APPENDIX L
PEER REVIEW COMMENTS

Peer Reviewer #1

23 November 2004

Santa Rosa Plain Conservation Strategy Team
c/o Brauner Consultation and Mediation
P.O. Box 4857
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Dear Conservation Strategy Team:

Thank you for allowing me the opportunity to review and comment on the Conservation Strategy for the Santa Rosa Plain. I am supportive of your work and recognized the substantial effort you put into creating this document.

Conserving CTS and the endangered plants in the Santa Rosa Plain will be a challenge, however, I do think it is an achievable goal. Most of my comments reflect my focus on the tiger salamander rather than the endangered plants. I hope that others more knowledgeable than myself will make sure the plants get sufficient attention.

My first impression of the Conservation Strategy is that it does not attempt to achieve or even present an optimal approach for long-term preservation. In my opinion, an optimal approach would seek to assemble large contiguous blocks of habitat. I recognize that this approach would be challenging given the extremely subdivided land ownership, but it is not clear why an optimal approach was not presented as a model against which to compare the proposed strategy. The rationale for selecting this sub-optimal strategy over other possibilities should be better developed.

On a positive note, I find the acreage goals to be on the order of what is likely to represent a reasonable reserve. However, I found little to the strategy beyond setting acreage goals. In my opinion just setting aside acres, without habitat restoration/creation, will do little to recover or secure the long-term preservation of CTS in the Plain. From the data I have seen, at this point it is primarily a dearth of suitable breeding pools which limits the distribution and abundance of this species. Pool creation or enhancement is the only way to change this. More focus needs to be placed on establishing a large number of productive breeding ponds nested within (if not reserve land) reasonably compatible upland habitat uses. Also establishing a broadly distributed network of breeding pools between which occasional movement is possible should be a component of the strategy.

I encourage you to continue with this effort. Ultimately, this entire project should be viewed as an experiment; especially with the proposed sub-optimal strategy, there is no certainty. Hypotheses for reserve design and management should be supported by the best available data, but do not assume that our understanding is complete. Mistakes will be made, but though monitoring and adaptive management hopefully you can avoid making the same mistakes repeatedly. This will be an iterative process and hopefully as you learn, from managing adaptively, your ability to provide the habitats these species require will improve.

Please feel free to contact me if any of my comments are not completely clear, or I can otherwise be of further assistance with this process.

Sincerely, Peer Reviewer # 1

APPENDIX L
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Summary:

I have completed my review of the "Conservation Strategy for the Santa Rosa Plain". I applaud this effort to find a workable solution for the long-term conservation of the CTS in Sonoma County. This is an extremely complex problem, and any working solution will require a long-term vision and cooperation among diverse parties. The Conservation Strategy is a good start in that process. Enhanced certainty is ultimately the goal of this process for both economic development and resource conservation; trust is essential for success here.

In my review I have focused mostly on the science, although where regulatory and process questions arose I attempted to explain my concerns and views on the available options. Of course, as a scientist, I would prefer to see additional research to fill in gaps in understanding before moving ahead with a plan. However, I recognize that for both the cause of economic development and conservation of the CTS, there is not time for extensive research before you act. I do think that using the best information available and a true adaptive management approach (where management actions are implemented as experiments, with monitoring designed to critically evaluate the assumptions on which management is based) substantial progress can be made towards conserving the CTS and the endangered plants in the Santa Rosa Plain.

Before addressing the specific questions raised by the Team, I think it is important to lay out my main concerns with the Conservation Strategy in its current form:

1) <u>There is no discussion of an optimal strategy for CTS protection in the Santa Rosa Plain:</u> In my opinion a reserve design that would protect at least three 1000 plus acre blocks of upland habitat with multiple large (>0.25 acre) breeding pools on each reserve would be best suited to the long-term protection of CTS. This design would afford protection of sufficient wetland and upland resources to maintain populations against most foreseeable threats to their long-term persistence. It would also allow flexibility in adaptive management; for example, the benefits of burning upland sections of grassland or enlarging a breeding pool could be tested with few confounding uncontrollable factors.
2) <u>The strategy that is advocated is not well justified:</u> From my reading of the strategy the goal is merely protection of a certain number of acres of upland and wetland habitats with little consideration of the spatial arrangement of habitats. I recognize the need for flexibility in this highly subdivided landscape, but I think this requires a more detailed discussion of how you plan to achieve your goals with this suboptimal design. The ultimate goal is not clear beyond the vague goal of long-term preservation of CTS. How specifically are you proposing to reach this goal, and why are you focusing on this sub-optimal strategy?
3) <u>An alternative strategy for expansion of CTS:</u> If protection of large contiguous blocks of habitat is not possible – an alternative strategy might be to create an extensive diffuse network of protected sites **each containing at least one substantial CTS breeding pool**. At this point the main factor limiting the distribution and abundance of CTS in the plain appears to be the small number of

productive breeding habitats. A focus on creation of a diffuse network of smaller preserves emphasizing the protection and construction of productive breeding pools, would be based on the hypothesis that off-reserve lands can provide sufficient suitable upland habitat for movement and some level of survival. That hypothesis is supported by the LSA report included in the package provided, and also by David Cook's study at Southwest Community Park. It seems to me that if portions of the nearly 3800 acres slated for protection were distributed in 10-30 acre habitat blocks across the Plain, a network of more than 100 breeding pools with some adjacent protected uplands could be established. This approach would be more likely to increase the abundance of CTS and their overall distribution in the Plain than even my 'optimal' strategy. However, it would also be more likely to lead to periodic (likely temporary) disappearances of CTS from certain breeding pools due to somewhat reduced upland survival, but the management hypothesis would be that the more extensive network of pools would also enhance the potential for interpond dispersal and natural recolonization. This approach is no more experimental than the one suggested in the Conservation Strategy, but I think it is superior in that it would increase the distribution and abundance of CTS.

4) <u>The Strategy contains little explicit discussion of CTS habitat needs for long-term persistence:</u> For long-term persistence CTS require sufficient areas of both breeding and upland habitats. If you reduce the area of breeding habitat, fewer larvae will survive to metamorphosis, and the population will be less likely to persist. If you reduce the area suitable upland habitat available, CTS will be either a) forced to live at higher densities within the available habitats, intensifying intraspecific competition, and reducing growth and survival; or b) be increasingly likely to wander into suboptimal habitats where growth and survival will be reduced if not eliminated. I suggest that a revised Strategy should more explicitly consider the habitat needs for CTS and the other species. Historic wetlands destruction appears to have resulted in a major decline in the number of suitable breeding pools for CTS, thus a key goal should be increasing the distribution and abundance of highly productive CTS breeding pools.
5) <u>Possible conflict between protecting uplands for CTS and creating wetlands for mitigation</u>: This is an issue that needs to be dealt with early in this process or it will lead to real problems down the line. Although studies, such as the one by LSA, show that a variety of upland land-uses are used as "aestivation habitat" **wetlands do not represent suitable upland habitat**. This is presumably why CTS have yet to be found within the 100 yr flood plain of the Laguna de Santa Rosa, even though suitable pools are present. Although burrows may develop in wetlands during the dry summer months, they are absent or extremely rare during the wet season when CTS move across the surface in search of new burrows. In research at Jepson Prairie, CTS were roughly three times less dense south of Olcott Lake where the landscape is largely flooded in winter as compared with north of the lake which is dominated by slightly higher terrain. In the Conservation Strategy there is no discussion of what portion of reserve areas must be upland habitat suitable for CTS 'aestivation'. My concern stems from experience. I have seen wetland mitigation banks with wetted areas approaching

50%. I think there needs to be a more explicit discussion about how these two potentially conflicting conservation goals will be accommodated within the revised Conservation Strategy.

6) No apparent provision for regional monitoring and management: The Conservation Strategy appears to rely completely on local monitoring and management on a reserve by reserve basis. However, this is a regional plan requiring complex regional oversight, management, and vision. This will require substantial resources and the strategy should better explain how this oversight and large scale management will be achieved.

The following are my responses to the explicit questions posed in Appendix H. My restatement of the questions are in **bold text**, my responses are in normal text.

1. **Are the minimum preserve acreages adequate to support both CTS aestivation and breeding and plants?** Note: I found it very troubling that the "Hale Bank" and possibly other areas that provide little to no benefit for CTS or endangered plants were included in the calculation of "existing preserve acreage" – this does not inspire confidence in these estimated acreages.
    a. **Adequacy for CTS** - For CTS I would answer this with a qualified yes. A 350 acre preserve, while not excessive, if including sufficient breeding wetlands and uplands, would have a high probability of supporting a CTS population with long-term viability. However, this is assuming that these acres are in one contiguous block. In addition, as I mentioned in my introductory comments, I do not think wetland acreage should be included in the determination of preserve acreage for CTS, or wetland and upland preserve acreage goals should be considered separately. I'd recommend a maximum of 10% wetland acres with hydroperiods exceeding 1 month in the areas within 600 m of CTS breeding pools, and these areas should not count as CTS upland habitat. Less persistent wetlands are less of a concern because there is more time for burrow re-establishment.
    b. **Adequacy for plants** - For the plants, this really depends on achieving sufficient acreages of suitable wetlands; uplands are less of a concern. Based on my understanding of the biology of the endangered plants under consideration, this adequacy could not really be determined based simply on reserve acreage. However, I would suspect that either through wetlands protection or protection and creation, sufficient habitat to maintain populations of these species could be encompassed within a 350 acre area.
    c. Impact of fragmented reserves – I have major concerns about the potentially fragmented reserves that would be created based on the strategy as currently written. I understand the need for flexibility given the extreme degree of parcel subdivision. I think the strategy would have more credibility if the minimum acreages only applied for contiguous (or nearly contiguous) reserves and the upper acreages were required if no single minimum acreage reserve could be assembled. In fragmented reserves a large proportion of the population might reside in off-reserve

upland habitats, where a change in land use could dramatically reduce upland survival and compromise the reserve. Can some statement be made that "to the extent possible minimization of fragmentation within the reserve will be sought"?

d. Are lands selection criteria sufficient – The land selection criteria seem generally reasonable. I would oppose reducing the minimum acreages set for each conservation area. Habitat preservation outside the conservation areas should not be discouraged, but it should not be counted towards meeting minimum acreage requirements within conservation areas.

2. Would establishing smaller minimum preserve acreages constitute biologically acceptable alternatives? – In my opinion any approach taken short of establishing 350+ acre blocks of contiguous land must be considered highly experimental. That said, I don't think complete habitat protection is the only way that CTS might be maintained in the Plain. An experimental approach worth consideration would be to establish large productive breeding pools on smaller preserves nested in rural residential landscape where largescale development or wholesale agricultural intensification are likely. The CTS population at Southwest Community Park provides a relevant example. This large, once-productive breeding pool is situated within a region of degraded rural residential uplands, and until recently supported breeding populations in excess of one hundred adults. Populations could be promoted through habitat creation/enhancement at other sites outside the urban growth boundary. It would seem that this approach might allow greater flexibility, however, it would be highly experimental and require long-term monitoring to ensure its success.

a. By establishing small preserves and promoting CTS on them you would be increasing the potential that neighboring landowners might be responsible for take. Would this be a problem? If so, this is a problem for the proposed fragmented preserve design generally. Ultimately this all points towards the need for an HCP for the Plain.

3. Would allowing up to 20% of preserve lands to be established outside conservation areas be likely to result in excessive fragmentation? If so what additional measures could be incorporated to avoid this? – If these areas were allowed to count towards preservation goals within conservation areas, and the lands protected were not along a conservation area boundary, then yes it seems clear that this approach would increase fragmentation. I would only opt for this approach if lands outside linked to lands inside the boundary and contributed to establishing a 350+ acre contiguous block. It is not clear why this allowance is even suggested. The revised strategy should include a clear rationalization for how this allowance would increase the overall benefit to the listed species – otherwise I do not think this allowance should be included.

4. Please comment on the potential effectiveness of the preserve design proposed for the Southwest Santa Rosa Conservation Area. – I consider this proposed design to be experimental, requiring verification of its long-term

efficacy. I know this area is of interest because it contains several known breeding ponds and efforts have been made to set aside some lands here (on Fig. 2 I cannot see any connection between the FEMA site and the triangular parcel to the west – I would hope some connection would be maintained). The extreme fragmentation here makes me less than confident in the long-term potential for maintaining CTS here, but I do think it is an experiment worth attempting.

a. **What would be a biologically acceptable corridor length and width? –** The proposed 500 foot corridor width seems reasonable to me. Based on the distances we have documented CTS moving, I would try to keep corridors less than 0.6 miles (1 km) in length. Biologically, the longer and narrower the corridor, the smaller the probability that a CTS could make it from one end to the other successfully.
b. **What attributes should the corridor have? –** I would suggest that corridors should: be dominated by upland grassland habitat; have walled barriers along both sides to keep animals from straying; and I'd recommend that at least one CTS breeding pool be constructed near the midpoint of the corridor. A pond within the corridor would reduce the need for individuals to make the complete trip from one end to the other. Rather if even a few adults bred in this pool a larger number of metamorphs would be produced and would have a greater chance of making it to the other side. It might also attact animals into the corridor, thus increasing the likelihood that it would serve its role of connecting reserves at each end.
c. **What scientific information is available upon which to base corridor requirements? –** Studies of CTS movement among ponds and through the uplands; Ivette Loredo's 1996 study published in the Journal of Herpetology; and the various survey reports of consultants submitted to the USFWS. All of these indicate that CTS are present, primarily in grassland habitats, up to 1.2 km from known breeding ponds. Although eastern amphibians have been shown to favor forested habitats, this is not the case for the CTS. Due to a lack of information I think these corridors would have to be considered experiments until their effectiveness could be verified. I strongly suggest monitoring that would allow critical evaluation of the effectiveness of corridors (pitfall trapping or other census methods would likely be required).
d. **Are proposed migration corridors adequate for seed dispersal… How would narrowing corridors affect this? -** I cannot knowledgeably comment.

