APPENDIX P

ANALYSIS OF EFFECTS ON THE NATOMAS BASIN HABITAT CONSERVATION PLAN REPORT

Greenbriar Development Project
Sacramento, California

Analysis of Effects on the Natomas Basin Habitat Conservation Plan Report

Prepared for:

City of Sacramento
Environmental Planning Services

July 19, 2006

EDAW

Greenbriar Development Project
Sacramento, California

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EXECUTIVE SUMMARY

ES.1 INTRODUCTION

This Analysis of Effects on the Natomas Basin Habitat Conservation Plan Report (effects analysis) (EDAW 2006) is an evaluation of the effects on each species covered by the Natomas Basin Habitat Conservation Plan (NBHCP), on the conservation strategy of the NBHCP, on specific conservation measures, and consequently on attainment of the NBHCP's goals and objectives as a result of implementing the proposed Greenbriar project. The U.S. Fish & Wildlife Service (Service) and the California Department of Fish & Game (Department) approved the NBHCP in the summer of 2003. The NBHCP establishes the overall conservation program for the development of a 17,500 acre-portion of the Natomas Basin. The Greenbriar site is located within the boundaries of the NBHCP plan area, but is not within an area permitted for development. This Effects Analysis is being released for public review in conjunction with the *Greenbriar Development Project Sacramento, California: Draft Environmental Impact Report* (DEIR) (EDAW 2006) because the EIR contains an evaluation of the Greenbriar project's effects on biological resources for purposes of CEQA review, as well as the evaluation of the project's effects on the NBHCP.

The Effects Analysis is organized in the following way:

- Section 1, Introduction
- Section 2, Evaluation Approach
- Section 3, Greenbriar Project's Alteration of Population and Habitat Attributes
- Section 4, Potential Effects of the Greenbriar Project on Covered Species
- Section 5, Potential Effects on the Conservation Strategy of the NBHCP
- Section 6, Potential Effects of the Greenbriar Project on NBHCP Goals and Objectives
- Section 7, Cumulative Effects
- Appendix A, Consistency of Greenbriar Project and NBHCP Measures to Reduce Construction-related Effects and Human-Wildlife Conflicts
- Appendix B, Change in Natomas Basin Land Cover in 2001–2004

ES.2 OVERVIEW OF GREENBRIAR PROJECT

As currently proposed, the Greenbriar project would:

- Develop 546 acres at the Greenbriar site;
- Avoid and preserve an on-site corridor (of 31 acres) along Lone Tree Canal;
- Create or enhance, preserve, and manage in perpetuity two proposed off-site reserves — the Natomas 130 and Spangler properties (with a combined acreage of 266 acres).

As designed, the proposed project includes a package of measures to avoid, minimize, and mitigate impacts from the proposed development. In addition, the City of Sacramento, through the CEQA process, has proposed mitigation measures to reduce further the adverse effects of the proposed project. (Throughout this Effects

Analysis, "mitigation" refers to the measures proposed by the City of Sacramento in the Draft EIR for the Greenbriar project [City of Sacramento July 2006].) With the DEIR mitigation, the project's avoidance, minimization, and mitigation measures include:

- Avoidance of a 31 acre (250-foot wide) corridor along Lone Tree Canal;
- Measures to reduce or offset effects on the Lone Tree Canal corridor including barriers/fencing, creation of marsh habitat along the canal corridor, design of canal crossings to minimize obstacles to giant garter snake movement, and an assurance that aquatic habitat would be maintained in this section of the canal;
- Funding to manage the Lone Tree Canal corridor in perpetuity;
- Measures to avoid and minimize construction-related effects on covered species; and
- Creation or enhancement, preservation, and management in perpetuity of 315 acres of high quality habitat in addition to the corridor conserved along Lone Tree Canal.

ES.3 SUMMARY OF FINDINGS

To evaluate the proposed project's effects on the effectiveness of the NBHCP, this effects analysis performed an extensive analysis of the project's potential effects on the future condition of the Natomas Basin. This analysis used the 2001 land cover data that represents baseline conditions of the NBHCP, and also considered 2001–2004 changes in land cover, and 2005 conditions. Interpretations of the project's effects on the NBHCP were based on the sum of anticipated effects on the viability of populations of covered species using the Natomas Basin, on the effectiveness of the NBHCP's conservation strategy, and on attainment of the goals and objectives of the NBHCP.

Although the proposed project would cause a variety of adverse and beneficial effects, overall, the proposed project (with the DEIR mitigation) would not reduce the viability of covered species, the efficacy of the NBHCP conservation strategy, or adversely affect attainment of the NBHCP goals and objectives. In part, it would have this outcome because its conservation strategy includes a substantial investment in the creation, enhancement, and management in perpetuity of high quality habitat on the preserved land, and in the avoidance, minimization, and mitigation of effects on the Lone Tree Canal corridor. For most covered species, the increased habitat values on preserved lands offset the habitat values lost as a result of development at the Greenbriar site, and thus prevent a net loss in resources in the Natomas Basin for these species. The conservation of the Lone Tree Canal corridor, while costly and resulting in a small reserve that will be costly to manage, is essential for maintaining connectivity of aquatic habitat and movement of giant garter snakes between the southern and central Natomas Basin; without this connectivity, the effectiveness of the NBHCP's conservation strategy would be reduced.

The project's adverse and beneficial effects on the viability of populations of covered species using the Natomas Basin, on the effectiveness of the NBHCP's conservation strategy, and on attainment of the goals and objectives of the NBHCP are summarized in the following sections of text.

ES 3.1 EFFECT ON POPULATION VIABILITY OF COVERED SPECIES

The Greenbriar project would not affect five of the 15 animal species covered by the NBHCP: California tiger salamander, western spadefoot toad, vernal pool fairy shrimp, vernal pool tadpole shrimp, and midvalley fairy shrimp. None of these vernal pool-associated species are known from the vicinity of the Greenbriar or proposed reserve sites, nor does suitable habitat occur in the vicinity of these sites.

The project is also unlikely to affect valley elderberry longhorn beetle (VELB) because VELB is not known from the vicinity of the Greenbriar or proposed reserve sites, and riparian habitat that might contain elderberry bushes

is only present at and in the vicinity of the proposed Natomas 130 reserve; also, in the future, riparian habitat may recover and persist in the proposed reserve along Lone Tree Canal; preservation of these sites was considered unlikely to benefit VELB.

The Greenbriar project would cause a variety of beneficial and adverse effects on populations of nine species covered by the NBHCP. For these species, the overall effect on population viability is summarized below.

Three of these species are birds that do not nest in the Natomas Basin but forage in the Basin in winter or during migration: Aleutian Canada goose, white-faced ibis, and bank swallow. Based on 2001 land cover, the Greenbriar project (with the DEIR mitigation) would decrease the acreage of foraging habitat available for these species in the Natomas Basin by 1–3% and would preserve and enhance 0–2% of the foraging habitat in the Basin. Because the size of these populations is not limited by the availability of foraging habitat in winter, or during migration, and the Greenbriar project would not substantially alter the availability of such foraging habitat, the project's effect on foraging habitat would be unlikely to alter the viability of these populations. The project would also increase the acreage of nesting habitat for white-faced ibis, and this could increase the likelihood of white-faced ibis establishing a nesting colony in the Natomas Basin; while not discounted, this effect was not considered likely.

The Greenbriar project would cause both adverse and beneficial effects on burrowing owl and loggerhead shrike populations in the Natomas Basin, but effects due to the project would be insufficient to alter the viability of these populations. Based on 2001 land cover, the project would preserve approximately 345 and 141 acres of shrike and owl habitat, respectively, and this beneficial effect would at least partially offset the project's adverse effects on these species. Adverse effects would include a net loss of 141 acres of habitat for the shrike, and for both species a loss of occupied habitat, habitat fragmentation, and probably some increased mortality and habitat degradation adjacent to the Greenbriar site. However, the project's effects would be small relative to the quantity of habitat that would remain in the Natomas Basin (for example, the project would eliminate 1% of shrike habitat), and the Natomas Basin represents only a small portion of the habitat for and population of these species in the Central Valley; thus, the project is unlikely to measurably alter the viability of the loggerhead shrike and burrowing owl populations using the Natomas Basin.

The project (with the DEIR mitigation) could cause a small adverse or beneficial effect on tricolored blackbird use of the Natomas Basin, but in either case this effect is unlikely to alter the viability of the tricolored blackbird population using the Natomas Basin. Based on 2001 land cover, the Greenbriar project would increase the quantity of nesting habitat in the Natomas Basin (by 201 acres or about 9%), but would decrease the quantity of foraging habitat (by 598 acres or about 3%). This loss of foraging habitat would be partially (but not fully) offset by the preservation and enhancement of 135 acres of foraging habitat. Although currently, nesting habitat is more limited than foraging habitat in the Natomas Basin, under the future condition much more nesting habitat will exist, and thus the additional nesting habitat that would be provided by the project may not affect the tricolored blackbird population more than the loss of foraging habitat that would also result. However, because the project would only cause a small beneficial or adverse effect on tricolored blackbird use of the Natomas Basin, and because the Natomas Basin accounts for only a small portion of the habitat for and population of tricolored blackbird in the Central Valley, the Greenbriar project is unlikely to alter the viability of the tricolored blackbird population using the Natomas Basin.

The project with the mitigation proposed in the DEIR would result in both adverse and beneficial effects on the Swainson's hawk population nesting and foraging in the Natomas Basin, but these effects would be insufficient to alter the population's viability. Adverse effects would include a reduction in the total acreage of foraging habitat under the future condition (by 222 acres or 2%), fragmentation, and possibly degradation of habitat near the Greenbriar site, and a reduction in habitat available to hawks nesting at reserves near the Greenbriar site. Beneficial effects would include an overall increase in the acreage of high quality habitat, enhancing and preserving habitat within a mile of TNBC reserves, and possibly contributing to the connectivity of foraging habitat adjacent to proposed reserves and the mitigation site required by mitigation measure 6.13-2 of the DEIR.

Overall, the project would have a neutral effect. This interpretation is based on the USFWS interpretation of effects on Swainson's hawk due to the NBHCP (USFWS 2003). The availability of foraging habitat during April–August (the nesting period) is considered to limit the abundance and reproductive success of Swainson's hawk in the Natomas Basin (CH2M HILL 2003, USFWS 2003). Based on the methods used by CH2M HILL (2003) to evaluate availability of foraging habitat, the enhancement of habitat at the proposed reserves and mitigation sites would increase the availability of foraging habitat during these months. Using an alternative analysis developed by EDAW, this effects analysis estimated that during April–June the increase in foraging habitat values at the proposed reserve and mitigation sites would be about 6% greater than the habitat values lost by development at the Greenbriar site; during July–August, foraging values would not be fully offset, but foraging habitat values would be higher within the Natomas Basin as a whole at this time because of the harvesting of crops. Thus, based on these analyses, the project would not be expected to reduce the number of hawks nesting in the Natomas Basin or their reproductive success.

The project would cause both adverse and beneficial effects on the populations of giant garter snake and northwestern pond turtle that use canals, wetlands, and rice in the Natomas Basin; overall, the project would not adversely affect these populations. Beneficial effects would include preserving, creating, and enhancing habitat at the reserve sites, preserving and enhancing a 250-foot wide corridor along a portion of Lone Tree Canal, and contributing to the connectivity of habitat and existing TNBC reserves adjacent to or near the proposed reserves. Adverse effects would include a reduction in the total acreage of habitat by 204 acres, and possibly degradation of habitat near the Greenbriar site and reduced connectivity along Lone Tree Canal as a result of increased human disturbance and predation (which would result from narrowing the corridor of land along Lone Tree Canal, and placing residential development adjacent to it). The DEIR mitigation would reduce these adverse effects and ensure that connectivity of giant garter snake habitat was conserved along Lone Tree Canal at the Greenbriar site. For example, to minimize risks to connectivity due to human disturbance and predation, the DEIR mitigation includes requirements for fencing and barriers, and the creation of habitat along the canal.

The loss of habitat acreage would be offset by the increased habitat quality resulting from the preservation of habitat, and conversion of rice to marsh. The project (with the DEIR mitigation) also would conserve connectivity and habitat for giant garter snake along the affected section of Lone Tree Canal, which is an important waterway connecting the southern and central Natomas Basin, and proposed reserves would contribute to connectivity of habitats and reserves in the southern and central Basin.

Of the seven plant species covered by the NBHCP, the Greenbriar project would not affect the five vernal pool-associated species because these species are not known to occur in the vicinity of the Greenbriar or proposed reserve sites, nor is suitable habitat present at or near these sites. These plant species are: Boggs Lake hedge-hyssop, Sacramento Orcutt grass, slender Orcutt grass, Colusa grass and legenere. The other two covered plant species (delta tule pea and Sanford's arrowhead) are not known to occur at the Greenbriar or the proposed reserve sites, but suitable habitat for these species does occur at or near some of these sites, which have not been surveyed for these species. Overall, the project would increase the acreage of suitable habitat for these species (i.e., marsh and canal habitats) in the Natomas Basin. Nonetheless, because these species are not known to occur in the Natomas Basin, the project probably would not alter the viability of any of their populations.

ES 3.2 EFFECTS ON THE CONSERVATION STRATEGY OF THE NBHCP

The Greenbriar project (with the *DEIR* mitigation) would not reduce the effectiveness of the NBHCP's conservation strategy. In Section IV.C.1 (pages IV 5-15), the NBHCP describes the basis of the key components of the NBHCP's conservation strategy and how these components provide effective mitigation for 17,500 acres of urban development. These components are:

- basis for 0.5 to 1 mitigation ratio (Section IV.C.1.a),
- preparation of site specific management plans (Section IV.C.1.b),
- buffers within the reserve lands (Section IV.C.1.c),

- connectivity (Section IV.C.1.d),
- foraging habitat (Section IV.C.1.e), and
- 2,500-acre/400-acre minimum habitat block size requirements (Section IV.C.1.f).

In describing the basis for the 0.5:1 mitigation ratio, the NBHCP states that the ratio mitigates the impacts of the incidental take authorized under the NBHCP because much of the land to be developed does not provide habitat or provides only marginal habitat, and because the TNBC-managed reserves will provide habitat of higher quality than the eliminated habitat. Because the Greenbriar project would not alter the habitat value of land authorized for development under the NBHCP, and would not adversely affect the habitat value of TNBC reserves established under the NBHCP, the project would not affect the basis for the 0.5:1 mitigation ratio of the NBHCP. Although the project would result in the conversion of agricultural land and open space to urban development on an additional 546 acres of land in addition to the 17,500 acres of permitted development under the NBHCP, with the proposed mitigation, this conversion to urban development would result in a minimal change to the conditions in which the NBHCP conversation strategy is being implemented.

The Greenbriar site is not adjacent to existing TNBC reserves, and thus would not alter the effectiveness of the buffers within these reserve lands. Also, because under the future condition of the Natomas Basin resulting from the NBHCP, the Greenbriar site would already be bordered by urban development, highways or major roads on all sides, development of the Greenbriar site could cause only very limited effects on the effectiveness of buffers within future reserves, even if reserves were established on adjacent land to the north or southwest (i.e., adjacent land that would not be developed under the future condition of the Natomas Basin).

The development and reserves resulting from the Greenbriar project would, however, need to be considered in the development of site-specific management plans for existing and future reserves in their vicinity. Although the loss of raptor habitat at the Greenbriar site would be mitigated, there would still be less foraging habitat in the vicinity of some sites as a result of the project, which could alter site-specific plans. Also, the proposed reserves would provide additional options for management and future acquisitions that could alter the management plans of nearby TNBC reserves.

Overall, the project with the DEIR mitigations would not reduce connectivity of reserves or habitats within the Natomas Basin. The proposed reserve and mitigation sites would probably improve connectivity of habitats and TNBC reserves, and potential adverse effects on Lone Tree Canal would be minimized by measures included in the project design and additional mitigation measures in the DEIR. A comprehensive set of measures would be implemented to both reduce the project's effects on and to enhance the habitat in a 250-foot wide corridor along the Lone Tree Canal, which would provide garter snake habitat connectivity. These measures would prevent the project from reducing the connectivity of canal habitats and TNBC reserves, and also would prevent the project from subdividing the Basin's giant garter snake population into two smaller, and thus less viable, populations.

With the DEIR mitigation, the project would not reduce the availability of foraging resources for the Swainson's hawk in the Natomas Basin, and thus not affect reproduction or survival. Based on 2001 land cover, the Greenbriar project, however, would result in a net reduction of 253 acres of upland land cover providing habitat for covered species, it would enhance or create, and preserve, at least 135 acres of upland land cover types (plus 60 acres of upland components of created marshes). As a result, the upland habitats that would result from the project would provide foraging resources during the months of April–August (when Swainson's hawks are nesting in the Basin) comparable to the habitats that would be eliminated by the project. Based on the method CH2M HILL (2003) used to analyze effects of the NBHCP, the acreage of available foraging habitat would be increased by the project; based on the additional analysis conducted by EDAW for this effects analysis, the increase of habitat values resulting from enhancement would be greater than values lost at the Greenbriar site during April–June but not during July–August. Although the loss of values would not be fully offset during July–August, foraging resources increase in the Natomas Basin during those months from the harvesting crops, and therefore, Swainson's hawk is unlikely to be affected. (Both the mitigation and eliminated habitat would be within a mile of nesting habitat that is currently occupied.) By maintaining foraging resources during the critical April–

June period, the Greenbriar project would not compromise the NBHCP Operating Conservation Program, and thus actions such as those listed on pages IV-13 and IV-14 of the NBHCP would not be necessary.

Overall, the project would avoid, minimize and mitigate adverse effects of development by establishing large blocks of preserved habitat. It would enhance and preserve 296 acres of additional habitat adjacent to or near existing TNBC reserves and the *DEIR* mitigation would increase this benefit by requiring the preservation of at least an additional 49 acres of land. The project would adversely affect the preservation of large blocks of habitat by developing existing habitat at the Greenbriar site. Under the future condition of the Natomas Basin, this land would be surrounded by major roads and urban development, and the Greenbriar project includes design measures to preserve the most ecologically important portion of the site, the corridor of land along Lone Tree Canal.

ES 3.3 EFFECTS ON ATTAINMENT OF NBHCP GOALS AND OBJECTIVES

For many of the same reasons that viability of populations and the effectiveness of the NBHCP's conservation strategy would not be reduced, the Greenbriar project would not reduce the likelihood of attaining the goals and objectives of the NBHCP. Below, the overall effect resulting from the project (with the *DEIR* mitigations) is summarized for each goal or objective that could be affected.

Overall Goal 1. *Establish and manage in perpetuity a biologically sound and interconnected habitat reserve system that mitigates impacts on Covered Species resulting from Covered Activities and provides habitat for existing, and new viable populations of Covered Species. (NBHCP, p. I-15)*

The project (with its mitigation) would have an overall beneficial effect on the establishment and management of reserves for the NBHCP. Because the acreage of land in the Natomas Basin that is potentially available and suitable for preservation substantially exceeds the 8,750 acres that will be preserved by the NBHCP, the project would not preclude the preservation of sufficient land to attain the NBHCP's goals and objectives. It would provide reserve lands adjacent to or near existing reserves, increasing the connectivity of habitats and the resources available to covered species using reserves established by the NBHCP; in addition, it would conserve a portion of an important corridor of canal habitat along Lone Tree Canal. The project also would increase opportunities to establish new reserves, particularly to create larger reserves by preserving additional land adjacent to the project's proposed and existing TNBC reserves.

Although the project would cause a net reduction in the acreage of upland and wetland habitats, the preservation and enhancement of habitat by the project would adequately mitigate for its effects on upland and wetland habitats of covered species. Based on 2001 land cover mapping, the Greenbriar project would eliminate 388 acres of rice and 16 acres of canal habitats, but would increase the acreage of marsh by 201 acres, creating a net loss of 204 acres of these wetland land cover types and of the habitats they provide. An acre of marsh, however, provides a greater quantity and variety of habitat than does an acre of rice for several reasons. These reasons include:

- Giant garter snakes primarily use the margins of rice fields, whereas they use the full extent of managed marshes. These marshes are designed to provide open water, foraging habitat, dense cover, basking sites, and refugia in close proximity throughout the marsh. (For example, an acre of managed marsh provides several times the edge habitat than does a rice field.)

- Marshes provide habitat throughout the active period of the snake. Rice fields do not provide habitat during early and mid-spring, and are typically drained before the end of the snake's active period. Thus, for a portion of their active period, giant garter snakes must rely entirely on non-rice habitats. In the Natomas Basin, these habitats are canals and managed marsh. In contrast, managed marshes provide habitat year-round.

- Rice is fallowed periodically, and thus does not provide habitat in all years; in contrast, a managed marsh does provide habitat in all years.

Thus, the additional habitat values provided by the created marsh offsets the habitat values lost in the rice and canal land cover types. In addition, the project would preserve, and manage for its habitat values, the 201 acres of created marsh (i.e., about 1 acre for each acre lost), ensuring the long-term persistence of this habitat. Similarly, based on 2001 land cover, the Greenbriar project would cause a net reduction of 253 acres of upland land cover providing habitat for covered species, but would enhance and preserve 135 acres of upland habitats (plus 60 acres of upland components in created marshes for a total of 195 acres of upland habitat preserved). For most covered species associated with upland habitats, the additional habitat values resulting from this enhancement and preservation would offset the project's reduction of the acreage of upland habitats in the Natomas Basin. For example, during the months of April–August, when Swainson's hawks are nesting in the Basin, the enhancement of upland habitats that would result from the project would provide foraging resources comparable to the habitats that would be eliminated by the project.

As previously described, the potential effects (both adverse and beneficial) that would result from implementing the proposed project (including the DEIR mitigation) would be unlikely to alter the population viability of any of the covered species.

Overall Goal 3. *Preserve open space and habitat that may also benefit local, non-listed and transitory wildlife species not identified within the NBHCP. (NBHCP, page I-16)*

As described under Overall Goal 1 above, the project would have an overall beneficial effect on the TNBC reserve system. Furthermore, the project (with DEIR mitigation) would slightly increase the ratio of habitat preserved to habitat developed in the Natomas Basin by setting aside land at a ratio (0.6:1) that exceeds the 0.5:1 ratio required for development authorized by the NBHCP, and would include more extensive creation, enhancement, and management of habitat. For these reasons, the project (with the DEIR mitigation) would have an overall beneficial effect on the attainment of this goal.

Overall Goal 4. *Ensure that direct impacts of Authorized Development upon Covered Species are avoided or minimized to the maximum extent practicable. (NBHCP, page I-16)*

With the DEIR mitigation, the project would not adversely affect attainment of this goal because it would implement a comprehensive set of measures to avoid and minimize effects on covered species to the maximum extent practicable. The potential direct impacts are comparable to the potential direct impacts of the development authorized by the NBHCP. Thus, the Greenbriar project with the DEIR mitigation would include all of the applicable avoidance and minimization measures included in the NBHCP to avoid and minimize construction-related effects, and several more stringent minimization measures. The project also would include a set of measures to avoid and minimize effects on the Lone Tree Canal corridor. The Greenbriar project also would not alter the effectiveness of any NBHCP conservation measures for avoiding and minimizing the effects of development authorized by the NBHCP.

Overall Objective 1. *Minimize conflicts between wildlife and human activities, including conflicts resulting from airplane traffic, roads and automobile traffic, predation by domestic pets, and harassment by people. (NBHCP, page I-16).*

With the DEIR mitigation, the project would not adversely affect attainment of this objective because it would implement a comprehensive set of measures that would minimize human-wildlife conflicts. These measures include all of the applicable measures that were included in the NBHCP to avoid and minimize construction-related effects and to reduce human-wildlife conflicts, plus additional measures (e.g., fencing and barriers) to reduce human-wildlife conflicts along Lone Tree Canal. The Greenbriar project also would not alter the effectiveness of any NBHCP conservation measures for minimizing human-wildlife conflicts resulting from development authorized by the NBHCP.

Overall Objective 3. *Ensure connectivity between TNBC reserves to minimize habitat fragmentation and species isolation. Connections between reserves will generally take the form of common property boundaries between*

reserves, waterways (primarily irrigation and drainage channels) passing between reserves, and/or an interlinking network of water supply channels or canals. (NBHCP, page I-16)

The Greenbriar project would cause beneficial and adverse effects on the attainment of this objective through most of these mechanisms; its overall effect, however, would not be adverse. The main beneficial effects would be increased connectivity of habitats and TNBC reserves due to preservation, creation and enhancement of habitat at the project's proposed reserves, two of which are adjacent to or near (i.e., within a half mile of) existing TNBC reserves. Adverse effects would include reducing the foraging habitat within a mile of a TNBC reserve, fragmenting and reducing the connectivity of upland habitats adjacent to the Greenbriar site, and possibly reducing the connectivity of wetland habitats and TNBC reserves because of effects on Lone Tree Canal (despite preserving a corridor along the canal). The DEIR mitigation would reduce these adverse effects by incorporating additional measures to ensure that connectivity along Lone Tree Canal is sustained, and to preserve and enhance foraging habitat within a mile of existing TNBC reserve(s). (The connectivity of upland habitats, however, would still be reduced at the Greenbriar site.) In the absence of an adverse effect on connectivity along Lone Tree Canal, the project would cause only small effects on the attainment of this objective, and most of these effects would be beneficial.

Wetland Species/Habitat Goal/Objective 1. *Acquire, enhance and create a mosaic of wetland habitats with adjacent uplands and connecting corridors to provide breeding, wintering, foraging, and cover areas for wetland species in the Plan Area. (NBHCP, page I-17)*

For wetland land cover (i.e., rice, canal, and ponds and seasonally wet areas), the net reduction in acreage resulting from the development of the Greenbriar site would be offset by creating and managing marsh at the project's proposed reserves. Based on 2001 land cover mapping, the Greenbriar project would eliminate 388 acres of rice and 16 acres of canal habitats, but would increase the acreage of marsh by 201 acres, creating a net loss of 204 acres of these wetland land cover types and of the habitats they provide. An acre of marsh, however, provides a greater quantity and variety of habitat values than does an acre of rice, and thus the additional habitat provided by the created marsh offsets the habitat lost in the rice and canal land cover types. In addition, the project would preserve, and manage for its habitat values, the 201 acres of created marsh (i.e., about 1 acre for each acre lost), ensuring the long-term persistence of this habitat.

The project would not have an overall adverse effect, and might have a beneficial effect on, connectivity of wetland habitats. This overall effect on connectivity of wetland habitats is described under Overall Objective 1 above.

Wetland Species/Habitat Goal/Objective 2. *Provide habitat to maintain, attract and sustain viable populations of the Covered Species. The habitat areas should be configured to encompass natural species migration areas, minimize species isolation, and prevent future habitat fragmentation. (NBHCP, page I-17)*

The project would enhance and preserve habitat to offset its adverse effects and that would sustain populations of the covered species, and would not alter the population viability of any of the covered species. The habitat enhanced and preserved by the project and the project's effects on the TNBC reserve system are described under Overall Goal 1 above. The project's effect on the viability of each covered species is described under *Effects on Covered Species* above.

Upland Species/Habitat Goal/Objective 1. *Acquire, enhance and create a mosaic of upland habitat types for breeding, foraging, and cover for species dependent on upland habitats. (NBHCP, page I-17)*

Overall, the project would not adversely and could beneficially affect this goal/objective. Because the acreage of upland habitat in the Natomas Basin that is potentially available and suitable for preservation is substantially more than the acreage of upland habitat that would be preserved and enhanced by the NBHCP, and the project would affect only a small percentage of this land, the project would not preclude the preservation of sufficient land to

attain the NBHCP's goals and objectives. The project would, however, increase opportunities to establish new and/or larger reserves, which would aid the attainment of this goal/objective.

Upland Species/Habitat Goal/Objective 2. *Ensure reserve land connectivity with travel corridors for upland-dependent species. The habitat areas should encompass grasslands, agricultural croplands, riparian habitats, and shelter and nesting habitat areas (fence rows, clusters of shrubs and small trees), as well as wetland areas to provide a year-round source of water for upland species. The upland areas should be configured to enhance natural species migration, minimize species isolation, and prevent future habitat fragmentation. (NBHCP, page I-17)*

A moderate level of uncertainty exists regarding the overall effect of the Greenbriar project on this goal/objective. The proposed changes at the Greenbriar site would have an uncertain effect on the movement and dispersal of upland species; also there is uncertainty regarding the project's contributions to connectivity elsewhere in the Basin because the location of the mitigation site that would account for much of upland habitat preserved has not been determined. However, because the project would cause adverse and beneficial effects that are similar in nature and magnitude, and would affect only a small portion of the Basin's land area, the project would have only a small overall effect on the attainment of this goal/objective, whether it was beneficial or adverse.

ES.4 SUMMARY

In summary, the Greenbriar project (with the DEIR mitigation) would not reduce the viability of populations of covered species using the Natomas Basin and would not reduce the effectiveness of the conservation strategy of the NBHCP. It also would have only small effects on the likelihood of attaining any of the goals and objectives of the NBHCP, and for most of these goals and objectives the overall effect would be neutral or beneficial.

1 INTRODUCTION

This section presents the scope of the effects analysis, an overview of the proposed Greenbriar project, and the intended uses of this document. This section also summarizes the organization of the Effects Analysis.

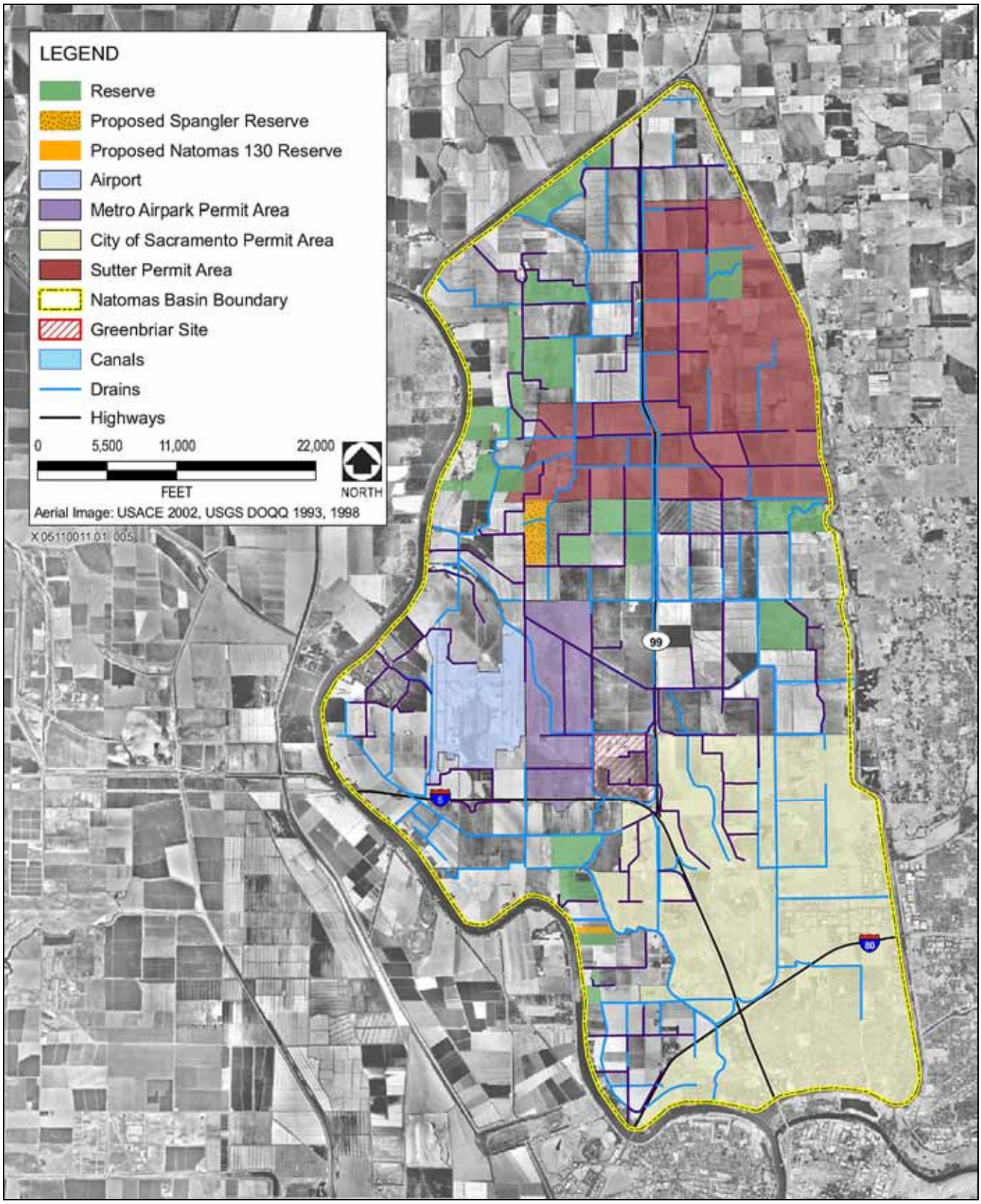
1.1 INTRODUCTION

This analysis of effects of the Greenbriar project on the Natomas Basin Habitat Conservation plan (effects analysis) evaluates the effects of the Greenbriar project on each species covered by the Natomas Basin Habitat Conservation Plan (NBHCP), on the conservation strategy of the NBHCP, and on attainment of the NBHCP's goals and objectives. This project would include development at the Greenbriar site, which is located within the boundaries of the NBHCP plan area, but is not within an area permitted for development. The project also includes establishment of onsite and offsite reserves. The project could affect the population viability of species covered by the NBHCP, the conservation strategy of the NBHCP, or the attainment of the NBHCP's goals and objectives. The purpose of this evaluation is to document the potential effects of the Greenbriar project and evaluate its overall effect on the viability of populations of species covered by the NBHCP and on attainment of the goals and objectives of the NBHCP. Effects on the Metro Air Park Habitat Conservation Plan (MAP HCP) also were considered. However, the MAP HCP was designed to support and follow the regional conservation strategy of the NBHCP; its covered species are a subset of those covered by the NBHCP, and its biological goals and objectives largely represent a subset of the NBHCP's goals and objectives. (In fact, the MAP HCP has been superseded by the 2003 NBHCP.) Thus, the results of this effects analysis also document the project's potential effects on the MAP HCP's covered species and biological goals and objectives. Potential conflicts with and relationships to specific measures of the MAP HCP are also included in this evaluation.

The NBHCP was developed to satisfy the requirements of the Endangered Species Act for a permit for the incidental take of threatened and endangered species. It is intended to minimize and mitigate for the loss of habitat and the incidental take of covered species that could result from urban development and management of reserves in the Natomas Basin. The NBHCP authorizes 17,500 acres of development in the MAP, City of Sacramento, and Sutter County permit areas, and outside of these areas it preserves 8,750 acres in a reserve system surrounded by agricultural lands (Exhibit 1). The reserve system will consist of 4,375 acres of rice, 2,187 acres of created marsh, and 2,187 acres of upland habitat. In this reserve system, land will be managed to enhance its habitat values. The future condition of the Natomas Basin resulting from the NBHCP would provide fewer acres of habitat for covered species than existed in 2001. The U.S. Fish and Wildlife Service (USFWS) considers the reserve system with high quality habitat created by the NBHCP to adequately mitigate and offset the effects of this habitat loss because most of the lost habitat would be of lower quality (USFWS 2003). Consequently, most of the NBHCP's goals and objectives are related to creating a reserve system that provides high quality habitats and is likely to sustain populations of the covered species in the Natomas Basin for the foreseeable future. The NBHCP also includes numerous avoidance, minimization, and mitigation measures to reduce the effects of development on covered species and to ensure the creation and effective operation of the reserve system.

1.2 OVERVIEW OF GREENBRIAR PROJECT

The Greenbriar project would develop the 577-acre Greenbriar site located northwest of the intersection of State Route 99 and Interstate 5 in Sacramento County (Exhibit 2). This site is bordered by agricultural land uses to the north and south, new residential development to the east, and the recently approved Metro Air Park development to the west. As currently proposed, the project would create a residential development with commercial and retail centers, an elementary school, neighborhood parks and a water feature (approximately 39 acres in size). A new east-west roadway, Meister Way, would be constructed through the center of the site. Along this roadway, a new light rail station is proposed to be eventually constructed by Sacramento Regional Transit near the center of the site that would connect the Greenbriar site to the Sacramento International Airport development to the west and to



Source: CH2M HILL, EDAW 2005

Location of Greenbriar Project in the Natomas Basin **Exhibit 1**

Source: CH2M HILL, Ellen Berryman, Sacramento County 2002

Project Boundary and Conservation Easement Locations at the Greenbriar Site **Exhibit 2**

the North Natomas Community to the east across Highway 99 via a new proposed overpass over Highway 99. This development is adjacent to, but outside of, the areas of development permitted by the NBHCP.

Along with this development, the project would preserve, enhance, and create habitat in a 250-foot wide corridor along the site's western edge (occupying approximately 31 acres) and would preserve, enhance, and create habitats off-site at two proposed reserves: the Natomas 130 (30.2 acres, primarily of alfalfa and created marsh with smaller acreages of canal, riparian, and tree grove) and Spangler (235.4 acres, primarily of alfalfa and created marsh with a smaller acreage of canal) reserves.

Preserved lands would become part of reserve system operated by TNBC, or if necessary would be managed by another nonprofit entity. For each reserve, TNBC develops a site-specific management plan, and management activities include habitat management, monitoring, invasive plant control, domestic/feral animal control, and restricting public access and patrolling reserves to enforce restrictions. As part of its management, TNBC also implements a set of measures to avoid and/or minimize take of covered species. These measures are described on pages IV-29 through IV-38 of the NBHCP.

The fee title and an endowment would be provided to TNBC (or if necessary another nonprofit entity) by the project proponent. The endowment would provide for the restoration/enhancement, operation, maintenance, monitoring, and administration of the reserves. For the reserves proposed by the Greenbriar project, a larger endowment fee than that required for NBHCP mitigation may be necessary to provide for the required management. Additional details regarding Greenbriar's funding of these reserves will be developed through the HCP amendment or HCP process together with the development of reserve management plans. The reserve management plans will include details regarding effectiveness monitoring, adaptive management, and a schedule for acquisition of reserve uplands and implementation of all mitigation measures required through the Section 10(a)(1)(B) and Section 2081 permit processes. (For the proposed reserve along Lone Tree Canal, the management plan will include a legal agreement with the Natomas Mutual Water Company regarding vegetation management.) These reserve management plans will form the basis for calculating Greenbriar's endowment fee in consultation with the wildlife agencies.

In addition to the proposed reserves and measures incorporated as part of the proposed Greenbriar project, the City of Sacramento, through the CEQA process, has proposed mitigation measures for the project to reduce further the project's adverse effects. (Throughout this document, "mitigation" refers to these measures proposed by the City of Sacramento in the DEIR, unless otherwise noted as measures incorporated into the Greenbriar project's design.) These DEIR mitigation measures include the preservation of at least an additional 49 acres of land managed to provide high quality Swainson's hawk foraging habitat. This preserved land also would become part of TNBC reserve system. The location of this mitigation land has not yet been determined.

