5.0 POTENTIAL BIOLOGICAL IMPACT/TAKE ASSESSMENT

5.1 DEFINITION OF TAKE

Under the Federal Endangered Species Act (ESA), take of wildlife species listed as threatened or endangered is illegal, unless authorized by an incidental take permit or other means. 16 USC §1539(a). The ESA defines the term "take" as "to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct." 16 USC §1533(19). By regulation, the Service has defined the terms "harm" and "harass" in the definition of "take." "Harm" means "an act which actually kills or injures wildlife. Such act may include significant habitat modification or degradation where it actually kills or injures wildlife by significantly impairing essential behavioral patterns, including breeding, feeding or sheltering." "Harass" means "an intentional or negligent act or omission which creates the likelihood of injury to wildlife by annoying it to such an extent as to significantly disrupt normal behavioral patterns which include, but are not limited to, breeding, feeding, or sheltering." 50 CFR §17.3.

5.2 IMPACTS CONSIDERED UNDER THE HABITAT CONSERVATION PLAN

Under Section 10(a)(2) of the ESA, an HCP must identify the incidental take of listed species that is anticipated, and the impacts that will likely result from such taking. Before the Service can approve an HCP and issue the requested incidental take permit, they must conduct an internal Section 7 consultation on the HCP, which will lead to a Biological Opinion as to whether implementation of the incidental take permit and HCP will (1) result in "jeopardy" to any listed species of plant or animal, or (2) result in the "destruction or adverse modification" of designated Critical Habitat. In doing its Section 7 consultation, the Service must look not only at the direct effects (i.e., anticipated incidental take resulting from the HCP) but also indirect and cumulative effects.

Following the preparation of a Biological Opinion, the Service will issue an incidental take permit upon a finding, in addition to other criteria, that the Covered Activities will not appreciably reduce the likelihood of the survival and recovery of the species in the wild, and that Stanford has minimized and mitigated the effects of their activities to the maximum extent practicable. The Minimization Measures and Conservation Program described in Section 4.0 have the ability to fully mitigate impacts to the Covered Species and therefore reduce the direct, indirect, and cumulative effects of the Covered Activities, and provide benefits to the Covered Species, such that the Service should be able to make a finding that meets the two most critical criteria above.

To meet the requirements of Section 10(a)(2), and facilitate the Biological Opinion and incidental take process, this HCP evaluates anticipated incidental take, and associated direct, indirect, and cumulative effects.

5.3 ANTICIPATED TAKE OF EACH COVERED SPECIES

Stanford University was established more than 100 years ago, on the site of Governor Stanford's famous Palo Alto stock farm. The type and frequency of the activities needed to run the University have evolved over the past 100 years, and will continue to evolve. However, the University has substantial information about its modern operations and anticipated future operations, and a substantial amount of information about the distribution and population of the Covered Species at Stanford, and based on the available data, evaluated the projected future take of the Covered Species by Stanford. Although direct and indirect take is not defined in the ESA, for the purposes of describing the anticipated impacts to the Covered Species, the HCP uses these terms as defined below.

Direct take as used in the HCP refers to the harm, harassment, and loss of individuals of the Covered Species. This includes losses from direct actions, such as stepping on an individual of a Covered Species; construction machinery harassing, injuring or killing an individual during development; or accidental harm, harassment or death of a species during the course of activities such as non-native species control efforts. Direct take also includes harassment, harm, or the death of a species that occurs during ongoing activities that disrupt the species' habitat for a short time, such as maintaining buried utilities that are occasionally excavated and subsequently reburied. Individual Covered Species may not be directly killed by the habitat disruption, but such disruptions can significantly alter the species' behavior and cause a temporary increase in the rate of mortality caused by some secondary factor, such as predation or desiccation. A summary of the anticipated level of incidental mortality is provided in Table 5-1.

Indirect take as used in the HCP describes the permanent loss of habitat that is not expected to result in the mortality or direct harm or harassment of a species. Reducing the amount of available habitat may reduce the future maximum size of the species' populations. This reduction in the potential maximum size of the population can affect a local population's persistence or may inhibit efforts to recover the species. The permanent loss of habitat can be more of a threat to a species' local persistence than the occasional loss of a few individuals, and is therefore considered take under the HCP. A summary of the anticipated loss of habitat is provided in Table 5-2. Potential locations and amount of habitat loss are provided in Figure 5-1.