5. **Are measures set forth sufficient to provide for CTS movement among conservation areas? –** No, not as far as I could tell. It is not clear from the document that this is a goal outside of connecting the SW Santa Rosa area to the Llano area. An alternative to natural connectivity is long-term monitoring and relocation when an area loses its CTS population. In a revised strategy I would like to see some consideration of the maximum distance between CTS pools that

would need to be maintained to promote regional connectivity among pools and conservation areas.

6. **Is the SW Santa Rosa conservation area of sufficient size and configuration to provide for a viable preserve? –** Maybe. This remains to be seen for all areas described here. Only monitoring will show whether or not the areas are sufficient, and if they are not the Conservation Strategy suggests that intensive management will be used to make them work. With intensive management, I imagine CTS could be maintained in many areas; however, this may ultimately be more costly than securing intact blocks of sufficient habitat. In this area I would suspect that creating or enhancing one or more breeding pools would improve the long-term potential for CTS.

7. **Are the measures adequate to facilitate migration within the proposed corridors? -** The corridors proposed should be considered experimental (see my response to #4 above).

8. **Do migration patterns differ among populations? –** Yes, but not in any way that we can predict. I would suggest that at this point you have to assume that CTS movement is essentially random. This is what unpublished data on the distribution of captures around two ponds in Monterey County reflect. David Cook's study at Southwest Community Park shows that more adults arrive at the pond from directions with more remaining undeveloped upland habitat, but that is presumably because animals have lower mortality in those areas. The fact that CTS commonly get stranded on roads indicates that they are not effective at assessing risk and moving accordingly. To be safe at this point I would assume random movement, unless barriers are created to divert or funnel movement.

9. **Are preserve management actions sufficient? –** No. The proposed monitoring and management recommendations are extremely vague. Because there is so much uncertainty in the sufficiency of the reserve design proposed in the Strategy, it seems to me like a more detailed adaptive management scheme would need to be put in place. This might include focused studies to determine a better way to quantitatively monitor this species, the actual effects of proposed 'management' actions, and what upland habitat features benefit CTS (the LSA report suggests that burrow density is not limiting). What sorts of management will be implemented if larval densities in pools appear to be declining over time, especially if you have no confidence that these measured densities are indicative of population trends. What sorts of monitoring and research will be implemented to determine the effectiveness of habitat corridors and road undercrossings? I would suggest that a more integrative monitoring and adaptive management plan for the entire Plain is what is required.

10. **Are the suitability criteria set forth sufficient to identify lands that will contribute to the conservation objectives? -** The basic criteria (in conservation area, supporting occupied or potential habitat or buffering existing habitat, <15%

hardscape, not isolated, not in 100-yr floodplain, no harardous materials) all seem reasonable, but are they sufficient to identify lands of value for conservation? Why is there no guidance based on maximum distance to a known or potential breeding pool? What about the potential for isolation by intensive agriculture or simple distance? Could surveys be required to document the presence of the species? For isolated parcels I would also want some assurance that a substantial CTS breeding pool exists or could be established on the property – isolated upland habitats with no breeding pools would seem of minimal conservation value.

11. **Are the plant translocation criteria sufficient? –** Others are better qualified that me to comment on this. However, it does seem like there is a history of at least limited success.

12. **Are the CTS translocation criteria sufficient? –** The criteria presented seem appropriate but incomplete. At a minimum there also needs to be a substantial requirement for monitoring translocation success so that this process can be verified and refined. At this point, you do not know that every pool that holds water into April is in fact suitable for CTS. For example, CTS larvae will likely perish in pools with 1) an insufficient food base and 2) insufficient vegetation/ depth as refuge from predators such as great blue herons. Newly created and existing pools may lack both of these important attributes. There should also be a minimum area and depth for translocation pools. Although CTS breed in small pools, overall fewer larvae survive to metamorphosis in these habitats. My opinion is that CTS should not be translocated into pools smaller than 400 m^2; and pools constructed specifically for CTS should be larger. An optimal design would include shallow margins where warm water stimulates productivity and rooted vegetation is present for egg laying, and also deeper sections as refuges for predators. Work in Monterey County (Trenham et al. 2000) suggests that larvae should be stocked into pools at a density not greater than 1 per square meter. Stocking at higher densities will just result in higher cannibalization rates. The following paper also contains some good recommendations regarding amphibian translocation and recovery planning generally (Semlitsch R.D. 2002, Critical Elements for Biologically-Based Recovery Plans for Aquatic-Breeding Amphibians. Conservation Biology 16: 619-629).

13. **Was the methodology used to create Figure 2 appropriate? -** I could not find any information on the methods used to create this figure and so could not evaluate this. However, it would have been instructive to also see some representation of land uses in the Plain.

14. **Will the 9 conservation areas be sufficient to establish long-term preservation of the CTS?** – I think they could be sufficient. If a network of productive breeding pools can be preserved or created on protected lands, situated such that interpond dispersal continues, and with sufficient resources long-term lands management, the 9 conservation areas may be sufficient to preserve CTS.

However, I have to stress that the reliance of the Conservation Strategy on a non-contiguous reserve design should be considered experimental with long-term monitoring built in and contingency plans if it appears that this strategy is not working (I saw no such contingency plan). Also, the assumption that regional land uses will remain similar to what currently exists seems like a big assumption in such a rapidly developing region.

15. **Will the proposed Conservation Strategy yield viable conservation preserves on a time scale sufficient for CTS preservation? Are other mitigation strategies potentially more effective? –** Unfortunately, you cannot know until you try. Because CTS are relatively long-lived, it is unlikely that they will go completely extinct before the conservation strategy can be implemented, and due to the capacity of females of this species to produce large numbers of eggs, if new breeding pools could be established, populations could recover rapidly. The strategy that is emphasized here appears to concentrate primarily on protecting existing habitat (pools and uplands). I suggest that a strategy focused on pool creation would be better suited to the recovery of the CTS. From the data I have seen most of the remnant vernal pools support tiny breeding populations of CTS and should not be relied upon for the long-term conservation of this species. Because we have seen that CTS at various sites (LSA report, SW Community Park) survive in uplands under a variety of land uses, an emphasis on the creation of a well distributed network of productive CTS breeding pools with none isolated from the next by more than 1 km might be a more promising strategy. A focus on a well-distributed network of productive breeding pools, if successful, would also preserve the CTS within a functioning ecosystem rather than in zoo-like isolated reserves. Potentially the best strategy would be a hybrid of the two approaches - with a mixture of large and small blocks of habitat each supporting at least one substantial CTS breeding pool to maintain the potential for pond-to-pond dispersal (i.e., stepping stone reserves rather than continuous corridors). I think a further essential consideration is that, because so little CTS breeding habitat remains, the number of breeding pools needs to be increased, which will require that in some cases the destruction of upland habitats be mitigated for with created or restored breeding pools.

16. **Is the conversion of upland habitat to wetlands a concern?** - YES
    a. **If so, what considerations should be taken in designing such projects to assure that CTS are not adversely affected? –** We cannot assure that CTS will not be adversely affected. Is there any chance that you could consider all or part of the Plain an experimental population to allow greater flexibility in testing experimental strategies? On the wetland conversion issue, I think all available information suggests that wetland habitats should not be considered upland habitat for CTS. This is a complex issue, CTS require wetland habitats for breeding but live most of their lives in upland burrows away from water. Wetlands are flooded for a substantial part of the year and thus cannot continuously support the mammal burrows that CTS require. Because I know large acreages of

wetlands will ultimately be created in the Plain for mitigation purposes, I think the primary consideration should be for maintaining regional upland connectivity across the Plain. Wetlands creation should not block CTS dispersal, for example large wetland should not be created which would completely block movement between two CTS breeding pools.

APPENDIX L
PEER REVIEW COMMENTS

Peer Reviewer # 2

November 28, 2004

PEER REVIEW OF THE
SANTA ROSA PLAIN CONSERVATION STRATEGY

This review is structured in two parts. Part 1 gives my concerns and recommendations in an approximate order of what I deem most critical. Part 2 gives responses to each of the reviewer questions for which you requested a response.

Overall, I find the Strategy to be well-constructed. It is a serious effort to create a successful plan to mitigate further loss of the listed species, and even to enhance their population numbers and likelihood for long-term success. The Strategy is structured within the framework of existing law, by parties with a long history of administering these laws. Indeed, if implemented as it is currently written, I believe that the Strategy could be used to streamline permitting as well as to enhance conservation of the CTS and four listed plant species. Despite the value of the Strategy as currently written, however, I believe that several changes are necessary if the goals are to be met fully, in a manner that could ultimately result in a delisting of the species.

The Strategy's overall goal is not completely clear. In the Peer Review Draft, page 3, under 2.2, it states "The role of the Team is to develop a conservation strategy … [that] will result in conservation of habitat and ultimately be a component of the recovery of the CTS and listed plant species." According to this sentence, a full recovery plan will be developed later, and the Strategy will be a part of it. However, under 2.1 on the same page, one listed goal is "Develop a habitat conservation strategy for the California tiger salamander and listed plant species." This statement implies that the Strategy <u>is</u> a complete plan for recovery. My opinion is that the Strategy is not a full recovery plan, but, consistent with the first quote in this paragraph, leads in that direction. The Strategy should state explicitly whether or not it is deemed to be equivalent to a plan for full recovery or a part of such a plan. If it is intended as a full plan, then a number of changes such as I present below will be needed. If it is not intended as a full plan, than language pointing to a more complete plan should be included in the implementation section.

Some of my recommendations are based on "science," *per se*, including within "science" a handful of observations that field biologists have made that I consider to be valid even though they are based on personal observations only. Since the science is incomplete, yet actions must be taken, other recommendations are based on my knowledge of the species and ecosystems in question, including what I believe to be reasonable assumptions about the biology of the species and the ecosystems of which they are parts.

APPENDIX L
PEER REVIEW COMMENTS

PART 1. Issues and recommendations in an approximate priority order.

Summary: The Strategy has several shortcomings that must be corrected if it is to fully achieve the goal of Section 2.1: [to] "Develop a habitat conservation strategy for the California tiger salamander and listed plant species." Foremost among these is that the plan depends on reaction to proposed mitigation measures that come from multiple parties. It is reactive, not proactive. Second, the Strategy concluded that two land-use practices, irrigation and discing, are compatible with CTS conservation, apparently based on documentation from LSA submitted along with the Strategy. I believe that this documentation has been misinterpreted and that it is far to early to conclude that these practices are benign. Third, the Strategy is based on a flawed assumption that tiger salamanders move along predictable corridors that can always be identified with surveys, and, based on this assumption, the Strategy presents an inadequate means for mitigating the effects of roads on the CTS. Fourth, the boundaries of some of the proposed Conservation Areas do not include adjacent areas that may be critical for conservation of the species involved, and adjustments to these boundaries should be made. Each of these concerns is discussed below.

1.1. Concern 1. The Strategy is reactive, not proactive. It will achieve its objectives only if the large number of separate mitigations and other actions happen add up to a suitable final product, but there is no broad plan to assure that this will be the case. What is needed is active planning for conservation within each area, not just response to mitigation and conservation proposals. Although the Strategy refers to "adaptive management" and both Management Plan Template and FWS/COE policies refer to this, the term is applied only within specific projects, not to whole conservation areas. Broader planning is essential and will require additional staff.

> **Discussion.** The identification of Conservation Areas (C.A.'s in my text) is excellent, although I believe that their delineations should be re-examined (see below under Concern 4). Furthermore, the use of movement data for the CTS from Olcott lake by Trenham and Shaffer is a good aid in establishing acreage goals. The Strategy, however, does not have an adequate mechanism to assure that the acreages outlined for each C.A. have contiguity, hence will really function as habitat for CTS. The Strategy evaluates each mitigation proposal on its own merits, but does not contain a mechanism to direct the various mitigations, both spatially and in terms of their elements (new and existing pools, small vs. large pools, terrestrial habitat, etc.) into something that works in each C.A. The primary Strategy mechanism of responding to mitigation proposals as they come forth would not necessarily result in success in each of the C.A.'s.
>
> Before detailing recommendations to rectify this problem, I note that the Strategy does contain a provision for implementation review (Section 5.4). In this review, however, data presented will be summaries of actions that themselves are not explicitly coordinated in advance according to an ecological plan, but are responses to mitigation needs that come forth independently from a number of separate parties. Although I respect all of the members of the rather large, proposed

Mitigation Review Team, my experience with such bodies in other contexts is that there are unwieldy. I believe that a more explicit, ecologically based planning function is required. A Review Team might still be valuable as an oversight board for this team. It does not escape my notice that my recommendations in this section are essentially a restatement of Part B: Comprehensive Conservation Planning Process, presented by the FWS itself on pages 11-13 of the July 17, 1998 Programmatic Formal Consultation for U.S. Army Corps of Engineers 404 Permitted Projects that may affect Four Endangered Plant Species on the Santa Rosa Plain, California. The Strategy does not call for anything as comprehensive as this section of the July 17, 1998 memorandum, yet it purports to lead to effective conservation of the CTS in addition to the listed plant species, and the 1998 memorandum appeared to require comprehensive conservation planning for the plants alone.