The Greenbriar site is outside of the area permitted for development; thus, the habitat loss, preservation and enhancement resulting from the project is in addition to that permitted by the NBHCP. Consequently, the project would alter the future condition of the Natomas Basin.

1.3 USE OF THIS DOCUMENT

The Greenbriar EIR and Effects Analysis operate in tandem to evaluate the effects of implementation of the Greenbriar project on biological resources. The EIR satisfies the requirements of CEQA partly by considering these effects in light of the NBHCP, IA, and ITP requirements as analyzed in depth in the Effects Analysis (DEIR, Appendix P). The Greenbriar Project is located outside of the 17,500 acre permit area of the NBHCP. The NBHCP, Implementation Agreement, Biological Opinion and ITPs provide that because the NBHCP's Operating Conservation Plan is based upon the City limiting total development to 8,050 acres within the City's Permit Area, approval by the City of future urban development beyond the 8,050 acres or outside of its Permit Area would "constitute a significant departure from the NBHCP's OCP" and would trigger reevaluation of the NBHCP, a new effects analysis, potential amendments and/or revisions to the NBHCP and ITPs, a separate conservation strategy

and the need to obtain a new ITP by the Permittee for that additional development, and/or possible suspension or revocation of the City's ITP in the event the City were to violate such limitations without having completed the required reevaluation, and amendments or revisions if necessary, or having obtained a new permit. (See e.g., Implementation Agreement for the NBHCP, Section 3.1.1[a].) As part of this process, Greenbriar intends to file an application for a project-specific HCP.

This EIR evaluates the effects of the Greenbriar project in consideration of the NBHCP, IA and ITP requirements and is based upon an Effects Analysis prepared by the City's EIR consultant with biological resource information provided by Greenbriar's biologists. The purpose of this effects analysis is to support the analysis contained in the EIR and to provide the foundation for the preparation of an amendment to the NBHCP or a new HCP for the addition of the Greenbriar project to the City's permit area.

When the amendment to the NBHCP or new HCP process is initiated with USFWS and CDFG, the Effects Analysis will be reviewed by the USFWS and CDFG through the Section 10(a)(1)(B) and Section 2081 permit processes to assure the Greenbriar project's consistency with federal and state endangered species act requirements and to guide the wildlife agencies in their determinations as to the project's effects on the effectiveness of the NBHCP. Following development of an amendment to the NBHCP or new HCP, the City and/or the Greenbriar project applicant will be required to obtain amended or new ITPs from USFWS and CDFG authorizing incidental take of state and federally listed threatened and endangered species.

If LAFCo approves the proposed annexation of the Greenbriar Project to the City, then the City and/or Greenbriar project applicant will be required to initiate a new HCP or NBHCP amendment process with the wildlife agencies prior to final map approval. USFWS approval of the HCP/NBHCP amendment and issuance of the ITP/ITP amendment will be subject to review under NEPA. The Greenbrier EIR would provide a basis for consideration of environmental impacts under NEPA, and it is intended to provide the environmental information for CDFG action under CEQA. However, CDFG consideration of the HCP/HCP amendment and ITP/ITP amendment could result in subsequent environmental review under CEQA, if CDFG determines, on the basis of substantial evidence in light of the whole record, that there are substantial changes in the project or circumstances in which the project is undertaken, or new information indicates that new or substantially more severe significant environmental effects would occur than were covered in the Greenbriar EIR. Although incidental take would not occur until grading of the site occurs, issuance of the ITPs/amendments will be required prior to final map approval by the City of Sacramento to ensure that any adjustments to the subdivision map approvals (e.g., changes in site design) resulting from the HCP/ITP process occur prior to recordation of a final map.

1.4 ORGANIZATION

This report presents the results of an analysis of the effects of the Greenbriar project (with the DEIR mitigation) on the future condition of the Natomas Basin, and how those changes would affect species covered by the NBHCP and attainment of the NBHCP's goals and objectives.

The Effects Analysis is organized in the following way:

- Section 1, Introduction
- Section 2, Evaluation Approach
- Section 3, Greenbriar Project's Alteration of Population and Habitat Attributes
- Section 4, Potential Effects of the Greenbriar Project on Covered Species
- Section 5, Potential Effects on the Conservation Strategy of the NBHCP
- Section 6, Potential Effects of the Greenbriar Project on NBHCP Goals and Objectives

- Section 7, Cumulative Effects
- Appendix A, Assessment of Avoidance and Minimization of Construction-related Effects and Human-Wildlife Conflicts
- Appendix B, Change in Natomas Basin Land Cover in 2001–2004

2 EVALUATION APPROACH

2.1 OVERVIEW

The Greenbriar project could affect covered species, effectiveness of the NBHCP conservation strategy, effectiveness of specific conservation measures, attainment of NBHCP goals and objectives, or cumulative effects by altering any of several population or habitat attributes. These attributes include:

- Construction-related effects on survival and reproduction,
- Zones with human-wildlife conflicts (i.e., areas adjacent to developed lands and roads),
- Acreage of habitat in Natomas Basin,
- Quality of habitat in the Natomas Basin,
- Connectivity of habitat in Natomas Basin,
- Connectivity of existing TNBC reserves,
- Habitat value of existing TNBC reserves,
- Water availability at TNBC reserves, and
- Opportunities to establish additional TNBC reserves.

For each of these attributes, alterations resulting from the Greenbriar project were analyzed. The findings of this effects analysis of the effects on covered species, effectiveness of the NBHCP conservation strategy, effectiveness of specific conservation measures, and NBHCP goals and objectives was based on the results of the analyses of the above attributes. The methodologies and the bases for the interpretations of effects on covered species and NBHCP goals and objectives are described below. In addition, this analysis of effects on covered species was also based on available information on the distribution of these species in the Natomas Basin and on their ecology.

Analyses of cumulative effects also were based on the results of these analyses together with additional analyses of land cover, and the compilation and review of projects proposed in the Natomas Basin.

2.2 DESCRIPTION OF GREENBRIAR PROJECT

The analysis of the effects of the Greenbriar project is based on a description of the project (including the mitigation measures proposed as part of the project design) that was compiled from multiple sources. The primary source was the Greenbriar Draft Environmental Impact Report (DEIR) (EDAW 2005). Additional information was derived from the draft conceptual mitigation plan for the project (Wildlands, Inc. 2005), Greenbriar Draft Biological Assessment (BA) (Berryman Ecological 2005), and personal communications with project consultants. The draft conceptual mitigation plan describes the proposed Natomas 130 and Spangler reserves, and the proposed on-site reserve along Lone Tree Canal, and the proposed restoration of these areas to provide upland and wetland habitats. This conceptual mitigation plan also evaluated whether the proposed reserve sites met the TNBC's typical conditions for mitigation-land dedication. The draft BA includes proposed avoidance and minimization measures, and a description of the proposed preservation, restoration, and future management of habitat along Lone Tree Canal.

After the conceptual mitigation plan and draft BA were produced, several changes were made to the proposed habitat creation and enhancement at the Natomas 130 and Spangler sites. First, the proposed acreage of restored habitats was changed to 204.2 acres of managed marsh and associated canals (14.2 acres at Natomas 130 created from upland non-rice cropland and 190 acres at Spangler created from rice) and 59.6 acres of upland in alfalfa (14.2 acres at Natomas 130 and 45.4 acres at Spangler). The managed marsh would have 30% upland components. A revised conceptual mitigation plan that reflects these changes is under development. This effects analysis also assumed that development of an HCP for this project would result in mitigation providing habitat values comparable or greater than the proposed acreage of marsh and alfalfa evaluated in this effects analysis.

As indicated by the draft conceptual mitigation plan, and as explicitly required by the DEIR mitigation, the proposed reserves would be dedicated to TNBC, or another entity if necessary, with an endowment sufficient to pay for required restoration and management in perpetuity. The management of these reserves would be as described in sections VI-D, V-B, VI-E, VI-F, and VI-G of the NBHCP (Conservation Plan – Reserve/Management/Site Specific Management Plans; Take Avoidance, Minimization, and Mitigation; and Plan Implementation-Monitoring of the NBHCP, Adaptive Management, Annual Report, respectively) or that comparable management would be developed in consultation with USFWS and incorporated into an HCP for the project. As described in sections VI-D, V-B, VIE, VI-F, and VI-G of the NBHCP, this management would include:

- Development of a site-specific management plan;
- Implementation of measures to reduce take of covered species as a result of restoration and reserve management;
- Implementation of the NBHCP's conservation strategies for covered species on the reserves;
- Management activities that include invasive plant control, domestic/feral animal control, and restricting public access and patrolling reserves to enforce restrictions;
- Compliance and biological effectiveness monitoring; and
- An annual reporting and review meeting to cover progress toward meeting goals, implementation, monitoring, and adaptive management measures.

The dedication of the proposed reserves and their endowments would occur prior to entitlement of the project, and restoration would be initiated within one year of their dedication. Because of their specific management requirements (e.g., having uplands planted in alfalfa), greater proportion of managed marsh, and the potentially high maintenance costs for the small reserve proposed along Lone Tree Canal, this endowment may be greater per acre than the endowment for NBHCP mitigation lands.

Furthermore, in the DEIR, mitigation includes preservation and enhancement of Swainson's hawk foraging habitat, multiple measures to reduce effects on giant garter snake habitat and the snake's use of Lone Tree Canal as a movement corridor, and development and approval of a Habitat Conservation Plan (HCP) for compliance with the federal Endangered Species Act.

The DEIR mitigation for Swainson's hawk foraging habitat (mitigation measure 6.13-2) requires the preservation of an area of habitat that provides habitat values to the species comparable to the habitat eliminated at the Greenbriar site. This DEIR mitigation measure would require preservation of at least an additional 49 acres of land to be enhanced and managed to provide high quality Swainson's hawk foraging habitat. The actual acreage of this mitigation will be determined during development of an HCP for the project (as described in the DEIR), and will depend on the site attributes and future management that determine the level of habitat enhancement (as described in Section 2.3.4 *Quality of Habitat in the Natomas Basin*).

The DEIR mitigation for giant garter snake includes measures to reduce the project's effects on snakes use of Lone Tree Canal as a movement corridor. These measures include:

a. To ensure that the project does not diminish habitat connectivity for giant garter snake between the southwest and northwest zones identified in the NBHCP, approximately 30.6 acres along Lone Tree Canal shall be protected and managed as giant garter snake habitat. This on-site habitat preservation shall protect an approximately 250-foot wide corridor of giant garter snake habitat that includes the canal and approximately 200 feet of adjacent uplands. Uplands within the linear open space/buffer area shall be managed as perennial grassland as described below. Additional aquatic habitat for giant garter snake shall be created along the east

bank of Lone Tree Canal by construction and maintenance of a 2.7 acre tule bench. The habitat shall be managed in perpetuity as high-quality habitat for giant garter snake. Compliance and biological effectiveness monitoring shall be performed and annual monitoring reports prepared within six months of completion of monitoring for any given year. This monitoring, reporting, and adaptive management shall be performed as described in Section IV of the NBHCP.

b. To ensure that the project does not diminish giant garter snake movement along Lone Tree Canal, all new road crossings of Lone Tree Canal shall be designed to minimize obstacles to giant garter snake movement. The use of culverts under new road crossings on Lone Tree Canal shall be prohibited unless it can be demonstrated that the culverts will not diminish the potential for giant garter snake movement through the section of Lone Tree Canal protected by the setback fence and conservation easement. .

c. Upland giant garter snake habitat within the Lone Tree Canal linear open space/buffer area shall be created and managed to provide cover, basking areas, and refugia during the winter dormant period. Hibernaculae would be constructed at regular intervals by embedding concrete or coarse rock in the bank or in a berm along the Lone Tree Canal corridor to provide additional winter refugia. Upland habitat with the linear open space/buffer areas shall be converted to native perennial grassland and managed, in perpetuity, as perennial grassland habitat.

d. Aquatic habitat shall be maintained throughout the giant garter snake active season in Lone Tree Canal, in perpetuity. This is the legal responsibility and obligation of Metro Air Park property owners (MAP). The MAP HCP includes provisions for maintaining water in the canal such that the basic habitat requirements of the giant garter snake are met. The MAP HCP also provides a road map, through "Changed Circumstances", to address procedures to follow if water is not being maintained in the canal to meet these requirements. As described in the MAP HCP, the MAP is legally obligated to assure these requirements are met, and financial and procedural mechanisms are included in the MAP HCP to enforce this. It is, therefore, assumed that MAP will provide water to Lone Tree Canal, as required by the MAP HCP and ITP, in perpetuity. It is also assumed that USFWS will use all reasonable means available to it, to enforce this MAP HCP requirement. If water is not provided to Lone Tree Canal by the MAP to meet the habitat requirements of giant garter snake, as required by the MAP HCP, and USFWS exhausts its enforcement responsibilities, the project applicant shall assume the responsibility of providing suitable giant garter snake aquatic habitat throughout the section of Lone Tree Canal protected by the fence and conservation easement. However, as stated herein, the project applicant shall only assume this responsibility if it has been sufficiently demonstrated to the City that USFWS has exhausted all reasonable means to compel MAP to comply with the relevant conditions of the MAP ITP. Specific requirements related to ensuring suitable aquatic habitat in Lone Tree Canal is present, in perpetuity, throughout the giant garter snake active season shall be developed through consultation with DFG and USFWS, and included in the new or amended HCP for Greenbriar, and may include mechanisms, such as installation of a well, to assure water is provided in the canal to meet habitat requirements.

e. A barrier shall be installed between the giant garter snake habitat linear open space/buffer area and the adjacent Greenbriar development to ensure that giant garter snakes do not enter the development area, and to prohibit humans and pets from entering the giant garter snake habitat. The design of this barrier shall be subject to USFWS and CDFG review and approval. The entire length of the barrier, which shall be bordered by yards rather than roadways, shall be maintained on the preserve side by a nonprofit land trust to ensure that vegetation or debris does not accumulate near the barrier and provide opportunities for wildlife and pets to climb over the barrier. On the development side, Covenants, Codes and Restrictions (CCRs) shall prohibit accumulation of vegetation or debris adjacent to the barrier. Chain link fencing shall be placed at both ends of the corridor, with locked gates permitting entry only by RD 1000 and NMWD for channel maintenance, and by the preserve manager for habitat monitoring and maintenance purposes.

f. Specific requirements associated with the barrier shall be developed through consultation with USFWS and DFG, and may include the following and/or other specifications that DFG and USFWS consider to be equally or more effective:

- Adequate height and below-ground depth to prevent snakes or burrowing mammals from providing a through-route for snakes by establishing burrows from one side to the other crossing;
- Constructed using extruded concrete or block construction extending a minimum of 36-inches above ground level;
- Maintenance to repair the barrier and to prevent the establishment of vegetation or collection of debris that could provide snakes with a climbing surface allowing them to breech the barrier;
- A cap or lip extending at least two-inches beyond the barrier's vertical edge to prevent snakes from gaining access along the barrier's top edge; and
- Signage to discourage humans and their pets from entering the area.

g. The Lone Tree Canal linear open space/buffer area shall be protected in perpetuity under a conservation easement and managed to sustain the value of this area for giant garter snake habitat connectivity. Compliance and biological effectiveness monitoring shall be performed and annual monitoring reports prepared. This monitoring, reporting, and adaptive management shall be performed as described in Section IV of the NBHCP or following procedures developed in formal consultation with USFWS and DFG and contained in an ESA Incidental Take Permit for the Greenbriar project.

As a result of consultation with the USFWS, the HCP for the Greenbriar project could result in different mitigation than is described in the draft BA, conceptual mitigation plan, or the DEIR. The mitigation described in the DEIR, however, establishes a level of mitigation that will be met or exceeded in the HCP. Thus, the HCP will reduce effects to a comparable or lower level than the mitigation analyzed in this effects analysis.

2.3 METHODOLOGY FOR ANALYZING ALTERATIONS OF POPULATIONS AND HABITATS

2.3.1 CONSTRUCTION-RELATED EFFECTS ON SURVIVAL AND REPRODUCTION

Information regarding the presence of covered species or potentially suitable habitat for these species at the Greenbriar site and adjacent lands was derived from the Greenbriar Draft Environmental Impact Report (DEIR) (EDAW 2005), Greenbriar Draft Biological Assessment (BA) (Berryman Ecological 2005), and a draft conceptual mitigation plan for the project (Wildlands, Inc. 2005). These documents, in turn, were based on site assessments by wildlife biologists and compilation and analysis of the best available data.

Each species was considered to be either likely, possibly, or not affected by construction-activities based on evidence of its presence and of the presence of potentially suitable habitat. Species documented recently (i.e., in the past 5 years) at or adjacent to the Greenbriar or proposed reserve sites were considered to still be using suitable habitat at that site; these species were considered likely to be affected by construction-related activities. The land area considered adjacent to the Greenbriar or proposed reserve sites differed among species according to their ecology (i.e., their territory and home range sizes, daily and seasonal movements, and their susceptibility to disturbance).

Species not recently documented at or adjacent to the Greenbriar site, but for which potentially suitable habitat has been documented at or adjacent to the site, were considered potentially present and thus individuals of those

species may be affected by construction activities. (These species were considered potentially present because surveys performed to date have not been adequate to determine absence of these species.)

Species not recently documented at or adjacent to the Greenbriar site, and for which no potentially suitable habitat was located on or adjacent to the site, were considered to not be affected by construction activities.

For species likely to be or possibly affected by construction-related activities, the avoidance and mitigation measures proposed for the Greenbriar project were evaluated. The extent of construction-related effects is reduced through appropriate avoidance and minimization measures. Where combinations of construction activities and affected species and habitats would be similar to those addressed by the NBHCP, this analysis considered the applicable avoidance and minimization measures in the NBHCP (Chapter V) that address construction-related effects to be a complete set of appropriate (and feasible) avoidance and minimization measures for comparable effects potentially caused by the Greenbriar project. Thus, a table of measures in the NBHCP was compiled, measures applicable to the project were identified, and inclusion of each measure in the project and its mitigation was evaluated based on the content of the BA and DEIR for the project. This table was used in evaluating the project's effects on attainment of NBHCP goals and objectives that address the implementation of avoidance and minimization measures. The analysis also considered the need for different measures to address effects that would be likely and that would differ from those addressed by the NBHCP, and the potential for the Greenbriar project to alter the efficacy of the NBHCP measures (Appendix A).

2.3.2 ZONES WITH HUMAN-WILDLIFE CONFLICTS

Considerable conflicts between wildlife use and human activities (e.g., animal-vehicle collisions, harassment and predation by pets, degradation of water quality) normally occur in habitat areas adjacent to developed land uses and major roads. These effects diminish with distance, but the distance at which they are no longer significant is debatable.

In this document, the widths used to evaluate human-wildlife conflicts, alterations of vegetation and other habitat conditions, habitat fragmentation, and effects on existing reserves, were based on the ecological literature regarding effects on habitat adjacent to developed land uses and roads, and on the distances used in previous analyses related to the NBHCP or incorporated into the NBHCP itself, The effects of developed land uses on adjacent land diminish with distance. The different types of effects, however, extend different distances onto adjacent land; these distances can be from tens to thousands of feet, and differ not only among mechanisms but among sites as well (because of variation in site attributes such as the presence of barriers and the quantity of impervious surfaces). Thus, in a regional analysis, the use of a specific width only indicates the area within which effects of adjacent developed land are often sufficient to alter habitats.

In the GIS-based evaluations, two widths were used, 800 feet and one mile. The 800-foot width was used in evaluating zones where increased human disturbance, predation from cats and dogs, vehicle collisions, dumping, and alterations to soils, hydrology and vegetation were likely to occur. The one-mile width was used in evaluating the effects on foraging habitat for animals with large home ranges, such as raptors. Both widths are consistent with the ecological literature regarding these effects and the ecology of species in the Natomas Basin, and were previously used in comparable analyses supporting the NBHCP.

The Greenbriar project could cause human-wildlife conflicts in this zone by altering the acreage in the zone (because of an altered perimeter of development) or by altering the intensity of wildlife-human conflicts (because of the avoidance and minimization measures implemented or a change in land cover types in this zone). Change in the extent of the 800-foot wide zone was calculated from the acreage in this zone around the MAP, City of Sacramento and Sutter County permit areas for urban development from the Final NBHCP (City of Sacramento et al. 2003) and around these permit areas plus a developed Greenbriar site. Changes to the intensity of wildlife-human conflicts in the 800-foot wide zone were assessed by calculating changes in land cover types within these zones and by comparing the project's avoidance and minimization measures with those in the NBHCP that

address these conflicts. An increase in land cover providing higher quality habitat (or land cover more sensitive to human disturbance) would increase human-wildlife conflicts, while a decrease in such land cover types would reduce human-wildlife conflicts. Similarly, a less comprehensive or stringent set of measures would increase the intensity of conflicts, while a more comprehensive or stringent set of measures would reduce the intensity of conflicts. Any reduction in the efficacy of specific NBHCP measures addressing human-wildlife conflicts also could increase conflicts; potential effects on the efficacy of these measures were evaluated in Appendix A.

2.3.3 ACREAGE OF HABITAT IN THE NATOMAS BASIN

A major component of the effects analysis in the NBHCP was an analysis of change in habitat acreage. For each covered species, the NBHCP analyzed the habitat that was available under baseline conditions and that would be available in the expected future condition of the Natomas Basin. The NBHCP documented baseline land cover in the Natomas Basin as of 2001. The data sources and methods used to do so are described in *Natomas Basin Conservation Plan Impacts to Proposed Covered Species* (CH2M HILL 2002) that was attached to the Final NBHCP as Appendix H. The Natomas Basin covers approximately 53,538 acres. The future condition evaluated was the result of developing an additional 17,500 acres of this land in the MAP, City of Sacramento, and Sutter County permit areas and establishing an 8,750–acre reserve system in the Natomas Basin outside of those permit areas. For each covered species, changes in habitat acreages were derived from the changes in the acreage of land cover types by identifying those land cover types that provide habitat for that species. Additional analyses were performed for Swainson's hawk that included assessment of changes in habitat within 1 mile of existing reserves and nests, quality of foraging habitat, and seasonal availability of foraging habitat.

The Greenbriar project would alter these future conditions by developing additional land and by preserving and enhancing additional land as part of the TNBC reserve system. Thus, for this project's effects analysis, for each covered species, the future condition of the Natomas Basin with the NBHCP and the Greenbriar project was compared to the future condition analyzed in the NBHCP and to the 2001 NBHCP baseline. For the Greenbriar and proposed reserve sites, these comparisons were based primarily on 2001 land cover to be consistent with and comparable to the NBHCP's effects analysis, and because 2001 conditions were used as the NBHCP baseline. These comparisons allow assessment of both the extent of future habitat under the future condition resulting from the NBHCP and under the future condition resulting from the NBHCP plus the Greenbriar project. These were GIS-based analyses. The land cover GIS data layer developed for the NBHCP was the data source for land cover. This was the available land cover data most applicable to this analysis.

Effects based on 2005 land cover were also quantified and considered. This was done by using aerial photography to update the land cover mapped in 2001 in a manner consistent with the 2001 mapping. This mapping used different criteria and was at a coarser scale than some of the land cover mapping in the BA and DEIR (which was based in part on site surveys by biologists). These differences did not lead to different conclusions regarding the efficacy of mitigation for the project's effects.

Land cover mapped by Jones & Stokes was also considered in our analyses (Jones & Stokes 2005; Jones & Stokes, unpublished data) (Appendix B). This mapping used different land cover classification and mapping methods from the 2001 mapping by CH2M HILL, which limited its applicability to this analysis. Nonetheless, a crosswalk between the CH2M HILL and Jones & Stokes land cover types was developed and a common classification was derived; after reclassifying both data sets, EDAW estimated land cover changes during 2001–2004, and used the results to assess overall changes in land cover, implementation of NBHCP conservation strategies on TNBC reserves, stability of agricultural land uses, and fallowing of rice in anticipation of development. This analysis is presented in Appendix B. Its results also were used in the cumulative effects analyses in Section 7 *Cumulative Effects*.

This assessment indicated that land cover changes since 2001 have occurred primarily within the MAP, City of Sacramento, and Sutter County permit areas for urban development, and at TNBC reserves; the primary land cover changes outside of these areas were an increase in the acreage of rice, a substantial decrease in the acreage

of non-rice crops and a corresponding increase in the acreage of fallowed and abandoned cropland. It did not indicate that fallowing of rice in anticipation of development was occurring. Although the dramatic changes in non-rice crop and idle cropland acreages affect the acreage of available habitat for just two covered species (burrowing owl and Aleutian Canada goose), they do illustrate that availability of agricultural habitats can change rapidly in the Natomas Basin; they also indicate that estimates of future availability of agricultural habitats in the NBHCP and in this report represent approximations based on assumptions that may not occur (i.e., that current patterns of agricultural land use are representative of future patterns).

Other GIS data layers used in the analyses included the locations of canals and drains, and the boundaries of the Natomas Basin, NBHCP permit areas, and of the Greenbriar and proposed reserve sites. In our analyses, canal habitats were analyzed differently than in the Final NBHCP. In the Final NBHCP, canals and drains were assigned to four categories (I-IV) based on the width of habitat they provided; of these, only category I canals were included in the land cover layer and categories II-IV were estimated separately. In contrast, we included all habitat along category I-IV waterways in the canal land cover type, Because these canal acreages were included in the canal land cover type in our analyses, the future acreages of land cover types differ somewhat from those presented in the NBHCP.

To assess the future condition of the Natomas Basin with the Greenbriar project, several assumptions were made regarding changes in land cover. These assumptions included the following.

- All land in the MAP, City of Sacramento, and Sutter County permit areas was assumed to be developed, or otherwise no longer providing habitat for covered species.

- Land at the Greenbriar site was assumed to be developed, or otherwise no longer providing habitat for covered species, except for a 250-foot wide corridor along the western edge of the Greenbriar site would be preserved. Land in this corridor would be converted to grassland, except for approximately 2.7 acres of tule marsh that would be created, and 1.4 acres of riparian habitat that was mapped in the conserved corridor in 2001 and would presumably recover and persist in the proposed reserve.

- All other areas were treated as in the effects analysis for the NBHCP, except that 8,750 acres (not including the project's proposed reserves) would be incorporated into a reserve system. The reserve system would be approximately 25% managed marsh, 50% rice and 25% upland land cover types. For estimating acreage changes, the managed marsh and rice was considered to come out of the baseline rice acreage.

- Under the future condition, land at the project's proposed reserve sites was assigned to land cover types based on the *Greenbriar Draft Conceptual Habitat Restoration Design* prepared by Wildlands, Inc. (2005), and subsequent revisions by the project applicant. The mitigation land required by Mitigation Measure 6.13-2 of the DEIR was not included in the GIS analysis because its location has not been determined.

- Preserved land would be dedicated to TNBC (or another nonprofit land trust) and an endowment would be provided for the enhancement, operations, maintenance, and administration of preserved land in perpetuity.)

Thus, the future condition that was analyzed assumes that the project, all development proposed under the NBHCP and all associated mitigation would occur, and that current agricultural land uses are representative of future agricultural land uses. These or comparable assumptions were also made in the effects analyses supporting the NBHCP (e.g., sections 3 and 4 of Appendix H of the NBHCP, and Section 2 of Appendix K).

Changes in the acreage of habitat for a covered species were the sum of changes in land cover types providing habitat for that species. The habitat-land cover relationships used in analyses supporting the NBHCP were also applied to analyses for the Greenbriar project. These relationships are summarized in Table 2-1. Vernal pool-associated species were not considered in these analyses because the Greenbriar and proposed reserve sites do not contain vernal pool habitats nor have vernal-pool associated species been documented in the vicinity of these sites.

Also, in addition to these analyses of Basin-wide GIS data sets, we also considered more detailed site-specific information provided in the DEIR, BA, and the most recent TNBC monitoring report (Jones & Stokes 2005).

Table 2-1
Species Habitat-Land Cover Relationships

Species	Land Cover Types																	
	Airport	Alfalfa	Canals	Grassland	Highways	Idle	Non-rice Crops	Oak Groves	Orchards	Other	Pasture	Ponds and Seasonally Wet	Rice	Riparian	Ruderal	Rural Residential	Tree Groves	Urban
Giant garter snake			X									X	X					
Swainson's hawk (N)								X						X			X	
Swainson's hawk (F)		X		X		X	X				X				X			
Burrowing owl		X	X	X		X					X				X			
Loggerhead shrike		X	X	X		X	X	X	X		X	X		X	X	X	X	
Tricolored blackbird (F)		X		X			X				X		X					
Aleutian Canada goose (F)							X				X		X					
White-faced ibis		X	X									X	X					
Bank swallow		X	X	X			X				X	X	X	X				
Valley elderberry longhorn beetle														X				
Northwestern pond turtle			X									X	X	X				
Sanford's arrowhead			X									X						
Delta tule pea			X									X						

2.3.4 QUALITY OF HABITAT IN THE NATOMAS BASIN

Changes in habitat quality can result from changes in land cover, connectivity, adjacent land uses, and the preservation and management of land to enhance its habitat quality, changes in connectivity, and adjacent land uses. In this report, changes in the acreage of land cover types providing different quality habitat and changes in the acreage of land preserved and managed to enhance habitat quality were derived from the analyses of change in habitat acreages described in the preceding section (*Acreage of Habitat in the Natomas Basin*). Changes in habitat quality resulting from changes in connectivity or adjacent land uses were evaluated separately, and these evaluations are described in other sections.

For Swainson's hawk, the quality and seasonal availability of foraging habitat for Swainson's hawk were evaluated in a manner comparable to the effects analysis conducted by CH2M HILL for the NBHCP (CH2M HILL 2003). In addition, based on a quantitative model of the relative value of different foraging habitats, EDAW also analyzed the overall quantity of resources provided by foraging habitat in the Natomas Basin with and without the Greenbriar project. Though based largely on similar interpretations of existing information as the CH2M HILL analyses for the NBHCP, this model was developed by EDAW biologists for this effects analysis.

In the analysis conducted for the NBHCP, crops and other land cover types were placed in high, medium and low categories for habitat value. This was done on the basis of previous research (e.g., Estep 1989, Estep and Teresa 1992). Seasonal availability of prey was considered separately by calculating the "monthly availability of

potential foraging habitat." (This analysis of habitat availability was based on the assumption that for row and field crops, prey were only available to hawks at the time of harvest.) Because food resources for Swainson's hawk vary substantially among land cover and crop types, these analyses provided much more information than a simple tabulation of acres of potential foraging habitat. However, these analyses did not produce an estimate of total foraging resources that would indicate the overall change in habitat. Therefore, in addition to applying the same analysis as CH2M HILL conducted for the NBHCP, EDAW also estimated the total food resource potentially provided by foraging habitat.

In the analyses supporting the NBHCP, alfalfa and idle cropland were considered to be high value habitat; sugar beet, tomato, melons, squash and cucumber, beans, wheat, pastures (clover, unspecified or mixed) and ruderal land was considered moderate value habitat; Corn, safflower, onions and garlic, and unspecified row and field crops were considered low quality habitat.

The temporal availability of prey was also considered in an analysis conducted for the NBHCP. In this analysis, prey was considered inaccessible to Swainson's hawk during much of the spring and summer because of the dense (and high) cover of vegetation in cultivated fields. In contrast, crops, such as alfalfa, and other land cover types (e.g., grassland) were considered to provide accessible prey for longer periods because of frequent harvests or the vegetation's growth form. Thus, during the months of April–October, for the different crop types grown in the Natomas Basin, prey was assumed to be accessible only during the months when harvest predominantly occurs. These time periods were June for wheat, July–August for tomato and unspecified crops, August for safflower onions and garlic, September–October for sugar beet, and October for beans, melons, squash and cucumber. (Swainson's hawks have migrated out of the Natomas Basin by October, and thus crops harvested in October do not provide foraging habitat in the NBHCP analysis.) For crops harvested during periods of two months, the total acreage of these crops was divided by two to determine the acreage of foraging habitat available during each of those months. Grassland, ruderal, idle cropland, and pastures (including alfalfa) were considered to provide habitat throughout April–September.

These analyses regarding habitat value and temporal availability were applied to the Greenbriar project. For this analysis, the habitat value of the Greenbriar, proposed reserve, and DEIR mitigation sites was compared with and without the proposed development and proposed habitat creation, enhancement, and preservation.

For these analyses, the habitat value of the Greenbriar, proposed reserve and DEIR mitigation sites without the Greenbriar project was based on the same data sources as the analysis conducted for the NBHCP (i.e., 1993 DWR mapping of croplands and 2001 land cover mapping by CH2M HILL of the entire Natomas Basin).

The habitat value of the Greenbriar, proposed reserve and DEIR mitigation sites with the Greenbriar project was based on an assumed future condition derived from the project description and mitigation measure 6.13-2 of the DEIR for the project. For this assumed future condition, the acreages of habitats at these sites are presented in Table 2-2. For the Greenbriar site, these assumptions were that the 26.5 acres of preserved grassland that would be created and preserved along Lone Tree Canal would be low quality habitat (because of its proximity to development), and that the rest of the site would not provide any habitat for Swainson's hawk. For the proposed off-site reserves, these assumptions were that the 59.6 acres of upland at the Natomas 130 and Spangler sites would be alfalfa (or otherwise managed to provide high quality habitat) and that the 59.5 acres of upland components of created marsh would provide moderate quality habitat.

Mitigation measure 6.13-2 of the DEIR, which requires at least 49 acres of land be preserved, enhanced, and managed in perpetuity to provide high quality foraging habitat for Swainson's hawk so that the project's proposed mitigation plus this DEIR mitigation would provide equal or greater value to the species than the habitat present at the Greenbriar site in 2005. The location(s) and existing land cover of the Swainson's hawk foraging habitat that would be required by mitigation measure 6.13-2 have not been determined; this analysis assumed that the current land cover of the mitigation site(s) that would provide foraging habitat for Swainson's hawk was agricultural land harvested during July–August and providing low quality habitat. As mitigation for the project, it

was assumed that this land would be converted to high quality habitat with prey available from April through September. These assumptions represent the minimum acreage at an additional site that would need to be preserved, enhanced, and managed in perpetuity to comply with mitigation measure 6.13-2.

Table 2-2
Habitat Type Acreages Used in Analyses of Effects on Swainson's Hawk Foraging Habitat

Habitat	Greenbriar Site		Proposed Reserves		DEIR Mitigation		Total	
	Without Project	With Project	Without Project	With Project	Without Project	With Project	Without Project	With Project
Alfalfa	-	-	-	59.6		49	-	108.9
Grassland[1]	-	26.5	-	-	-	-	-	26.5
Idle	62.5	-	-	-	-	-	62.5	-
Ruderal	9.2	-	-	-	-	-	9.2	-
Pasture	33.8	-	-	-	-	-	33.8	-
Upland component of marsh	-	-	-	59.5	-	-	-	59.5
Field crop – Moderate quality, harvested September–October	203.7	-	28.4	-	-	-	232	-
Field crop – Low quality, harvested July–August	30.4	-	-	-	49	-	79.4	-

Note: [1] In analysis, this grassland area was considered to be low quality foraging habitat because of its proximity to development.

The EDAW model of Swainson's hawk foraging habitat uses the same current and assumed future conditions as were used for the NBHCP. The range of habitat quality, however, was divided into four categories, rather than three. These ratings changed seasonally for cropland, and a relative quantitative value was assigned to each category so that the total quantity of food resources potentially available could be estimated. The following text describes EDAW's methodology for calculating this estimate.

For each month during April–September, each crop and other land cover type providing foraging habitat was assigned to one of four quality ratings: high, high-moderate, moderate, or low. These ratings are given in Table 2-3. Crops and the other land cover types that provide foraging habitat were assigned these ratings on the basis of prey abundance; the accessibility of prey to the hawk; and on the frequency of harvest, flood irrigation, and other activities that create valuable foraging opportunities for Swainson's hawks, as indicated by the existing literature (Estep 1989, Estep and Teresa 1992). The frequency of harvest, flood irrigation and other activities was considered in rating habitats because of the importance of these activities for hawk foraging. For example, in the radio telemetry study conducted by Estep (1989), approximately half of all Swainson's hawk foraging was associated with harvest, flood irrigation, and other agricultural activities.

Alfalfa combines a high frequency of mowing and irrigation with low vegetation that leave prey accessible to hawks. For these reasons, this land cover type was rated "high" quality.

Grassland, ruderal, idle cropland, upland components of marsh, and fallowed rice also have low vegetation that leaves prey accessible, and can have prey abundance comparable (or even greater than) alfalfa. However these land cover types lack the frequent cultivation and irrigation activities that provide valuable foraging opportunities, and therefore were rated "high-moderate."

Row crops with relatively dense vegetation that limits prey accessibility but still allows some foraging throughout the field (e.g., tomato, beets) were rated "moderate."

Dense, tall crops (e.g., corn, wheat) that restrict foraging to field margins were considered "low" quality foraging habitat. Because of its proximity to development, the proposed grassland along Lone Tree Canal also was considered to provide low quality foraging habitat.

Table 2-3
Habitat Quality and Harvest Months for Swainson's Hawk Foraging Habitats in the Natomas Basin[1]

Habitat	Harvest Month(s)	Growing Season Quality	Harvest Quality	Post-Harvest Quality
Alfalfa	April-Sept	High	High	High
Grassland[2]	-	High-Moderate	-	-
Idle	-	High-Moderate	-	-
Fallowed Rice	-	High-Moderate	-	-
Tomato	July-August	Moderate	High	Low
Sugar beet	September-October	Moderate	High	Low
Beans	October	Moderate	High	Low
Squash, pumpkin	October	Moderate	High	Low
Upland Marsh	-	Moderate	-	-
Pasture	-	Moderate	-	-
Ruderal	-	Moderate	-	-
Wheat	June	Low	High	Low
Unspecified crop	July-Aug	Low	High	Low
Safflower	August	Low	High	Low
Onions and garlic	August	Low	High	Low
Corn	September	Low	High	Low

Notes:
[1] - Data based on CH2M Hill 2003, except for growing season quality of grassland, idle and fallowed rice, as described in methods section.
2 – Grassland in proposed reserve along Lone Tree Canal was considered to be low quality habitat because of surrounding development.

The harvest of crops makes the relatively high density of prey in cropland much more accessible, and this brief period of high accessibility and high abundance is followed by continued accessibility but rapidly declining abundance. Therefore, crops providing low and moderate quality habitat during the growing season were considered to provide high quality habitat for a two weeks at harvest, and then subsequently their habitat quality was reduced to low. Harvest times were considered to be the same as in the NBHCP analysis (CH2M HILL 2003) and these are listed in Table 2-3. For crops harvested during a two-month period, half of the acreage was assumed to be harvested each month, and for that half of the acreage, the growing season and harvest quality ratings were averaged for that month.