The anticipated levels of take described below, and the anticipated incidental mortality shown in Table 5-1 reflect the current population levels. The implementation of the HCP's Conservation Program will likely increase the population of the Covered Species during the life of the HCP. As the population increases, the number of individuals that are harassed, harmed, or killed may increase numerically. However, the impact to the population as a whole will decrease because a numerically robust population has a much better chance at survival or recovery. Thus, increases in the absolute number of individuals subject to take each year will be more than compensated for by the elevated overall population levels, and the overall percentage of the population that is subject to take is not expected to increase.

For example, recent population estimates for California tiger salamanders at Stanford range from 400 to 4,000 adults and juveniles. The Covered Activities are projected to result in the incidental mortality of an average of 20 adult and juvenile tiger salamanders per year. This represents an annual loss of between 1 percent and 5 percent of the current population. If successful implementation of the Conservation Program increases the number of tiger salamanders to 10,000, a loss of 1 percent to 5 percent per year of the increased population would be between 100 and 500 adult and juvenile California tiger salamanders. The significance of this annual loss of 1 percent to 5 percent of the population is reduced as the overall population increases because as populations increase in size, they become less susceptible to the multitude of risks associated with small populations. Therefore, a population's chance of long-term persistence is greatly enhanced when the overall number of individuals increases.

Take generally occurs only in Zones 1 and 2, and Table 5-2 provides a summary of the estimated loss of areas designated Zone 1 and 2. These areas contain habitat for the Covered Species, and are either occupied by the Covered Species or provide the species with habitat that is necessary for their survival, including buffers between occupied habitat and disturbed areas, food sources, and dispersal routes. Zone 3 is comprised of undeveloped open space that benefits the local flora and fauna, including the Covered Species. This benefit, however, is very diffuse and is not linked to any specific population of the Covered Species. Zone 4 includes urbanized areas, and incidental mortality only occurs in Zones 3 or 4 when a species strays from its habitat.[1]

For purposes of this analysis, Stanford estimated the number of Covered Species at Stanford. The population estimates used for this analysis are based on 15 years or more of site-specific work on the Covered Species. However, accurate population estimates are difficult to attain especially when invasive methods are not used. The population estimates in this analysis therefore provide a range of population levels for each of the Covered Species, and the analysis relies on the low end of the range to assess the maximum potential impact to the species. The estimated population levels and potential maximum level of incidental mortality are shown in Table 5-1.

5.3.1 California red-legged frog

The estimated number of California red-legged frogs at Stanford are based on annual surveys conducted since the mid-1990s. These surveys include day and night field activities. While eggs and tadpoles were routinely observed during these field activities, the estimates are for juvenile and adult frogs only. Repeated visits to areas known to support red-legged frogs were used to estimate the number of unseen frogs, which is based on the likelihood of observing an individual known to be in the area on a specific site-visit. This information, along with precise information on the spatial distribution of sightings, was then used to estimate the number of unseen frogs. In this case, the surveys concluded that for every individual red-legged frog that was observed during the surveys, there were another 2 to 3 individuals in the area. Other methods, most notably toe-

[1] California tiger salamanders are occasionally found in the urbanized areas of the campus. Curbs and other improvements trap the tiger salamanders and prevent them from returning to suitable habitat.

clipping or pit-tagging, could yield more quantitatively precise estimates, but gathering data in this manner could cause the take of red-legged frogs. Based on the data available, over the last decade the number of California red-legged frogs at Stanford has ranged from 25 to 250.

Direct Impacts. Agricultural activities, cattle grazing, academic field work, vegetation management, and activities within the riparian areas and creek banks, such as bank stabilization, may result in the take of red-legged frogs. In addition to direct harassment, harm, or mortality from these activities, approximately 2 acres per year of red-legged frog habitat will be temporarily disturbed. This disturbance will cause individual red-legged frogs to alter their behavior, which may increase their level of mortality, either by increased risk of predation or by dispersing frogs to inhospitable locations. Although the Minimization Measures will reduce the amount of take associated with the Covered Activities, the Covered Activities could result in the incidental mortality of an average of three frogs per year, and represents 1 to12 percent of the recent population estimates.

