 certain land at the Marine Corps Base, Camp Pendleton, for public park purposes, and

WHEREAS, certain additional land is now available for public park purposes, and

WHEREAS, Lessee has requested the lease be amended to include said additional land and certain other changes:

NOW THEREFORE, in consideration of the premises and of the term and conditions hereinafter set forth, Government and Lessee hereby agree as follows:

1. ARTICLE I, PART I. First paragraph describing the leased property is amended as follows:

First: Delete Parcel 2 being leased property designated "Parcel 2" described and delineated in Exhibits "A" and "B" of the lease comprising 160 acres more or less,

Insert in lieu thereof the following described property: "Revised Parcel 2" comprising 99 acres more or less, described and delineated in Exhibit "A-1" attached hereto and made a part hereof.

Second: Add Parcel 4 comprising 145 acres, more or less, described d delineated Exhibit A-2 attached hereto and made a part hereof.

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Third: Add Parcel 5 comprising 209 acres described and delineated in Exhibit "A-3" attached hereto and made a part hereof.

2. ARTICLE I, PART I (PAGE 2) Delete in its entirety: Second Paragraph commencing with the words "Provided, however...." and ending with the words "comparable facilities."

3. ARTICLE I, PART I (PAGE 2). Third paragraph: Delete the word "further," and in lieu thereof insert the word "however."

4. Lessee agrees to make every reasonable effort to install at its own expense a chain link security fence along the southeasterly boundary of the herein Parcel 5 with a bearing and distance described as "S19° 08' 29"W 1,076.887 feet" as shown on sheet 2 of Drawing No. 9854 attached hereto. Such fencing shall be installed as expeditiously as possible in accordance with Navy specifications with at least three strands of barbed wire at the top.

Lessee also agrees to post "No Trespassing" signs on said aforementioned southerly boundary of said Parcel 5 to restrain visitors from trespassing on adjoining Marine Corps property. All the foregoing to be accomplished to the satisfaction of the Commanding General, Marine Corps Base, Camp Pendleton.

In no event shall said aforementioned Parcel 5 be opened for public use until fencing and signing as herein required shall be completed.

5. Except as herein notified, all terms and conditions of Lease NF(R)-13233 shall remain unchanged and in full force and effect.

6. IN WITNESS WHEREOF, the parties hereto have duly executed this First Amendment to Lease NF(R)-13233 effective as of the date hereinabove set forth.

UNITED STATES OF AMERICA

W. H. HERMES
Acting Director
Real Estate Division
By direction of the Commanding Officer

By direction of the Commanding Officer
Western Division, Naval Facilities
Engineering Command, San Bruno, California

STATE OF CALIFORNIA

By Herbert Rhodes
Director

Department of General Services
APPROVED
JUL 7 1976
BY C.O. Shreoler
Ass't. Chief Counsel

N6247401RP03233

METES AND BOUNDS DESCRIPTION

Revised PARCEL #2 Beach Area North of San Onofre Nuclear Generating Plant

Commencing for reference at a 1-1/2" iron pipe with a brass cap marked 10-11-14-15, accepted as marking the Northwest corner of Section 14, Township 9 South, Range 7 West, San Bernadino Base and Meridian as said corner shown on Record of Survey Map No. 794, coordinates of said point being N 450,185.110, E 1,591,041.500; thence S 47°05'33" E, 9,652.553 feet to the True Point of Beginning at the Southwesterly Right of Way of Interstate Highway 5, coordinates of said point being N 443,613.490, E 1,598,111.549; thence S 63°56'36" E, 119.997 feet along said Right of Way; thence S 63°17'41" E, 104.138 feet; thence S 61°51'26" E, 40.282 feet; thence S 61°34'32" E, 70.021 feet; thence S 58°24'20" E, 48.921 feet; thence S 56°17'50" E, 49.884 feet; thence S 55°51'52' E, 79.532 feet; thence S 52°54'34" E, 304.256 feet; thence S 48°03'05" E, 239.100 feet; thence S 41°57'45" E, 797.478 feet; thence S 49°12'48" E, 660.242 feet; thence S 56°11'29" E, 532.385 feet to the Northerly corner boundary of the Southern California Edison Company San Onofre Nuclear Generating Plant leased area; thence S 32°59'59" W, 1,197.593 feet departing from the Interstate Highway 5 Right of Way and proceeding along the Nuclear Generating Plant boundary to the Mean High Tide Line of the Pacific Ocean; thence N 65°57'52" W, 133.856 feet along said Mean High Tide Line; thence N 53°50'31" W, 161.012 feet; thence N 67°22'48" W, 325.000 feet; thence N 54°24'19" W, 584.144 feet; thence N 40°36'05" W, 184.390 feet; thence N 47°27'33" W, 576.823 feet; thence N 63°02'28" W, 650.711 feet; thence N 51°20'25" W, 288.140 feet; thence N 27°19'26" W, 337.675 feet; thence N 37°30'15" W, 271.016 feet; thence N 50°17'04" E, 406.901 feet departing.

N6247401RP03233

from the Mean High Tide Line; thence N 85°38'14" E, 368.066 feet; thence N 33°23'12" E, 593.417 feet to the Southwesterly Right of Way of Interstate Highway 5, and the True Point of Beginning, and enclosing an area of 99.00 Acres, all as shown on EFD Drawing C102182 entitled "State Park Lease Boundaries, Parcel Number 2 Revised Area North of Power Plant" attached hereto and made a part hereof.

SECOND AMENDMENT TO AGREEMENT OF LEASE NF(R)-13233
Between
STATE OF CALIFORNIA, DEPARTMENT OF PARKS AND RECREATION
and
UNITED STATES OF AMERICA

This Amendatory Agreement, effective the 6th day of April 1981 by and between the United States of America, represented by the Commanding Officer, Western Division, Naval Facilities Engineering Command acting under the direction of the Secretary of the Navy, hereinafter referred to as the Lessor and the State of California, Department of Parks and Recreation hereinafter referred to as Lessee:

W I T N E S S E T H:

WHEREAS, Lessor leases to Lessee certain land at the Marine Corps Base, Camp Pendleton, California, for public park purposes under Lease NF(R)-13233, and

WHEREAS, Lessee has had an engineering survey made redefining the boundaries of the said leasehold, and

WHEREAS, Lessor and Lessee agree that the property description of Lease NF(R)-13233 should be conformed to the details of the abovementioned engineering survey; and

WHEREAS, for administrative purposes a change of the contract number is required,

NOW THEREFORE, in consideration of the premises, Lease NF(R)-13233 is hereby amended as follows:

1. Delete all of Article 1, LEASED PROPERTY of Part I thereof, as amended by First Amendment dated July 28, 1977 and Exhibits "A", "A-1", "A-2", "A-3" and "B", and substitute the following new Article 1 therefore:

ARTICLE 1. LEASED PROPERTY

The Government hereby leases to the Lessee the following described portions of the U.S. Marine Corps Base, Camp Pendleton, California, consisting of five parcels hereinafter called the "Leased Property", said five parcels of land in the County of Orange and the County of San Diego, State of California being portions of fractional Section 25, Township 8 South, Range 7 West, San Bernardino Base and Meridian, and portions of Sections 25, 26, 35, and 36, Township 8 South, Range 7 West; Sections 1, 2, 10, 11, 12, 14, 15, 23, and 24, Township 9 South, Range 7 West; Sections 29, 30, 31, 32 and 33, Township 9 South, Range 6 West; Sections 3 and 4, Township 10 South, Range 6 West of Rancho Santa Margarita, according to Record of Survey Map 794, filed January 17, 1940, in the Office of the County Recorder of said San Diego County more particularly described as follows:

PARCEL 1

BEGINNING at a 6" x 6" concrete monument with brass cap marked "Rancho Santa Margarita, Jos. A. Hurley Survey", from which monument a 2" iron pipe with Southern California Edison Company Brass Camp Stamped V.I.L.S. 2827 marking the center of transmission tower M6-T3 #879 shown on sheet 4 of Record of Survey Map No. 7033, San Diego County Records, bears N 5° 01' 21" E 60.31 feet; thence from said point of beginning following the westerly line of Rancho Santa Margarita S 13° 13' 44.42" W 16,608.57 feet to a 1" iron pipe, which pipe is N 13° 13' 44.42" E 4,438.19 feet from the northerly right of way line of Interstate Route 5; thence leaving the westerly line of said Rancho, S 71° 59' 43" E 528.76 feet to a 1" iron pipe; thence S 48° 43' 33" E 1,329.06 feet to a 1" iron pipe; thence S 18° 57' 47" W 1,695.97 feet to a 1" iron pipe; thence S 34° 00' 00" W 1,770.00 feet to a 1" iron pipe, thence South 820.00 feet to a 1" iron pipe; thence S 26° 00' 56" W 760.19 feet to a 1" iron pipe in the northerly right of way line of said Interstate Route 5; thence following said right of way line; the following nine courses;

1. S 27° 07' 15" E, 178.79 feet;
2. S 78° 08' 09" E, 105.48 feet;
3. S 28° 25' 21" E, 810.89 feet;
4. S 30° 39' 17" E, 546.23 feet;
5. S 34° 08' 52" E, 475.33 feet;
6. S 41° 16' 50" E, 429.55 feet;
7. S 47° 34' 17" E, 358.78 feet;
8. S 54° 05' 38" E, 326.40 feet;
9. S 67° 37' 03" E, 230.29 feet;

thence leaving said right of way line N 17° 34' 03" E 4.02 feet to a 1" iron pipe; thence continuing N 17° 34' 03" E 542.38 feet to a 1" iron pipe; thence S 33° 09' 19" E 136.87 feet to a 1" iron pipe; thence N 10° 42' 30" E 350.53 feet to a 1" iron pipe; thence N 30° 33' 52" E 435.90 feet to a 1" iron pipe; thence N 54° 14' 28" E 1,286.18 feet; thence N 29° 40' 00" E 2,250.00 feet; thence N 35° 02' 21" E 900.00 feet to a 1" iron pipe; thence N 25° 14' 58" E 1,763.95 feet to a 1" iron pipe; thence N 77° 40' 44" E 328.54 feet to a 1" iron pipe; thence N 03° 23' 07" E 653.98 feet to a 1" iron pipe; thence N 14° 51' 42" E 1,207.23 feet to a 1" iron pipe; thence N 28° 09' 25" E 883.66 feet to a 1" iron pipe; thence N 16° 39' 15" W 901.68 feet to a 1" iron pipe; thence N 05° 41' 12" W 1,142.11 feet to a 1" iron pipe; thence N 85° 02' 53" W 620.11 feet to a 1" iron pipe; thence N 28° 39' 04" W 297.81 feet to a 1" iron pipe; thence N 42° 31' 08" E 463.99 feet to a 1" iron pipe; thence S 87° 52' 30" E 423.13 feet to a 1" iron pipe thence N 07° 48' 57" E 1,150.08 feet to a 1" iron pipe; thence N 12° 05' 06" E 868.78 feet to a 1" iron pipe; thence N 09° 47' 40" E 863.02 feet to a 1" iron pipe; thence N 61° 26' 26" W 361.20 feet; thence S 48° 27' 39" W 866.44 feet; thence N 18° 35' 59" W 1,179.86 feet to a 1" iron pipe; thence N 01° 43' 10" E 2,853.76 feet to a 1" iron pipe; thence N 20° 00' 51" E 1,882.40 feet to a 1" iron pipe; thence N 28° 09' 20" E 1,034.38 feet to a 1" iron pipe; thence N 00° 53' 08" E 2,062.76 feet to a 1" iron pipe;

thence N 12° 51' 16" E 754.66 feet to a 1" iron pipe; thence N 06° 58' 29" E 640.72 feet to a 1" iron pipe; thence N 22° 27' 36" E 623.16 feet to a 1" iron pipe in the north line of the U.S. Naval Reservation at Camp Pendleton; thence following said Naval Reservation boundary the following three courses:

1. N 89° 17' 30" W 1,898.61 feet to a 1-1/2" iron pipe;

2. S 00° 46' 30" W 511.99 feet to a 1" iron pipe;

3. N 79° 20' 58" W 1,610.69 feet to the point of beginning,

enclosing an area containing 2,386.69 acres more or less.

Bearings and distances used in this description are based on the California Coordinate system Zone VI.

PARCEL 2

Beach Area North of San Onofre Nuclear Generating Plant Commencing for reference at a 1-1/2" iron pipe with a brass cap marked 10-11-14-15, accepted as marking the Northwest corner of Section 14, Township 9 South, Range 7 West, San Bernardino Base and Meridian as said corner shown on Record of Survey Map No. 794, coordinates of said point being N 450,185.110, E 1,591,041.500; thence S 47° 05' 33" E, 9,652.553 feet to the True Point of Beginning at the Southwesterly Right of Way of Interstate Highway 5, coordinates of said point being N 443,613,490, E 1,598,111.549; thence S 63° 56' 36" E, 119.997 feet along said Right of Way; thence S 63° 17' 41" E, 104.638 feet; thence S 61° 34' 32" E, 40.282 feet; thence S 61° 34' 32" E, 70.081 feet; thence S 58° 24' 20" E, 48.921 feet; thence S 56° 17' 50" E, 49. 884 feet; thence S 55° 51' 52" E, 79.532 feet; thence S 52° 54' 34" E, 304.256 feet; thence S 48° 03' 05" E, 239.100 feet; thence S 41° 57' 45" E, 797.478 feet; thence S 49° 12' 48" E, 660.242 feet; thence S 56° 11' 29" E, 532.385 feet to the Northerly corner boundary of the Southern California Edison Company San Onofre Nuclear Generating Plant leased area; thence S 32° 59' 59" W, 1,197.593 feet departing from the Interstate Highway 5 Right of Way and proceeding along the Nuclear Generating Plant boundary to the Mean High Tide Line of the Pacific Ocean; thence N 65° 57' 52" W, 133.856 feet along said Mean High Tide Line; thence N 53° 50' 31" W, 161.012 feet; thence N 67° 22' 48" W, 325.000 feet; thence N 54° 24' 19" W, 584.144 feet; thence N 40° 36' 05" W, 184.390 feet; thence N 47° 27' 33" W, 576.823 feet; thence N 63° 02' 28" W, 650.711 feet; thence N 51° 20' 25" W, 288.140 feet; thence N 27° 19' 26" W, 337.675 feet; thence N 37° 30' 15" W, 271.016 feet; thence N 50° 17' 04" E, 406.900 feet departing from the Mean High Tide Line; thence N 85° 38' 14" E, 368.066 feet; thence N 33° 23' 12" E, 593.417 feet to the Southwesterly Right of Way of Interstate Highway 5, and the True Point of Beginning, and enclosing an area containing 99.00 Acres, more or less.

PARCEL 3 Beach Area South of Nuclear Plant

BEGINNING at the intersection of the Southeasterly line of an easement for construction and operation of a nuclear generating station, granted to Southern California Edison Company and San Diego Gas and Electric Company, with the Mean High Tide line of the Pacific Ocean, said point of intersection being the most Southerly corner of said easement; thence northeasterly 1,000 feet more or less to an intersection with the Southwesterly Right-of-Way line of Highway Interstate 5; thence Southeasterly along said Southwesterly right-of-way line of said Interstate 5 to an intersection with a line lying 18,220 feet Southeasterly from Southeasterly line of said nuclear generating station;

thence Southwesterly at right angles to said highway right-of-way line 1,500 feet more or less to the Mean High Tide line of the Pacific Ocean; thence Northwesterly along said Mean High Tide line to the point of BEGINNING, enclosing an area containing 405 Acres more or less.

TOGETHER WITH the right of ingress and egress between Parcels 2 and 3 across that portion of the easement for construction and operation of a nuclear generating station granted to Southern California Edison Company and San Diego Gas and Electric Company lying between the Quay Wall of said station and the Mean High Tide line.

PARCEL 4 Inland Area Southwest of Parcel 1

Beginning at a 6' x 6' concrete monument with a brass cap marked "Rancho Santa Margarita, Jos. A. Hurley Survey", from which monument a 2" iron pipe with a Southern California Edison Company brass cap stamped V.I.L.S. 2827, marking the center of transmission tower M6-T3 #879 shown on sheet 4 of Record of Survey Map No. 7033, San Diego County Records, bears N 5° 01' 21" E, 60.31 feet, coordinates of said point being N 470.886.049, E 1,595,049.350; thence S 13° 13' 44.42" W, 16,068.57 feet along the Northwesterly boundary line of Camp Pendleton (Rancho Santa Margarita) to a 1" iron pipe, this being the True Point of Beginning; with coordinates of N 454,718.218, E 1,591,248.583; thence S 71° 59' 43" E, 528.760 feet; thence S 48° 43' 33" E, 1,329.060 feet; thence S 18° 57' 47" W, 1,695.970 feet; thence S 34° 00' 00" W, 1,770.000 feet, thence S 00° 00' 00" W, 820.00 feet; thence S 26° 00' 56" W, 760.186 feet to the Easterly Right-of-Way line of Interstate Highway 5; thence N 27° 07' 15" W, 55.822 feet along said Right-of-Way; thence N 21° 16' 19" W, 440.900 feet; thence N 14° 00' 29" W, 182.280 feet; thence N 18° 05' 35" E, 67.760 feet; thence along the curve concave Northwesterly, said curve having a radius of 740.000 feet and bearing N 41° 21' 01" E to the center point, an arc length of 259.302 feet, through an angle of 20° 04' 37"; thence N 61° 25' 38" W, 80.00 feet; thence S 73° 34' 22" W, 23.470 feet; thence N 55° 09' 09" W, 535.490 feet; thence along a curve concave Northeasterly, said curve having a radius of 460.000 feet, an arc length of 80.918 feet, through an angle of 10° 04' 44" to the Northwesterly boundary line of Camp Pendleton (Rancho Santa Margarita); thence N 13° 12' 29" E, 4,439.262 feet along said Boundary Line to the True Point of Beginning and enclosing an area containing 144.99 Acres, more or less.

PARCEL 5 Beach Area South of USCG Station

Commencing for reference at a 1-1/2" iron pipe with a brass cap marked 10-11-14-15, accepted as marking the Northwest corner of Section 14, Township 9 South, Range 7 West, San Bernardino Base and Meridian as said corner shown on Record of Survey Map No. 794, coordinates of said point being N 450,185.110 E, 1,591,041.500; thence S 37° 16' 23" E, 6,343.334 feet to the True Point of Beginning at the Southwesterly Right of Way of Interstate Highway 5, coordinates of said point being N 445,137.349, E 1,594,883.114; thence S 19° 08' 29" W, 1,076.887 feet to the Mean High Tide Line of the Pacific Ocean; thence along said Mean High Tide Line N 81° 52' 12" W, 565.685 feet; thence N 61° 04' 25" W, 434.166 feet; thence N 70° 27' 48" W, 657.875 feet; thence N 79° 17' 28" 1,775.929 feet; thence N 54° 34' 59" W, 276.089 feet; thence N 42° 27' 59" W, 799.812 feet; thence N 58° 09' 03" W, 776.981 feet; thence N 36° 29' 45" W, 730.642 feet to the Northwesterly corner boundary of Camp Pendleton (Rancho Santa Margarita); thence N 13° 13' 43" E, 485.140 feet along said boundary line to the Southwesterly corner boundary of the U.S. Coast Guard Loran Station; thence along said boundary line along a curve concave Northeasterly, said curve having a radius of 2,764.930

feet and bearing N 52° 34' 35" E to the centerpoint, an arc legth of 238.109 feet, through an angle of 04° 56' 02.5"; thence N 57° 26' 10" E, 511.500 feet; thence N 35° 14' 09" E, 1,371.920 feet to the Northeasterly corner boundary of the U.S. Coast Guard Loran Station; thence N 59° 39' 13" E, 92.310 feet along the Southeasterly boundary line of an Interstate Highway 5 Drainage Easement, part of Camp Pendleton (Rancho Santa Margarita), to the intersection of the Westerly Right of Way of Interstate Highway 5; thence S 32° 20' 00" E, 550.500 feet along said Right of Way; thence S 31° 20' 24" E, 475.130 feet; thence S 28° 56' 03" E, 421.030 feet; thence S 38° 48' 07" E, 493.810 feet; thence S 47° 44' 01" E, 306.610 feet; thence S 42° 54' 30" E, 809.650 feet; thence S 49° 56' 48" E, 414.870 feet; thence S 82° 32' 10" E, 70.860 feet; thence S 75° 47' 34" E, 70.000 feet; thence N 76° 23' 59" E, 101.370 feet; thence S 77° 42' 04" E, 250.000 feet; thence S 70° 52' 42" E, 336.700 feet; thence S 68° 15' 40" E, 396.960 feet; thence S 66° 56' 09" E, 550.570 feet; thence S 56° 44' 20" E, 151.323 feet to the True Point of Beginning, and enclosing an area containing 208.86 Acres, more or less.

APPROVED BY CADASTRAL

Signature

24 DEC 1980

The above 5 parcels are as shown on EFD Drawing C-102269, attached hereto and made a part hereof, and comprise 3,289.54 Acres, more or less.

Provided, however that this Lease shall not be effective as to any portion of the Leased Property which is presently out-leased by the Government for agricultural purposes until such time as such agricultural lease terminates, notice of which will be promptly given in writing by the Local Government Representative to this Lessee in each instance. It is further agreed between the Government and Lessee that upon termination of any existing agricultural lease the Government shall have the right to enter into further agricultural leasing of the area involved, subject to the consent of the Lessee herein in each instance.

2. Delete all reference to contract number NF(R)-13233 and substitute therefor the following new contract number: N6247401RP03233.

Except as herein amended, all terms and conditions of Lease N6247401RP03233, previously NF(R)-13233, shall remain unchanged and in full force and effect.

UNITED STATES OF AMERICA

By Warren K. Branscum

WARREN K. BRANSCUM
By direction of the Commander,
Naval Facilities Engineering Command
Acting under the direction of the
Secretary of the Navy

STATE OF CALIFORNIA

By Jack Hanson

Services
APPROVED
FEB 10 1981
BY
Ass't. Chief Counsel

06-0000

THIRD AMENDMENT TO AGREEMENT OF LEASE N6247401RP03233

BETWEEN

STATE OF CALIFORNIA, DEPARTMENT OF PARKS AND RECREATION

AND

UNITED STATES OF AMERICA

This Amendatory agreement, is effective the 20th Day of December 1985 by and between the United States of America, acting by and through the Department of the Navy, represented by the Commander, Western Division, Naval Facilities Engineering Command, San Bruno, California, hereinafter referred to as "Lessor" and the State of California, Department of Parks and Recreation hereinafter referred to as "Lessee":

WITNESSETH:

WHEREAS, Lessor leases to Lessee certain lands at the Marine Corps Base, Camp Pendleton, California, for public park purposes, and

WHEREAS, by First Amendment to Lease Agreement No. NF(R)-13233 the Lessor and Lessee agreed to delete and add acreages to several parcels in the lease area, and to change certain responsibilities of the Lessee, and

WHEREAS, by Second Amendment to Lease Agreement No. NF(R)-13233 the Lessor and Lessee agreed that the Lessee conduct an engineering survey of the lease area for the purpose of redefining the boundaries with the provision that the Lessor remains in control of the agricultural outlease program within the surveyed area and that the Lease Agreement number be changed from NF(R)-13233 to N6247401RP03233, and

WHEREAS, For administrative purposes a change in the acreage in Parcels 1, 2 and 4 and the installation of a security fence is now required.

NOW THEREFORE, in consideration of the premises, Lease N6247401RP03233 is hereby amended as follows:

The areas of parcels 1, 2, and 4 shall be reduced as follows:

Parcel 1 from 2,386.69 acres to approximately 1182.69 acres
Parcel 4 from 144.99 acres to approximately 138 acres
Parcel 2 from 99. acres to approximately 84.1 acres
All as shown on Exhibit "A" or "B" attached hereto and made a part hereof.

The Lessee at its own expense shall install and maintain three (3) strand barb wire security fencing along a portion of the boundary of Parcel 1 as shown on Exhibit "A" in order to deter unauthorized entry by park users onto the area of Marine Corps Base, Camp Pendleton not included in this lease agreement. State park personnel and park users shall be permitted access to the park area from Cristianitos Road.

The deletion of 14.9 acres (3.5+11.4 acres) of Parcel 2 is conditional upon the right of first refusal by the State Department of Parks and Recreation to lease the 14.9 acres should the Southern California Edison or the military activity no longer need the property. ~~Consideration for the new lease would be at fair market value.~~

The Lessor at its own expense shall maintain and repair Cristianitos Road.

Except as herein amended, all terms and conditions of Lease N6247401RP03233, previously NF(R)-13233, shall remain unchanged and in full force and effect.

UNITED STATES OF AMERICA

By Charles J. Williams

CHARLES J. WILLIAMS
Director
Real Estate Division

STATE OF CALIFORNIA

By Les McCargo

Mr. Les Mc Cargo
Chief Deputy Director
Department of Parks and Recreation

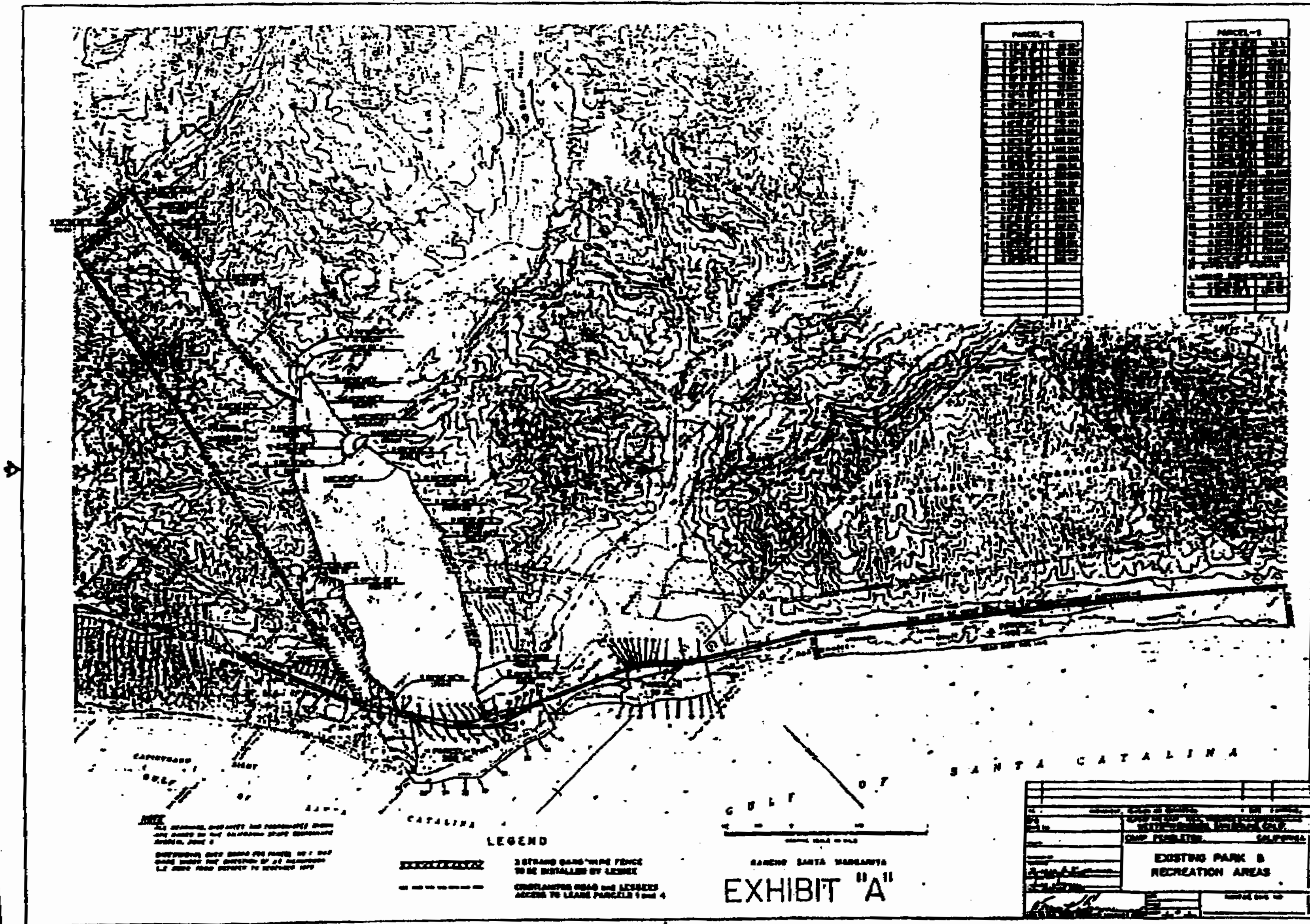
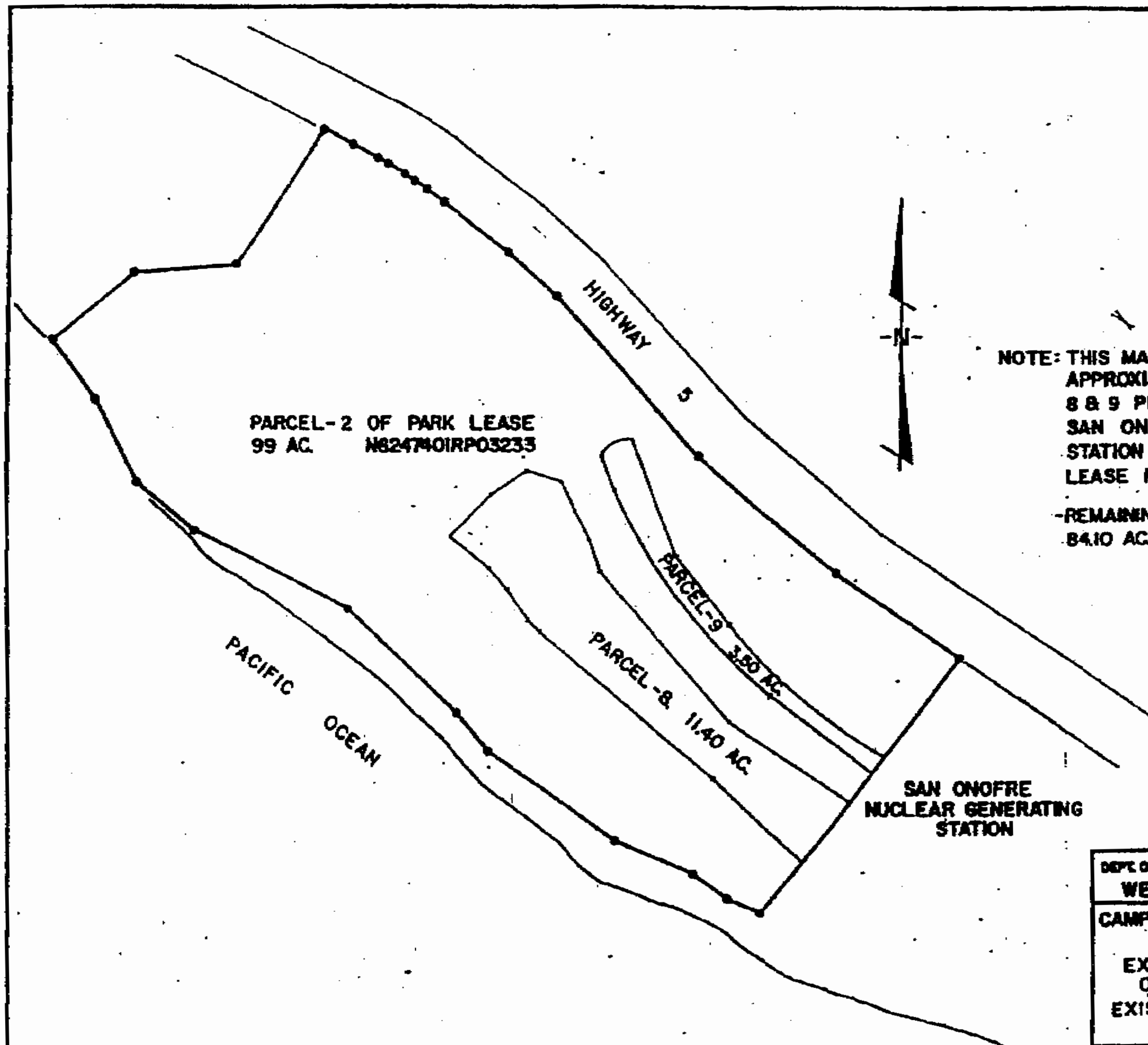

SANTA CATALINA
GULF OF
LEGEND
3 STRAND BARB WIRE FENCE TO BE INSTALLED BY LESSEE
RANCHO SANTA MARGARITA
EXISTING PARK & RECREATION AREAS
CAMP PENDLETON
CALIFORNIA

EXHIBIT "A"



NOTE: THIS MAP ILLUSTRATES THE APPROXIMATE RELATIONSHIP OF PARCELS 8 & 9 PRESENTLY USED BY THE SAN ONOFRE NUCLEAR GENERATING STATION AND PARCEL 2 OF PARK LEASE N6247401RP03233.

-REMAINING ACREAGE OF PARCEL 2 IS 84.10 AC. PER THIRD AMENDMENT.

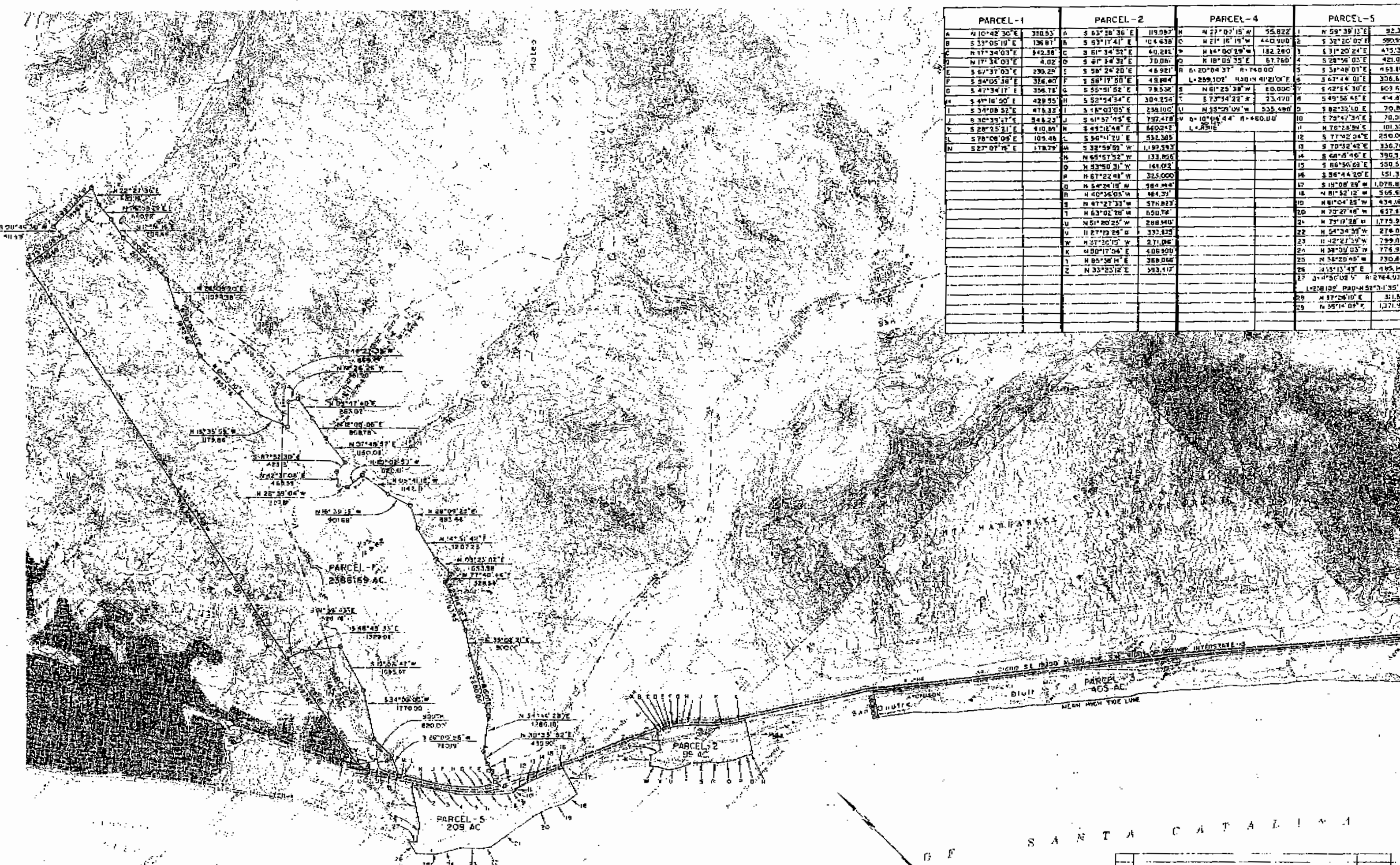
DEPT. OF THE NAVY NAVAL FACILITIES ENGINEERING COMMAND
WESTERN DIVISION, SAN BRUNO, CALIF.