To calculate an estimate of food resources provided by foraging habitats, the value of each habitat type was expressed relative to high quality habitat, which was assigned a value of "1." These values are an interpretation of the relevant existing scientific literature that includes studies of the use of foraging habitat and relative prey abundance in different crop and other cover types (Estep 1989, Estep and Teresa 1992). Because in low quality habitat, the tall and dense vegetation restricts foraging to field margins, low quality habitats were assigned a value of "0.1." (However, because harvest makes prey available, the value of these lands is raised to "1" for a two-week interval during the harvest period.) Because the vegetation height and density of moderate quality crops allows some access to prey throughout the field, these crops were assigned a value of "0.3." (During harvest, moderate

quality crops were assigned a "1" rating for a two-week interval, and their rating was subsequently reduced to "0.1".) Because high-moderate quality foraging habitat has accessible and relatively abundant prey, but not the frequent harvest, flood irrigation, and other activities of high quality habitat, it was assigned a value of "0.5".

Multiplying the acreage in each habitat quality category by these relative values, and then summing the products, provides an estimate of the total forage available to Swainson's hawks in the Natomas Basin. The units of this estimate are the equivalent acreage of high quality foraging habitat. These estimates, though rough approximations, provide an explicit, consistent basis for analyzing changes in the quantity of food potentially available to Swainson's hawk in the Natomas Basin. Estimates were calculated for the Greenbriar, proposed reserve, and mitigation sites with and without the proposed project and DEIR mitigation.

In addition to these analyses, other effects on habitat quality for Swainson's hawk and giant garter snake also were considered. As in the NBHCP, effects on habitat within 1 mile of recently documented Swainson's hawk nests (i.e., nests documented in the last 5 years) were considered. For giant garter snake, effects were also considered for upland land cover types that could provide habitat and that were adjacent to canals.

2.3.5 CONNECTIVITY OF HABITAT IN THE NATOMAS BASIN

The Greenbriar project could affect the connectivity of habitat by eliminating or creating waterways, affecting the use of waterways by covered species, or by altering the length, width, or habitat attributes of existing corridors of natural vegetation. In assessing these effects, several assumptions were made including the following.

- All of the Greenbriar site would be developed, except for a 250-foot wide corridor along Lone Tree Canal.
- All waterways in the developed portion of the Greenbriar site would be eliminated.
- In the absence of avoidance and minimization measures, all waterways and uplands within 800 feet of the Greenbriar, Spangler, or Natomas 130 sites could potentially be affected by the project. (Ecologically significant effects caused by developed land uses were considered to not extend beyond an 800-foot wide zone adjacent to developed land cover and highways, and the basis for selecting this width is further described in Section 2.2.2 *Zones with Human-Wildlife Conflicts*.)
- At the proposed Spangler and Natomas 130 reserves, waterways would remain except where rice was converted to upland land cover, and land cover would be changed as described in the Draft Conceptual Restoration Plan prepared by Wildlands, Inc. (2005) and subsequent revisions by the project applicant.

Interpretations of effects on connectivity were based on general ecological literature regarding wildlife use of corridors, recent reviews of the ecology of covered species, and consultations with species experts. Along canals, potential changes in physical conditions (e.g., flow regime, culvert dimensions), vegetation structure and extent, human disturbance, and predation were all evaluated as factors potentially altering connectivity.

2.3.6 CONNECTIVITY OF TNBC RESERVES

The connectivity of TNBC reserves can be altered by altering upland corridors or waterways between existing reserves. Upland corridors are affected by narrowing their width, altering the habitat attributes of the land in them, or by altering their length. The assessment of these potential effects was based on the same assumptions and conducted in the same manner as previously described for Connectivity of Habitat in the Natomas Basin, except that only effects on corridors between existing reserves were considered rather than effects on all lands. (Corridors were considered to not pass through urban land.) We assumed that the most ecologically important upland corridors include the shortest paths between reserves.

Waterways are also important corridors connecting TNBC reserves. Thus, altering the location or habitat value of waterways could affect the connectivity of existing reserves. This effect was evaluated by identifying all waterways within 800 feet of the Greenbriar site, and determining if they were part of the shortest path along waterways between reserves, in a corridor between reserves with multiple waterways, or otherwise could be important for species movement between reserves (e.g., species use of the waterway has been documented). We also considered the recent documentation of habitat conditions along canals by Eric Hansen (Jones & Stokes 2005, Eric Hansen, unpublished data). Our analysis of waterways connecting TNBC reserves was based on analysis of GIS data for waterways in the Natomas Basin, and on boundaries of existing TNBC reserves, MAP, City of Sacramento, and Sutter County permit areas, and of the Greenbriar, Spangler, and Natomas 130 sites, and on species distribution data and consultation with knowledgeable individuals. For this analysis, ecologically significant effects of developed land uses and roads were not considered to extend in general beyond an 800-foot zone of adjacent land; the basis for selecting this width is further described in the section describing the evaluation of zones with human-wildlife conflicts.

2.3.7 HABITAT VALUE OF EXISTING TNBC RESERVES

Changes in adjacent land cover can affect existing TNBC reserves by altering foraging habitat accessible from a reserve or by altering the habitat values of reserve lands through development or preservation of adjacent lands. Thus, we performed three analyses to evaluate effects on the habitat value of existing TNBC reserves. These analyses are described below.

- The effects of the project on foraging habitat were evaluated based on changes in land cover because of the project within 800 feet and 1 mile of existing reserves. Most effects of developed land uses and roads were considered to not extend beyond an 800-foot wide zone of adjacent land. (The basis for selecting this width is described in the section describing the evaluation of zones with human-wildlife conflicts.) Furthermore, as summarized in Section 4 of this document (*Potential Effects of the Greenbriar Project on Covered Species*), the territories and home ranges of some covered (and many other) species residing at the reserves are unlikely to extend more than 800 feet from reserve boundaries. However, Swainson's hawk and other raptors have much larger home ranges and territories; for these species, land within 1 mile of reserves was considered to include the most important habitat for individuals nesting on reserves. (This premise is comparable to that underlying the analysis of Swainson's hawk habitat in the Natomas Basin presented in *Natomas Basin Conservation Plan Impacts to Proposed Covered Species* [CH2M HILL 2003] and included in Appendix K of the NBHCP).

- The effects of additional development on habitat values of TNBC reserves were evaluated by calculating the acreage of existing TNBC reserves within 800 feet of additional developed land cover that would result from the project. This 800-foot criterion is the desired distance of reserves from urban land (described on page IV-16 of the NBHCP) and also includes the area that would experience ecologically significant effects caused by adjacent developed land uses and roads.

- The proximity of the proposed reserves to existing reserves was examined to determine if any were adjacent to existing reserves, and if they expanded the area, increased the habitat variety or reduced the perimeter-to area ratio of the reserve.

2.3.8 WATER AVAILABILITY AT TNBC RESERVES

The project could alter water availability at TNBC reserves if it were to eliminate sections of canals that are required for water deliveries to TNBC reserves, contribute to the elimination of other canals by affecting demand for water deliveries and increase the land ownership of TNBC and its corresponding water use and ownership of stock in Natomas Mutual.

It was assumed that all canals in developed portions of the Greenbriar site would be eliminated, and that consequently, sections of canal off-site but directly connected to canal segments on the Greenbriar site could be

abandoned. The connection of each of these eliminated or potentially abandoned canal segments to TNBC reserves was evaluated, and the effect on water availability to reserves was assessed.

In addition, Natomas Mutual and RD 1000 were contacted regarding waterways that could be eliminated because of the project. Elimination of canals or drains by these water agencies or due to a development project, however, would likely require mitigation under either Section 7 or Section 10 of the Endangered Species Act, and therefore their effects would likely be mitigated even if their elimination occurred separately from the project.

The project's effect on TNBC stock ownership in Natomas Mutual also was considered. Natomas Mutual is a privately held water company comprised of landowner stockholders. As TNBC acquires mitigation lands in the Natomas Basin, it increases its shares in Natomas Mutual. This increased ownership could result in TNBC changing operations and maintenance practices to support the goals and objectives of the NBHCP. The project would increase TNBC ownership and thus its influence on the operations of Natomas Mutual. The magnitude of this increase in ownership and its likely effects were assessed.

2.3.9 OPPORTUNITIES TO ESTABLISH ADDITIONAL TNBC RESERVES

The Greenbriar project could affect opportunities to establish additional TNBC reserves by reducing the acreage of land available for satisfying the mitigation requirements of the development permitted through the NBHCP, or by expanding existing reserves so that more interconnected reserves can be established that exceed the 400-acre minimum desired size. These potential effects were evaluated by estimating the acreage potentially available for NBHCP mitigation with and without the project, and by examining the connectivity of the proposed Spangler and Natomas 130 reserves to existing TNBC reserves.

The acreage potentially available for NBHCP mitigation without the project was estimated by subtracting the following areas from the Natomas Basin's total acreage of land suitable for preservation followed by restoration or enhancement: MAP, City of Sacramento, and Sutter County permit areas for urban development, the County-owned airport buffer, and levee slopes around the perimeter of the plan area. Land cover considered unsuitable for restoration or enhancement included existing developed land cover outside of permit areas, and other, ruderal and rural residential land cover.

The acreage potentially available for NBHCP mitigation after development of the project was estimated by subtracting the following areas from the acreage potentially available without the project: the proposed Spangler and Natomas reserves and the developed portion of the Greenbriar site (that otherwise would be suitable for preservation). The fragmentation by the project of a block of land that otherwise was potentially suitable for preservation also was considered.

The location of the proposed reserves was examined to determine if these lands expanded existing TNBC reserves, could contribute to the expansion of TNBC reserves in the future or could be expanded into a reserve that was greater than 400 acres in size, or if they were isolated from TNBC reserves by developed lands or other barriers.

2.4 BASIS FOR INTERPRETATIONS OF EFFECTS ON COVERED SPECIES

For each covered species, we evaluated:

- construction-related effects on individuals using the Greenbriar site or adjacent lands,
- change in habitat quantity, and
- change in habitat quality.

For this evaluation, the available information on the ecology and distribution of each covered species was compiled, reviewed, and summarized. Interpretations of construction-related effects on individuals were based on the analysis of the likely alterations of survival and reproduction of individuals using the Greenbriar site or

adjacent lands. Interpretations of effects on habitat availability were based on the analysis of alterations to habitat acreage that was described previously.

Interpretations of change in habitat quality were based on the analyses of land cover acreages and connectivity of habitat in the Natomas Basin, and of the acreage in zones with human activity-wildlife conflicts. We also considered changes in the acreage of preserved lands, and in the acreage of high quality habitat.

For each covered species, the interpretations of effects on habitat acreage and quality (and of construction-related effects and human-wildlife conflicts) were used to evaluate the project's overall effect on the viability of the population using the Natomas Basin. A population's viability (i.e., its likelihood of long-term persistence) is strongly influenced by population size, population demography, and environmental variability (which in turn has a strong influence on reproduction and mortality). In the Natomas Basin, fluctuations in the acreage of crop types and changes in agricultural practices cause substantial environmental variability affecting the populations that rely on agricultural habitats. By reducing the quantity or quality of habitat, urban development can reduce population size and adversely affect demography.

2.5 BASIS FOR INTERPRETATIONS OF EFFECTS ON NBHCP CONSERVATION STRATEGY

The previously described analyses of effects on population and habitat attributes, and on covered species, were used to evaluate the potential effect of the Greenbriar project on the effectiveness of the NBHCP conservation strategy. This strategy is described in Section IV.C of the NBHCP. This section describes six key components of the NBHCP's conservation strategy for effectively mitigating 17,500 acres of urban development. These components are:

- basis for 0.5 to 1 mitigation ratio (Section IV.C.1.a),
- preparation of site specific management plans (Section IV.C.1.b),
- buffers within the reserve lands (Section IV.C.1.c),
- connectivity (Section IV.C.1.d),
- foraging habitat (Section IV.C.1.e), and
- 2,500-acre/400-acre minimum habitat block size requirements (Section IV.C.1.f).

Potential effects of the Greenbriar project on each of these components was assessed individually (using the results of the analyses described in Section 2.3 *Methodology for Analyzing Alterations of Populations and Habitats*); these effects were then synthesized into an overall effect of the Greenbriar project on the effectiveness of the NBHCP's conservation strategy.

2.6 BASIS FOR INTERPRETATIONS OF EFFECTS ON HCP GOALS AND OBJECTIVES

The NBHCP's goals and objectives represent the desired outcomes from implementation of the NBHCP's conservation strategy. Nine of the NBHCP's goals and objectives could be affected by the Greenbriar project. Table 2-4 lists these goals and objectives; it also identifies the population and habitat attributes potentially affected by the project that could affect attainment of the NBHCP's goals and objectives. This effects analysis evaluated the effects of the Greenbriar project on each of these nine goals and objectives of the NBHCP. Interpretations of the project's overall effect on the attainment of a goal or objective were based primarily on the sum of these anticipated effects. Substantial effects (beneficial or adverse) could alter the viability of a covered species or interfere with attainment of a goal or objective. Effects that would reduce the viability of a covered species, preclude attainment of a goal or objective, or otherwise result in a change to the NBHCP's conservation strategy were considered significant effects that would conflict with the NBHCP.

Table 2-4
Relationships Between Applicable NBHCP Goals and Objectives and Attributes Potentially Affected by the Greenbriar Project[1]

NBHCP Goals and Objectives	Species and Habitat Attributes							
	Survival and reproduction of individuals using Project Site or adjacent lands	Zones with human-wildlife conflicts	Acreage of habitat in Natomas Basin	Connectivity of habitat in Natomas Basin	Connectivity of existing TNBC reserves	Habitat value of existing TNBC reserves	Water availability at TNBC reserves	Opportunities to establish additional TNBC reserves
Overall Goal 1. *Establish and manage in perpetuity a biologically sound and interconnected habitat reserve system that mitigates impacts on Covered Species resulting from Covered Activities and provides habitat for existing, and new viable populations of Covered Species. (NBHCP page I-15)*	-	-	**X**	**X**	**X**	**X**	**X**	**X**
Overall Goal 3. *Preserve open space and habitat that may also benefit local, non-listed and transitory wildlife species not identified within the NBHCP. (NBHCP page I-16)*	-	-	**X**	**X**	**X**	**X**	**X**	**X**
Overall Goal 4. *Ensure that direct impacts of Authorized Development upon Covered Species are avoided or minimized to the maximum extent practicable. (NBHCP, page I-16)*	**X**	-	-	-	-	-	-	-
Overall Objective 1. *Minimize conflicts between wildlife and human activities, including conflicts resulting from airplane traffic, roads and automobile traffic, predation by domestic pets, and harassment by people. (NBHCP, page I-16)*	**X**	**X**	-	-	-	-	-	-
Overall Objective 3. *Ensure connectivity between TNBC reserves to minimize habitat fragmentation and species isolation. Connections between reserves will generally take the form of common property boundaries between reserves, waterways (primarily irrigation and drainage channels) passing between reserves, and/or an interlinking network of water supply channels or canals. (NBHCP, page I-16)*				**X**	**X**	**X**	**X**	

Table 2-4
Relationships Between Applicable NBHCP Goals and Objectives and Attributes Potentially Affected by the Greenbriar Project[1]

NBHCP Goals and Objectives	Species and Habitat Attributes							
	Survival and reproduction of individuals using Project Site or adjacent lands	Zones with human-wildlife conflicts	Acreage of habitat in Natomas Basin	Connectivity of habitat in Natomas Basin	Connectivity of existing TNBC reserves	Habitat value of existing TNBC reserves	Water availability at TNBC reserves	Opportunities to establish additional TNBC reserves
Wetland Species/Habitat Goal/Objective 1. *Acquire, enhance and create a mosaic of wetland habitats with adjacent uplands and connecting corridors to provide breeding, wintering, foraging, and cover areas for wetland species in the Plan Area. (NBHCP, page I-17)*				**X**	**X**	**X**	**X**	**X**
Wetland Species/Habitat Goal/Objective 2. *Provide habitat to maintain, attract and sustain viable populations of the Covered Species. The habitat areas should be configured to encompass natural species migration areas, minimize species isolation, and prevent future habitat fragmentation. (NBHCP, page I-17)*	-	**X**	**X**	**X**	**X**	**X**	**X**	**X**
Upland Species/Habitat Goal/Objective 1. *Acquire, enhance and create a mosaic of upland habitat types for breeding, foraging, and cover for species dependent on upland habitats. (NBHCP, page I-17)*	-	-	**X**	-	-	**X**	-	**X**
Upland Species/Habitat Goal/Objective 2. *Ensure reserve land connectivity with travel corridors for upland-dependent species. The habitat areas should encompass grasslands, agricultural croplands, riparian habitats, and shelter and nesting habitat areas (fence rows, clusters of shrubs and small trees), as well as wetland areas to provide a year-round source of water for upland species. The upland areas should be configured to enhance natural species migration, minimize species isolation, and prevent future habitat fragmentation. (NBHCP, page I-17)*	-	-	-	**X**	**X**	**X**	-	**X**

Note:
[1] An "X" indicates that alteration of that species or habitat attribute could directly affect attainment of that goal or objective.

3 GREENBRIAR PROJECT'S ALTERATION OF POPULATION AND HABITAT ATTRIBUTES

3.1 CONSTRUCTION-RELATED EFFECTS ON SURVIVAL AND REPRODUCTION

Based on CNDDB, surveys of the Greenbriar site, and other data on the distribution of species in the Natomas Basin, species covered by the NBHCP that likely use the Greenbriar site include Swainson's hawk, burrowing owl, loggerhead shrike and giant garter snake. For these species, construction at the Greenbriar site could affect the survival and/or reproduction of individuals by killing, injuring or disturbing individuals, or by eliminating habitat that those individuals depend on for food or shelter. These potential effects are summarized below and described in detail in the sections addressing potential effects for each covered species.

Nesting Swainson's hawks could be affected by the project's construction activities. Though no Swainson's hawk nests have been documented on the Greenbriar, Spangler or Natomas 130 sites, five nests have been recently documented within one mile of the Greenbriar site, 12 nests within one mile of the proposed Natomas 130 reserve (where marsh habitat would be constructed), and 59 nests in the Natomas Basin (Jones & Stokes 2005). Swainson's hawks at any of these nest sites might have their reproduction and survival affected to some degree by construction of the project, and those at the nest sites within one mile could have reduced nesting success or abandon their nest. To avoid and minimize these potential effects, the project includes the same measures that were included in the NBHCP to avoid and minimize construction-related effects on Swainson's hawk. An evaluation of the applicability of NBHCP measures and their inclusion in the Greenbriar project and its mitigation is presented in Appendix A. (These measures are also comparable to those incorporated into the MAP HCP [which has been superseded by the 2003 NBHCP].)

Burrowing owls nesting on or near and foraging on the Greenbriar site could be affected by the project's construction activities. A burrowing owl has been observed on the Greenbriar site. Other burrowing owls could be residing on adjacent land, and any residing within about a mile of the Greenbriar site also could be foraging on the Greenbriar site. Construction of the project could cause nest abandonment or trap or injure owls in their burrows. To avoid and minimize these potential effects, the DEIR mitigation includes the same measures that were included in the NBHCP to avoid and minimize construction-related effects on burrowing owls. An evaluation of the applicability of NBHCP measures and their inclusion in the Greenbriar project and its mitigation is presented in Appendix A. (These measures are also comparable to those incorporated into the MAP HCP [which has been superseded by the 2003 NBHCP].)

Loggerhead shrikes nesting on or near (i.e., within a quarter-mile) and foraging on the Greenbriar site could be affected by the project's construction activities. Shrikes were observed on the Greenbriar site during March 2005 surveys. Because shrikes are distributed throughout the Natomas Basin and suitable habitat is present, shrikes also could be present at the proposed Natomas 130 reserve (where marsh habitat will be constructed). Construction of the project could cause nest abandonment. To avoid and minimize this potential effect, the project includes the same measures that were included in the NBHCP to avoid and minimize construction-related effects on loggerhead shrike. An evaluation of the applicability of NBHCP measures and their inclusion in the Greenbriar project or the DEIR mitigation is presented in Appendix A. (These measures are also comparable to those incorporated into the MAP HCP [which has been superseded by the 2003 NBHCP].)

Giant garter snakes foraging or residing on the Greenbriar site could be affected by the project's construction activities. Giant garter snakes have been observed along Lone Tree Canal, which provides high quality habitat for this species; the other canals on and bordering the Greenbriar site, and the uplands adjacent to these canals, also provide habitat for giant garter snake. The proposed reserve sites also contain or are bordered by giant garter snake habitat. Because giant garter snakes in the Natomas Basin travel widely (i.e., several miles or further)

during their daily and seasonal movements, the Lone Tree Canal is an important movement corridor for this species, and the Greenbriar site contains suitable habitat, giant garter snakes could be killed or injured during construction activities.

The construction activities associated with the Greenbriar project would be comparable to those covered by the NBHCP, as are the species and habitats affected by these activities. Therefore, the applicable measures from the NBHCP would be appropriate for avoiding and minimizing this project's construction-related effects, and the project includes the same measures that were included in the NBHCP to avoid and minimize construction-related effects on giant garter snake. The DEIR (EDAW 2005) also proposes additional measures to avoid and minimize construction-related effects on giant garter snake including exclusion fencing erected prior to the onset of the dormant season preceding construction, routine monitoring of giant garter snakes stranded on the interior (i.e., construction side) of the fence, and documentation and reporting of mortality with the provision to modify avoidance and minimization measures to prevent future moralities due to similar causes.

3.2 ZONES WITH HUMAN-WILDLIFE CONFLICTS

As described in the methodology, areas within 800 feet of the MAP, City of Sacramento, or Sutter County permit areas, or major highways, were considered to be areas with high levels of potential human-wildlife conflicts. The Greenbriar project would reduce the total area, and the area of most land cover types, in these zones, and would include measures to reduce effects on adjacent habitats, but it would increase the area of rice and managed marsh within 800 feet of urban development or major highways. Overall, the project with the DEIR mitigation would not significantly increase human-wildlife conflicts in the Natomas Basin.

3.2.1 FUTURE CONDITIONS UNDER THE NBHCP

Under the future conditions resulting from implementation of the NBHCP, a portion of the Greenbriar site would be adjacent to urban development or major highways, and thus potentially experiencing high levels of human-wildlife conflicts. Urban development would be adjacent to the Greenbriar site along its eastern and western sides and part of its southern side (Exhibit 1). Lone Tree Canal and Lone Tree Road would be between the Greenbriar site and urban development to the west. Highway 99 would separate the site from the urban development to the east. Along the site's southern side, Interstate 5 would be between the site and both urban development and the agricultural or natural vegetation remaining to the southwest. Along the site's northern boundary, Elkhorn Boulevard would be a six land road between the Greenbriar site and agricultural or natural land cover to the north. The expansion of Elkhorn Boulevard was authorized by the MAP HCP, and although in this analysis it was not considered urban development or a major highway that would generate high levels of human-wildlife conflicts, it would increase levels of human-wildlife conflicts.

Under the future conditions resulting from implementation of the NBHCP, the proposed Spangler reserve would be bordered to the north by development in Sutter County's permit area. A portion of the Natomas 130 parcel would be within 800 feet of urban development in the City of Sacramento's permit area, but would be separated from it by Fisherman's Lake.

3.2.2 POTENTIAL EFFECTS OF GREENBRIAR PROJECT UNDER FUTURE CONDITION

Development of the Greenbriar project would reduce the area of habitat in zones with potentially high levels of human-wildlife conflicts. This counter-intuitive result would occur because the project would develop portions of the Greenbriar site that would otherwise be in such zones, and would create smaller new zones with potentially high levels of human-wildlife conflicts. Under the future condition resulting from the NBHCP, about 230 acres of the Greenbriar site would be within 800 feet of urban development or major highways. Development of the Greenbriar site would eliminate most of this acreage and would create a new, but smaller, zone with potentially high levels of human-wildlife conflicts north of the Greenbriar site (about 62 acres in size), because this

undeveloped land would be within 800 feet of urban land after development of the project. The net change would be a reduction of 137 acres in the extent of areas with high levels of human-wildlife conflicts.

Though land to the north would be adjacent to development on the Greenbriar site, a six-lane road (Elkhorn Boulevard) would be between this land and residential development on the Greenbriar site. The road would partially isolate the Greenbriar site from land to the north, and thus limit human-wildlife conflicts resulting from the Greenbriar Project.

Nonetheless, the project would increase the area of rice and managed marsh that is within 800 feet of urban development or a major highway, and thus increase the area of giant garter snake, northwestern pond turtle and white-faced ibis habitat in zones with potentially high levels of human-wildlife conflicts. In the 2001 land cover map, the area within 800 feet of the northern border of the Greenbriar site was primarily in rice (53 of 62 acres). This acreage was greater than the 47 acres of rice on the Greenbriar site that were within 800 feet of the MAP or City of Sacramento permit areas. Thus, based on 2001 land cover for the Greenbriar site, the acreage of rice in areas with high levels of human-wildlife conflicts would increase as a result of developing the Greenbriar site. In addition, up to about 14.2 acres of managed marsh could be created at the proposed Natomas 130 reserve within 800 feet of the City of Sacramento's permit area for urban development, and at the proposed Spangler reserve about 37 acres of the created marsh could be within 800 feet of the Sutter County's permit area. At the proposed reserves, on-site buffers and reserve management (e.g., limiting access) would reduce human-wildlife conflicts, and the proposed Natomas 130 reserve is separated from urban development in the City of Sacramento by Fisherman's Lake, which also would limit human-wildlife conflicts.

Compared to the total area of land in the Natomas Basin that is within 800 feet of a major highway or of the MAP, City of Sacramento, or Sutter County permit areas, these changes are relatively small. There is approximately 2,790 acres of land outside of the three permit areas but within 800 feet of such areas or of a major highway. Thus, the Greenbriar project would reduce the area of these zones by about 5%. Similarly, there are roughly 1,420 acres of rice and managed marsh in these zones, and the Greenbriar project would increase this area by 4% (52 acres).

Without mitigation, the Greenbriar project also could increase human-wildlife conflicts along Lone Tree Canal. Under the future condition resulting from the NBHCP, a 1.1 mile section of the Lone Tree Canal would be within 800 feet of urban development; these urban land uses and highways would be adjacent to one bank of the canal except at road crossings. Development of the project would place urban land uses within 200 feet of the other bank of Lone Tree Canal as well. The Lone Tree Canal is an important corridor for animal movement, particularly for giant garter snake. The project's potential effects on this canal, and measures to reduce those effects, are discussed in detail in Section 3.4 *Connectivity of Habitat in the Natomas Basin*.

The project and its mitigation would also implement measures to reduce human-wildlife conflicts. The project includes all of the applicable measures incorporated into the NBHCP to avoid and minimize human-wildlife conflicts. An evaluation of the applicability of NBHCP measures and their inclusion in the Greenbriar project or the DEIR mitigation is presented in Appendix A. To further reduce human-wildlife conflicts along Lone Tree Canal, the project also would implement a comprehensive set of measures including fencing and a barrier. These measures are described in more detail under Section 3.4 *Connectivity of Habitats in the Natomas Basin* and would be further developed during the HCP process.

Overall, the Greenbriar project, with the DEIR mitigation, would not cause a significant increase in human-wildlife conflicts in the Natomas Basin. This is in part because much of the Greenbriar site is, or under NBHCP and MAP permit conditions would be, bordered by urban development, highways, and major roads under the future condition, and in part because of the measures incorporated into the project and the DEIR mitigation.

3.3 HABITAT ACREAGE IN THE NATOMAS BASIN

The project would reduce the acreage of habitat available in the Natomas Basin for several species covered by the NBHCP. These losses would result from changes in land cover at the Greenbriar and proposed reserve sites.

3.3.1 CHANGE IN HABITAT ACREAGE AT THE GREENBRIAR SITE

The Greenbriar project would alter the Greenbriar and proposed reserve sites. Most of the Greenbriar site would be converted to urban land cover (Exhibit 2, Table 3-1). But, a 30.6 acre area along the western edge, bordering the Lone Tree Canal, would be conserved. This area would be preserved, restored as tule marsh (approximately 2.7 acres) or native grassland, and added to the TNBC reserve system. (The existing, disturbed patch of riparian land cover [at the southern end of this conserved area] would probably recover and persist.)

Table 3-1
Land Cover Acreages of Greenbriar Project

Land Cover Types	Greenbriar Site[1]			Proposed Spangler & Natomas 130 Reserves[2]			Total		
	2001	2005	Post-Project	2001	2005	Post-Project	2001	2005[3]	Post-Project
Alfalfa	-	-	-	-	-	59.6			59.6
Canals	15.0	15.0	-	7.6	7.6	6.2	22.6	22.6	6.2
Grassland	-	-	26.5	-	-	-	-	-	26.5
Idle	62.5	115.1	-	-	28.4	-	62.5	143.5	-
Non-rice crops	234.1	381.0	-	28.4	-	-	262.6	381.0	-
Pasture	33.8	-	-	-	-	-	33.8	-	-
Ponds & seasonally wet areas	-	1.7	2.7	-	-	198.2	-	1.7	200.9
Rice	160.0	-	-	228	228	0	395.4	228	0
Riparian	1.4	1.4	1.4	1.6	1.6	1.6	3.0	3.0	3.0
Roads and Highways	17.5	17.5	-	-	-	-	17.5	17.5	-
Ruderal	9.2	2.0	-	-	-	-	9.2	2.0	0
Rural Residential	43.3	43.3	-	-	-	-	43.3	43.3	-
Tree Groves	-	-	-	0.2	0.2	0.2	0.2	0.2	0.2
Urban	-	-	546.4	-	-	-	-	-	546.4
Total	577	577	577	265.8	265.8	265.8	842.8	842.9	842.9

Note:

[1] The Greenbriar site included the 30.6 acre area along Lone Tree Canal that would become a preserve and 546.4 acres that would be developed. Lone Tree Canal was considered immediately adjacent to but outside of the project site.

[2] Reserve acreages do not include the additional preservation and enhancement of upland habitats required by mitigation measure 6.13-2 of the DEIR because location, acreage, and current land cover of this land has not been determined.

[3] These 2005 acreages differ from those in the DEIR because they were based on a GIS analysis comparable to that performed for 2001 (as described in the methods) and the DEIR acreages were based on a different analysis that included a field survey of the site.

If the Greenbriar site were to remain predominantly in agricultural land cover, a variety of crops probably would be cultivated on it and portions of the site would be idle in many years. Land cover in 2001 and 2005 indicates the range of habitat values the Greenbriar site could provide over the long-term, and thus that would be lost by the site's development. In 2001, the site contained idle, pasture, ruderal, canal, rice, riparian, non-rice crops, and rural residential land cover (Table 3-1). In 2005, pasture and rice were no longer present and the area of idle and non-rice cropland had expanded.

Estimates of habitat loss depend on whether they are based on 2001 or 2005 land cover. For some species (e.g., giant garter snake), estimates of habitat loss would be greater if based on 2001 land cover than if based on 2005 land cover. For other species (e.g., Swainson's hawk), estimates of habitat loss would be greater if based on 2005 land cover. For evaluating how the project would alter the future condition of the Natomas Basin, changes from 2001 land cover were used because 2001 land cover was the baseline for the NBHCP's estimates of future habitat conditions.

Although different analyses were conducted for this effects analysis and for the DEIR, both considered 2001 and 2005 conditions. To evaluate the proposed project's effects on the effectiveness of the NBHCP, this effects analysis performed an extensive analysis of the project's potential effects on the future condition of the Natomas Basin. This analysis used the 2001 land cover data that represents baseline conditions of the NBHCP, and also considered 2001–2004 changes in land cover, and 2005 conditions. To comply with CEQA requirements and to assure that the proposed project does not compromise the effectiveness of the NBHCP, the impact analysis in the DEIR evaluated conditions documented in 2005 when the Notice of Preparation (NOP) was released, and provides mitigation designed to reduce impacts to less than significant under both 2005 conditions (for CEQA purposes) and 2001 conditions (to assure that the project does not compromise the effectiveness of the NBHCP).

3.3.2 CHANGE IN HABITAT ACREAGE AT PROPOSED RESERVE SITES

Land cover would also be altered at the proposed reserve sites (Table 3-1). Approximately 45 acres of the Spangler site would be converted to upland foraging habitat (assumed to be alfalfa), 184 acres would be converted to marsh that would include upland components, and about 6 acres would be canal. At the Natomas 130 site, about 14 acres that were in non-rice crops in 2001, and are currently idle, would be converted to marsh, about 2 acres would remain in riparian habitat, and the remaining 14 acres at this site would be managed as foraging habitat for Swainson's hawk. The location and existing land cover of the mitigation site(s) providing at least an additional 49 acres of Swainson's hawk foraging habitat (to fulfill mitigation measure 6.13-2 of the DEIR) have not been specified, and thus the effects of these land cover changes are not included in Tables 3-1, 3-2 and 3-3. However, this mitigation needs to provide high quality habitat for Swainson's hawk, and so land would probably be converted from non-rice crops to alfalfa (or otherwise be managed to provide high quality foraging habitat).

3.3.3 OVERALL CHANGE IN HABITAT ACREAGE

Together, these changes at the Greenbriar and proposed reserve sites, but not including additional DEIR mitigation for Swainson's hawk, would reduce the acreage of several natural or agricultural land cover types that provide habitat for covered species, and would increase the acreage of alfalfa, grassland, and of ponds or seasonally wet areas (Table 3-2).

Based on 2001 land cover, these changes represent a reduction in habitat acreage for most species that use non-rice cropland and other upland land cover, a net gain of habitat for two plant species that grow in wetlands and along canals, and a net loss for species using both canal and rice land cover (Table 3-3, which does not include additional DEIR mitigation for Swainson's hawk). (No change in the acreage of vernal pool or riparian habitats would result from the project.) Except for burrowing owl, the covered species that forage in non-rice crops and other upland land cover (Swainson's hawk, loggerhead shrike, tricolored blackbird, Aleutian Canada goose, and bank swallow) would lose from about 14 to 684 acres of habitat. Because the acreage of created marsh habitats would be much greater than the acreage of lost canal habitats, potential habitat for Sanford arrowhead and delta tule pea (which occur in marsh or canal habitats) would increase by 184 acres.

The acreage of habitat would decrease for white-faced ibis, giant garter snake, and northwestern pond turtle by 144–204 acres, because the loss of rice and canal habitats would be greater than the acreage of marsh created from non-habitat (Table 3-3).

Table 3-2
Change in Land Cover Acreage Because of Natomas Basin HCP and Greenbriar Project

Land Cover	Natomas Basin 2001[1]	Future Condition Resulting from NBHCP[1, 2]	Future Condition Resulting from NBHCP Plus Project[1, 2, 3, 4]	
			2001 Greenbriar Land Cover	2005 Greenbriar Land Cover
Airport	1,532	1,492	1,492 (0)	1,492 (0)
Alfalfa	368	368	427 (60)	427 (60)
Canals	1,753	1,162	1,146 (-16)	1,146 (-16)
Grassland	882	284	311 (27)	311 (27)
Highway or Major Road	1,353	770	753 (-18)	753 (-18)
Idle	1,449	422	360 (-63)	307 (-115)
Non-rice Crops	16,395	9,533	9,271 (-263)	9,152 (-381)
Oak Grove	94	77	77 (0)	77 (0)
Orchard	178	165	165 (0)	165 (0)
Other	460	314	314 (0)	314 (0)
Pasture	660	494	460 (-34)	494 (0)
Ponds & Seasonally Wet Areas	93	2,259	2,460 (201)	2,458 (199)
Rice	22,129	11,643	11,255 (-388)	11,415 (-228)
Riparian	115	91	91 (0)	91 (0)
Ruderal	1,882	370	361 (-9)	368 (-2)
Rural Residential	369	287	244 (-43)	244 (-43)
Tree Grove	102	44	44 (0)	44 (0)
Urban	3,725	23,763	24,309 (546)	24,309 (546)
Total	**53,538**	**53,538**	**53,538**	**53,538**

Notes:

[1] Acreage along Class II-IV canals included in acres of canals, thus reducing acreages in other categories from those given in NBHCP.

[2] Acreages include changes in land cover occurring at proposed Spangler and Natomas 130 reserves.

[3] Change in acreage from future condition of NBHCP is in parentheses.

[4] Changes resulting from the preservation and enhancement of upland habitat required by Mitigation Measure 6.13-2 are not included in these acreages.

Table 3-3
Change in Habitat Acreage Because of Natomas Basin HCP and Greenbriar Project

Species	Natomas Basin 2001[1]	Future Condition Resulting from NBHCP[1, 2]	Future Condition Resulting from NBHCP Plus Project[1, 2, 3, 4]	
			2001 Greenbriar Land Cover	2005 Greenbriar Land Cover[5]
Giant garter snake	23,975	15,064	14,860 (-204)	15,019 (-45)
Swainson's hawk (Nesting)	311	211	211 (0)	211 (0)
Swainson's hawk (Foraging)[6]	21,636	12,018	11,796 (-222)	11,638 (-380)
Burrowing owl[6]	6,994	3,647	3,673 (24)	3,631 (-16)
Loggerhead shrike	24,339	15,555	15,415 (-141)	15,254 (-301)
Tricolored blackbird (foraging)	40,434	22,322	21,724 (-598)	21,799 (-523)
Aleutian Canada goose	39,184	21,670	20,986 (-684)	21,061 (-609)
White-faced ibis	24,343	15,432	15,228 (-144)	15,446 (-14)
Bank swallow	42,395	25,834	25,420 (-414)	25,494 (-340)
Valley elderberry longhorn beetle	115	91	91 (0)	91 (0)
Northwestern pond turtle	24,090	15,155	14,951 (-204)	15,110 (-45)
Sanford's arrowhead	1,846	3,421	3,605 (184)	3,604 (183)
Delta tule pea	1,846	3,421	3,605 (184)	3,604 (183)

Notes:

[1] Acreage along Class II-IV canals were included in acres of canals, thus reducing acreages in other land cover categories from those given in NBHCP as baseline conditions; this altered habitat estimates as well.

[2] Acreages include changes in land cover occurring at proposed Spangler and Natomas 130 reserves, and assume that land in MAP, City of Sacramento, and Sutter County permit areas would not provide habitat under future conditions.

[3] Change in acreage from future condition because of NBHCP is in parentheses.

[4] Changes resulting from the preservation and enhancement of additional upland habitat to satisfy Mitigation Measure 6.13-2 are not included in this table's acreages because the acreage, location, and current land cover of this land has not been specified.

[5] 2005 habitat acreages differ from those in the DEIR because different methodologies were used; this effects analysis relied on a GIS analysis comparable to analyses of 2001 land cover, whereas the DEIR used by GIS analyses and field surveys by biologists .to estimate habitat acreages.

[6] For these species future condition acreages also include upland components of created marshes.

3.4 HABITAT QUALITY IN THE NATOMAS BASIN

Besides these changes in habitat acreage, changes in the quality of the remaining habitat also would occur. In part, changes in habitat quality result from changes in the acreage of land cover types providing lower or higher habitat quality. For example, the project would increase ruderal land cover that provides habitat for Swainson's hawk, burrowing owl, and loggerhead shrike, but this habitat is of lesser quality than that provided by other land cover types, including types whose acreage was reduced by the project (e.g., idle cropland). Similarly, marshland

created by the project would provide higher quality habitat for some species (e.g., northwestern pond turtle and white-faced ibis) than the canal habitats eliminated by the project.