Indirect Impacts. Permanent loss of Zone 1 and 2 habitat will reduce the number of California red-legged frogs that Stanford can support. Approximately 30 acres of red-legged frog habitat is anticipated to be lost during the life of the HCP.

Net Effects. During the life of the HCP, the overall red-legged frog population is expected to increase. The Conservation Program, particularly the Matadero/Deer Easement, construction of new off-channel breeding ponds, control of non-native species, and bank stabilization should result in a net increase in the quality of red-legged frog habitat and decrease in mortality rates, which will lead to an increase in the red-legged frog population. As discussed above, an increase in the species' population will lead to a greater distribution of the red-legged frog at Stanford and greatly reduce the chance of local extinction. It will also lead to an increase in the absolute number of frogs that are harmed or killed. While the number of red-legged frogs subject to incidental mortality may increase, the overall percentage of the population that is impacted will not increase.

5.3.2 California tiger salamander

Although Stanford has conducted rainy night surveys for nearly 2 decades, it is difficult to estimate the number of tiger salamanders at Stanford. California tiger salamanders have a secretive nature, and the landscape at Stanford is a complex mix of urban facilities, roads, and undeveloped academic lands. The presence of a large number of people, including residents, visitors, and college students, renders traditional surveys, which include fencing and pit-fall traps, too difficult to conduct. The wildlife agencies have recommended against toe-clipping and pit-tagging, and Stanford has therefore relied primarily on visual surveys.

Despite these difficulties in surveying for California tiger salamanders, rainy night surveys since the early 1990s have produced an abundance of data on the number of migrating adult and juvenile salamanders. During most years, fewer than 50 salamanders are observed, either as live migrating individuals or as road-kill. During years with appropriately timed fall rains, however, approximately 500 individual salamanders have

been observed. Although not all of the populations' adult and juvenile salamanders migrate during these mass migrations, and observers undoubtedly did not encounter every migrating salamander, these mass migrations provide valuable data on the size of the local population. To determine the estimated number of tiger salamanders at Stanford, this analysis assumed that at least 50 percent of adult and juvenile salamanders migrate during mass migrations, and based on the spatial configuration of the campus, concluded that approximately 25 percent of those migrating are observed. Based on these assumptions, Stanford concluded that over the last 15 years, there was a maximum of approximately 4,000 adult and juvenile tiger salamanders at Stanford.

There has not been a mass migration of salamanders at Stanford for nearly a decade. During the past decade, California tiger salamander migration has been much less synchronized, although tiger salamander reproduction has been observed regularly. In these years, the percentage of individuals migrating is well below 50 percent, and salamander migration is not frequently observed. This results in less precise estimates of the population size, and likely leads to an underestimation of the size of the population. Based on the data provided during these years, Stanford estimates that the California tiger salamander population could be as low as 400 individuals.[2]

Direct Impacts. Most of the take will occur because the majority of Stanford's California tiger salamander population breeds in and resides near Lagunita, which is located adjacent to the urbanized portion of the campus. Take of California tiger salamanders may also occur in the foothills south of Junipero Serra Boulevard in areas where there are urban facilities, such as the radio telescope and student observatory or areas where existing utility corridors exist. (The population sinks in the foothills are shown on Figure 2-4). Landscaping, pipe repair, road maintenance, development and redevelopment, and other routine activities needed to operate the University therefore all affect the California tiger salamander. On average, approximately 2 acres of tiger salamander habitat will be temporarily disturbed per year. This short-term disruption of habitat does not result in a permanent reduction of habitat, but may increase the level of mortality for those salamanders that inhabit the disturbed area. The take of tiger salamanders during the course of day-to-day operations has been reduced since the mid-1990s when a range of educational and conservation measures were implemented, and will be further reduced through the implementation of the HCP. However, the Covered Activities could cause the incidental mortality of up to 20 tiger salamanders per year, which is approximately 1 percent to 5 percent of the current tiger salamander population at Stanford.