CAMP PENDLETON CALIFORNIA

EXHIBIT "B" FOR THIRD AMENDMENT OF LEASE NO. N6247401RP03233
EXISTING PARK & RECREATION AREAS

SCALE: 1"=300'
SHEET 1 OF 1

WESTDIV. DWG. NO. A-102354



PARCEL-1		
A	N 10°42'30" E	310.53'
B	S 33°05'19" E	136.87'
C	N 17°34'03" E	342.38'
D	N 17°34'03" E	4.02'
E	S 67°37'03" E	230.29'
F	S 34°05'38" E	326.40'
G	S 47°34'17" E	356.78'
H	S 41°16'50" E	429.55'
I	S 34°08'52" E	475.33'
J	S 30°39'47" E	546.23'
K	S 28°25'21" E	410.89'
L	S 78°08'09" E	105.46
N	S 27°07'19" E	178.79'

PARCEL-2		
A	S 63°36'36" E	119.997'
B	S 63°17'41" E	104.638'
C	S 61°34'32" E	40.285'
D	S 61°34'32" E	70.081'
E	S 58°24'20" E	46.921'
F	S 56°17'50" E	49.884'
G	S 55°51'52" E	79.532'
H	S 52°54'34" E	304.256'
I	S 18°03'05" E	239.100'
J	S 61°57'15" E	797.478'
K	S 49°12'48" E	640.242'
L	S 56°41'20" E	532.385'
M	S 32°59'59" W	1,197.593'
N	N 65°57'52" W	133.866'
O	N 53°50'31" W	161.012'
P	N 67°22'41" W	325.000'
Q	N 54°24'19" W	384.444'
R	N 40°36'05" W	484.39'
S	N 47°27'33" W	576.823'
T	N 63°02'28" W	650.78'
U	N 51°20'25" W	288.340'
V	N 27°13'29" W	332.835'
W	N 37°30'15" W	271.06'
X	N 80°17'04" E	406.900'
Y	N 85°38'14" E	368.066'
Z	N 33°23'12" E	393.117'

PARCEL-4		
N	N 27°07'15" W	55.822'
O	N 21°16'19" W	440.900'
P	N 14°00'29" W	182.280'
Q	N 18°05'35" E	67.760'
R	Δ=20°04'37" R=740.00' L=259.102' RAD=N 41°21'01" E	
S	N 61°25'38" W	60.000'
T	S 73°34'22" W	23.470'
U	N 55°29'09" W	535.490'
V	Δ=10°44'44" R=460.00' L=[illegible]'	

PARCEL-5		
1	N 59°39'12" E	92.31'
2	S 32°20'02" E	590.90'
3	S 31°20'24" E	475.3'
4	S 29°56'03" E	421.03'
5	S 38°48'01" E	453.11'
6	S 43°44'01" E	336.61'
7	S 42°54'30" E	603.65'
8	S 49°56'45" E	414.87'
9	S 82°32'10" E	70.86'
10	S 75°47'34" E	70.00'
11	N 76°23'54" E	101.37'
12	S 77°42'34" E	250.00'
13	S 70°52'42" E	336.70'
14	S 68°15'40" E	390.36'
15	S 66°56'09" E	550.57'
16	S 56°44'20" E	151.323'
17	S 19°08'29" W	1,076.887'
18	N 81°52'12" W	565.689'
19	N 61°04'25" W	434.166'
20	N 73°27'46" W	657.875'
21	N 79°17'28" W	1,775.929'
22	N 54°34'39" W	276.081'
23	N 42°21'39" W	799.012'
24	N 38°09'03" W	776.981'
25	N 36°20'45" W	730.842'
26	N 15°13'43" E	485.140'
27	Δ=4°50'02.5" R=2764.93' L=238.139' RAD=N 52°31'35" E	
28	N 37°26'10" E	311.50'
29	N 35°14'09" E	1,371.99'

GRAPHIC SCALE IN MILE

RANCHO SANTA MARGARITA

NOTE

ALL BEARINGS, DISTANCES AND COORDINATES SHOWN ARE BASED ON THE CALIFORNIA STATE COORDINATE SYSTEM, ZONE 6

DIMENSIONAL DATA SHOWN FOR PARCEL NO. [illegible] WAS MADE UNDER THE DIRECTION OF J.F. RICHARDSON L.S. 2355 FROM OCTOBER TO DECEMBER [illegible]

NO.	AMENDMENT, REVISION OR CORRECTION	DATE	APPROVED

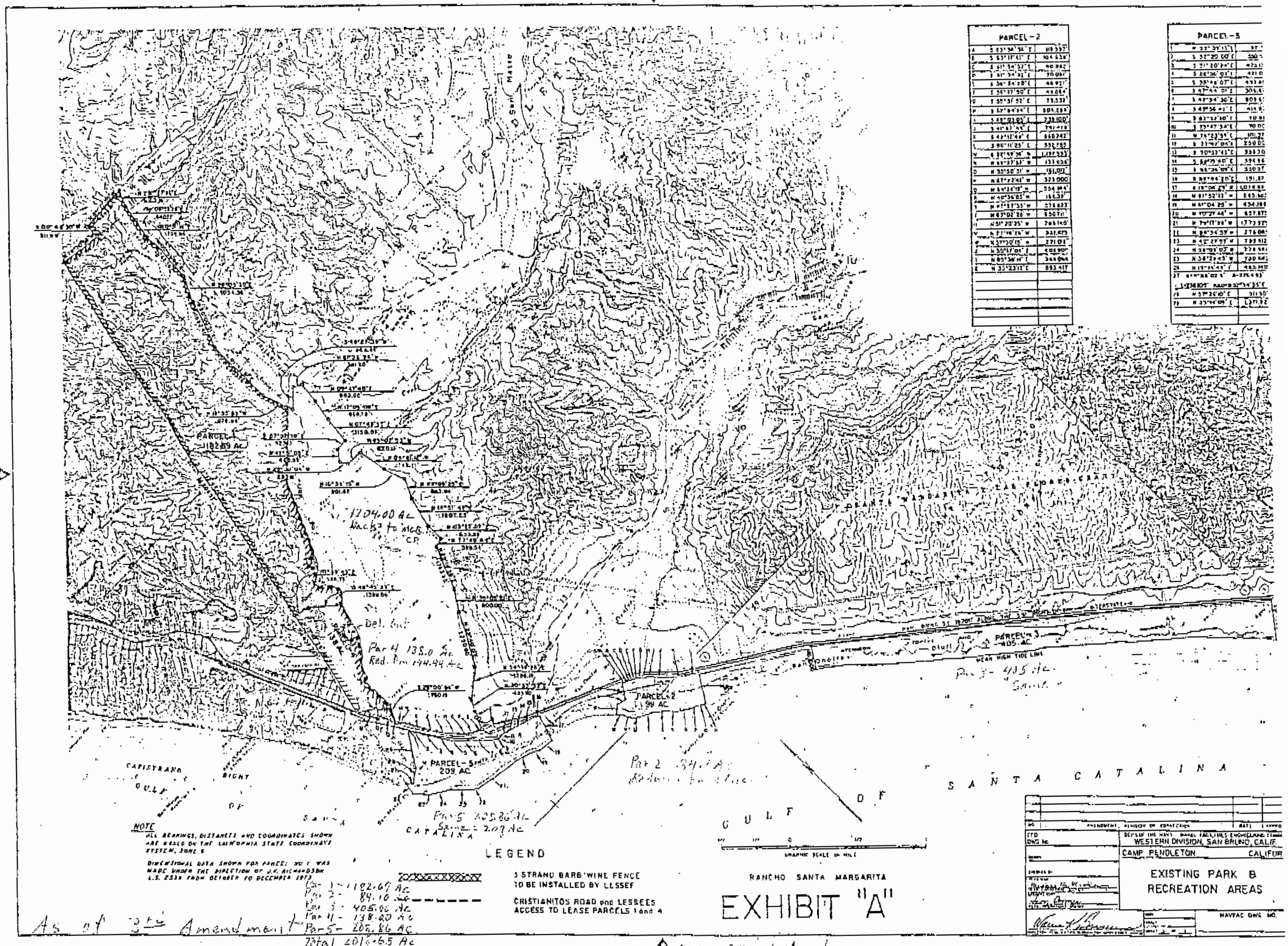
EFD. DWG. No. C-102269

DEPT. OF THE NAVY NAVAL FACILITIES ENGINEERING COMMAND
WESTERN DIVISION, SAN BRUNO, CALIF.

CAMP PENDLETON, CALIFORNIA

EXISTING PARK & RECREATION AREAS

NAVFAC DWG. NO 6032443


PARCEL-2
PARCEL-3
PARCEL-1
1182.69 AC
1704.00 AC
PARCEL-3
405 AC
PARCEL-2
PARCEL-5
209 AC
CAPISTRANO
BIGHT
GULF
OF
SANTA
CATALINA
Par 5 - 205.86 Ac
Same - 209 Ac
NOTE
ALL BEARINGS, DISTANCES AND COORDINATES SHOWN ARE BASED ON THE CALIFORNIA STATE COORDINATE SYSTEM, ZONE 6
LEGEND
3 STRAND BARB WIRE FENCE TO BE INSTALLED BY LESSEE
CRISTIANITOS ROAD and LESSEES ACCESS TO LEASE PARCELS 1 and 4
Par 1 - 1182.69 Ac
Par 2 - 84.10 Ac
Par 3 - 405.00 Ac
Par 4 - 138.40 Ac
Par 5 - 205.86 Ac
Total 2016.65 Ac
As of 3rd Amendment
GULF OF SANTA CATALINA
GRAPHIC SCALE IN MILE
RANCHO SANTA MARGARITA
EXHIBIT "A"
WESTERN DIVISION, SAN BRUNO, CALIF.
CAMP PENDLETON CALIFOR
EXISTING PARK & RECREATION AREAS
NAVFAC DWG NO.

NOT FOR PUBLICATION

UNTIL RELEASED

BY THE HOUSE

RESOURCES COMMITTEE

MAJOR GENERAL WILLIAM G. BOWDON III

COMMANDING GENERAL, MARINE CORPS BASE CAMP PENDLETON

UNITED STATES MARINE CORPS

TESTIMONY

BEFORE THE COMMITTEE ON RESOURCES

UNITED STATES HOUSE OF REPRESENTATIVES

ENCROACHMENT

MAY 6, 2003

NOT FOR PUBLICATION

UNTIL RELEASED

BY THE HOUSE

RESOURCES COMMITTEE

Chairman Pombo, Congressman Rahall, and distinguished members of the Committee, thank you for the invitation to report on the effect encroachment is having on Camp Pendleton's ability to support the training and readiness requirements of Marines and units operating on and deploying from this vital Marine Corps training installation. On behalf of the Marine Corps, I want to thank the Committee for its interest and support. Your attention reveals both a commitment to ensuring the common defense and a genuine concern for the welfare of our Marines and their families.

BACKGROUND

By way of background, Marine Corps Base, Camp Pendleton is the Marine Corps' only training installation on the West Coast for amphibious operations - operations that involve the projection of U.S. force from the sea, which is a principle mission of the Corps. Camp Pendleton is the home of the 1st Marine Expeditionary Force (MEF), which as you know is heavily engaged in Operation Iraqi Freedom. Major subordinate commands of the MEF, the 1st Marine Division, the 1st Force Service Support Group, and elements of the 3rd Marine Aircraft Wing are also based at and train on Camp Pendleton. Elements of the MEF, Marine Expeditionary Units (MEU) are continuously deployed year-round, in support of operations and contingencies in the western Pacific and southwest Asia.

Camp Pendleton's mission is to provide ranges, training lands, and facilities on which Marines can train to achieve the highest possible state of combat readiness. Mr. Chairman, I cannot state strongly enough that the ability of our Marines to achieve their mission and survive in combat depends directly and completely upon the quality of leadership and training they receive. If we cannot provide our Marines, who train on and deploy from Camp Pendleton, with the ability to train as they will be expected to fight in combat, then we (the Marine Corps) will not have met our obligation, either to the Nation or to the Marines that put their lives on the line when called to do so.

Within the past decade, the ability of Camp Pendleton to provide the realistic training environment necessary to prepare Marines for combat has eroded significantly. The factors that cause this degradation of mission capability are termed encroachment by the Department of Defense (DoD). Encroachments present an immediate, serious challenge to the capability of the Base to perform its military mission. Today, the encroachment factors with the potential to impede military training include urban growth, competing land uses, endangered species, cultural resources, and wetlands regulation, airspace restrictions, airborne noise, and air quality.

While we face all of these encroachment factors at Camp Pendleton, endangered species issues are among our most pressing concerns. Camp Pendleton is rich in natural resources and biodiversity, including 18 species listed as threatened or endangered, which have coexisted with our military training and operations for some 60 years now. Still, as the biodiversity of the region surrounding the Base has been steadily depleted by development, the value and regulation of Camp Pendleton's resources have increased. Predictably, restrictions on the military training and operations that occur and need to occur on the Base have increased correspondingly.

As you are aware, just over two years ago on March 20, 2001, congressional dialogue on encroachment impacts was opened by the Senate Armed Services Committee's Subcommittee on Military Readiness and Management Support. Well before 9/11, the Senate, and other congressional committees (such as the House Government Reform Committee and House Armed Services Committee) invited the Marine Corps to provide testimony on the subject of encroachment and its effect on our Title 10-mandated national security missions.

In past hearings, the Marine Corps reported on the impacts of encroachment by providing examples, primarily anecdotal, based on the experience of our trainers. We raised concerns with regard to an erosion of Camp Pendleton's capability to provide realistic combat training for Marines and other services that train on our installation and ranges. Simply stated, the Marines who train at Camp Pendleton and the leadership of the Base, we who are responsible for providing the best possible training environment, have observed that encroachments in fact have degraded and continue to degrade the Base's capability to provide for realistic combat training.

Our commanders have reported that their tactical decisions increasingly are being driven more by restrictions and prescriptions to avoid impacts to protected resources than by the application of sound military doctrine. On a broader scale, the primary determinant for Camp Pendleton's land use has been undergoing a fundamental and disturbing transition - from a Title 10-based, military driver with a responsibility for conservation, to a conservation-based driver within a military context. Marine commanders and small unit leaders should be taught to develop sound tactical schemes of maneuver based upon the mission, the enemy situation and disposition, the terrain, and sound tactics. Yet in the context of training at Camp Pendleton, they are required to plan their training scenarios to avoid protected species and resources and seek permissions and clearances to execute very rigid and tightly orchestrated events. This situation not only significantly diminishes the training value of the exercise but also can instill undesirable habits in our Marines.

QUANTIFYING ENCROACHMENT IMPACTS

To verify the operator's anecdotal experience, Marine Corp Base, Camp Pendleton has been engaged in an effort to develop a methodology and a mechanism that would help us to identify and quantify the encroachment factors that impact the Base's ability to train Marines.

A contracted study, just completed, conducted an assessment of 739 training tasks, as established by Marine Corps Orders, and concluded that encroachment has a measurable negative impact on field training at Camp Pendleton. The data indicated that all field training assessed at Camp Pendleton is affected to some degree by encroachment with ground training tasks being impacted the most. Realistic training is significantly degraded within prime maneuver corridors, training areas, and on the training beaches at Camp Pendleton due to encroachments. For 75 percent of the entities assessed within the context of a notional tactical scenario, the Base could support completion of required tasks to less than 85 percent of the established standard. For 37 percent of the entities assessed within the same scenario, the subject matter experts reported that Camp Pendleton could support the completion of required tasks to less than 70 percent of the established standard. The study determined that a Battalion Landing Team, which is the combat power of a MEU, could complete its required non-firing tasks to less than 68 percent of the Marine Corps standard in a notional tactical scenario. It is precisely the type of training that is required to prepare Marine Corps MAGTFs for deployment and combat that also is most affected by encroachments at Camp Pendleton.

As Figure 1 (A-1) reflects, the effects of encroachment on training increase according to the relative complexity and size of the training event. In general, when tactics are factored into the assessment, the larger the unit involved and the more advanced the task the more significant and adverse the impacts of encroachment on the task completion percentage. In the same vein, the study concluded that the more complex and integrated combat training, involving multiple combat elements, maneuver, and tactical operations, generally is more restricted by encroachment than intermediate unit level training. Intermediate unit training, in turn, generally is more restricted than individual training.

The quantification study confirms that the types of training most inhibited by encroachment include digging, earth-moving activities, and off-road vehicular movement. Limitations on digging have implications far beyond the simple foxhole or fighting position, as important as that is. If individual digging is highly restricted, or regulated, then imagine the difficulty of preparing company or battalion defensive positions. Earthmoving activities to construct emplacements for vehicle or weapons systems, such as artillery pieces, and vehicle recovery operations cannot be accomplished on any significant operational scale. In this case we find the data being reinforced by anecdote, by our operators' real world experiences.

In testimony in May of last year before the House Government Reform Committee, the Commanding Officer of the 15th MEU, who had just returned from Operation Enduring Freedom, Afghanistan, stated that "...The establishment of the security and defensive posture at this position was, in reality, the first time the Marines were able to actually dig and construct appropriate fighting positions required for protection." He added that "...This technique, which should be second nature to Marines in a combat theater, is rarely used in training due to environmental restrictions."

Our quantification effort also has revealed that regulatory restrictions to limit impacts or potential impacts to protected natural and cultural resources constitute over 70% of the primary encroachment factors affecting Camp Pendleton's capability to accommodate essential military training. Compliance with the Endangered Species Act is the leading encroachment factor impacting military training and operations at Camp Pendleton. Despite declarations to the contrary by some groups, our quantification analysis indicates that physical obstacles, such as Interstate 5 and the nuclear power generation plant, both of which have been in place for decades, are not the leading encroachment factors confronted by our forces as they train aboard Camp Pendleton. Our operators insist that the most significant degradation of their training has occurred over the last 10 to 15 years, coincidental with unfettered urbanization and the associated depletion of biodiversity and habitat fragmentation, and the resultant increase in numbers and regulation of endangered species and resources. Unlike infrastructure, which is fixed in time and space, most endangered species move, they often multiply when effectively managed, and additional species become listed as a result of factors over which the Marine Corps has little or no control.

Allow me to provide another real world experience that reinforces this finding. Recently, Marines of the 1st Marine Division approached my staff with a real-world operational requirement to conduct vehicle recovery operations in our Base's lake and ponds and in one of our most highly protected areas, the Santa Margarita River (SMR) estuary. The estuary training was most important to our Marines because it is the largest and only estuary with significant tidal action. There the crews would be subject to changing conditions associated with tidal flows, they could be trained to recognize the optimal crossing points that would support tracked vehicle operations with reduced risk of becoming mired, and to conduct recovery operations while maintaining the momentum of the advance. The estuary also is a prime nesting and management area for endangered California least terns and western snowy plovers; it also is considered essential fish habitat and is designated as critical habitat for the tidewater goby. The unit's request was initiated during the non-nesting period for the least terns and snowy plovers. From the time the request was received, it took two months, and a commitment to implement required avoidance measures, to process the request and receive regulatory clearances for our Marines to conduct their training in the lake and ponds. The process required four months, however, to accomplish the required surveys, prepare necessary documentation, conduct the consultation, and receive regulatory clearances for training in the SMR estuary. Thus, even with all parties providing expedited, priority handling of this operational requirement, the ultimate result was that recovery operations were limited to the lake, as the unit was mobilized and deployed to combat prior to being able to train in the estuary. This is not acceptable.

For years these units have been required to train for vehicle recovery operations by use of a single ditch, specifically established for such operations. One vehicle, one at a time, could pull into the ditch, get stuck and be pulled from the mire. In no conceivable way can this "canned" process be construed to prepare a Marine in vehicle recovery operations for a real-world theater situation. This limited level of training does not begin to replicate the dynamics of vehicle recovery operations while under fire or pressure to maintain the advance, the integrity of an assault and, ultimately, the capture of an objective.

The tragedy of this situation is that for many years Camp Pendleton Marines have accepted that they could not conduct these required operations on the Base – either individually or as a unit – within a tactical scenario. Hence, a critical skill set was allowed to atrophy. A related aspect of great concern, highlighted both by these incidents and by the quantification study, is not to be missed. That lesson is that these deficiencies are then carried over to and absorbed by the major commands to which the Marines are joined and with which they deploy for combat.

This is not to suggest that we can anticipate or should expect the opportunity to rehearse every potential complex, combat evolution. However, what we have learned over the past decade, now reinforced by our recent quantification study, is that we require key areas of Camp Pendleton to be capable of providing an optimal combat training environment. Unit commanders and small unit leaders must be able and, indeed, required to exercise and hone their tactical decision-making skills within the context of scenarios that allow for free play and require instantaneous and correct decision-making.

Restrictions on Camp Pendleton's amphibious landing beaches are well documented in the congressional records, so I will not restate them here except to note that amphibious assaults, raids, and withdrawals are core missions of our Marine Expeditionary Units, Special Operations Capable (MEUSOC's). In addition, the Navy and Marine Corps strategy of From-the-Sea and Over-the-Shore Projection of Force and Sustainment operations requires that we have beaches where realistic amphibious operations can be conducted. Our Marines must have some beach areas available where they can recreate conditions that they expect to encounter in the execution of their global contingencies. In that regard we continue to work closely with our regulatory agencies to reduce those restrictions related to protected resources on our primary training beaches and other areas of the Base to provide more open and realistic use of these crucial training areas.

We are concerned, however, that, in today's climate of regulation-by-litigation, certain laws may not support efforts to accommodate military training and mission requirements in regulatory determinations and opinions. Thus, we view the Department of Defense's Readiness and Range Preservation Initiative as pivotal in the effort to halt the steady erosion of the capability of our installations and ranges to provide realistic training experiences for present and future Marines, units and weapons systems.

READINESS AND RANGE PRESERVATION INITIATIVE

Migratory Bird Treaty Act

The provision enacted by Congress last year, as a result of DoD's Initiative, allows some take of migratory birds, incidental to military training, while requiring that such take be minimized. To operators in the field this provision provides significant benefit as our training activities were previously subject to potential litigation and injunction. Be assured that Camp Pendleton will, through its Integrated Natural Resource Management Plan process, continue to identify measures to monitor, minimize and mitigate - to the extent practicable - adverse impacts to migratory birds that may be attributable to our military readiness activities.

Buffer Acquisition

Through last year's Defense Authorization Bill, Congress granted the authority to military departments to partner with non-governmental organizations, and State and local governments to acquire land adjacent or proximate to military installations to prevent incompatible development, and to preserve habitat that may eliminate or relieve current or anticipated environmental restrictions that could interfere with military training, testing or operations. Already, Camp Pendleton has initiated a partnership effort, the South Coast Conservation Forum (SCCF), to investigate opportunities to acquire interest in lands that could assist in the conservation of many of the federally protected species in the region. Participating in the SCCF are representatives of Orange, Riverside and San Diego Counties, and non-governmental conservation organizations such as The Nature Conservancy, Trust for Public Land, Sierra Club and Endangered Habitats League. Though driven by differing concerns and motivations, this group is quickly finding common purpose for acquiring lands available from willing sellers to support compatible land use and help achieve both encroachment relief and resource conservation objectives.

Critical habitat

Marine Corps concerns about the potential impacts of critical habitat on training at Camp Pendleton often have been described to the Congress, the U.S. Fish and Wildlife Service (Service) and the public. In February 2000, the Service proposed to designate nearly one-half of Camp Pendleton, including all or part of 26 training areas, as critical habitat for the coastal California gnatcatcher. Subsequent, geographically overlapping proposals for several additional species expanded the potential designation of critical habitat to include 57 percent of Camp Pendleton's 125,000 acres, Figure 2 (A-2). In response, the Marine Corps provided detailed comments voicing serious concerns about the impacts of these proposals on training at Camp Pendleton. In his letter forwarding these comments to the Director of the Service, the Commandant of the Marine Corps stated: "Increasingly, limitations on our land use flexibility present a major readiness issue. At stake is the success and survival of our Nations' Marines and Sailors in combat. The proposed critical habitat squarely implicates these urgent military readiness concerns." (Commandant of the Marine Corps, Letter to Director, U.S. Fish and Wildlife, April 6, 2000.)

In October 2000, after extensive inter-agency dialogue, both Camp Pendleton and MCAS Miramar were excluded from the final gnatcatcher critical habitat rule, on the basis of Integrated Natural Resources Management Plans (INRMPs) and the finding that for Camp Pendleton the benefits of exclusion outweighed the benefits of designation under ESA Section 4(b)(2). Subsequently, the Service applied these approaches to exclude military lands in critical habitat proposals for additional species on Camp Pendleton and MCAS Miramar, and to other military lands, including Vandenburg Air Force Base, Camp Parks and Camp San Luis Obispo, California.

The Natural Resources Defense Council (NRDC) immediately sued the Service alleging that the exclusion of Marine Corps lands from critical habitat violated the ESA. These contentions have not been resolved, but have been preserved after the Service petitioned to withdraw and re-examine the gnatcatcher critical habitat rule. As directed by the court, the Service has re-proposed critical habitat for the gnatcatcher and the San Diego fairy shrimp within this past week. The Service has broadly excluded Camp Pendleton from both proposals; approximately 7700 acres are currently proposed as critical habitat for the gnatcatcher and 850 acres of Base lands are proposed for the San Diego fairy shrimp. Similar to such exclusions previously applied to Camp Pendleton, the Service has indicated its understanding of the potential adverse impacts to military training and that those impacts outweigh the potential benefit to the species provided by designation of critical habitat for these species. While we recognize and appreciate the Service's efforts to consider the relevant impacts to our military mission, we have every expectation that, should the final rules for these species also exclude significant portions of Camp Pendleton, there will be a renewal of litigation challenging those exclusions. Thus, the potential remains that 57% of Camp Pendleton lands could be designated as critical habitat, pending court determinations or a legislative remedy. In the meantime, developing case law has had much to say about critical habitat, with a Federal district court opinion holding that the Service's policy on critical habitat designation is unlawful.

Designation of military lands as critical habitat presents a complex public policy problem in sharp focus. The Service has thoughtfully attempted to address this problem through regulatory critical habitat exclusions. These efforts, however, repeatedly have been challenged, and undoubtedly will continue to be challenged, in litigation that disregards military readiness concerns. Having exhausted efforts at administrative and negotiated approaches to solutions, the Marine Corps looks to Congress for guidance. We believe that legislative exclusion of military lands from critical habitat rules is both appropriate and necessary, and is the only solution that will provide the certainty and flexibility we need to train effectively. The critical habitat provision of DoD's Readiness and Range Preservation Initiative proposal, which would exclude military installations and ranges with approved INRMP's in place from designation of such lands as critical habitat, would provide measured and much needed relief from related encumbrances on our military mission activities.

Findings

Among the most important aspects of DoD's RRPI for Camp Pendleton, and as Chairman of the West Coast Regional Review Board I speak for all Marine Corps installation commanders in the Southwest, are the findings that provide congressional recognition of the fundamental purpose for the existence of our installations and ranges. We consider codification of these findings to be absolutely essential to address core encroachment issues by affirming the principle that our military installations, ranges, and airspace exist to ensure military preparedness. Such language is necessary to establish the basis, the balance point, for inclusion of national security requirements in regulatory determinations. Although the basic principle that military lands exist for military purposes, as articulated by the RRPI's findings, would seem self-evident, we find that is generally not the case.

That said, we do not understand the RRPI to be seeking sweeping exemptions from our Nation's environmental laws. We see this initiative to be narrowly focused on a few important resource-related laws and only as they may relate to or unacceptably inhibit our military readiness capabilities that are required by Title 10, U.S.C. The RRPI does not lessen to any degree my responsibility to fully comply with laws that protect both the health and safety of the citizens of our neighboring communities and our natural resources. Camp Pendleton's record clearly reflects our commitment to compliance and responsible stewardship of this national treasure entrusted to our care. I can assure you that Camp Pendleton is committed to continue to advance both compliance and responsible management of our resources to support the sustainable use of our ranges.

STEWARDSHIP

In that regard, Camp Pendleton has a proven record of diligent and responsible stewardship of the environment, including the natural resources entrusted to our care. We remain committed to managing all of our resources, including listed species, in compliance with applicable law. Over the years, our military training has proven to be compatible with healthy ecosystems, and our stewardship both enhances that compatibility and provides assurance of sustainable use. A fundamental principal of our land use and management has been, and will remain, retention of the large, contiguous open spaces necessary for realistic training.

At Camp Pendleton, previous Base commanders and I have restricted infrastructure development to less than 15% of the Base. When additional facilities have been required, our preferred approach has been to refurbish or replace outdated facilities, or to build within existing developed areas. This disciplined land management, coupled with the fact that military training is a relatively low-impact land use (David S. Wilcove, et.al., Quantifying Threats to Imperiled Species in the United States, 48 Bioscience 607, (August 1998)), has resulted in the continuing presence of large tracts of natural habitat beneficial to the wildlife that occupies our lands. In marked contrast to the typical development practices found in other parts of the region, Camp Pendleton's experience is that species, both federally listed and not listed, coexist with our operations and flourish under our management.

In October of 2001, Camp Pendleton published and began implementation of our Integrated Natural Resources Management Plan (INRMP). The import of the INRMP is that it addresses ecosystem requirements holistically, considering the human element (military mission) as an integral part of the ecosystem, and integrates our resource management with our mission essential training and operations. Indeed, the Sikes Act Improvement Amendment (SAIA) requires that INRMP implementation support mission and not constitute a "net loss" in the capability of the installation to support mission requirements. So as land is managed to provide long term, renewal of resources, both the mission and species (listed and unlisted) benefit. It is important to note that implementation of INRMP's is complementary to the Endangered Species Act (ESA) and does nothing to diminish the requirement to comply with the ESA. In fact, Camp Pendleton's INRMP is structured to include all regulatory agreements and requirements established through consultation under the ESA, thereby providing heightened visibility for those commitments.

Over the past five years the Marine Corps has invested, on average, approximately $32 million per year in Camp Pendleton's environmental program. Generally, over $4 million per year has been applied to support our natural and cultural resources programs, with an average of $1.7 million applied directly to threatened and endangered species related requirements. The species depicted in Figure 3 (A-3) represent indicator species for the primary ecosystems that comprise Camp Pendleton - riparian, beaches, and uplands. The least Bell's vireo (riparian species), least tern (beach species) and coastal California gnatcatcher (uplands species) have enjoyed significant success under Base management. The Fish and Wildlife Service has established conservation goals, for some of the listed species we manage, in recovery plans and in the course of consultations under ESA. For the least Bell's vireo, the Base's goal of 300 breeding pairs was established in 1995. Today, we have exceeded that goal by 150%, with over 750 pairs of this species, even considering the significant drought conditions of the past three years. Similarly, for the least tern, the Service's 1980 recovery plan established the recovery objective for the entire species at 1200 pairs distributed in 20 areas over its entire range. Today, Camp Pendleton alone supports 1000 pairs of least terns.

As the populations of listed species increase on Base and as more species that use our habitats become listed, associated restrictions have and will continue to blanket our training lands with increasing limitations on our ability to support mission-essential training requirements. The presence of multiple listed species on Camp Pendleton and required avoidance and minimization measures impose significant constraints on where we train, when we train, and how we train. Hence our dilemma and the reason for my testimony before you today – the costs of endangered species compliance and our resource management programs transcend mere dollars. As our quantification assessment concludes, the true bill-payer is erealistic combat training...and for Camp Pendleton, that has become a source of grave concern.

CONCLUSION

Camp Pendleton is the Marine Corps' only amphibious training base for the west coast, and the only west coast installation capable of supporting combined and comprehensive air, sea and ground combat training. Moreover, its proximity to the Navy's homeport at San Diego is strategically significant in supporting mobilizations and deployments to and contingencies for the western Pacific and Southwest Asia. The Base is a cornerstone of the Marine Corps' training range complex in the southwestern United States, which includes the Marine Corps Air Ground Combat Center in 29 Palms, the Barry M. Goldwater range near MCAS Yuma, Arizona, and the Chocolate Mountains range in the southeastern corner of California. Each installation plays an integral role in the training of Marines and MAGTFs for combat operations. Many of these ranges also are utilized by Marine units from Camp Pendleton to accomplish specific training requirements and as "workarounds" necessary to obtain required training that cannot be satisfactorily completed at Camp Pendleton. Workarounds are not a satisfactory solution. Since these events then must be accomplished in a segmented fashion that is isolated in time, space, and context, much of the tactical decision-making, timing, and training value is lost. Workarounds are insidious in nature, in that they provide the illusion that the training has been accomplished.

While encroachment concerns presently are acute at Camp Pendleton, the Marine Corps also is concerned about encroachments at all installations and ranges in the region. As training opportunities become more encumbered with restrictions or are lost altogether and as encroachment pressures continue to mount - locally, regionally, nationally, and overseas - threats to readiness from the loss of range capabilities are an immediate and serious concern.

Solutions are necessary. A 1992 study of military training in the context of environmental regulation concluded that potential conflicts present "an unusually profound public policy problem." ("Two Shades of Green: Environmental Protection and Combat Training" (Rand 1992).) At Camp Pendleton, we face this profound problem every day. Conflicts or potential conflicts between realistic training and environmental rules, the challenges presented by urban growth, and other competition for scarce land, sea and airspace training resources must be resolved in a way that does not further degrade training.

Again, I thank you for the opportunity to present the Marine Corps' concerns though the eyes of one of its installation commanders. I trust that this testimony will be helpful to your distinguished Committee. Let me assure you that we at Camp Pendleton will continue to be a responsible, effective steward of our environment and our natural resources. We also will continue our efforts to identify and quantify the effects of encroachments on our federally mandated missions. With your assistance and support of DoD's Readiness and Range Preservation Initiative, I am confident that we can achieve and maintain the appropriate balance between military readiness and competing demands for scarce resources. This we must do to ensure that your Marines and their units will be trained and ready to deploy at the highest possible readiness when called by our Nation to do so.

Figure 1. In-Scenario: Tactical Task Completion

Figure 2. Potential Critical Habitat (proposedCY'01)

Major General William G. Bowdon

Commanding General

Bldg 1160

Marine Corps Base

UNITED STATES MARINE CORPS
MARINE CORPS BASE
BOX 555010
CAMP PENDLETON, CALIFORNIA 92055-5010

IN REPLY REFER TO:
5700
CPLO
4 APR 01

Mr. Jeffrey W. Kolb, P.E.
Program Delivery Team South-Team Leader
Federal Highway Administration California Division
980 Ninth Street, Suite 400
Sacramento, CA 95814-2724

Dear Mr. Kolb:

This letter is forwarded as a follow-up to your visit to Marine Corps Base, Camp Pendleton on March 8th. During this visit you asked that Camp Pendleton provide the Federal Highway Administration (FHWA) with a written summary outlining specific reasons why the Marine Corps will not accept nor support either of the two additional on-base SOCTIIP route alignments which have been recently proposed by the SOCTIIP Collaborative group.