3.4.1 HABITAT QUALITY ADJACENT TO THE GREENBRIAR SITE

Habitat quality would be reduced on land adjacent to development at the Greenbriar site. Roads, urban, and exurban development detrimentally affect the provision of wildlife habitat and other ecosystem functions on adjacent lands. These effects are caused by a wide variety of mechanisms that include alteration of hydrology, water quality, disturbance regimes, and vegetation structure, and the introduction of non-native species, collisions with vehicles, noise disturbance, and harassment by humans, and predation by cats, dogs, and wildlife associated with human land uses. The distance that effects on wildlife habitat extend from developed land varies with the mechanism causing the effect, the species affected, and attributes of the development and its surrounding landscape, but distances may range from less than 10 to over 1,000 feet (De Snoo and de Wit 1998, Forman and Alexander 1998, Paul and Meyer 2001, ELI 2003, Miller et al. 2003, Allan 2004). The most likely causes of effects on adjacent habitats because of the project are:

- Decreased runoff to and lower water levels in Lone Tree Canal,
- Spread of non-native invasive species,
- Harm and harassment by humans, cats, and dogs,
- Dumping of trash,
- Increased levels of noise and nighttime light, and
- Loss of upland vegetation adjacent to canals.

Several of these effects on wildlife habitat could extend hundreds of feet from the site. Although the mechanisms by which development affects habitat are well understood, a moderate level of uncertainty exists regarding the magnitude and location of the effects resulting from specific development projects (including the Greenbriar project). The degradation of habitat on adjacent lands is also assessed in the sections of this report that address zones with high levels of human-wildlife conflicts and those addressing effects on covered species.

In addition, the habitat quality of adjacent agricultural lands would be altered by changes in crop types or the cessation of agriculture. Land cover on adjacent land north of the Greenbriar site could possibly change because of conflicts between rice cultivation and the residential development created by the project. Aerial application of pesticides and herbicides probably is not feasible immediately adjacent to residential development (C. Aubry, pers. comm.), which could cause part, or all, of the adjacent parcel to be removed from rice cultivation. The North Natomas Community Plan has reduced these conflicts through a 350-foot wide buffer of open space along roads separating developed and agricultural land uses (EDAW 2005). Similarly, the Metro Air Park includes a 250-foot wide buffer along its northern and eastern borders in which developed land uses are restricted to open space, warehouses, or parking areas (USFWS 2001). The Greenbriar project would not contain an open space buffer along its borders between its development and adjacent land uses, and the only buffer would be Elkhorn Boulevard, which would be a six lane road. The project would include notification of all prospective residents and tenants within 500 feet of existing agricultural uses describing the types of agricultural operations that could occur in proximity to their homes or businesses (DEIR mitigation measure 6.11-3). Nonetheless, agricultural-residential conflicts could occur.

The extent of potential conflicts is not known. If all agricultural use of land within 350 feet of the project's residential development were to cease, roughly 23 acres of rice would become idle land. This would increase the project's effects on giant garter snake, and on other species associated with rice but not idle land, and would decrease the project's effects on Swainson's hawk and other species associated with idle land but not rice. However, other scenarios are equally plausible, and it would be speculative to quantify the habitat that could be affected, and base mitigation on that estimate.

In addition to these local effects, development also degrades wildlife habitat through landscape-scale effects on the distribution of habitat. These effects are described in sections of this report addressing effects on connectivity, the habitat value of existing reserves, and on covered species.

3.4.2 HABITAT QUALITY AT PROPOSED RESERVES

Habitat quality would be increased through preservation and management of at least 345 acres at the Spangler, Natomas 130, Greenbriar, and DEIR mitigation sites. Habitat quality would increase at these sites because:

1. Habitat would be preserved in perpetuity;
2. Habitat would be monitored and actively managed for the benefit of covered species;
3. Habitat would not be subject to continuous disturbance caused by farming or canal maintenance activities; and
4. Habitat would be relatively free of human intrusion (USFWS 2003).

In addition to the increase in habitat quality resulting from preservation, habitat quality would be increased at the proposed reserves as a result of habitat enhancement and conversion to land cover types that provide higher quality habitat.

As part of the proposed project, at the Spangler site, 184 acres of rice at the Spangler site and 14 acres of upland at the Natomas 130 site would be converted to marsh that provides higher quality habitat, and would be managed to increase habitat quality for covered species, particularly giant garter snake. Managed marsh provides substantially greater habitat values for giant garter snakes than does rice for several reasons. These reasons include:

- Giant garter snakes primarily use the margins of rice fields, whereas they use the full extent of managed marshes. These marshes are designed to provide open water, foraging habitat, dense cover, basking sites, and refugia in close proximity throughout the marsh. (For example, an acre of managed marsh provides several times the edge habitat than does a rice field.)

- Marshes provide habitat throughout the active period of the snake. Rice fields do not provide habitat during early and mid-spring, and are typically drained before the end of the snake's active period. Thus, for a portion of their active period, giant garter snakes must rely entirely on non-rice habitats. In the Natomas Basin, these habitats are canals and managed marsh. In contrast, managed marshes provide habitat year-round.

- Rice is fallowed periodically, and thus does not provide habitat in all years; in contrast, a managed marsh does provide habitat in all years.

The quality of existing upland habitats also would be enhanced at the proposed reserves and the DEIR mitigation site(s). Upland habitat at the proposed Spangler and Natomas 130 reserves would be enhanced, and additional mitigation land (at least 49 acres) would be enhanced through conversion to alfalfa (or would be otherwise managed to provide high quality foraging habitat for Swainson's hawk).

However, some uncertainty exists regarding the magnitude of habitat enhancement that would result from the project. For example, marsh creation would be used to replace habitat values lost at the Greenbriar site because marsh has greater habitat value than rice. (The general basis for this scenario is repeatedly outlined in the NBHCP, EIR, and BO.) And, for the reasons given previously, this difference in habitat value is inferred to be substantial. But, studies have not yet been conducted that document this difference in habitat value between managed marsh and rice. Furthermore, most marshes created by TNBC are only several years old, and the habitat attributes of created marsh changes rapidly during their first few years. Therefore, the long-term results of marsh creation and management have not yet been determined. Currently, it is known that giant garter snakes are using created marshes to some extent, our understanding of giant garter snake's ecology supports arguments that marsh

provides substantially higher quality habitat than rice (and higher quality than canals), and preserved lands are more likely to continue to provide habitat than unpreserved lands.

The effects of changes in the quality of habitat provided by enhanced and preserved land, are further described in the sections of this report that address potential effects on each covered species.

3.4.3 HABITAT QUALITY FOR SWAINSON'S HAWK FORAGING

The effects of the Greenbriar project on the quality of Swainson's hawk foraging habitat was evaluated through three analyses: acres of foraging habitat in low, moderate and high quality categories; total acres of foraging habitat available per month; and total foraging habitat available each month expressed as an equivalent acreage of high quality foraging habitat. The first two analyses (acres by habitat quality category and monthly availability) were conducted as in the NBHCP, and the third was developed for this evaluation of the Greenbriar project. All three methods are described in detail in the methods section. The acres of habitat types at the Greenbriar, proposed reserve and DEIR mitigation sites with and without the project that were used in these analyses of effects on Swainson's hawk foraging habitat are shown in Table 2-2.

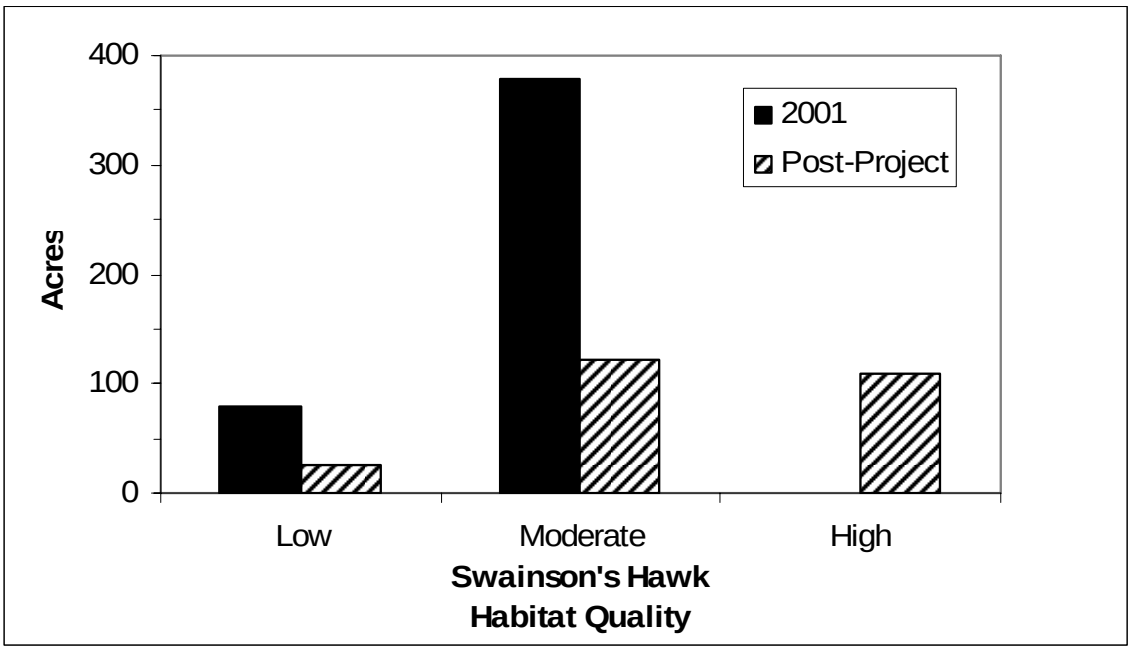
The project would result in a net loss of habitat acreage but an increased percentage of the remaining habitat would be in the high quality category (Exhibit 3a). This increase in high quality habitat would result from enhancement of habitat at the Spangler, Natomas 130, and the DEIR mitigation sites. Upland habitat at the proposed Natomas 130 reserve would be enhanced, and high quality foraging habitat would be created at the proposed Spangler reserve and to satisfy the DEIR mitigation at least 49 acres of land would be enhanced and managed to provide high quality foraging habitat for Swainson's hawk.

Based on the analysis approach in the NBHCP, the project would result in greater availability of foraging habitat during April–September, despite causing a net loss in overall acreage of habitat (Exhibit 3b). (However, this approach assumes that row and field crops are not available to foraging hawks except at harvest, and thus underestimates the acreage of foraging habitat available, particularly during April–May, which is prior to the harvest of row and field crops in the Natomas Basin.)

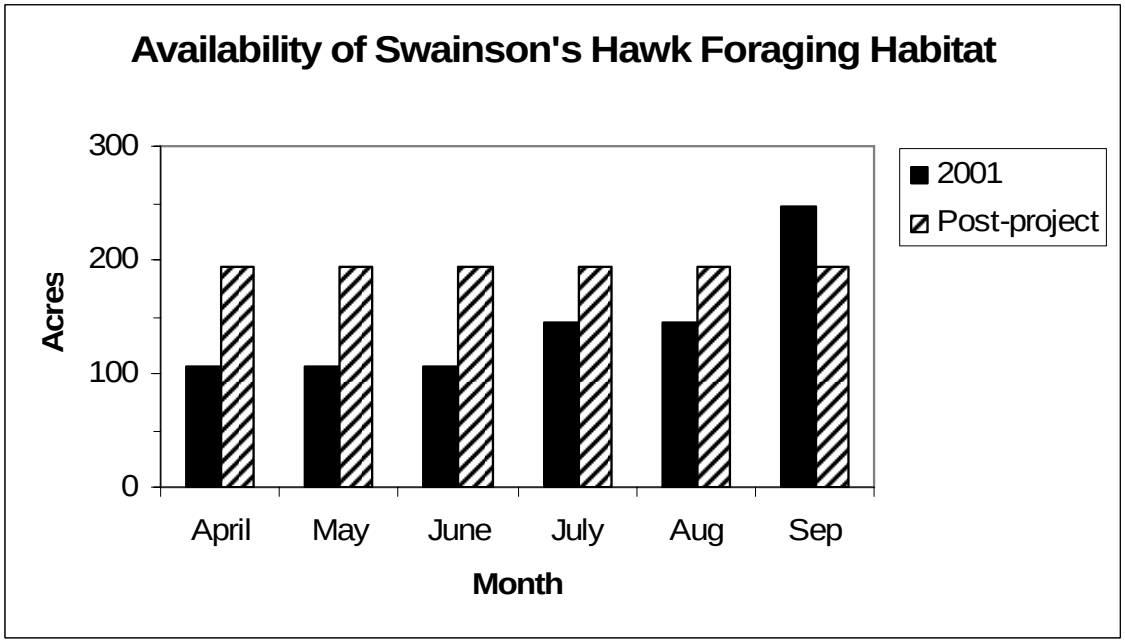
Based on EDAW's evaluation approach, total foraging resources would be comparable with and without the project. At the Greenbriar, proposed reserve, and DEIR mitigation sites, during April–June, slightly greater foraging resources would be available with the project (the equivalent of 129 acres of high quality foraging habitat with versus 122 acres without the project), while during July–September there would be less (129 versus 140 acres in July–August and 162 acres in September) (Exhibit 4). (Throughout the Natomas Basin, during July–September, more foraging resources are available because that is when most crops are harvested [CH2M HILL 2003].)

3.5 CONNECTIVITY OF HABITAT IN THE NATOMAS BASIN

The Greenbriar project would cause adverse and beneficial effects on connectivity of habitats in the Natomas Basin. By developing the Greenbriar site, it would fragment habitats for loggerhead shrike, burrowing owl, Swainson's hawk, and the other covered bird species, which would adversely affect connectivity. It also could cause detrimental effects on connectivity because of human disturbance and predation on giant garter snake and northwestern pond turtle using habitat along Lone Tree Canal. However, the project and the DEIR mitigation include measures to reduce human disturbance and predation effects resulting from the project, and to create and enhance habitat along Lone Tree Canal, which would beneficially affect connectivity of canal and marsh habitats. In addition, the proposed reserves would increase connectivity of habitats for giant garter snake and northwestern pond turtle. Further, the project would ensure the long-term conservation of a corridor along a segment of Lone Tree canal. This canal is important for maintaining connectivity of canal habitats between the southern and northern Natomas Basin, but a corridor along the canal has not yet been preserved.



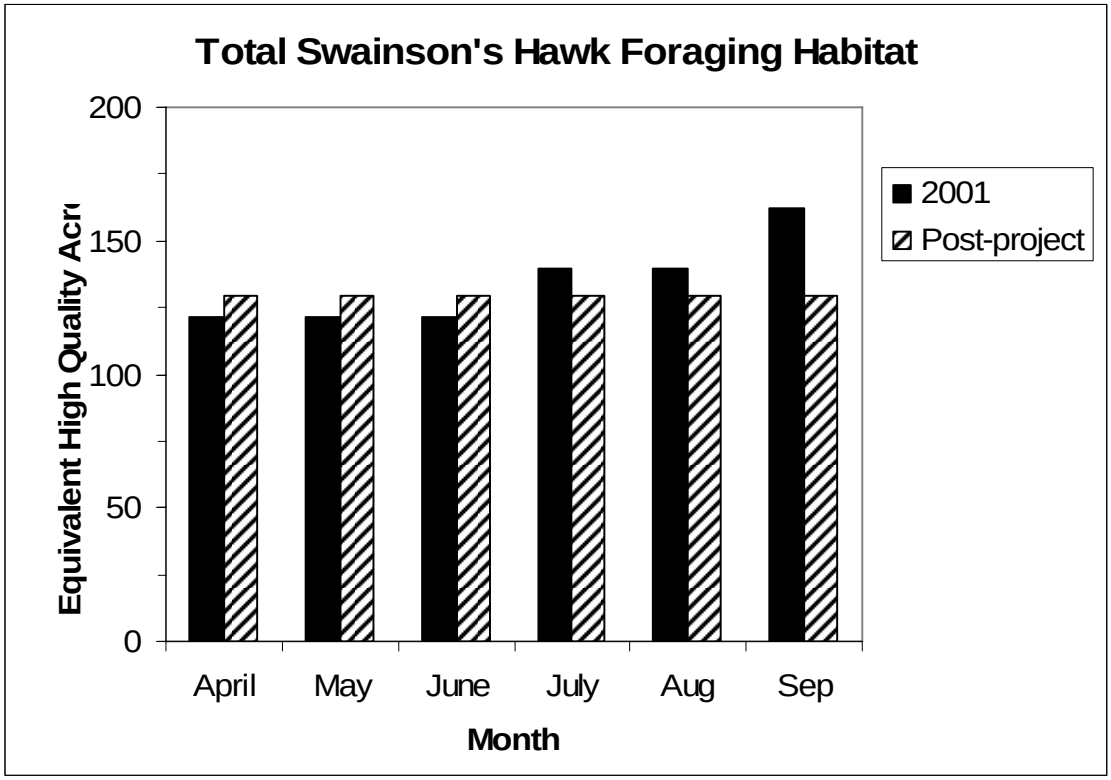
A) Total acres of high, moderate, and low quality habitat at the project and mitigation sites; quality assessed as in CH2M Hill 2003.



B) Acres of foraging habitat available by month; availability of prey assessed as in CH2M Hill 2003.

Notes: Estimates are based on approach used by CH2M Hill to support the NBHCP.
Sources: Wildlands 2005, DWR 1993, and CH2M Hill 2001

Quality and Availability of Swainson's Hawk Foraging Habitat at the Project and Mitigation Sites **Exhibit 3**



Low, moderate, high-moderate, and high quality habitats were combined in an estimate of the acreage of high quality habitat providing equivalent foraging resources, as described in the methods section.

Sources: Wildlands 2005, DWR 1993, and CH2M Hill 2001

Total Swainson's Hawk Foraging Habitat **Exhibit 4**

Overall, the project (with the mitigation included as part of the project design and with the DEIR mitigation) is unlikely to significantly reduce connectivity of habitat for covered bird species. Depending on the location, land cover, and management of the mitigation land providing foraging habitat for Swainson's hawk, the project could cause small, but significant, effects (adverse or beneficial) on connectivity of habitat for covered bird species.

The following sections provide a detailed description of the Greenbriar project's effects on connectivity at the regional and local levels, and along Lone Tree Canal. This section also evaluates the effect of the Greenbriar project on the implementation of the connectivity measures in the NBHCP's conservation strategy.

3.5.1 OVERVIEW OF EXISTING AND FUTURE CONDITIONS

In 2001 and currently, the proposed Greenbriar site provides agricultural and canal habitats, as do some adjacent lands. However, because the Greenbriar site is bordered to the south and east by Interstate 5 and State Route 99, respectively, habitats for less mobile animals, or those highly sensitive to human disturbance, are at least partially isolated from similar habitats to the east or south. Birds, including covered species, can fly over these highways. The Greenbriar site's canal habitats are connected to similar habitats to the south by a culvert under Interstate 5 through which Lone Tree Canal flows, and the site's canal habitats are also connected to habitats north of the site by Lone Tree Canal and a culvert in the northeastern corner of the site. These culverts may limit animal movement from the southern to central Natomas Basin across the site. Nonetheless, Lone Tree Canal currently

provides a movement corridor and habitat for giant garter snake. In recent years, flows in the canal have not been optimal for giant garter snake, although the Metro Air Park HCP provides assurances that at least some water will be present in this drainage canal in the future (see pages 70-71 in Thomas Reid Associates 2001). The other canals within and along the southern and eastern borders of the Greenbriar site also have recently provided (or still provide) some habitat for giant garter snake, and they may also serve as a movement corridor. Lone Tree Canal is the primary remaining corridor for movement of giant garter snakes between the southern and central portions of the Natomas Basin (C. Aubry, pers. comm.; E. Hansen, pers. comm.). Loss of this corridor could isolate the southern portion of the Natomas Basin, dividing the current giant garter snake population into two smaller populations, which would substantially reduce the likelihood of giant garter snakes persisting in the Natomas Basin.

Under the future condition (i.e., assuming development as permitted under the NBHCP), the Greenbriar site would occupy much of one of two remaining corridors connecting the southern and central Natomas Basin. Except for these two corridors, the Sacramento International Airport, Metro Air Park and City of Sacramento would separate the southern and central Basin (Exhibit 1). A western corridor, between the airport and the Sacramento River, would be 0.4–1.6 miles wide. This western corridor may not contain sufficient canal, rice and wetland habitats to provide for connectivity of populations of giant garter snake, western pond turtle and other wetland and aquatic species between the southern and central portions of the Natomas Basin. To the east, another corridor would pass between the Metro Air Park and the City of Sacramento. At Interstate 5, this corridor would be about 0.4 miles wide and at the northern end of the Greenbriar site it would be almost a mile wide. In this eastern corridor, the Lone Tree Canal, which passes under Interstate 5, would be an important waterway, and possibly the only waterway, connecting habitats in the southern and central Natomas basin (Jones & Stokes 2005; C. Aubry, pers. comm.; E. Hansen, pers. comm.); this canal has a north-south orientation along the western edge of this corridor.

Under the future condition, the proposed Spangler and Natomas 130 reserves would be outside of but adjacent to permit areas where development has been authorized. The northern border of the proposed Spangler reserve would be immediately adjacent to development in the Sutter County permit area. The eastern border of the proposed Natomas 130 reserve would be across Fisherman's Lake from development in the City of Sacramento's permit area.

3.5.2 CONNECTIVITY OF AQUATIC, WETLAND, AND RICE HABITATS WITHIN THE NATOMAS BASIN

Within the Natomas Basin, aquatic, wetland, and rice habitats are connected by a series of irrigation and drainage canals. Most of these waterways are suitable for use and movement of a variety of animals, including giant garter snake and western pond turtle, and thus provide movement corridors for these animals between wetland and rice habitats.

In the Natomas Basin, irrigation water is provided by Natomas Central Mutual Water Company (Natomas Mutual), a private water company. Natomas Mutual diverts water from five locations along the Sacramento River and the Natomas Cross Canal, and distributes this water throughout the Basin through a series of canals and pump stations.

Drainage and flood control is provided by Reclamation District (RD) 1000, a public agency. RD 1000 operates the primary drainage canals within the Natomas Basin and is responsible for conveying and pumping nonurban stormwater runoff from the Basin. Runoff from agricultural lands within the Natomas Basin flows into numerous local drainage ditches that ultimately flow into the primary RD 1000 canals. RD 1000's primary system of interior drains includes the following:

- The East Drainage Canal conveys drainage water from the northern and eastern Natomas Basin to its confluence with the Main Drainage Canal northwest of the Interstate 80 (I-80)/Interstate 5 (I-5) interchange. At its closest point the East Drainage Canal is approximately 1.8 miles east of the Greenbriar site.

- The West Drainage Canal conveys drainage water from the western Natomas Basin northwest of Sacramento International Airport to its confluence with the Main Drainage Canal. Fisherman's Lake, a natural slough, is a portion of the West Drainage Canal. The West Drainage Canal is approximately 3,000 feet (0.6 mile) south of the Greenbriar site at its closest point across I-5, just before the drainage canal turns south toward Fisherman's Lake.

- The Main Drainage Canal conveys the combined flows of the East and West Drainage Canals from their confluence northwest of the I-80/I-5 interchange through South Natomas west of I-80. Drainage water from the Main Drainage Canal is pumped into the Sacramento River approximately 5 land miles to the south (downstream) of the Greenbriar site.

- The North Drainage Canal is an interior canal that conveys drainage water from the Sutter County portion of the Natomas Basin northward, where it is pumped into the Natomas Cross Canal.

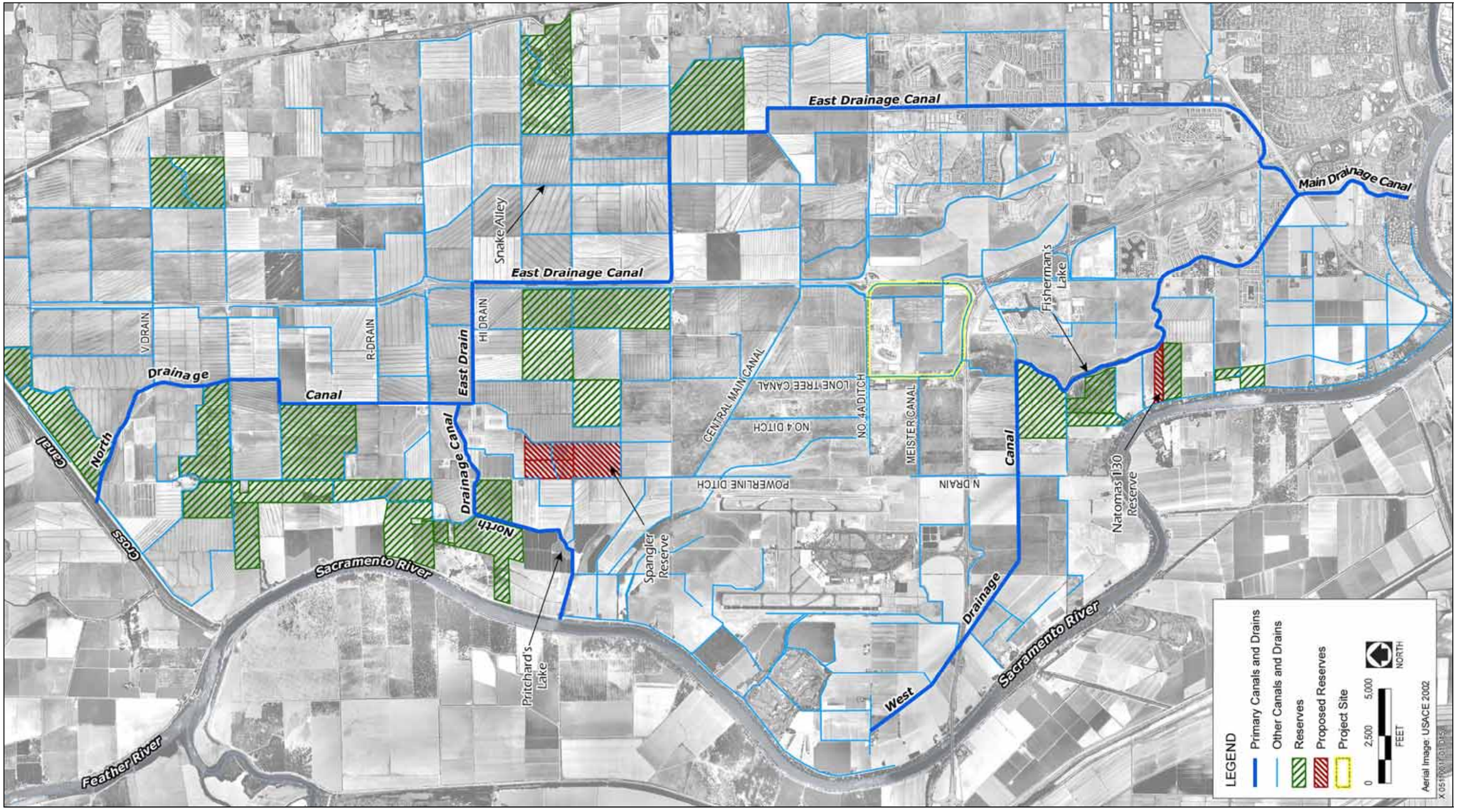
- The Cross Canal conveys drainage water from central portions of Sutter County westward to the Sacramento River. The Cross Canal connects with the Sacramento River approximately 7.1 miles north of the Greenbriar site.

- The Natomas East Main Drainage Canal conveys drainage water from Dry Creek, Arcade Creek, and a large portion of the Natomas area north of the confluence with Dry Creek. The Natomas East Main Drainage Canal is also referred to as Steelhead Creek. The Natomas East Main Drainage Canal outfalls to the Sacramento River at the northern edge of Discovery Park and near the confluence of the Sacramento River and American River approximately 5.2 miles south of the Greenbriar site.

These primary drainage canals are significant corridors of aquatic habitat to which the entire drainage network is connected. Exhibit 5 graphically depicts this primary drainage system.

Although the canal network hydrologically connects aquatic and wetland habitats throughout the Natomas Basin, roads impede or block the movement of many animals through aquatic or wetland habitats. Even for animals that could attempt crossing a road surface, such as turtles and snakes, major roads are effectively impassable (Forman et al. 2003, Dodd et al. 2004, Aresco 2005). For major roads, passage is restricted to the culverts through which the canal waters flow. Culverts are themselves obstacles to animal movement; although a wide variety of animals will move through culverts, for most species, the frequency of these movements is low (Yanes 1995, Rodriguez et al. 1996, Clevenger et al. 2001, Forman et al. 2003, Ng et al. 2004). In general, the use of culverts decreases with their length and with the presence of fencing or debris pits (Yanes 1995, Rodriguez et al. 1996, Clevenger et al. 2001, Forman et al. 2003, Ng et al. 2004). Nonetheless, regular animal crossings (including by other species of garter snake) have been documented through even long culverts that are comparable to those under I-5 (see Forman et al. 2003, Ng et al. 2004, Dodd et al. 2004). Conversely, the use of culverts increases with presence of adjacent habitat or cover, roadside fencing that "funnels" animals towards culverts, and with increased visibility through the culvert (Yanes 1995, Rodriguez et al. 1996, Clevenger et al. 2001, Forman et al. 2003, Ng et al. 2004).

Within the Natomas Basin, Interstate 5 (I-5) and State Route 99 (SR 99) are major barriers to animal movement that are crossed by only a few long culverts. Thus, habitat south of I-5 (i.e., in the southern Natomas Basin), such as at Fisherman's Lake, is partially isolated from habitat north of I-5. Similarly, habitats west of SR 99 (i.e., in the northwestern Natomas Basin), such as at Pritchard Lake, are partially isolated from habitat east of SR 99 (i.e., in the northeastern Natomas basin), such as Snake Alley.



Source: CH2M Hill, EDAW 2005

Canals and Drains of Natomas Basin **Exhibit 5**

In 2001 and presently, habitats east and west of SR 99 are linked by culverts on the V Drain, R Drain, H1 Drain, and Central Main Canal; each of these canals in turn connects to a series of drains and ditches.

In 2001, aquatic habitats north and south of I-5 were linked through culverts by the West Drainage Canal, the N Drain (parallel to Powerline Road), and the Lone Tree Canal. The West Drainage Canal passes north under I-5 to the west of the airport. The N Drain and Lone Tree Canal pass north under I-5 to the west and east of MAP where each is connected to a series of ditches, drains, and canals (including Meister Canal) throughout the northwestern portion of the Basin, and to the culverts under SR 99 to the northeastern portion of the Basin. After it passes under Interstate 5, the N Drain, via Powerline Ditch, also connects giant garter snake habitats south of I-5 to those in the northwestern portion of the Basin.

However, as the development authorized by the MAP HCP and the NBHCP has occurred, and will occur, the system of canals connected to the culverts under I-5 has been changing and will continue to change. Except for the West Drainage Canal, all corridors connecting giant garter snake habitats in the southern Natomas Basin to habitats north of I-5 pass through or drain the MAP, and thus they all will be altered under the future condition of the Natomas Basin permitted by the NBHCP. Development authorized by the MAP HCP and NBHCP will eliminate the Powerline Ditch, No. 4 and 4a ditches, and Meister Canal, eliminate water sources to the Airport East Ditch, and replace the open Central Main Canal with an underground pipe. It also will affect habitat along Lone Tree Canal by reducing the area of land draining into Lone Tree Canal, placing urban development along one side of the canal, and widening Elkhorn Boulevard to six lanes (Thomas Reid Associates 2001, USFWS 2002). (The widening of Elkhorn will not increase the length of the culvert, which is already 115 feet long, but it will increase its diameter from 2.5 feet to 4 feet.

Thus, under the future condition permitted by the NBHCP, giant garter snake habitat south of Interstate 5 would be largely isolated from habitat north of Interstate 5. Two possible corridors would remain: the West Drainage Canal and Lone Tree Canal. Both corridors could connect important habitats in the southern Natomas Basin (such as Fisherman's Lake which is along the West Drainage Canal) with those in the northwestern and northeastern portions of the Basin. Along both of these potential corridors, there will be obstacles to giant garter snake movement. Both waterways will pass under Interstate 5 through long culverts (over 300 feet long). The West Drainage Canal currently has limited connection to other waterways north of Interstate 5; in the future, it will probably remain isolated because zones of canals and drainage ditches that are currently not suitable habitat for giant garter snake will likely continue to separate it from habitats north and east of the airport. Lone Tree Canal will pass through a culvert under Elkhorn Boulevard (115 feet long). Development of the Metro Air Park will also affect water flow within Lone Tree Canal, however, the MAP HCP includes provisions under changed circumstances (pages 70-71 in Thomas Reid Associates 2001) that address these effects if water levels are less than 12 inches.

Even if snake movement along these north-south corridors were a rare event, this movement would be very important. It would allow genetic interchange between the Basin's northern and southern subpopulations of giant garter snake, and it would allow giant garter snakes to reestablish in the southern Natomas Basin if that smaller subpopulation were to become extirpated (e.g., due to environmental fluctuations or demographic stochasticity).

Thus, although the relative importance for connectivity of the Lone Tree Canal was not described in the NBHCP, the opportunity for giant garter snakes to move along Lone Tree Canal will be important for the viability of the giant garter snake population in the Natomas Basin.

Under the future condition permitted by the NBHCP at the Greenbriar site, water in Lone Tree Canal would flow south under Elkhorn Boulevard through a 4-foot diameter culvert 115 feet long. It would then flow in a waterway 12 feet wide at the bottom and about 6 feet deep. Along this waterway, set back 25 feet from its western bank will be a low wall 3 feet high, on the other side of which will be Lone Tree Road and commercial and industrial development. Along the eastern bank will be agricultural, ruderal, or natural vegetation. This vegetation would extend for nearly a mile and if cultivated it would include waterways that irrigate and drain the area. At the

southern end of the Greenbriar site, water from the Metro Air Park would enter the canal, and together these waters would flow into three 8-foot by 5-foot box culverts and two 6.5-foot diameter pipes, and pass under Interstate 5.

For this section of Lone Tree Canal between the Interstate 5 and Elkhorn Boulevard culverts, the Greenbriar project would alter these future conditions. The following description of conditions under the future condition with the Greenbriar project is based on the description of the Greenbriar project in the DEIR, BA, the draft conceptual mitigation plan for the project and mitigation measure 6.13-1 of the DEIR. Water would still flow through a 4-foot diameter culvert 115 feet long under Elkhorn Boulevard; there would still be a low wall and development along the western shore, and water would still enter from the Metro Air Park and then flow under Interstate 5 through three 8-foot by 5-foot box culverts and two 6.5-foot diameter pipes. However, near the center of this section of Lone Tree Canal, there would be an additional road crossing (100 feet wide with a 50-foot span that would be 7 feet in height) where Meister Way would cross the canal and an additional road crossing where residential Street 3 would cross the canal (a 53-foot wide crossing). (These crossings would be designed to minimize obstacles to giant garter snake movement [as described in mitigation measure 6.13-1 of the DEIR].) Also, along the eastern bank would be strip (a bench) of tules and other emergent vegetation. This strip of marsh and open water would be relatively narrow; grassland would be on its far side, and within 250 feet of the water flowing in the canal would be a barrier wall and fence separating the corridor along the canal from residential development to the east. There would also be fencing and a wall along Meister Way where it crossed the corridor of managed vegetation along Lone Tree Canal.

This corridor of vegetation along the eastern bank, and the associated structures, would be developed, preserved, maintained, monitored, and adaptively managed by TNBC or another 503(C)(1) organization. This management would be funded by an endowment sufficient for this purpose provided along with the fee title to TNBC (or another 503(C)(1) organization if necessary) which will be established through the process of developing an HCP for the project.

Flows within the canal would also be maintained. The MAP and Greenbriar projects would reduce the area draining into Lone Tree Canal. However, the MAP HCP contains assurances that sufficient water will be maintained in Lone Tree Canal to provide aquatic habitat (as described on pages 70-71 in Thomas Reid Associates 2001), and the Greenbriar project provides an additional assurance that suitable aquatic habitat will be maintained (as described in mitigation measure 6.13-1 of the DEIR).

3.5.3 POTENTIAL CONSEQUENCES OF THE GREENBRIAR PROJECT FOR FUTURE CONNECTIVITY

Development of the Greenbriar site, and the creation, enhancement and preservation of habitat at the proposed reserves, could affect the connectivity of habitats at local and regional scales. At a local scale, both development and habitat enhancement/restoration alter the spatial distribution of habitat. Development reduces connectivity and the quantity of habitat accessible to individuals on nearby lands, increases the distance individuals must travel to meet their needs for food and shelter, and increases the risks individuals are exposed to during these movements. Conversely, the enhancement and creation of habitat can increase connectivity, by creating larger areas of contiguous habitat, increasing the food and shelter provided by habitat, or by facilitating movement of individuals. The preservation and active management for habitat values also can maintain connectivity.

POTENTIAL EFFECTS ON CONNECTIVITY AT A LOCAL SCALE

Development of the Greenbriar site would adversely affect connectivity of some habitats at a local scale. At this scale, development of the Greenbriar site would reduce the quantity and contiguity of habitat available to individuals of some species using this site and adjacent lands. These individuals would lose part or all of the habitat in their home ranges or territories, and the remaining habitat could be split into separate pieces (i.e., fragments) that would be isolated by development, or require increased risk and energetic cost to access. This

fragmentation of habitat would occur along the northern and southern borders of the Greenbriar site where lands would not be developed under the future condition resulting from the NBHCP, and it would occur along the western border for those species still able to use the remaining corridor of land as habitat. Habitat fragmentation attributable to the Greenbriar project could affect all covered species, except those associated with vernal pools. For example, both burrowing owl and loggerhead shrike currently use the Greenbriar site; after development of the project, patches of habitat for these species would be smaller in size and separated by greater widths of non-habitat.

Conversely, the connectivity of habitats at a local scale would be increased by the creation, enhancement, and preservation of habitat at the proposed Spangler and Natomas 130 reserves, and at the unidentified DEIR mitigation site(s) providing the Swainson's hawk foraging habitat. For example, the marsh created at the Natomas 130 site would be in close proximity to similar habitats at Fisherman's Lake, and the adjoining TNBC Cummings Reserve (Exhibit 5). Based on the evaluation contained in this effects analysis, on balance, the proposed project would not adversely affect habitat connectivity within the Natomas Basin.

POTENTIAL EFFECTS ON CONNECTIVITY AT A REGIONAL SCALE

At a regional scale, development can create barriers that isolate areas of otherwise suitable habitat or can subdivide a population into two smaller, and thus less viable, populations. Conversely, habitat creation and enhancement as a result of a conservation strategy associated with development can reduce or eliminate barriers, and can increase connectivity at a regional scale.

In the absence of effective mitigation, development at the Greenbriar site could adversely affect habitat connectivity at a basin-wide scale. Land use at the Greenbriar site could affect connectivity of the southern and central Basin, because it occupies one of the two corridors of habitat that would remain under the future condition resulting from the NBHCP.

The Greenbriar project would convert this site to urban land cover except for a 250-foot wide zone that would remain along the Lone Tree Canal and patches of ruderal habitat east of the Greenbriar site (Exhibit 2). In addition, this remaining habitat along Lone Tree Canal would be crossed by Meister Way and Street 3, which would be new roads that connect the developed Greenbriar site to Lone Tree Road. This development would reduce connectivity of the southern and central Natomas Basin for some species.