To make the Strategy more proactive, I recommend the following:

1.1.1. The Strategy should mandate examination of all of the habitat in each C.A., and identify the specific needs for CTS and plants. Based on this analysis, site-specific targets for mitigation and acquisition should be set. Since the "willing seller" idea is central, alternative targets would need to be identified. The plans for the C.A.'s would not only identify parcels that would meet goals, but would scope out the ways in which the actual mitigation plans could enhance the C.A. as a whole. The plans would be presented to consultants and others involved in conservation and mitigation, and proposals would be ranked and approved based on how well they fit into the plan for each C.A.

For the native plants, there are a number ways in which C.A.-wide planning would be beneficial. Each mitigation could be planned to help create self-sustaining metapopulations of the plants, a metapopulation being a set of smaller populations that interact through time. The nature and distribution of upland habitat as a zone for seed dispersal on the feet of animals like the California hare and as habitat for pollinators of the vernal pool plants, would be more comprehensively planned. Planning could seek to maintain some natural vernal pool areas as comparators for change through time with modified areas, rather than allowing mitigation proposals to add wetlands to all natural complexes. Advance ecological planning could also evaluate the restoration potential of parcels that mitigation specialists might not consider, and then direct mitigations toward those areas. In addition, smaller parcels with significant features could be highlighted for mitigation or preservation with other funds, rounding out and connecting various projects. Such smaller parcels may be critical for success, yet will be less attractive to mitigation specialists. Programs of landowner cooperation can be undertaken, and these are unlikely to be targeted as forms of mitigation. Finally, inoculation of new mitigations would be best done with seed from other sites, natural or created,

within the same C.A., and a C.A.-wide plan would facilitate the communication needed for this to occur.

For the CTS, C.A.-wide planning is particularly critical since the species relies heavily on all resources of an area. It is known that the a given salamander doesn't always breed in the same pool, and the theory of metapopulation dynamics suggests that a complex of multiple pools will better sustain the species over extended periods of time than a single pool. For example, prey for CTS larvae may not develop in one pool in a given year, but be abundant in the same pool in a different year. Avian predators often focus on limited areas, and might affect a given pool differently in different years. Freedom of movement among the various breeding pools in a given C.A. is essential. For these reasons, coordination of the construction of new mitigation pools in relationship to existing pools and open terrestrial habitat is critical, and this can be planned only by considering all resources of a C.A.

There is also a relationship between plant and CTS mitigation that needs to be considered. The kinds of habitats the plants require, generally shallower pools and swales, are not the same as required for CTS breeding, and the construction of pools consumes upland habitat. It is possible as well that shallow pools could be "reproductive sinks" for the CTS, reducing reproduction in a given area. Were this the case, extensive shallow-pool-construction should not occur next to known or constructed large pools where CTS may breed. Furthermore, uplands of one proposed mitigation site may be essential for CTS associated with a nearby existing or constructed breeding pond, hence these uplands should have less wetland creation on them than on uplands more distant from CTS breeding areas.

Here is an example of this proactive approach: I know that CTS breed on the Haroutunian Open Space Parcel in the proposed Stony Point C.A. I am also aware that larvae have been found in roadside ditches in many places within this area, and I show on the following two pages just how extensive this breeding (or attempt at breeding) is. (There may be other non-ditch sites of which I am not aware. In addition, there is a parcel of land north of Todd Road and west of Bane Road on which native wetlands were recently destroyed, and this area could have been breeding habitat for the CTS.) It is very likely that the rural residential nature of this area allows for movement and reproduction of CTS in many parts of the whole C.A. at the present time. Proactively, the Strategy could direct the construction of spaced, new breeding sites, which could dramatically elevate the chances for long term CTS success across the whole C.A. These sites could be placed in a desirable way on parcels of as little as a few acres and still function to allow CTS to survive on many of the surrounding rural residential lands, a consideration that suggests revision of the Strategy's concept that each proposed mitigation should have the capacity to be self-sustaining. Reactively, no such plan would be likely to emerge, because each proponent would be developing site-specific mitigation

APPENDIX L
PEER REVIEW COMMENTS

The following page presents known locations
for CTS in and near the proposed Stony Point Conservation Area.
Red dots are CNDDB locations prior to 2002. Black dots designated "001, 002," etc. indicate egg locations from 2001 or 2002, and black dots designated "CTS1, CTS2," etc. are larval capture locations from 2002.
All black dot data were collected by Trish Tatarian, and data have been submitted to the CNDDB

APPENDIX L
PEER REVIEW COMMENTS

goals, not C.A.-wide goals, and small parcels would not be likely to be targeted by those developing mitigation proposals. The movement of CTS within an area with numerous roads is also essential for its survival, an issue that I will address separately in Part 3 below, and one that also requires a C.A.-wide plan.

In sum, the proactive approach would direct mitigation to specific areas as the pattern for a given C.A. emerges, and would specify the kinds of mitigation required (large pool, shallow pool and/or swale; upland habitat improvement, etc.), not just respond to the proposals that emerge. There would be an overall strategy for each C.A., shared with mitigation consultants, and these consultants would be charged with developing pieces of an overall plan.

1.1.2. The Strategy should assure that it unfolds equally in all C.A.'s. As is, the plan assumes that conservation actions would be dispersed in some equitable way across the C.A.'s. However, there is no assurance that this would occur, even though Mitigation Review is stated as addressing this concern. I believe that the Strategy should address this concern from the outset. One of the criteria in approving any mitigation should be that, over time, the collective actions bring restoration to each C.A. Therefore, banks, mitigations, purchases, easements, and other actions should unfold so as to assure the viability of each C.A.

As an example, suppose that a few very large pieces of land, perhaps along Llano Road in the Llano Crescent or Stony Point Road in the Southwest Cotati area were proposed as a mitigation bank. It is possible that these few large banks could absorb much of the developmental pressure for a number of years, removing the incentive to mitigate elsewhere. This should be countered by limiting the number of credits that one of these banks could sell until other banks or actions in other C.A.'s have been put in place and achieved some success.

1.1.3. The Strategy should place a hold on most development outside of the urban growth boundaries, and in all areas shown for C.A.'s that happen to fall within urban growth boundaries, until the minimum acreages for conservation within the affected C.A. have been achieved in conformance with a C.A.-wide plan as described in Section 1.1.1 above. It is clear that "chipping away" at the available acreages for conservation within a given C.A. by approving development projects within the C.A. on a piecemeal basis could severely compromise the Strategy, further endangering the species involved.

1.1.4. The Strategy should be enhanced by developing funds for management activities that go beyond the roles of approving mitigations, maintaining data on these mitigations, and meeting annually to review the data. All of the roles for implementation shown under Section 5.4

"Implementation Review" are necessary and valuable. The laws and policies that the agencies enforce are essential elements of a plan, and the guidelines and consultations that lead to these are likewise essential. The agencies involved have a long and successful history of administering the laws and policies involved. Collectively, however, these agency actions represent a reactive function. (I recognize that DFG and others have initiated valuable land purchases, but for most of these, management funds have been too limited.) I believe that without additional human resources, the Strategy will be limited to a reactive function, because staff are stretched rather thin and don't have time to do the sort of ecological planning that I described above in 1.1.1. In addition to ecological planning, solicitation of additional funds such as listed in Section 6 of the Strategy is a potentially powerful addition to the Strategy. Gaining access to these funds is a very time-consuming process that involves meetings with agencies that have funds, developing proposals, and managing proposals that are successful. The responsibilities for obtaining and administering these funds are not identified in the Strategy. To perform these enhanced functions of ecological planning and funding, I propose the following:

1.1.4.1. Have the FWS appoint a recovery team for the Strategy at an appropriate and early stage of implementation, or an equivalent body that can enhance the implementation of the Strategy. So that the process of the Strategy is not slowed down, the implementation stages of the Strategy would go forward as planned, but the recovery team would be charged with serving as a sounding board for FWS, CDF, and other agencies on ecological planning issues. It should be clear that the involvement of such a team must be a constructive implementation of the finally approved Strategy, and not a re-examination of all of the issues and wholesale revision of the Strategy.

The new recovery team (or its equivalent) and agencies that appoint and interact with it should be supported by at least two staff members: (1) a fully-qualified conservation biologist who would develop C.A.-specific proactive plans for the team and agency review, and then lay the groundwork for implementation, and (2) a funding specialist who would develop and administer proposals outside of the mitigation funding that come from the routes specified in the Strategy and other funding sources not listed. Each of these positions would also require a research assistant and secretarial support as well as funds for space and equipment. It may also be beneficial to have mitigation funds used for a unified monitoring and management function under the authority of the conservation biologist, rather than having each consultant develop a plan. The personnel for such activities could still be hired and paid for by consultants, but the work would be undertaken in a unified way. It would be valuable if one member of the recovery team could be

affiliated with The Nature Conservancy, since this group has decades of experience in handling multi-pronged conservation strategies.

We live in an era of limited governmental funding for resource agencies, hence paying for these staff members and providing some part-time funding for the recovery team within agency budgets is unlikely. The Strategy should therefore allocate a portion of the mitigation "management funds" to these additional activities that enhance the entire Strategy, rather than just taking care of individual projects. Outside grants, or perhaps shared funding from the cities and counties could also be used for this purpose. Indeed, since the cities and county benefit substantially from the Strategy, it would not be inappropriate for them to fund an endowment to initiate hiring these staff people, with the understanding that the endowment would grow from grant funds and mitigation funds. Finally, the conservation biologist position and its support should be funded in perpetuity, and the funding specialist position should be continued until each C.A. has reached the desired self-sufficiency or it is clear that the use of outside funds has substantially achieved its role in implementing the Strategy. I view the Preserve System as an entity, like a state or national park, that requires ongoing management specifically directed toward it. Putting such management responsibility in the hands of busy people with other responsibilities is not desirable.

Where to house the staff is an issue the Strategy Team could address. Clearly, DFG and FWS are the central agencies, but proximity to the Santa Rosa Plain would be valuable for these staff people. It appears to me that association with either the Sonoma County Agricultural and Open Space Protection District or the Laguna Foundation would be valuable, with lines of authority to DFG and FWS.

1.2. Concern 2. The Strategy inappropriately indicates that irrigation and discing are compatible with CTS. In addition, irrigation is clearly incompatible with the listed plants.

Discussion. In Section 5.2.2.3, the Strategy states that "other activities in an impact area that would not have significant impact [on CTS] include irrigation and farming activities, such as shallow discing (6 to 8 inches deep) ..." It is possible that the statement is based on the study of the Santa Rosa City Farms by LSA dated August 12, 2004, which was included in the review materials. This study did find usage of irrigated and disced areas by CTS, but, notably, substantial CTS use of 1 hectare plots sampled on the City Farms occurred on only 2 of 14 plots (one plot had a single CTS capture). The two plots that did contain CTS in good numbers (Kelly D and Kelly C) were adjacent to natural habitat with presumed or documented

breeding habitat. The major conclusion of the LSA study is that the irrigated and/or disced areas of the City Farms do not support CTS.

In addition, even the conclusions of LSA (Section 4.6.3 on pp. 22-23) point to unstudied and possibly adverse consequences of irrigation and discing. Specifically, LSA raises the question about whether or not added moisture might create disease problems for CTS, and points out that discing can directly kill CTS or possibly crush them inside burrows. Not mentioned by LSA is that any irrigation that permanently hydrates a pool will encourage the non-native predators like bullfrogs and crayfish, which LSA did find to be negatively associated with use of a pool for CTS breeding, and that extensive hydration can even give large predatory insects in pools the advantage of being large and active when the CTS larvae hatch. A possible additional effect of irrigation is that it could lead to extinction of Mediterranean-climate-adapted vernal pool crustaceans that provide prey for CTS larvae. One prey item in particular, the clam shrimp, could be affected in this way. Regarding discing, as LSA noted, this practice does not necessarily lead to the elimination of CTS nor reduce the density of pocket gopher burrows upon which the CTS depends. As LSA notes, however, discing can reduce the numbers of CTS, and in areas where other factors are also leading to population declines, this mortality could contribute to local extinction.

Beyond considerations of CTS, irrigation almost certainly leads to the elimination of the listed plant species because it encourages invasion of non-native wetland plants, or natives that are adapted to permanent moisture and persist in the summer-wet pools. This crowds out the natives. Permanent moisture could also disrupt the seed viability and germination of the natives.

The analysis of the above discussion leads me to three recommendations regarding the Strategy:

1.2.1. Remove reference in Section 5.2.2.3 to the acceptability of irrigation and discing in CTS areas. In mitigation and acquired lands and easements, the two practices should not be permitted. In dealing with landowners, the practices should be discouraged or minimized, recognizing however that owners may have needs that require some discing and irrigation. (It does appear to me that discing is often used as a means of weed control when mowing would be just as effective.)