As you may recall during your Team's visit to Camp Pendleton, we discussed several factors associated with the two particular SOCTIIP alignments in question (the Cristianitos Road variation and the Ag Field variation) which make them untenable to the Marine Corps. We also provided some specific examples of how, in our opinion, these two alignments will negatively impact the Marine Corps mission at this Base. As presented to your FHWA Team at that time, we view each of these alignments as detrimental to the future mission capabilities of this Base, not to mention the fact that they were created outside the scope of the Marine Corps previous commitment and agreements with the Transportation Corridor Agencies (TCA) regarding any potential use of Camp Pendleton to satisfy the objectives of this project.

The enclosure is forwarded for your information and use as desired. It provides specific details outlining reasons why the Marine Corps is adamantly opposed to, and will not support, either of these two newly-created SOCTIIP alignments. Besides addressing specific mission impacts and other issues of concern resulting from these two non-supportable alignments, the enclosure also provides background information on the Marine Corps long-time involvement with this project. It additionally offers insight regarding the Marine Corps perspective on the issue of "encroachment." In our view, the Collaborative's recent nomination of these more intrusive route alignments (having been added without Marine Corps concurrence or consultation) provides a clear example of this encroachment issue, and illustrates how encroachment, if unchecked, can insidiously effect future mission capability.

We trust that the information provided in this document will be helpful toward your efforts to have these two add-on Camp Pendleton alignments dropped from further EIS consideration. On behalf of the Commanding General, I would like to thank you and the FHWA staff in advance for your personal support and leadership role in attempting to eliminate these two alignment alternatives. Should you have any questions regarding the matters addressed in this correspondence, please do not hesitate to contact the undersigned at (760) 725-6513.

Sincerely,

L D Rannals

L. D. RANNALS
Community Plans & Liaison Officer
By direction of the Commanding General

Enclosure

Why the Marine Corps will not accept the Cristianitos Road or Ag Field Variations as EIS alternatives for SOCTIIP

Background. In 1988, the Commandant of the Marine Corps agreed that the Transportation Corridor Agencies' (TCA) could evaluate one potential alignment of its future-planned Foothill Transportation Corridor-South (FTC-S) project on Marine Corps Base, Camp Pendleton. This Marine Corps Headquarters approval giving the TCA authorization to establish and evaluate one proposed alignment of the FTC-S toll road project on Camp Pendleton was granted subject to the following four stipulations: (1) that other off-base alignment alternatives must also be considered and evaluated in an equal manner; (2) that any proposed Camp Pendleton alignment must closely adhere to the Base's northern boundary; (3) that any adverse environmental impacts created as a result of siting this route on Camp Pendleton must be fully and properly mitigated; and most importantly, (4) **that any on-base alignment must not impact the Marine Corps mission nor interfere with the Base's operational flexibility.**

Since this1988 establishment of Marine Corps policy regarding the TCA's FTC-S project (now known as SOCTIIP), Camp Pendleton has continued to work cooperatively with the TCA and other federal, state or local agencies, as necessary, on various planning issues and other matters associated with the potential location of a SOCTIIP toll road route on this Base. Furthermore, the Marine Corps has agreed to be a federal "Cooperating Agency" with respect to the TCA's preparation of an Environmental Impact Statement (EIS) for the SOCTIIP project. While the Marine Corps has continued to stand behind the Commandant's 1988 commitment to this project, it has also consistently emphasized that only one FTC-S (SOCTIIP) alignment alternative on Camp Pendleton would be authorized for EIS evaluation.

A proposed Camp Pendleton alignment for the FTC-S project was ultimately established and agreed-to by all concerned parties following completion of the TCA's EIR 3 Study, published in 1991. That particular on-base alignment, known at the time as the "Modified C" alignment, was later re-designated as the "CP" alignment; and then under the SOCTIIP nomenclature for this project, it has again been renamed as the "Far East" alignment. Although the name has changed several times, this particular route has been the one and only Camp Pendleton alignment that the Marine Corps has consistently acknowledged as potentially feasible since day-one of its involvement with this project.

During the latter part of 2000, however, the SOCTIIP Collaborative (comprised of several federal regulatory agencies including the Federal Highway Administration (FHWA), U.S. Fish & Wildlife Service (USFWS), Army Corps of Engineers (ACOE), and Environmental Protection Agency (EPA)) determined that two additional SOCTIIP alignment alternatives should be added within Camp Pendleton for EIS analysis. This collective Collaborative decision was made unilaterally without Marine Corps consultation or participation. The Collaborative's addition of two more SOCTIIP route alternatives on Camp Pendleton without Marine Corps concurrence is totally contrary to the Marine Corps long-standing policy regarding the use of Base land to meet the needs of this proposed toll road project. The Marine Corps policy on this matter has been quite clear, consistently expressed, and well-documented for more than a decade now.

Enclosure (1)

Purpose of this Information. The purpose of this paper is to provide the FHWA with more insight into why the Marine Corps cannot support, and will not approve, the selection of either of these additional SOCTIIP alignment alternatives to be constructed on Camp Pendleton. To be quite candid, the Collaborative's unilateral decision to add these two extra Camp Pendleton alignments (without Marine Corps concurrence) is completely antithetical to the Marine Corps last and most important stipulation regarding the use of Camp Pendleton. To reiterate, the Marine Corps most important condition regarding use of Camp Pendleton to meet the needs of this SOCTIIP project requires **that any on-base alignment must not impact the Marine Corps' mission nor interfere with the Base's operational flexibility.**

In our opinion, both of these new alignment proposals (the Cristianitos Road variation and the Ag Field variation) directly conflict with this stipulation. Each of these alignments is seen by the Marine Corps as a serious mission encroachment threat. Before getting into the specific mission impacts associated with these two alignments, it might be helpful to first provide a general discussion on the issue of "encroachment" itself, and how encroachment debilitates the Marine Corps mission at Camp Pendleton. Understanding the issue of encroachment and how this bears on Camp Pendleton's concern with these two additional SOCTIIP route alignments will help the FHWA to better understand the Marine Corps specific concerns with these alignments.

Encroachment at Camp Pendleton: A serious issue of Marine Corps concern. Encroachment, by definition, is insidious. Encroachment at Camp Pendleton comes in many forms, but generally speaking, it's an outgrowth of two major factors - increased environmental regulations and increased urbanization within the regional area around this Base. (Note: It's this latter element, increasing growth and urbanization within many of the southern Orange County communities which has, in fact, been the genesis of the TCA's long-time pursuit of the SOCTIIP project.) Today, the ability of our Marine Corps units to train effectively at Camp Pendleton is being slowly eroded by encroachment on many fronts. Increasing urbanization, environmental restrictions, and increasing requests from civilian authorities for use of Camp Pendleton's land, airspace and sea space threaten the long-term sustained use of this Marine Corps installation.

When Camp Pendleton was first acquired in 1942, the Base was sized to fit the weapon systems of that day. At the time of its establishment, this Base was located in a rural setting having little development and its surrounding communities were relatively small in size. During the 1940s, '50s, and '60s there were no environmental regulations and few man-made encroachments that seriously affected the training mission of Camp Pendleton. Beginning in the 1970s, however, with passage of the Endangered Species Act, along with increasing population growth and urbanization within the communities around the Base, Camp Pendleton begin to experience the initial effects of encroachment. A number of new restrictions, as an outgrowth of increased encroachment pressures, begin to place impediments on the Marine Corps ability to train at this Base. Since then the number of federal environmental laws and regulations has grown exponentially, while simultaneously within many communities around the Base, growing amounts of "hardscape" have slowly replaced landscape. This continued growth in encroachment pressure has now reached the point of strangling training effectiveness. Encroachment continues to be a serious and ever-growing challenge at Camp Pendleton.

While our Base boundaries have essentially remained the same, the footprints of our weapon systems today have become larger. Simultaneously, the once rural, non-populated communities around Camp Pendleton have urbanized and actually developed right up to the Base fence line in some cases. Urban sprawl has now become a close neighbor to Camp Pendleton and its training areas, which were once very remotely located. Noise impacts from many of our routine training activities are already an issue with several surrounding communities.

Marine Corps Base, Camp Pendleton is considered the Marine Corps most complete amphibious training base, yet doctrinal landing and training of a Regimental Landing Team (that first element of ground combat forces which would go ashore in a typical forced-entry amphibious landing operation) is no longer possible at this Base because of various encroachment limitations stemming from both environmental regulations and man-made restrictions. These encroachment limitations not only preclude the execution of Battalion and Regimental sized amphibious landing operations, but they also hinder other training activities even within the Base's inland training ranges and maneuver areas. Because of the many existing encroachment-related restrictions on Camp Pendleton, every square-foot of this Base is considered important from a training perspective.

Fundamental to the success of modern Marine Corps training operations are the concepts of expeditionary maneuver warfare and combined arms. Yet current encroachment restrictions on Camp Pendleton severely degrade the Marine Corps ability to train using doctrinal maneuver warfare and combined arms tactics. The employment of naval surface fires, air support, artillery, mortars and direct fire weapons in conjunction with maneuver warfare is essential to the effectiveness of the Marine Air Ground Task Force (MAGTF). Currently at Camp Pendleton, encroachment limitations have debilitated our MAGTF training capabilities. The impact of encroachment on mission readiness is difficult to measure in tangible terms because of its insidious nature. However, we do know that a long list of current encroachment restrictions has created a very inflexible training environment at Camp Pendleton. This lack of flexibility impacts the effectiveness of a unit's tactical training, which in turn leads to the unit's tendency to avoid certain types of training activities, which decreases the use of some areas on the Base, which leads to more potential encroachment of these little-used areas, which leads to less training and a continual debilitating downward spiral.

The agonizing result of this whole matter is the inability of Marine unit leaders to execute various courses of action during training operations. Commanders of MAGTF organizations must be able to think and operate "on the move." In the Marine Corps' view, the ability to change courses of action represents the embodiment of initiative and judgement, which is what "military tactics" is all about. Initiative and judgement can only be learned in a flexible training environment where leaders are confronted with various courses of action and must make decisions. Regrettably, however, we are now training a generation of Marines who will have less experience in the intricacies of combat operations because of our inability to allow flexibility to exist in our training activities. If encroachment pressures continue to grow at Camp Pendleton, many of today's junior leaders may be forced to face the full challenge of combat for the first time during actual combat itself.

While encroachment inexorably shrinks the use of our training ranges, the Marine Corps continues to be faced with the need to introduce and train with new weapon systems possessing increased, stand-off, survivability, and lethality capabilities. The present training demand on Camp Pendleton is already high. Furthermore, potential closures of other military installations around the country and overseas, which could be brought about with another round of future congressionally-mandated base closings, may result in Camp Pendleton having to assume new mission responsibilities. This Base is already arguably one of the Department of Defense's busiest military installations; and as new Marine Corps weapon systems are brought into the inventory or activities of other defense installations are relocated here, we expect Camp Pendleton to become even busier in the future.

One may ask, what does SOCTIIP have to do with the Marine Corps' encroachment concerns? The simple answer is that this proposed SOCTIIP project represents a prime example of how the effects of surrounding urban sprawl can negatively impact a military installation's training mission. Further, this project also presents a good example of how the use of federal land is oftentimes viewed by public agency officials as the easiest means for solving regional transportation problems. As previously stated, the Marine Corps and Camp Pendleton have acknowledged and accepted the Far East alignment as a reasonable SOCTIIP alternative; and should this route be the one ultimately selected by FHWA as the most appropriate alignment to construct, the Far East alignment could be established on this Base with little detrimental impact to the Marine Corps mission, now or in the future. Such would not be the case for either of the other two Camp Pendleton proposed alternatives, however. Presented below in more detail are specific reasons why neither of these other two suggested on-base SOCTIIP alignments are acceptable to the Marine Corps.

Protection of Marine Corps Mission Requirements (Now and in the Future). After presenting the above background information on the Marine Corps' past history with this project, and providing a general overview of the Marine Corps' encroachment concerns, the remainder of this paper will now focus on reasons why the Marine Corps cannot agree to support either of the two newly proposed on-base SOCTIIP alignments. Although any number of potential SOCTIIP alignments could be proposed along the northern boundary area of Camp Pendleton, the Marine Corps views any alignment (other than the Far East alignment) to be a clear threat to its national security mission. For this reason, we believe no other alignments on this Base should be considered by FHWA as either feasible or prudent.

In our view, any alignment other than the previously agreed-upon Far East alignment will stifle Camp Pendleton's ability to develop new training facilities or expand current training resources to meet future training needs within this area of the Base. We believe Camp Pendleton is a unique national asset; any degradation of this installation's ability to train Marines to fight and win on the battlefield is not in the best interests of the United States. Moreover, we believe the potential negative impact to national security readiness, that could result with construction of either of these other two unacceptable alignments, would represent a far greater loss than any adverse affects construction of the Far East alignment might pose to the State Park or its natural resources. Let's now examine some specific issues of concern directly related to these other two proposed alignments. Summarized below are the mission-related impacts which we believe would occur in conjunction with implementation of either of these other two alternatives.

San Mateo Aquifer. One of our biggest concerns with the Cristianitos Road and Ag Field alignments is their potential negative impact on the San Mateo aquifer. In comparison to the Far East alignment, these two routes are aligned much closer to the San Mateo aquifer, and even potentially overlie a portion of it. This aquifer is extremely important to Camp Pendleton, as it provides the primary source of all potable water for the entire northern half of Camp Pendleton between Camp Horno and the Base's northern border with Orange County. Camps San Mateo, San Onofre, Cristianitos, Talega, and 1,150 units of family housing located at the northern end of the Base are all served with potable water from this aquifer. Additionally, all training facilities within the northern half of the Base and the 600-acre San Mateo agricultural lease all receive their water supply from this aquifer. Of the four underground aquifers which serve all of Camp Pendleton's potable water needs, the water of the San Mateo aquifer has been found to be the most pristine, so it's our best (water quality) aquifer. It provides approximately 3/4 of the total water consumed within all of the northern portion of Camp Pendleton.

We are concerned that the further south a potential SOCTIIP alignment may come into the Base, the more potential it has to jeopardize the Base's long-term use of this aquifer as a result of storm water runoff or hazardous spill events, either of which could contaminate or degrade water quality within this aquifer. One of Camp Pendleton's biggest assets today, is its self-sufficiency with respect to potable water needs. The Base's entire water system is supplied from well sites within our four underground aquifers. Unfortunately, however, the Base, in reality, actually operates two separate and independent water systems, a north Base and south Base system. These two systems are not interconnected, so if one system is lost to contamination, the affected water service area cannot be fed by the other system. This points directly to one of our major concerns with these two additional SOCTIIP alignments and their potential affect on the San Mateo aquifer. If we should lose use of it as a result of runoff or hazardous spill contamination, the Marine Corps would then be forced to import water from an outside agency to serve the northern Base areas, presumably at great expense.

To be more specific about this aquifer protection issue, several additional points are listed below as to why we are opposed to any SOCTIIP route alignment within or near the San Mateo Basin area of the Base (which is the case of both these two newly proposed alignments):

(1) The water quality impacts within the Cristianitos and Lower San Mateo Watersheds from pavement runoff will likely be more severe than from the Far East alignment, and the risks of damage from a toxic spill will be greater. Even the Far East alignment gives us some concern with respect to this aquifer, but the magnitude of threat increases dramatically as the roadway moves closer to (or directly overlies) the aquifer, which is the case with these two alignments.

(2) The roadway embankment will reduce aquifer recharge by interfering with infiltration within a substantial area of ground to be covered by the embankment and all associated roadway structures. Further, a major part of the precipitation falling on this area will not only be degraded in quality, but lost to pavement runoff as well, while much of the remainder will be prevented from reaching the water table due to the roadway geometry and ground cover.

(3) Compaction induced by the weight of the roadway embankment will reduce aquifer capacity. Due to the unconfined nature of the aquifer, earthquake ground motion and drought drawdown

will exacerbate this impact.

(4) Aquifer yield may become limited due to restrictions on the flexibility with which the aquifer can be managed. The substantial surface area to be covered by the roadway embankment will severely restrict the Base's latitude with respect to where future wells can be placed and operated for optimum management of this groundwater resource.

(5) Similar water supply impacts will also be suffered by the San Mateo Basin riparian ecosystem, thereby potentially adversely affecting several listed endangered/threatened species as well.

(6) Finally, no substitute water supply will be as dependable or reliable as the San Mateo aquifer. An imported water supply from Orange County into the northern area of the Base will be subject to all the same potential disruptions and reductions as are oftentimes typical of many water sources and supplies imported into Southern California.

Future Training Requirements. A second area of concern, but of no less importance than protecting our on-base water supply is the issue of protecting this land area for use in the future to support Marine Corps training requirements. The construction of either of these other two alignment alternatives would severely limit (or possibly even prohibit) Camp Pendleton's ability to develop new training areas and/or training support facilities within this most northern section of the Base. Although there may be no current plans now calling for development of additional training areas or facilities at locations near the proposed routes for these other two SOCTIIP alternatives, we cannot allow development of either of these two routes to closeout that option in the future. The Marine Corps must be able to maintain flexibility with respect to its land use options, so as to meet any future training requirements. Once in place, a SOCTIIP toll road on Camp Pendleton will establish a permanent land use barrier along the entire northern section of the Base, thus forever impeding the Marine Corps future ability to support any new missions or adapt future training needs to meet mission requirements within this area of the Base. While the Marine Corps has agreed that one on-base alignment of the SOCTIIP project can, in fact, be planned and evaluated by the TCA as an EIS alternative, it's also important that the Marine Corps minimize the amount of Camp Pendleton land area that will forever be lost to future training uses because of its being segmented (severed by presence of the toll road) from the remainder of the Base.

Marines will soon be operating the revolutionary MV-22 Osprey tilt-rotor aircraft and the Advanced Amphibious Assault Vehicle (AAAV). Along with the Navy's Landing Craft, Air-Cushioned (LCAC) ocean transportation vessel, the MV-22 and AAAV provide enhanced ship-to-shore capabilities required for future Marine Air Ground Task Force operations. The Marine Corps aviation element will also eventually be receiving the Short Take-off and Vertical Landing version of the Joint Strike Fighter, an aircraft that can be operated from expeditionary airfields as well as permanent bases, amphibious ships and aircraft carriers. In addition, the Marine Corps will soon be fielding a new generation of modern ground weapons systems to include the High Mobility Artillery Rocket System (HMARS) and the lightweight 155-mm Howitzer. Finally, the Marine Corps will also be acquiring a new replacement for the medium tactical vehicle and the Hercules recovery vehicle. The Marine Corps' ability to fully exploit these future weapon systems and support such equipment modernizations and improvements will depend, in part, on the availability of adequate training space at bases like Camp Pendleton.

The above list of new Marine Corps equipment and weapon systems will eventually be introduced to Camp Pendleton; and once on-board, may require that some additional land areas along Camp Pendleton's northern boundary be used to support their specific mission requirements. Many of these new weapons systems are already approved for Marine Corps acquisition, while others like the MV-22 are still undergoing research, test and evaluation before introduction into the Marine Corps inventory. The key point, however, is that once they're here at Camp Pendleton, we must find the land, air or sea space to support their operational training requirements and everyday utilization. That area of the Base selected by the Collaborative, without Marine Corps concurrence, for alignment of the Cristianitos Road and Ag Field variations of SOCTIIP, may ultimately prove to be the most desirable or appropriate training area of the Base for operating some of this new equipment. Thus, we cannot agree to eliminate such future training support considerations right off-the-bat by authorizing this area of Camp Pendleton to be reserved for or consumed by the SOCTIIP project.

Northern Maneuver Corridor. Both of these two unacceptable SOCTIIP alignments also have the potential to negatively impact or even eliminate the use of Camp Pendleton's most northern Maneuver Training Corridor (see the attached Camp Pendleton map depicting all of the Base's Maneuver Corridors). The northern Maneuver Corridor, like others on the Base, has primarily been established for use by battalion-sized units to train in maneuver warfare. Typically, such training within the northern Maneuver Corridor begins with an amphibious landing at Green Beach, along the northern coast of Camp Pendleton. After crossing Interstate 5, Marine units then utilize a combination of live-fire and maneuver tactics to advance inland toward ultimate objective areas, usually located in the northeastern portion of Camp Pendleton near Case Springs. The Talega and San Mateo Canyon areas represent two of the best routes for units to use in advancing along the northern Maneuver Corridor toward Case Springs. However, units oftentimes utilize areas of the Base adjacent to the State Park lease, including Cristianitos Road, as an inland access route to reach interior areas of the Base where more intensive live-fire and maneuver training activities can occur. The Marine Corps is concerned that the more inland any SOCTIIP alignment may come, the more potential it will have to negatively affect the Marine Corps' ability to use the northern Maneuver Corridor and practice this type of well-dispersed, highly mobile maneuvering which characterizes modern warfare.

LCAC Inland Training Area. The U.S. Navy's Landing Craft, Air-Cushioned (LCAC) vessel plays a key role in the support of the Navy/Marine Corps amphibious assault team. The LCAC is capable of bringing large payloads of personnel and equipment ashore from ships at sea at very fast speeds. And although the LCAC is primarily used to bring both Marines and large pieces of Marine Corps equipment ashore during amphibious landings, it also has an over-land mission support requirement as well. One of the LCAC's assigned mission requirements is to be able to operate within inland areas over land masses away from the beachhead itself. At Camp Pendleton, the only place along the Base's 17 miles of coastline where LCAC vessels are able to gain access to such inland training areas is along the northern coast of the Base. This inland LCAC access to Camp Pendleton is now only available via San Mateo Creek and passage beneath the I-5 bridge above the creek, then directly into the San Mateo Ag Field area. The San

Mateo Ag Field and Basin area is currently the only place on Camp Pendleton where this type of inland LCAC training can take place.

Although no LCAC training operations are presently conducted in the San Mateo Basin or adjacent Ag Field area today, the Navy has, in fact, studied and evaluated the potential use of this particular Base area as a future LCAC training site. As is the case with our previously-expressed concern regarding the Marine Corps' soon-to-be-received new weapon systems and equipment upgrades, we cannot now eliminate the Navy's future ability to use either the San Mateo Basin or Ag Field area as an LCAC training site by now agreeing to offer-up this area to support a potential SOCTIIP toll road route. Any early agreement that allows for a SOCTIIP route alignment to traverse this area of the Base would unquestionably prohibit the Navy's future use of this area for LCAC training purposes.

Future Expansion of Camp Talega. Camp Talega, which is presently Camp Pendleton's most northern and least developed cantonment area, currently serves as the headquarters area for the Base's Reserve Support Unit (RSU). It also provides support facilities for a variety of other Marine Corps and Naval organizations based at Camp Pendleton. While some of Camp Talega's assigned units are active-duty organizations, this area of the Base mostly supports Marine Reserve units and a variety of other assigned organizations. The tenant organizations currently located at Camp Talega include the aforementioned RSU Headquarters, the 4th Light Armored Reconnaissance Battalion, Special Operations Training Group (I MEF G-7), the Mobilization Processing Center, Naval Personnel Mobilization Team 2419, and Construction Battalion Maintenance Unit 303. Camp Talega is also used in support of the Young Marines and Sea Cadets youth programs when these organizations come aboard Camp Pendleton for training sessions and other field activities. Finally, Camp Talega is the primary location on Camp Pendleton where, on average, over 185 visiting Reserve units of all Services are located/billeted each year when they are here to fulfill active duty training obligations. During Fiscal Year (FY) 2000, Camp Talega hosted over 18,000 Reservist personnel from all Service branches. We expect that number to significantly increase in FY-01.

Although Camp Talega is already a busy facility, we envision this Camp becoming even busier in the future. A major revitalization effort to improve facilities at this Camp is just now entering the early phases of a planning process. This future Camp Talega improvement process is being driven to a large degree by recently passed Congressional legislation which directs all Services to begin implementation of more joint use training activities and shared use of facilities. The sense of the Congress with this new legislation is to require that both active and reserve components of all Services only pursue funding for facility construction projects which meet this "joint service" utilization criteria. With this legislation as enacted by the 106th Congress in mind, the Camp Pendleton RSU has begun to see an increased interest within both Marine Corps and other Service reserve units, in wanting to relocate some of these Reserve organizations to Camp Pendleton and Camp Talega, in particular.

At the current time, we are already aware of one Marine Corps Reserve organization with preliminary plans to relocate to Camp Talega. This unit is the 4th Force Reconnaissance Company (Det) now located in Reno, Nevada. We are currently in the initial planning phase for a potential move of the 4th Force Recon Company to occur possibly as soon as the summer of

2001. Another Marine Reserve unit, the 4th Tank Battalion, also has plans to relocate it's Headquarters element to Camp Talega, although no specific date has yet been established. We've also had direct inquiries from the 640th Military Intelligence Battalion of the California National Guard regarding their desire to relocate to Camp Talega. Planning for that move is already underway within the California Guard organization.

These above planned relocations represent only the first of what we expect to be a major thrust in the future, because of this new Congressionally driven desire to see more Reserve unit co-locations and use of joint training facilities. With its location on Camp Pendleton, and the many valuable training resources that this Base has to offer, we're finding that Reserve Forces among all the Services are now beginning to take a serious look at the potential to relocate units to Camp Talega and this Base. Because of this new shift in thinking, we see the use of Camp Talega and its surrounding training areas as continuing to grow exponentially over the next several years; thus, our current plan to begin a major revitalization effort within this Camp.

While this projected growth in the future use of Camp Talega will primarily be oriented to the construction of new facilities in support specific missions and training requirements for the active and reserve units previously mentioned, a Base master planning effort is also underway which envisions the use of Camp Talega as a Marine Corps historical area. The Base History and Museums Office is considering the use of Camp Talega to highlight the history of Camp Pendleton's contribution to the legacy of the United States Marine Corps. As part of this effort, the Base would establish a museum and historical center within Camp Talega, open for civilian and military visitors alike, which serves to commemorate the rich heritage of Camp Pendleton's contribution to the nation's past wars and conflicts.

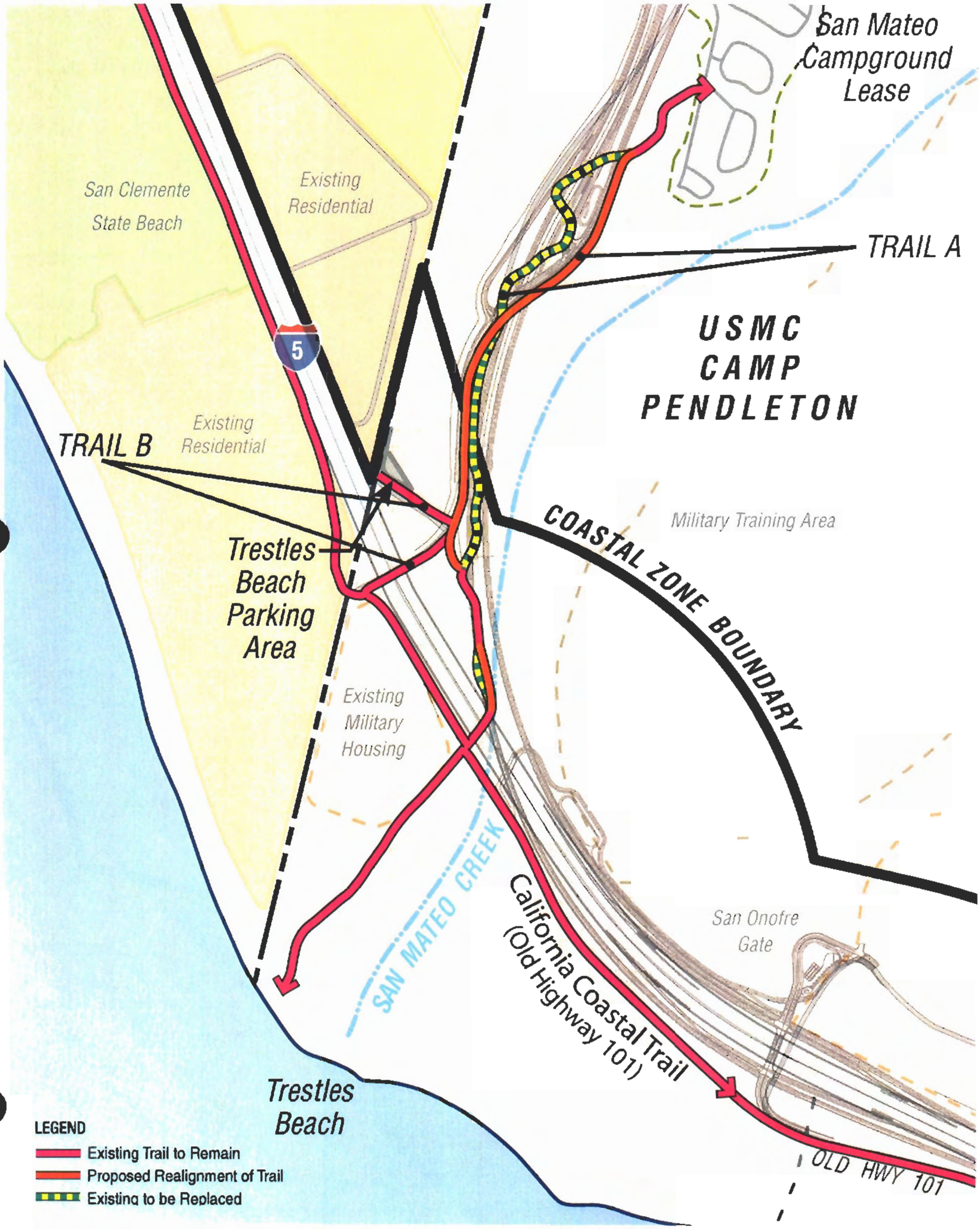
With these projected increased future uses of Camp Talega in mind, this adds yet one more reason why the Marine Corps is unable to concur with the SOCTIIP Collaborative's recent decision to insert yet two more, further intrusive toll road alignments on this Base.

__Future BRAC Requirements__. In a close parallel to the Camp Talega issue discussed above, we're also concerned with what may result from the recommendations contained within any future Congressionally approved Base Realignment and Closure Commission (BRAC) studies. There's currently a recognition within DoD that another round (or possibly several successive rounds) of potential BRAC studies may be initiated within the next few years. If this occurs, there's likely to be many more DoD Base closings directed in the outyears, and some of the functions or organizations at those closed Bases would likely be relocated to Camp Pendleton.

With this future need in mind, Camp Pendleton must preserve as much of its currently available land resources as possible, so as to incorporate and support any newly acquired missions/functions that could come here from other BRAC-closed facilities/installations. This absorption of new missions may even require that Camp Pendleton to consider canceling or modifying some of its current tenant land use agreements. This is just one more reason why we must minimize the Camp Pendleton land area that will be severed and forever lost from use by construction of a SOCTIIP toll road through this Base.

Trail References in SOSB

Staff Report (9/07) Response



State Parks Adjacent To, On or Bisected By State Highways

Park Name[1]	Highway/No Highway	Includes Camping	Trailer/RV
1. Andrew Molera State Park 1)[2] 1968; 2)[3] 11/71	adj. to Hwy.	Andrew Molera State Park "walk-in" Trail Camp	
2. Anza-Borrego Desert State Park 1) 1933; 2) 5/63	bisected by Hwy. 78	Vaqui Pass; Tamarisk Grove and Vaqui Well Campgrounds	X
3. Benbow Lake State Recreation Area 1) 1958; 2) 5/63	adj. to Hwy. 1	No formal name for "campground"	X
4. Benicia State Recreation Area 1) 1951; 2) 9/63	adj. to Hwy. 780 as Rt. 74 – became Hwy. 780	Limited to RV's; campground not named on DPR web site	
5. Basin Redwoods State Park 1) 1906; 2) 5/63	bisected by Hwy. 236	Huckleberry, Sky Meadow, Sempervirens, Sequoia Group, and Blooms Creek Campgrounds	X
6. Bothe – Napa Valley State Park 1) 1960; 2) 5/63	adj. to Hwy. 29	Ritchey Creek Campground	
7. Brannan Island State Recreation Area 1) 1952; 2) 5/63	adj. to Hwy. 160 as Rt. 11 – became Hwy. 160	Willow and Cottonwood Campgrounds	
8. Calaveras Big Trees State Park 1) 1931; 2) 5/63	adj. to Hwy. 4	North Grove and Oak hollow Campgrounds	
9. Carpinteria State Beach 1) 1932; 2) 7/63	adj. to Hwy. 101	Anacapa, Santa Rosa Santa Cruz and San Miguel Campgrounds	X

[1] Park and campground names, locations and descriptions obtained from DPR state park web site at http://www.parks.ca.gov/?page_id=21491; last accessed 12/13/07.
[2] 1) = Year property was acquired by the State.
[3] 2) = Parks for which a specific, legislatively-defined classification was approved either by the State Park and Recreation Commission or, in rare instances, assigned to the land by the California Legislature on the date specified.

Park Name[1]	Highway/No Highway	Includes Camping	Trailer/RV
10. Castle Rock State Park 1) 1968; 2) 7/68	adj. to Hwy. 35	Waterman Gap and Castle Rock Trail Camps	
11. Crystal Cove State Park 1) 1979; 2) 4/80	adj. to Hwy's. 73 and 1	"backcountry primitive camping;" lodging at Crystal Cove Beach Cottages	
12. Cuyamaca Rancho State Park 1) 1933; 2) 5/63	bisected by Hwy. 79	Green Valley and Paso Picacho campgrounds; Los Vaqueros Group Camp; Los Caballos Horse Camp	X
13. Del Norte Coast Redwoods State Park 1) 1925; 2) 5/63	bisected by Hwy. 101	Campground not named on DPR web site	X
14. D.L. Bliss State Park 1) 1929; 2) 5/63	adj. to or bisected by Hwy. 89	Campground not named on DPR web site	X
15. Donner Memorial State Park 1) 1928; 2) 5/63	adj. to Hwy. 80	Ridge, Splitrock and Creek campgrounds; Murphy "cabin sites"	
16. Eastshore State Park 1) 1985; 2) 12/02	adj. to Hwy. 80		
17. Ed Z'berg/Sugar Pine Point State Park 1) 1965; 2) 6/66, 8/03	adj. to Hwy. 89	General Creek campground	
18. Emerald Bay State Park 1) 1953; 2) 5/63	bisected by Hwy. 89	Campground not named	
19. Fort Ross State Historic Park 1) 9/1909; 2) 9/63	on Hwy. 1	Reef Campground	
20. Garrapata State Park 1) 1979; 2) 11/05	on Hwy. 1		

Park Name[1]	Highway/No Highway	Includes Camping	Trailer/RV
21. Gaviota State Park 1) 1953; 2) 7/63, 2/68	bisected by Hwy. 101	Gaviota State Park campsite	
22. Grizzly Creek Redwoods State Park 1) 1943; 2) 5/63	adj. to Hwy. 36	Campground not named	
23. Henry Cowell Redwoods State Park 1) 1953; 2) 5/63	partially adj. to Hwy. 9	Campground not named	
24. Humboldt Lagoons State Park 1) 1931; 2) 5/63, 6/83	adj. to Hwy. 101	Dry Lagoon and Stone Lagoon Campgrounds	
23. Humboldt Redwoods State Park 1) 1921; 2) 5/63	adj. to Hwy. 101	Albee Creek, Baxter Environmental, Hamilton Barn Environmental, Burlington, Hidden Springs and Williams Grove campgrounds; Cuneo Creek Horse Group camp	
24. Jedediah Smith Redwoods State Park 1) 1939; 2) 5/63	bisected by Hwy. 199	Jedediah Smith Campground	X
25. Julie Pfeiffer Burns State Park 1) 1962; 2) 5/63	Bisected by, and adjacent to, Hwy. 1	Walk-in environmental campsites[4]	
26. Leo Carrillo State Park 1) 1953; 2) 7/63, 10/96	on Hwy. 1	Canyon Campground	
27. Limekiln State Park 1) 1994; 2) 2/01	adj. to Hwy. 1	Campground not named	

[4] "Environmental Campsites' are "isolated, primitive campsites within state parks where cars are not allowed, and supplies must be carried in." *California Coastal Resource Guide* at pg. 371 (California Coastal Commission 1987)

Park Name[1]	Highway/No Highway	Includes Camping	Trailer/RV
28. MacKerricher State Park 1) 1949; 2) 5/63	on Hwy. 1	Campsites: West Pinewood, East Pinewood, Cleone and Surfwood	
29. Navarro River Redwoods State Park 1) 1996; 2) 4/91	on Hwy. 128	Paul M. Denmick and Nevarro Beach Campgrounds	
30. Pfeiffer Big Sur State Park 1) 1933; 2) 5/63	on Hwy. 1	Campsites along Big Sur river – campground not named	
31. Point Magu State Park 1) 1966; 2) 3/67; 2/71	adj. to Hwy. 1		
32. Red Rock Canyon State Park 1) 1970; 2) 7/73, 2/80	bisected by Hwy. 14	Ricardo Campgrounds	X
33. Richardson Grove State Park 1) 1926; 2) 5/63	bisected by Hwy. 1	Huckleberry, Dawn Redwoods Group, Madrone and Oak Flat Campgrounds	
34. Russian Gulch State Park 1) 1933; 2) 5/63	adj. to Hwy. 1	Campground not named	
35. Salt Point State Park 1) 1968; 2) 1/69	adj. to Hwy. 1	Gerstle, Woodside and Group Campgrounds	X
36. Salton Sea State Recreation Area 1) 1951; 2) 5/63	adj. to Hwy. 111	Campground not named	X
37. San Elijo State Beach 1) 1953; 2) 5/69	adj. to Old Hwy. 101		
38. San Luis Reservoir State Recreation Area 1) 1969; 2) 6/67 [sic?]	adj. to Hwy. 152	Basalt, San Luis Creek, Medeiros and Los Banos Campgrounds	X

Park Name[1]	Highway/No Highway	Includes Camping	Trailer/RV
39. Silverwood Lake State Recreation Area 1) 1978; 2) 6/72	adj. to and bisected by Hwy. 138		X
40. Sonoma Coast State Park 1) 1934; 2) 7/63	Adj. to Hwy. 1		X
41. Topanga State Park 1) 1967; 2) 7/74	bisected by Hwy. 27		
42. Van Damme State Park 1) 1932; 2) 5/63	bisected by Hwy. 1	Highland Meadow and not named campground areas	

LSA

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20 EXECUTIVE PARK, SUITE 200
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949.553.8076 FAX

BERKELEY
CARLSBAD
COLMA
FORT COLLINS
PALM SPRINGS
POINT RICHMOND
RIVERSIDE
ROCKLIN
SAN LUIS OBISPO

MEMORANDUM

DATE:	December 20, 2007
TO:	David Lowe, Project Engineer
FROM:	Steve Conkling, LSA Associates, Inc.
SUBJECT:	The Need for Traditional Cultural Property Evaluations for *Panhe* and Trestles in the vicinity of the Foothill Corridor-South (FTC-S), as Requested by California Coastal Commission Staff

The Staff Report identifies the need for Traditional Cultural Property (TCP) Evaluations for *Panhe* and Trestles Beach. This memorandum is intended to explain why the California Coastal Commission has adequate information to evaluate the impacts to cultural resources and to assess the reasonableness of the mitigation measures in the absence of additional TCP evaluations.