If connectivity of habitats were reduced at the Greenbriar site, relatively few species would be adversely affected. First, most species in the Natomas Basin are abundant, widely distributed and highly mobile. (The species observed during monitoring for TNBC support this characterization [Jones & Stokes 2005].) This is largely a consequence of the Natomas Basin being primarily an agricultural (and developed) landscape that is frequently disturbed. Second, Interstate 5 (which is along the entire southern border of the site), and adjacent development to the east and west, already reduces use of the site as a movement corridor by terrestrial animals that are less mobile or are highly sensitive to human disturbance.

The species most likely to be adversely affected at a regional scale by a reduction in connectivity across the Greenbriar site are species dependant on the aquatic or wetland habitat in and immediately adjacent to canals. This is because under the future condition resulting from the NBHCP, there will be few corridors (or perhaps only this one) along canals between the southern and central Natomas Basin, none of which is likely to provide for relatively high levels of movement and dispersal. In particular, in the absence of comprehensive and effective avoidance, minimization, and mitigation measures to offset its effects, development at the Greenbriar site could cause substantial adverse effects on habitat connectivity for the giant garter snake.

At a regional scale, the mitigation for the Greenbriar project also could improve connectivity of wetland and rice habitats in the northern Natomas Basin through its enhancement of habitat at the proposed Spangler reserve, and in the southern Natomas Basin through its creation of marsh habitat at the proposed Natomas 130 reserve. These

sites are connected to the regional system of waterways; thus, the restoration, enhancement and preservation of habitat at these sites could facilitate the movement of covered species along these waterways. This effect, while less important than effects at the Greenbriar site, could still be significant.

The potential effects on connectivity of giant garter snake habitat are further evaluated in the following section.

POTENTIAL EFFECTS ON CONNECTIVITY OF GIANT GARTER SNAKE HABITAT AT THE GREENBRIAR SITE

The effects analysis for the connectivity of giant garter snake habitats are based on several assumptions including:

1. Giant garter snakes currently use Lone Tree Canal at the Greenbriar site and are likely to continue to do so under the future condition resulting from the NBHCP;

2. Occasionally snakes cross through the culverts under Interstate 5;

3. The frequency of crossings under Interstate 5 is affected by the extent that snakes use the adjacent sections of Lone Tree Canal;

4. The level of snake use is affected by the habitat features provided by Lone Tree Canal and immediately adjacent land (i.e., movement along the canal is not independent of habitat availability and condition along the canal); and

5. Mitigation for other projects affecting Lone Tree Canal south of Interstate 5 and north of Elkhorn Boulevard would sustain giant garter snake habitat along those segments of Lone Tree Canal.

In the absence of effective mitigation to maintain or improve connectivity, the Greenbriar project could substantially affect the use of Lone Tree Canal (and of the entire Greenbriar site) by giant garter snakes. The project would:

- eliminate canals and natural vegetation within the Greenbriar site,
- create additional road crossings of Lone Tree Canal at Meister Way and Street 3,
- create residential development within 250 feet of Lone Tree Canal, and
- reduce the acreage draining into Lone Tree Canal (potentially reducing flow in the canal).

In the absence of mitigation, these changes could affect giant garter snake use of Lone Tree Canal. Developing agricultural land at the Greenbriar site would directly eliminate habitat that provides prey, cover, basking sites, and refugia. Additional obstacles, increased predation, and increased human activities all could degrade the quality of remaining habitat, increase mortality and reduce snake use of this segment of Lone Tree Canal.

To offset the effects resulting from these changes and to retain giant garter snake habitats and the movement corridor along Lone Tree Canal, the project would have to:

- Assure that water would be provided in the canal to maintain adequate aquatic habitat,

- Minimize effects on giant garter snake movement at the crossings of Meister Road and Street 3,

- Maintain vegetation and conditions along the canal and in adjacent uplands to meet requirements for giant garter snake use and movement, and

- Reduce the effects of human disturbance, mortality from vehicle collisions, and predation by the cats, dogs, and wildlife associated with developed land uses.

Thus, measures would need to include:

- Providing some water to the canal in perpetuity or otherwise ensuring that adequate aquatic habitat would be maintained,
- Restricting adjacent land uses to allow only those compatible with provision of snake habitat, barriers to human and animal use of the site,
- Designing the Meister Road and Street 3 crossings to minimize impediments to snake movement (e.g., maximize cross-sectional area of and visibility across the canal crossing),
- Incorporating barriers that prevent giant garter snake access to developed areas and visually screening developed areas, and
- Funding site maintenance and management of habitat along the canal and on adjacent land.

The Greenbriar project with applicant-proposed and DEIR mitigation, includes such a set of measures. Measures in the DEIR include:

a. To ensure that the project does not diminish habitat connectivity for giant garter snake between the southwest and northwest zones identified in the NBHCP, approximately 30.6 acres along Lone Tree Canal shall be protected and managed as giant garter snake habitat. This on-site habitat preservation shall protect an approximately 250-foot wide corridor of giant garter snake habitat that includes the canal and approximately 200 feet of adjacent uplands. Uplands within the linear open space/buffer area shall be managed as perennial grassland as described below. Additional aquatic habitat for giant garter snake shall be created along the east bank of Lone Tree Canal by construction and maintenance of a 2.7 acre tule bench. The habitat shall be managed in perpetuity as high-quality habitat for giant garter snake. Compliance and biological effectiveness monitoring shall be performed and annual monitoring reports prepared within six months of completion of monitoring for any given year. This monitoring, reporting, and adaptive management shall be performed as described in Section IV of the NBHCP.

b. To ensure that the project does not diminish giant garter snake movement along Lone Tree Canal, all new road crossings of Lone Tree Canal shall be designed to minimize obstacles to giant garter snake movement. The use of culverts under new road crossings on Lone Tree Canal shall be prohibited unless it can be demonstrated that the culverts will not diminish the potential for giant garter snake movement through the section of Lone Tree Canal protected by the setback fence and conservation easement. .

c. Upland giant garter snake habitat within the Lone Tree Canal linear open space/buffer area shall be created and managed to provide cover, basking areas, and refugia during the winter dormant period. Hibernaculae would be constructed at regular intervals by embedding concrete or coarse rock in the bank or in a berm along the Lone Tree Canal corridor to provide additional winter refugia. Upland habitat with the linear open space/buffer areas shall be converted to native perennial grassland and managed, in perpetuity, as perennial grassland habitat.

d. Aquatic habitat shall be maintained throughout the giant garter snake active season in Lone Tree Canal, in perpetuity. This is the legal responsibility and obligation of Metro Air Park property owners (MAP). The MAP HCP includes provisions for maintaining water in the canal such that the basic habitat requirements of the giant garter snake are met. The MAP HCP also provides a road map, through “Changed Circumstances”, to address procedures to follow if water is not being maintained in the canal to meet these requirements. As described in the MAP HCP, the MAP is legally obligated to assure these requirements are met, and financial and procedural mechanisms are included in the MAP HCP to enforce this. It is, therefore, assumed that MAP will provide water to Lone Tree Canal, as required by the MAP HCP and ITP, in perpetuity. It is also assumed that USFWS will use all reasonable means available to it, to enforce this MAP HCP requirement. If

water is not provided to Lone Tree Canal by the MAP to meet the habitat requirements of giant garter snake, as required by the MAP HCP, and USFWS exhausts its enforcement responsibilities, the project applicant shall assume the responsibility of providing suitable giant garter snake aquatic habitat throughout the section of Lone Tree Canal protected by the fence and conservation easement. However, as stated herein, the project applicant shall only assume this responsibility if it has been sufficiently demonstrated to the City that USFWS has exhausted all reasonable means to compel MAP to comply with the relevant conditions of the MAP ITP. Specific requirements related to ensuring suitable aquatic habitat in Lone Tree Canal is present, in perpetuity, throughout the giant garter snake active season shall be developed through consultation with DFG and USFWS, and included in the new or amended HCP for Greenbriar, and may include mechanisms, such as installation of a well, to assure water is provided in the canal to meet habitat requirements.

e. A barrier shall be installed between the giant garter snake habitat linear open space/buffer area and the adjacent Greenbriar development to ensure that giant garter snakes do not enter the development area, and to prohibit humans and pets from entering the giant garter snake habitat. The design of this barrier shall be subject to USFWS and CDFG review and approval. The entire length of the barrier, which shall be bordered by yards rather than roadways, shall be maintained on the preserve side by a nonprofit land trust to ensure that vegetation or debris does not accumulate near the barrier and provide opportunities for wildlife and pets to climb over the barrier. On the development side, Covenants, Codes and Restrictions (CCRs) shall prohibit accumulation of vegetation or debris adjacent to the barrier. Chain link fencing shall be placed at both ends of the corridor, with locked gates permitting entry only by RD 1000 and NMWD for channel maintenance, and by the preserve manager for habitat monitoring and maintenance purposes.

f. Specific requirements associated with the barrier shall be developed through consultation with USFWS and DFG, and may include the following and/or other specifications that DFG and USFWS consider to be equally or more effective:

   - Adequate height and below-ground depth to prevent snakes or burrowing mammals from providing a through-route for snakes by establishing burrows from one side to the other crossing;
   - Constructed using extruded concrete or block construction extending a minimum of 36-inches above ground level;
   - Maintenance to repair the barrier and to prevent the establishment of vegetation or collection of debris that could provide snakes with a climbing surface allowing them to breech the barrier;
   - A cap or lip extending at least two-inches beyond the barrier's vertical edge to prevent snakes from gaining access along the barrier's top edge; and
   - Signage to discourage humans and their pets from entering the area.

g. The Lone Tree Canal linear open space/buffer area shall be protected in perpetuity under a conservation easement and managed to sustain the value of this area for giant garter snake habitat connectivity. Compliance and biological effectiveness monitoring shall be performed and annual monitoring reports prepared. This monitoring, reporting, and adaptive management shall be performed as described in Section IV of the NBHCP or following procedures developed in formal consultation with USFWS and DFG and contained in an ESA Incidental Take Permit for the Greenbriar project.

Assessment of Required Width and Other Setback Attributes

To date, several recommendations have been made regarding the required width of a setback to conserve canal habitat for giant garter snake use and movement. These previous recommendations include:

- In the avoidance and minimization measures of a biological opinion for a programmatic consultation with the U.S. Army Corps of Engineers, a measure was included to avoid construction activities within 200 feet from the banks of giant garter snake aquatic habitat (USFWS 1997). The basis given for this distance was that most giant garter snake use of uplands was within 200 feet of aquatic habitat. This same biological opinion also included a requirement that replacement habitat must be located at least 200 feet from roadways "to reduce vehicular mortality" (USFWS 1997).

- The NBHCP includes a requirement (for which there may be exceptions) that reserves be at least 800 feet from existing or planned urban lands, because intensively developed land is "significantly incompatible with the objectives and purposes of the reserve system" and that urban lands are likely to cause significant adverse effects on reserve viability or on covered species occupying the reserve (City of Sacramento et al. 2003, page IV-16). The NBHCP does not include an explanation of why these effects would no longer be significant with urban land at a distance of 800 feet.

- The NBHCP includes a requirement that reserves contain a buffer (typically of natural or ruderal vegetation) 30–75 feet in width to minimize the effects of incompatible land uses. These effects are referred to as "population mortality effects"; the relationship of these effects to the width of the buffer is not described.

- Planning documents for North Natomas have included setbacks ranging from 200 to 250 feet in width between urban development and adjacent agricultural areas (Padre Associates 2005). Initially, these setbacks were intended to reduce conflicts between agriculture and development; later, open space and habitat benefits were added to their purpose.

- The Fisherman's Lake Buffer Zone Study (Padre Associates 2005) includes a species account for giant garter snake, a review of the USFWS, Natomas Community Plan, and NBHCP setbacks and buffers described above, and a brief evaluation of the effectiveness of the 250- and 800-foot wide buffers that were under consideration at Fisherman's Lake. This evaluation concludes that "For GGS, all scenarios from the City Boundary and the RD 1000 ROW Boundary alternatives would provide adequate protection of 200 feet from the edge of the channel banks per USFWS guidelines." Relationships between setback width and particular effects on giant garter snake were not evaluated in this study.

Although the documents with these recommendations did not include analyses to support their recommended setback or buffer widths, our understanding of the ecology of giant garter snake, and of the effects of development on adjacent habitats is sufficient to evaluate the width of habitat required in canal setbacks, the benefits of different buffer widths, and the need for active management and for other measures in setbacks in addition to buffers.

Without a setback that includes sufficient habitat for giant garter snake use and movement, a buffer to prevent adjacent development from degrading this habitat, other measures (such as barriers) incorporated into the setback, and active management of the setback, giant garter snakes might not use and move along Lone Tree Canal.

Determining the required width and constituents of setbacks are subject to several factors. First, increasing land values are a factor in the purchase of the needed setback areas. Second, the level of scientific understanding can adequately determine the need for setbacks, but is generally not adequate for determining the required width for the setbacks (or even a relatively wide range of widths, in many cases) (ELI 2003). In general, wider setbacks reduce adverse effects of adjacent development, but some types of effects diminish only gradually with increased setback width (such as increased predation), and some adverse effects are largely unaltered across a wide range of setback widths (such as the introduction and spread of invasive plants). Consequently, unless setbacks are actively managed and include additional measures (such as barriers) only very wide setbacks (over a thousand feet wide) can preclude most adverse effects.

Although such wide buffers would sustain habitat functions, they are often impracticable, and generally would be a more inefficient use of conservation. Narrower but actively managed setbacks with barriers are also expensive and provide relatively little habitat. They are, however, justified if the conserved habitat is irreplaceable or

otherwise of very high value. Assuming that giant garter snakes would use Lone Tree Canal under the future condition permitted by the NBHCP, and occasionally cross under I-5, Lone Tree Canal provides high value habitat that merits conservation even at a relatively high cost.

Along Lone Tree Canal, the purpose of the setback is to conserve giant garter snake use of, and movement along, the canal to facilitate the occasional movement of individuals through the culverts under I-5. In general, a moderate level of uncertainty exists of the attributes necessary for wildlife use of corridors (ELI 2003). Important factors affecting animal use of a corridor include the corridor's suitability as habitat, the feasibility of passing through the corridor and the level of effort and of risk involved in doing so. If a corridor does not meet a species' habitat requirements for residence or foraging, it may not be used for daily or seasonal movement, or for dispersal, and hence would not connect habitat patches (Noss et al. 1996, Rosenberg et al. 1997; Brinson et al. 2002).

Therefore, a setback along Lone Tree Canal should include sufficient habitat to support giant garter snake use of the canal for foraging and residence. This habitat would need to include the canal itself and adjacent uplands.

In general, even species associated with wetlands, streams and waterways may require and regularly use wide zones of adjacent uplands as habitat. For this reason, to provide habitat that meets year-round requirements, setbacks of several hundred feet or more have been recommended for many wetland- and riparian-associated animals (Semlitsch and Bodie 2003).

The width of uplands used by giant garter snakes varies considerably. Giant garter snakes primarily use canals, canal banks, immediately adjacent uplands, and the edges of rice fields. Giant garter snakes generally do not use non-rice agricultural crops (Wylie and Casazza 2000). Many summer basking and refuge areas used by this snake are immediately adjacent to canals and other aquatic habitats, and may even be located in the upper canal banks (Eric Hansen, pers. comm.).

Giant garter snakes, however, also use uplands hundreds of feet from waterways or wetlands. They have been observed hibernating as far as 820 feet from water, and any land within this distance could be important for snake survival in some cases (Hansen 1988). (Hibernaculae [i.e., hibernation sites] this distant from water, however, are most often found in areas with high winter floods.) Giant garter snakes also seek refuge in upland burrows during hot summer weather (Hansen and Brode 1993), and have been documented up to 164 feet from aquatic habitat during this time (Wylie et al. 1997). Use of sites at greater distances from wetlands is associated with landscapes where suitable close sites are not available. This is not generally the case in the agricultural landscape of the Natomas Basin because canal banks often provide refuges and hibernaculae, and the agricultural lands themselves are at slightly lower elevations than canal banks, generally have less cover and fewer refugia than canal banks, and may be flooded or tilled during winter.

The width required to provide cover, forage, refugia, and basking sites along Lone Tree Canal could be quite narrow. Many canals provide cover, foraging habitat, and refugia; and, giant garter snakes regularly use narrow corridors of habitat along canals crossing agricultural landscapes. Although giant garter snake use of, and movement along, a canal might require little more than habitat along the canal and its banks, habitat on adjacent land would likely increase giant garter snake use of, and movement along, a canal.

In addition to habitat, a setback also must contain a sufficient buffer to preclude degradation of canal habitats by human activities. Different types of effects on canal habitats could diminish substantially over short distances, gradually over relatively large distances, or the magnitude of effects could be largely unrelated to setback width. For example, alteration of local microclimates, drift of herbicides and pesticides applied on adjacent lands, and sediment and pollutants in runoff from adjacent land all typically diminish substantially across a distance of 50–100 feet (de Snoo and de Wit 1998, Wenger 1999, Forman et al. 2003).

In contrast, the effects of human disturbance diminish gradually with increasing distance. In this context, human disturbance is any human activity that changes the contemporaneous behavior or physiology or one or more animals (Nisbet 2000). Human activities could interrupt the foraging or reproductive activities of animals and

cause them to flee or avoid an area. This may expose these animals to increased risk of mortality, or reduce their reproductive success. In essence, animals perceive humans as potential predators and respond accordingly (Frid and Dill 2002). This perceived predation risk diminishes with distance, but it is affected by other factors. The sensitivity to human disturbance varies among animal species (Cooke 1980, Blumstein et al. 2003), across sites (Blumstein et al. 2003, Rodgers et al. 1997), on trails versus off trails (Miller et al. 2001), with barriers visible to animals (Ikuta and Blumstein 2003) the number of humans (Beale and Monaghan 2004), the type of activity (Holmes et al. 1993, Rodgers and Smith 1995, Rodgers and Smith 1997, Miller et al. 2001), and the visibility of humans to animals (Richardson and Miller 1997, Phillips et al. 2001). Also, to some extent, some animals habituate to human activities (Cooke 1980, Nisbet 2000).

Giant garter snakes are highly sensitive to such human disturbance, and will abandon otherwise suitable habitat as a result of increased human activity such as fishing (Eric Hansen, pers. comm.). Human visits to areas occupied by snakes could result in lowered snake abundance even when the visits are brief in duration and no more than one person, once per day (Eric Hansen, pers. comm.). Human activities can also degrade giant garter snake habitats by trampling vegetation, compacting soils, destabilizing banks, and crushing burrows.

Human use of habitats along Lone Tree Canal would diminish with increasing distance from development. However, human access from Elkhorn Boulevard, Lone Tree Road, Meister Way, and Street 3 would allow dumping, trampling of vegetation and refugia, and harassment of snakes to occur almost independent of buffer width. This human access would probably reduce giant garter snake use of this section of Lone Tree Canal. Maintained fences, however, would probably reduce human access to levels that would not reduce snake use of the canal or degrade habitat quality by trampling vegetation and damaging banks.

Similarly, domestic and feral cats and dogs associated with residential development can range widely (hundreds of feet), and harass or prey upon a wide variety of small animals (Crooks and Soule 1999, Hayes et al. 1999, Risbey et al. 2000, Odell and Knight 2001, Lepczyk et al. 2003). Therefore, although it has not been studied, such harassment and predation of giant garter snakes should be considered likely until evidence indicates otherwise. In addition to causing mortality, this predation and harassment could reduce giant garter snake use of the canal. A wide variety of fences have been used to exclude cats and other animals from conserved areas, and many have been found to be effective with regular maintenance (Long and Robley 2004, Moseby and Read 2005).

Some effects are unrelated to buffer width. For example, the effects of road crossings and other structures within setbacks are not mitigated by increasing buffer width. Roads frequently are located across riparian areas, canals, and conserved corridors. These crossings can provide human access across buffers and setbacks, alter physical processes, cause mortality of animals from collisions with vehicles, and create obstacles to animal movement.

At the Greenbriar site, existing culverts on Lone Tree Canal reduce animal movement and the project would also add an additional road crossing at Meister Way and at an additional residential street (Street 3). The canal would not pass under Meister Way through a culvert but rather the roadway would span the canal leaving a 50-foot wide by 7-foot high space for the canal to flow through. At Street 3, the crossing would be 53 feet wide, and although flow under the crossing could be accommodated by two 42-inch culverts, mitigation measure 6.13-1 of the DEIR prohibits placing Lone Tree Canal in culverts at new road crossings (unless it is demonstrated that the culverts would not reduce the potential for giant garter snake movement). Thus, this crossing also would likely be an open span. The effect of these crossings would not be directly related to setback width, but the flow of water through this section of canal, and the enhancement and management of vegetation near the crossings, would likely affect giant garter snake use.

Collisions with vehicles may be an important source of mortality for giant garter snake (Leidy 1992; E. Hansen pers. comm.). Numerous studies have documented mortality of snakes along roads (Rosen and Lowe 1994, Bonnet et al. 1999), negative correlations of reptile or amphibian abundance with road density or traffic levels (Marchand and Litvaitis 2004; Pellet et al. 2004), and the potential for roads to affect population persistence (Marchand and Litvaitis 2004; Gibbs and Shriver 2002). Increasing setback width would not reduce this effect along roads that cross the

setback. Therefore, barriers to prevent snakes from entering roads (and adjacent developed areas) should be incorporated into setbacks. The effectiveness of such barriers has been demonstrated for other species where culverts also exist to allow passage under the road (Guyot and Clobert 1988; Dodd et al. 2005; Aresco 2005).

Buffers can reduce the effects of altered hydrology where they include a considerable portion of the watershed, or where the alteration involves increased overland flow. The effects of water diversions, however, are not reduced by setbacks.

Because of the existence of effects that do not diminish with setback width (or that diminish gradually), additional measures are necessary to buffer canal habitats from adjacent land uses. These additional measures include barriers to human and pet access, visual barriers to shield nearby human activities from sight, provision of supplemental water, and active management of the buffer.

Where barriers are added to buffers, and conserved habitat and buffers are actively managed, the width required for an adequate setback (i.e., conserved habitat plus buffer) can be determined with more precision, because many types of adverse effects can be substantially reduced and some aspects of habitat structure can be maintained by human action.

For giant garter snake setbacks, the buffer must be of sufficient width to include barriers to human and pet access into the buffer, a barrier to prevent snake access to developed areas and roads, and a barrier that shields human activities in developed areas from the vision of snakes. It also should be of sufficient width to include an access road and additional habitat features that are necessary or beneficial for giant garter snake use of the protected corridor.

Because canals, unlike riparian areas, have stable boundaries, the habitat, barrier, and road components of a managed setback can be located in a zone immediately adjacent to the base of the canal bank. The width of this zone would vary primarily with the width desired for incorporating additional habitat components, because the road, fence, and other barrier features would require relatively standard widths.

A setback that consisted of a canal and a buffer of 25–50 feet from the base of each canal bank might be sufficiently wide to include a corridor of canal habitat for giant garter snake use and movement, and an access road and necessary barriers. But, it would not allow additional giant garter snake habitat to be incorporated.

Although giant garter snake uses narrow corridors within agricultural landscapes, additional habitat along canals may be necessary or beneficial in more intensively developed landscapes, particularly if such corridors are lengthy or include impediments to movement, as at the Greenbriar site. In an agricultural landscape, in addition to canal habitat, snakes have access to some cover basking sites, refugia, and foraging habitat on adjacent land, and the presence of these adjacent habitat features could influence snake use of canals. This adjacent habitat also could help protect them from predators, floodwaters, and canal maintenance and other human activities. In particular, because maintenance of vegetation along canals and fluctuations in water levels could temporarily degrade canal habitat along a conserved corridor, additional adjacent habitat may enhance use of the corridor by providing more stable conditions. (This may be important at the Greenbriar site because RD 1000 has an easement for access and maintenance of the Lone Tree Canal.)

Wider setbacks would provide the opportunity to incorporate such additional habitat, provide greater flexibility for future management, and would likely result in more effective conservation of conserved corridors along canals. Setbacks with buffers outside of the canal banks that are 100 feet or more in width probably should be sufficient to incorporate habitat components such as channels parallel to the canal and with an adjacent strip of marsh vegetation. To incorporate large water features or wide tracts of managed marsh, buffers would need to be several hundred feet wide. However, creating such extensive habitat immediately adjacent to development may not be desirable. A notable exception might be the inclusion of storm water retention basins; including these structures within canal setbacks may result in wider buffers that more effectively isolate canal habitat from development, while also making more land available for development. It is not known if storm water detention basins and associated structures can be designed to provide suitable habitat for giant garter snake.

In summary, canal habitats actively used by giant garter snake for movement along a canal may be relatively narrow (i.e., less than 50 feet from the canal banks). But, to sustain giant garter snake use of this habitat, a buffer is required to reduce adverse effects from adjacent development and allow additional habitat to be created along the canal as necessary, and to provide some flexibility for future management. To reduce adverse effects, buffers must either be very wide (hundreds to thousands of feet in width), or incorporate barriers to prevent human and pet access and to prevent giant garter snakes from entering developed areas, and must be accessible and actively managed. These components probably add 25–50 feet to the required buffer. Habitat components that may be necessary for giant garter snake use of a canal corridor through a developed landscape probably require at least an additional 50–100 feet, and some types of additional habitat features (e.g., large water bodies) may require a buffer with a width of several hundred feet. Therefore, the total width of setbacks should be at least the width of the canal and its banks, plus an additional 125–200 feet.

The setback proposed by the Greenbriar project is consistent with this width. With the DEIR mitigation it would contain fencing, barrier, habitat enhancement, and management measures, habitat would be enhanced, and the effects of adjacent land uses on this habitat would be minimized. (The specific design of fencing/barriers along Lone Tree Canal, the location of the access road, and the details of habitat enhancement and management measures would be developed in consultation with DFG and USFWS during the development of an HCP for the project.)

OVERALL EFFECT ON CONNECTIVITY OF GIANT GARTER SNAKE HABITATS

The DEIR mitigation would likely offset the Greenbriar project's effects on giant garter snake movement along Lone Tree Canal, and are in addition to, and do not conflict with, the measures incorporated into the MAP HCP. (For example, a smaller setback and a barrier also exist on the Metro Air Park side of Lone Tree Canal.)

In addition, because existing conditions do not provide high value habitat for giant garter snake along the entire length of Lone Tree Canal and are not optimal for movement of the snake along the canal, opportunities also exist to enhance connectivity. Management of the canal and adjacent uplands for giant garter snake would result in an improvement over current conditions, and over the future condition resulting from the NBHCP. The project and the mitigation proposed in the DEIR include measures to enhance habitat along the canal (e.g., the creation of marsh habitat along the eastern bank of the canal).

In conclusion, for giant garter snake, significant adverse effects on connectivity between habitats in the southern and central Natomas Basin would be unlikely, and would not cause adverse effects on the implementation of the NBHCP giant garter snake conservation measures.

3.6 CONNECTIVITY OF EXISTING TNBC RESERVES

In the absence of effective avoidance, minimization, and mitigation, the Greenbriar project could adversely affect connectivity of TNBC reserves in the Natomas Basin. As described in the preceding section, in the absence of mitigation measures proposed in the DEIR connectivity of habitats in the southern and central portions of the Natomas Basin could be reduced by the Greenbriar development, and this reduction would be substantial for species that would not pass through the corridor remaining along Lone Tree Canal.

For species not passing through the remaining corridor along Lone Tree Canal, the connectivity of TNBC reserves would be reduced. The travel distances between reserves in the southern and central Natomas Basin, with and without passing through a corridor between the Metro Air Park and the City, indicate this change in reserve connectivity. For example, passing through the Greenbriar site, the distance between the nearest reserve in the southern Basin (the Rosa property) and the nearest reserve in the central Basin (the Tufts property) is about 4 miles across uplands and 4.2 miles along canals (Exhibit 5). If development of the Greenbriar site prevented a species from passing between the Air Park and the City, these distances would become 6.7 and 8.7 miles via uplands and canals, respectively. (These distances assume that an individual that cannot pass between the Air Park and the City also can not pass between the Air Park and the Airport.) Similarly, crossing the Greenbriar site, the shortest distance between

existing reserves in the southern and central Basin (i.e., the Rosa and Ayala properties) is about 3.8 miles across uplands and 5.2 miles along canals. If development of the project prevented movement through a corridor between the Air Park and City, then these distances would increase to 9.4 and 11.2 miles via uplands and canals, respectively. Though these examples involved the southern reserves closest to the central Natomas Basin, the change in connectivity would be comparable at other reserves in the southern Natomas Basin.

However, as described in the preceding section that addressed effects on habitat connectivity, the Greenbriar project (with the mitigation proposed in the DEIR) would include a set of measures to reduce effects on connectivity; in addition, canal and adjacent upland habitats would be enhanced along Lone Tree Canal. Therefore, significant adverse effects on the connectivity of existing TNBC reserves would be unlikely.

The project's proposed off-site reserve lands also could cause some positive effects on connectivity. This would be due primarily to the enhancement of habitat on the Spangler site, which could increase connectivity among the nearby reserves to the east and northwest (the Atkinson/Ruby and Sills reserves, respectively). The preservation of additional land to provide Swainson's hawk foraging habitat (as required by mitigation measure 6.13-2 of the DEIR) also could increase connectivity of existing TNBC reserves. The location of these lands, however, has not been determined, and thus this potential benefit cannot be described in any detail.

3.7 HABITAT VALUE OF EXISTING TNBC RESERVES

The Greenbriar project would cause adverse and beneficial effects on the habitat value of existing TNBC reserves. The adverse effects would result from reducing the acreage of foraging habitat most accessible to (i.e., within 1 mile of) an existing TNBC reserve. The beneficial effects would result from preserving, creating and enhancing habitat adjacent to or near existing TNBC reserves.

3.7.1 EFFECTS OF DEVELOPMENT AT GREENBRIAR SITE

No existing TNBC reserves are within 800 feet of the Greenbriar site and only one reserve (the Rosa property) is within a mile (Exhibit 5). Development at the Greenbriar site would detrimentally affect the quantity and connectivity of foraging habitat for raptors nesting at or near this reserve, and also would similarly affect the Souza and Natomas Farms reserves that are within one and a quarter miles of the site.

The foraging habitat available to raptors nesting at these existing reserves would be detrimentally affected by development at the Greenbriar site. Of the land within a mile of TNBC's Rosa property, about 31% is in the Metro Air Park or City of Sacramento permit areas; the Greenbriar site accounts for an additional 6%. Thus, habitat value for raptors nesting at this reserve would be reduced under the future condition of the Natomas Basin, and development of the Greenbriar site would further reduce habitat value for raptors. Development of the Greenbriar site also would detrimentally affect the value of TNBC's Souza and Natomas Farms reserves for nesting raptors, though to a lesser degree than at the Rosa property because these reserves are further from the Greenbriar site (Exhibit 5).

The DEIR requires additional mitigation to offset these effects. For Swainson's hawk foraging habitat lost, mitigation measure 6.13-2 of the DEIR requires preservation of habitat that provides equal or greater habitat values than the habitat lost at the Greenbriar site. To provide equal or greater foraging habitat values, this mitigation measure would require enhancement and preservation of at least 49 acres of to provide high quality habitat within one mile of an existing TNBC reserve (or of the Swainson's hawk zone along the Sacramento River). This DEIR mitigation is in addition to the project's proposed reserves. The habitat provided by this mitigation measure would likely offset the project's effect on Swainson's hawks and other raptors residing at or near existing reserves, though the reserves benefiting from habitat enhancements may differ from those adversely affected by the loss of foraging habitat on the Greenbriar site.

Though it is possible that the project could detrimentally affect foraging habitat available to giant garter snakes at the Rosa, Souza and Natomas Farms reserves, this effect was considered insignificant. Because canals connect these reserves to habitat suitable for giant garter snake on the Greenbriar site, and because the site is within 1–2 miles of these reserves (Exhibit 5), development of the Greenbriar site could reduce the quantity of suitable habitat available to giant garter snakes foraging or residing at these reserves. While not discountable, this effect may be negligible because the culvert at Interstate 5 may restrict snake movement along the canal such that snakes residing south of Interstate 5 rarely forage north of Interstate 5. Furthermore, loss of habitat within 1–2 miles of these reserves would be partially, or perhaps even fully, offset by the creation of 14 acres of marsh habitat at the Natomas 130 parcel that is also connected to these reserves by canals, and is at a distance from the reserves comparable to that of the Greenbriar site.

3.7.2 EFFECTS OF PROPOSED RESERVES

The restoration of marsh at the proposed reserves would cause both adverse and beneficial effects on the habitat value of existing reserves. The acreage of Swainson's hawk foraging habitat would be reduced at the Natomas 130 parcel. Restoration at this proposed reserve would reduce the acreage of Swainson's hawk habitat because 14 acres of fallow agricultural land (which was non-rice crop in 2001) would be converted to marsh, which would provide only smaller areas of moderate quality foraging habitat, while only 14 acres would be enhanced for Swainson's hawk foraging on the remainder of the site. However, the enhanced foraging habitat would be of high quality which would provide resources sufficient to offset the lost habitat acreage.

The proposed reserves could increase habitat available to giant garter snakes at existing TNBC reserves in the Central Basin (i.e., the Tufts, Sills, Ruby, and Atkinson reserves) because one of these reserves (the Spangler property) could be accessible to snakes using those reserves. These existing reserves are all within two miles of the proposed Spangler reserve where marsh would be created and rice will be managed to enhance its habitat value for giant garter snake (Exhibit 5).

The project's proposed reserves would contribute to the size and connectivity of existing TNBC reserves. The North Natomas 130 parcel is immediately north of the TNBC Cummings reserve (Exhibit 5) and would increase the size of that reserve; the Spangler parcel is located between the Tufts and Atkinson reserves and is also connected to them via canals and drains (Exhibit 5); thus, it would increase their connectivity. The preservation of additional land to provide Swainson's hawk foraging habitat (as required by mitigation measure 6.13-2 of the DEIR) also could increase connectivity of existing TNBC reserves. By increasing the size and connectivity of existing reserves, and by increasing the area of preserved land in the vicinity of existing reserves, the project would beneficially affect the habitat value of existing reserves.

3.7.3 OVERALL EFFECT ON HABITAT VALUE OF TNBC RESERVES

Overall, the Greenbriar project would not adversely affect the habitat quality of the existing TNBC reserve system, and could cause a beneficial effect by preserving, creating, and enhancing habitat on adjacent or nearby lands that would benefit wildlife residing at or using existing TNBC reserves. However, it could cause small adverse effects on the foraging habitat available to Swainson's hawks nesting at or near reserves in the southern Natomas Basin, and though its mitigation would provide foraging habitat for hawks nesting at TNBC reserves, these may not be the same reserves that would experience a loss of foraging habitat. Thus, individual reserves may experience small adverse or beneficial effects due to the Greenbriar project.

3.8 WATER AVAILABILITY AT TNBC RESERVES

The Greenbriar project would eliminate several canals on the Greenbriar site, and would convert this site from predominantly agricultural to urban land cover. These changes, however, would not be anticipated to alter water availability to TNBC reserves or cause additional canals to be eliminated outside of the Greenbriar site (Dave Fischer, Natomas Central Mutual Water Company, pers. comm.).

The project would alter drainage of the Greenbriar site, and eliminate delivery of irrigation water by canals. These changes would affect water levels in canals and drains connected to the site. Because no TNBC reserves are adjacent to the Greenbriar site, these alterations are not anticipated to alter water availability at TNBC reserves.

The additional reserve lands associated with the Greenbriar project are in the Natomas Basin and thus would increase the portion of the Natomas Central Mutual Water Company held by shareholders concerned with the habitat values of the canal system and with the availability of water at TNBC reserves. In fact, TNBC has already requested changes to operations and maintenance practices (J. Roberts, pers. comm.). In the future, this may contribute to attainment of NBHCP goals and objectives, but is not anticipated to alter any specific operations by the water company in the near future.

3.9 OPPORTUNITIES TO ESTABLISH ADDITIONAL TNBC RESERVES

The Greenbriar project would cause both beneficial and adverse effects on opportunities to establish additional TNBC reserves. The adverse effects would result from reducing the acreage of land available to provide the mitigation required by the NBHCP. The beneficial effects would result from increasing the total acreage of reserves in the Natomas Basin, and thus increasing opportunities to establish larger reserves.

3.9.1 EFFECTS ON AVAILABILITY OF LAND FOR NBHCP RESERVE ESTABLISHMENT

Mitigation for the NBHCP consists of 8,750 acres of managed marsh, rice, and uplands. Based on the acreage of the Metro Air Park, City of Sacramento, and Sutter County permit areas for urban development, and of existing development outside of those areas, the Natomas Basin contains substantially more than 8,750 acres of land potentially suitable as and potentially available for mitigation. Of the Natomas Basin's 53,537 acres, about 26,376 are outside of permit areas and in land cover types suitable for preservation. However, at least 5,205 acres of these lands are unavailable for preservation as NBHCP mitigation (e.g., lands in suitable land cover that are owned by the Sacramento International Airport). Thus, there are about 21,171 acres of land that are both potentially suitable as mitigation and potentially available.

Although the acreage of potentially suitable and available land could be over twice the acreage required by the NBHCP for preservation, the NBHCP, nonetheless, requires that a substantial portion of suitable land in the Natomas Basin be preserved. Thus, numerous factors affecting the suitability of land for preservation could complicate establishment of an interconnected reserve system of this size, and may increase its cost or compromise the habitat quality of reserves. These factors include existing easements, infrastructure and buildings, availability of land for purchase, adjacent land uses and proximity to urban development, connectivity to other reserves, availability of water, suitability of soils for the establishment of managed marsh, and parcel size relative to the desired size of reserves.

The Greenbriar project would reduce the acreage available for preservation as mitigation for development permitted by the NBHCP and affect the feasibility of preserving land adjacent to the Greenbriar, proposed reserve and mitigation sites. Because of the Greenbriar project, 815 acres would become unavailable or unsuitable for preservation. These lands include: 546 acres developed at the Greenbriar site, 265.8 acres at the proposed Natomas 130 and Spangler reserves, 30.6 acres at the proposed reserve along Lone Tree Canal, and at least 49 acres of Swainson's hawk foraging habitat required by mitigation measure 6.13-2 of the DEIR at mitigation site(s) still to be determined. Of this land, 76 acres are already in land cover types that are unsuitable for preservation and subsequent restoration or enhancement (e.g., rural residential land). Thus, overall, the Greenbriar project reduces the acreage of land potentially suitable and available for preservation by 815 acres, from 21,171 to 20,356 acres, a reduction of about 4%. Even with this reduction, the remaining acreage of land potentially suitable and available for preservation (20,356 acres) would be more than twice the 8,750 acres the NBHCP requires for the reserve system.