1.2.2. Delete the Kelly Farm C.A. from the Strategy, unless restoration to Mediterranean-climate conditions will be undertaken. Along with this, expand the Wright C.A. to include any non-irrigated areas currently shown in the Kelly Farm C.A..

1.2.3. Add language to the Strategy that summer-long irrigation is incompatible with mitigation of other conservation lands where plant or CTS mitigation is the goal.

1.3. Concern 3. The Strategy mischaracterizes the use of upland habitats by the CTS, and, as a consequence, does not plan adequately for access to uplands by the species.

Discussion. Three aspects of the Strategy are relevant to this critique, one more serious than the other. The first, perhaps merely a semantic one, is that the use of uplands by the CTS is referred to in the Strategy as "aestivation," and this term is defined as "living underground." This definition and use of the term are incorrect: aestivation means going into a state of torpor during the summer to survive adverse hot and/or dry conditions. It may be done by a given species in any habitat, not just underground. There is no evidence that the CTS enters a state of torpor, and, more importantly, its use of the terrestrial habitat is not just for resting. Like other salamanders it relies on this habitat for many needs. As stated by Semlitsch (Semlitsch, R.D. 1998. "Biological delineation of terrestrial buffer zones for pond breeding salamanders." Conservation Biology 12: 1113-1119.): "Terrestrial habitat is a 'life zone,' a critical habitat vital for feeding, growth, maturation, and maintenance of the entire juvenile and adult population." This statement applies to CTS, hence language in the Strategy should remove the term aestivation and substitute phrases like "terrestrial existence" and "upland habitat use." In his Ph.D. thesis, Peter Trenham Jr. points out that CTS take 4-5 years to mature, and that they suffer something like 95% of mortality after metamorphosis. He points out that "regulation of these populations may be more dependent upon terrestrial survival than previously suspected." Although changing the word "aestivation" to something more appropriate doesn't materially affect any policy of the Strategy, it does highlight the large importance of uplands to the species as spaces for growth, maturation, and survival as opposed to just "resting."

A second and more important problem in the Strategy regarding use of the land by the CTS is that the document does not properly characterize or take account of the pattern with which the species moves on land. This mischaracterization is portrayed in Section 5.2.6. where it states "Minimization measures may include ... passageways/under-crossings for CTS based on a recent survey..." Additional language regarding movement that portrays a partially misleading picture is found in 5.2.6.1: "If not well-designed, roads in these locations could divide conservation areas and prevent CTS migration from breeding pools to aestivation areas." The Strategy proposes underpasses in areas where recent surveys have indicated that CTS cross roads. All of these statements are well-intentioned, and, indeed, there are some places were road-kill of CTS is concentrated. The conceptual model for these recommendations, however, is that CTS breed in certain ponds and then "migrate" on predictable routes to "aestivation" habitat.

The literature on CTS movement has focused mainly on determining how far the animals move from breeding pools into upland habitat. Very little has been published on the patterns with which the animals move. I pointed this out to Dr. H. Bradley Shaffer a year or so ago, asking him what his experience has been, since he and his students have performed years of work with the species. His answer was

that the animals move from pools "pretty randomly." Peter Trenham's Ph.D. thesis referred to above also suggests movement in less than regular ways in that some adults bred in different ponds from year to year. Finally, the wide distribution I showed above for CTS locations in the Stony Point C.A. suggests that the CTS move in many ways throughout the area. In sum, the thought that surveys can pinpoint exact locations where road underpasses are needed is not the best means for assuring contiguity among habitats. The better model of how CTS move out of pools is that they disperse in many directions. "Dispersal," meaning a radiation of animals outward from one area to another is the appropriate concept, not "migration." Seemingly regular "migration corridors" are probably the exception rather than the rule, and some of the identifiable "corridors" may be the result of restriction of terrestrial habitat in the areas surrounding breeding pools.

A third deficiency in the Strategy is that it describes how curbs along roads can prevent CTS from crossing the roads, but then goes on to recommend omitting curbs or putting gaps in curbs (in addition to creating underpasses) as possible mitigations for the "roads as barriers" phenomenon. The Strategy does not mention that road kill has a large adverse affect on CTS populations. The effect of curbs is not just preventing crossing of the roads, but in trapping the salamanders in the roads where they get killed by vehicles. In an area with increasing traffic such as the Santa Rosa Plain, the Strategy should focus on ways to eliminate road kill by preventing the salamanders from entering the roads in the first place.

To deal with this problem of developing habitat contiguity and at the same time preventing road kill, I recommend the following:

> **1.3.1. Rather than basing the locations of underpasses on surveys, attempt to maximize the ability of CTS to move freely through an entire road-dissected area.** This can be accomplished by constructing "reverse curbs" along all roads in C.A.'s. Instead of a curb that goes up from the road to surrounding land, construct curbs that go up from surrounding land to the road. This will keep the animals off of the roads. (If a curb is needed for drainage of water off the road, curbs can be constructed to fulfill both functions.) Then, as an additional measure, provide underpasses at multiple points along the road. The spacing of these underpasses can account for any known corridors, but where these don't exist, plans should examine the habitats on both sides of the road and locate underpasses wherever movement is likely to be needed. I would envision having an underpass on average about every 300 feet along roads. I agree with the language of the Strategy, that "CTS passages underneath roadways should be based on current research results for effective passage design..." Funding for most of these road modifications can come as a part of any new road project in the area. Many County roads now require bike paths, turn lanes, and other features subsumed into the overall cost of building roads. For an issue as critical as CTS conservation, it is not unreasonable to require these added measures.

Some parties may initially think that this proposal requires an excessive number of CTS crossings, but I submit that the cost of having consultants look for and identify specific migration corridors in a way that would be defensible under CEQA and the ESA would quickly exceed the cost of constructing multiple underpasses. Referring again to the map of CTS locations in the Stony Point CA, we know now of 18 roadside locations, and this number is undoubtedly fewer than actually exist. These were determined "the easy way," by looking into aquatic habitat for eggs or larvae. The task of finding definitive "road crossing" areas would require significantly more effort: many people over periods of many years searching roads on rainy nights, at a huge cost. Problems of even defining "migration corridors" would doubtless arise. If an investigator found one salamander on a road, would this mandate an undercrossing? If he or she found four salamanders over an area of 200 lineal feet, but not all together, would only one undercrossing do? Better to assume that CTS move in ways that aren't fully predictable and make all of the roads "CTS-permeable" when they are improved.

1.3.2. Seek governmental and other funds, enhanced by the fund-raising staff member recommended in section 1.1.4.1, to provide "reverse curbs" and underpasses where high-traffic roads already exist. Major, high-traffic roads, many of which have been recently reconstructed and therefore fall outside of the Strategy as now worded will either impede CTS movement, or, equally importantly, result in road kill numbers that significantly threaten populations. Such major roads exist in at least four of the C.A.'s (Stony Point, Northwest Cotati, Southwest Cotati and Southeast Cotati), and provision for crossings of major roads is essential if the contiguity of CTS habitat required for self-sustenance is to be achieved. Without such crossings, the C.A.'s will be too fragmented to function properly. (The Strategy already plans for allowing movement of CTS between the Llano Crescent and Southwest Santa Rosa C.A.'s, which is essential for the long-term success of the latter C.A.) The standards for these crossings can be the same as developed for the above section: reverse curbs with multiple undercrossings based on the latest information about which undercrossing designs work best.

The most critical need is in the Northwest Cotati CA. A major breeding area existed in a farm pond southeast of the Highway 116/Stony Point Road intersection until just before the emergency federal listing took hold. Loss of this site is significant, and the success of the C.A. may well depend on restoration of the site or an equivalent site nearby. For this site to function, free movement across both Stony Point Road to the west and Highway 116 to the north must be assured. In addition, movement back and forth across Stony Point Road north of Highway 116 will be required if lands to the west of Stony Point Road in this zone are included in the final plan. To the south, both Stony Point and Mecham Roads must be made permeable for success in the Southwest Cotati C.A., and Petaluma Hill Road must be modified if the

Southeast Cotati C.A. is to succeed. The same may be true of Railroad Avenue. In the Stony Point Road C.A. free movement of CTS across Stony Point Road is essential, and the same will be true for Todd Road if the final plan includes restored habitat north of Todd Road. (It may be sufficient to include this northern restored habitat only for endangered plants, obviating the need for undercrossings.) As the ecological planning for each C.A. unfolds, all necessary crossings should be identified, and the funding specialist should work aggressively to assure that adequate crossing measures are implemented.

1.3.2 Be vigilant regarding state and federal projects that may not come before the parties to the MOU, and assure that CTS-compatible road measures are included in these projects.

1.4. Concern 4. The Strategy excludes from Conservation Areas some adjoining lands that have or may have wetlands or other habitat features capable of supporting the species. Boundaries should be adjusted to include these areas.

Discussion. The major outlines of the C.A.'s are well thought out, but selected additions to them should be made. These are as follows:

1.4.1. The Alton Lane C.A. should be expanded north of Wood Road, where known wetlands exist, some of which have harbored one or more of the endangered plants. Additional review of aerial photographs will be needed to identify the appropriate lands, but my preliminary suggestion is to go as far north as Parnell road and a line from the end of Parnell Road to the Wood Road/Spurgeon Road intersection.

1.4.2 As discussed fully under Concern 2, Data from LSA show that City Farms do not support the CTS except in a limited way. For this reason, the Kelly Farm C.A. should be eliminated as an entity, but portions of it that do support the CTS, or may have this potential, should be included in an expanded Wright C.A. Within this expanded Wright C.A., the Strategy should specify that restoration of irrigated lands on the Kelly Farm to Mediterranean-climate adapted ecosystems could lead to conservation of the listed species, and that such lands could be appended to the newly-described Wright C.A. following such restoration.

1.4.3. As also discussed under Concern 2, and for the reasons given in the above paragraph, areas in the Llano Crescent C.A. where extensive irrigation is done on private lands in ways similar to the City Farms should be excluded; for example, lands east of Merced Avenue and south of Highway 12. Alternatively, these areas could be included if the plan indicates that they will count toward conservation only if they are restored to the natural Mediterranean-climate ecosystem that supports the CTS and listed plants.

1.4.4 In the Stony Point C.A., significant wetlands with natural topography that lay north of Todd Road and west of Bane Road were recently destroyed. I was not party to any discussions regarding these wetlands, but it seems reasonable to me that they should be restored unless the destruction was properly authorized by the USACE and other agencies. Surrounding these former wetlands are other rural residential areas that are not dissimilar from parcels south of Todd Road. If restoration of these wetlands has been mandated, they and their surroundings should be included within the Stony Point C.A. A tentative suggestion for this addition would be to include lands north of Todd Road between Stony Point Road and the Colgan Creek Channel on the west and Bane Road on the east extending north to the vicinity of Oasis Drive and West Robles Avenue.

1.4.5. Adjacent to the Northwest Cotati C.A., there are significant potential habitat areas in most of the lands north of Highway 116 south of Helman Lane, and west of Alder Avenue, which are designated as "development areas" in the Strategy. Although some of the lands in this "development area" adjacent to Derby Lane and Highway 116 are now industrialized, other lands south of Helman Lane and west of Alder Avenue (to and past Locust Avenue) are rural residential, with substantial open areas that may harbor natural pools. These lands lie generally between the current city limits of Cotati and Helman Lane. The C.S. should be amended to include these rural residential and open lands within it, not as part of the development area. This change in the boundary of the C.A. is especially critical since these open lands are close to known breeding habitat east of Alder Avenue that was recently destroyed, and these areas may harbor adults and maturing juveniles that were associated with the now-destroyed pools. Such individuals may be critical for maintaining CTS viability in this area.

1.4.6. The Southwest Cotati C.A. should be extended further south in the areas on both sides of Mecham Road. Recently, I received a call from a qualified zoologist who lives on Wambold Lane who found a crushed CTS adult on his property. I have not yet reported this finding to CNDDB, and the landowner did not save the remains of the animal. Nonetheless, I believe that this finding indicates that CTS ranges further south along Mecham Road than indicated in the C.A. (Wambold Lane is the furthest south of the small residential roads in this area.) It is appropriate to include in the C.A. the small lots along Wambold Lane, Everett Road, and Balma Lane in that CTS may occupy habitat in and around structures on these properties, and the Strategy does not mandate any change of use for the property owners that might adversely affect them. In order to include lands from or to which the above-mentioned salamander may have moved, the C.A. should be extended west of Mecham Road to the northern limits of the Sonoma County landfill site, and east of Mecham Road to a line approximately 1,000 feet south of Wambold Lane and parallel to it.

APPENDIX L
PEER REVIEW COMMENTS

PART 2. Responses to peer-reviewer questions included in the review materials.

Question 1: Are the minimum reserve acreages established by the strategy for the conservation areas (see Table 1) adequate to support both CTS aestivation and breeding within these areas over the long-term?

I believe that they are, however as noted in my Part 1, there needs to be specific advance planning of an ecological nature to assure a proper configuration of breeding pools in each C.A. I did not specify a number of breeding pools in Part 1, but believe that 7-10 pools per C.A. will be necessary, and movement among them by the CTS must be possible.

Are these preserve acreages adequate to also meet the needs of the federally listed plants?