Panhe

The status of Panhe as a TCP is not in question: it is recognized by the fact that the San Mateo Archaeological District (SMAD) has been determined eligible under both Criteria A and D. The Criterion A eligibility is centered on the status of the site as *Panhe* (an ethnographic village) and is based on oral descriptions and traditional use. Since the eligibility of the District has been extablished, the impacts have been assessed in accordance with that status.

The project is consistent with the requirement in Section 30244 of the Coastal Act that "reasonable mitigation" be required through the project's compliance with Section 106 of the National Historic Preservation act of 1966 (as amended) and 36 CFR Part 800, and by the avoidance, monitoring, preservation and recordation measures incorporated into the project. A Historic Property Treatment Plan is being prepared as part of the Section 106 compliance, and that Treatment Plan will include implementation level details of the mitigation that has been included in the project.

Trestles Surfing Area

On November 27, 2007, the Federal Highway Administration (FHWA), in consultation with Caltrans, Camp Pendleton Environmental Security and the Advisory Council on Historic Preservation, established that the boundary of the surfing use area is well outside of the Area of Potential Effect for the FTC-S project, and that other existing modern facilities (e.g., the train tracks/trestle bridge, old SR-101, and Interstate 5[I-5]) are present between the surfing use area and the FTC-S. FHWA therefore has concluded that the FTC-S project will not have any effect on the surfing use area. Therefore, a TCP Evaluation to determine the status of the surfing use area is not necessary because FTC-S is not within the area of surfing use, and the proposed FTC-S/I-5 connectors are far enough away from the surfing area that there will be no substantive indirect effects to its use.

U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION
CALIFORNIA DIVISION
650 Capitol Mall, Suite 4-100
Sacramento, CA 95814
December 31, 2007

IN REPLY REFER TO
HDA-CA
Document # P58067

CERTIFIED RETURN RECEIPT REQUESTED: **7003 1680 0002 3834 1619**

Mr. Milford Wayne Donaldson, FAIA
State Historic Preservation Officer
Office of Historic Preservation
P.O. Box 942896
Sacramento, CA 94296-0001

Attention: Ms. Susan Stratton

Dear Mr. Donaldson:

Susan, thank you for coming down to meet with us on December 19, 2007 on the Mid County Parkway and SOCTIIP for an update on each project. I wanted to follow up with you on the discussion we had regarding Trestles, as it is a deviation from our plan earlier this year. Specifically, Mike McGuirt had requested that we determine whether Trestles was a traditional cultural property. We agreed, and a scope of work was developed for the analysis. At that time, we determined the area to be studied as the area from about 2,300 feet north of the northern bank of the San Mateo Outlet (a break locally called "Cottons") to well south of the San Onofre Nuclear Generating Station and extending on the east to the area between the sandy beach and the vegetated and developed areas along the coast.

In the preliminary stages of literature review, it became apparent that there was not universal agreement as to the boundary and that some parties identified the topic, "Trestles," as much larger than the mouth of San Mateo Creek, as I had originally believed. Some sources indicate that it may extend up and down the coast for perhaps several miles.

Consequently, we met with Camp Pendleton, the landowner, to discuss the situation. At that meeting, we established that the FHWA would determine its study area under Section 106. On November 28, 2007, FHWA, Caltrans, and Camp Pendleton confirmed the study area, and on December 19, 2007, ACHP agreed with the study area.

When we visited the portion of the "Trestles Surfing Area" closest to San Mateo Creek on October 10, 2007 with Mike and Carol Legard of the ACHP, I was truly surprised to see how far away from our project it is. It is not close enough to be within the area of potential effect. From the beach, San Mateo Creek is not visible, as a berm of sand blocks its mouth, forming an inland fresh water impoundment. Except during major storm events, San Mateo Creek drains into the Pacific Ocean through the subsurface. As described by Robinson in 1840, this appears to be the natural condition of this drainage. TCA has prepared additional visual simulations which illustrate that the preferred alternative for SOCTIIP would not be visible from various locations along the beach. While the surf break is itself an impressive sight from the beach the wave noise completely obscures any audible indication that the I-5 freeway was only about 3/4 mile away. In fact, the embankment of the Amtrak Rail Line and the old Pacific Coast Highway are closer to the beach but again not noticeably so. The intervening vegetation completely screens the beach from the development. Trains on the rail line are visible from the beach, and there are 174 weekly passenger trains on that line. There are also an undetermined number of freight trains using that route.

The proposed SOCTIIP project will not impose visual, auditory, or atmospheric elements on the Greater San Onofre Surfing Area. FHWA has determined that the entire Greater San Onofre Surfing Area is outside of the SOCTIIP study area. This is true regardless of how far south the boundary of any Surfing Area is defined. The SOCTIIP Preferred Alternative would be located on the inland side of existing old Highway 101, and the improvements on the I-5 (for the connector and merging of the Preferred Alternative with the I-5) end a short distance after the existing San Onofre Bridge. Therefore, the study area is wholly outside of the Trestles area.

Sincerely,

/s/ Edrie Vinson

For
Gene K. Fong
Division Administrator

TCA I-5 MOTEL/INN ANALYSIS

)otels/Inns < $100	# of Rooms	Address	Phone #	APN #	Alternative	Rate (Varies Seasonally)	Notes
C VU MOTEL	6	2415 S. EL CAMINO REAL SAN CLEMENTE, CA 92672	*	060-031-33	I-5 & AIP	$35 - sgl or dbl	* Would not give out phone number Photos # 38 & 39
LA VISTA INN MOTEL	10	2435 S. EL CAMINO REAL, SAN CLEMENTE, CA 92672	949-498-2782	060-031-44	I-5 & AIP	$40 - sgl, $50 - dbl	Photos # 36 & 37
TRADE WINDS MOTEL	10	2001 S. EL CAMINO REAL, SAN CLEMENTE, CA 92672	949-492-8888	690-402-11	I-5 & AIP	$50 - sgl, $85 - dbl	Photos # 57 & 58
CARMELO MOTEL	12	3619 S. COAST HIGHWAY SAN CLEMENTE, CA 92672	949-492-0387	060-111-14	I-5 & AIP	$60 - sgl, $70 - dbl	Photos # 16 - 20
THE INN AT CALAFIA	16	2341 S. EL CAMINO REAL, SAN CLEMENTE, CA 92672	949-492-1174	060-031-11	Not in either Alternative	$60 - sgl, $70 - dbl	Photos # 40 - 43
BUDGET LODGE	23	2002 S. EL CAMINO REAL SAN CLEMENTE, CA 92672	949-361-2110	690-443-01	I-5 & AIP	$60 - $70 - sgl, $70 - $80 - dbl	Photos 45 & 46
TRAVEL LODGE MOTEL	24	2441 S. EL CAMINO REAL SAN CLEMENTE, CA 92672	949-498-5954	060-031-43	I-5 & AIP	q	Photo # 35
SAN CLEMENTE'S LITTLE INN BY THE BEACH	18	1819 S. EL CAMINO REAL SAN CLEMENTE, CA 92672	949-492-1960	690-401-39	I-5 & AIP	$70 - sgl, $80 - dbl	Photo # 47
SAN CLEMENTE MOTOR LODGE	15	2222 S. EL CAMINO REAL SAN CLEMENTE, CA 92672	949-492-4992	690-445-04	I-5 & AIP	$75 - sgl, $80 - $85 - dbl	Photo # 44

TCA I-5 MOTEL/INN ANALYSIS

Motels/Inns < $100 (Cont.)	# of Rooms	Address	Phone #	APN #	Alternative	Rate (Varies Seasonally)	Notes
LAGUNA INN & SUITES	32	28742 CAMINO CAPISTRANO SAN JUAN CAPISTRANO, CA 92672	949-347-8520	637-231-04	I-5 & AIP	$79.95 - sgl, $89.95 - dbl	Photos # 55 & 56
MOTEL ENGLISH	8	2727 S. EL CAMINO REAL SAN CLEMENTE, CA 92672	No Phone Number	060-074-12	I-5 & AIP	$ 800/mo.	Photos # 21 & 22
Total # of Hotels: 11	**Total # of Rooms: 174**						
Motels/Inns < & > $100	**# of Rooms**	**Address**	**Phone #**	**APN #**	**Alternative**	**Rate (Varies Seasonally)**	**Notes**
BRISA DE SAN CLEMENTE	14	711 S. EL CAMINO REAL SAN CLEMENTE, CA 92672	949-492-3114	692-411-06	I-5 & AIP	$69 - sgl, $109 - dbl	Photos # 48 - 50
COMFORT SUITES	63	3700 S. EL CAMINO REAL SAN CLEMENTE, CA 92672	949-361-6600	060-112-17	I-5 & AIP	$89.99 - sgl, $119 - dbl	Photos # 13 - 15
Total # of Hotels: 2	**Total # of Rooms: 77**						
Motels/Inns > $100	**# of Rooms**	**Address**	**Phone #**	**APN #**	**Alternative**	**Rate (Varies Seasonally)**	**Notes**
HOLIDAY INN	72	111 S. AVENIDA DE LA ESTRELLA SAN CLEMENTE, CA 92672	949-361-3000	692-401-08	I-5 & AIP	$109 - $139 - sgl & dbl $169 - ocean view	Photos # 51 & 52
HOLIDAY INN	147	25205 LA PAZ ROAD LAGUNA HILLS, CA 92672	949-586-5000	620-81-08	I-5 & AIP	$119 - sgl, $119 - $159 - dbl	Photos # 53 & 54

TCA I-5 MOTEL/INN ANALYSIS

Motels/Inns > $100 (Cont.)	# of Rooms	Address	Phone #	APN #	Alternative	Rate (Varies Seasonally)	Notes
HAMPTON INN & SUITES (FORMERLY QUALITY INN SUITES)	69	2481 S. EL CAMINO REAL SAN CLEMENTE, CA 92672	949-366-1000	060-041-01	I-5 & AIP	$139 - sgl, $179 - dbl	Photos # 32 - 34
Total # of Hotels: 3	**Total # of Rooms: 288**						

City of San Clemente
Engineering Division
M. Akram Hindiyeh, Senior Civil Engineer
Phone: (949) 361-6127 Fax: (949) 361-8316

March 20, 2000

RECEIVED
MAR 23 2000
CDMG

Mr. R. Scott Bacsikin
Transportation Corridor Agencies
125 Pacifica
Irvine, CA 92618-3304

Subject: "No Build" I-5 Widening for Foothill South

Dear Scott:

Thank you for providing the information on the I-5 widening alternative through San Clemente. We have reviewed the drawings and identified certain design features of note, as well as other items that should be included in this reconstruction alternative. The "No Build" I-5 widening alternative has devastating impacts on the City, long term and short term during the construction.

The drawing does not show travel lanes on the freeway mainline, ramps, or City streets. We have estimated the number of lanes based upon the envelope of construction shown, however it will be necessary to have the actual proposed number of lanes to conduct a complete review. It is our understanding that a minimum of two lanes are needed along the I-5 in each direction. We are also unsure if existing or required climbing lanes and auxiliary lanes are included in the study. Auxiliary lanes should be provided between most closely spaced interchanges. Climbing lanes should be provided for the upgrades on both sides of Avenida Pico.

The information provided does not indicate traffic conditions or expected Levels of Service at ramp junctions or at intersections that will be affected by the proposed alternative. Several proposed intersections may experience significantly changed volumes due to reorientation of access and changes in freeway access.

The Camino de Estrella interchange should provide 3 lanes for the off ramps at the ramp junctions. Also, the overcrossing should provide width to allow for dual left turn lanes to I-5 southbound in addition to 4 through lanes. Similarly dual right turn lanes are required for the northbound direction in the northeast quadrant.

The Vista Hermosa interchange shows impact to the two apartment buildings on the northeast quadrant.

The Avenida Pico interchange shows full takes for numerous retail and light industrial businesses and the Main Post Office Building. This includes large areas within the northwest and southwest quadrants. The amount of displaced businesses may be significant enough to affect the overall city tax base, particularly if relocation within San Clemente is not possible. The businesses of the type found in the northwest quadrant cannot be easily relocated due to the unique nature of the industrial neighborhood at this location.

The disruption of access to the remaining retail businesses near Avenida Pico is severe. The plan shows all access to the retail center remaining on the southwest quadrant via a frontage road intersection with Avenida de los Molinos near Avenida Pico. The ability of these commercial businesses to survive this access reduction is in question, however the ability to meet the needs of the commercial center with the access proposed is in greater doubt. An alternate plan that is less disruptive to businesses is requested, if possible.

The traffic forecasts for Avenida Pico are quite high at the freeway (54,000 - 60,000 ADT) and the traffic is mostly accessing the freeway, evidently. This interchange illustrates the need to evaluate traffic conditions on the arterial system in more detail. Also, since Avenida La Pata and Avenida Pico are clearly acting as a replacement to the Foothill South in the forecast, we are concerned with potential future actions to ramp meter the southbound on-ramp. A strategy to meter this ramp would be in direct conflict with the functional purpose indicated for the roadway.

The El Camino Real interchange also shows full takes of numerous businesses and residences on the west side of the freeway due to the realignment shown for El Camino Real. The need for this realignment is not understood. It seems that an alternative that preserves the existing alignment and reduces the number of full takes is possible in this area.

El Camino Real is shown to be relocated easterly about 30 feet south of Avenida Mendocino. This results in a full take of numerous residences and businesses along the street. Again, the amount of displacement of small businesses and affordable housing in this area probably cannot be replaced easily within the City.

The "No Build" I-5 widening alternative assumes that Avenida La Pata is built to its maximum capacity of six lanes within the City limits. The traffic flow map shows that Avenida Pico will be operating at LOS E or F. Therefore, Avenida Pico between Avenida La Pata and the I-5 will be required to be widened by at least one lane in each direction. This will have a large impact on the existing retail businesses and the High School.

The traffic flow map projects the traffic volume on El Camino Real to be 60,000 ADT within the City. This will have a devastating impact on the City, as El Camino Real will be required to be widened to a minimum of 6 lanes, plus additional right and left turn lanes. This will require the complete full take of the businesses on El Camino Real. This will have significant impact to the City's tax base, as relocation of these businesses to other locations within the City, is not possible.

Thank you for the opportunity to review the proposed alternative.

Sincerely,

M. Akram Hindiyeh

M. Akram Hindiyeh
Senior Civil Engineer

CC: David N. Lund, Public Works & Economic Development Director
James S. Holloway, Community Development Director
William E. Cameron, City Engineer

STATE OF CALIFORNIA--BUSINESS, TRANSPORTATION AND HOUSING AGENCY Arnold Schwarzenegger, Governor

DEPARTMENT OF TRANSPORTATION
DISTRICT 12
3337 MICHELSON DRIVE, SUITE 380
IRVINE, CA 92612-8894
PHONE (949)724-2102
FAX (949) 724-2591

Flex your power!
Be energy efficient!

June 21, 2006

Ms. Lisa Cathcart-Randall
Federal Highway Administration
650 Capitol Mall, Suite 4-100
Sacramento, CA 95814

Subject: Response to Submitted Documents Addressing SOCTIIP

Dear Ms. Cathcart-Randall:

Below are the California Department of Transportation (Department) comments to statements made in the **Shute, Mihaly & Weinberger's** letter to TCA dated January 12, 2006 and January 18, 2006 and their supporting documents **(KCA Engineering, Smart Mobility Incorporated – (SMI), Dr. Caroline Rodier, Jared Ikeda Report** and **Dan Silver)**. In summary all comments relate to the following issues:

1. Viability of the Arterial Improvement Plus (AIP) which includes one general purpose lane and one HOV lane in each direction above the baseline on the I-5,
2. Question the right-of-way needs for the I-5 improvements,
3. Suggest using the HOT lane concept in lieu of HOV to pay for the proposed infrastructure,
4. Do not follow the Department's mandatory design standards,
5. Claim that the Department's design standards are not mandatory, and
6. Question modeling methodologies used in the SOCTIIP EIS.

The above referenced issues address geometric standards, operational strategies and planning methodologies. The following is a discussion of these issues. (For a more detailed description of the issues please see the attachment).

Department response to Issues # 1, # 2, #3, #4 and #5.

- **Topic 82.1.2 Application of Standards of the Highway Design Manual (HDM)** states Mandatory Design Standards are those considered most essential to achievement of overall design objectives. Many pertain to requirements of law or regulations such as those embodied in the FHWA's 13 controlling criteria. Mandatory standards use the word "**shall**" and are printed in **Boldface** type (i.e. **Topic 301** mandates lane width **shall** be 3.6m or 12 feet, **Table 302.1** Shoulder Width left and right **shall** be 3.0m or 10 feet for a multi-lane freeway).
- **Department Standards (Topic 102) referenced in the Highway Design Manual (HDM)** states "freeways should be designed to accommodate design year peak hour (PH) traffic volumes". The number of lanes required on a multi-lane urban freeway is based on PH volume per lane at level of service between C and E. KCA was tasked to study two

options (1) addition of HOV lane in each direction and (2) addition of HOV and General Purpose Lane in each direction. There was no level of service analysis indicating how either one of the proposals would provide an adequate level of service.

- **Design Period HDM Topic 103.2 "Geometric design** of new facilities should normally be based on estimated traffic 20 years after completion of construction." **New facilities shall be designed to full standard.** Projects such as Safety, Resurfacing, Restoration, and Rehabilitation (RRR) and operational improvements are designed on the basis of current Average Daily Traffic (ADT). Non-standard features may be approved as an "interim" treatment since they provide a quick and cost effective mitigation for an existing condition with the caveat the Department commits restoring the non-standard condition to full standards in the future. For example the SR-55 HOV lane (17^{th} Street to SR-91) in 1985 was constructed at a minimal cost ($255,000 Contract Change Order) only to be restored to full standards in 2001. A project on the I-405 to restore the median shoulder and full width lanes between SR-73 and I-605 is currently under study. The **KCA Study** should follow standards used on the I-5, to add lanes, north of SR-133 in lieu of "interim" standards used between Camino de Las Ramblas and SR-133. **KCA analysis** assumes elimination of the shoulder, reduction in the width of the lanes and no enforcement areas. This approach is not in compliance with state and national standards used for implementation of projects addressing future needs.

- When considering alternatives, the Department must consider full standards for all alternatives such as 12' lane, 4' HOV Buffer, 10' median, and 10' outside right shoulders. **KCA's study task** of **Task 1,** 1 HOV lane and **Task 2,** 1 General Purpose Lane and 1 HOV lane in each direction. In either case the proposed lane additions would not provide the number of lanes required to meet demand or design standards referenced above. For instance, implementing **Task 2** would require an additional 60 to 84 feet if auxiliary lanes were added where needed. In summary **KCA** analysis by not using adequate number of lanes to meet demand and ignoring mandatory standards to implement Tasks 1 and 2, results in erroneous right-of-way needs.

- The Department has no programmed funding for any capacity enhancement project for the I-5 in south Orange County. Also, it does not anticipate any funding from the **Transportation Equity Act: A Legacy for Users (TEA-LU).** SMI assumes a single lane HOT lane is financially viable option and capable of providing sufficient funds to plan, design, construct and operate this strategy. There is no single project in the country that has shown that this assertion is achievable. SMI provided no data showing how it arrived at such a conclusion. SMI also assumes that you can build HOV or HOT lanes on freeway segments that experience high demand only. Unlike auxiliary lanes that could be built between on and off ramps. It is not possible to take a similar approach when constructing HOV/HOT lanes. This is due to the difficulty of beginning and ending HOV/HOT facilities on a segment by segment basis. SMI also ignore the need for gap closure. For instance, SANDAG's Regional Transportation Plan shows four (4) managed lanes to the Orange County Line.

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Department response to Issues #2, 4 and 5

- **SMI** states that the I-5 impact could have been reduced and refined through re-striping and widening on one side by moving the centerline.....All **Build Alternatives** include several **Project Design Features (PDFs)** intended to reduce and minimize potential environmental impacts on the human and natural environments (i.e. wildlife crossings, runoff management features, retaining and soundwalls, landscaping and lighting). Typically any realignment to the centerline is considered during refinement at the design stage. The SOCTIIP analysis arguably is very conservative in its estimate of right of way needs to implement the I-5 widening alternative. For instance, if the Foothill South Extension is not built, the added traffic to the I-5 ramps through the cities of San Clemente and San Juan Capistrano would require a greater storage capacity necessary for ramp metering operation and hence greater right-of-way takes necessary to reconfigure the ramps. Benefits of added interchange capacity, provided by the Foothill South Extension, could not be underestimated. It provides significant improvements to the ramp metering operation along the I-5 corridor and minimizes the impact to the arterial system in the vicinity of the I-5 interchanges that would result by the combination of increased demand and inadequate storage capacity. Also design refinement along the I-5 may show the need for additional climbing lanes at Avenida Pico for the HOV lane, general-purpose lanes as well as the need for CHP enforcement areas. These potential refinements may result in greater right-of-way needs.

- **SMI** also assumes that providing additional lanes on Antonio Parkway/Avenida La Pata between Oso Parkway and Avenida Pico would further support the I-5 alternative. Although Antonio Parkway/Avenida La Pata would be a critical component of the arterial circulation system, their benefit to the I-5 is anticipated to be minimal and in some cases detrimental. In the northbound direction Avenida La Pata/Antonio Parkway take you further away from the I-5 that runs diagonally making it more difficult to return to the I-5. In the southbound direction traffic terminating at Avenida Pico would further exacerbate the currently congested I-5/Avenida Pico Interchange. There is no analysis provided in the **SMI** report to indicate how traffic terminating at Avenida Pico could continue to the I-5 from this location. Arterial improvements along the I-5 corridor are critical in minimizing short trips but lack any viability when it comes to providing a significant alternative to the I-5 diagonal corridor. Currently, the portion of the I-5 between the Orange/San Diego County Line and Oso Parkway continues to be the only significant highway with adequate capacity to support local and regional traffic north of the San Diego County Line. This is evidenced during major incidences in San Juan Capistrano and San Clemente when regional traffic is advised to use SR-91 and I-15 due to lack of any viable alternative to the I-5. The Foothill South Extension would provide the needed alternate for both recurrent and non-recurrent demand.

Department response to Issue #6

- Results of any model are only estimates - they cannot provide a definitive picture of what will happen in the future. Much like economic projections, transportation forecasts are greatly affected by the long-term economic health and attractiveness of the region, by population changes, and by the individual behavior of each person using the transportation system. Methodologies used in the SOCTIIP EIS are consistent with other modeling efforts used in other projects throughout the state. It may have actually gone further than is required. Furthermore, members of the Collaborative representing several federal and state agencies insisted on having a consultant verify and validate the traffic model being used in the study. **Mr. John Long** of **DKS Associates** located in Sacramento, California after a lengthy review of all methodologies concluded that "the proposed modeling tools are sound and well validated and I have not found any new issues concerning the proposed forecasting process." Furthermore, he states, "the proposed process should provide an adequate and defensible analysis of the SOCTIIP alternatives for the EIR/EIS." The Department as well as members of the Collaborative reviewed the independent consultant conclusion and concurred with the **DKS** findings.

OTHER NON-RAISED ISSUES THAT DIRECTLY IMPACT CONSIDERATION OF ALTERNATIVES

- **What would be the impact of the TCA's non-compete agreement on any I-5 improvements?**

  The non-compete clause stipulates that should we decide that it's in the best interest of the state to provide a competing project, the state shall pay the **TCA** on an annual basis, an amount equal to the loss of toll revenues directly or indirectly resulting from the specific improvement and only if **TCA** is unable to satisfy its obligations under the Indentures of Trust. The agreement allows an HOV lane to be constructed on I-5 from Avenida Pico to Pacific Coast Highway (where the HOV now terminates). The state can construct all safety, maintenance, and operational improvements without restrictions. All non-compete clauses expire in 2020.

- **Exclusions of the non-compete agreement include**:

  1. Any State highway projects included in the 1992 STIP adopted by the CTC in 1992.
  2. Those State highway improvements specifically described in OCTA's Revised Improvement and Growth Management Plan" (Measure "M") which were approved in November 1990.
  3. Any State highway improvements necessary for improved safety, maintenance or operational purposes.
  4. Any project identified for the Congestion Management Plan (CMP), adopted by OCTA but limited to intersection improvements and those that are consistent with the MPAH adopted by the Orange Co. Board of Supervisors on 8/11/92.
  5. Any inter-city, Commuter, Urban, and/or High Speed rail projects supported by the State and or others.
  6. Any HOV exclusive lanes operationally required by environmental regulatory agencies.
  7. Any HOV exclusive lanes on I-5 between Avenida Pico and State Route 1.

- **Capacity Adequacy of 2025 Freeway/Tollway Mainline**

The Department has reviewed the Capacity Adequacy of the preferred alternative (2 general purpose lanes and 1 HOV lane in each direction in lieu of 3 general purpose lanes and 1 HOV in each direction) and **found that it met the Highway Design Manual as well as other national standards**. The analysis shows that the Level of Service (LOS) under the preferred alternative is **LOS D** or better. Please refer to **Page D-89 SOCTIIP Traffic and Circulation Technical Report Appendices (Volume 1)** for pertinent and detailed information.

In responding to the above issues, the Department has made every effort to address every concern and include documentation that would support its reasoning and arguments. However, should you have any additional questions on this, please do not hesitate to contact me at (949) 724-2102.

Sincerely,

Lisa Ramsey

Lisa Ramsey
Office Chief/Corridor Project Manager

Cc: J. Beil
S. Vega

Attachment

Attachment

Department's Technical Review and Comments for FHWA Regarding Documents Provided by Dan Silver

Below are California Department of Transportation (Department) comments to statements from Shute, Mihaly & Weinberger's letter to TCA dated January 12, 2006 and January 18, 2006 and their supporting documents.

Summary of Comments by Shute, Mihaly and Weinberger et al

- The EIR summarily rejected an alternative combining limited improvements to the I-5 and selected arterials, based on demonstrably erroneous claims of displacement impacts and associated funding shortfalls. Erroneous Information concerning taking of homes and other structures. The numbers were used as a basis for concluding that the AIP and several other I-5 focused alternatives were infeasible. **Peter Bekey of KCA Engineering** was employed to assess displacement impacts.

- **Peter Bekey's KCA Report** is based on a weekend trip, in which, he reviewed the I-5 in San Clemente. Peter drove the freeway and walked the fronting streets and cul-de-sacs and reported on his findings. This report was not based, on any construction or right-of way plans, nor was there any analysis of traffic volumes. He concludes that the addition of an HOV lane in each direction should not involve the need to acquire buildings. Peter was also to address what the impact would be if the freeway were increased by one more lane of about 13' in each direction in addition to an HOV lane.

- **Mr. Bekey** asserts that Caltrans could provide widening in San Clemente, similar to what was done on I-5 within the San Juan Capistrano area by simply restriping to create a high occupancy vehicle (HOV) lane adjacent to the exist median. In some areas, he proposes to widen on one side of the freeway to avoid displacement impacts. The report concludes that with this two-stage widening of I-5 within San Clemente can be accomplished with acquisitions of approximately 23-27 buildings. And, if based on the "very preliminary overview of the site conditions," that it is determined as a viable project, then the next step is to acquire existing construction drawings and right-of-way and Assessor maps. Based on that information, preliminary plan lines could be drawn and design criteria established relative to such items as lane width, shoulder width, median island widths, etc.

- **Smart Mobility Incorporated – (SMI),** a practical, Cost Effective and Environmentally Superior Alternative to a New Toll Road for the SOCTIIP states, "TCA's Failure to Incorporate Induced Demand in Traffic Modeling underestimates future traffic by an amount that is an Order of Magnitude greater than the purported Benefits of the Project." TCA used demonstrably inferior static modeling approach that dramatically overstates the traffic benefits of the Project. The static approach fails to account for induced demand, that is, increases in traffic volumes or changes in traffic patterns that result when drivers respond to new roads or greater highway capacity. **SMI** suggests a conversion to HOT lanes should also be considered as is similar to SR-91 and I-15 in San Diego County.

- **Caroline Rodier Response to Traffic Response to Comments for the SOCTIIP EIS/SEIR** – Dr. Rodier alleges, "the failure to represent the change in land uses induced by an increase in the supply of highway capacity in analysis of the SOCTIIP alternatives would tend to
  1. Overestimate congestion benefits of the build alternative and
  2. Underestimate VMT and vehicle emissions for the build alternative."

- **JARED IKEDA REPORT** - Diagrams prepared by Jared Ikeda provide graphic illustration of information contained in the KCA Report and the TCA Relocation Impacts Technical Report. Diagrams identify a thirteen-foot wide area from the edge of existing shoulder of either side of the highway.

STATE OF CALIFORNIA—BUSINESS, TRANSPORTATION AND HOUSING AGENCY ARNOLD SCHWARZENEGGER, Governor

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Flex your power!
Be energy efficient!

January 7, 2008

Tay Dam
Federal Highway Administration
650 Capital Mall, Suite 4-100
Sacramento, California 95814

Dear Mr. Dam:

The California Department of Transportation (Department) reviewed the September 2007 version of "An Alternative to the Proposed Foothill South Toll Road; The Refined AIP Alternative", a report prepared by Smart Mobility, Inc. (SMI Report) in collaboration with Philip Williams & Associates, Ltd., ORW Inc., and Oman Analytics. The Department finds that the SMI Report and its conclusions are not supported by adequate engineering and technical analysis.

The SMI Report proposes refinements to the Transportation Corridor Agencies' Arterial Improvement Plus (AIP) Alternative to reduce right of way impacts associated with the AIP alternative and states that the SMI Report alternative is functionally identical to the AIP.

The SMI Report does not provide supporting analysis for traffic capacity, traffic operations, application of standards and practicality of horizontal and vertical geometric design, and fails to address cumulative infrastructure impacts (such as utilities), construction staging impacts and other constructability concerns. Attachment "A" details Department concerns specifically related to missing interchange details and missing traffic performance information in the SMI Report alternative. The alternative presented in the SMI Report does not meet Department standards, and in our view does not meet applicable engineering standards of care. Therefore, the Department cannot support the proposed design refinements or conclusions.

Please call me at (949) 440-3440 or Lisa Ramsey, Office Chief/Corridor Project Manager at (949) 724-2102 if you have additional questions on the information provided herein.

Sincerely,

Cindy Quon

CINDY QUON
Director
District 12

Attachment

c: J. Beil, Caltrans
L. Ramsey, Caltrans
T. Margro, TCA
D. Lowe, TCA

Although not a comprehensive list, following are some California Department of Transportation (Department) concerns and comments concerning the Smart Mobility Report (SMI Report) dated September 2007.

1. The Interchange Detail Sheets, also described as Interchange Area Concepts, show interchanges with only minimum associated right of way impacts. The proposed Interchange Detail Sheets show that Department Single Point Interchange (SPI) Guidelines and Department Highway Design Manual (HDM) guidelines are not accurately represented. Therefore, interchange right of way impacts identified in the SMI Report appear to be misrepresented due to the following:

    a. *El Toro Interchange:*
        i. The right turn on ramp alignments from El Toro road do not merge safely with the main segment of the onramps, and are not in conformance with design standards.
        ii. Detail concept drawings are missing the following details: merge, storage, auxiliary lanes and shoulders.
        iii. The I-5 undercrossing would require complete reconstruction to provide proper vertical clearances and horizontal sight distances.
        iv. Impacts associated with vertical clearances and necessary profile changes are not shown.
        v. Minimum distance between ramp intersections and local road intersections are not met.

    b. *La Paz and Oso Parkway, and El Camino Real Interchanges:*
        i. Horizontal and vertical geometric data is not provided in the report and impacts cannot be ascertained.

    c. *Crown Valley Parkway Interchange:*
        i. The right turn on ramp alignments from Crown Valley Parkway do not merge safely with the main segment of the on ramps, and are not in conformance with design standards.
        ii. It is unclear how the southbound off ramp flyover gets under Crown Valley Parkway and has the required vertical clearance over the I-5 freeway; and then is able to span the northbound ramps and touch down in just a few hundred feet just prior to the intersection. Or, if the southbound off ramp flyover goes over Crown Valley parkway, then the ramp will need to start further back to achieve an acceptable profile. These impacts are not clearly shown.
        iii. Required auxiliary, merge and storage lanes, and shoulders are missing.