3.9.2 EFFECTS OF GREENBRIAR SITE DEVELOPMENT ON TNBC RESERVE ESTABLISHMENT

Though the NBHCP did not identify the Greenbriar site as a potential reserve, the NBHCP also did not identify a complete set of potential reserve sites; therefore, most land outside of areas permitted for urban development, including the Greenbriar site, could be considered a potential reserve site. Development of the Greenbriar site would reduce options for establishing a reserve over 400 acres in size that included parcels adjacent to the Greenbriar site, and would eliminate any opportunity for a reserve that included the Greenbriar site. Consequently, this eliminates the option of preserving the entire corridor between the Metro Air Park and Sacramento City permit areas.

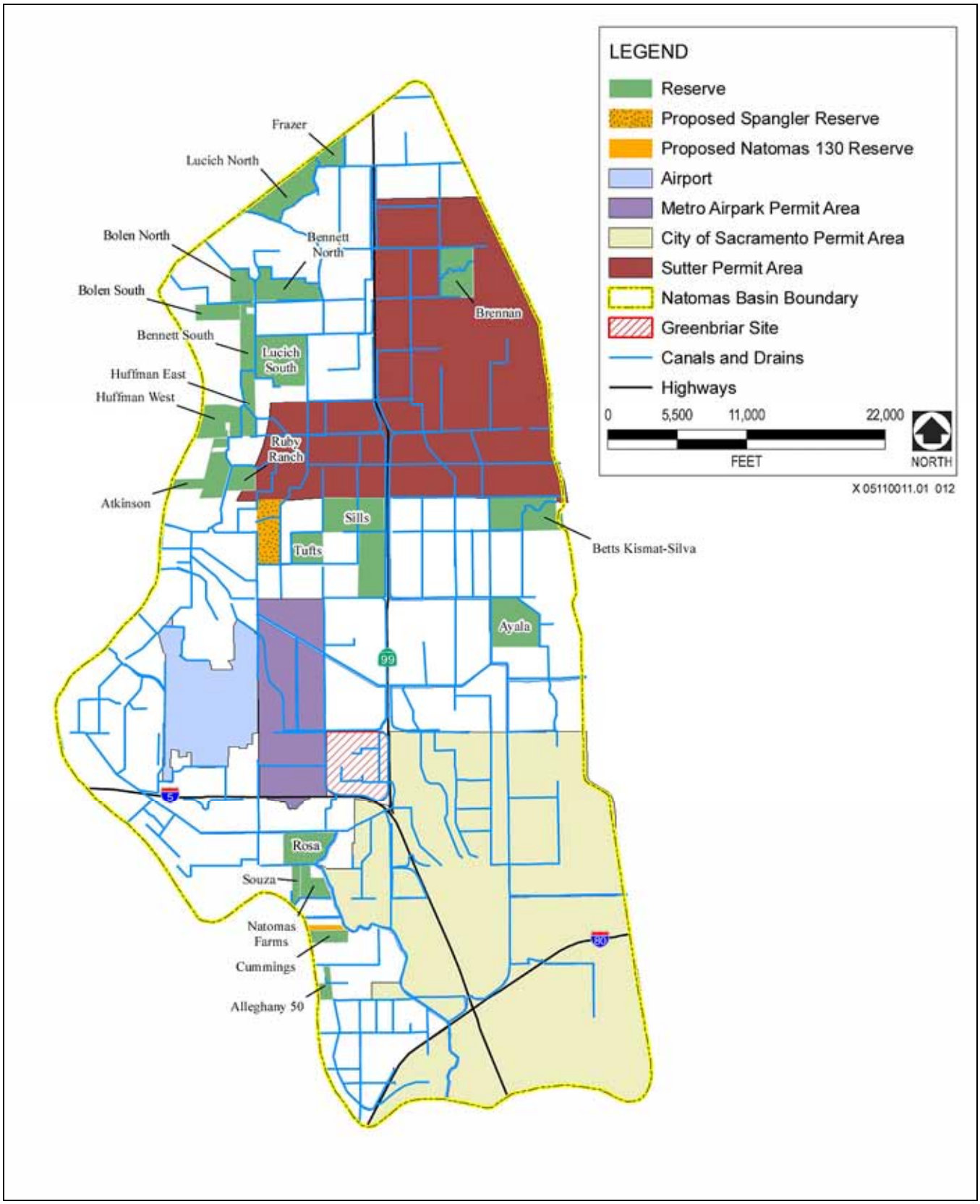
The Greenbriar site has, or could be enhanced to provide, conservation values that would merit preservation, but it also has several major limitations on the habitat values that it could provide. Much of the Greenbriar site provides habitat for covered species, and the site could be managed to provide various combinations of marsh, rice, upland, and canal habitats. It also occupies a corridor between the southern and central Natomas Basin that is important for the movement and dispersal of individuals, particularly for giant garter snake. A portion of the site, however, is in land cover types that are unsuitable for preservation and subsequent restoration or enhancement (e.g., rural residential land). Other portions of the site are immediately adjacent to major highways, or under the future condition of the Basin would be adjacent to urban development, and these areas would potentially experience high levels of human-wildlife conflicts. Nearly half of the site is either unsuitable for preservation and restoration or would be within 800 feet of a major highway or urban development. Highways and urban development would also reduce the connectivity of habitats on the Greenbriar site with habitats that would remain to the north and to the south. Despite these limitations, preserving the Greenbriar site could contribute more to sustaining the viability of the Basin's giant garter snake population and to attaining the goals and objectives of the NBHCP than would many other sites, because the Greenbriar site provides the opportunity to preserve and enhance the connectivity of canal habitats between the southern and central Natomas Basin.

Though it would develop most of the site, the project would preserve the most important portion of the site for giant garter snake and for connectivity between the southern and central Natomas Basin. It would preserve 30.6 acres immediately adjacent to Lone Tree Canal that would establish a 250-foot wide conserved corridor. This reserve would include barriers to reduce effects of adjacent development, measures to assure water flow, restoration and enhancement of habitat, and funding for TNBC to actively manage the site. Thus, the project would contribute to the conservation of a narrow, but ecologically important, corridor along this canal adjacent to the Metro Air Park.

3.9.3 EFFECTS OF PROPOSED RESERVES ON NBHCP RESERVE ESTABLISHMENT

The Greenbriar project's reserves also could contribute to the size and connectivity of future reserves. By preserving additional land adjacent to TNBC reserves, the project creates additional opportunities to create reserves of a given size and to create larger reserves (which would tend to have greater habitat values per acre than smaller reserves). For example, the Spangler reserve potentially could be joined to the Tufts reserve through future land acquisitions, as it would be only about a quarter-mile from the Tufts reserve (Exhibit 6); in this case, preservation of the intervening parcel would result in a larger reserve than would have resulted without the Greenbriar project's preservation of the Spangler property.

Overall, the Greenbriar project would not substantially reduce opportunities for establishing additional reserves for the NBHCP because sufficient suitable land is available to provide reserves both for the NBHCP and for the Greenbriar project, the project would preserve the most ecologically important portion of the Greenbriar site, and the project's reserves would increase opportunities to establish larger reserves.



Source: Wildlands 2005

Location of TNBC Reserves **Exhibit 6**

4 POTENTIAL EFFECTS OF THE GREENBRIAR PROJECT ON COVERED SPECIES

4.1 GIANT GARTER SNAKE

4.1.1 SPECIES ECOLOGY

HABITAT ASSOCIATIONS/REQUIREMENTS

Habitat Type

Giant garter snakes (*Thamnophis gigas*) typically inhabit sloughs, marshes, and drainage canals characterized by slow flowing or standing water, permanent summer water, mud bottoms, earthen banks, and an abundance of preferred forage species.

During their active season (May through October), mature giant garter snakes typically spend the majority of their time in canals and sloughs (Wylie and Casazza 2000). During late spring and summer, rice fields also provide foraging habitat for this species (Brode and Hansen 1992). Use of rice, however, is concentrated around the perimeter of the fields (Wylie and Casazza 2000; E. Hansen, pers. comm.). (Rice may, however, be an important source of prey and may export prey with drain waters into connected canals.) Giant garter snakes avoid areas of dense riparian overstory, and use burrows, crevices, undercut banks and large rocks to hide from predators. Winter hibernaculae include small burrows and soil crevices above prevailing flood elevations; these are typically located near aquatic habitat and in grassland or ruderal vegetation. (In the Natomas Basin, most canal banks have small burrows and crevices, and thus the banks of canals that are dewatered in winter can provide hibernaculae.)

Managed marsh also provides habitat for giant garter snake. In contrast to rice, managed marsh provides habitat year-round, and habitat elements (such as dense cover, basking sites, and refugia) to meet all of the giant garter snakes daily and seasonal needs. Managed marshes in the Natomas Basin have been designed to provide these habitat elements throughout the marsh, as opposed to the limited availability of the same elements in rice, which contributes to the use of rice primarily around the perimeter of rice fields.

The USFWS (1997) has determined that essential habitat components consist of the following:

- Adequate water during the snake's active period (early spring through mid-fall) to provide a prey base and cover;
- Emergent, herbaceous wetland vegetation, such as cattail and bulrushes, for escape cover and foraging habitat;
- Upland habitat for basking, cover, and retreat sites; and
- Higher elevation uplands for cover and refuge from flood waters.

Land cover types designated as giant garter snake habitat in the NBHCP include canals, ponds and seasonally wet areas and rice. Managed marsh also provides habitat. Small fish are the primary prey of this species; they will also take amphibians when available.

Home Range Size and Movement

Based on radio-telemetry studies by Wylie and Casazza (2000), the size of giant garter snake home ranges were between 32 and 215 acres (median = 86 acres) at Elverta and Fisherman's Lake sites. For comparison, home

ranges were between 5 and 213 acres (median = 39.5 acres) at Gilsizer Slough in Sutter County, and 22 and 2,070 acres (median = 128 acres) at the Colusa National Wildlife Refuge. Most giant garter snake activity within these home ranges is concentrated along canals, sloughs, and the edge of aquatic habitats (Wylie and Casazza 2000; Wylie et al. 2000; Wylie et al. 2003).

Giant garter snakes rely on canals and ditches as movement corridors. These corridors provide important habitat, are used during daily movements within a home range, and are necessary for giant garter snake dispersal and the resulting exchange of individuals and alleles between subpopulations. Unvegetated canals may be used as dispersal corridors, but snakes typically do not remain in exposed canals because of increased vulnerability to predators. Giant garter snakes have been reported traveling over one mile, and may move as much as two miles in a day (Hansen and Brode 1992).

The USFWS has previously considered 200 feet as the width of upland vegetation providing habitat along the borders of aquatic habitat for giant garter snake (USFWS 1997). However, the width of uplands used by giant garter snakes varies considerably. Many summer basking and refuge areas used by this snake are immediately adjacent to canals and other aquatic habitats, and may even be located in the upper canal banks (Eric Hansen, pers. comm.). Giant garter snakes have also been observed hibernating as far as 820 feet (250 m) from water, however, and any land within this distance may be important for snake survival in some cases (Hansen 1988). (Hibernaculae this distant from water, however, are most often found in areas with high winter floods.) Giant garter snakes also seek refuge in upland burrows during hot summer weather (Hansen and Brode 1993), and have been documented up to 164 feet from aquatic habitat during this time (Wylie et al. 1997).

Mechanisms of Habitat Degradation

Increased Predation

Known predators of giant garter snake include raccoons, skunks, opossums, foxes, hawks, egrets, herons, and bitterns (USFWS 1999a). All of the mammalian predators in this list increase in proximity to residential areas as a result of supplemental food sources and reduced coyote abundance (Crooks and Soule 1999). Domestic dogs may also prey on giant garter snakes, and cats may prey on juveniles. Although predation of giant garter snake by cats and dogs has not been studied scientifically, the effects of cats and dogs on small animals has been documented in a variety of ecosystems, and based on current understanding, cat and dog predation on giant garter snake is highly likely.

Disturbance from Human Activity

Giant garter snakes are highly sensitive to human disturbance, and will abandon otherwise suitable habitat as a result of increased human activity such as fishing (Eric Hansen, pers. comm.). Human visits to areas occupied by snakes may result in lowered snake abundance even when the visits are brief in duration and no more than one person, once per day (Eric Hansen, pers. comm.). Human activities can also degrade giant garter snake habitats by trampling vegetation, compacting soils, destabilizing banks, and crushing burrows, and can cause vehicle collisions with snakes.

Habitat Fragmentation

In a dynamic habitat such as the Natomas Basin, giant garter snakes frequently move in response to changing conditions in their rice, marsh, canal, and ditch habitats, especially during the dry summer months (Wylie and Casazza 2000). Connectivity between these areas is thus extremely important for snake survival and reproduction, as well as the genetic interchange and patch-recolonization ability necessary for the viability of the overall Basin population. Any loss or degradation of snake movement corridors may thus cause effects that far outreach the area of the directly impacted corridors.

Operation and Maintenance of Waterways

Water channels lose their habitat value for giant garter snakes when cleaned of aquatic vegetation, during low/no flow periods or when high water releases eliminate or alter basking sites, refugia, foraging areas or juvenile microhabitat (USFWS 1999a). In the Natomas Basin, canal and drain maintenance, and irrigation practices, involve periodic clearing of vegetation along waterways, and short-term, seasonal and inter-annual changes in flow in waterways. A recent habitat assessment of canals and drains throughout the Natomas Basin indicates that operation and management practices are reducing habitat quality along a substantial portion of these waterways (Jones & Stokes 2005). Water diversions may also reduce the abundance of the snakes' aquatic prey. Water diversions or changes in land use within the area served by a canal or drain watershed may alter flows or even cause a canal or drain to be abandoned.

Water Quality

Aquatic communities may be greatly affected by surrounding land use. Urban areas can exert different and in some cases stronger effects than agricultural lands (Bury 1972, Moore and Palmer 2005). Residential developments typically result in increased runoff of hydrocarbons and of chemicals used for lawns and gardens, and increased stormwater volume (and associated increases in flow depths and velocities) because of high coverage of impervious surfaces.

DISTRIBUTION

Information on CNDDB Occurrences

The 2002 CNDDB records cited in the NBHCP listed 168 giant garter snake occurrences in California, 38 of which occurred in the Natomas Basin. As of 2005, there are 171 known occurrences in California, of which 170 are considered extant. At this time, CNDDB lists 42 occurrences in the Natomas Basin, of which 42 are considered extant.

Other Information on Distribution and Abundance in Natomas Basin

A USGS-BRD study conducted from 1998 to 1999 recorded 277 individual giant garter snakes in the Natomas Basin (Wylie and Casazza 2000). Surveys conducted in 2004 for the Natomas Basin Conservancy recorded 152 snake observations, at least 86 of which were verified individuals (Natomas Basin Conservancy 2004). At the western edge of the Greenbriar site, sampling conducted during 1998 and 1999 detected at least five giant garter snakes in Lone Tree Canal; based on these results, giant garter snake population density for the canal was estimated at 2.4 snakes per 1,000 feet of canal length (95% confidence interval = 2–3.7) (Wylie et al. 2000). The density of snakes recorded at the Greenbriar site and elsewhere along canals and in rice lands of the Natomas Basin has a couple of important implications for this analysis. First, any alteration of even an acre of these land cover types is likely to affect at least one giant garter snake. Second, canals can provide moderate or high quality habitat, and thus arguments based on the premise that canals in general provide marginal habitat may be inaccurate.

Monitoring data collected in 2004 for The Natomas Basin Conservancy (Jones & Stokes 2005) recorded smaller snake sizes on average (corresponding to younger snakes with lower reproductive outputs) than in previous years. When combined with data from previous years, this suggests a declining trend in snake size, which would correspond to an on-going decline in population viability unless coupled with a rapidly increasing population size (which is not indicated by the monitoring data). However, changes in sampling techniques and sampling locations make the interpretation of these data problematic.

4.1.2 PROJECT EFFECTS ON SPECIES

LONG-TERM EFFECTS ON HABITAT

Effect on Quantity of Habitat

Changes in habitat acreages are summarized in Table 4-1. At the Greenbriar site, there would be a loss of an estimated 172 acres of GGS habitat from conditions at the time of the NBHCP (2001). At the proposed reserves, approximately 45 acres of snake habitat would be converted to non-habitat and 14 acres of snake habitat would be created from non-habitat. Thus, the project as a whole would yield a net loss of 204 acres of snake habitat.

Table 4-1
Change in Acreage of Giant Garter Snake Habitat at Project Sites and in the Natomas Basin

Land Cover Type Providing Habitat	Future Condition	Change at Each Project Site			Total Change	Future Condition with Project
		Greenbriar	Natomas 130	Spangler		
Canals	1,162	-15.0	0.0	-1.4	-16.4	1,146
Ponds & seasonally wet areas	2,259	2.7	14.2	184	200.9	2,460
Rice	11,643	-160.0	-	-228	-388	11,255
Total	15,064	-172.4	14.2	-45.4	-203.5	14,860

Note: Acreages are based on 2001 land cover mapping used to evaluate future condition resulting from the NBHCP and future land cover proposed at project sites.

Effects on Quality of Habitat

Areas Adjacent to Developed Land or Highways

As discussed above in *Mechanisms of Habitat Degradation*, without mitigation, snakes traveling through the Lone Tree Canal or using other canal and rice habitats near the proposed development would likely be adversely affected by the project's residential development through increased predation, disturbance, and degradation of aquatic habitat. (The adjacent Metro Air Park development does not include residential development.) Development of the Greenbriar site also would reduce the acreage of land draining into Lone Tree Canal, and thus would likely lead to reduced flows in the canal. In the absence of measures to offset these alterations, the quality of giant garter snake habitat along Lone Tree Canal would likely be reduced.

The project does, however, include measures to reduce these effects, and the DEIR mitigation includes additional measures. These measures are described in the following section (*Effects on Connectivity*).

The project also could create conflicts with continued cultivation of rice on the property north of the Greenbriar site. Aerial application of pesticide and herbicide probably is not feasible immediately adjacent to residential development (C. Aubry, pers. comm.), which could affect the viability of rice cultivation on the adjacent parcel. This issue is discussed further under *Habitat Quality in the Natomas Basin* in Chapter 3 of this report.

Alteration of Habitat Quality at Proposed Reserve Sites

At the proposed Spangler and Natomas 130 reserves, in addition to the 14 acres of marsh habitat creation (from non-habitat), 190 acres of giant garter snake habitat would be enhanced by creating marsh from rice (i.e., 184 acres of marsh and 6 acres of associated canals). This change in land cover and management should considerably increase habitat quality for giant garter snake, because marsh provides higher quality habitat for giant garter snake than rice. The reasons that marsh provides higher quality habitat than rice include:

- Giant garter snakes use the full extent of managed marshes, whereas they primarily use the margins of rice fields;

- Marshes provide habitat throughout the active period of the snake, whereas rice fields do not provide habitat during early and mid-spring, and are typically drained before the end of the snake's active period; and

- Marsh provides habitat in all years, whereas rice is fallowed periodically.

Though some uncertainty exists regarding the magnitude of benefits resulting from these enhancements, it is likely that they offset the habitat values that would be lost by development at the Greenbriar site. The preservation and management of this 204 acres of habitat for giant garter snake also provides benefits (such as reduced human disturbance) in addition to the benefits resulting from the conversion of rice to managed marsh.

Effects on Connectivity

The Greenbriar project's potential effects on connectivity of giant garter snake habitat are described in detail in Section 3.5 Connectivity of Habitat in the Natomas Basin.

Effects of Construction-Related Activities

During the construction at the Greenbriar and proposed reserve sites, giant garter snakes could be killed or injured by vehicle strikes (Leidy 1992), crushed beneath heavy machinery, entombed in or excavated from their winter retreats (Wylie and Casazza 2000). The Greenbriar DEIR and Natomas Basin HCP include measures to avoid and minimize direct loss of giant garter snakes through construction. For the Greenbriar project, these measures include:

a. To ensure that the project does not diminish habitat connectivity for giant garter snake between the southwest and northwest zones identified in the NBHCP, approximately 30.6 acres along Lone Tree Canal shall be protected and managed as giant garter snake habitat. This on-site habitat preservation shall protect an approximately 250-foot wide corridor of giant garter snake habitat that includes the canal and approximately 200 feet of adjacent uplands. Uplands within the linear open space/buffer area shall be managed as perennial grassland as described below. Additional aquatic habitat for giant garter snake shall be created along the east bank of Lone Tree Canal by construction and maintenance of a 2.7 acre tule bench. The habitat shall be managed in perpetuity as high-quality habitat for giant garter snake. Compliance and biological effectiveness monitoring shall be performed and annual monitoring reports prepared within six months of completion of monitoring for any given year. This monitoring, reporting, and adaptive management shall be performed as described in Section IV of the NBHCP.

b. To ensure that the project does not diminish giant garter snake movement along Lone Tree Canal, all new road crossings of Lone Tree Canal shall be designed to minimize obstacles to giant garter snake movement. The use of culverts under new road crossings on Lone Tree Canal shall be prohibited unless it can be demonstrated that the culverts will not diminish the potential for giant garter snake movement through the section of Lone Tree Canal protected by the setback fence and conservation easement. .

c. Upland giant garter snake habitat within the Lone Tree Canal linear open space/buffer area shall be created and managed to provide cover, basking areas, and refugia during the winter dormant period. Hibernaculae would be constructed at regular intervals by embedding concrete or coarse rock in the bank or in a berm along the Lone Tree Canal corridor to provide additional winter refugia. Upland habitat with the linear open space/buffer areas shall be converted to native perennial grassland and managed, in perpetuity, as perennial grassland habitat.

d. Aquatic habitat shall be maintained throughout the giant garter snake active season in Lone Tree Canal, in perpetuity. This is the legal responsibility and obligation of Metro Air Park property owners (MAP). The

MAP HCP includes provisions for maintaining water in the canal such that the basic habitat requirements of the giant garter snake are met. The MAP HCP also provides a road map, through "Changed Circumstances", to address procedures to follow if water is not being maintained in the canal to meet these requirements. As described in the MAP HCP, the MAP is legally obligated to assure these requirements are met, and financial and procedural mechanisms are included in the MAP HCP to enforce this. It is, therefore, assumed that MAP will provide water to Lone Tree Canal, as required by the MAP HCP and ITP, in perpetuity. It is also assumed that USFWS will use all reasonable means available to it, to enforce this MAP HCP requirement. If water is not provided to Lone Tree Canal by the MAP to meet the habitat requirements of giant garter snake, as required by the MAP HCP, and USFWS exhausts its enforcement responsibilities, the project applicant shall assume the responsibility of providing suitable giant garter snake aquatic habitat throughout the section of Lone Tree Canal protected by the fence and conservation easement. However, as stated herein, the project applicant shall only assume this responsibility if it has been sufficiently demonstrated to the City that USFWS has exhausted all reasonable means to compel MAP to comply with the relevant conditions of the MAP ITP. Specific requirements related to ensuring suitable aquatic habitat in Lone Tree Canal is present, in perpetuity, throughout the giant garter snake active season shall be developed through consultation with DFG and USFWS, and included in the new or amended HCP for Greenbriar, and may include mechanisms, such as installation of a well, to assure water is provided in the canal to meet habitat requirements.

e. A barrier shall be installed between the giant garter snake habitat linear open space/buffer area and the adjacent Greenbriar development to ensure that giant garter snakes do not enter the development area, and to prohibit humans and pets from entering the giant garter snake habitat. The design of this barrier shall be subject to USFWS and CDFG review and approval. The entire length of the barrier, which shall be bordered by yards rather than roadways, shall be maintained on the preserve side by a nonprofit land trust to ensure that vegetation or debris does not accumulate near the barrier and provide opportunities for wildlife and pets to climb over the barrier. On the development side, Covenants, Codes and Restrictions (CCRs) shall prohibit accumulation of vegetation or debris adjacent to the barrier. Chain link fencing shall be placed at both ends of the corridor, with locked gates permitting entry only by RD 1000 and NMWD for channel maintenance, and by the preserve manager for habitat monitoring and maintenance purposes.

f. Specific requirements associated with the barrier shall be developed through consultation with USFWS and DFG, and may include the following and/or other specifications that DFG and USFWS consider to be equally or more effective:

   - Adequate height and below-ground depth to prevent snakes or burrowing mammals from providing a through-route for snakes by establishing burrows from one side to the other crossing;
   - Constructed using extruded concrete or block construction extending a minimum of 36-inches above ground level;
   - Maintenance to repair the barrier and to prevent the establishment of vegetation or collection of debris that could provide snakes with a climbing surface allowing them to breech the barrier;
   - A cap or lip extending at least two-inches beyond the barrier's vertical edge to prevent snakes from gaining access along the barrier's top edge; and
   - Signage to discourage humans and their pets from entering the area.

g. The Lone Tree Canal linear open space/buffer area shall be protected in perpetuity under a conservation easement and managed to sustain the value of this area for giant garter snake habitat connectivity. Compliance and biological effectiveness monitoring shall be performed and annual monitoring reports prepared. This monitoring, reporting, and adaptive management shall be performed as described in Section IV of the NBHCP or following procedures developed in formal consultation with USFWS and DFG and contained in an ESA Incidental Take Permit for the Greenbriar project.

In combination, these measures would minimize injury and mortality to giant garter snakes as a direct result of construction-related activities.

EFFECTS OF HUMAN-WILDLIFE CONFLICTS

As discussed above in *Mechanisms of Habitat Degradation*, without mitigation, giant garter snakes would likely experience increased predation near the proposed residential development because of the increased abundance of domestic dogs and cats, as well as human-associated raccoons, skunks and opossums. Domestic cats have been recorded between 98–590 feet from homes, unattended domestic dogs between 590–1,083 feet from homes (Odell and Knight 2001), and increased abundance of native predators may extend farther. As this distance is well beyond the proposed 250-foot wide corridor between the proposed residential development and the Lone Tree Canal, the project would likely result in increased predation of snakes using the canal. The increased human population in the area would also increase the potential for human activity near the canal, which may lead to site avoidance or abandonment by snakes (Eric Hansen, pers. comm.). Increased human activity along the canal could result in increased canal maintenance including further clearing of vegetation. Snake mortality because of vehicle strikes (Leidy 1992) may also increase on existing roads because of the increased traffic associated with the project.

The project does, however, include measures to reduce these effects, and the DEIR mitigation includes additional measures. These measures are described in the preceding section (*Effects on Connectivity*).

OVERALL EFFECT ON POPULATION VIABILITY

The project would cause both adverse and beneficial effects on the giant garter snake population of the Natomas Basin. Beneficial effects would include preserving, creating, and enhancing habitat at the reserve sites, preserving a corridor along Lone Tree Canal, and contributing to the connectivity of habitat and existing TNBC reserves adjacent to or near the proposed reserves. Adverse effects would include a reduction in the total acreage of habitat, and possibly degradation of habitat near the Greenbriar site and reduced connectivity along Lone Tree Canal due to increased human disturbance and predation. The DEIR mitigation, however, would reduce adverse effects and ensure that connectivity of giant garter snake habitat was conserved along Lone Tree Canal.

Overall, the project would not adversely affect giant garter snake, and its overall effect on population viability could be beneficial. The loss of habitat acreage would probably be offset by the increased habitat quality resulting from the preservation of habitat, and conversion of rice to marsh.

The proposed creation of 14 acres of marsh from non-rice crops, conversion of 184 acres of rice to marsh, and preservation of an additional 6.2 acres along associated canals would likely offset the loss of 388 acres of rice and 16 acres of canal habitat. The basis of this interpretation is the greater habitat value of managed marsh relative to rice and the general benefits of habitat preservation.

Managed marsh provides substantially greater habitat values for giant garter snakes than rice for several reasons. These reasons include:

- Giant garter snakes primarily use the margins of rice fields, whereas they use the full extent of managed marshes. These marshes are designed to provide open water, foraging habitat, dense cover, basking sites, and refugia in close proximity throughout the marsh. (For example, an acre of managed marsh provides several times the edge habitat than does a rice field.)

- Marshes provide habitat throughout the active period of the snake. Rice fields do not provide habitat during early and mid-spring, and are typically drained before the end of the snake's active period. Thus, for a portion of their active period, giant garter snakes must rely entirely on non-rice habitats. In the Natomas Basin, these habitats are canals and managed marsh. In contrast, managed marshes provide habitat year-round.

- Rice is fallowed periodically, and thus does not provide habitat in all years; in contrast, a managed marsh does provide habitat in all years.

Preservation of habitat has benefits in addition to those of habitat enhancement. In the Natomas Basin, a particularly important benefit of habitat preservation is that it ensures that the habitat will continue to exist, and it buffers total habitat availability from year to year fluctuations. For giant garter snake, privately owned habitat in the Natomas Basin is primarily rice and associated canals, and there are no assurances that rice cultivation will continue on any particular site. Furthermore, agricultural markets will cause the total acreage of rice, and consequently of giant garter snake habitat, to fluctuate substantially from year to year. Such environmental fluctuations strongly influence populations and reduce their viability. In contrast, preserved lands will provide habitat on a much more consistent basis, and thus reduce the magnitude of fluctuations in habitat availability.

Both habitat enhancement and preservation also can contribute to population viability by reducing anthropogenic causes of mortality. Preservation reduces human disturbance, and minimizes activities that could harm or kill snakes. Habitat enhancement also reduces or eliminates agricultural activities that can harm or kill snakes. In addition, the preservation and enhancement of habitat typically results in larger blocks of higher quality habitat, and this should reduce long distance movements by snakes, which would also reduce the risk of mortality associated with those movements. (Dispersal and other long distance movements are dangerous for snakes, particularly where road crossings are involved [Bonnet et al. 1999, Rosen and Lowe 1994].)

For these reasons, an acre of managed marsh may provide habitat values comparable to or substantially greater than two acres of rice. The project would reduce rice acreage by 388 acres (and canal acreage by 16 acres) and would increase the acreage of preserved, managed marsh by 201 acres. Thus, it is likely that the project would not reduce habitat values for giant garter snake, and thus would not reduce the viability of the giant garter snake population due to a reduction in habitat values.

The project is also unlikely to reduce the viability of the giant garter snake population due to adverse effects on connectivity. The project (with the DEIR mitigation) would conserve connectivity and habitat for giant garter snake along Lone Tree Canal, which is an important waterway connecting the southern and central Natomas Basin, and proposed reserves would contribute to connectivity of habitats and reserves in the southern and central Basin.

4.2 NORTHWESTERN POND TURTLE

4.2.1 SPECIES ECOLOGY

HABITAT ASSOCIATIONS/REQUIREMENTS

Habitat Type

Northwestern pond turtles (*Clemmys marmorata marmorata*) are most commonly found in permanent or nearly permanent wetlands, ponds, slow-moving streams and irrigation ditches (Zeiner et al. 1988). Adjacent upland areas are also used for basking and egg-laying. Land cover types designated as pond turtle habitat in the NBHCP include canals, ponds and seasonally wet areas, rice and riparian. Special habitat features that improve turtle abundance, survival and reproductive success are rocks, logs, open mud banks, emergent aquatic vegetation and streamside vegetation. These features provide the turtles with basking sites and cover from predators (Stebbins 1972). Although pond turtles feed primarily on aquatic invertebrates (USFWS 1992), they also feed on plants, small fish and carrion.

Home Range Size and Movement

Upland areas adjacent to aquatic habitat are essential for reproduction, and eggs may be laid as far as 1,319 feet (0.25 mi) from water (Hays et al. 1999). Hatchling and adult turtles may winter in upland sites, and turtles may move more than one mile overland in response to desiccation of local water bodies or other forms of habitat loss or degradation.

Mechanisms of Habitat Degradation

Increased Predation

Hayes et al. (1999) documented predation on pond turtles by domestic dogs; unattended dogs have been recorded between 590–1,083 feet (180–330 m) from homes (Odell and Knight 2001). These distances indicate the project would likely result in increased predation of any pond turtles using Lone Tree Canal for movement between habitat areas to the north and south of the property. Populations of native pond turtle predators such as raccoons and opossums also typically increase in proximity to residential areas as a result of supplemental food sources and reduced coyote abundance (Crooks and Soule 1999).

Disturbance from Human Activity

Pond turtle observations have been known to decline in areas with increased human activity (Eric Hansen, pers. comm.). Human visits to areas occupied by turtles may result in lowered turtle abundance even when the visits are brief in duration and no more than one person, once per day (Eric Hansen, pers. comm.).

Habitat Fragmentation

Although pond turtles may travel less frequently than giant garter snakes, turtles occupying dynamic habitats such as the Natomas Basin may need to travel in response to changing conditions in their aquatic habitats, especially during the dry summer months. Connectivity between these areas may thus be important for turtle survival and reproduction, as well as the genetic interchange and patch-recolonization ability that may be necessary for the viability of the overall Basin population. Any loss or degradation of turtle movement corridors may thus yield effects that outreach the area of the directly impacted corridors.

Operation and Maintenance of Waterways

Water channels lose their habitat value for pond turtles when cleaned of aquatic vegetation, during low/no flow periods and when high water releases eliminate or alter basking sites, refugia, foraging areas or hatchling microhabitat (Holland 1991a; USFWS 1999). Water diversions or changes in land use within the area served by a canal or drain watershed may alter flows or even cause a canal or drain to be abandoned.

Water Quality

Aquatic communities may be greatly affected by surrounding land use. Urban areas can exert different and in some cases stronger effects than agricultural lands (Bury 1972; Moore and Palmer 2005). Residential developments typically result in increased traffic and fuel runoff, runoff of chemicals used for lawns and gardens, and increased stormwater volume and currents because of high coverage of impervious surfaces. Increased exposure to contaminants has been implicated in pond turtle population declines (Bury 1972; Holland 1991).

DISTRIBUTION

Information on CNDDB Occurrences

When information was compiled for the NBHCP in 2001, there were 117 known occurrences in California, of which 116 were considered extant. At that time, CNDDB did not list northwestern pond turtle occurrences in the Natomas Basin. As of 2005, there are 232 known occurrences in California, of which 231 are considered extant. At this time, CNDDB does not list northwestern pond turtle occurrences within one mile of the Natomas Basin.

Other Information on Distribution and Abundance in Natomas Basin

Surveys conducted in 2004 for the Natomas Basin Conservancy documented six northwestern pond turtle occurrences in the Natomas Basin. Two of these occurrences were just over one mile from the Greenbriar site, one was less than a mile from the proposed Natomas 130 reserve, and another was just over a mile from the proposed Spangler reserve. Many Natomas Basin canals are considered suitable habitat for this species, and high quality habitat exists near the Greenbriar and Natomas 130 sites, at Fisherman's Lake.

4.2.2 PROJECT EFFECTS ON SPECIES

LONG-TERM EFFECTS ON HABITAT

Effect on Quantity of Habitat

Effects on the acreage of pond turtle habitat are summarized in Table 4-2. The proposed development at the Greenbriar site would result in the loss of an estimated 172 acres of pond turtle habitat from conditions at the time of the NBHCP (2001), and an additional 45 acres of rice habitat would be converted to upland at the Spangler site. Although the canal and marsh on the Greenbriar site were determined by the DEIR biologist to be of marginal quality and unlikely to support pond turtles, we have included these acres in our analysis for consistency with the broad habitat categories in the GIS analysis and NBHCP, and also because turtles may occasionally use the site as a movement corridor between higher quality habitats to the north and south of the site. At the proposed reserves, approximately 14 acres of pond turtle habitat would be created from non-habitat. Thus, the project as a whole would yield a net loss of 204 acres of turtle habitat.

Table 4-2
Change in Acreage of Northwestern Pond Turtle Habitat at Project Sites and in the Natomas Basin

Land Cover Type Providing Habitat	Future Condition	Change at Each Project Site			Total Change	Future Condition with Project
		Greenbriar	Natomas 130	Spangler		
Canals	1,162	-15.0	0.0	-1.4	-16.4	1,146
Ponds & seasonally wet areas	2,259	2.7	14.2	184	200.9	2,460
Rice	11,643	-160.0	-	-228	-388.0	11,255
Riparian	91	0.0	0.0	-	0	91
Total	15,155	-172.4	14.2	-45.4	-203.5	14,951

Note: Acreages are based on 2001 land cover mapping used to evaluate future condition resulting from the NBHCP and future land cover proposed at project sites.

Effects on Quality of Habitat

Areas Adjacent to Developed Land or Highways

As discussed above in *Mechanisms of Habitat Degradation*, turtles traveling through the Lone Tree Canal or inhabiting other canals and wetlands downstream from the proposed development would likely be adversely affected by residential development through increased predation, disturbance, and degradation of aquatic habitat. (The adjacent Metro Air Park development does not include residential development.) Development of the Greenbriar site also would reduce the acreage of land draining into Lone Tree Canal, and thus could lead to reduced flows in the canal. In the absence of measures to offset this alteration, the quality of pond turtle habitat along Lone Tree Canal could be reduced by this loss of water. However, both the MAP HCP (see pages 70-71 in Thomas Reid Associates 2001) and the DEIR (mitigation measure 6.13-1) contain measures to assure the maintenance of aquatic habitat in Lone Tree Canal.

As described under *Connectivity of Habitats in the Natomas Basin* (in Section 3 of this report), the project and mitigation proposed in the DEIR for the Greenbriar project include measures that would substantially reduce the effects of development at the Greenbriar site on adjacent pond turtle habitat.

Alteration of Habitat Quality at Proposed Reserve Sites

In addition to 14 acres of managed marsh that would be created from upland at the Natomas 130 reserve and the 2.7 acres of marsh that would be created along Lone Tree Canal, rice would be converted to marsh at the Spangler reserve enhancing 190 acres of habitat (184 acres of marsh and 6 acres of associated canals). This created and enhanced habitat would be preserved and managed for its habitat values.

These changes should considerably increase habitat quality for pond turtle, primarily because marsh provides much higher quality habitat for pond turtle than rice, management would include reduce adult mortality caused by human disturbance, and nesting and overwintering habitat would be created. Though a moderate level of uncertainty exists regarding the magnitude of benefits resulting from these enhancements, it is likely that they offset the habitat values that would be lost by development at the Greenbriar site.

Effects on Connectivity

The importance of habitat connectivity for this species is discussed in *Mechanisms of Habitat Degradation*, above. In the absence of effective mitigation, the project would reduce connectivity of pond turtle habitat by altering adjacent uplands, reducing water flows in the canal, and increasing predation and human disturbance. However, as described under *Connectivity of Habitats in the Natomas Basin* (in Section 3 of this report), the project and mitigation proposed in the DEIR for the Greenbriar project include measures that would substantially reduce these effects. These measures include creation, enhancement and preservation of habitat (including tule bench along Lone Tree Canal) in the 30.6 acre reserve along Lone Tree Canal, a barrier/fencing to reduce predation and human disturbance effects, an additional assurance that aquatic habitat would be maintained in Lone Tree Canal, and funding to maintain and operate this conserved area. These measures would substantially reduce project's effects on connectivity.

EFFECTS OF CONSTRUCTION-RELATED ACTIVITIES

Construction-related activities associated with the project could affect this species, though the Greenbriar site currently provides only marginally suitable habitat. Also, construction-related degradation of water quality in Lone Tree Canal could affect turtles downstream. In addition, pond turtles could be harmed during restoration activities at the proposed Natomas 130 reserve, by crushing under equipment or entombment in their winter burrows. Measures to avoid and minimize take of northwestern pond turtles and giant garter snakes, described in the Greenbriar project DEIR and Natomas Basin HCP, would reduce any direct construction-related effects on

this species. These measures where listed in Section 4.1 *Giant Garter Snake* under *Effects of Construction-related Activities*.