I believe that they are, however as noted in my Part 1, there needs to be specific advance planning of an ecological nature to assure a proper distribution of plant-supporting pools in each C.A., as well as healthy adjoining uplands, and to assure that plant and CTS goals are not in conflict. As noted in Part 1, I believe that some natural pool systems should be largely free of creation and modification to serve as "natural controls" of the behavior of the entire system. The call for proper grazing and burning measures will go a long way toward meeting the plant needs. Without these provisions, no acreage alone would meet the goals.

Will fragmented preserve areas, resulting from economically driven selection of noncontiguous parcels within areas of rural residential and agricultural lands, be adequate for long term preservation of CTS?

No, they will not, and this is the central theme of my response in Part 1.1.

Are the criteria for selecting preserve sites within areas of rural residential and agricultural lands as described in the Administrative Draft sufficient to guide the assemblage of the preserve system?

The Suitability Criteria as given in the Draft Strategy under 5.1.1 are sufficient for implementation of the initial stages of the plan. As I note in Part 1.1 above, however, explicit planning for a given C.A. would further enhance preserve selection. Among other considerations, I personally favor using only disturbed but restorable lands for wetland creation, because this would extend the habitat for species far more than simply amplifying wetland acreages in areas already having natural wetlands. Amplification and minor restoration are appropriate in natural areas if done minimally.

I would add one consideration, also given above in at the end of my Part 1.1.1 where I use CTS mitigation on the Stony Point C.A. as an example. In this area and other sections of C.A.'s, the rural residential areas should be viewed as they now exist as essentially continuous CTS habitat. The multiple roadside breeding attempts are strong evidence for this conclusion. Given this, the first requirement for success is probably the creation and stocking via transplantation of at least five new CTS breeding ponds, and many parcels in this C.A. would be suitable for this activity.

Question 2: An economic analysis conducted in connection with the strategy provides estimates for the costs of meeting its preserve requirements which, based on proposed acreage requirements, are very considerable. Would establishing smaller minimum preserve acreages for the conservation areas, or a range of acreages within which specific minimums that would be determined through time (e.g. based on further study and Implementation Review), constitute biologically acceptable alternatives to the minimum acreages currently specified? The following alternative to Table 1 in the Conservation strategy is provided for consideration: (Table not recreated here.)

As noted in my Part 1.4, I believe that the Alton C.A. should be expanded somewhat. If this is undertaken, then additional plant, and possibly CTS habitat will result, which addition could offset reductions in other C.A.'s with no effect on the balance.

I also recommended combining Wright and Kelly, because I do not believe that irrigated lands should be counted in conservation plans. If there is sufficient contiguous land of a non-irrigated nature (or land now irrigated that can be restored to Mediterranean-climate conditions) I believe that a single preserve in the area with a minimum area of 450 acres would be sufficient. This might make acceptable the alternative plan of reducing the requirement of 240 additional acres in the Wright C.A. depending on the geometry and connectedness of the parcels.

Llano is one of the recommended C.A.'s most critical to the success of the whole conservation effort, and it's acreage requirement should be held at 900 acres initially. If, however, a broad band of habitat that creates complete freedom of movement for CTS were to develop, the use of a corridor connecting it to the Southwest Santa Rosa C.A. were demonstrated for CTS, and all of the necessary road underpasses were in place, I believe that the recovery team and conservation biologist I recommend combined with review by the Implementation Team could be asked to consider a reduction below 900 acres. Connectedness to Wright/Kelly under Highway 12 (clearly an expensive proposition) as well as contiguity with the Stony Point C.A. across the Colgan Creek Channel could also be weighed in approving such a reduction.

The Southwest Santa Rosa C.A. is already minimal in area, and should not be reduced.

The same arguments I gave for the Llano Crescent C.A. above apply to Stony Point. If a truly functional 630 acre preserve were to emerge then reduction from 900 acres could be considered by the recovery/implementation team. In addition, in this area, if development interests and/or the municipalities were to proactively assure contiguity of movement for CTS at multiple points across Stony Point Road, then this action could justify some reduction in the target acreage.

For NW, SE, and SW Cotati, the data on CTS movement from Trenham and Shaffer indicate that 450 acres is a minimum preserve size, and the target should not be changed.

Question 3: Would allowing up to 20% of the strategy's preserve lands to be established outside the conservation areas, under the conditions specified and assuming the preserve selection criteria are appropriately applied, be likely to result in excessive fragmentation of its overall preserve system? If so, what, if any, additional measures could be incorporated to prevent this?

This provision would be acceptable if developed via a comprehensive planning process that I have outlined in Part 1.1 above. Contiguity and function are central concerns. A fully functioning, more or less ovoid section of habitat that adjoins the suggested 20% "out-of-C.A." zone would be better than multiple "blobs" of habitat within a C.A. connected by corridors that may or may not function well.

Question 4. The conservation strategy requires CTS migration corridors averaging 500 feet in width with a 200-foot minimum. Specifically corridors are identified in the Southwest Santa Rosa Conservation area to connect existing preserves and potential preserves within the conservation area and to connect these preserves to the adjacent conservation areas. Given the size of the preserves, please comment on the potential effectiveness of such a preserve design in providing for a viable CTS population in the Southwest Santa Rosa Conservation Area.

The plan can potentially work, but only actual data on CTS and on small mammals, including the California hare as a seed disperser, will be able to confirm function. Any corridor should have a CTS barrier along it in all places where adjoining uses threaten the animals. One possible way to test the effectiveness would be to reserve a larger corridor, say 1000 feet across, but confine movement and occupation to the Strategy recommendation. If study

over the first 5-10 years of the plan show the smaller width to be adequate, then that could be set aside as the permanent corridor.

In Part 1 above, I present a different model from "corridor" for movement of CTS across roads, however the corridor concept is appropriate for other habitat connections among habitat areas. Although complete contiguity is the goal in each C.A., some corridors may be necessary. Data from monitoring above would be valuable in designing these corridors as well.

On the broader issue of corridors, (a) what generally would be a biologically acceptable corridors length and width, (b) what attributes should be corridor have, and (c) what, if any relevant scientific information upon which to base CTS corridor requirements is currently available?

I am not up to date on corridor literature, but point to my recommendation of hiring a full time conservation biologist to manage the plan as valuable in setting standards within each C.A. One task of this person and his or her research assistant would be to examine all alternatives. In Part 1 above, I present a different model from "corridor" for movement of CTS across roads, however the corridor concept is appropriate for other habitat connections among habitat areas. Although complete habitat contiguity is the goal in each C.A., some corridors may be necessary. Data from monitoring above would be valuable in designing these corridors as well.

Are the proposed migration corridors adequate for seed dispersal and genetic exchange between isolated populations of listed plant species: How would narrowing of the corridors affect this?

The key to plant species dispersal would be to encourage occupation of corridors by the California hare and other animals such as the raccoon. I have observed hares on many small, rural residential parcels of 10-20 acres that are semi-isolated from other lands. A segment of corridor 500 feet by 2000 feet (23 acres) provides this sort of area. Segments of a 200 foot wide corridor might be too small. In contrast with determining CTS use, however, use by these mammals is easy to determine, hence studies such as suggested above could answer the questions (artificially creating a prospective corridor within a larger protected zone as an interim measure). Additionally, creation of wetlands along the corridor, including some for CTS and others for plants, preferably in somewhat separate areas, could facilitate function.

Question 5: Are the measures set forth in the Administrative Draft sufficient to provide for CTS movement between conservation areas bisected by roads, streams, and flood control channels?

They are not, and, for roads, I have addressed this issue fully in Part 1.3 above. The same concepts I presented for roads can apply to drainage channels and streams should be considered: CTS "reverse curbs" to prevent CTS from entering the channels combined with multiple crossing areas over the channels. The designs of such crossings require further study, as does the degree to which the channels and streams actually are barriers.

Question 6: Is the Southwest Santa Rosa conservation area of sufficient size and configuration to provide a viable preserve area for CTS?

In isolation, I would not want to say that success is probable. The habitats in question are already fragmented. Success really depends on the effectiveness of corridors, as addressed above.

Question 7: Are the measures outlined in the Administrative Draft adequate to facilitate migration within the proposed corridors (i.e. raised curbs, road under-crossings, or other protective measures)?

I have addressed these issues above in response to these questions and in Part 1.3. In short, the Draft needs to be revised based on a better model of CTS movement as dispersal rather than migration.

Question 8: Do CTS migration patterns differ from population to population, and if so, what factors are though to influence these patterns, and why?

Marsh and Trenham (Marsh, D.M. and P.C. Trenham. 2001. "Metapopulation dynamics and amphibian conservation." Conservation Biology 15: 40-49) addressed this issue in part for amphibians in general stating: "pond occupancy may be more indicative of the spatial arrangement of terrestrial habitat than the arrangement of breeding ponds." In other words, each population will have a different pattern of habitat use, and the use of a pond may depend as much on the suitability of surrounding terrestrial habitat as on the nature of the pond itself. The paper clearly implies that each population has a different pattern of habitat use. Equally importantly, note my analysis in Part 1.3 above to the effect that CTS do not really "migrate" hence the whole idea of finding identifiable "migration patterns" is flawed. As an example, if a really good breeding pool were surrounded by uniformly good terrestrial habitat, we would not expect the salamanders to "migrate" to just one part of the terrestrial habitat, but to <u>disperse</u> into it and to move back into the pool from all directions. The animals probably move about from one part of the habitat to another as they mature and then survive as adults.

Question 9: Are the preserve management actions set forth in the Administrative Draft, including Appendix D, sufficient to adequately protect the preserve lands as habitat for CTS and listed plant species?

I believe that these management actions are generally adequate, but I recommend, as in Part 1.1 above, a coordinated management plan that uses a paid ecologist and assistant to develop coordination among the units. Specific to Appendix D, I favor a sampling plan for rare plants that can plot actual data over time. An estimate of cover and areal extent might be more reliable than a count of plants, since counts in dense patches are very hard to make. The ecologist should have data that provide quantitative tracking possibilities for the plants, as do estimates of larval numbers for CTS. The design and implementation of such plans would be the responsibility of this person.

Question 10: Are the suitability criteria set forth in the Administrative Draft sufficient to adequately identify lands that will contribute to the conservation objectives of the Conservation Strategy?

See my response to Question 1.

Question 11: Are the translocation criteria set forth in the Administrative Draft, including Appendix B, sufficient to support establishment of new populations of listed plant species?

I believe they are.

Question 12: Are the translocation criteria set forth in the Administrative Draft sufficient to support reintroducing CTS, minimizing project impacts, and conserving the genetic diversity of CTS on the Santa Rosa plain?

I am not a geneticist, and cannot comment on the issue of genetic diversity within the plan area, except to note that the most conservative assumption is that there is some diversity over the area covered by the plan, and therefore translocation should be limited to adjoining areas. The Strategy is not completely adequate in the section on CTS translocation in that it does not indicate what characteristics make a pool a good candidate for translocation. Primary among these is the availability of cover to protect larvae from avian predators. Second is the availability of food. Both of these characteristics generally require that a new pool "season" for a few years before receiving larvae.

APPENDIX L
PEER REVIEW COMMENTS

Question 13: Was the methodology used to create Figure 2 appropriate?

Yes, this methodology was appropriate, and the figure represents a good comprehension of the issues. However, for advance, ecological planning, as I propose in Part 1 above, each C.A. will need to be studied in much more detail, and the existing GIS data will go a long way toward doing this.

Question 14: Will the preserve areas within the collective nine conservation areas proposed in Sections 4 and 5 of the Strategy, to be secured during the expected 5-10 year period of the Strategy, be sufficient to establish long term preservation of the CTS and listed plants within the range?

Yes, provided the kinds of issues I have discussed above, such as providing habitat contiguity, providing an adequate number of CTS breeding pools, and avoiding conflict between CTS and rare plant measures, are undertaken in a comprehensive, proactive way. In addition, management in perpetuity is essential since these highly disturbed systems cannot just be let to "run on their own."

Question 15: Will the proposed Conservation Strategy yield viable conservation preserves on a time scale sufficient for CTS preservation? Are other mitigation strategies potentially more effective?

This is a very important question. Regarding time scale, the plan should work in general, but there are selected areas where more immediate action may be necessary. One of these is the Stony Point C.A. The breeding effort in roadside ditches could represent a large, successful population with as yet unknown successful breeding sites nearby. Most of these roadside breeding efforts are not successful because the habitat dries out too soon, however, and it is possible that some of the animals represent females that might have bred in natural habitat north of Todd Road prior to destruction of this habitat. If this is the case, there is an immediate need for new breeding habitat somewhere in the northern end of this C.A.

The situation is even more urgent in the Northwest Cotati C.A. There are undoubtedly maturing salamanders south of Highway 116, produced in the now-destroyed breeding pool, that will have no breeding habitat when they mature in 2-3 years. Likewise, there may be such individuals in the vicinity of Alder Avenue (see section 1.4.5 above). In this latter zone, there may be breeding habitat sufficient to accommodate these individuals, but if not, new habitat should be created very soon.

Question 16: To address impacts to wetlands on the Santa Rosa Plain, project proponents are required to create, restore or enhance wetland on at least a 1:1 basis. Wetland creation results in the conversion of uplands to wetlands. Some of this conversion is expected to occur in areas occupied by CTS. Is the conversion of upland habitat to wetlands a concern? If so, what considerations should be taken in designing such projects to assure that CTS are not adversely affected?