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iv. Southbound off ramp merge conflicts with signalized interchange. Potential weave related issues are not addressed. Merge lane ends at existing right turn only lane.
v. Access Control is not attainable without removal of adjacent intersection. This would have additional impacts, including re-routing traffic and increasing traffic in other locations.
vi. The profile of Crown Valley would need to be raised if a ramp flyover or SPI were installed (which would require the reconstruction of both Camino Capistrano and Crown Valley Parkway). Associated traffic impacts not identified.
vii. Horizontal curve hidden by Crown Valley over crossing and horizontal curves following vertical crests created. Associated sight distance restrictions are not addressed.
viii. Reverse curves should provide adequate tangent section for superelevation transitions.
ix. Horizontal and vertical geometric data and/or assumptions are not provided in the report.
x. Length of southbound off ramp requires a second passing lane (HDM 504.3).
xi. Side slopes are not identified (HDM 304.1)

d. *Ortega Highway Interchange:*
i. The detail concept drawing is missing dedicated right turn lanes; and merge, auxiliary, and storage lanes and shoulders.
ii. The right turn on ramp alignments do not merge safely with the main segment of the onramps, and are not in conformance with the design standards.
iii. Impacts associated with vertical clearances and necessary profile changes are not shown.
iv. Minimum distance between ramp intersections and local road intersections are not met.

e. *Pico Interchange:*
i. The concept drawing is missing the following: dedicated right turn lanes on Pico; and merge, auxiliary, storage lanes and shoulders.
ii. The right turn on ramp alignments do not merge safely with the main segment of the onramps, and are not in conformance with the design standards.
iii. Pico is on a horizontal curve. The horizontal curve will make it difficult for the driver to determine the proper lane as the driver approaches the intersection.

iv. Impacts associated with vertical clearances and necessary profile changes are not shown.

2. The SMI Report claims that "The interchange designs as shown for the AIP-R alternative provide sufficient capacity to serve the I-5 interchange ramp volumes cited in the Supplemental Environmental Impact Report…" However, the SMI Report does not provide any SPI level of service analysis for review. The SPIs would not provide similar levels of service as the interchange designs listed in TCA's Traffic and Circulation Technical Report, Table E-40 for AIP. The following is a rough assessment of the Table E-40 AIP traffic numbers and levels of service, and how the traffic volumes may be reflected in an SPI.

   Pico/I-5: southbound direct and loop on ramp PM peak hour volumes of 370 and 1410 provides level of service A and E respectively. If a SPI or diamond interchange were provided, then the combined peak hour volumes of 1780 vehicles provide a level of service F.

   Crown Valley/I-5: northbound direct and loop on ramp PM peak hour volumes of 1810 and 900 provides a level of service F and D respectively. If an SPI or diamond interchange were provided, then the combined volumes of 2710 cars provide a level of service F. The AM Peak hour volumes for northbound direct on ramp and northbound loop on ramp of 1570 and 720 provide level of service F and B respectively. If an SPI or diamond interchange were provided, then the combined peak hour volumes of 2290 vehicles provide a level of service F.

   Ortega/I-5: northbound direct and loop on ramp PM peak hour volumes of 1720 and 800 provide level of service F and A respectively. If an SPI or diamond interchange were provided then the combined volumes of 2520 vehicles provide a level of service F. Southbound off ramp PM peak hour level of service is at Level of service F and E with mitigation.

   The Department typically manages mainline I-5 freeway traffic by metering on ramps along the entire corridor. The affected on ramps should have adequate storage in order to accommodate vehicles queued up behind ramp meters without disrupting traffic on the local arterials. The Interchange details shown in the SMI report do not reflect any additional widening required for ramp storage capacity, which may have led to an incorrect assessment of right of way impacts.

   Ramp meters should meet various criteria to perform effectively. For example, vehicle storage capacity estimates for metered ramps of between 5 and 10 percent of ramp volumes are recommended. For a single lane metered ramp, a 4-second cycle (allowing for a discharge rate of 900 VPH (vehicles per hour)) is the most rapid cycle recommended. Similarly, for a 2 lane metered ramp, a 6-6.5 second cycle (allowing for a discharge rate off 1100 VPH) is the most rapid recommended rate. Furthermore, when ramp volumes exceed 1500 vph, a 1000' minimum length of auxiliary lane should be provided beyond the ramp convergence point. For example, an on ramp with volumes similar to northbound Ortega, with 2500 vph volume would have 42 vpm (vehicles per minute) arrival rate while discharging @ 18 vpm; thereby causing the entire peak hour traffic to queue. Therefore, the proposed SPI design with single on-ramp will not provide the required storage capacity needed for safe and effective operation of ramp meters.

3. An interchange is expected to operate at an acceptable level of service based on forecasted traffic volumes for 20 years after construction. The traffic and circulation numbers from the AIP alternative show how the traffic level of service performs with partial cloverleaf interchanges. There is no technical analysis in the SMI Report that shows SPI level of service and operational performance. Partial cloverleaf interchanges provide better capacity over other interchange types due to the advantage of having two on ramps (loop and direct onramps), which offer more capacity and better traffic management. With partial cloverleaf interchanges, left-turn movements from crossroads are eliminated thereby permitting two phase operation at signalized ramp intersections versus the three phase SPI cycle.

4. The 2001 Department Single Point Interchange Planning, Design, and Operations Guidelines (Guidelines) provide guidance to exercise sound judgment in the selection of interchanges. Interchange choices should never be prejudiced, and if SPIs are applicable in candidate locations, the Department's SPI Design Guidelines should be followed to bring *concept proposals* forward for *conceptual approval*. Design issues should be resolved as early in the environmental phase as possible, and not in later stages of engineering.

   Unlike other interchange types, the Department's SPI guidelines require SPI concept approval from our Headquarters Chief of Design and Traffic Operations Divisions for the limited use of SPI's due to the specific risks and concerns with performance, safety, operations, and capacity.

   The following bullet points represent Department concerns (identified from SPI Guidelines) for the placement of SPI's on I-5 that must be reviewed and vetted prior to potential inclusion as a viable alternative.

   a. Capacity: In urban settings, the local road system is often the controlling factor for overall system capacity. When adequate storage length cannot be provided the capacity advantages of the SPI diminish due to the close proximity of adjacent local intersections. Intersection spacing becomes even more critical because all stopped traffic must be stored between the near stop bar and the adjacent intersection. Short spacing from the ramp intersection to the adjacent local streets and driveways will limit the ability for the local street system to handle the large volumes of through traffic that the SPI can deliver. The purported advantages of the SPI will often not materialize where the local street system is not compatible. These are concerns for I-5 at El Toro, Ortega, and Crown Valley Pkwy.

b. Traffic Operations: The size of SPI intersections necessitates a long traffic signal clearance interval for all moves. The all-red clearance interval represents dead time to the signal timing cycle, which reduces capacity and efficiency. Under moderate to heavy traffic demands, SPIs require longer signal cycle lengths to maximize operations. SPIs may not operate efficiently when the traffic volumes along legs of the intersection are unbalanced. This condition exists at Crown Valley, Ortega, and other interchanges along the corridor. Bicycles and pedestrians adversely affect the capacity and operation of motor vehicles at SPI intersections, thereby negating the benefits of an SPI over another interchange alternative with high volumes of pedestrians and bicyclists. Because traffic signals at SPI intersections are timed to move motorists efficiently through the intersection, pedestrians normally can only cross a portion of the intersection in a single cycle. Therefore, it may take a pedestrian as many as four cycles to cross the separate ramps. These are concerns for I-5 at Pico and El Toro.

c. Geometrics (vertical and horizontal alignment): SPIs are best suited for under crossings since it is difficult to provide good geometrics at over crossings. Off ramps on ascending grades are particularly prone to directing headlights into opposing exit ramp driver's eyes. SPI guidelines state that when the local street alignment is curved, it may be difficult for the driver to determine the proper lane as they approach the SPI intersection. Corner sight distance is a problem at off ramps when the cross street is skewed as it is important to provide visibility between off ramp traffic and cross traffic approaching from the left. These are concerns for I-5 at El Toro, Pico, Ortega, and Crown Valley.

d. Construction: Stage construction will be very costly and challenging. In every instance, the profile of the mainline I-5 would be reconstructed to achieve safe sight distance for the mainline and ramps. The I-5 structures will also require reconstruction. Temporary structures would be required to stage the reconstruction significantly adding to the cost of the project and traffic impact to the motorists. Managing the traffic for the high traffic volume on I-5 freeway and local streets during construction period would be a major undertaking and a huge impact to motorists. In addition, any future expansion of an SPI would be extremely difficult and costly.

e. Utility and other easement issues: Utility relocations and utility or other easement issues that may impact right of way have not been identified.

5. The SMI Report (page 11) reports the incorrect number of existing and future I-5 improvements for the AIP alternative and as such provides fewer lanes in the SMI Report than the AIP alternative. The SMI Report also proposes fewer lanes on several Secondary Master Planned Arterial Highways adjacent to I-5. One arterial is El Camino Real, which is the only local arterial through San Clemente. These impacts negatively affect the SMI Report alternative level of service and require evaluation.

6. The SMI Report proposes elimination of northbound off ramps and on ramps at I-5/El Camino. The elimination of these ramps is in conflict with Federal Highway guidelines, which require full service interchanges for return movements if drivers mistakenly exit the freeway. The SMI Report needs to address the impact to local traffic circulation.

7. All extended detention basins (EDB) must meet Department approved Statewide Management Plan (SWMP) guidelines, which provide for EDBs to be constructible, maintainable and effective in removing pollutants using appropriate location and design criteria. SMI has proposed placement of EDBs in steep slopes above the freeway and ramps, or underground in adjacent privately owned parking areas. SMI's placements of EDBs do not meet SWMP guidelines.

8. The SMI Report notes "*...only properties in which building structures would have to be removed are considered displacements*" and despite not being listed "*acquisition of additional small portions of properties may be required.*" Displacements relating to buildings and structures should be clarified more accurately as full-take and part-take acquisitions.

9. The interchange detail drawings lack accurate standard horizontal and vertical geometric details necessary to make right-of-way impact assessments.

10. The SMI Report 2005 data for business and residence acquisition costs are unrealistic given the dynamic real estate values in the area.

11. Page vi, first paragraph states that "Nearly all of the widening of the I-5 can be completed within the existing I-5 right of way". Contrary to this statement, we could not identify any excess R/W to be used for the proposed widening at the following locations: El Toro Road to Alicia Parkway; PCH to San Juan Creek Road; SB I-5, north of Avery Pkwy; SR-73 to Junipero Serra.

12. It appears that where right of way was not available, ramp closures (NB I-5 El Camino Real off and on ramps), lane reductions (on secondary arterials), and reduced lane and

shoulder widths were proposed without evaluating the impact. This ignores the Department's mandatory design standards.

13. The SMI Report did not factor in the cost of retaining walls along the I-5 and for the reconstruction of the entire I-5/SR-73 interchange needed for this widening.

14. Page 7, 2nd paragraph states, "This listing of these improvements in the LRTP provides a much clearer path for funding of these improvements than is suggested in the SEIR". The Orange County Long-Range Transportation Plan (LRTP) includes the toll road, funded through the Toll Road program and bonded against future tolls, as a baseline. Therefore, the funding for these additional capacity improvements has not been identified.

15. Page 7; last paragraph states that "*The major design components of the AIP Alternative, such as lane width, conform to the AASHTO standards*". As noted in Section 82.3 of the Highway Design Manual (HDM), "AASHTO policies and standards, which are established as nationwide standards, do not always satisfy California conditions. When standards differ, the instructions in the HDM govern, except when necessary for FHWA approval."

16. Page 18 shows the proposed SPI for Ortega Highway. Redesign and reconstruction of this interchange is currently under consideration by the Department.

17. The SMI Report proposes to replace several interchanges along the I-5 with SPIs without considering geometric constraints, operational and safety impacts (i.e. close proximity of local intersections and pedestrian safety).

18. SPI design is usually considered as an alternative for tight diamond interchange.

19. SMI asserts that "*traffic performance of the carpool lane/surface street improvement alternative*" SMI proposes "*has been validated by TCA's own consultants,*" and that "*AIP-R alternative outperforms the toll road in relieving congestion.*" The SMI Report makes this claim by stating that the AIP and SMI Report alternatives are "*functionally*" identical with the exception of the interchanges and assumes the benefits from the AIP alternative provided from prior TCA traffic studies without additional study. The SMI Report does not provide supporting analysis that demonstrates how the alternatives are functionally identical.

20. The Department's June 21, 2006 letter to Federal Highway Administration (attached) affirms TCA's "adequate and defensible" modeling methodologies and TCA's appropriate application of minimum Department Design Standards when comparing alternatives.

21. The Department will not provide comments on the arterial component of the SMI Report alternative, as this is a local agency issue.

22. The SMI Report includes excerpts from the 2006 Orange County Long-Range Transportation Plan (LRTP) that describe "*improvements proposed for the I-5 corridor, many of which were also included in the AIP alternative.*" The SMI Report's excerpts are not comprehensive references to the LRTP to provide full information. The SMI Report fails to fully acknowledge that the completion of the southern portion of the Foothill Transportation Corridor and widening of the toll road system to its planned ultimate width (Eastern/Foothill Transportation Corridor Agency Project) plays a significant role in the LRTP baseline. As such, the right of way impacts related to the LRTP Interstate 5 improvements would be less than the AIP alternative because they do not provide the same capacity benefits. The Department is working with the South Orange County Major Investment Study team that is evaluating the current and future needs of traffic demands in south Orange County. Initial traffic studies show that a significant multi-modal capacity increase is required on I-5 in addition to the benefits provided from the toll road.

COUNTY OF ORANGE

BOARD OF SUPERVISORS

ROBERT E. THOMAS HALL OF ADMINISTRATION
10 CIVIC CENTER PLAZA
P. O. BOX 687
SANTA ANA, CA 92702-0687

December 20, 2007

Patrick Kruer, Chairman
California Coastal Commission
45 Fremont Street, Suite 2000
San Francisco, CA 94105

Attention: Mark Delaplaine, Manager
Energy, Oceans and Federal Consistency

RE: OPPOSE Using the Report from Smart Mobility Inc., Titled "An Alternative to the Foothill South Toll Road"

Dear Chairman Kruer:

On behalf of three million plus people of Orange County, we, the members of the Board of Supervisors are writing to advise you of our opposition to the use of "An Alternative to the Proposed Foothill South Toll Road," a report prepared by Smart Mobility, Inc. (SMI) of Norwich, Vermont, as a substitute for the Final Environmental Impact Report/South Orange County Transportation Infrastructure Improvement Project (FEIR/SOCTIIP) approved by the Foothill/Eastern Transportation Corridor Agency (TCA).

The SMI report contends that a series of Arterial Improvements Plus (AIP), arterial and I-5 improvements, called the Refined AIP (AIP-R) meets the future traffic demands in South County and is a better alternative to the Foothill Transportation Corridor-South (FTC-S) due to its minimal impact to the environment, homes, and businesses. Our review of this report does not support this conclusion. The AIP-R does not use the same lane configurations as the FEIR/SOCTIIP AIP Alternative and is **not** substantiated by any technical engineering or traffic analysis. In addition, some of the arterial improvement assumptions will have detrimental impacts on approved development in South County in general and specifically on the communities of Las Flores, Ladera, Rancho Mission Viejo/Ranch Plan, and the Prima Deshecha Landfill operations.

The widening of I-5 and arterials proposed in the AIP-R, are planned to be generally within the existing road right-of-way. The feasibility of the SMI report is not supported by any technical engineering or survey analysis. This proposal does not seem to be practical without significant impacts to adjacent properties or reducing MPAH (Master Plan of Arterial Highways) Standards. Reduction of arterials below these standards will have adverse impacts to fire and emergency response times in communities served by the County. The report states that proposed AIP-R improvements would maintain the "SOCTIIP AIP Traffic Performance of equivalent traffic relief." **This conclusion is only a qualitative judgment and not supported by any traffic analysis.**

In addition, both the AIP & AIP-R assume expansion of Antonio Parkway/Avenida La Pata to an eight-lane Smart Street facility from Oso Parkway to San Juan Creek Road and to a six-lane Smart Street from San Juan Creek Road to Avenida Pico. Smart Street technologies would also be included on Ortega Highway between Antonio Parkway/Avenida La Pata and I-5, Camino La Ramblas between Avenida La Pata and I-5, and Avenida Pico between Avenida La Pata and I-5. Smart Street technologies include a combination of advanced traffic management strategies such as traffic signal coordination, real time monitoring and surveillance, and traveler information, as well as modest physical improvements such as additional turn lanes at intersections. This report does not provide any quantification of the traffic/ Level of Service (LOS) benefits due to the application of this technology to these facilities.

Antonio Parkway is designated on MPAH as a Major Arterial Highway (six lanes) and La Pata Avenue as a Primary (four lanes). The AIP proposed changes will require amendments to the MPAH to upgrade these facilities— a proposal that is not likely to be supported by any adjacent jurisdictions. Significant new development has been approved and constructed along Antonio Parkway since the SOCTIIP AIP was developed in 2001. Widening Antonio Parkway to an eight-lane roadway is inconsistent with the goals and objectives of the approved environmental documents for these communities. La Pata Avenue is designated as a Primary Arterial Highway and is currently the only access to the Prima Deshecha landfill facility, to the adjacent San Juan High School and other adjacent development. A six-lane facility through the landfill is inconsistent with the approved Prima Deshecha General Development Plan and with the approved development along La Pata Avenue. The AIP-R also relies on an extension of La Pata Avenue as a six-lane facility (unbuilt segment). This proposal is inconsistent with the MPAH and the Circulation Plan of the City of San Clemente. Plus, improvements beyond the MPAH to both Antonio Parkway and La Pata Avenue are inconsistent with the environmental document of the recently approved Ranch Planned Community. The feasibility and effectiveness of providing grade separation at the intersections of Antonio Parkway/Oso Parkway, Antonio Parkway/Crown Valley Parkway, Antonio Parkway-La Pata Avenue/Ortega Highway, and Avenida La Pata/Avenida Pico as proposed in the AIP-R are also unknown and not addressed in the AIP-R report.

The Orange County Board of Supervisors is requesting that the California Coastal Commission not only review our concerns regarding the SMI report, "An Alternative to the Proposed Foothill South Toll Road," but oppose its implementation and support the conclusions of the Final Environmental Impact Report/South Orange County Transportation Infrastructure Improvement Project (FEIR/SOCTIIP) approved by the Foothill/Eastern Transportation Corridor Agency (TCA).

Sincerely,

CHRIS NORBY
Chairman of the Board
Supervisor, Fourth District

John M. W. Moorlach, Vice Chairman
Supervisor, Second District

Janet Nguyen
Supervisor, First District

Bill Campbell
Supervisor, Third District

Pat Bates
Supervisor, Fifth District

cc: Members, Orange County Congressional Delegation
Members, Orange County State Legislative Delegation
Thomas G. Mauk, County Executive Officer
Deputy County Executive Officers

BRIEFING PAPER

Smart Mobility Study – The Refined Arterial Improvement Plan Alternative

Background
We have reviewed "An Alternative to the Proposed Foothill South Toll Road", a report prepared by Smart Mobility, Inc. (SMI) of Norwich, Vermont, in the context of the Final Environmental Impact Report/South Orange County Transportation Improvement Implementation Plan (FEIR/SOCTIIP) approved by the Foothill/Eastern Transportation Corridor Agency (TCA). The SMI report contends that a series of Arterial Improvements Plus (AIP), arterial and I-5 improvements, called the Refined AIP (AIP-R) meets the future traffic demands in South County and is a better alternative to the extension of the Foothill Transportation Corridor-South (FTC-S) due to its minimal impact to the environment, homes and businesses.

Specific Issues:
The widening of I-5 and arterials proposed in the AIP-R, are proposed to be generally within the existing road right-of-way. The feasibility of this proposal is not supported by any technical engineering or survey analysis. The proposal does not seem to be practical without significant impacts to adjacent properties or reducing MPAH (Master Plan of Arterial Highways) Standards. Reduction of arterials below these standards can have adverse impacts to fire and emergency response times in communities served by the County.

The study states that proposed AIP-R improvements would maintain the "SOCTIIP AIP Traffic Performance…of equivalent traffic relief" This conclusion is only a qualitative judgment and not supported by any traffic analysis.

The report also concludes that 'even minor refinements to the design of the SOCTIIP AIP can greatly reduce or even eliminate displacement, such as …context-sensitive interchange design'. A Context Sensitive Design alternative was evaluated in the approved FEIR/SOCTIIP. However this alternative was considered and rejected by the TCA Board as not meeting the project goals and objectives. The following Federal Highway Administration (FHWA) statement summarizes the TCA Board deliberation as follows: "for each potential project, designers are faced with the task of balancing the need for the highway improvement with the need to safely integrate the design into the surrounding natural and human environments."

Impacts to Orange County Unincorporated areas.
The AIP & AIP-R reports assume expansion of Antonio Parkway/Avenida La Pata to an eight lane Smart Street facility from Oso Parkway to San Juan Creek Road and to a six-lane Smart Street from San Juan Creek Road to Avenida Pico. In addition, Smart Street technologies would also be included on Ortega Highway between Antonio Parkway/Avenida La Pata and I-5, Camino La Ramblas between Avenida La Pata and I-5, and Avenida Pico between Avenida La Pata and I-5. Smart Street technologies include a combination of advanced traffic management strategies such as traffic signal coordination, real time monitoring and surveillance, and traveler information, as well as modest physical improvements such as additional turn lanes at intersections. The study does not provide any quantification of the traffic/LOS benefits of the application of this technology to these facilities.

Antonio Parkway is designated on MPAH as a Major Arterial Highway (six lanes) and La Pata Avenue as a Primary (four lanes). The AIP proposed changes will require amendments to the MPAH to upgrade these facilities-a proposal that is not likely to be supported by any adjacent jurisdictions. In addition significant new development is approved and constructed along Antonio Parkway since the SOCTIIP AIP was developed in 2001. Widening Antonio Parkway to an eight lane roadway is inconsistent with the goals and objectives of the approved environmental documents for these communities. La Pata Avenue is designated as a Primary Arterial Highway and is currently the only access to the Prima Deshecha landfill facility and to the adjacent San Juan High School and other adjacent development. A six lane facility through the landfill is inconsistent with the approved Prima Deshecha General Development Plan and with the approved development along La Pata Avenue. The AIR-R also relies on an extension of La Pata Avenue as a six lane facility (unbuilt segment). This proposal is inconsistent with the MPAH and the Circulation Plan of the City of San Clemente. In addition improvements, beyond the MPAH, to both Antonio Parkway and La Pata Avenue are inconsistent with the environmental document of the recently approved Ranch Planned Community.

In addition the feasibility and effectiveness of providing grade separation at the intersections of Antonio Parkway/Oso Parkway, Antonio Parkway/Crown Valley Parkway, Antonio Parkway-La Pata Avenue/Ortega Highway, and Avenida La Pata/Avenida Pico as proposed in the AIP-R are also unknown and not addresses in the AIP-R report.

Recommendations

Our review of this report does not support the study's conclusion because the AIP-R does not use the same lane configurations as the FEIR/SOCTIIP AIP Alternative and is not substantiated by any technical engineering or traffic analysis. In addition some of the arterial improvement assumptions will have detrimental impacts on approved development in South County in general and specifically on the communities of Las Flores, Ladera, Rancho Mission Viejo/Ranch Plan and the Prima Deshecha Landfill operations.

Response to Smart Mobility Report
The Refined AIP Alternative

Orange County
District 12
On Interstate Route 5
From the Orange/San Diego County Line to Interstate 405

Submitted To:

Foothill/Eastern
Transportation Corridor Agency

Prepared And Submitted By:

Corridor Design Management Group

January, 2008

Table of Contents

List of Exhibits

I. INTRODUCTION

The subject report purports to show that a refined series of arterial and I-5 improvements could practically and cost-effectively meet future traffic demand without construction of a new toll road corridor through open space and state parkland.

The report was prepared by Smart Mobility, Inc. (SMI) of Norwich, Vermont. The primary preparers of the report are not engineers licensed in the State of California. Review of work experience of the preparer of the main report indicates that they have no previous work experience in the State of California working on Caltrans projects. Only the preparer of the Appendix *Conceptual Runoff Management Plan for the I-5 AIP-R Alternative* is licensed in California.

II. FLAWS

There are several flaws in the Refined AIP (AIP-R) Alternative as presented by SMI. They include the following:

A. FREEWAY COMPONENT

1. Lane Configurations -
AIP-R Text[1] states:

> *"The (AIP-R) mainline, interchange and arterial improvements are functionally identical to the (SOCTIIP) AIP Alternative but include(s) basic design refinements that maintain the (SOCTIIP) AIP Traffic Performance… "* (Emphasis added)

In Fact:

> Several "Final Lane Configurations" shown in Table 1 "Existing Lanes and Proposed Improvements by Segment for (SOCTIIP) AIP and AIP-R" on page 11 of the SMI Report are different than those in the SOCTIIP AIP. The SMI report is missing lanes which are included in the SOCTIIP AIP for over 40% of the project length. See Page 16 for specific locations.

Since the AIP-R does not use the same lane configurations as the SOCTIIP AIP, the claim that the AIP-R provides "the same superior traffic benefits associated with the (SOCTIIP) alternative"[2] is unsubstantiated and, without adequate traffic analysis in the SMI report, the entire premise of the AIP-R is negated.

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[1] (4th paragraph, page 4) An Alternative to the Proposed Foothill South Toll Road, The Refined AIP Alternative, Smart Mobility Inc, (AIP-R, SMI) September 2007
[2] (3rd paragraph, page 1), AIP-R, SMI

PROJECT LOCATION

PROJECT LOCATION MAP

2. Interchanges –
The AIP-R does not include two interchanges that were included in the SOCTIIP AIP. Proposed southbound exit and entrance ramps at Laguna Hills Mall (south of El Toro Road) and a southbound exit ramp at Stonehill Drive (north of SR-1) were under study by Caltrans and were included in the SOCTIIP AIP as additional capacity enhancements.

3. Frontage Roads -
AIP-R[3] text states:

> *"As demonstrated in this report, even minor refinements to the design of the (SOCTIIP) AIP can greatly reduce or even eliminate displacement, such as... narrowing frontage roads with low traffic demand to allow mainline freeway widening."*

In Fact:

> The definition of the SOCTIIP AIP Alternate is the "**A**rterial **I**mprovement **P**lus I-5 HOV and Spot Auxiliary Lanes". The "frontage roads" cited to be narrowed in the report are actually primary and secondary arterials as described on the County of Orange Master Plan of Arterial Highways and are a part of the local cities' critical arterial network. Narrowing of "frontage roads" is actually narrowing of arterial roadways, is not a minor refinement and, in fact, reduces arterial capacity rather than improving the county arterial system. The SMI proposal to narrow the arterial roadways ("frontage roads") would result in the increase of congestion on the local streets in direct conflict with the purpose of the SOCTIIP AIP Alternative.

The County of Orange standard for primary arterials as set forth in Topics 101 and 301 of the Orange County Highway Design Manual is a 4-lane roadway with median, parking and sidewalks in a 100' right-of-way. The narrowing of these arterials as proposed by SMI violates the County arterial design standards and would not be acceptable to local agencies because of concerns such as public safety (including fire and police response), local traffic mobility requirements and commercial access concerns. See Page 19 for specific examples of narrowed arterials.

4. Stormwater Facilities -
AIP-R[4] text states:

> *"As demonstrated in this report, even minor refinements to the design of the (SOCTIIP) AIP can greatly reduce or even eliminate displacement, such as ...design and siting of stormwater facilities to avoid developed property."*

In Fact:

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[3] (2nd paragraph, page 4), AIP-R, SMI
[4] (2nd paragraph, page 4), AIP-R, SMI

The AIP-R siting of many EDBs would not only be exceedingly costly but several would require exceptional engineering/construction solutions and some are just not practical nor do they conform to accepted engineering practice. See Page 26 for specific examples.

The existing I-5 is located in an area of significantly variable topography. There are many areas where the land next to I-5 differs in elevation by over 50 feet. Because of the variable topography, there are substantial areas of open space directly adjacent to the I-5 roadway both within the right-of-way and outside the right-of-way which are sloped due to hills and canyons. The location of EDBs cannot be based solely on the availability of "open space" as seen from an aerial photograph because the location of the EDBs must account for topography and related constraints such as hydrology.

The AIP-R plan has two areas where no EDBs are shown – from north of SR-1 (EDB 7B) to Vista Hermosa, a distance of over 3 miles which has several drainage points which require some type of stormwater runoff treatment. Also, from south of Avenida Presidio to Cristianitos Road, a distance of almost 2 miles with 2 distinct drainage points would require stormwater runoff treatment. The conceptual runoff management plan has no proposed water treatment facilities within these two reaches of the proposed AIP-R I-5 widening. It is unclear whether this is simply an oversight by the "nationally recognized experts in....hydrological engineering" or rather a planned avoidance of the issue designed to avoid necessary property takes related to these important water quality protection facilities.

5. Context Sensitive Interchange Design

AIP-R[5] text states:

"As demonstrated in this report, even minor refinements to the design of the (SOCTIIP) AIP can greatly reduce or even eliminate displacement, such as ...context-sensitive interchange design."

In Fact:

Context Sensitive Design is not a process in which a single entity advances their design ideas without consideration from other parties, as SMI has done in their report. Rather, Context Sensitive Design "is a collaborative approach to developing and redesigning transportation facilities that fit into their physical and human environment while preserving the aesthetic, historic, community, and natural environmental values. CSD contributes to community, safety, and mobility." (Context Sensitive Design, FHWA http://www.fhwa.dot.gov/environment/csd.htm). FHWA also notes that the "ultimate decision on the use of existing flexibility

[5] (2nd paragraph, page 4), AIP-R, SMI

rests with the State design team and project managers." (http://www.fhwa.dot.gov/environmentl/flex/intro.htm). The SOCTIIP project followed the collaborative approach recommended by Context Sensitive Design. This is detailed in the Final EIR which describes the collaborative process with several federal resource agencies and with federal, state, regional and local agencies. In addition, local communities provided peer review of the traffic study (see Exhibit 1, following page 3-44 in the Final EIR). The design of the SOCTIIP AIP reflects Context Sensitive Design, including Caltrans' direction regarding safety standards. The SOCTIIP collaborative evaluated many factors, including the same factors noted above for Context Sensitive Design, in deciding which of the original alternatives should be developed for further evaluation in the EIS/SEIR, which of the EIS/SEIR alternatives were not the preferred alternative and in selecting the preferred alternative. As noted by FHWA, for "each potential project, designers are faced with the task of balancing the need for the highway improvement with the need to safely integrate the design into the surrounding natural and human environments." (http://www.fhwa.dot.gov/environment/flex/intro.htm).

Several interchange configurations which the AIP-R proposes are not in context with the significant planning studies which have been conducted by Caltrans in conjunction with local agencies and with extensive public input. These include Interstate 5 interchanges at Ortega Highway in San Juan Capistrano, Avenida Pico in San Clemente and El Toro Road in Laguna Hills. These planning studies were conducted according to the Caltrans Project Development Procedures Manual (PDPM) and resulted in the elimination of consideration of the single point interchanges proposed by SMI at these locations. The studies represent the appropriate Context Sensitive Interchange Design evaluation because they were conducted by the local agencies with extensive public input. The SMI report is inconsistent with the conclusions of the local agencies which implemented a Context Sensitive Interchange Design process for these interchanges.

In summary, the SOCTIIP process was consistent with Context Sensitive Design and maintaining safety was an important aspect of the alternatives design. The SOCTIIP collaborative collectively agreed that the design of the AIP was the safe design that met Caltrans standards. In addition, the SOCTIIP collaborative determined, in accordance with Context Sensitive Design provisions to preserve community values, that any alternative that included widening of I-5, beyond existing adopted plans, would involve significant impact to community values. For those reasons, the SOCTIIP collaborative, through a collaborative process encouraged by Context Sensitive Design, collectively decided that the AIP alternative was not an alternative that would be pursued further.

Specific comments on the interchanges at El Camino Real, Avenida Pico, Ortega Highway and Crown Valley Parkway are included later in this report.

6. Single Point Interchanges
General Discussion:

The Single Point Interchange (SPI) is a concept which essentially combines two separate diamond ramp intersections into one large at-grade intersection. The traffic capacity of the SPI can exceed that of a compact diamond if long signal times can be provided (not possible in many of the SMI proposed locations) and left turning volumes are balanced. This additional capacity may be offset if nearby intersection queues interfere with weaving and storage between intersections - which is true at most of the proposed locations. Two disadvantages of the SPI are: 1) future expansion of the interchange is extremely difficult; 2) they create poor bicycle and pedestrian circulation – this is particularly important at El Toro Road and Avenida Pico interchanges which have high pedestrian traffic.

The SPI incorporates free-right turns. Recent Caltrans policy [see **Caltrans Highway Design Manual (HDM) Topic 405.3(3)**] has been to remove free-right turns, as they pose a safety risk to pedestrians. If free-right turns are permitted, they must have a dedicated lane where they connect with the arterial. Serious conflicts occur when the right turning vehicle must weave across multiple lanes on the local street in order to turn left at a major cross street close to the ramp terminal which is the usual case with the intersecting arterials along I-5. Free-right turns should generally be avoided unless there is room for a generous acceleration lane or a lane addition on the local street which produces additional property takes – usually businesses in the vicinity of I-5.

Additionally, although the SMI Report includes very little information on which to base any comments about the design work, based on comparison with the other ramps that are shown in the interchange concepts, the ramps for the Single Point Interchanges look very short – they look shorter than the ramps for the existing interchanges. In fact, ramps for SPI's tend to be longer to provide adequate sight distance. Lengthening the ramps will require additional right-of-way acquisition and/or retaining walls.

SPI Example:

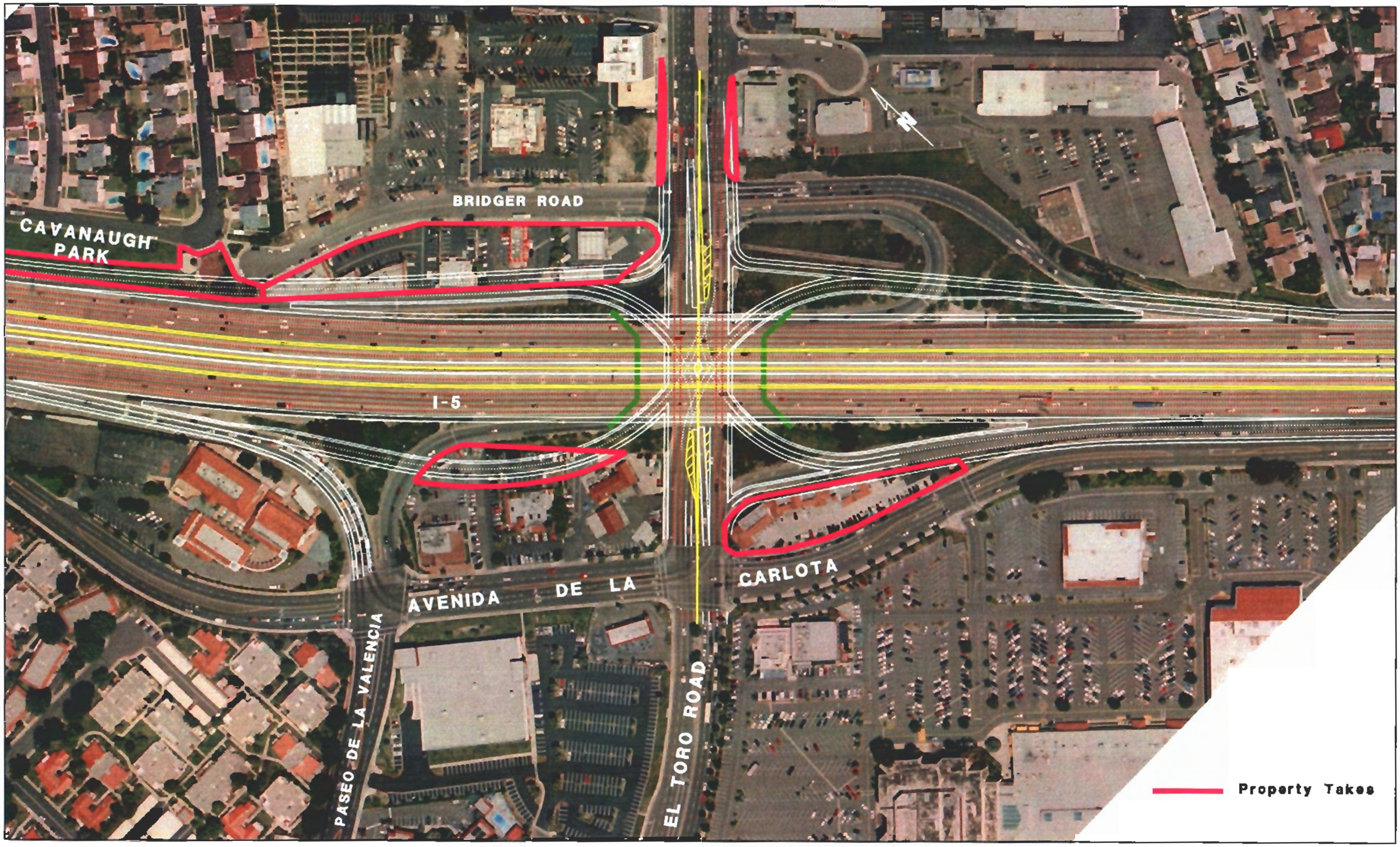
Exhibit F (attached) provides an example of a Single Point Interchange which meets Caltrans Highway Design Manual Criteria. The existing I-5/El Toro Road interchange is a combination of a partial cloverleaf and "hook" ramps due to the proximity of I-5 to Avenida de la Carlota to the west. The northbound exit and one of the north bound entrance ramps form an intersection with Bridger Road to the east. There are also numerous business properties adjacent to the interchange. Reconfiguring the interchange to a SPI which meets Caltrans Highway Design Manual Criteria would have significant impacts on El Toro Road and Bridger Road traffic and the adjacent businesses.