Indirect Impacts. Approximately 68 acres of Zone 1 and 2 California tiger salamander habitat could be developed during the life of the HCP. As part of the Conservation Program, Stanford is actively creating new tiger salamander breeding habitat south of Junipero Serra Boulevard. The location of these new ponds will allow tiger salamanders to more readily occupy larger portions of the undeveloped foothills. The HCP will create

[2] Estimates of the tiger salamander population do not include eggs and larvae, which are monitored every year. The Covered Activities generally affect only the adult and juvenile tiger salamanders, and therefore direct effects to the eggs and larvae were not included.

a 315-acre CTS Reserve that will initially include the eight tiger salamander breeding ponds built in 2003. Three of these ponds already support tiger salamander breeding. The Conservation Program will effectively shift the center of the local tiger salamander population from Lagunita, located at the edge of the developed main campus, to the largely undeveloped lower foothills. Thus, the habitat quality of grassland and oak woodland available for upland habitat for tiger salamanders will increase if the Conservation Program is successful. However, up to 1.4 acres of upland tiger salamander habitat per year or 68 acres over the duration of the HCP could be permanently lost at Stanford.

Net Effects. Several of the ongoing Covered Activities, including maintenance and operation of Lagunita, mowing, and cattle grazing, benefit California tiger salamanders. Lagunita is an artificial flood control and water storage facility that supports tiger salamander breeding. Mowing the bed of Lagunita for fire control and grazing in the foothills facilitate California tiger salamander dispersal. The implementation of the Conservation Program, which includes a 315–acre CTS Reserve and newly constructed breeding ponds away from developed areas, will substantially increase the quality of tiger salamander habitat at Stanford. Overall, the HCP will have a beneficial effect on the California tiger salamander, and the overall population is expected to increase substantially. As discussed above, an increase in the species' population may result in an increase in the number of individual salamanders that are subject to incidental mortality. However, the overall percentage of the population that is affected (1 to 5 percent of the population) will not increase.

5.3.3 San Francisco garter snake

Stanford currently supports a small garter snake population. A few individual garter snakes are encountered at Lagunita every year, but specimens from other locations at Stanford are only very infrequently observed. Recent observations indicate that fewer than 100 garter snakes currently live at Stanford. However, the number of garter snakes at Stanford may be increasing, primarily due to recent salamander-related changes in land management (e.g., Lagunita is no longer disced for fire control).

Direct Impacts. Approximately 80 acres of potential garter snake habitat[3] will be unavoidably disturbed annually. This disturbance is primarily the result of dry season vegetation management. However, dry season mowing generally has very little effect on the garter snakes, and since the population density of garter snakes at Stanford is very low, all lethal take of garter snakes will be avoided. These activities may harass any garter snake that happens to be present. By avoiding the lethal take of all garter snakes, Stanford will avoid any potential lethal take of the protected San Francisco garter snake.

Indirect Impacts. Approximately 98 acres of potential garter snake habitat is anticipated to be lost during the life of the HCP. Suitable habitat areas could support a larger garter

[3] This habitat is suitable for all local garter snakes, and the effects apply to all local garter snakes at Stanford, whether or not they are considered San Francisco garter snakes.

snake population. Therefore, a slight reduction in the amount of suitable habitat will not have an adverse effect.

Net Effects. The implementation of the Conservation Program, particularly the riparian easements and the Central Campus CTS Management Plan will protect and improve potentially suitable habitat. It is unclear whether the local garter snake population will continue to increase during the life of the HCP, even with the successful implementation of the Conservation Program. The low number of garter snakes at Stanford is due to several historic factors, including the development of the surrounding communities and now discontinued land management practices. Overall, the HCP will improve habitat conditions.

5.4 CUMULATIVE IMPACTS

As described above, the impacts of the Covered Activities were assessed relative to the existing conditions at Stanford. Chapter 3 of the HCP defines the Covered Activities as broadly as possible to encompass a wide variety of University-related activities and future development. Development in the surrounding communities, which is outside the scope of this HCP, may contribute to cumulative impacts on the Covered Species. Thus, other activities and projects in the region that are not covered by this HCP may, in conjunction with this HCP, affect the Covered Species. Specific projects not covered in this HCP that may impact the Covered Species are described below. Additional potential cumulative impacts are described in the EIS for the HCP.