I have addressed this to some extent in Part 1. Clearly, removal of uplands is a concern because the CTS population in a given area may already be minimal. The best measure to avoid this impact is to keep uplands near known or created CTS breeding pools undisturbed within the immediate vicinity of the pool (up to about 300 feet) so that created pools do not draw breeding effort away from the successful pools into shallow reproductive "sinks." Beyond this, comprehensive C.A. wide planning will be necessary to answer the multiple questions presented by each site.

APPENDIX L
PEER REVIEW COMMENTS

Peer Reviewer # 3

Review of the Draft Santa Rosa Conservation Strategy
November 28, 2004

General Comments

Overall, I agree with the "Conservation Strategy" approach to endangered species and their critical habitat. Landscape-level considerations of distribution, fragmentation, connectivity, and habitat utilization are essential for locating preserves and prioritizing acquisition in a rapidly urbanizing region. It also specifies the rules for mitigation, translocation, management plans, implementation and funding. The document "Santa Rosa Conservation Strategy" (SRCS) contains these essential elements, along with the regulatory background and some discussion of agency responsibility with respect to major tasks (e.g. selection of properties, permitting, data maintenance, convening Implementation Review Team).

However, there are other essential elements that a Conservation Strategy must specify in order to be effective. This document lacks these elements:

1) Adaptive Management Framework

The Implementation Review Process is an incomplete and ultimately ineffective form of adaptive management because, as proposed, it does not go beyond land acquisition to include the equally important science-driven land management necessary to maintain the focus species and improve (or simply maintain) the quality of their habitats. To provide an effective conservation umbrella that integrates decision-making and makes sure that decisions are implemented and evaluated, an "adaptive management framework" must a) include user groups as part of an adaptive management working group b) integrate policy, management, and research, c) meet frequently enough to insure focused and ongoing management action, monitoring, evaluation, and funding, and d) have a technical advisory group that can design the monitoring and science necessary to achieve management goals. Specifically:

a) The document outlines a process of "Implementation Review" (IR, section 5.4) to insure that elements of the SRCS are carried out, along with a program of "Implementation Monitoring" (IRM, section 5.5). The members of the Implementation Review Team are derived only from the participating agencies and do not include representatives of "user groups" whose cooperation will be essential (especially when money and labor are needed or when the inevitable "need for changes in conservation efforts" (pg 27) arises). Such changes are often seen as a violation of the Conservation Strategy approach by user groups excluded by the process of IR. In the case of the SRCS, the user groups include development interests (landowners group, developers group), conservation interests (e.g. CNPS), and recreational interests (e.g. bicyclists).

Each should have one representative on an "Adaptive Management Working Group" (AMWG) that also includes agency and local government representatives. The AMWG can consider political, economic and biological factors in implementing the Conservation Strategy, and as such, act as a conduit for information as well as distributing the long-term costs of implementation.

b) Although the SRCS mentions the importance of research to fill gaps in our understanding of these species and their habitats (pgs 20, 21, 27), it is the job of an AMWG to set management goals and objectives and thus set the priorities for management-oriented research. In this way, research is not a haphazard collection of "studies" that reflect the desires of academics and a few agency personnel (the current situation). It is kept focused on the immediate needs of the preserve system though a series of "key management questions" that comes directly from the goals and objectives of the AMWG. And the monitoring needed to actually implement effective resource management (e.g. status and trend, cause and effect) can also be focused to support specific decisions that the AMWG will have to make. Otherwise, file cabinets will continue to fill with unused monitoring reports and data (the current situation).

c) Meeting annually will not be at all adequate for actually implementing the SRCS and actually doing the management needed to achieve an effective reserve system (see #2, below). This document ignores how difficult it is to coordinate overworked agencies, develop goals, objectives and key management questions, coordinate management and research, write useful reports, sustain long-term, science-driven management across the landscape of acquired properties, and obtain the necessary, long-term funding to sustain those efforts.

d) Ultimately, when the AMWG hammers out its goals, objectives, and key management questions while providing a forum for political, regulatory and economic concerns, it is up to a "Technical Advisory Group" (TAG) to design the tools, science and monitoring programs that affect management, fill data gaps and allow evaluation of all management actions. The TAG is a subset of the AMWG, insulated from politics as much as possible, that can provide the objectivity needed for supporting the AMWG's decision-making. An experienced consultant or resource management group (e.g. Circuit Riders) can be hired to lead the TAG.

2) Mechanism for Sustaining Management

Believe it or not, acquisition of properties to preserve habitat is the easy part of the conservation process. Management is much harder because of a) data gaps in how to manage to maintain the biological diversity that justified acquisition in the first place (hence the need for adaptive management to integrate research with monitoring and policy), b) the need to sustain management into the indefinite future with adequate funding and labor, and c) the lack of an institutional home to make sure actions are taken, relevant monitoring data are collected, summarized and given to the AMWG. Specifically,

a) The adaptive management framework described above is needed to fill data gaps that arise when the AMWG must make a decision. The SRCS acknowledges these limitations with respect to genetic information (pgs 20-21), translocation (21-22), mitigation efforts (23-24), including wetlands creation projects. The document must specify a mechanism for resolving these questions, and not simply leave it to the current array of agencies. The mechanism is the framework discussed above.

b) Filling data gaps needs to be systematically approached by the AMWG. This will often require science to develop prescriptions or tools, and that science takes time (5-10 years for some tools) and money (on the order of $10,000's to $100,000's for a single, focused research question). The time and money requirements often stall or sink conservation efforts, yet development and its impacts are not deterred. Meanwhile, doing nothing results in the loss or degradation of populations from preserved lands, as has been the case at the Todd Road Reserve.

c) The issue of "who actually does the management?" is not addressed in the SRCS. This is not trivial, in fact it is and has been a major impediment to better resource management on the Santa Rosa Plain for decades. Agencies such as DFG and FWS do not have the expertise or the labor to actually do reserve management. With one or two people in each agency, the efforts have been Herculean but unsustainable. These people should advise the AMWG and seek funding, but the properties need a "Reserve Manager", a labor source, and a system for tracking management actions and monitoring (as directed by the AMWG). User groups, if included in the adaptive management process, could be an important source of labor. However, the doing of the management may have to be turned over to an experienced land management organization (e.g. Sonoma Land Trust).

Also, I have to say that an agency such as DFG cannot "maintain preserve data and monitoring data" (pg 27). As an institution they simply cannot cope with information, especially in the absence of an adaptive management framework. You are simply piling more unfunded work on a handful of people whose principle job is enforcement. The AMWG structure must be in place to make sure things happen in a timely manner, to make sure that decision-based monitoring takes place, and that data and reports are properly archived.

3) Summary of Existing Management Research

Although the narrative for CTS (Appendix A) and the SRCS (pgs 10-14) contain a good number of relevant facts for determining suitable habitat, minimal areas, and corridor characteristics, there are no such facts presented for the listed plants. USFWS and DFG have been funding research to determine management regimes for its Santa Rosa properties for more than five years, including an Access database that summarizes the biological, logistical and security characteristics of each reserve (some of which form cores of the proposed conservation areas). Yet, none of this is cited in the SRCS. It may point to the problems agencies have in knowing what to do with the information they are given (2c, above), or they simply not be aware of the implications of the research they

have already paid for. In any case, the SRCS should at least elude to the existence of this research as a basis for implementing an adaptive management process.

Responses to Questions for Peer Reviewers

Questions 1 and 2.

Regarding minimal acreage for listed plants, one of the most important features is that preserves be large enough to contain entire, and not truncated, pool and swale systems. Swales are long, linear features that can bring (or once brought) floodwaters and propagules to pools. We have found that swales with altered hydrological characteristics (becoming too dry or too wet) significantly affect habitat quality for the listed plants. competitive, invasive grasses and perennials take over habitat and reduce its suitability for the listed plants. Also, swales that dry too quickly or fill too slowly (due to drainage alteration) lead to severe herbivory by non-native slugs. So, a property must be large enough to contain complete swale systems that will be unaffected by alterations on adjacent properties.

Also, smaller reserves invariably require greater management efforts, including time and money that are extended into the indefinite future. These costs can and will be substantially greater than the price per acre for acquisition. Effective management can overcome the effects of small size if it is sustained into the indefinite future and if the small property is spatially or hydrologically linked to a larger, adjacent property. Some small properties surrounded by development are simply too difficult to manage because grazing and fire are politically unfeasible.

From the standpoint of listed plants, the 174 acre Wright Preservation Bank is large enough to contain many, intact swales with a minimal amount of intensive management (if restoration is not the goal). Its populations (*Limnanthes vinculans, Pogogyne douglasii*) are apparently stable. Todd Road, at 77 acres, has been unmanaged with respect to listed plants for the 20+ years since cattle were removed. Unfortunately, its listed plant populations have been declining (e.g. *Limnanthes vinculans*) or apparently extirpated (*Lasthenia burkei*). The roughly 15 acres of intensively managed lands at the Sonoma County Airport provide an effective refuge for *Lasthenia burkei*. But in this case, regular mowing around the tarmacs with removal of cuttings retards competition from exotic annual grasses (in part by lowering available nitrogen). However, the 30 acres of unmanaged Haroutunian property does not contain many intact swales and is slowly losing its plant populations to slugs and competition from introduced plants (mostly *Lolium*). So, reserves on the order of $> 10^2$ acres may get by with minimal management (if they are not already too degraded), but those less than that degrade in the absence of focused, long-term management.

Q 4.

The listed plant species probably dispersed by flooding events, as swales overflowed their bankless edges. Corridors, in the usual sense of the word, and as mapped in Figure 2 of the SRCS, are irrelevant given the amount of drainage that has been installed across the plain. Within a large property (e.g. Wright), overflow may still occur in rare years and would be important. But unless these corridors were designed hydrologically and unless they connected vigorous populations, I doubt they would ever operate to affect genetic exchange.

Q 9.

As I said above, effective, long-term management is the key to making small reserves work in a fragmented landscape. Effective "management plans" (5.2.5) need to be coherent, landscape-wide, sensitive to property attributes, and science-driven. They need an adaptive management framework to be implemented and evaluated over time. I do not believe DFG and FWS will be able to do this.

Examining Appendix D, it is clear why adaptive management is needed. The "goal" is never to monitor (as stated in Elements 1-1, 1-2, 1-3). The goal is to affect some endpoint that is beneficial to the target species or ecosystem (actually an objective). Monitoring only tells you whether you've achieved the objective. And for the purpose of maintaining/enhancing habitat, status and trend monitoring is inappropriate. Instead, cause and effect monitoring is used to test a management-oriented hypothesis (e.g. "Ho: Grazing is not beneficial to subpopulation sizes of *Limnanthes vinculans* at Wright Preservation Bank"). The process of selecting the right management question to address, matching it to the right tool (e.g. mowing or grazing) and instituting the proper type of monitoring is the meat and potatoes of an adaptive management framework. The "template approach", consigned to overworked, underfunded agencies, has not and will not succeed in actually benefiting the species and ecosystems of concern.

Q 11.

As the SRCS says, translocation of listed plants is still experimental (pg 20), lacks clear success criteria (pg. 21), and evaluation using long-term monitoring data (pg. 21). It also tends to create populations and not communities. This is important because natural communities are being lost to development (not just populations), and because it is the community and ecosystem context that will ultimately determine whether translocated populations will persist. So, the SRCS should emphasize preservation of intact natural communities on large, contiguous parcels and not rely upon a still "unproven" fix. Salvage of the seed bank is important, but again, who is now doing collection and banking for purposes of restoration? It seems like it is only being done for mitigation purposes on a project by project basis, not as a hedge until "existing populations are adequately secured and managed, and until plants at additional sites are found, repatriated or introduced" (pg 22). This is a job for a reserve management institution, as discussed in the general comments above.

APPENDIX L
PEER REVIEW COMMENTS

Q 14.

I believe the distribution and proposed size of the reserves is adequate for long-term preservation, but only if long-term, science driven management takes place in the context of an adaptive management framework.

Q 16

High quality uplands should not be sacrificed to create seasonal wetlands (the latter with dubious conservation value at the gene and community levels). High quality means with populations of native perennial grasses and forbs, as well as a scattering of woody savanna species. These uplands should also be managed in concert with the natural wetlands so that total biological diversity remains high across the landscape. Otherwise, places like Alton Lane get the "Swiss cheese" treatment, with the density of natural and created pools far exceeding anywhere else on the Plain.

APPENDIX L
PEER REVIEW COMMENTS

Peer Reviewer # 4

Comments/answers to "original" questions. The "new" question addressed at the end.

SANTA ROSA PLAIN CONSERVATION STRATEGY TEAM
QUESTIONS FOR PEER REVIEWERS

The Santa Rosa Plain Conservation Strategy Team has prepared a Draft Conservation Strategy for the Sonoma County population of the California tiger salamander (CTS) and the listed plant species (Sonoma sunshine, Burke's goldfields, and Sebastopol meadowfoam) located in the Santa Rosa Plain. The Team determined that it would be appropriate to have this strategy reviewed by qualified professionals (peer reviewers). The Team would like the peer reviewers to answer the following questions when evaluating the Draft Conservation Strategy. The Team also asks that the peer reviewers to provide whatever data they have which supports their assumptions, opinions, or conclusions.