The northbound exit ramp to and northbound entrance ramp from eastbound El Toro would need to be realigned and would no longer create an intersection with Bridger. Bridger would need to be modified to a right in/right out access from and to westbound El Toro and with no left-turn access to or from eastbound El Toro. The traffic impacts from this change would need to be studied, as significant eastbound traffic on El Toro Road would be forced to travel beyond Bridger and make U-turns to enter and exit the businesses on Bridger.

Additional impacts from the modification of these ramps include the need to widen the westbound El Toro to northbound I-5 ramp, extending the length of the ramp northerly to provide standard merging distances. This widening would require right-of-way takes from Cavanaugh Park, north of Bridger Road, as well as taking all of the businesses between the ramp and Bridger.

The property takes on the west side of I-5 would also be severe, requiring right-of-way takes from multiple parcels and impacting several businesses adjacent to Avenida de la Carlota. Some businesses would be complete takes due to severe impacts, while some might simply require modification.

Due to the proximity of Avenida de la Carlota to I-5, the storage lengths for the left turn lanes of the northbound entrance ramps are constrained. Modifications to El Toro Road would be needed along with substantial signage changes. The changes would likely confuse motorists who do not regularly travel in this area.



CDMG

EXHIBIT F

I-5 - El Toro Road Single Point Interchange (SPI)
11-16-2007

B. <u>ARTERIAL COMPONENT</u>

Widening Within Right-of-Way

AIP-R[6] states:

"Most of these (improvements to several arterial corridors) can be accommodated within the publicly owned right-of-way, and therefore do not result in property impacts."

In Fact:

The arterial right-of-way is typically set at the back of sidewalk. Therefore, unlike the I-5 where the right-of-way includes slopes, <u>ANY</u> widening of the arterial roadway will require property acquisition along the entire length of the arterial improvement (over 8 miles along Antonio/LaPata) as well as at all improved intersections. (See Exhibit A attached)

Therefore, the SMI report greatly underestimates the property impacts of the arterial component. If the AIP-R design were implemented, the property takes would be substantially higher than those stated by SMI. Therefore, the SMI statement is incorrect.

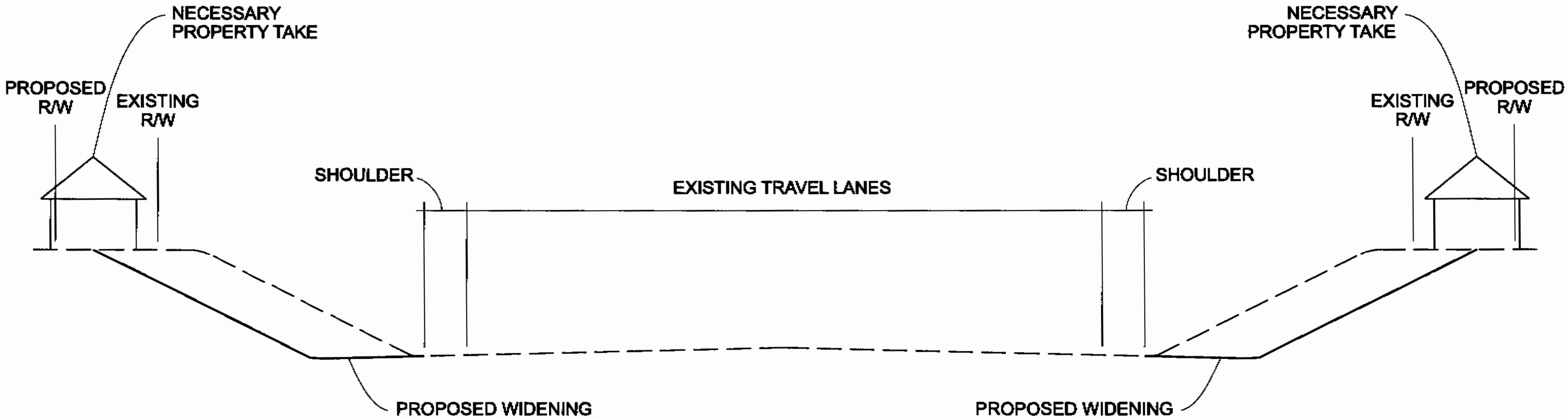
C. <u>OVERALL DESIGN</u>

The SMI report generally assumes that the area in which the widening is to occur is flat and, therefore, does not take into account topography. The cross sections that are included in the report are very deceiving – they make the corridor look flat.

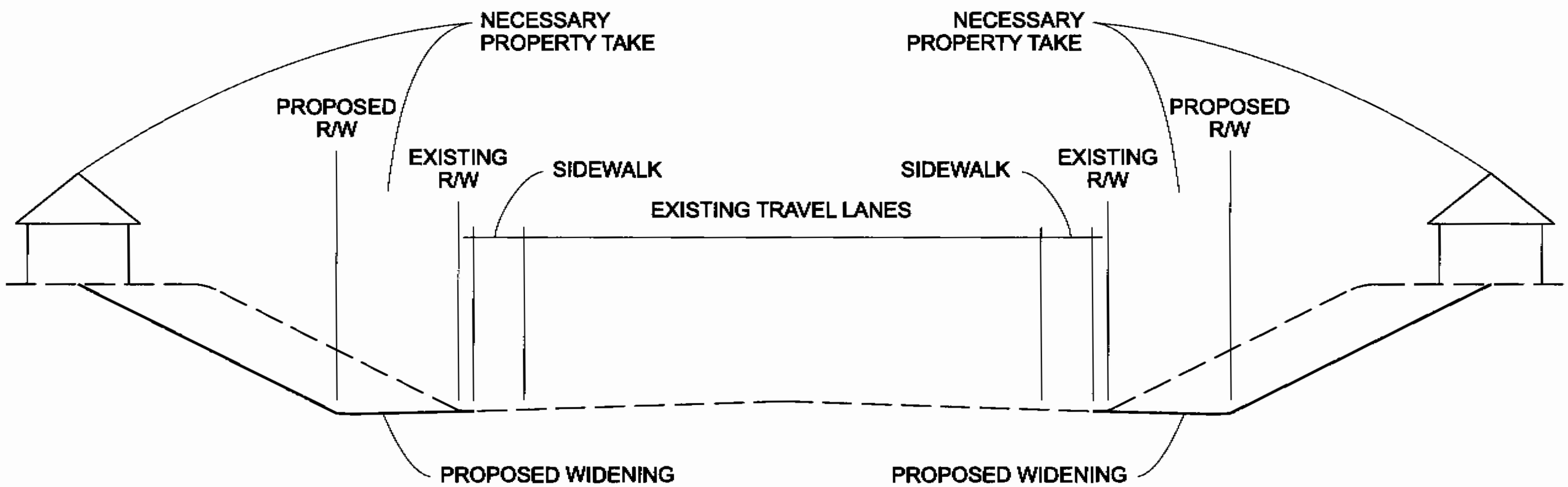
In Fact:

There is a significant elevation difference between I-5 and the surrounding ground at almost all locations between El Toro Road and the San Diego County line (see Exhibits B, C and D attached for examples) as well as along the arterial widenings. The reason this is significant is that the cross sections make it appear that there is no need to take adjacent private land and buildings to accommodate the required slopes (See Exhibit A and Cross Section P Existing and Proposed attached). To accomplish freeway and arterial widening and stay within the existing roadway right-of-way, retaining walls would be needed along almost the entire corridor (in many areas retaining walls already exist). Retaining walls carry a very significant capital construction cost, and they also have significant on-going maintenance cost (graffiti removal, structural inspection).

[6] (last paragraph, page 20), AIP-R, SMI



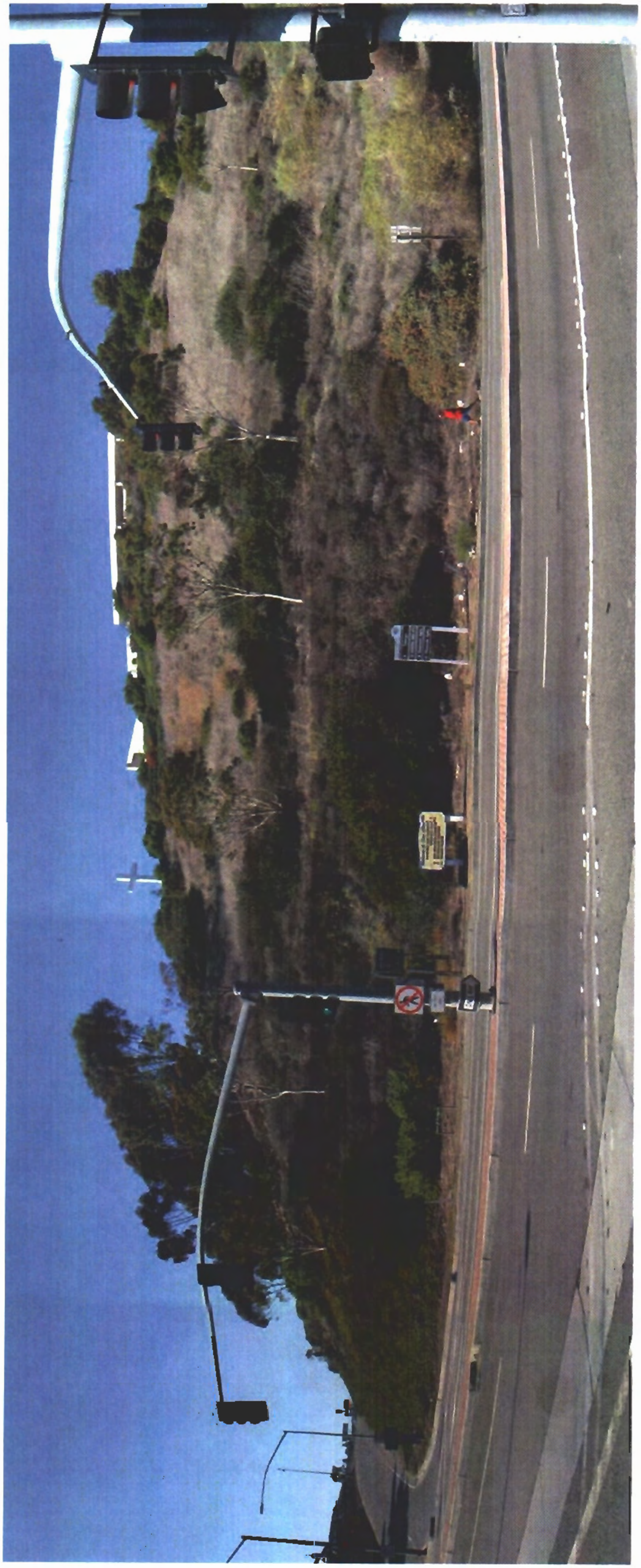
I-5 TYPICAL SECTION

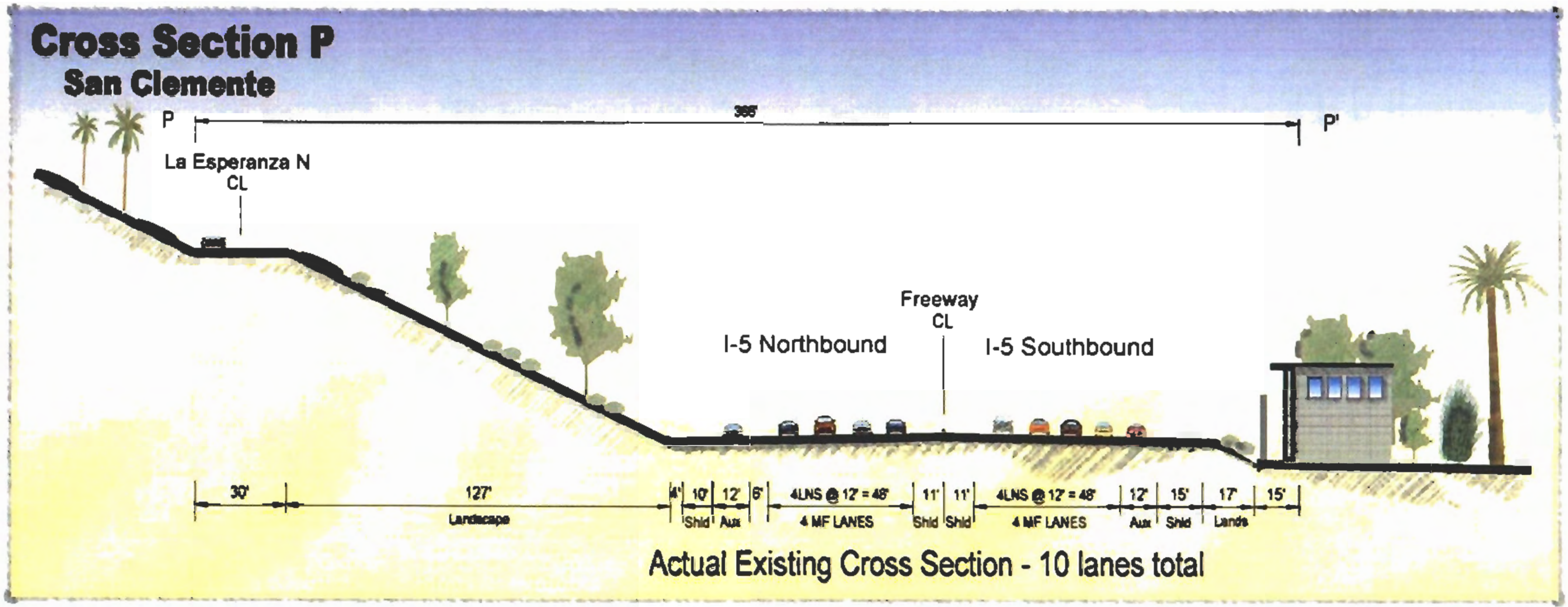


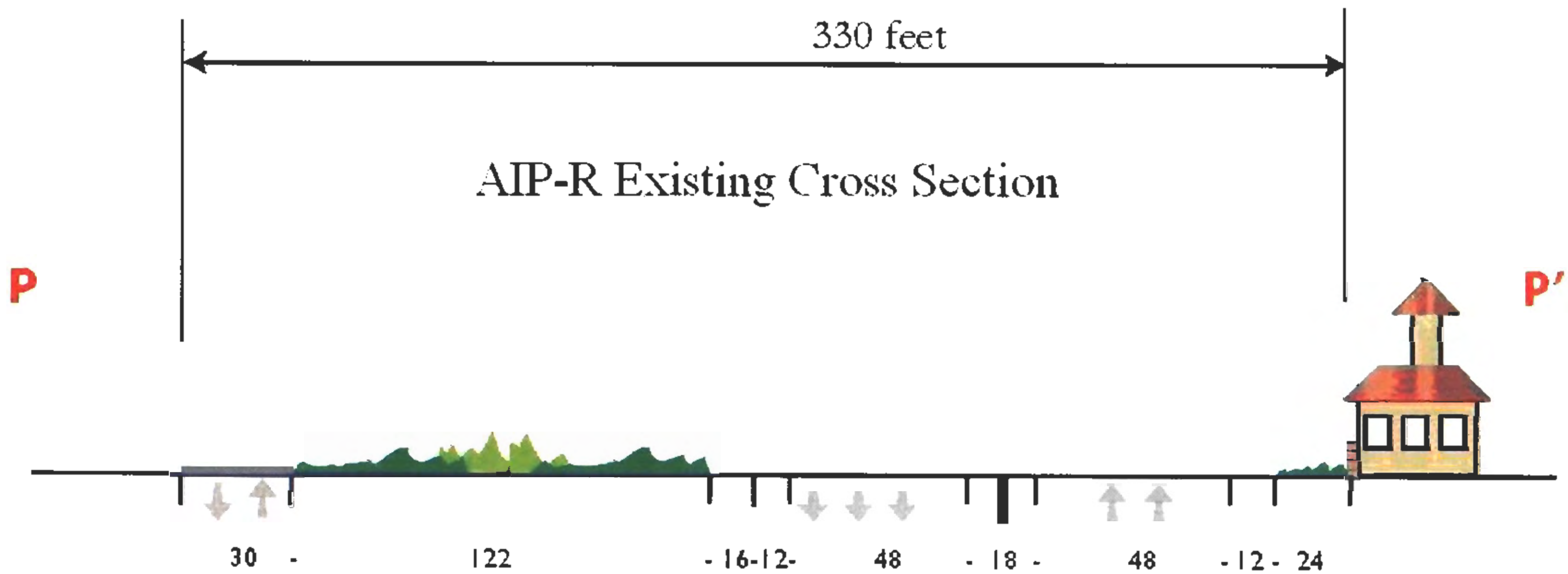
COUNTY ARTERIAL TYPICAL SECTION

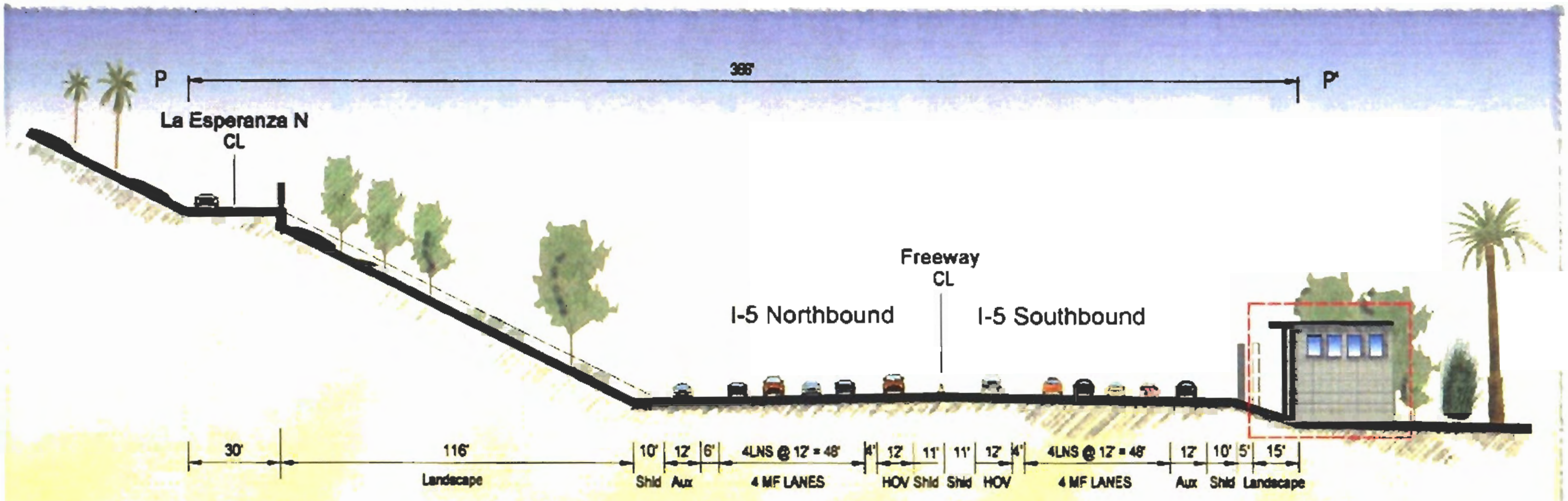
EXHIBIT A

PROPERTY IMPACTS DUE TO WIDENING



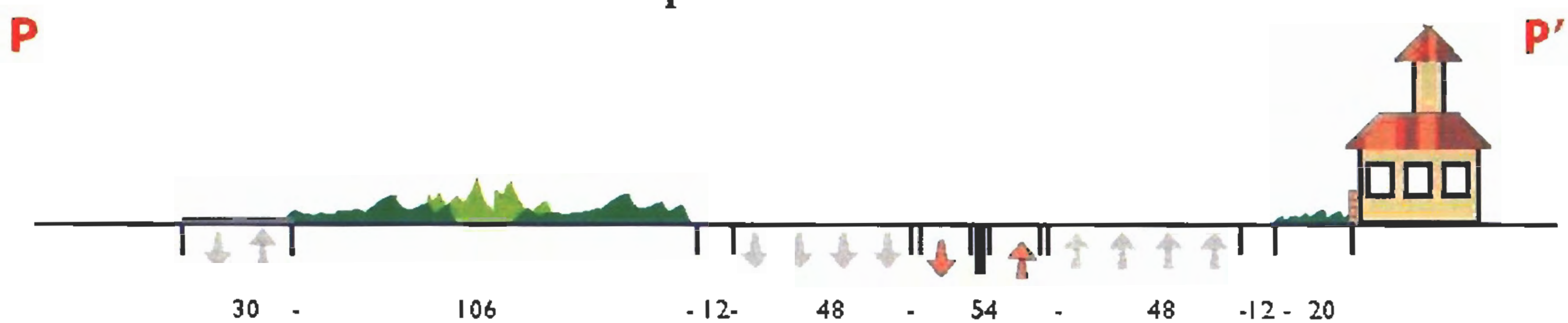

Cross Section P
San Clemente
P
385'
P'
La Esperanza N CL
Freeway CL
I-5 Northbound
I-5 Southbound
30'
127'
Landscape
4'
10' Shld
12' Aux
6'
4LNS @ 12' = 48'
4 MF LANES
11' Shld
11' Shld
4LNS @ 12' = 48'
4 MF LANES
12' Aux
15' Shld
17' Lands
15'
Actual Existing Cross Section - 10 lanes total


330 feet
AIP-R Existing Cross Section
P
P'
30 -
122
- 16-12-
48
- 18 -
48
- 12 - 24



AIP Proposed Cross Section - 12 lanes total

AIP-R Proposed Cross Section



The SMI report states that the conceptual design plans are consistent with all applicable Caltrans guidelines. We cannot verify this statement because horizontal and vertical sight distance standards would need to be verified and without vertical profiles this cannot be determined. Although we do not have the information to either verify or determine this is an inaccurate statement, our engineering review of the AIP-R concludes that it is highly unlikely that the AIP-R is consistent with all applicable Caltrans guidelines.

III. FREEWAY COMPONENT – SPECIFIC EXAMPLES

The following are specific examples of the above listed flaws:

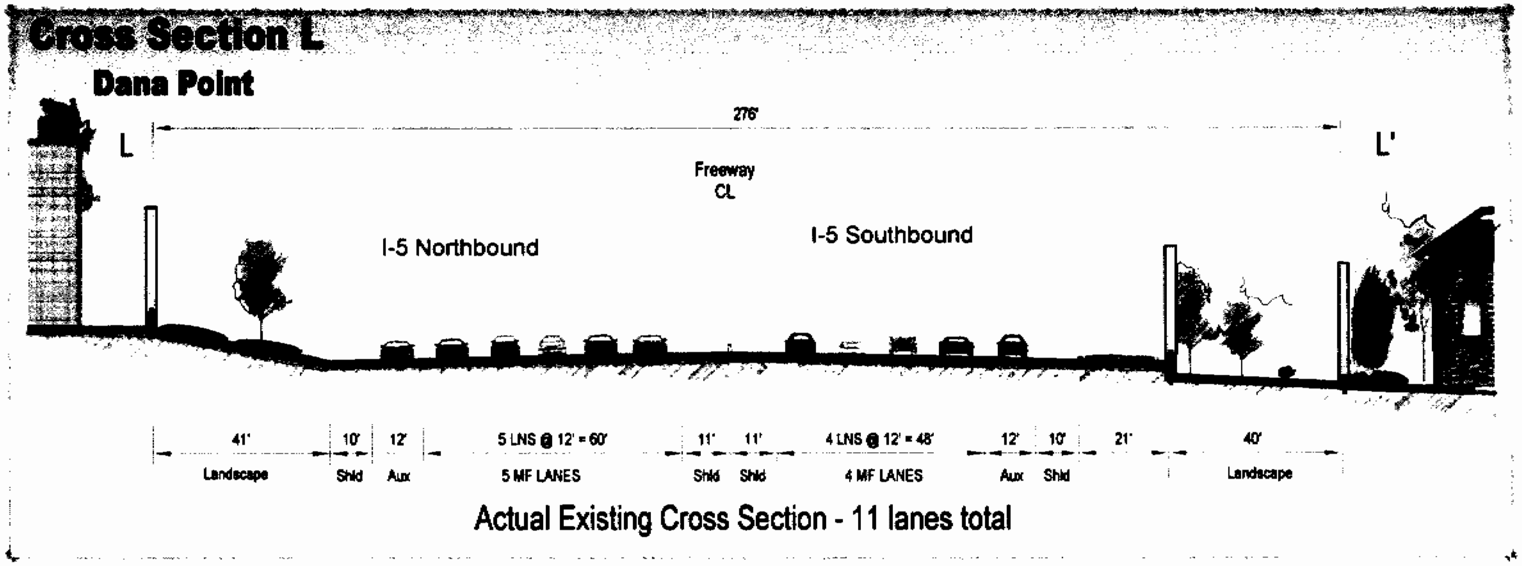
A. Lane Configurations

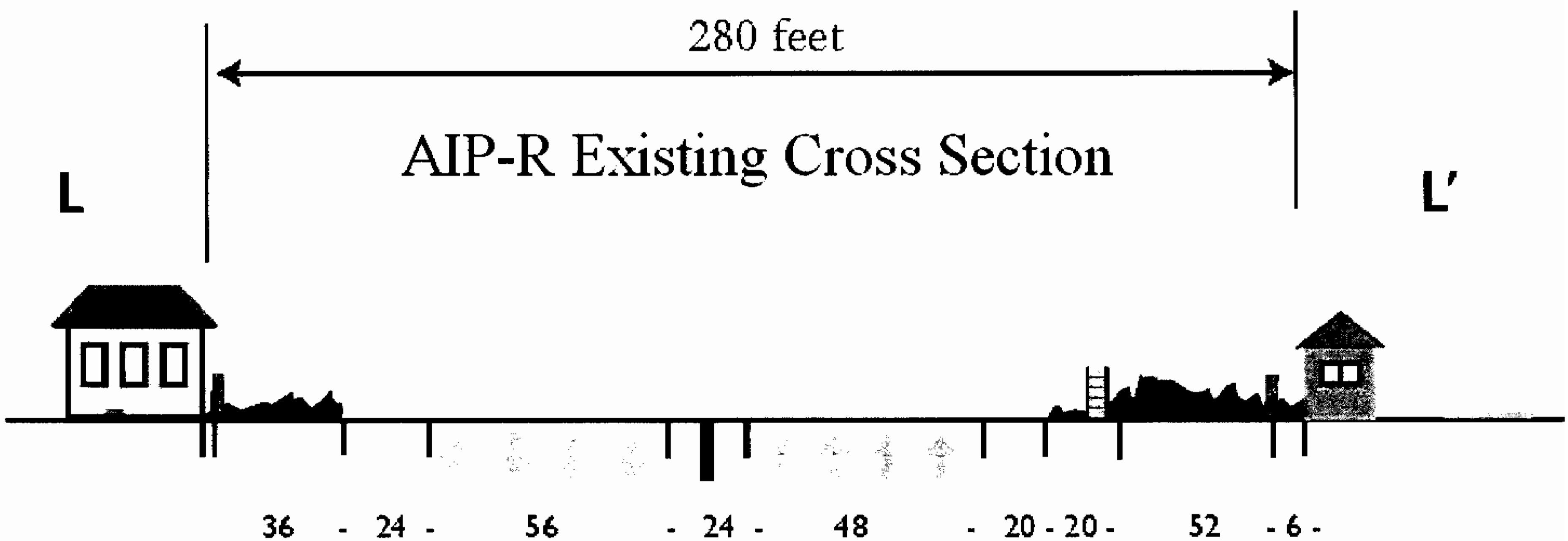
In Fact: Several "Final Lane Configurations" shown in Table 1 "Existing Lanes and Proposed Improvements by Segment for (SOCTIIP) AIP and AIP-R" on page 11 of the SMI Report are not the same as used in the SOCTIIP AIP.

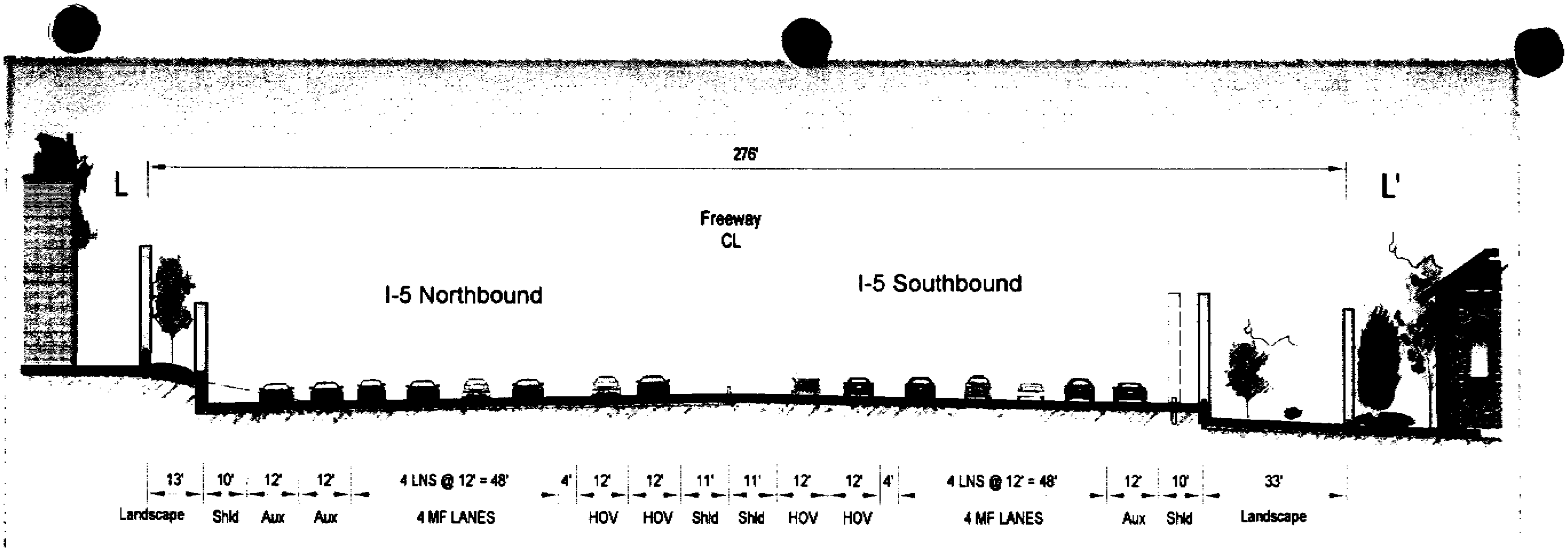
- Segment H (SMI Cross Section H) – SR-73 to J. Serra in San Juan Capistrano. There are 6 existing general purpose lanes northbound – not 4 as used in the AIP-R. The final lane configuration should be six general purpose lanes and two HOV lanes in each direction.
- Segments L, M and N – Pacific Coast Highway to Avenida Pico in Dana Point and San Clemente (See Cross Section L Existing and Proposed attached). The RTP has 1 HOV lane in each direction programmed and the SOCTIIP AIP proposed an additional HOV lane NB and SB that the AIP-R did not include. This results in a 15-lane roadway in Segment L, a 12-lane roadway in Section M and a 14-lane roadway in Segment N through Dana Point and San Clemente with a final lane configuration of four general purpose lanes, two HOV lanes and auxiliary lanes, as necessary, in each direction. See Exhibit B (attached) for a visual example of a 14-lane roadway (photo of existing I-5 south of El Toro Road).
- Segment O – Avenida Pico to Palizada in San Clemente. The SOCTIIP AIP proposed a second auxiliary lane in addition to the existing auxiliary lane southbound which the AIP-R does not include. The final lane configuration should be two auxiliary lanes southbound, one auxiliary land northbound, and four general purpose lanes and one HOV lane in each direction.

Since the AIP-R does not use the same lane configurations as the SOCTIIP AIP, the claim that the AIP-R provides "the same superior traffic benefits associated with the (SOCTIIP) alternative"[7] is unsubstantiated and, without

[7] (3rd paragraph, page 1), AIP-R, SMI


Cross Section L
Dana Point
276'
L
L'
Freeway CL
I-5 Northbound
I-5 Southbound
41' Landscape
10' Shld
12' Aux
5 LNS @ 12' = 60' 5 MF LANES
11' Shld
11' Shld
4 LNS @ 12' = 48' 4 MF LANES
12' Aux
10' Shld
21'
40' Landscape
Actual Existing Cross Section - 11 lanes total


280 feet
AIP-R Existing Cross Section
L
L'
36 - 24 - 56 - 24 - 48 - 20 - 20 - 52 - 6 -



AIP Proposed Cross Section - 15 lanes total

AIP-R Proposed Cross Section

adequate traffic analysis in the SMI report, the entire premise of the AIP-R is negated.