The cumulative impact analysis addresses a relatively local geographic area that includes San Mateo and Santa Clara counties on the San Francisco Peninsula.

5.4.1 Santa Clara Valley Draft HCP/NCCP

The Santa Clara Valley HCP/NCCP is a regional partnership between the County of Santa Clara; Santa Clara Valley Transportation Authority; Santa Clara Valley Water District; the cities of San Jose, Gilroy and Morgan Hill; the CDFG; and the Service. The HCP/NCCP will cover approximately 520,000 acres in southern Santa Clara County, and will address the California tiger salamander, California red-legged frog, western pond turtle, western burrowing owl, Bay checkerspot butterfly, and other plant and animal species. The draft HCP/NCCP identifies a broad range of activities, including urban development, major capital improvements, and instream operations, maintenance, and projects. The draft finds that the Covered Activities will result in the take of the Covered Species and in habitat loss and degradation. However, the draft also includes a conservation strategy that recommends preserving approximately 45,000 acres of habitat. Thus, the Santa Clara Valley HCP/NCCP in conjunction with the Stanford HCP should provide regional protection for the Covered Species.

5.4.2 Urban Growth

Future non-Stanford development in San Mateo and Santa Clara counties will continue during the life of the HCP. Continued development will have a cumulative effect on all of the Covered Species. For example, the loss of wetlands in Santa Clara County from

future development will reduce breeding habitat for the California tiger salamander, storm water runoff from urban landscapes in both counties that includes pesticides and human use of creek habitats for recreation alter California red-legged frog habitat. Recreational trails in upland areas can degrade California red-legged frog and California tiger salamander habitat. Urban development outside Stanford, coupled with Stanford's future development, will reduce the amount of existing habitat for the Covered Species. Some or all of these losses may be offset by mitigation. However, it is unknown at this time whether mitigation will make up for the lost functions and values of the existing habitat. Therefore, the precise impact of cumulative future growth is unknown.

5.4.3 Ongoing and Routine Agriculture

Ongoing and routine agricultural activities off of Stanford lands may have some cumulative impacts on the Covered Species. Ongoing grazing may limit or degrade riparian habitat for the California red-legged frog. Unregulated grazing can also degrade upland habitat for the California tiger salamander, garter snakes, and California red-legged frog, and individuals may be trampled by cattle. Since the impacts of ongoing and routine agriculture are generally unregulated, and mitigation is therefore not required for impacts associated with these activities, some adverse effects on the Covered Species is expected. However, the precise impacts of ongoing and routine agriculture, and their cumulative effects, are unknown.

Table 5-1 Summary of Estimated Incidental Mortality of Individuals

	Estimated annual incidental mortality	Minimum population level	Maximum incidental mortality (percent)	Maximum population level	Minimum incidental mortality (percent)
California red-legged frog	3	25	12 percent	250	1 percent
California tiger salamander	20	400	5 percent	4,000	1 percent
Garter snake	0	20	0 percent	100	0 percent
Population estimates are based on studies conducted at Stanford: 1992 to present (most variation is based on annual fluctuations)					

Table 5-2 Summary of Estimated Loss of Zone 1 and 2 Habitat

	Annual estimated short-term habitat disruption	Total estimated short-term habitat disruption	Annual estimated permanent loss of habitat	Total estimated permanent loss of habitat
California red-legged frog	2.0 acres	100 acres	0.4 acres	20 acres
California tiger salamander	2.0 acres	100 acres	1.4 acres	68 acres
Garter snake	4.0 acres [4]	200 acres	1.8 acres	88 acres
Permanent loss of habitat totals are not identical to the values shown in Table 4-1 because some of the habitat is shared by multiple species and some permanent loss of habitat is associated with Covered Activities other than future development, such as maintenance of existing utilities.				

[4] In addition, there would be approximately 76 acres of grassland that would be mowed each year for fire break and CTS conservation purposes.