1. Is the minimum preserve size as developed by the Strategy Team adequate for both aestivation and breeding? Is the preserve size adequate to also meet the needs of the listed plant species? Ok, a pet peeve, I always refer to the non-breeding habitat as upland habitat (which also not 100% correct) – CTS do a hell of a lot of living away from the breeding sites – including occasionally going dormant – aestivation habitat sounds like CTS migrate there, go dormant for years, then wake-up and migrate.

   As for minimum preserve size – obviously there is no definitive answer. We've all seen CTS persist (at least on the order of a decade or two) in areas surprisingly fragmented and limited in extent, and CTS have disappeared from many fairly large and apparently unfragmented areas – so determining how much is necessary is as much art as science, and, therefore, erring on the conservative side (bigger reserves) is necessary.

   The extent required to support a population of CTS over the long-term is clearly dependent on a whole host of factors, with a main one being habitat quality (= level of fragmentation, condition of the vernal pools and uplands, hydrologic and geomorphic stability/succession, presence of other species [both native and non-native], level of on-going human impacts, etc…..). Another factor contributing to the size necessary to support a CTS population over the long-term is the level of management.

   So at one end of the spectrum of how big is necessary is an unfragmented, unmanaged, and largely intact system, that is low on non-native species and on-going human impacts. Such a "pristine natural reserve" likely needs to be moderately large in order support CTS for 10s or 100s of years. Depending on

how the specific site responds to variation in weather, 100s of acres + are likely necessary. If there is considerable variation in location and longevity of the seasonal pools, then more pools, more upland habitat will be necessary in order to provide a safety net of heterogeneous conditions (= 1000s of acres). If the seasonal pools are relatively stable (= predictable in location and fill characteristics), then only a few hundred acres (or fewer) may be necessary to support a CTS population over many 100s of years.

At the other end of the spectrum are sites that require significant on-going management. I'm sure that you could design a 1-acre or less CTS reserve that could persist for many years (think of the prairie dog town exhibits that were standard parts of many zoos – and expand slightly, and add in a seasonally filled, artificial pond – and you've got a CTS reserve/exhibit). Such reserve would take daily maintenance in order to keep the few components in check, but you could conceivably keep one of these going indefinitely. Not a great conservation success story, but…..

Back to the question of specific acreages of the proposed conservation reserves – it is hard to evaluate the situation. If you were able to set aside the target acreages in such a way as to have a single, or a few, large, unfragmented block of habitat in each of the broad conservation areas, then the acreages listed should be more than enough (particularly with some perpetual funds to conduct management). However, a piecemeal arrangement of 10 acres here, 50 acres there, possibly with some sort of a corridor linking them, is worrisome (to say the least). A reserve system of 450, or 700, or 150 acres may or may not be worth anything – really depends on the specifics (without knowing the site by site specifics, I'd take a 200 acre single block of habitat over a checkerboard of sites that add up to 400 acres [but with no single one being larger than 50 acres]).

While I know this is a difficult political situation, as I read the document, a project-by-project approach will still be in effect, albeit slightly constrained and goal oriented. That approach is not my favorite. In a perfect world, I'd start setting up central/core preserves now, buying out those whose parcels are deemed critical to the conservation goals – using money from others within the conservation area who are in areas known to provide some benefit to the covered species, but are in areas not deemed critical. Once the initial core areas are secured, a project-by-project approach can be layered into the system.

Maybe starting with some core area can completed via external mitigation banks, maybe this document/agreement can mandate its own. In any event, defining a real central/core area within each conservation zone and building a preserve from the central/core area is necessary.

A second point on use of terms – I hope that you really aren't trying to target the minimum extent necessary. Given the vast uncertainties of CTS and natural systems, doing minimum will undoubtedly fail in its conservation objectives.

As for the discussed mitigation ratios: a 2:1 mitigation ratio results in a 33% loss of habitat – this should be the absolute minimum ratio for any wetland area supporting covered species.

2. Does the Conservation Strategy reflect a balance between proposed wetland restoration and creation projects and preservation of adequate aestivation habitat for CTS? Will the listed plant species benefit from this approach?

   The 2200 feet away from breeding locations is fine way to include enough uplands with specific breeding locations – as long as there aren't barriers. The majority of CTS are found within 500 meters of the breeding site = this finding fits well with the 95% within 2200 feet.

   The acreage discussed should serve the plants well – but some management will be required in order for the plants to persist.

3. Do the proposed migration corridor requirements reflect the needs of CTS based on life history and potential barriers to seasonal movement?

   I hate constructed corridors – they rarely work. Linking "core" areas with blocks of habitat – suitable for year-round residence are fine. Trying to design CTS freeways should be avoided. As for a tunnel under a road – that is not a corridor, that is a tunnel under a road. They actually do accomplish some good, but it is hard to justify the expense of tunnel construction and maintenance.

   Bottom-line is that no new roads should be constructed through areas deemed of critical importance. And relocation of existing roads should be mitigation option. Retrofitting existing roads with curbs and tunnels may help a little, but the roads will always be an issue.

   That said, the 500-foot wide "corridor" mentioned seems potentially ok—more of a block of habitat than a corridor – as long as human intrusion into these areas is a minimum (= no roads).

   What kind of "funneling fencing" is proposed? (= how do the animals know they are headed through a corridor?). Barriers on the sides are great (and necessary), but what is the extent of methods used to orient animals to the corridor?

4. Are the measures set forth in the Conservation Strategy effective for assuring CTS movement between conservation areas bisected by roads, streams, or flood control channels?

Short answer – no.

APPENDIX L
PEER REVIEW COMMENTS

1) Given that there is going to be a net loss of habitat – the existing level of take caused be roads and traffic may prove too much for the CTS. Things are changing, so it is incorrect to assume that any given population can withstand the same level of existing impacts just because they have in the past.

2) A project that increases the amount of traffic – along an existing road – is definitely something that needs mitigation.

3) CTS can and do traverse rolled curbs – inclusion of nice rolled curbs, however, should not be taken to imply that a new road or trail has no impact.

4) "..excellent passageways/under crossing.." Window dressing. The features described need to be required, but as with rolled curbs, a road is a road – and do not site new roads in critical areas. I'd much rather lose some acreage and have a road as a boundary than have a "well designed" road go through somewhere important.

5) Buried pipelines – no real problem. It is good idea to have "utility corridors" where multiple utilities are buried. Preconstruction survey, monitoring of construction, fencing around site, and seeding with appropriate plants……The usual construction stuff is fine

6) Ditches/creeks. These are tough. CTS can clearly cross these sometimes, but I've also seen them washed away. My impression is that CTS really try to avoid flowing water. So on rainy nights when CTS are migrating, ditches and creeks can be real barriers.

5. Given the layout of the Air Center conservation area, can it be considered viable component of the Conservation Strategy?

   Air Center = ?

6. Are the measures outlined in the Conservation Strategy adequate to ensure that migration is successful within the 500-foot corridors (i.e., barrier fencing, raised curbs, road under-crossings, or other protective measures)? Are the 500-foot migration corridors adequate for seed dispersal and genetic exchange between isolated populations of listed plant species?

   Seed dispersal – what is the agent of seed dispersal for these plants – water? Maybe birds and possibly ants/beetles. Given the corridors were designed for CTS, and CTS do not transport seeds, there may be no link between corridor design and seed dispersal. Check water flow patterns and see if any animal vectors are transporting seeds. My guess is that most of the sites are already functionally isolated from one another – and rare dispersal is caused by birds or downstream flooding. Presumably bird dispersal will not be altered, but the hydrologic regime will undoubtedly be changed.

In any even, seed transport by humans is not too difficult and may be called for in order to keep "viable" numbers of individuals at preserve sites.

Pollination -- again, who or what is doing the pollinating. And do the species in question require pollination by an outside source (or are they a bunch of selfers?). If they need a pollinator, then bumblebees, solitary bees, and a host of other insects need to be taken care of. Usually this isn't too much of a problem – but local pesticide use, loss of nesting locations (= uplands, usually), and competition from non-native can cause problems.

7. Are the migration distances described in the literature applicable to the Santa Rosa Plain? What additional studies in which portions of the Santa Rosa Plain might shed light on the distance traveled by the majority of CTS?

   A lot of good work went into this document. The distances are fine – and trying to fine-tune them would likely not add to the discussion. Identifying exactly where CTS are hanging out in the non-breeding season is always useful – as is finding out if they have migration routes (or do they migrate spread across a broad front – as at Stanford). If there are real existing routes (= areas where CTS concentrate during their migrations) preservation of these would help the overall conservation process.

8. Does the Conservation Strategy adequately address connectivity between listed plant species?

   I doubt that the question of what is the geographic extent of the population(s) of the covered species has been addressed by any of the studies. So the species in question may exist in already isolated populations – or the plants at different locations could be part of a single diffuse population. If I had to guess, I say that most of the different locations are already isolated populations – therefore the issue of connectivity is moot.

9. Does the Conservation Strategy reflect the most recent findings in the literature regarding minimum size, shape, and characteristics of plant preservation areas?

   Well, the Conservation Strategy is long on good policies and guidelines, but I'd rather see some specific reserves with specific management plans. The target acreages are good. As with CTS roads and other in-holdings will cause nothing but trouble. Succession will be an issue, management will be an issue, fire control will be an issue, hydrology will be an issue, and control of non-native species will be an issue

10. Does the Conservation Strategy adequately address preserve management actions and land uses necessary to assure viable habitat for CTS and listed plant species?

Doubtful. The strategy has the real potential to create a bunch of mini/moderate reserves associated with individual projects and a few minor mitigation banks. I doubt that such a reserve system will provide for a reasonable chance for long-term persistence of the listed species.

11. Do the preserve selection criteria adequately address the conservation of CTS and listed plant species?

    Generally the criteria are sound, but I'd do the classification now – both to try out the whole system and to, hopefully, get the system up and running. I don't want future decision makers to have too much flexibility – yes I know that is what you wish, but that will result in a piecemeal approach…

12. Does the Conservation Strategy adequately address transplanting/relocation (of seed) to establish new populations as an appropriate conservation tool?
13. Does the Conservation Strategy appropriately address translocation of CTS as an appropriate conservation tool?

The document does a decent job of describing the use of translocations. As noted, translocations are reasonable when trying to establish new populations—either in completely new sites or in sites that formerly supported target species. All translocations need to be monitored carefully – while spreading some seeds around is not a huge risk, moving CTS to an unsuitable site is problematic (unless large numbers of CTS are being "ranched" for the purpose). Folks need to keep in mind that local extinctions are not all that uncommon, and that recolonizations are also part of the natural system. So humans helping things along is not too crazy an idea – especially since we've likely made it much more difficult for things to naturally recolonized sites.

Salvaging individuals from sites being bulldozed, however, is not stellar conservation. It needs to be done, but is not part of an effective conservation plan.

14. Are the CTS and listed plants data on the Conservation Area maps acceptably complete and accurate?

Hard to tell. The maps need to be larger in order for a better review.

New Questions

1) mainly addressed, but the following will be addressed further:
Will fragmented preserve areas, resulting from economically driven selection of noncontiguous parcels within areas ….be adequate for long-term preservation of CTS? --- NO – a checkerboard of small reserves is not ok.
Are the guidelines strong enough? – guidelines never are.

APPENDIX L
PEER REVIEW COMMENTS

2) I'd much rather have some smaller (~200-300 acre?) reserves that are intact and functioning than a fragmented reserve "system" consisting of left over pieces. While you cannot go too small without major management commitments, you likely can go somewhat smaller. Getting less than 1:1 mitigation (or 2:1 for that matter) for take of federally protected species is, however, not in the best interests of conservation.

3) What do you mean outside the conservation areas? Off-site mitigation? In the Central Valley? Or are there adjacent areas of suitable habitat? If there are adjacent sites occupied by the target species they should be included in the conservation areas and planned for accordingly. Politics be dammed. As for disjunct, isolated, and small preserves

4) Again, I don't like corridors. There are few, if any, studies that can provide specific recommendations to the current planning process. If you must try to link distant preserves, make it a habitat linkage and as wide and topographically correct as possible. And try to devise some why to help orient dispersing individuals and be prepared for lots of management (vegetation, squirrel, etc…)

5) Addressed already.

6) Maybe – I'd be very tempted to trade the entirety of this area for much larger reserves in the others – but that would require some more information of distribution and abundance of CTS.

7) Roads are roads. No amount of fluff will make them ok. Better yes, ok no.

8) Unknown. There are always exceptions – but all of the CTS populations I've worked on or encountered were pretty similar. The mean distance migrated undoubtedly changes with local topography and land use, but I suspect the basics stay the same.

9) Reasonable outline. Vegetation management will be key (both by people and by grazing). As will issues related to the hydrology of the sites – and potential succession issues (are the wetlands themselves stable now that the region has changed? or are they themselves changing). CTS larval sampling doesn't need to be done every year.

10) All-in-all, I'd apply the criteria now – and see what you get (I'm assuming that this has been done – a parcel-by-parcel evaluation). Then run some development scenarios and see where the problems lie – does it work?. Generally, I think such criteria are informative, but future implementers can manipulate them for fun and profit.

11) Addressed.