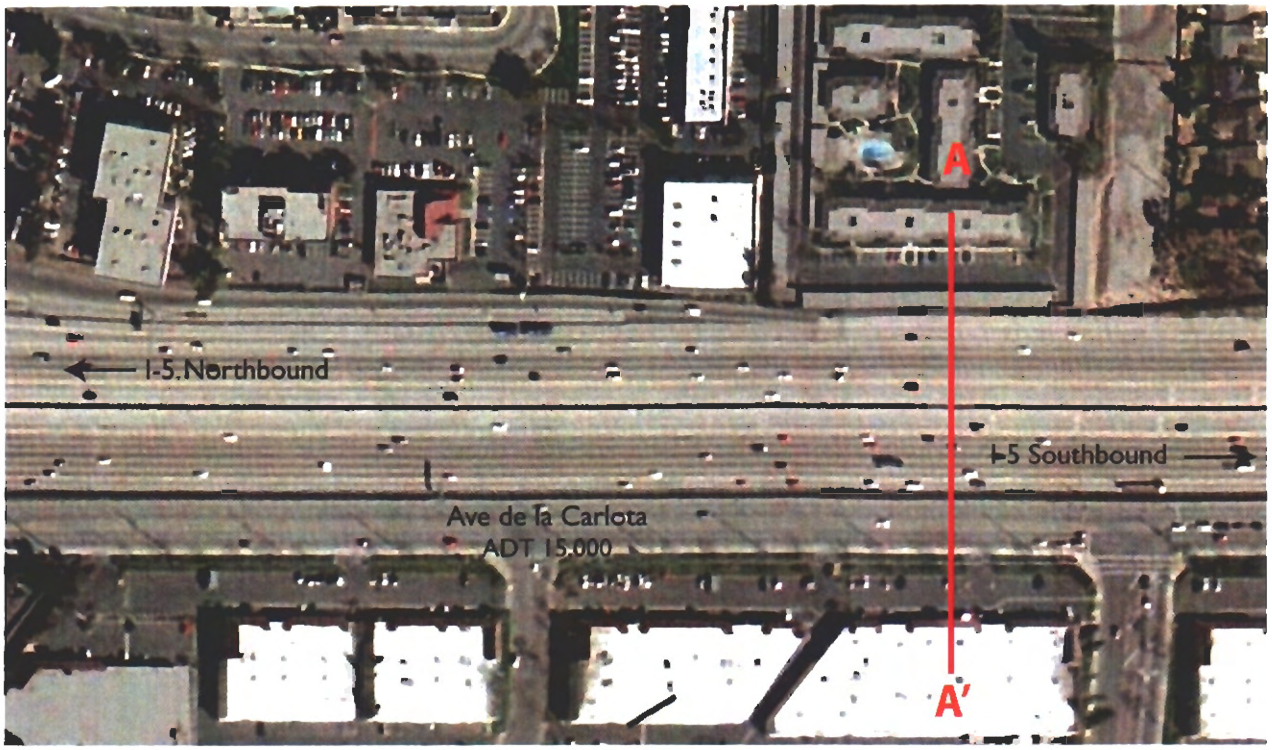
B. Frontage Roads

In Fact: The "frontage roads" cited to be narrowed in the SMI report are primary and secondary arterials as described on the County of Orange Master Plan of Arterial Highways:

- **Avenida de la Carlota** (see Cross Sections A and B, Exhibit E and Refined Plan Sheet 1 attached) serves major commercial areas including a regional shopping mall. North of El Toro Road (see Cross Section A attached) the existing roadway is designated a Secondary Arterial and generally consists of 4 lanes with a median, no shoulders, and sidewalk on the west side only. The median varies from 6' (where there is no sidewalk) to 14' where there are left turn movements. The existing/forecast traffic in this segment is 16,000 (2007) / 20,000 (2030) ADT (Average Daily Traffic). The Secondary Arterial designation requires 4 lanes (without median) with 8' shoulders for a 64' pavement width plus sidewalks in an 80' right of way. The SMI Report reduces this Secondary Arterial to two lanes with a median for left turn movements in a 62' right-of-way, which does not conform to County standards for MPAH.
- **Avenida de la Carlota** south of El Toro Road (see Cross Section B attached) is designated a Secondary Arterial and generally consists of 4 lanes with a median, no shoulders and a sidewalk on the west side only. The existing/forecast traffic in this segment is 13,000 (2007) / 23,000 (2030) ADT. The Secondary Arterial designation requires four lanes (without median) with 8' shoulders for a 64' pavement width plus sidewalks in an 80' right of way. The SMI Report reduces this Secondary Arterial to two lanes with a median for left turn movements and reduces the right-of-way width by 12', which does not conform to County standards for MPAH. In addition the 2030 traffic volumes will require four lanes plus a median.
- **Rancho Viejo Road** north of Junipero Serra Road (see Cross Section H and Refined Plan Sheet 5 in SMI report) is designated a Secondary Arterial and generally consists of 4 lanes with a median, no shoulders and a sidewalk on the east side only. The existing/forecast traffic in this segment is 10,000 (2003) / 12,000 (2025) ADT. The Secondary Arterial designation requires 4 lanes (without median) with 8' shoulders for a 64' pavement width plus sidewalks in an 80' right of way. The SMI Report reduces this Secondary Arterial to two lanes with a median for left turn movements and reduces the right-of-way width by 8' which does not conform to County standards.
- **Camino Capistrano** north of Stonehill Drive (See Cross Section K and Refined Plan Sheet 6 attached) serves a major commercial/industrial area

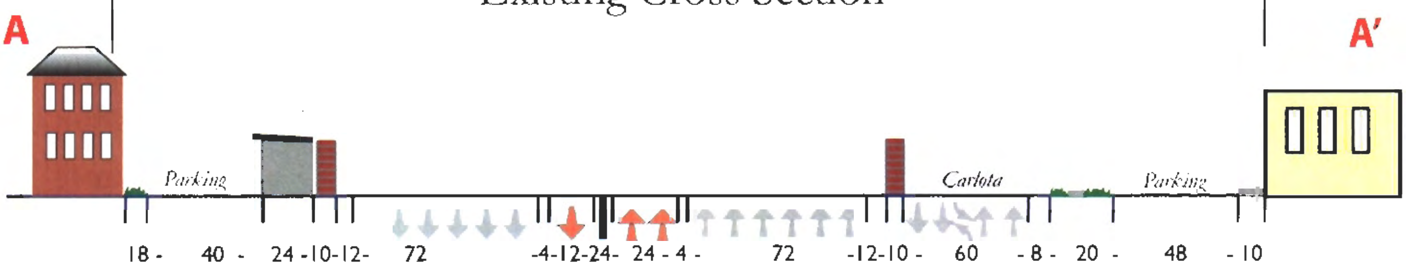
Cross Section A

Laguna Hills, North of El Toro Interchange

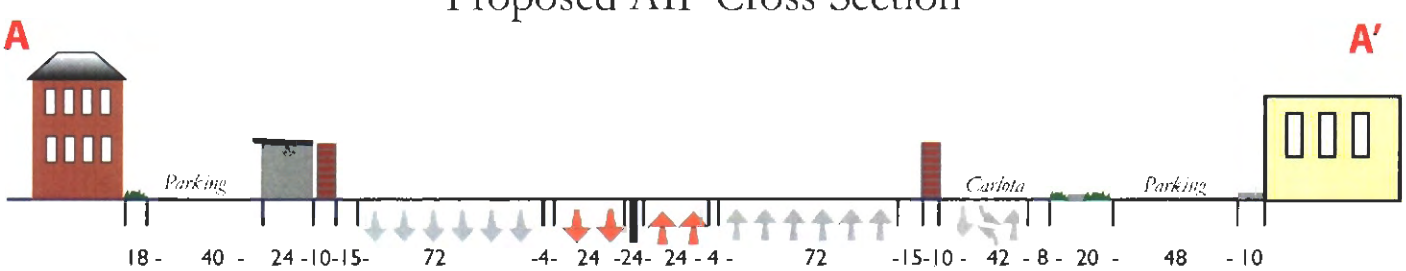


484 feet

Existing Cross Section

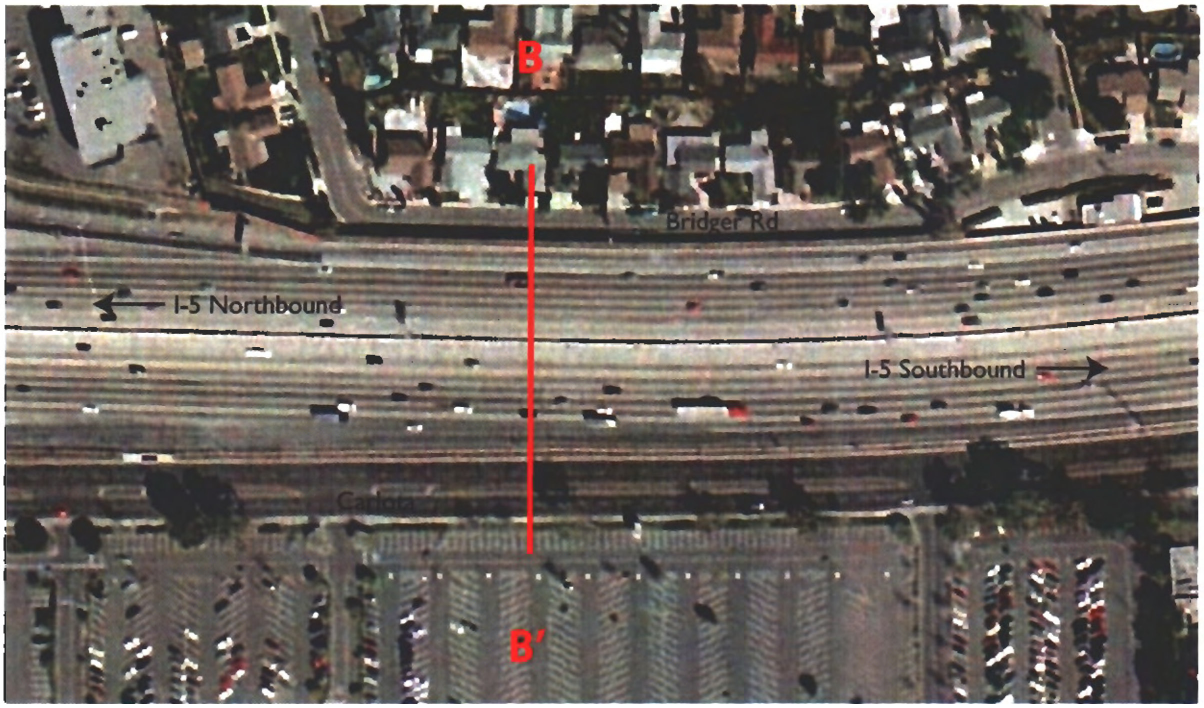


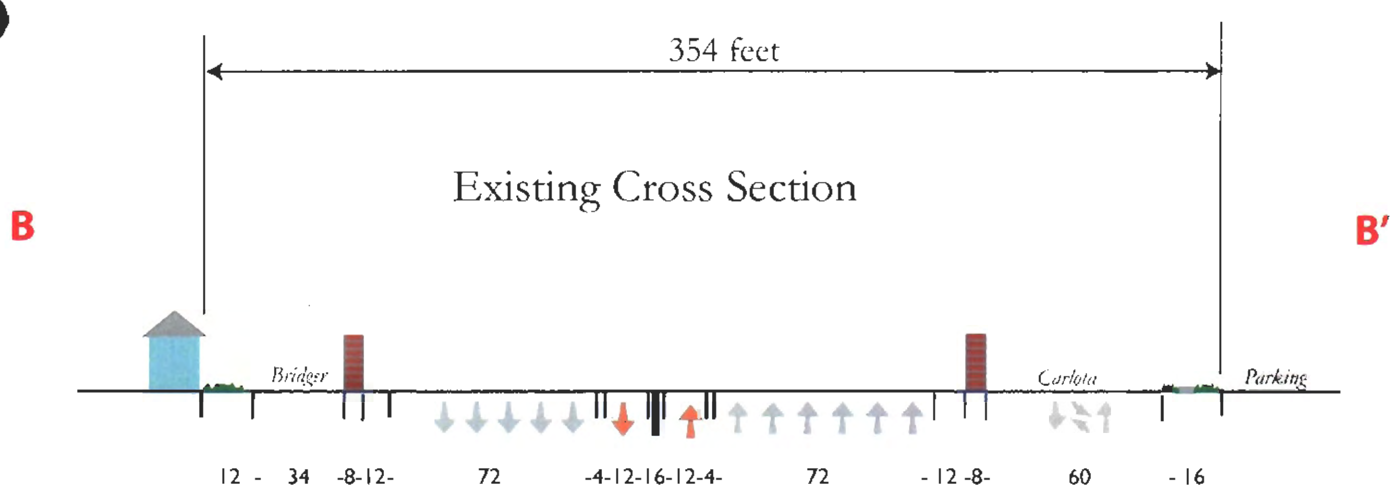
Proposed AIP Cross Section

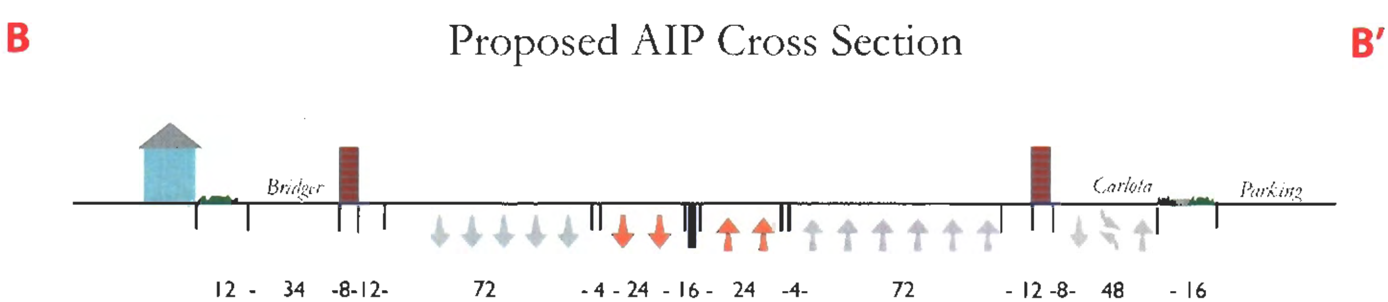


Cross Section B

Laguna Hills, South of El Toro Interchange








45
FOR
LEASE

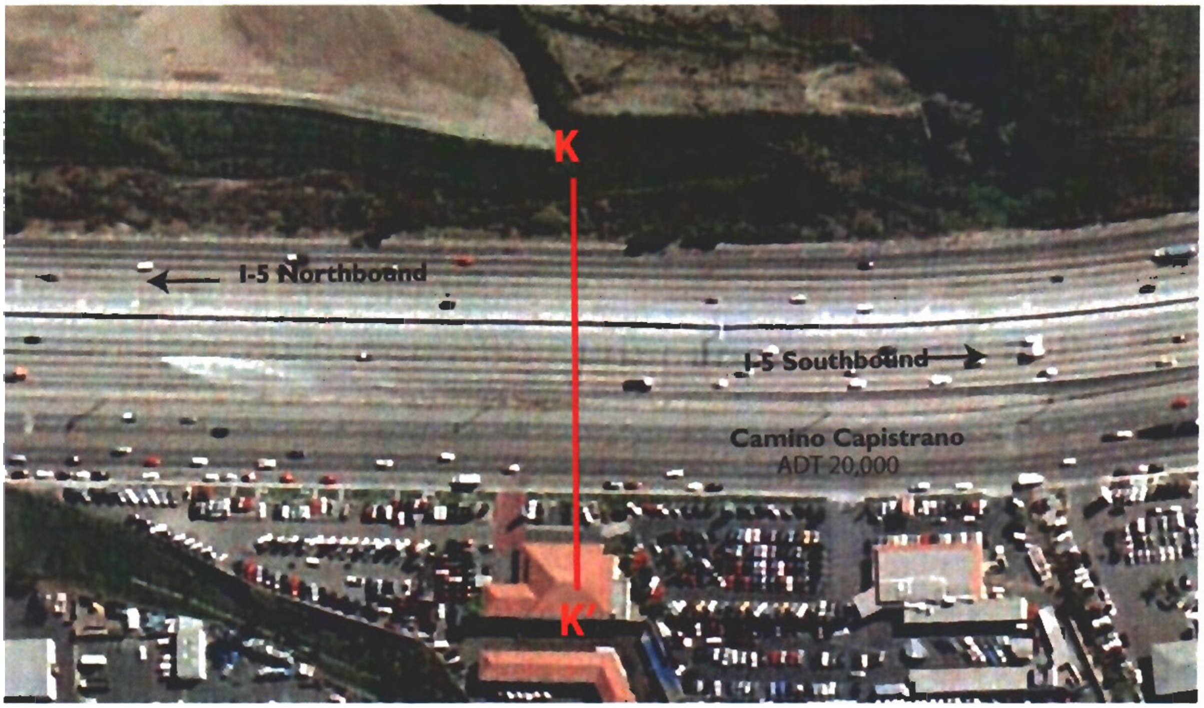
2,500 feet

Smart Mobility, Inc
Norwich, Vermont
www.smartmobility.com

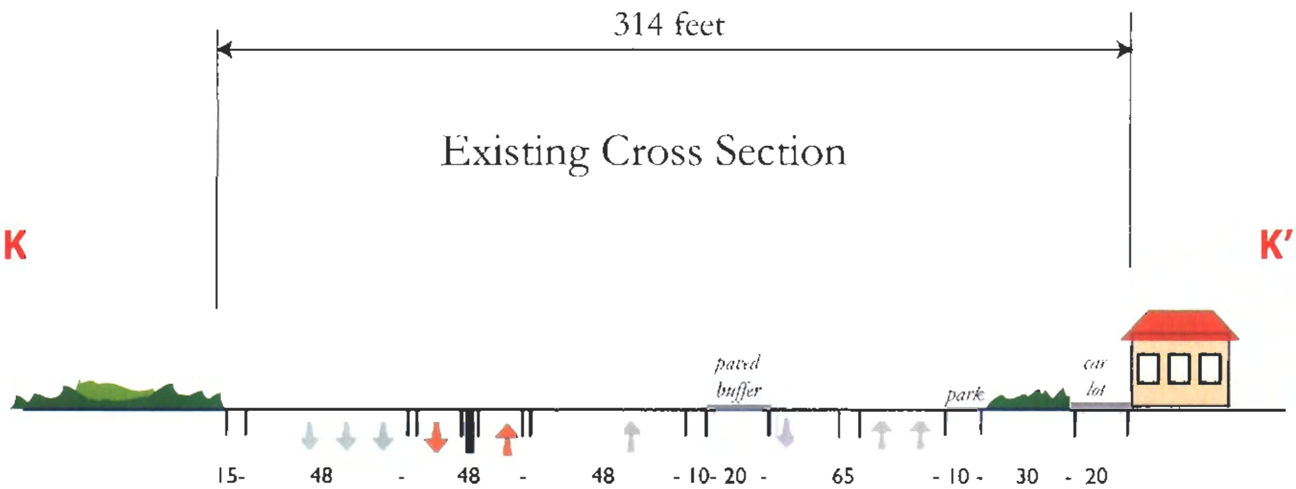
smart mobility

Cross Section K

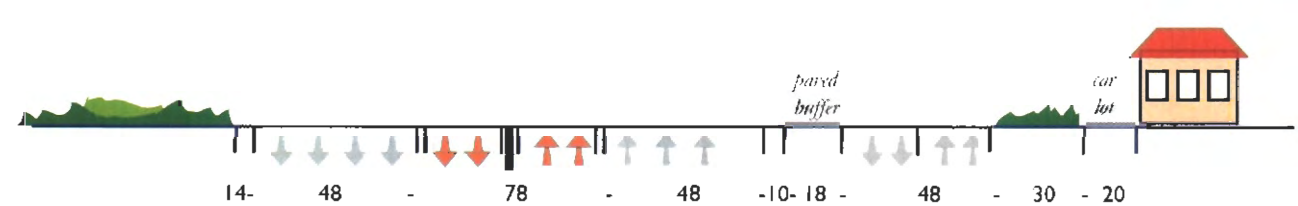
San Juan Capistrano



Existing Cross Section



Proposed AIP Cross Section



2,500 feet

Smart Mobility, Inc
Norwich, Vermont
www.smartmobility.com

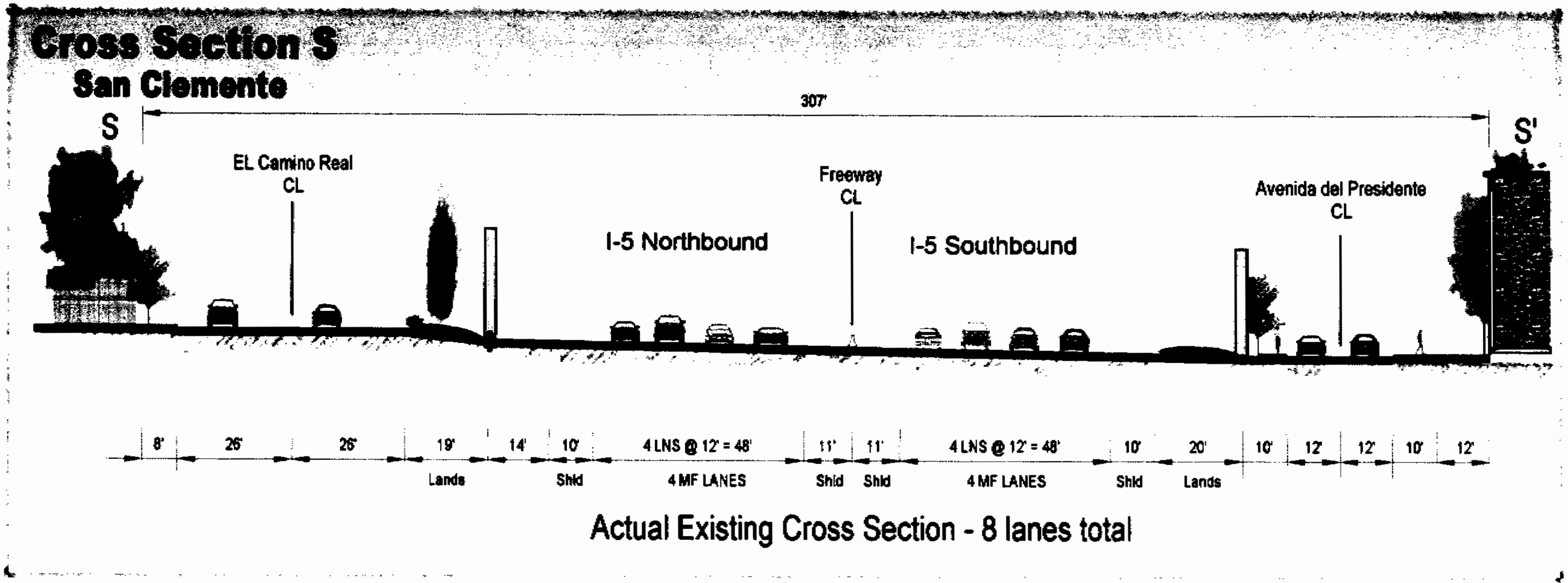
with multiple commercial entrances, requiring right and left turns as well as street parking. Camino Capistrano is designated a Primary Arterial and generally consists of 4 lanes with a median with a shoulder (for parking) and a sidewalk on the west side only. The existing/forecast traffic in this segment is 24,000 (2003) / 30,000 (2025) ADT. The Primary Arterial designation requires four lanes (with median) with 8' shoulders for an 80' pavement width plus sidewalks in a 100' right of way. The SMI Report reduces this Primary Arterial to two lanes with a median for left turn movements and reduces the right-of-way width by 28' which does not conform to County standards. In addition the 2025 traffic volumes indicate the need for a six lane divided roadway.

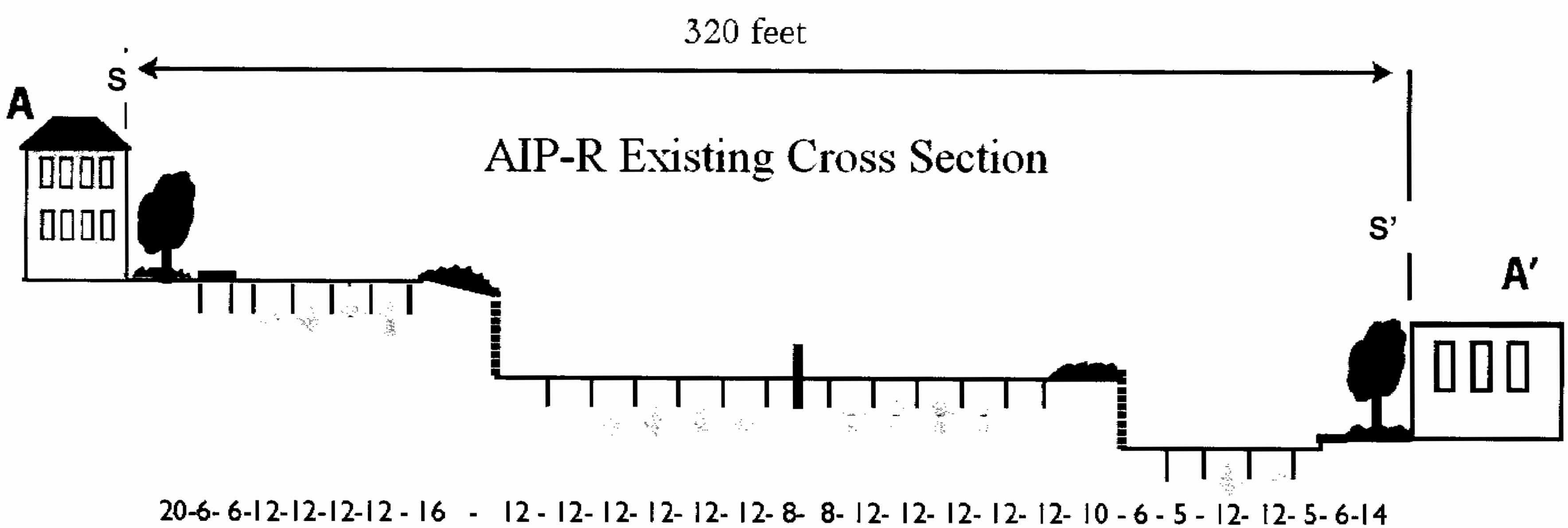
- **El Camino Real** south of the I-5 exit (See Cross Section S Existing and Proposed attached) is the ONLY continuous alternative route to I-5 and the only emergency access from the county line through San Clemente to Pacific Coast Highway (SR-1). El Camino Real is designated a Secondary Arterial and generally consists of four lanes with no median, 6' shoulders and a sidewalk on the northeast side only. The existing/forecast traffic in this segment is 17,000 (2004) / 17,000 (2030) (ADT). The existing roadway does not meet the Secondary Arterial designation requirements of four lanes (without median) with 8' shoulders for a 64' pavement width plus sidewalks in an 80' right of way. The SMI Report reduces this Secondary Arterial to two lanes with no median and 4' shoulders and reduces the right-of-way by 23' which does not conform to County standards.

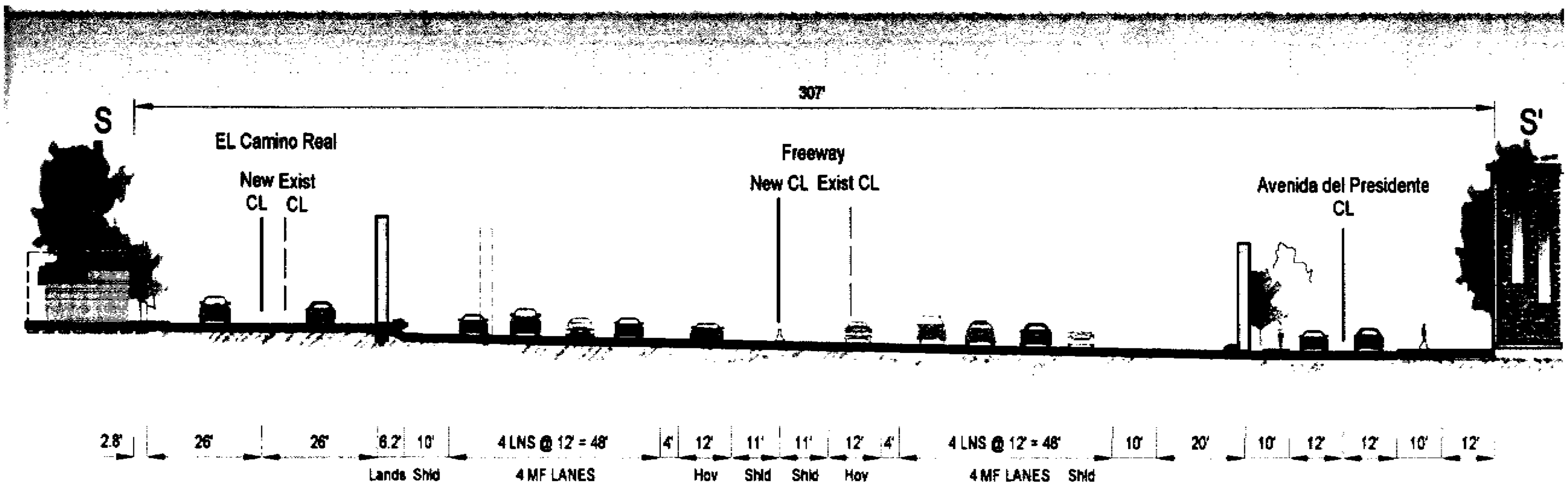
C. Stormwater Facilities

In Fact: The AIP-R siting of many EDBs would not only be exceedingly costly but several would require exceptional engineering/construction solutions and some are just not practical.

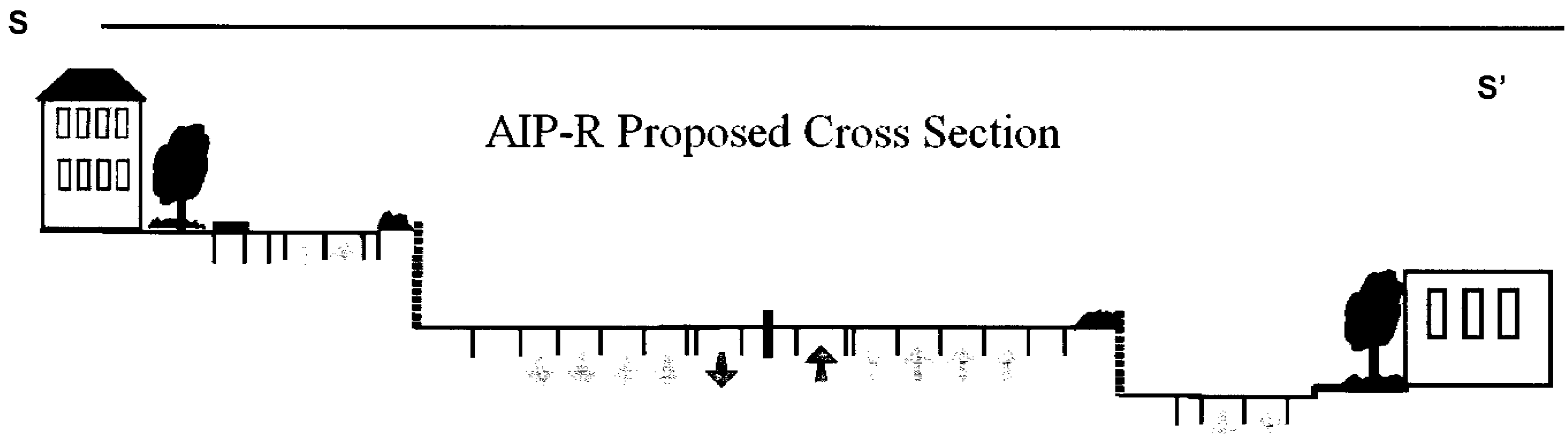
- EDB 3F is located on a steep slope above the existing ramp and arterial which border the site. See Exhibit D (attached) which is a photo of the site showing the existing church located immediately at the top of the slope which exceeds 140 feet high and is underlain by the Capistrano formation which is known locally to be geotechnically unstable. This location is not practical.
- EDB 3E is located below I-5 on a steep slope at the bottom of which is the primary access road to a hotel/convention facility and a commercial parking area. This EDB would require a full take of the hotel/convention facility. It would therefore not be feasible.
- EDB 7B is proposed on a hillside which is on the far side of a drainageway and over 20 feet above the roadway. See Exhibit C (attached) which is a photo of the actual hillside location of EDB 7B. This site has recently been filled to build the office buildings shown in the photo. Not only is location not practical, it would require at least a partial take of the new office building.


Cross Section S
San Clemente
307'
S
S'
EL Camino Real
CL
Freeway
CL
Avenida del Presidente
CL
I-5 Northbound
I-5 Southbound
8'
26'
26'
19'
Lands
14'
10'
Shld
4 LNS @ 12' = 48'
4 MF LANES
11'
Shld
11'
Shld
4 LNS @ 12' = 48'
4 MF LANES
10'
Shld
20'
Lands
10'
12'
12'
10'
12'
Actual Existing Cross Section - 8 lanes total


320 feet
A
S
S'
A'
AIP-R Existing Cross Section
20-6- 6-12-12-12-12 - 16 - 12 - 12- 12- 12- 12- 12- 8- 8- 12- 12- 12- 12- 12- 10 - 6 - 5 - 12- 12- 5- 6-14



AIP Proposed Cross Section - 10 lanes total



AIP-R Proposed Cross Section

20-6- 7-4-11-11- 4- 6- 10- 10-12-12-12-12-4-12-11-3-11-12-4-12-12-12- 12- 10- 8- 6 - 5- 12- 12- 5- 6- 14

- EDBs 13A and 11 are sited in commercial mall/shopping area parking lots which have no adjacent land available for replacement parking. Provision for Caltrans to have title and access to maintain the EDBs would require construction of multi-level replacement parking structures for private entities.
- The AIP-R plan has two areas where no EDBs are shown – from north of SR-1 (EDB 7B) to Vista Hermosa, a distance of over 3 miles which has several drainage points which require some type of stormwater runoff treatment. Also from south of Presidio to Cristianitos Road, a distance of almost 2 miles with 2 distinct drainage points requiring stormwater runoff treatment.

IV ADDITIONAL COMMENTS:

A. Traffic Analysis/Lane Configuration

The design of the Arterial Improvements Plus HOV and Spot Mixed-Flow Lanes on I-5 (SOCTIIP AIP) was based on Caltrans standard preliminary design procedures to establish the roadway widening improvements necessary to meet the lane criteria established/confirmed by the collaborative traffic consultant's analysis.

The AIP was predicated on the Purpose and Need of the SOCTIIP to meet minimum capacity requirements. The **Caltrans Highway Design Manual (HDM) Topic 102** states "freeways should be designed to accommodate design year peak hour (PH) traffic volumes". The number of lanes required on a multi-lane urban freeway is based on PH volume per lane at level of service between C and E. In other words, the Caltrans "metric" or standard for "minimum capacity requirement" is Level of Service E for project/expenditure planning of widening projects. The addition of one HOV lane (required by AQMD) for the AIP, plus the addition of auxiliary lanes where possible, **still did not bring the capacity up to LOS E in all areas**. Therefore, the Caltrans "metric" for further study of the AIP was not met.

Consequently, the SMI claim that the AIP-R provides "the same superior traffic benefits associated with the (SOCTIIP) alternative"[8] is inappropriate.

B. Roadway Design

Topic 82.1.2 Application of Standards of the HDM states Mandatory Design Standards are those considered most essential to achievement of overall design objectives. Many pertain to requirements of law or regulations such as those embodied in the FHWA's 13 controlling criteria.

[8] (3rd paragraph, page 1), AIP-R, SMI

As has been demonstrated with the widening of I-5 throughout Orange County from El Toro Road north to the Los Angeles County line, the widening and reconstruction of the I-5 to provide a roadway sufficient for the next 20 years is classified as "new construction" and, as such, the roadway design for the SOCTIIP AIP was based on the Caltrans requirement that new facilities shall be designed to full HDM standards.

As an example of geometric changes proposed in the SOCTIIP AIP to meet the HDM standards, the existing I-5 alignment immediately north of State Route 1 in Segment K has a substandard curve which would be exacerbated with the proposed AIP-R widening. The SOCTIIP AIP design proposed a realignment of I-5 through the SR-1 interchange and northerly through the long curve in order to meet current standards for safety and, thus, improve capacity on I-5.

Consequently, our engineering review of the AIP-R concludes that it is highly unlikely that the AIP-R is consistent with all applicable Caltrans guidelines, especially the FHWA's 13 controlling criteria.

C. <u>Interchange Redesigns</u>

Following Caltrans practice to comply with state and national standards used for implementation of projects addressing future needs, the SOCTIIP AIP design evaluated existing interchanges and, where necessary, new interchange designs were developed to meet minimum Caltrans HDM criteria for the ramp configurations, horizontal alignments and arterial interface.