EFFECTS OF HUMAN-WILDLIFE CONFLICTS

As discussed above in *Mechanisms of Habitat Degradation*, in the absence of avoidance and minimization northwestern pond turtles would likely experience increased predation near the proposed residential development because of the increased abundance of domestic dogs and cats, as well as human-associated raccoons, skunks and opossums. The increased human population in the area would also increase the potential for human activity near the canal, which may lead to site avoidance by turtles (Eric Hansen, pers. comm.). Mortality because of vehicle strikes may also increase on existing roads because of the increased traffic that the project would produce.

However, as described under *Connectivity of Habitats in the Natomas Basin* (in Section 3 of this report), the project and the DEIR mitigation include measures that would substantially reduce these effects.

OVERALL EFFECT ON POPULATION VIABILITY

The project would cause both adverse and beneficial effects on the northwestern pond turtle population in the Natomas Basin. Beneficial effects would include preserving, creating, and enhancing habitat at the reserve sites, preserving a corridor along Lone Tree Canal, and contributing to the connectivity of habitat and existing TNBC reserves adjacent to or near the proposed reserves. Adverse effects would include a reduction in the total acreage of habitat, and possibly degradation of habitat near the Greenbriar site and reduced connectivity along Lone Tree Canal due to increased human disturbance and predation. The DEIR mitigation would reduce these adverse effects and ensure that connectivity of pond turtle habitat was maintained along Lone Tree Canal.

Overall, the project would not adversely affect pond turtle. The loss of habitat acreage would be more than offset by the increased habitat quality resulting from the preservation of habitat, conversion of rice to marsh, and management of rice to enhance habitats. The project would have a beneficial effect on pond turtle habitat largely because the created marsh would provide much higher quality habitat for pond turtle than rice (USFWS 2003). Also, the project (with the DEIR mitigation) would conserve connectivity and habitat for pond turtle along Lone Tree Canal and near proposed reserves in the southern and central Basin. These beneficial effects on habitat and connectivity may be sufficient to increase the viability of the Natomas Basin's northwestern pond turtle population.

4.3 SWAINSON'S HAWK

4.3.1 SPECIES ECOLOGY

HABITAT ASSOCIATIONS/REQUIREMENTS

Habitat Type

Swainson's hawks (*Buteo swainsoni*) are most commonly found in grasslands, low shrublands, and agricultural habitats that include large trees for nesting. Land cover types designated as Swainson's hawk nesting habitat in the NBHCP include oak groves, tree groves, and riparian. These habitats are suitable for nesting only where adjacent to adequate foraging habitat. Land cover types designated as Swainson's hawk foraging habitat in the NBHCP include alfalfa, grassland, idle, non-rice crops, pasture, and ruderal. Swainson's hawks will also nest in these foraging habitats if large trees are available; however, isolated trees may be less suitable for nesting than trees in groves or riparian areas.

Prey abundance and accessibility (for capture) are the most important features determining the suitability of hawk foraging habitat. In addition, agricultural operations (e.g., mowing, flood irrigation) have a substantial influence

on the accessibility of prey and thus create important foraging opportunities for Swainson's hawk (Estep 1989). Crops which are tall and dense enough to preclude the capture of prey (e.g., corn) do not provide suitable habitat except around field margins, but prey in these habitats are accessible during and immediately following harvest. Other crops (e.g., tomato, sugar beet) are tall and dense enough to inhibit but not to prevent the capture of prey during the growing season, and also provide valuable foraging opportunities during their harvest. Alfalfa, idle crop land, and most ruderal land and grassland have low and or open vegetation that doesn't impede prey capture, but prey abundance varies among these habitats and so does the frequency of agricultural operations (which are absent from ruderal land and grassland). Based on these considerations, we have divided crops and other foraging habitats into four categories of quality (i.e., low, moderate, high-moderate, and high) (Table 2-3). The basis for this classification is described in detail in the methods section (Section 2) under *Habitat Quality*.

Home Range Size and Movement

Although the most important foraging habitat for Swainson's hawks lies within a one-mile radius of each nest (City of Sacramento et al. 2003), Swainson's hawks have been recorded foraging up to 18.6 miles from nest sites (Estep 1989). Any habitat within this foraging distance may provide food at some time in the breeding season that is necessary for reproductive success. In a dynamic agricultural environment such as the Natomas Basin, the area required for hawk foraging depends on the time of season, crop cycle, crop type, and discing/harvest schedule, as these factors affect the abundance and availability of prey (City of Sacramento et al. 2003). Swainson's hawk foraging ranges during the breeding season have been estimated at approximately 1,000-7,000 acres (Bechard 1982, Estep 1989, Johnsgard 1990).

Mechanisms of Habitat Degradation

Reduction of Prey Base

The order of habitat suitability for Swainson's hawks listed above was determined by the abundance and availability of prey. Conversion of higher-suitability habitats to lower-suitability habitats would be accompanied by a reduction in prey base that may reduce nest survival or the fat reserves required by hawks for their fall migration to Central Mexico (Swainson's Hawk Technical Advisory Committee 2001), without any change in overall habitat acreage.

Changes in the hawks' rodent prey base may also result from impacts of residential development to adjacent mammalian predator communities. Crooks and Soule (1999) quantified the impacts of domestic cats on rodents and other small animals. They estimated that the average domestic cat population in moderately sized fragments (~50 acres of upland habitat bordered by 100 residences) returns about 840 rodents, 525 birds, and 595 lizards to residences each year. Assuming that cats do not bring back all prey that they kill, actual impacts to hawk prey numbers are probably even greater. Crooks and Soule (1999) also documented increased extirpations of songbird species in habitat fragments with higher densities of cats, raccoons and opossums, all of which often increase in proximity to residential development. Although rodents are the primary prey of breeding Swainson's hawks in the Natomas Basin, songbirds also contribute to their diets.

Several studies indicate that the abundance of bird species is lower near residential development. Compared to undeveloped areas at least 2,297 feet from development, Odell and Knight (2001) demonstrated lower densities of the hawks' secondary songbird prey within 1,083 feet of sparse residential development (less than 0.4 dwelling units/acre); impacts of higher density development are expected to be greater. Similarly, Blair (1996) reported 1/3 fewer bird species in lands adjacent to residential development, when compared to habitat preserves in the same area. Increased predation on the hawks' rodent prey is likely to extend between 98–590 feet from homes because of domestic cats, 590–1,083 feet from homes because of domestic dogs, and farther because of increased populations of small wild predators such as opossums and foxes (Odell and Knight 2001).

Habitat Fragmentation and Reduced Patch Size

The contiguity of foraging habitat and its placement near nest sites may also affect hawk foraging (and subsequently breeding) success. Longer foraging flights carry higher energetic costs than foraging closer to nests, and reduce the amount of time adults are present to defend nests from predators. Similarly, there may be a threshold of required habitat area near each nest, related to the foraging ranges discussed above, such that habitat loss beyond this threshold would result in a greater impact to nest survival than habitat loss from a larger area. The diversity and abundance of Swainson's hawk prey have also been reported to decline in fragmented habitat (Crooks et al. 2001; Helzer and Jelinski 1999; Hinsley et al. 1995).

Increased Predation

Corvids (crows, magpies) and great horned owls are the most common predators of Swainson's hawk eggs and nestlings (England et al. 1997). Corvid populations typically increase near human settlement because of the supplemental food source of human refuse and additional perches provided by urban trees, street lights, and other infrastructure (Steenhof et al. 1993; Marzluff et al. 2001). This increase in predator abundance may result in increased nest predation near residential development.

Nest Disturbance

Swainson's hawk responses to nest disturbance vary with each nesting pair and the timing, regularity, and nature of the disturbance. Although some researchers have described disturbed nest sites that successfully fledge young (Estep 1989; England et al. 1995), others have recorded nest abandonment in response to human activity, especially during nest building and incubation (Bent 1937; Stahlecker 1975). In addition to nest abandonment, significant disturbances near hawk nests may interfere with parental care and feeding of young in a way that reduces nest success.

DISTRIBUTION

Information on CNDDB Occurrences

When information was compiled for the NBHCP in 2001, there were 892 known occurrences in California, of which 882 were considered extant. The NBHCP did not list CNDDB occurrences for the Natomas Basin, but local surveys (described below) provided extensive data. As of 2005, there are 1,380 known Swainson's hawk occurrences in California, of which 1,350 are considered extant. At this time, 35 occurrences are known in the Natomas Basin, of which 34 are considered extant. Sixteen additional occurrences are known within one mile of the Basin, all of which are considered extant. Of these occurrences, two are within one mile of the Greenbriar site and eight are within one mile of the proposed reserve sites. All ten of these occurrences are considered extant.

Other Information on Distribution and Abundance in Natomas Basin

Estep (2001) indicates that nesting sites and foraging activity occur throughout the Basin, depending on the availability of suitable nest trees in proximity to upland foraging areas. The most recent survey of the Natomas Basin at the time the Habitat Conservation Plan was prepared located 62 breeding sites in or immediately adjacent to the Basin (Swainson's Hawk Technical Advisory Committee 2001). Hawks nesting at the 35 sites adjacent to the Basin were located along the Sacramento River and may have depended on the Basin's foraging habitat for their survival and reproduction. The NBHCP asserts that the Swainson's hawk population supported by the Natomas Basin is "important to the continued viability" of the species, which has been estimated by the California Department of Fish and Game to have declined by 94% from historical conditions in the state (Bloom 1980, California Department of Fish and Game 1989).

The most recent survey published by the Natomas Basin Conservancy mapped 89 nest sites in or adjacent to the Basin in 2004, of which 59 were active in that year. Each of these nests was within the 18.6 mile recorded

foraging distance from the project and proposed reserve sites and may be affected by changes in land cover at those sites. The Natomas Basin Conservancy has mapped five nests within one mile of the Greenbriar site, two of which were active in 2004, and 12 nests within one mile of the proposed Natomas 130 reserve, six of which were active in 2004. No Swainson's hawk nests have been mapped within one mile of the proposed Spangler reserve.

The most recent monitoring report prepared for The Natomas Basin Conservancy (Jones & Stokes 2005) also contains information on population trends in the Natomas Basin. In 2004, the number of successful nests increased by five, but the downward trend in number of young per successful nest has continued, resulting in reproduction relatively similar to previous years (1999–2003).

4.3.2 PROJECT EFFECTS ON SPECIES

LONG-TERM EFFECTS ON HABITAT

Effect on Quantity of Habitat

The project would not change the acreage of Swainson's hawk nesting habitat at the Greenbriar or proposed reserve sites from current (2005) conditions or conditions at the time of the NBHCP (2001), but would preserve two acres of nesting habitat.

The project's effects on foraging habitat are summarized in Table 4-3. The project would reduce the acreage of Swainson's hawk foraging habitat in the Natomas Basin from conditions at the time of the NBHCP (2001). The proposed development at the Greenbriar site would reduce foraging habitat by an estimated 313 acres from conditions in 2001. At the proposed Spangler and Natomas 130 reserves, foraging habitat would increase by 91 acres. Thus, the project as a whole would yield a net loss of 222 acres of Swainson's hawk foraging habitat.

Table 4-3
Change in Acreage of Swainson's Hawk Foraging Habitat at Project Sites and in the Natomas Basin

Land Cover Type Providing Habitat	Future Condition	Change at Each Project Site			Total Change	Future Condition with Project
		Greenbriar	Natomas 130	Spangler		
Alfalfa	368	-	14.2	45.4	59.6	428
Grassland	284	26.5	-	-	26.5	311
Idle	422	-62.5	-	-	-62.5	360
Non-rice crops	9,533	-234.1	-28.4	-	-262.5	9,271
Pasture	494	-33.8	-	-	-33.8	460
Ruderal	370	-9.2	-	-	-9.2	361
Upland marsh components	547	-	4.3	55.2	59.5	607
Total	12,018	-313.1	-9.9	100.6	-222.4	11,796

Note: Acreages are based on 2001 land cover mapping used to evaluate future condition resulting from the NBHCP and future land cover proposed at project sites.

Effects on Quality of Habitat

Areas Adjacent to Developed Land or Highways

Although the expanded urban area that would be created by the Greenbriar project would result in a net reduction of areas within 800 feet or one mile of urban development or highways, the project would expand a gradient of urban influence into the previously unaffected area to the north of the property and could increase the urban

influence on the agricultural land to the southwest. The impacts to Swainson's hawk prey in this area that could occur as a result of proximity to development are discussed under *Mechanisms of Habitat Degradation*, above. However, the existing roads that border the site, would function as partial barriers that limit the extent of urban influences on adjacent agricultural lands.

The current land use immediately to the north of the Greenbriar site is rice and as such does not support Swainson's hawk habitat except when fallowed. However, the creation of hawk habitat at the Greenbriar site between 2001 and 2005 attests to the potential for the area to the north to become hawk habitat in the future. The recent creation of habitat at the Greenbriar site resulted from the conversion of the rice acreage to non-rice crops and fallow agriculture. The current land use to the southwest of the property is idle cropland, which supports Swainson's hawk habitat.

Altered Habitat Quality at Proposed Reserve and Mitigation Sites

The project with the DEIR mitigation would enhance and preserve at least 190 acres of foraging habitat (26.5 acres of grassland along Lone Tree Canal, 59.7 acres of alfalfa [or other high quality foraging habitat] and 59.5 acres of upland marsh components at Spangler and Natomas 130, and at least an additional 49 acres of high quality foraging habitat required by the *DEIR* mitigation). Habitat at the unspecified DEIR mitigation site(s) and at the proposed Spangler and Natomas 130 reserves would be actively managed with the primary goal of providing high quality foraging habitat.

Conservation of the corridor along Lone Tree canal may improve its value as foraging habitat because it would be converted to perennial grassland that might have higher habitat value than the corridor's current or recent agricultural land cover. This corridor, however, would be a relatively narrow band of potential habitat surrounded by urban development, and this setting might limit its use by Swainson's hawk. Consequently, this proposed corridor was considered to provide only low quality foraging habitat.

Habitat quality for Swainson's hawks would increase in the remaining upland habitat at the proposed Natomas 130 reserve because it would be managed to provide high quality Swainson's hawk habitat.

The proposed Spangler property does not currently function as Swainson's hawk habitat except when fallowed. One hundred eighty four acres of this proposed reserve would be restored to marsh (with upland components providing foraging habitat) and the remainder (45 acres) would be converted to upland managed to provide high quality foraging habitat for Swainson's hawk. Although the Spangler property is within the 18.6 mile maximum foraging distance from all known nests in the Basin, its distance from the Greenbriar site would limit its benefit as foraging habitat for hawks affected by the project regardless of the reserve's management.

Mitigation measure 6.13-2 of the DEIR requires the enhancement and preservation of at least 49 acres to provide high quality foraging habitat that would prevent a net loss of foraging habitat values. This mitigation is in addition to the proposed reserves.

The effect of the Greenbriar project with the DEIR mitigation on the quality of Swainson's hawk foraging habitat was evaluated through three analyses:

1. acres of foraging habitat in low, moderate and high quality categories;
2. total acres of foraging habitat available per month; and
3. total foraging habitat available each month expressed as an equivalent acreage of high quality foraging habitat.

The first two analyses (acres by habitat quality category and monthly availability) were conducted as in the NBHCP, and the third was developed for this effects analysis. All three methods are described in detail in the methods section. The acres of habitat types at the Greenbriar, proposed reserve and DEIR mitigation sites with and without the project that were used in these analyses are shown in Table 2-2, and are also tabulated in tables 3-1 and 4-3.

Though the project would result in a net loss of habitat acreage, an increased percentage of the remaining habitat would be in the high quality category (Exhibit 3a). This increase in high quality habitat would result from the creation and enhancement of habitat at the Spangler, Natomas 130, and the DEIR mitigation sites. Upland habitat at the proposed Natomas 130 reserve would be enhanced, 45 acres of high quality foraging habitat would be created at the Spangler site and to provide DEIR mitigation at least 49 acres of land would be enhanced and managed to provide high quality foraging habitat for Swainson's hawk.

Based on the analysis approach in the NBHCP, the project also would result in greater availability of foraging habitat during April–September, despite causing a net loss in overall acreage of habitat (Exhibit 3). (However, this approach assumes that row and field crops are not available to foraging hawks except at harvest, and thus underestimates the acreage of foraging habitat available, particularly during April–May, which is prior to the harvest of row and field crops in the Natomas Basin.)

Based on EDAW's analysis approach, total foraging resources would be comparable with and without the project. At the Greenbriar, proposed reserve, and DEIR mitigation sites, during April–June, slightly greater foraging resources would be available with the project (the equivalent of 129 acres of high quality foraging habitat with versus 122 acres without the project), while during July–September there would be less (129 versus 140 acres in July–August and 162 acres in September) (Exhibit 4). (Throughout the Natomas Basin, during July–September, more foraging resources are available because that is when most crops are harvested [CH2M HILL 2003].)

Effects on Connectivity

With the exception of the 250-foot wide proposed conservation easement along Lone Tree Canal, the Greenbriar site would become urban land cover, which would reduce upland connectivity between the Swainson's hawk nests south of the site and foraging habitat north of the Greenbriar site. This connectivity will already be reduced by development of the Metro Air Park, which would leave the Greenbriar site as the last north-south habitat corridor in the Basin east of the mile-wide corridor along the Sacramento River. Although nesting hawks have the ability to fly past a developed Greenbriar site to northern foraging areas, they may be less likely to use foraging habitat beyond this 546-acre urban area because of the energetic cost and additional time away from the nest required by the flight. (Long foraging flights are more likely to follow lines of contiguous habitat, as hawks may scan for prey along the entire flight.)

For Swainson's hawk, the consequences of this potential habitat fragmentation depend on the distribution of foraging and nesting habitat under the future condition of the Natomas Basin resulting from the NBHCP. Currently, there is relatively little foraging habitat north and east of the Greenbriar site, and this habitat is already fragmented. There also is very little potential nesting habitat north and east of the Greenbriar site. (Both foraging habitat and nesting habitat are concentrated to the south and west of the Greenbriar site.) Thus, changes in land cover at the Greenbriar site are unlikely to cause substantial alterations of movement of Swainson's hawks across the Greenbriar site. However, the distribution of Swainson's hawk habitat in the Natomas Basin could change, and under the future condition of the Natomas Basin there would be non-urban land both north of the Greenbriar site in the central Natomas Basin and to the south of the Greenbriar site in the southern Natomas Basin. Thus, the potential for effects on connectivity of Swainson's hawk habitat can not be discounted.

The potential effects of habitat fragmentation and reduced upland connectivity on Swainson's hawk prey are discussed under *Mechanisms of Habitat Degradation*, above.

EFFECTS OF CONSTRUCTION-RELATED ACTIVITIES

Construction at the Greenbriar site and habitat management at the proposed reserve sites has the potential to displace and/or disturb nesting Swainson's hawks. Nest disturbance from the operation of heavy construction equipment and continued activity near nest sites could cause nest abandonment or interfere with the incubation and feeding of young in a way that reduces nesting success.

The DEIR for the Greenbriar project and the Natomas Basin HCP both include measures to avoid and minimize construction-related effects on Swainson's hawks. In the DEIR, these measures include:

- Pre-construction surveys shall be conducted for Swainson's hawk and other raptors no more than 14 days and no less than 7 days prior to the beginning of any construction activity between March 15 and August 15. The survey area shall include all potential nesting sites located within ½ mile of the project and mitigation-sites

- Should nesting be discovered within the survey area, a qualified biologist shall notify DFG and no new disturbance shall occur within 1/2 mile of the nest until the nest is no longer active or appropriate avoidance measures are approved by DFG to ensure that the nest is adequately protected. Potential mitigation measures may include visual screening and timing restrictions for construction activity. Monitoring (funded by the project applicants) of active nests by a DFG-approved raptor biologist shall be required to determine if project construction is disturbing Swainson's hawks at the nest site. Exact implementation of this measure shall be based on specific information at the project site.

These measures should adequately reduce the impacts to Swainson's hawks that may result specifically from construction-related activities. Any construction-related displacement of hawks from foraging habitat is akin to habitat loss, as discussed above.

EFFECTS OF HUMAN-WILDLIFE CONFLICTS

The proposed development is located within a ½ mile of one Swainson's hawk nest active in 2005. Although this nest tree was cut down (without authorization) during the breeding season, the pair attempted to renest in another nearby tree and may return in future years. This breeding pair would be close enough to the Greenbriar site that human disturbance from the residential development proposed at the Greenbriar site may cause nest abandonment (Bent 1937; Stahlecker 1975) or interfere with incubation and feeding of young in a way that reduces reproductive success. Predation of eggs and young chicks by crows and other corvids may also increase as a result of increased human refuse and infrastructure at the Greenbriar site (Steenhof et al. 1993; Marzluff et al. 2001). Mortality because of vehicle strikes may also increase on existing roads because of the increased traffic associated with the project. Human-wildlife conflicts are unlikely to occur at the proposed reserves.

OVERALL EFFECT ON POPULATION VIABILITY

The project would cause both adverse and beneficial effects on the Swainson's hawk population nesting and foraging in the Natomas Basin. Adverse effects would include a reduction in the total acreage of foraging habitat, fragmentation, and possibly degradation of habitat near the Greenbriar site, and a reduction in habitat available to hawks nesting at reserves near the Greenbriar site. Beneficial effects would include increasing the acreage of high quality habitat, preserving high quality habitat within a mile of TNBC reserves (or of the Swainson's Hawk zone along the Sacramento River), and possibly contributing to the connectivity of foraging habitat adjacent to the mitigation site(s) required by mitigation measure 6.13-2.

Overall, based on the USFWS interpretation of effects on Swainson's hawk due to the NBHCP (USFWS 2003), the Greenbriar project would not be expected to adversely affect the viability of the Swainson's hawk population in the Natomas Basin. Because the availability of foraging habitat during April-July is considered to limit the abundance and reproductive success of Swainson's hawk in the Natomas Basin (CH2M HILL 2003; USFWS 2003), and the project would not reduce the acreage of habitat available during these months, the project would not be expected to reduce the number of hawks nesting in the Natomas Basin or their reproductive success.

4.4 BURROWING OWL

4.4.1 SPECIES ECOLOGY

HABITAT ASSOCIATIONS/REQUIREMENTS

Habitat Type

Burrowing owls (*Athene cunicularia hypugea*) typically inhabit grasslands, savannahs and other open habitats with low-lying vegetation. Land cover types designated as burrowing owl habitat in the NBHCP include alfalfa, grassland and pasture. Owls are also known to nest and forage in idle agricultural fields, ruderal fields and the edges of cultivated fields, although these areas provide lower quality habitat than native grasslands. The NBHCP also describes canals as potential nesting habitat for burrowing owls, although it does not include canals in the habitat table for this species. Levees and upper banks of canals and ditches provide burrowing owl nesting habitat when canal maintenance activities are limited, water levels remain below nesting burrows and the area remains relatively undisturbed. Small mammal populations (particularly California ground squirrels) are the most important feature in burrowing owl habitat, as these mammals provide both food and nesting burrows for the owls. When natural burrows are scarce, burrowing owls will also nest in artificial structures such as culverts. They often nest in elevated areas such as berms and levees, where they may scan adjacent lands for predators and prey. Burrowing owls feed primarily on large insects and rodents, and will also feed opportunistically on birds, reptiles and amphibians (NatureServe 2005).

Home Range Size and Movement

Although the more northern burrowing owl populations migrate seasonally, burrowing owls are year-round residents of the Natomas Basin. The owls often form loose colonies, with nest burrows 46–2,952 feet apart (Ross 1974; Gleason 1978). Surprisingly few data are available on home range size for this species. Published estimates vary from 0.05–1.86 square miles (Haug and Oliphant 1990).

Mechanisms of Habitat Degradation

Increased Predation

Ground- and burrow-nesting birds such as burrowing owls are particularly vulnerable to predation by domestic dogs and cats. Many wild predators of burrowing owls also increase near human habitation. In proximity to residential development, dominant carnivores such as coyotes are typically replaced by foxes, opossums, skunks, and other small predators that feed on burrowing owls (Sheffield 1997; Wellicome 1997b; Crooks and Soule 1999). Avian predators such as great-horned owls and crows may also increase in proximity to residential development, in response to introduced nesting trees, increased food supplies and increased hunting perches such as street lights and other infrastructure (Steenhof et al. 1993; Marzluff et al. 2001). This increase in predator abundance would likely result in increased predation of burrowing owl nests and adults near residential development.

Reduction of Prey Base

Changes in the owls' prey base may result from residential development affecting adjacent mammalian predator communities. Rodents and insects are the primary prey of burrowing owls; songbirds also contribute to their diets (NatureServe 2005). Crooks and Soule (1999) quantified the effects of domestic cats on small animals. They estimated that the average domestic cat population in moderately sized fragments (~50 acres of upland habitat bordered by 100 residences) returns about 840 rodents, 525 birds and 595 lizards to residences each year. Assuming that cats do not bring back all prey that they kill, actual effects on prey numbers are probably even greater. Crooks and Soule (1999) documented increased extirpations of songbird species in habitat fragments with

higher densities of cats, raccoons and opossums, all of which often increase in proximity to residential development.

Compared to undeveloped areas at least 2,296 feet from development, Odell and Knight (2001) demonstrated lower densities of the owls' secondary songbird prey within 1,083 feet of sparse residential development (about 0.4 houses per acre); impacts of higher density development are expected to be greater. Similarly, Blair (1996) reported 1/3 fewer bird species in lands adjacent to residential development, when compared to habitat preserves in the same area.

Habitat Fragmentation and Reduced Patch Size

Habitat fragmentation has been implicated as a major cause of population decline in grassland birds in general, and is likely to specifically impact burrowing owls. Helzer and Jelinski (1999) found both overall avian species richness and the presence of several common grassland species to increase with the size of habitat patches (especially when >124 acres) and decrease with the perimeter-area ratio of these patches, which reflects the proportion of habitat influenced by edge effects.

In fragments 5–250 acres in size, Crooks et al. (2001) found fragment size to be the most important factor determining extinction and colonization of songbirds. No fragments up to 247 acres in size were large enough to support the full complement of native bird species with 95% probability over a 100-year period. Burrowing owls forage in larger habitat patches than the smaller birds studied by Crooks et al. (2001), and are likely to be similarly affected by fragmentation. Hinsley et al. (1995) also demonstrated the instability of bird populations in habitat fragments.

Nest Disturbance

Although burrowing owls are tolerant of human activity outside of the breeding season, they have been shown to abandon nests if disturbed during incubation. In addition to nest abandonment, significant disturbances near owl nests may interfere with parental care and feeding of young in a way that reduces nest success.

DISTRIBUTION

Information on CNDDB Occurrences

When information was compiled for the NBHCP in 2001, there were 370 known occurrences in California, of which 300 were considered extant. At that time, three occurrences were known from the Natomas Basin, all of which were considered extant. As of 2005, there are 709 known occurrences in California, of which 671 are considered extant. At this time, seven occurrences are known in the Natomas Basin, of which six are considered extant. Of these occurrences, one is within a mile of the Greenbriar site, and none are within a mile of the proposed reserve sites.

Other Information on Distribution and Abundance in Natomas Basin

No systematic surveys have been conducted to determine burrowing owl distribution or abundance across the Natomas Basin. A burrowing owl was incidentally observed in a culvert on the southwestern portion of the Greenbriar site during the March 17, 2005 site visit. A number of owl pellets and whitewash were also observed, indicating extended use of the site by at least one owl for roosting and foraging over a period of time, and possible nesting. During biological effectiveness monitoring for the NBHCP, burrowing owls were observed in the eastern Basin south of Elverta Road and in the central Basin along Highway 99 (approximately 1.3 miles north of the Greenbriar site) (Jones & Stokes 2005). Burrowing owls have also been incidentally observed east of the Greenbriar site along Elkhorn Blvd. and west of the Greenbriar site on the Metro Air Park and Sacramento International Airport.

4.4.2 PROJECT EFFECTS ON SPECIES

LONG-TERM EFFECTS ON HABITAT

Effect on Quantity of Habitat

The project's effects on foraging habitat for burrowing owl are summarized in Table 4-4. The project would reduce the acreage of burrowing owl habitat in the Natomas Basin from conditions at the time of the NBHCP (2001). The proposed development at the Greenbriar site would reduce habitat by an estimated 94 acres from conditions in 2001. At the proposed reserves, 118 acres of burrowing owl habitat would be created (assuming the Swainson's hawk foraging also provided burrowing owl habitat). Thus, the project as a whole would yield a net gain of 24 acres of burrowing owl habitat. Additional burrowing owl foraging habitat may be created by the enhancement and management of at least 49 acres of land to provide high quality foraging habitat for Swainson's hawk that is required by mitigation measure 6-13.2 of the DEIR.

Table 4-4
Change in Acreage of Burrowing Owl Habitat at Project Sites and in the Natomas Basin

Land Cover Type Providing Habitat	Future Condition	Change at Each Project Site			Total Change	Future Condition with Project
		Greenbriar	Natomas 130	Spangler		
Alfalfa	368	-	14.2	45.4	59.6	428
Canals	1,162	-15.0	0.0	-1.4	-16.4	1,146
Grassland	284	26.5	-	-	26.5	311
Idle	422	-62.5	-	-	-62.5	360
Pasture	494	-33.8	-	-	-33.8	460
Ruderal	370	-9.2	-	-	-9.2	361
Upland marsh components	547	-	4.3	55.2	59.5	607
Total	3,647	-94.1	18.5	99.2	23.7	3,673

Note: Acreages are based on 2001 land cover mapping used to evaluate future condition resulting from the NBHCP and future land cover proposed at project sites.

Effects on Quality of Habitat

Areas Adjacent to Developed Land or Highways

Although the expanded urban area that would be created at the Greenbriar site would result in a net reduction of areas within 800 feet or 1 mile of development, the project would expand a gradient of urban influence into the previously unaffected area to the north of the property and could increase the urban influence in the idle field to the southwest. The potential effects on burrowing owls and their prey in these areas are discussed under *Mechanisms of Habitat Degradation*, above. These adverse effects, however, would be limited by Interstate 5 along the Greenbriar site's southern border, and by Elkhorn Boulevard (which would be expanded to six lanes) that would serve as partial barriers between development on the Greenbriar site and adjacent agricultural lands.

The current land use immediately to the north of the Greenbriar site is rice and as such does not support burrowing owl habitat. However, the creation of burrowing owl habitat at the Greenbriar site between 2001 and 2005 attests to the potential for the area to the north to become burrowing owl habitat in the future. The habitat creation on the Greenbriar site resulted from the conversion of a portion of the rice acreage to fallow agriculture. The current land use to the southwest of the property is fallow agriculture, which supports burrowing owl habitat.

Altered Habitat Quality at Proposed Reserve and Mitigation Sites

In addition to habitat lost due to development of the Greenbriar site, and created at the proposed reserves, the quality of burrowing owl habitat could be altered at the conserved corridor along Lone Tree Canal, the proposed Spangler and Natomas 130 reserves, and the mitigation site that would be required by mitigation measure 6.13-2 of the DEIR.

Conservation of the corridor along Lone Tree canal may improve its value as foraging habitat because it would be converted to perennial grassland that might have higher habitat value. This corridor, however, would be a relatively narrow band of potential habitat surrounded by urban development, and this setting might limit its use by burrowing owl.

At all of the proposed reserves, management practices would enhance habitat for burrowing owl. These enhancements include maintaining buffers in as natural a state as possible, controlling feral cats if necessary, and reducing human disturbance due to trespassers (City of Sacramento et al. 2003, John Roberts, TNBC, personal communication). Also, preservation of habitat, even without enhancement measures, provides some benefits, including that it precludes land use changes that would eliminate habitat, and should reduce or eliminate uses that could cause mortality of individuals.

In addition to habitat enhancement at the proposed reserves, mitigation measure 6.13-2 of the DEIR requires that at least 49 acres be enhanced to provide high quality foraging habitat. This mitigation could also benefit burrowing owls. This mitigation land will be managed to provide high quality foraging habitat for Swainson's hawk, but would also enhance foraging habitat for burrowing owl.

Effects on Connectivity

With the exception of the 250-foot wide conservation easement proposed along Lone Tree Canal, the development at the Greenbriar site would eliminate the existing contiguity of upland habitats to the north and south of the site. This connectivity will already be substantially reduced by development at the Metro Air Park, which would leave the Greenbriar site as the last north-south corridor of habitat in the Basin east of the mile-wide corridor along the Sacramento River. Owl survival and reproduction are likely to be higher in larger, more contiguous habitat areas. Connectivity benefits owls by providing greater ease of locating mates, greater flexibility in year-round foraging opportunities, and safer passages for juvenile dispersal. The potential effects of reduced connectivity on upland birds in general are discussed under *Mechanisms of Habitat Degradation,* above.

The proposed reserves and mitigation site(s) could increase connectivity of burrowing owl habitat elsewhere in the Natomas Basin. If larger, more contiguous areas of habitat resulted from the creation of these reserves, this would benefit owl survival and reproduction. Other foraging habitat is available near the Natomas 130 site, and thus this proposed reserve would result in larger more continuous areas of habitat (Jones & Stokes 2005). The land cover surrounding the Spangler property is primarily rice (Jones & Stokes 2005)

EFFECTS OF CONSTRUCTION-RELATED ACTIVITIES

Earth-moving activities may trap or injure owls in their burrows, and disturbance near nests may cause nest abandonment. Both the Greenbriar DEIR and Natomas Basin HCP require comparable measures to avoid impacts to burrowing owls during construction. The DEIR measures include:

a. No more than 30 days and no less than 14 day prior to project site grading, a qualified biologist shall conduct focused surveys for burrowing owls in areas of suitable habitat on and within 300 feet of the project site. Surveys shall be conducted in accordance with DFG protocol (DFG 1995).

b. If no occupied burrows are found in the survey area, a letter report documenting survey methods and findings shall be submitted to DFG, and no further mitigation is necessary.

c. If occupied burrows are found in the survey area, impacts shall be avoided by establishing a buffer of 165 feet during the non-breeding season (September 1 through January 31) or 300 feet during the breeding season (February 1 through August 31). The size of the buffer area may be adjusted if a qualified biologist and DFG determine it would not be likely to have adverse effects. No project activity shall commence within the buffer area until a qualified biologist confirms that the burrow is no longer occupied. If the burrow is occupied by a nesting pair, a minimum of 6.5 acres of foraging habitat contiguous to the burrow shall be preserved until the breeding season is over.

d. If impacts to occupied burrows are unavoidable, on-site passive relocation techniques may be used if approved by DFG to encourage owls to move to alternative burrows outside of the impact area. However, no occupied burrows shall be disturbed during the nesting season unless a qualified biologist verifies through non-invasive methods that the burrow is no longer occupied. Foraging habitat for relocated pairs shall be provided in accordance with guidelines provided by DFG (1995). DFG guidelines recommend a minimum of 6.5 acres of foraging habitat per pair or unpaired resident bird, be acquired and permanently protected.

e. If relocation of the owls is approved for the site by DFG, the developer shall hire a qualified biologist to prepare a plan for relocating the owls to a suitable site. The relocation plan must include: (a) the location of the nest and owls proposed for relocation; (b) the location of the proposed relocation-site; (c) the number of owls involved and the time of year when the relocation is proposed to take place; (d) the name and credentials of the biologist who will be retained to supervise the relocation; (e) the proposed method of capture and transport for the owls to the new site; (f) a description of the site preparations at the relocation-site (e.g., enhancement of existing burrows, creation of artificial burrows, one-time or long-term vegetation control, etc.); and (g) a description of efforts and funding support proposed to monitor the relocation. Relocation options may include passive relocation to another area of the site not subject to disturbance through one way doors on burrow openings, or construction of artificial burrows in accordance DFG guidelines.

f. The project applicant shall implement Mitigation Measure 6.12-2 to mitigate for the loss of burrowing owl foraging habitat.

By following these measures, the potential for injury, entrapment, and nest abandonment would be reduced. However, nests may be abandoned because of loss of the surrounding foraging habitat during construction, and owl viability at relocation sites is not guaranteed.

EFFECTS OF HUMAN-WILDLIFE CONFLICTS

On the remaining habitat adjacent to the proposed development, human activity may cause owl nest abandonment or interfere with the incubation and feeding of young in a way that reduces reproductive success. Increased owl predation would also likely occur in proximity to the proposed development, as a result of the typical increase in human-associated owl predators discussed above under Mechanisms of Habitat Degradation. Increased predation by domestic cats is likely to extend between 98–540 feet from homes, predation by domestic dogs is likely to extend between 540–990 feet from homes, and increased predation by wild predators is likely to extend farther (Odell and Knight 2001). Mortality because of vehicle strikes may also increase on existing roads because of the increased traffic that would result from the project.

OVERALL EFFECT ON POPULATION VIABILITY

The Greenbriar project with the DEIR mitigation would cause both adverse and beneficial effects on burrowing owl. Adverse effects would include loss of occupied habitat, and fragmentation and some degradation of habitat adjacent to development at the Greenbriar site. Beneficial effects would include a net increase in acreage of foraging habitat, and preservation and enhancement of at least 197 acres of habitat, and possibly increased connectivity of habitats in the vicinity of the mitigation lands. Overall, the project would likely result in a beneficial effect on burrowing owl. However, the project is unlikely to have a substantial effect on burrowing

owls using the Natomas Basin, and since the Basin accounts for a very small portion of the Central Valley's burrowing owl population and of the habitat it occupies (USFWS 2003), the project would not alter the viability of the burrowing owl population using the Natomas Basin.

4.5 LOGGERHEAD SHRIKE

4.5.1 SPECIES ECOLOGY

HABITAT ASSOCIATIONS/REQUIREMENTS

Habitat Type

Loggerhead shrikes (*Lanius ludovicianus*) are most commonly found in grasslands, agricultural lands, open shrublands, and open woodlands (Bent 1950). Land cover types designated as shrike habitat in the NBHCP include alfalfa, grassland, non-rice crops, oak groves, orchard, pasture, ponds and seasonally wet areas, riparian, ruderal, rural residential, tree groves, and canals. Special habitat features that improve shrike abundance, survival, and reproductive success are hunting perches, low nesting trees and shrubs, thorny vegetation, and/or barbed wire on which to impale their prey. Shrikes select a variety of prey including insects, reptiles, mammals, and birds.

Home Range Size and Movement

The mean territory size of breeding loggerhead shrikes in mainland California is 22 acres (Miller 1931). The range-wide maximum and minimum breeding territory sizes recorded are 1.7 and 44 acres (Yosef and Grubb 1994). Territory size varies with habitat quality, prey abundance and availability, and density of hunting perches (Kridelbaugh 1982, Yosef and Grubb 1992). Loggerhead shrikes have been observed foraging up to a quarter mile from active nests (Brooks 1988). Shrikes are year-round residents in California, and breeding pairs disband in autumn to defend separate, adjacent, winter territories (Miller 1951, Craig 1978). As food availability decreases in winter, seasonal home ranges may increase to 128 acres (Blumton et al. 1989). Juvenile shrikes move an average of 3.4 miles from their natal territories to their fall territories.