12) Translocations in order to remove individuals from out of the way of bulldozers are a real last resort. I'd do it, but it is not part of any real conservation plan. Moving them around to further conservation goals (establish new populations or reestablish extirpated ones) is very reasonable.

13) Probably so – In general, 11X17 maps covering 150 + square mile do not convey information too well. A much larger map would have been helpful. As would close-up maps of each of the conservation areas. Fortunately the data collected were from numerous sources, and not simply the CNDDB (which is fine, but can be very limited in its content). An expanded map specifically showing surveyed sites and un-surveyed areas would be useful.

14) If they are managed well, and not too fragmented (100+ acres of continuous "core" areas), probably yes (with long-term being 25 years). If they are highly fragmented, probably not (they'll be functional extinctions within a decade).

15) Given the "cookbook" of options listed, if properly implemented (= not a project-by-project approach), there should be enough support as to allow for the local persistence of the target species – if and only if the creation of some central/cores reserves can occur ASAP. A project here, and a project there and the whole thing drags on……and there are small reserves here and smaller ones there…….then species will not persist.

16) First of all if the original wetland was "healthy" and supported listed species, 1:1 is a terrible ratio for conservation purposes. Why trade an existing wetland that supports native species, and has for some length of time, for an unproven/recently-constructed hole in the ground? There needs to be a reasonable trade in order to account for the added level of risk. If the wetlands in question are stock ponds (which are widely used by CTS), then a 1:1 trade is slightly more acceptable – but only slightly so since the stock ponds presumably have been in existence for some time (decades?). If the wetlands are natural – and have been in existence for 100s if not 1000s of years – then the mitigation needs to exceed 1:1.

As for worry that creation of wetlands will significantly reduce the amount of upland, remember that there is a functional limit as to how far the majority of CTS will travel from a breeding site. Put in a new breeding site and presumably the range of available upland will expand accordingly.

Every time I build a new pond, I measure out a 500-meter line (in your case you'd use the 2200 foot line) denoting where most of the salamanders will reside. I don't site a pond in a location that doesn't have the "full" amount of upland, and I try to place new ponds in areas that facilitate CTS use of previously unoccupied uplands.

As for creating the new wetlands – the usual preconstruction surveys, and phased construction need to occur (first mow or otherwise clear vegetation, and check any potential burrows, then when clear, start construction, with a monitor on site…).

I would consider it inappropriate to build a new wetland on an upland area that is found to support an unusually high concentration of CTS – a few displaced CTS is no problem (= proportional to the amount of land being altered: if creation of a new wetland is destroying 1% of the uplands within 2200 feet of a breeding site, a few % of the total

CTS in the areas would be expected to be impacted), but there could be cases where for some reason, a significantly higher percentage of the non-breeding CTS might occupy a comparatively small area – I haven't seen such a situation yet, but I always do a quick check prior to siting new ponds – I'd hate to destroy an key feature of the landscape. (Again, I haven't seen this in CTS, and have looked – but I have encountered such hard to explain concentrations of target species in many of the other species I've worked with).

APPENDIX L
PEER REVIEW COMMENTS

Peer Reviewer # 5

December 3, 2004

Subject: Peer Review of the Santa Rosa Conservation Strategy

Note: My expertise is primarily with the California Tiger Salamander, and I have restricted my comments to aspects of the plan that relate to that species.

Overview:

The stated purpose of the Santa Rosa Plain Conservation Strategy (SRPCS) is to "produce a strategy for habitat conservation and enhancement of listed species on the Santa Rosa Plain" (SRPCS p. 3). By aiming to preserve the species throughout its distribution (SRPCS p. 4), recognizing the key importance of both terrestrial and aquatic habitat, and including consideration of metapopulation dynamics and principles of landscape ecology into the draft strategy, the authors of the strategy take an appropriate approach to this task. However, while the basic approach of the strategy has merit, the specifics of the plan are flawed, and my assessment is that the strategy, as currently formulated, is unlikely to succeed. Below I have provided my specific criticisms of the strategy and suggestions for changes to address those criticisms. Because the overall approach is sound, I think it is possible that the specifics of the strategy could be altered to more effectively accomplish the mission of species recovery.

My specific criticisms are as follows:

1. Further loss of habitat
The fundamental shortcoming of the strategy is that the Sonoma California Tiger Salamander (CTS) is declining primarily because of human-caused habitat loss (Wooten 2002), and further habitat loss will occur under the plan. It is estimated that more than 80% of the vernal pool habitat has been lost from the Santa Rosa Plain (Patterson et al 1994), along with high proportions of upland habitat. Despite the designation of the nine new conservation areas and the increased amount of preserved land proposed in the draft strategy, the result of adoption of this plan will be less actual CTS habitat on the ground. While some habitats--perhaps even some of the best habitats--will be protected from future development, there will be a further overall reduction in the amount of CTS habitat, which is the leading reason for the endangerment of the species in the first place. If the species is declining under current conditions, there is no reason to think that further habitat loss will produce recovery.

The only way that further habitat loss could lead to recovery, is if remaining habitat were to be improved to the extent that the improvement *more than compensated* for continued

habitat loss. The measures for mitigation in the current draft to not appear to meet that standard (see below).

2. Inadequate mitigation standards

As stated above, the only hope for recovery of a species threatened by habitat loss under a plan that includes continued habitat loss, is improvement of remaining habitat. In theory, this could be done through mitigation, but the mitigation proposed in the strategy would not improve conditions enough to offset the habitat loss that would occur under the plan. At the outset, it should be noted that compensatory mitigation (i.e., habitat creation to replace destroyed habitat) is often unsuccessful, and therefore the proposed 2:1 mitigation ratio is likely to be too low (Zedler and Callaway 1999). If mitigation is expected to bring about an improvement in the species status, the implication of a 2:1 mitigation ratio is that the mitigation will fail substantially less than 50% of the time. Studies of the outcomes of wetland restorations suggest that is overly optimistic. On the other hand, there is reason to think that mitigation may have the potential to provide CTS habitat. CTS have been found to use artificial breeding pools for breeding (Trenham et al. 2000, Cook, Northen, and Stokes *unpubl. data*) and inhabit diverse upland habitats if necessary conditions are met (e.g., LSA 2004). In light of past mitigation failure rates and the many unknowns involved, a more conservative mitigation ratio of 3 or 4 to 1 would be more credible. Further research on the effectiveness of mitigation on the Santa Rosa Plain could result in later reduction (or increases) of this ratio.

Even if the mitigation ratio is revised upwards, the measures proposed in the draft will produce insufficient benefits to the CTS to overcome the additional habitat loss. I suggest the following additions to the proposed mitigation measures:

-- Increase the number of breeding pools in areas where none exist but which have otherwise appropriate habitat. In particular, expand breeding pools in areas likely to re-establish metapopulation function within and between conservation areas.

-- Provide salamander crossing routes across major barriers between conservation areas (e.g. Highways 12 and 101).

-- Require mitigation for some apparently minor projects that are likely to have effects on CTS. Unfortunately, the threats to species encompassed under the rubric of habitat loss often constitute a death by a thousand cuts, and each of the cuts-- though minor in itself-- must be addressed in order to protect the species. For example, swimming pools are cited as an example of a project that would have insignificant effects on CTS (SRPCS p. 14). However, small losses of habitat have a cumulative effect, and a swimming pool can be a CTS trap. Another example is any project involving a curb or other CTS barrier. Such small projects should be subject to mitigation and CTS-friendly construction standards.

-- The 1.3 mile figure (the distance from CTS occurrence within which mitigation is required) should be subject to revision based on potential expansion of conservation areas (#4 below), reestablishment of landscape connectivity (#5 below), and findings of future research. Research to establish CTS use of its terrestrial habitat should be specified in the strategy.

-- The prescribed mitigation for roads should be increased. Roads are a particularly

serious threat to amphibians (Houlahan and Findlay 2003), and have an impact out of proportion to their aerial extent. It is a good idea to offer smaller CTS mitigation ratios for roads incorporating CTS design features, but a 1:1 mitigation ratio implies that there is no negative effect of the road beyond the lost habitat. This is highly unlikely. At the very least, the road will be a filter to movement. I suggest a mitigation ratio of 2 : 1 for CTS-friendly roads. Roads without CTS design features should have mitigation of 3 : 1 or higher.

-- Mitigation should target the retrofitting of existing built features, such as curbs, roads, etc. that are barriers to CTS movement. Again, improvement of habitat is the only way that compensate for reduced amount of habitat.

3. Probable unfavorable preserve configuration

The plan describes reserves in terms of acreage only, and does not spatially define them. While a recognition of the importance of upland habitat and reserve size in conserving a species is a good first step, the spatial configuration of a preserve is critical to its success in maintaining the species and must be considered in the strategy. The minimum area to be conserved in the proposed conservation areas is based on the radius (2200 ft) encompassing 95% of adult and subadult movement in a study of a breeding population in Solano County (SRPCS p. 10, from Trenham and Shaffer *in review*). However, this value has little meaning without a definition of the shape and location of the protected lands. A highly fragmented preserve is less likely to sustain viable populations than a consolidated contiguous preserve. Given the piecemeal way in which lands are to be added to the conservation areas under the plan, it is highly unlikely that the conserved lands will be aggregated in large-radius unfragmented areas around breeding sites. This is acknowledged in the SRPCS (p. 5). Just as important as total acreage is habitat quality, location, and distance with respect to breeding ponds.

How to exercise more control over preserve configuration under the proposed mitigation banking scenario is admittedly a difficult question. A prioritization algorithm that considers habitat quality and spatial configuration, and reflects contingency and evolving reserve configuration will be required. More difficult will be arranging for the acquisition of particular high-priority parcels. This will be a challenge, but essential for the success of the strategy.

4. Failure to support metapopulation dynamics

Small populations are highly prone to extinction. Most, if not all of the proposed conservation areas are likely to contain small populations of CTS. Such populations are only likely to persist in the long term through movement of individuals between pools and pool complexes, resulting in genetic exchange between subpopulations as well as augmentation, recolonization, and rescue of subpopulations that have declined or become extinct. Prior to anthropogenic alteration of the Santa Rosa Plain, numerous vernal pools scattered across a landscape dominated by oak grassland vegetation constituted a large, mostly continuous, mosaic of suitable upland and aquatic CTS habitat. In this environment, the Sonoma CTS population probably functioned as a large metapopulation,

with sub-populations centered around vernal pools or pool complexes. Maintenance, or re-establishment, of metapopulation function will be necessary for the long-term conservation of a species characterized by this kind of population structure (Marsh and Trenham 2001, Semlitsch 2002, Houlahan and Findlay 2003).

The current draft strategy does not provide sufficient connectivity between conservation areas to sustain this metapopulation structure and is likely to result in five-to-nine isolated extinction-prone populations. An important improvement in the plan would be to foster habitat acquisition, cross-barrier movement (e.g. accommodation for crossing roads), and vernal pool creation in locations that would facilitate movement between conservation areas. Such inter-area linkages should be explicitly prescribed by in the plan. Conservation areas should be expanded in the direction of neighboring conservation areas, and pools created and surrounding upland habitat conserved. This would have the effect of reversing some of the anticipated habitat loss by providing new habitat where CTS may not currently exist, and increasing connectivity (a stepping stone) to the next conservation area. This measure may be allowable in the SRPCS under 5.1.1 (2b) (p. 10).

5. Need to accommodate terrestrial movement, particularly by subadults

In many species, it is the subadults that account for the majority of the dispersal and provide the majority of movement on which metapopulations depend. The little available data (Trenham and Shaffer *in review*) suggests this is true for CTS as well. The proposed strategy has two shortcomings with regard to subadult dispersal. First, because there is so little information available, research needs to be undertaken to determine patterns of movement of CTS on the Santa Rosa Plain. Given that landscape and habitat variables are likely to have an effect on how far individuals move, it is important to establish values from field data on the local population. It is possible that the Sonoma CTS disperses shorter distances than other populations. Or much farther. This information is critical to the success of the strategy, and should be established.

Second, studies of many animal species have found that metapopulation function can be sustained by very low rates of interchange between subpopulations. Thus, comparatively rare long-distance subadult dispersal events may be important in maintaining genetic diversity and recolonization of currently vacant sites. Thus, while the 2200 foot figure is a good starting point (It was estimated that 95% of subadult movement occurred within this distance of a breeding site (Trenham and Shaffer *in review*), it may be that to successfully maintain metapopulation function of the Sonoma CTS, the plan must accommodate more than 95% of subadult movements. More research is needed on this point, and this should be explicitly called for in the plan.

These considerations, and those relating to metapopulation dynamics (#4 above), may lead to the conclusion that conservation and preserve areas must be revised upward to effectively protect the species. More information is needed to make that determination.

APPENDIX L
PEER REVIEW COMMENTS

6. Need for information

As outlined above, a great deal of additional information about the Sonoma CTS is needed. As with other ambystomatid salamanders, there is much that is unknown regarding terrestrial habitat use and terrestrial movement and dispersal (Madison and Ferrand 1998, Semlitsch and Bodie 2003). The strategy should explicitly outline the types of research projects that will be undertaken and a timeline for completion. Research related to translocations should also be specified. Finally, the draft appropriately calls for an adaptive management approach, but more specificity is needed on the mechanism for integrating research and monitoring into ongoing implementation of the strategy.

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APPENDIX L
PEER REVIEW COMMENTS

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