- El Camino Real/Magdalena Interchange

The SMI proposal for the El Camino Real Interchange on page 19 includes "*closing the northbound ramp at the El Camino Real interchange, and replacing with the existing ramp, just to the south, also exiting to El Camino Real. These interchanges are more closely spaced than desirable, and this change will improve safety.*"

What the SMI design does not consider is the Caltrans practice to comply with state and national standards for implementation of projects addressing future needs. The SMI design does not address either the existing non-standard geometry or the access control issues at all the existing ramp intersections with El Camino Real (see Exhibit X-1 attached). The closing of the NB ramps at El Camino Real and the use of the trumpet ramps to the south at Avenida Magdalena creates two issues. First, this violates the Caltrans advisory policy in HDM **Topic 502.2 Local Street Interchanges:** "<u>The use of isolated off ramps or partial interchanges should be avoided because of the potential for wrong-way</u>

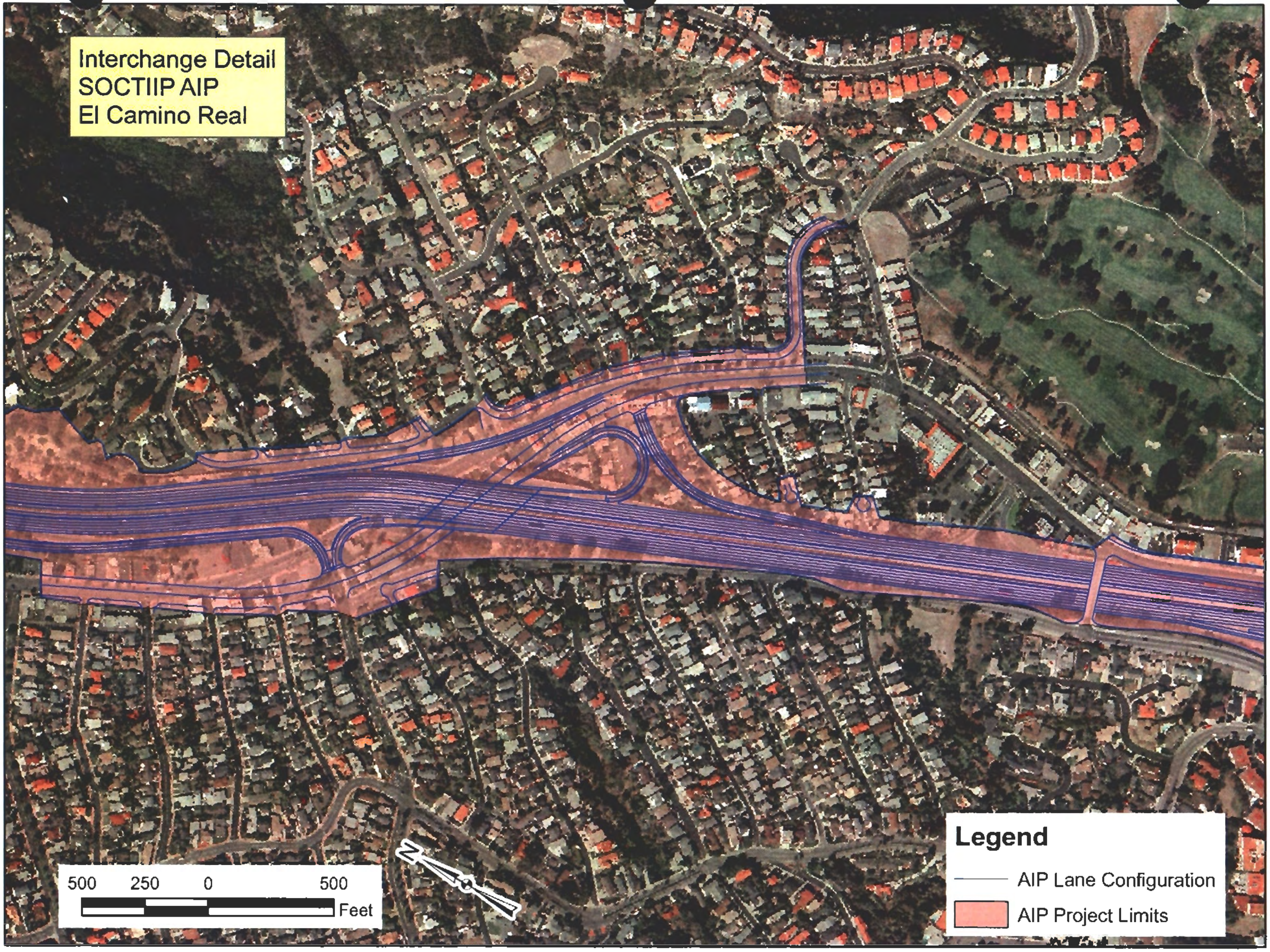
AIP-R Interchange Detail

El Camino Real

1,000 feet

Source Data: NASA 2005

Legend
Approx. Limit of Freeway Lanes
Property Takings
New Structures



Interchange Detail
SOCTIIP AIP
El Camino Real
500 250 0 500
Feet
N
Legend
AIP Lane Configuration
AIP Project Limits

movements and added driver confusion." The second issue is safety related in that the existing ramps at Magdalena have substandard curve radii and the NB exit ramp does not meet the current stopping sight distance standard. The SMI ramps would make the curve radii more substandard and exacerbate the deficient stopping sight distance which would make the ramps even more dangerous than they are currently.

The SOCTIIP AIP design evaluated the existing El Camino Real interchange and a new interchange design was developed to meet minimum Caltrans HDM criteria for the ramp configurations, horizontal alignments and arterial interface (see Exhibit X-2 attached). In order to create ramp configurations that meet minimum capacity needs and HDM design standards, the SOCTIIP AIP design started with the realignment of El Camino Real itself (approximately 0.6 mile) and, consequently, all the ramp intersections with El Camino Real had to be relocated. Then, the existing substandard weaving distance from the adjacent SB entrance ramp to the north (entrance from Avenida Presidio) required that the SB El Camino Real exit ramp be "braided" with the Avenida Presidio ramp. This "braiding" moved the SB El Camino Real ramp exit from I-5 to north of Avenida Presidio with the addition of structures to carry the SB El Camino Real ramp over Avenida Presidio and the Avenida Presidio entrance ramp. Thus, the SB El Camino Real exit ramp would be over 0.7 mile long and require the taking of at least 8 blocks of commercial buildings fronting on El Camino Real. The SB El Camino Real entrance ramp intersection with El Camino Real was moved northerly to intersect El Camino Real north of its crossing with I-5 to provide minimum geometric standards for the turning movements from NB and SB El Camino Real onto the ramp. The loop ramp for SB El Camino Real to NB I-5 traffic was provided to meet safety and capacity requirements. The reconfiguration of the NB El Camino Real exit ramp also required that the NB exit and entrance ramps at Avenida Magdalena be eliminated due to their substandard separation from the NB El Camino Real ramp and, then, the traffic from these ramps had to be reallocated to the El Camino Real ramps.

The realignment of El Camino Real and the Caltrans requirement for access control along El Camino Real through and beyond the I-5 ramp intersections with El Camino Real also necessitated the realignment and extension of Calle Alcazar to the east of I-5 from Avenida Cordoba on the north to Avenida San Gabriel on the south (approximately 0.5 mile). These street relocations, which would be required to provide local access to the adjacent residential areas, result in significant commercial and residential takes.

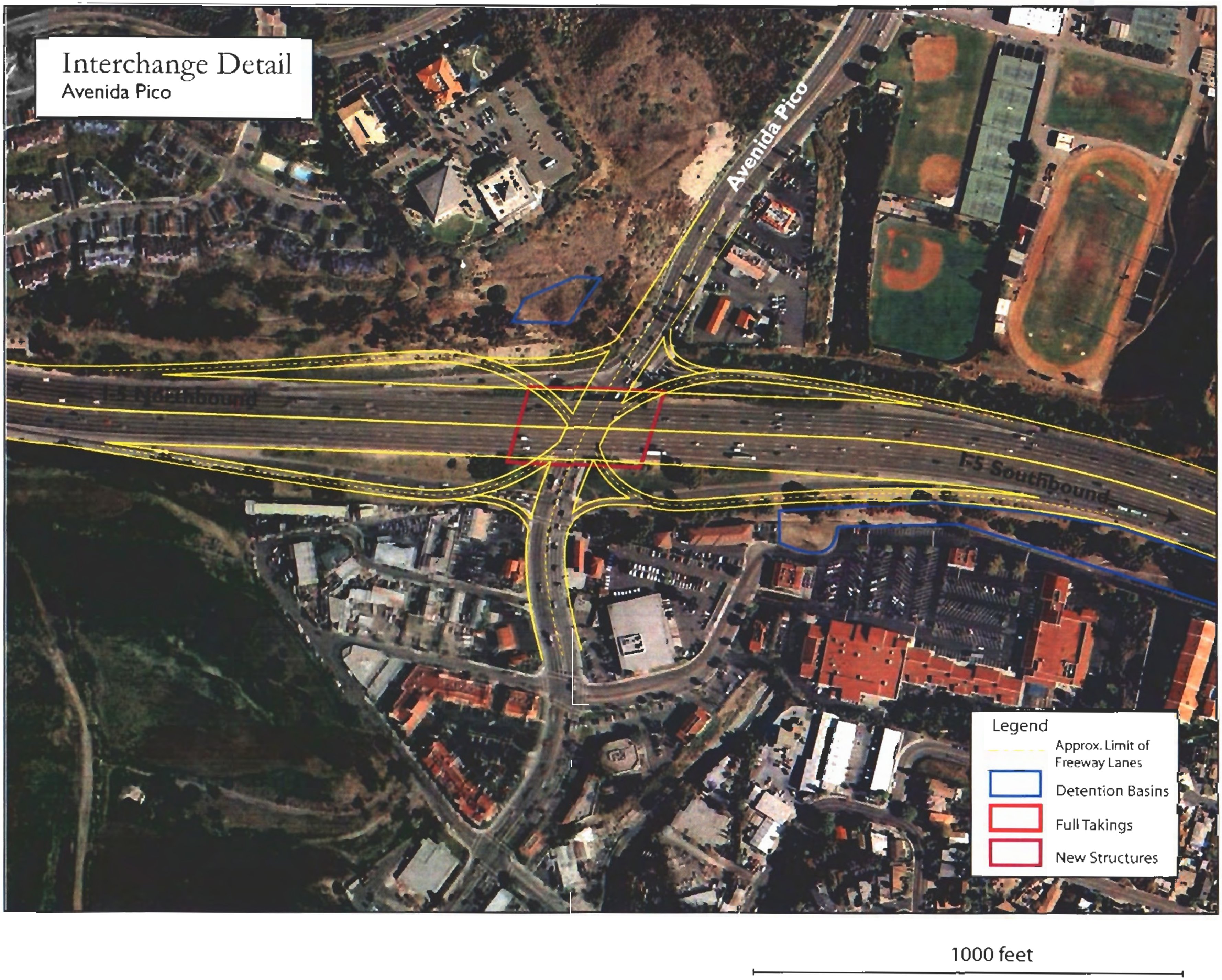
- Avenida Pico

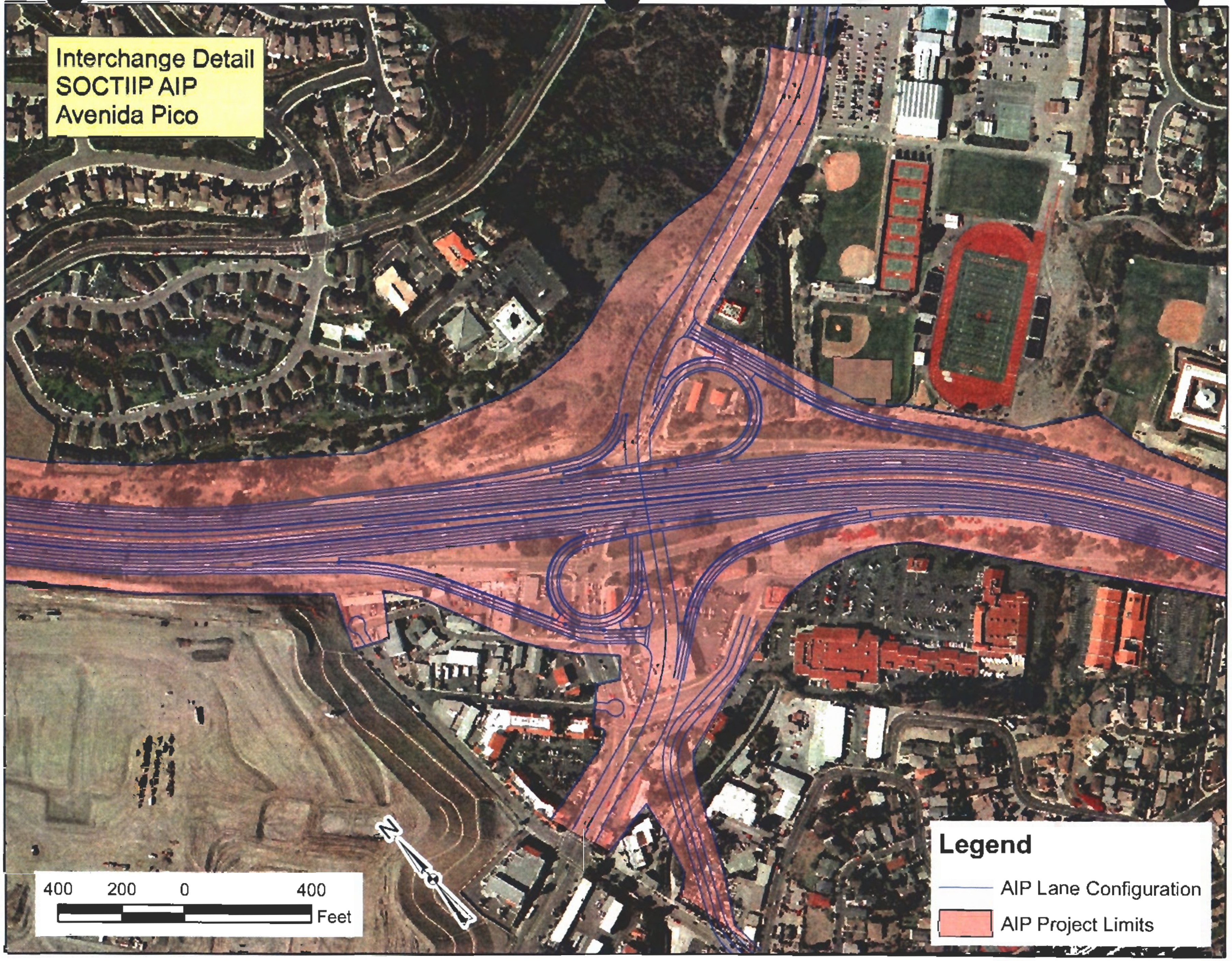
The SMI AIP-R report proposes replacing the current tight diamond interchange at Avenida Pico with an SPI, with only a minor realignment of Avenida Pico to the east of I-5. Also, minor modifications to the ramps are shown with minimal right-of-way impacts. While the design may appear to be a workable solution to the traffic issues here, there are many flaws in the design proposed by SMI which severely affect the safety and operation of the interchange (see Exhibit Y-1 attached). First, placing an SPI where the intersecting arterial is on a curve makes it difficult for drivers to determine the proper lane to enter when making left turns from the off ramps. There are also several places on the ramps, at the approaches to Avenida Pico and where lanes merge, where adequate stopping and decision sight distances are not provided. Another safety issue occurs as the on ramps enter the mainline I-5 where substandard geometry does not provide for safe merging of the ramp traffic with mainline traffic which would also cause safety and traffic issues on I-5. While it is difficult to verify based on the sketch in the report, it appears that the opposing left turn movements of the northbound and southbound exit ramps conflict and do not line up with the lanes on Avenida Pico they are supposed to join.

Another major issue is the fact that the right turn lanes do not maintain tangency to Avenida Pico or the ramps they tie into. This is both a traffic capacity and safety hazard, as vehicles would be joining lanes with higher speed traffic with no space to merge and would be required to make abrupt direction changes to stay within the proper lane. Also, since this is an urban area with San Clemente High School and many retail and commercial businesses, pedestrian traffic is expected to be high, creating safety concerns at the free-right turns.

Aside from the extremely unsafe conditions resulting from the proposed SMI design, there are several other constructability and right of way issues which are not addressed. The SMI report does note that the mainline I-5 structure would need to be replaced; however, the report fails to mention the associated major reconstruction of the approaches to the structure to provide adequate vertical clearance for vehicles traveling under the structure. As shown on the proposed SMI exhibit, the bridge does not appear to be long enough to clear to northbound exit and entrance ramps. Regardless, placing a single-span structure with a length that exceeds typical dimensions would require specialized design and an exceptionally large depth (thickness) for the proposed structure, if such a structure is even feasible. As a result of the increased depth, the approaches to I-5 and/or Avenida Pico would need to be revised vertically to account for this.

There is also the issue of the EDBs, which are mentioned in the SMI report, but generally glossed over without much thought on feasibility or


Interchange Detail
Avenida Pico
Avenida Pico
I-5 Northbound
I-5 Southbound
Legend
Approx. Limit of Freeway Lanes
Detention Basins
Full Takings
New Structures
1000 feet



Interchange Detail
SOCTIIP AIP
Avenida Pico
400
200
0
400
Feet
N
Legend
AIP Lane Configuration
AIP Project Limits

practicality. It is noted that Basin 3-E is located on a slope adjacent to a parking lot and results in partial displacement and even discusses the option of constructing Basin 3-E under the privately owned parking lot. Caltrans policy would not allow for such a condition. Basin 3-F is described as being at the foot of a hillside when, in fact, it is in the middle of the hillside. Aside from the obvious constructability issues with providing a basin with sufficient capacity at this location, there is also the issue with conveying runoff to a basin that is substantially higher than the freeway (water does not flow uphill).

In contrast to the proposed SMI design, the SOCTIIP AIP proposed a design which meets Caltrans Design Criteria, providing a safe, operationally superior and feasible solution (see Exhibit Y-2 attached). The realignment of Avenida Pico (approximately 0.5 mile) is necessary to accommodate the needed storage capacity of the ramps and allow for typical intersection designs at the ramp termini. This realignment requires the mainline structure to be reconstructed at the new crossing location. The existing tight diamond interchange was replaced with a partial cloverleaf interchange to reduce signal times and provide two entrance ramps for each direction of mainline traffic, thus adding ramp capacity and reducing congestion on the ramps and Avenida Pico. The exit ramps have been realigned to accommodate the new loop ramps and intersect Avenida Pico at nearly right angles. All entrance ramps have been realigned to a partial clover interchange design. All ramps have been redesigned to meet current HDM standards and to tie into the widened mainline. With the ramp realignments, properties in the northwest, southwest and southeast quadrants of the interchange would need to be acquired, resulting in several business relocations.

With the realignment of Avenida Pico, Via Pico Plaza was realigned to intersect Calle de Los Molinos (0.2 mile) and a cul de sac was placed at the end of Calle de Industrias closest to Avenida Pico, removing the intersection with Avenida Pico completely. These changes were necessary to provide the Caltrans required access control along Avenida Pico adjacent to the interchange in order to improve traffic capacity. Also, the northern end of Calle de Los Molinos was terminated with a cul de sac and Avenida Navarro was eliminated, as the properties along the east side of the street were part of the proposed right of way to accommodate the southbound exit ramp and southbound loop entrance ramp.

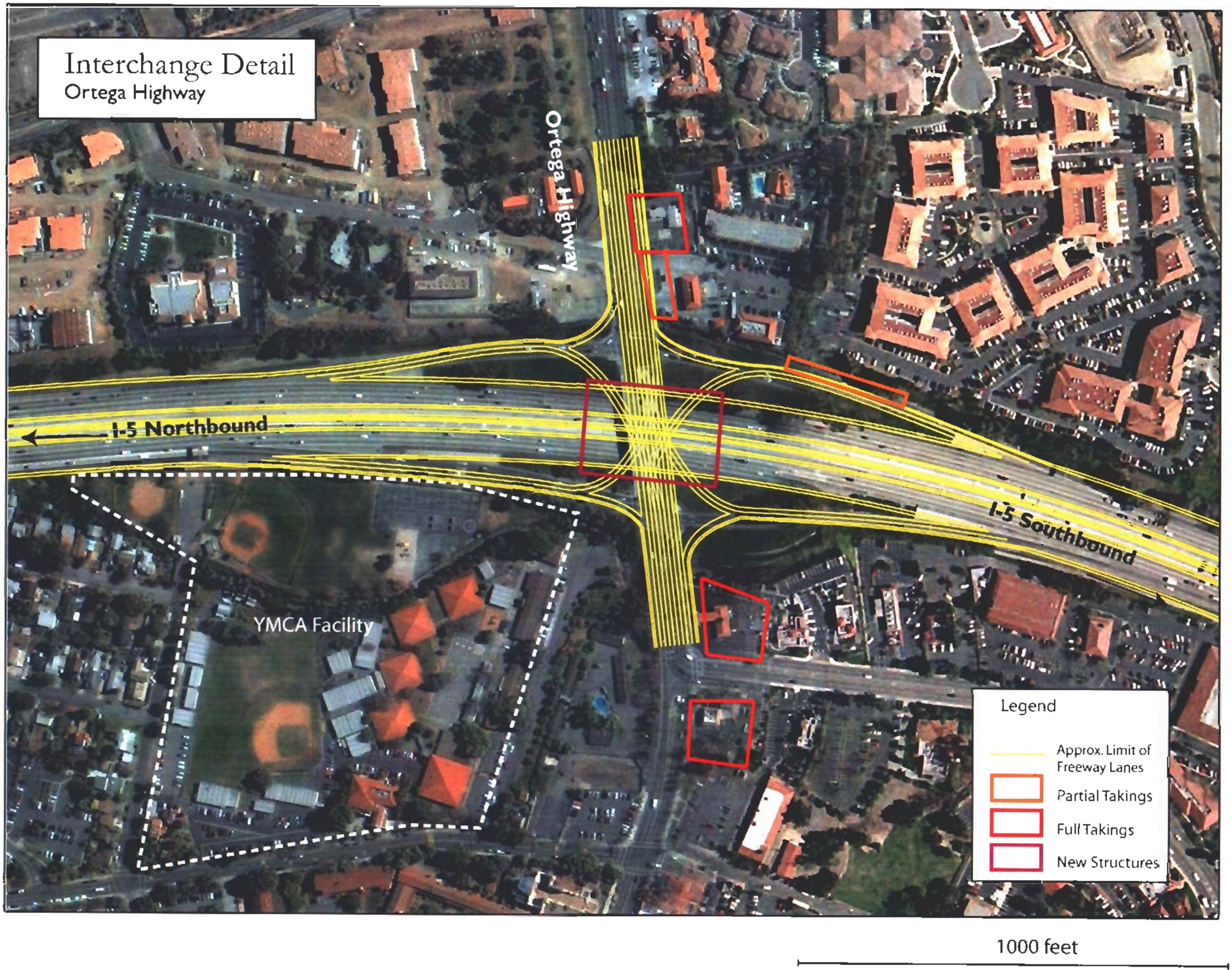
In order to provide the traveling public with an interchange configuration that accommodates present and future traffic demands, significant right of way impacts are unavoidable.

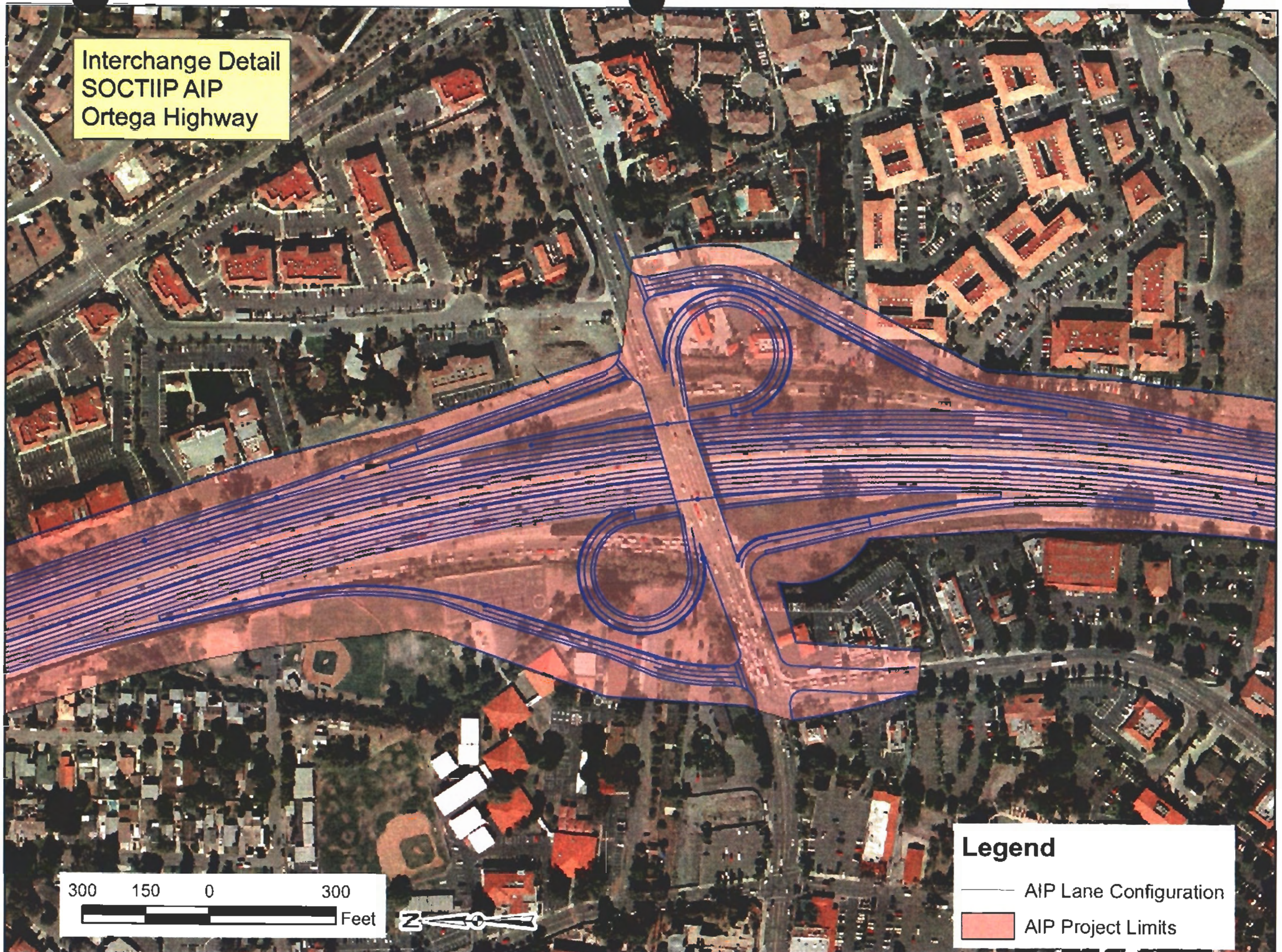
- Ortega Highway/State Route 74 Interchange

The Ortega Highway/State Route 74 interchange with I-5 is currently a tight diamond configuration that the SMI report proposes replacing with an SPI. Some widening of Ortega Highway is proposed with right-of-way impacts along the south side of Ortega Highway. The ramps have been modified with only minimal right-of-way impacts. The SMI Ortega Highway design appears to address traffic issues, but several operational and safety issues result from the flawed design proposal (see Exhibit Z-1 attached). Adequate stopping and decision sight distances are not provided at several locations on the ramps, including at the approaches to Ortega Highway and where the right and left turn lanes merge. The substandard geometry where the ramps enter mainline I-5 produces another safety and operational issue, as ramp traffic cannot safely merge with mainline traffic, affecting traffic flow on both mainline I-5 and on the ramps. The operation of the interchange would also be adversely affected by the large distance between opposing left turns and the ramps, increasing the distance vehicles must travel to clear the intersection. This increased distance adversely affects signal times, reducing overall capacity of the interchange. Additionally, the turn lanes on Ortega Highway do not appear tangent to their respective lanes nor do they line up properly with the entrance ramps.

Another serious safety issue is the fact that the right turn lanes do not maintain tangency to Ortega Highway or the ramps they tie into. This is a serious hazard, as vehicles would be joining lanes with higher speed traffic with no space to merge and would be required to make abrupt direction changes to stay within the proper lane. Also, as this is an urban area with a YMCA facility and several retail and commercial businesses, pedestrian traffic is expected to be high, creating safety concerns at the free-right turns.

The SOCTIIP AIP proposed a partial cloverleaf design which meets Caltrans Design Criteria providing a safe, operationally superior and feasible solution (see Exhibit Z-2 attached). By introducing new loop ramps, realigning the existing ramps to accommodate them and allowing for only right turn access onto the ramps, the signals at the off ramps are spaced further apart with fewer signal phases. This eliminates the need for left turn lanes and storage space along Ortega Highway, providing for additional through lane capacity within the existing Ortega Highway roadway width. The result is the need for only minor widening of the existing structure approaching the southbound entrance ramp to I-5. With the realignments, all ramps meet current HDM standards and to tie into the widened mainline. Properties in the northwest, southwest and southeast quadrants of the interchange are impacted by the realignments and would necessitate acquisition of right of way and the relocation of portions of the YMCA facility and several businesses.


Interchange Detail
Ortega Highway
Ortega Highway
I-5 Northbound
I-5 Southbound
YMCA Facility
Legend
Approx. Limit of Freeway Lanes
Partial Takings
Full Takings
New Structures
1000 feet


Interchange Detail
SOCTIIP AIP
Ortega Highway
Legend
AIP Lane Configuration
AIP Project Limits
300
150
0
300
Feet
N

With the realignment of the southbound exit ramp, a portion of Del Obispo Street (0.1 miles) has been realigned to intersect Ortega Highway at the same location, combining two previously signalized intersections into one and further enhancing the capacity of Ortega Highway.

- Crown Valley Parkway

Page 16 of the SMI report describes the construction of a "flyover ramp" for the southbound exiting left turns at the Crown Valley Parkway Interchange. This alternate design is very impractical for this location for many reasons.

First, the design shows the ramp crossing under Crown Valley Parkway then over I-5. There is not sufficient horizontal or vertical clearance between Crown Valley Parkway and I-5 to accommodate this ramp without complete vertical realignment of Crown Valley Parkway which would have significant impact on the other ramp terminals.

Second, the ramp, which would be two lanes wide, connects to Crown Valley Parkway east of the existing northbound exit ramp and the required access control would necessitate the taking of all of the businesses between the existing ramp and the entrance to the regional mall which is approximately 1000 feet to the east.

Third, the distance from where the ramp crosses the northbound exit ramp to where it connects to Crown Valley Parkway does not appear to provide sufficient length to allow an acceptable vertical alignment of the ramp as it connects to Crown Valley Parkway.

Fourth, the run out of the 2 lane ramp connection to Crown Valley Parkway would require all traffic that now turns left into the major commercial/business area along Puerto Real to be rerouted further east which would further congest that portion of Crown Valley Parkway.

The SMI conclusion that this design could "provide sufficient traffic capacity" is totally inconsistent with the reality of the impacts the design would have on the Crown Valley Parkway traffic.

truelife

SANTA SAFARI

A family's **Christmas tradition** includes presents and, with luck, a decent break.

By KEVIN GRANGE
SPECIAL TO THE REGISTER

When my brother Sean first suggested surfing San Onofre the morning of Dec. 25, I was shocked: "Christmas morning?" I belted. "No way!"

My family had held the same Christmas-morning tradition for as long as I could remember and, as much as I loved surfing, I wasn't about to upset the apple (i.e. present) cart.

"Fine," replied Sean, heading for the door, "but San Onofre's gonna be head high, glassy and ... completely empty."

"Hold up!" I hollered. "Get back here."

Like many in Southern California, I'd spent hours in my car in the summer, waiting in the heat, to simply get into the state beach, only to wait again in the lineup to score my own wave. The thought of catching this world-famous surf spot uncrowded on an epic swell was simply too good to refuse. "Count me in," I declared, "but what about Hunter and Taylor?"

Hunter and Taylor are Sean and his wife Corie's two blue-eyed boys, who were then 2 and 17 months, respectively. While they were still at an age where Santa scared them and their handing out presents seemed better than receiving them, my conscience told me Christmas was about the children.

"We'll bring the boys," declared Sean. "Corie and I will take turns surfing and watching them on the beach – it'll be great!" He was right: It was the perfect plan. That is, if my parents agreed.

My family's Christmas ritual was as unchanging as the date it fell on. We'd spend

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the night before at my parents house in San Clemente, going to Christmas Eve Mass, then wake up at dawn, tear through presents, stuff ourselves silly on brunch, followed by either a) seeing a movie b) taking a nap or c) trying to assemble toys whose instructions required a graduate degree in engineering.

It was a tradition passed on to my parents from their parents and their parents before them. Would changing it now be a slap in the collective family face – the holiday equivalent of changing my last name to something more surfer sounding, like Slater?

I found my folks in the living room, watching TV. "Hey guys," I stammered, shy at the prospect of parental disapproval. "I was, um, thinking we might, ah, change Christmas this year."

My dad hit mute on the remote control. Now, I've learned over the years that his hitting this tiny black button is never a good thing. Dad only hit mute in instances of missed curfews, the occasional bad grade and when I told him I was eloping with my seventh-grade sweetheart. Fortunately for me, I hit the stop on the marriage button, but fast forward 20 years and Dad's mute button still had batteries.

FATHER AND SON: Sean Grange looks at the San Onofre surf with his son, Hunter.

Maybe it was because it was Christmas morning, or that we were surfing a break called "Churches," but, paddling out, there seemed no separation between ocean and sky or heaven and earth.

"Excuse me?" said Dad.

"Can-we-surf-San-O-tomorrow-before-presents?"

"I have to tell you, Kevin," he began, "Your mother and I are very disappointed."

I felt awful. "I'm sorry. I take it back. We'll stay here!"

"We're disappointed because," he said, taking off his glasses, "it's not polite to go surfing on Christmas and not invite your parents."

Suddenly Mom and Dad burst into laughter and I realized not only were they joking, but they were watching "Step Into Liquid" in high definition.

"So you're in?" I gasped.

"We've already packed the car," Mom said excitedly.

It was one of those moments when, as a son, you see your folks as peers more than parents and realize: "They're rad!" I gave them both a hug then dashed upstairs to wrap presents and prepare.

As I crawled into bed that night, I was filled with a giddiness and Christmas magic I hadn't felt since childhood. I cracked my window, only instead of reindeer bells, I listened for the distant crash of waves. If Santa came tonight, he wouldn't slide down the chimney – he'd arrive on an ocean swell and his presents would wear the foam wrapping of waves.

Before I knew it, my alarm went off and I was racing down the stairs with excitement. Presents of all shapes and sizes sat neatly stacked under a tree glowing with colored lights. Stockings hung over the chimney, stuffed with candy, rolled magazines and candy canes. But what excited me most was seeing Hunter and Taylor wearing "Baby on Board" sweatshirts and my family packed and ready to go.

As we rolled into the parking lot at San Onofre, I was surprised to see a few other cars parked. Evidently word of Santa's swell had spread beyond the cozy confines of our home. I've always found the surfers at San-O a cheery bunch, but this morning our greetings celebrated a common secret. "It's all ours!" said one man, running toward the water.

"Can you think of a better way to start the day?" yelped another.

We grabbed our boards from the roof racks with glee. Dad volunteered to watch Hunter and Taylor on the beach as Mom, Corie, Sean and I suited up. Maybe it was because it was Christmas morning, or that we were surfing a break called "Churches," but, paddling out, there seemed no separation between ocean and sky or heaven and earth. Minutes later and a few hundred yards out, we sat up on our boards and gazed at the calm, still-dark sea around us.

"Where are the waves?" I asked.

"If you wait ... they will come," said Sean, not unlike Kevin Costner in "Field of Dreams."

Suddenly, a bolt of sunlight shot across the ocean. Everyone in the water turned and watched in awe as a golden sun rose above the eastern bluff. Undoubtedly, we'd all dawn patrolled before and seen the sun rise, but that day it felt nothing short of miraculous. It was as if inhaling in ever-deepening breaths, the ocean woke up. A wave train rolled in and Sean yelled, "All aboard!" like a good conductor. Corie, Mom, Sean and I paddled furiously, arms flailing and feet kicking. The wave curled up behind us and carried us all forward in its gentle palm.

Now, I could tell you the joy of looking down a wave and seeing those you love surfing it with you, but it's really something you should experience yourself.

The rest of our Christmas Day defied tradition. Our fingers were so frozen after surfing [illegible] our wetsuits and sprinted for the hot tub. After the hot tub, we were so hungry we ate brunch before opening presents. And after the presents, we managed to assemble all our toys without one problem or missing piece!

Our holidays have never been the same since. What started as a private San Onofre Christmas has now spread to extended family and friends and become the routine for birthdays, holidays and (hope my boss isn't reading this) the occasional sick day.

But, most importantly, what started as a search for uncrowded waves has become a time for our family to simply enjoy being together, celebrating one another's presence – along with presents.

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