Mechanisms of Habitat Degradation

Increased Predation

Domestic cats are a common predator of loggerhead shrike adults, juveniles and nests (Luukkonen 1987, Novak 1989), and would increase in abundance following the proposed development. Crooks and Soule (1999) quantified the impacts of domestic cat predation on songbirds such as loggerhead shrikes, and estimated that the average domestic cat population in moderately sized fragments (~50 acres of upland habitat bordered by 100 residences) returns about 525 birds to human residences each year. Assuming that cats do not bring back all prey that they kill, actual impacts to birds are probably even greater.

Many wild mammalian predators of shrikes also increase near human habitation. In proximity to residential development, dominant, larger carnivores such as coyotes are typically replaced by foxes, opossums, skunks, and other small predators that feed on shrikes and other songbirds. Crooks and Soule (1999) have recorded increased avian extirpation rates in habitat fragments as a result of these predator increases.

Shrike nest predators such as crows also typically increase in proximity to residential development, in response to introduced nesting trees, increased food supplies, and increased hunting perches such as street lights and other infrastructure (Steenhof et al. 1993; Marzluff et al. 2001). Predation of loggerhead shrike nests is also more intense along roads, urban edges, and other linear habitats (DeGeus 1990), presumably because of the increased use of linear rights-of-way by crows and mammalian predators (Knight et al. 1995). Of loggerhead shrike nest failures, 40–90% have been attributed to predation in the various studies of this species (NatureServe). Shrike

mortality from vehicle collisions has also been significant in some areas (NatureServe), and may increase with increased traffic generated by the proposed residential development.

Nest Disturbance

Loggerhead shrikes will abandon nests if disturbed by humans during egg-laying or early in incubation. Shrikes are generally tolerant of human activity near nests later in the breeding season, however, and nest abandonment is not generally a significant factor in nest failure (Collister 1994).

Habitat Fragmentation

Habitat fragmentation has been implicated as a major cause of population decline in grassland birds in general, and is likely to specifically affect loggerhead shrikes. Helzer and Jelinski (1999) found both overall avian species richness and the presence of several common grassland species to increase with the size of habitat patches (especially when >50 ha) and decrease with the perimeter-area ratio of these patches, which reflects the proportion of habitat influenced by edge effects. Hinsley et al. (1995) and Crooks et al. (2001) also demonstrated the instability of upland bird populations in habitat fragments.

DISTRIBUTION

Information on CNDDB Occurrences

Although loggerhead shrikes are known to occur in open habitats throughout California (California Department of Fish and Game 1990), they have not been extensively surveyed and few occurrence data are available in the state. The CNDDB lists five occurrences for this species, all in southern California.

Other Information on Distribution and Abundance in Natomas Basin

The Natomas Basin Conservancy lists 82 shrike occurrences throughout the Basin, and suitable nesting and foraging habitat is common throughout the area. Shrikes were observed on the Greenbriar site during March 2005 surveys.

4.5.2 PROJECT EFFECTS ON SPECIES

LONG-TERM EFFECTS ON HABITAT

Effect on Quantity of Habitat

The project's effects on the acreage of shrike habitat are summarized in Table 4-5. The project would reduce the acreage of loggerhead shrike habitat in the Natomas Basin from conditions at the time of the NBHCP (2001). The proposed development at the Greenbriar site would reduce habitat by an estimated 369 acres from conditions in 2001. At the proposed Spangler reserve, shrike habitat would increase by 228 acres because habitat would be created (by converting rice to marsh and upland habitat). Thus, the project as a whole would yield a net loss of 141 acres of loggerhead shrike habitat.

Effects on Quality of Habitat

Areas Adjacent to Developed Land or Highways

Although the urban area that would be created by the Greenbriar project would result in a net reduction of areas within 800 feet or 1 mile of development, the project would expand a gradient of urban influence into the previously unaffected area to the north of the property and could increase the urban influence in the idle field to

the southwest. The potential affects on loggerhead shrikes in these areas are discussed under *Mechanisms of Habitat Degradation*, above.

Table 4-5
Change in Acreage of Loggerhead Shrike Habitat at Project Sites and in the Natomas Basin

Land Cover Type Providing Habitat	Future Condition	Change at Each Project Site			Total Change	Future Condition with Project
		Greenbriar	Natomas 130	Spangler		
Alfalfa	368	-	14.2	45.4	59.7	428
Canals	1,162	-15.0	0.0	-1.4	-16.4	1,146
Grassland	284	26.5	-	-	26.5	311
Idle	422	-62.5	-	-	-62.5	360
Non-rice crops	9,533	-234.1	-28.4	-	-262.6	9,270
Oak groves	77	-	-	-	0.0	77
Orchards	165	-	-	-	0.0	165
Pasture	494	-33.8	-	-	-33.8	460
Ponds & seasonally wet areas	2,259	2.7	14.2	184	200.9	2,460
Riparian	91	0.0	0.0	-	0.0	91
Ruderal	370	-9.22	-	-	-9.2	361
Rural residential	287	-43.319	-	-	-43.3	244
Tree groves	44	-	0.0	-	0.0	44
Total	15,555	-368.8	0.0	228	-140.8	15,415

Note: Acreages are based on 2001 land cover mapping used to evaluate future condition resulting from the NBHCP and future land cover proposed at project sites.

The current land use immediately to the north of the Greenbriar site is rice and as such does not support loggerhead shrike habitat. However, the creation of shrike habitat at the Greenbriar site between 2001 and 2005 attests to the potential for the area to the north to become impacted shrike habitat in the future. The habitat creation on the Greenbriar site resulted from the conversion of a portion of the rice acreage to fallow agriculture and non-rice crops. The current land use to the southwest of the property is fallow agriculture, which supports loggerhead shrike habitat.

Adverse effects on adjacent land, though probably not insignificant, would be limited by Interstate 5 along the Greenbriar site's southern border and by Elkhorn Boulevard (which would be expanded to six lanes) that would serve as partial barriers between development on the Greenbriar site and adjacent agricultural lands.

Altered Habitat Quality at Proposed Reserve and Mitigation Sites

In addition to habitat loss due to development of the Greenbriar site and habitat creation from rice at the proposed Spangler reserve, the quality of loggerhead shrike habitat could be altered at the conserved corridor along Lone Tree Canal, the proposed Natomas 130 reserve, and the mitigation site(s) that would be required by mitigation measure 6.13-2 of the DEIR.

Conservation of the corridor along Lone Tree canal may improve its value as foraging habitat because it would be converted to perennial grassland that might have higher habitat value than the current and recent agricultural land cover. This corridor, however, would be a relatively narrow band of potential habitat surrounded by urban development, and this setting might limit its use by loggerhead shrike.

At the proposed Natomas 130 reserve, there would be little overall change in habitat quality. Habitat quality would decrease on the 14 acres of created marsh, because this land cover type provides lower quality shrike habitat than the agricultural cropland it would replace. Conversely, habitat quality would increase on the 14 acres managed to provide high quality foraging habitat for Swainson's hawk. At the Spangler site, 235 acres would be enhanced for loggerhead shrike by the conversion of rice to managed marsh and uplands. Loggerhead shrike habitat would also be enhanced at the on 49 acres at the *DEIR* mitigation site. Mitigation measure 6.13-2 of the DEIR requires the enhancement and preservation of at least 49 acres to provide high quality foraging habitat. This DEIR mitigation is in addition to the proposed reserves. Its management to provide high quality foraging habitat for Swainson's hawk would also increase habitat quality for loggerhead shrike.

Overall, the project would preserve and actively manage 345 acres of habitat (30.4 acres at the Natomas 130 site, 235.4 acres at the Spangler site, 30.6 acres at the Greenbriar site, and at least 49 acres at the mitigation site required by mitigation measure 6-13.2 of the DEIR). This preservation and management would provide additional benefits (such as reduced human disturbance).

Effects on Connectivity

With the exception of the 250-foot wide proposed conservation easement along Lone Tree Canal, development at the Greenbriar site would eliminate the existing contiguity of upland habitats to the north and south of the site. This connectivity will already be substantially reduced by development at the Metro Air Park, which would leave the Greenbriar site as the last north-south habitat corridor in the Basin east of the mile wide corridor along the Sacramento River. Shrike survival and reproduction are likely to be higher in larger, more contiguous habitat areas. Connectivity benefits shrikes by providing greater ease of locating mates, greater flexibility in year-round foraging opportunities, and safer passages for juvenile dispersal and seasonal movements. The potential effects of reduced connectivity on upland birds in general are discussed under *Mechanisms of Habitat Degradation*, above.

Except for the proposed Spangler reserve, the proposed reserve and mitigation sites already provide shrike habitat, and thus their preservation and management are unlikely to significantly increase habitat connectivity. The creation of habitat at the proposed Spangler reserve could locally increase connectivity of shrike habitats.

EFFECTS OF CONSTRUCTION-RELATED ACTIVITIES

Construction activities associated with the proposed development or the proposed habitat creation on proposed reserve sites could disturb or displace loggerhead shrikes and may cause nest abandonment. In the Greenbriar project DEIR and Natomas Basin HCP, preconstruction surveys for loggerhead shrikes would be conducted before construction. If shrikes are found, disturbance would be avoided during the nesting season to the maximum extent possible.

EFFECTS OF HUMAN-WILDLIFE CONFLICTS

On the remaining habitat adjacent to the proposed development, human activity may cause shrike nest abandonment or interfere with the incubation and feeding of young in a way that reduces reproductive success. Increased shrike predation would also be likely to occur in proximity to the proposed development, as a result of the typical increase in human-associated predators discussed above under *Mechanisms of Habitat Degradation*. Human-wildlife conflicts are unlikely to occur at the proposed reserve sites.

OVERALL EFFECT ON POPULATION VIABILITY

Overall, the Greenbriar project could cause a small adverse or beneficial effect on loggerhead shrike. Though it would enhance 298 acres of shrike habitat and preserve 345 acres of habitat, these beneficial effects might not fully offset the project's adverse effects on loggerhead shrike, which include a net loss of 141 acres of habitat, reduced habitat quality on 45 acres (14 acres at Natomas 130 and 30.6 acres along Lone Tree Canal),

fragmentation of habitat, a reduction of connectivity, and probably some increased mortality and habitat degradation adjacent to the Greenbriar site. However, the project's effects would be small relative to the quantity of habitat that would remain in the Natomas Basin (e.g., the project would cause the loss of approximately 1% of habitat that would be available under the future condition), and the Natomas Basin represents only a small portion of the habitat used by shrikes in the Central Valley (USFWS 2003). Thus, the project is unlikely to alter the viability of the loggerhead shrike population using the Natomas Basin.

4.6 TRICOLORED BLACKBIRD

4.6.1 SPECIES ECOLOGY

HABITAT ASSOCIATIONS/REQUIREMENTS

Habitat Type

Tricolored blackbirds (*Agelaius tricolor*) nest in dense colonies that range from less than 25 individuals to over 80,000. As nesting and foraging habitat differ for this species, we analyzed these habitats separately. Common nesting substrates include tule and cattail marsh, blackberry, thistle, willow, nettle, and some grain crops (Beedy and Hayworth 1991). Because patches of dense nesting substrate do not necessarily correlate with the land cover types defined by the NBHCP, the NBHCP analyzed these patches separately as "tricolored blackbird nesting habitat." Special habitat features that improve nesting blackbird abundance, survival and reproductive success include dense nesting substrates and proximity to concentrated insect populations large enough to sustain the colony (Grinnell and Miller 1944, DeHaven 2000).

Tricolored blackbirds forage in grassland, pasture, silage, wetlands and flooded fields, rice, and other grain fields (Zeiner et al. 1990). Land cover types designated as tricolored blackbird foraging habitat in the NBHCP include alfalfa, grassland, non-rice crops, pasture, and rice. As they represent a transition between cropland and grassland habitats, idle and ruderal fields may also provide marginal foraging habitat. Tricolored blackbirds are primarily insectivorous, with grasshoppers, beetles, and weevils dominating their diet (Beedy and Hayworth 1991).

Home Range Size and Movement

Breeding tricolored blackbirds concentrate foraging activity in proximity to nesting colonies, and may travel up to 4 miles from nest or roost sites to forage. The species is generally nomadic when not breeding, and may be found year-round throughout lowland California.

Mechanisms of Habitat Degradation

Increased Predation

Abundance of blackbird predators such as domestic cats and foxes typically increases in proximity to residential development (Crooks and Soule 1999). Although increased predation near residential development would likely be much less for vigilant, mobile flocks of foraging blackbirds than for more stationary nesting birds such as loggerhead shrikes or burrowing owls, predation rates would be expected to increase for all small bird species near residential development.

Nest Disturbance

Nesting colonies of tricolored blackbirds are highly sensitive to disturbance, which may cause nest abandonment or interfere with the incubation and feeding of young in a way that reduces reproductive success (NBHCP 2001).

Water Diversion and Runoff

Water diversions may degrade wetland habitat for tricolored blackbirds nesting downstream from a diversion.

DISTRIBUTION

Information on CNDDB Occurrences

The NBHCP does not list state-wide or Basin-specific CNDDB occurrences of tricolored blackbirds, but notes 9 occurrences in Sutter County, 7 of which were extant in 2001. As of 2005, there are 408 known occurrences in California, of which 339 are considered extant. At this time, CNDDB does not list tricolored blackbird occurrences within one mile of the Natomas Basin.

Other Information on Distribution and Abundance in Natomas Basin

At the time of the NBHCP in 2001, the Betts-Kismat-Silva reserve on the eastern edge of the Natomas Basin supported a tricolored blackbird colony of approximately 4,000 nesting birds (NBHCP 2001). At the time of the most recent TNBC monitoring report in 2004, the blackbirds did not nest at this site, although 125–300 birds were regularly seen in the area. Tricolored blackbirds similarly did not nest at this site in 2005 (unpublished data). Tricolored blackbirds are known to forage throughout the Basin (NBHCP), and have been observed foraging on the Metro Air Park site near the Greenbriar site (Thomas Reid Associates, 2000).

4.6.2 PROJECT EFFECTS ON SPECIES

LONG-TERM EFFECTS ON HABITAT

Effect on Quantity of Habitat

The Project's effects on the acreage of nesting habitat for tricolored blackbirds are summarized in Table 4-6. The Greenbriar and proposed reserve sites do not currently support tricolored blackbird nesting habitat. The proposed creation of 198 acres of marsh at the Natomas 130 and Spangler sites would provide potential nesting habitat in these managed marshes. However, at the Natomas 130 site, because of the extensive urban development nearby and variety of habitats surrounding the parcel, it is unclear whether the foraging habitat surrounding the created marsh would be adequate to sustain a nesting colony of blackbirds. This is not the case at the Spangler site where most of the marsh (184 of 198 acres) would be created.

Table 4-6
Change in Acreage of Tricolored Blackbird Nesting Habitat at Project Sites and in the Natomas Basin

Land Cover Type Providing Habitat	Future Condition	Change at Each Project Site			Total Change	Future Condition with Project
		Greenbriar	Natomas 130	Spangler		
Ponds & seasonally wet areas	2,259	2.7	14.2	184.0	200.9	2,460
Total	2,259	2.7	14.2	184.0	200.9	2,460

Note: Acreages are based on 2001 land cover mapping used to evaluate future condition resulting from the NBHCP and future land cover proposed at project sites.

The Project's effects on the acreage foraging habitat for tricolored blackbirds are summarized in Table 4-7. The project would reduce the acreage of tricolored blackbird foraging habitat in the Natomas Basin. The proposed development at the Greenbriar site would eliminate an estimated 402 acres of habitat, based on 2001 land cover.

At the proposed Spangler and Natomas 130 reserves, 197 acres of foraging habitat would be eliminated (by conversion of rice and non-rice crop to marsh). Thus, the project as a whole would yield a net loss of 598 acres of tricolored blackbird foraging habitat.

Table 4-7
Change in Acreage of Tricolored Blackbird Foraging Habitat at Project Sites and in the Natomas Basin

Land Cover Type Providing Habitat	Future Condition	Change at Each Project Site			Total Change	Future Condition with Project
		Greenbriar	Natomas 130	Spangler		
Alfalfa	368	-	14.2	45.4	59.6	428
Grassland	284	26.5	-	-	26.5	311
Non-rice crops	9,533	-234.1	-28.4	-	-262.6	9,270
Pasture	494	-33.8	-	-	-33.8	460
Rice	11,643	-160.0	-	-228	-388.0	11,255
Total	22,322	-401.5	-14.2	-182.6	-598.3	21,724

Note: Acreages are based on 2001 land cover mapping used to evaluate future condition resulting from the NBHCP and future land cover proposed at project sites.

Effects on Quality of Habitat

Areas Adjacent to Developed Land or Highways

Although the urban area that would be created by the proposed Greenbriar development would result in a net reduction of areas within 800 feet or 1 mile of development, the project would expand a gradient of urban influence into the previously unaffected area to the north of the property and increase the urban influence in the idle field to the southwest. The potential effects in this area on tricolored blackbirds are discussed under *Mechanisms of Habitat Degradation*, above. These effects include increased predation of foraging tricolored blackbirds but not of nesting blackbirds. Tricolored blackbird nesting habitat does not currently exist in the vicinity of the Greenbriar site; therefore, the project would not result in nest disturbance unless new nests were established near the site.

The current land use to the north of the Greenbriar site is rice, which provides tricolored blackbird foraging habitat. The current land use to the southwest of the property is fallow agriculture, which does not support quality blackbird habitat. However, the conversion of rice to non-rice crops at the Greenbriar site between 2001 and 2005 attests to the potential for agricultural habitats to change; the area to the southwest may thus become blackbird foraging habitat in the future (and conversely, foraging habitat to the north could become less suitable).

Adverse effects on adjacent land, though probably not insignificant, would be limited by Interstate 5 along the Greenbriar site's southern border and by Elkhorn Boulevard (which would be expanded to six lanes) along the site's northern border, which would serve as partial barriers between development on the Greenbriar site and adjacent agricultural lands.

Habitat Alteration at Proposed Reserve and Mitigation Sites

The project would preserve approximately 198 acres of nesting habitat (14 acres at the Natomas 130 site and 184 acres at the Spangler site). (The 2.7 acres of marsh created at the Greenbriar site was not considered suitable as nesting habitat because of its small size and surrounding urban development.) In addition to its other benefits, preservation should reduce the level of human disturbance, which could enhance the quality of nesting habitat.

The project with the DEIR mitigation would preserve at least 135 acres of foraging habitat: 14 acres at the Natomas 130 site, 45 acres at the Spangler site, 27 acres at the Greenbriar site, and at least an additional 49 acres required by mitigation measure 6-13.2 of the DEIR. (The Spangler site is within foraging distance of the TNBC Betts-Kismat-Silva reserve where tricolored blackbirds have nested.) At the Natomas 130, Spangler, and DEIR mitigation sites, management of 109 acres to provide high quality foraging habitat for Swainson's hawk would also enhance habitat values for tricolored blackbird; however, because the benefits of such management for tricolored blackbirds have not been documented, a moderate level of uncertainty exists regarding their magnitude. (The preservation of land along Lone Tree Canal and its conversion to grassland was not considered an enhancement of foraging habitat because this site would also be affected by the proposed development.)

Effects on Connectivity

Because tricolored blackbirds are largely nomadic when not nesting, connectivity for this species is mostly pertinent to a 4-mile radius of foraging habitat surrounding nesting colonies. The Greenbriar site is at the edge of this radius from the TNBC Betts-Kismat-Silva reserve where tricolored blackbirds have nested, and thus development at the Greenbriar site would not affect connectivity of foraging habitat near this reserve (although it would reduce the habitat acreage within 4 miles of the reserve). The proposed Spangler reserve is similarly located along the edge of this radius and would preserve foraging habitat within 4 miles of the TNBC Betts-Kismat-Silva reserve (but would not affect connectivity). The proposed Natomas 130 reserve is located outside of this 4-mile radius. The land that would be preserved to provide Swainson's hawk foraging habitat also might increase connectivity of tricolored blackbird habitat depending on its location, but the location of this mitigation land has not yet been specified.

EFFECTS OF CONSTRUCTION-RELATED ACTIVITIES

Construction-related activities are unlikely to affect tricolored blackbirds because they do not nest in the vicinity of the Greenbriar and proposed reserve sites. Potential effects would be limited to displacement of birds foraging or roosting on the sites during the initial phases of construction when fields are graded. This impact is largely akin to habitat loss, as the physical flight of the birds from these areas would not cause a significant effect.

EFFECTS OF HUMAN-WILDLIFE CONFLICTS

Because tricolored blackbirds do not currently nest in the vicinity of the proposed development or reserve sites, nest disturbance by humans would not be created by the project. Increased populations of human-associated predators may result in increased predation of foraging blackbirds near a developed Greenbriar site, as discussed in *Mechanisms of Habitat Degradation*, above.

OVERALL EFFECT ON POPULATION VIABILITY

There is a moderate level of uncertainty regarding the overall effect of the Greenbriar project on tricolored blackbird because of the limited current use of the Natomas Basin by tricolored blackbird, opposite effects on nesting and foraging habitat, and uncertainty regarding the benefits provided by foraging habitat enhancement. Recently, only a single colony of tricolored blackbirds has nested in the Natomas Basin (Jones & Stokes 200). However, substantial quantities of foraging habitat (over 21,000 acres, Table 3-3) and an increasing acreage of nesting habitat exist in the Basin, and thus tricolored blackbird use of the Basin could increase. The Greenbriar project would increase the quantity of nesting habitat in the Natomas Basin (by 198 acres), but would decrease the quantity of foraging habitat (by 598 acres). Although currently, nesting habitat is more limited than foraging habitat in the Natomas Basin, under the future condition much more nesting habitat will exist, and thus the additional nesting habitat that would be provided by the project may not affect the tricolored blackbird population more than the loss of foraging habitat that would also result. This loss of foraging habitat would be partially but not fully offset by the preservation of 135 acres of foraging habitat and enhancement of 109 of these 135 acres. However, the magnitude of the benefits provided by this enhancement is moderately uncertain. Because of these

uncertainties, overall, the project could cause a small adverse or beneficial effect on tricolored blackbird use of the Natomas Basin.

Because the project would only cause a small effect on tricolored blackbird use of the Natomas Basin, and because the Natomas Basin accounts for only a small portion of the habitat for and population of tricolored blackbird in the Central Valley, the Greenbriar project is unlikely to alter the viability of the tricolored blackbird population using the Natomas Basin.

4.7 WHITE-FACED IBIS

4.7.1 SPECIES ECOLOGY

HABITAT ASSOCIATIONS/REQUIREMENTS

Habitat Type

White-faced ibis (*Plegadis chihi*) breed in wetlands with dense emergent vegetation such as cattails and rushes. They forage in shallow wetlands, irrigation ditches and a variety of irrigated crops and flooded agricultural fields (Ryder and Manry 1994, Cogswell 1977). Land cover types designated as ibis habitat in the NBHCP include alfalfa, canals, ponds and seasonally wet areas, and rice. White-faced ibis feed on aquatic and moist-soil invertebrates such as earthworms, larval insects, snails, and bivalves. Although white-faced ibis feed intensively in rice fields, rice seeds have not been noted in food samples and only trace, incidental amounts of vegetation have been recorded in ibis diets (Belknap 1957).

Home Range Size and Movement

Nesting colonies have ranged in size from 1.3 acres to 600 acres (USFWS 1985e). Foraging distances from nesting sites vary widely and depend on the availability of food. Some colonies concentrate their foraging activity within 2–4 miles of their breeding sites (Bray 1986, Bray and Klebenow 1988), while others forage 25–30 miles from nest sites (Trost 1989). Some colony locations are used for nesting year after year, while others are used more sporadically depending on water conditions and the availability of food (Ryder 1967).

Mechanisms of Habitat Degradation

Water Quality and Water Diversion

White-faced ibis depend on healthy populations of aquatic invertebrate prey, which in turn may be greatly affected by surrounding land use. Urban areas can cause different and in some cases stronger effects than agricultural lands (Bury 1972, Moore and Palmer 2005). Residential developments typically result in increased runoff of hydrocarbons and of chemicals used for lawns and gardens, and increased stormwater volume (and associated increased depths and velocities) because of high coverage of impervious surfaces. Water diversions may also reduce the abundance of ibis prey. Decreased abundance of aquatic invertebrates has been shown to impact insectivorous birds in both observational field studies and controlled field experiments (Baxter et al. 2004, in press and in review).

DISTRIBUTION

Information on CNDDB Occurrences

When information was compiled for the NBHCP in 2001, there were seven known breeding colonies in California, all of which were considered extant. At that time, no colonies were known in the Natomas Basin, and the nearest known nesting occurrence was in Yolo County, north of Woodland. As of 2005, there are 15 known

occurrences in California, of which 13 are considered extant. At this time, CNDDB does not list white-faced ibis occurrences within one mile of the Natomas Basin.

Other Information on Distribution and Abundance in Natomas Basin

White-faced ibis are common winter foragers in the Natomas Basin (NBHCP), and 10,000 to 11,000 ibis have been estimated in the Sacramento Valley as a whole (Hickey and Shufford 1996, Thomas Reid Associates 2000).

4.7.2 PROJECT EFFECTS ON SPECIES

LONG-TERM EFFECTS ON HABITAT

Effect on Quantity of Habitat

Neither the Greenbriar site nor the proposed reserves currently support potential nesting habitat for white-faced ibis. However, the proposed creation of 198 acres of marsh at the Natomas 130 and Spangler sites could provide nesting habitat. (The 2.7 acres of marsh proposed along Lone Tree Canal was not considered suitable nesting habitat because of its small size and the surrounding urban development.) Thus, the project could increase white-faced ibis nesting habitat in the Natomas Basin by up to 198 acres from conditions at the time of the NBHCP (2001).

The project's effects on the acreage of white-faced ibis foraging habitat are summarized in Table 4-8. The project would reduce the acreage of white-faced ibis foraging habitat in the Natomas Basin from conditions at the time of the NBHCP (2001). The proposed development at the Greenbriar site would reduce habitat by an estimated 172 acres from conditions in 2001. At the proposed Natomas 130 reserve, 28 acres of white-faced ibis habitat would be created from non-habitat (by converting 28 acres of non-rice crop to 14 acres of marsh and 14 acres of alfalfa). Thus, the project as a whole would yield a net loss of 144 acres of white-faced ibis habitat. (This total change does not include habitat at the mitigation site required by mitigation measure 6-13.2 of the DEIR for Swainson's hawk foraging habitat because the existing land cover type of that site is not known.)

Table 4-8
Change in Acreage of White-faced Ibis Habitat at Project Sites and in the Natomas Basin

Land Cover Type Providing Habitat	Future Condition	Change at Each Project Site			Total Change	Future Condition with Project
		Greenbriar	Natomas 130	Spangler		
Alfalfa	368	-	14.2	45.4	59.6	428
Canals	1,162	-15.0	0.0	-1.4	-16.4	1,146
Ponds & seasonally wet areas	2,259	2.7	14.2	184	200.9	2,460
Rice	11,643	-160.0	-	-228	-388.0	11,255
Total	15,432	-172.4	28.4	0	-143.9	15,288

Note: Acreages are based on 2001 land cover mapping used to evaluate future condition resulting from the NBHCP and future land cover proposed at project sites.

Effects on Quality of Habitat

Areas Adjacent to Developed Land or Highways

Potential impacts to white-faced ibis that forage near developed areas are discussed under *Mechanisms of Habitat Degradation*, above. They are primarily associated with canal and wetland habitats, but also forage in rice, and these habitats exist near the Greenbriar site.

Habitat Alteration at Proposed Reserves and Mitigation Sites

A total of 316 acres of white-faced ibis habitat would be preserved. Of this preserved habitat, 190 acres (184 acres of rice and 6 acres of associated canals) would be enhanced by the conversion of rice to marsh at the proposed Spangler reserve. In addition, habitat values for white-faced ibis might be improved by habitat enhancement for Swainson's hawk at the proposed Natomas 130 and Spangler reserves (60 acres) and at the DEIR mitigation site (at least 49 acres to satisfy mitigation measure 6.13-2 of the DEIR).

Effects on Connectivity

Habitat connectivity is of lesser importance to foraging ibis than to nesting or less mobile animals. Ibis survival is likely to be higher, however, in larger, more contiguous foraging habitat where prey is more abundant and the energetic costs of travel are decreased.

EFFECTS OF CONSTRUCTION-RELATED ACTIVITIES

Construction-related activities are unlikely to affect white-faced ibis because they do not nest in the vicinity of the Greenbriar and proposed reserve sites. Potential effects would be limited to displacement of birds foraging or roosting on the sites during the initial phases of construction when fields are graded. This would be largely akin to habitat loss, as the physical flight of the birds from these areas would not cause a significant effect.

EFFECTS OF HUMAN-WILDLIFE CONFLICTS

Humans entering active colonies may cause partial or total desertion of the colony, particularly during nest-site selection, nest-building, and incubation (Ryder and Manry 1994). Because white-faced ibis do not currently nest in the Basin, the project is unlikely to affect human conflicts with this species. (Foraging ibis are less sensitive to disturbance than nesting birds.) Similarly, changes in predator communities associated with residential development would be unlikely to affect large ibis as much as smaller birds such as burrowing owls and loggerhead shrikes.

OVERALL EFFECT ON POPULATION VIABILITY

The Greenbriar project is not likely to affect the viability of the white-faced ibis population using the Natomas Basin. Currently, white-faced ibis uses the Natomas Basin only for winter foraging. The Greenbriar project would reduce the area of foraging habitat in the Natomas Basin (by 1%), and would at least partially offset this effect by preserving and enhancing 2% of foraging habitat in the Natomas Basin. The abundance of white-faced ibis, however, is not considered limited by the availability of winter foraging habitat, and the Greenbriar project would not substantially alter the quantity of winter foraging habitat in the Natomas Basin; thus, the project's effect on foraging habitat is not likely to alter the population viability of white-faced ibis. The project would also increase the acreage of nesting habitat by creating marsh, and this could lead to the establishment of a white-faced ibis nesting colony in the Natomas Basin. While not discounted, this effect was not considered likely.

4.8 ALEUTIAN CANADA GOOSE

4.8.1 SPECIES ECOLOGY

HABITAT ASSOCIATIONS/REQUIREMENTS

Habitat Type

Aleutian Canada geese (*Branta canadensis leucopareia*) winter in California's central valley. They forage primarily in pasture, corn, wheat, rice and other grain crops, wetlands, and grasslands, and typically prefer short

vegetation. Wintering geese roost in large ponds and lakes, flooded fields, and rice checks. Land cover types designated as Aleutian Canada goose habitat in the NBHCP include non-rice crops, pasture, and rice. While Aleutian Canada geese feed primarily on grasses and wetland sedges during their Alaskan summer, they forage primarily on seeds and agricultural grains while in California in fall and winter (NatureServe 2005).

Home Range Size and Movement

Aleutian Canada geese nest in the western Aleutian Islands and migrate through coastal Oregon and northern California after the breeding season. Most wintering Aleutian Canada geese concentrate in the Modesto, Los Banos, and Colusa areas of California; the Natomas Basin may provide important foraging and roosting habitat during goose migration.

Mechanisms of Habitat Degradation

Because Canada geese are particularly well-adapted to foraging in agricultural landscapes and may persist in small numbers in suburban parks, habitat loss is a greater issue for this species than habitat degradation. This species is similarly not dependent on animal prey populations or sensitive to the increases in small mammalian or corvid predators that typically occur near residential developments.

DISTRIBUTION

Information on CNDDB Occurrences

When information was compiled for the NBHCP in 2001, there were 13 known occurrences in California, all of which were considered extant. At that time, no occurrences were known from the Natomas Basin. As of 2005, there are 10 known occurrences in California, all of which are considered extant. At this time, CNDDB does not list Aleutian Canada goose occurrences within one mile of the Natomas Basin.

Other Information on Distribution and Abundance in Natomas Basin

Although Aleutian Canada geese have not been recorded in the Basin, its proximity to important wintering areas suggests that they are likely to forage and roost in the Basin during migration.

4.8.2 PROJECT EFFECTS ON SPECIES

LONG-TERM EFFECTS ON HABITAT

Effect on Quantity of Habitat

The project's effects on the acreage of Aleutian Canada goose habitat are summarized in Table 4-9. The project would reduce the acreage of Aleutian Canada goose habitat in the Natomas Basin from conditions at the time of the NBHCP (2001). The proposed development at the Greenbriar site would reduce habitat by an estimated 428 acres from conditions in 2001. At the proposed Spangler and Natomas 130 reserves, an additional 256 acres of goose habitat would be eliminated (by converting rice and non-rice crop to marsh). Thus, the project as a whole would yield a net loss of 684 acres of Aleutian Canada goose habitat.

Table 4-9
Change in Acreage of Aleutian Canada Goose Habitat at Project Sites and in the Natomas Basin

Land Cover Type Providing Habitat	Future Condition	Change at Each Project Site			Total Change	Future Condition with Project
		Greenbriar	Natomas 130	Spangler		
Non-rice crops	9,533	-234.1	-28.4	-	-262.6	9,270
Pasture	494	-33.8	-	-	-33.8	460
Rice	11,643	-160.0	-	-228	-388.0	11,255
Total	21,670	-428.0	-28.4	-228	-684.4	20,986

Note: Acreages are based on 2001 land cover mapping used to evaluate future condition resulting from the NBHCP and future land cover proposed at project sites.

Effects on Quality of Habitat

Areas Adjacent Developed Land or Highways

As discussed above under Mechanisms of Habitat Degradation, the predominant impacts typically associated with areas adjacent to housing developments are unlikely to adversely affect Canada geese. This species is especially well-adapted to foraging in close proximity to humans.

Habitat Alteration at Proposed Reserve and Mitigation Sites

Aleutian goose habitat probably would not be preserved or enhanced at the proposed reserve and DEIR mitigation sites. However, the 109 acres that would be actively managed to provide high quality foraging habitat for Swainson's hawk (at the proposed reserve and DEIR mitigation sties) might provide goose habitat values.

Effects on Connectivity

Habitat connectivity is of lesser importance to foraging geese than to nesting or less mobile animals. Goose survival is likely to be higher, however, in larger, more contiguous foraging habitat where food is more abundant and the energetic costs of travel are decreased.

EFFECTS OF CONSTRUCTION-RELATED ACTIVITIES

Construction-related activities are unlikely to affect Aleutian Canada geese because they do not nest in the vicinity of the Greenbriar and proposed reserve sites. Potential effects would be limited to displacement of birds foraging or roosting on the sites during the initial phases of construction when fields are graded. This effect is largely akin to temporary habitat loss.

EFFECTS OF HUMAN-WILDLIFE CONFLICTS

Because Aleutian Canada geese do not nest in the Basin, the project would not likely result in human conflicts with this species, other than the changes in habitat. Foraging geese are less sensitive to disturbance than nesting birds. Similarly, changes in predator communities associated with residential development would be unlikely to affect large geese as significantly as smaller birds such as burrowing owls and loggerhead shrikes.

OVERALL EFFECT ON POPULATION VIABILITY

Currently, Aleutian Canada geese do not nest in the Natomas Basin, but do roost and forage in the Basin during seasonal migration to a limited extent. Although the Greenbriar Project would reduce the acreage of foraging

habitat in the Natomas Basin (by 3%), an effect on the population's viability is unlikely because the population's size is not considered to be limited by the quantity of foraging habitat available during migration and the Greenbriar project would not substantially alter the availability of this habitat, which is abundant in the Natomas Basin (approximately 21,000 acres).

4.9 BANK SWALLOW

4.9.1 SPECIES ECOLOGY

HABITAT ASSOCIATIONS/REQUIREMENTS

Habitat Type

Bank swallows (*Riparia riparia*) nest in colonies in vertical banks, cliffs and bluffs that are typically along streams but occasionally near roads or gravel quarries. Nesting colonies may range in size from 10 to 1,500 pairs, and average 100–200 nesting pairs (NBHCP). Bank swallows forage in a variety of open habitats including wetlands, open water, grasslands, agricultural fields, shrublands, and open or riparian woodlands. Aquatic and flooded habitats provide the best foraging opportunities. Land cover types designated as bank swallow habitat in the NBHCP include alfalfa, canals, grassland, non-rice crops, pasture, ponds and seasonally wet areas, rice, and riparian. Swallows are almost exclusively insectivorous and catch their prey while flying.

Home Range Size and Movement

Most breeding season foraging flights are within a kilometer (0.62 mile) of the nesting colony (Garrison 1999). Bank swallows are long-distance migrants and may use any available foraging habitat in the Basin during migration.

Mechanisms of Habitat Degradation

Bank Erosion and Water Diversion

The major contributors to bank swallow habitat degradation are flood and erosion control projects that apply riprap or reduce the slope of river banks and canals, rendering them unusable for nesting and reducing their habitat quality for roosting and foraging (Garrison et al. 1987, Small 1994). Diversion of water may affect bank swallows if it results in the dewatering of canals or reduction of aquatic habitat for larval insects.

Water Quality and Runoff

Aquatic communities may be greatly affected by surrounding land use. Urban areas can cause different and in some cases stronger effects than agricultural lands (Bury 1972, Moore and Palmer 2005). Residential developments typically result in increased runoff of hydrocarbons and of chemicals used for lawns and gardens, and increased stormwater volume (and associated increases in depths and velocities) because of high coverage of impervious surfaces. Decreased abundance of aquatic invertebrates has been shown to impact insectivorous birds in both observational field studies and controlled field experiments (Baxter et al. 2004, in press and in review).

Predation and Nest Disturbance

Although predation of most birds increases in proximity to human settlement, bank swallows are largely protected from human-associated predators because of the cliff locations of their nests. These aerial hunters are also largely protected from human-associated predators while foraging because they spend relatively very little time foraging from perches or among vegetation. Kestrels are the primary predators of this species while foraging; snakes are

most common while nesting. Bank swallows are typically tolerant of human activity near nesting colonies, if humans do not attempt to climb the nest banks (Garrison 1999).

DISTRIBUTION

Information on CNDDB Occurrences

When information was compiled for the NBHCP in 2001, there were 171 known occurrences in California, of which 170 were considered extant. At that time, no nesting colonies were known in the Natomas Basin. As of 2005, there are 176 known occurrences in California, of which 171 are considered extant. At this time, CNDDB does not list bank swallow occurrences within one mile of the Natomas Basin.

Other Information on Distribution and Abundance in Natomas Basin

Although no nesting colonies are known in the Basin, the area provides potential foraging habitat for migrating swallows.

4.9.2 PROJECT EFFECTS ON SPECIES

LONG-TERM EFFECTS ON HABITAT

Effect on Quantity of Habitat

The project would not affect bank swallow nesting habitat, as bank swallow nesting colonies do not exist at the Greenbriar or proposed reserve sites, nor would nesting habitat be created, enhanced or preserved at the proposed reserves.

The project's effects on the acreage of bank swallow foraging habitat are summarized in Table 4-10. The project would reduce the acreage of bank swallow foraging habitat in the Natomas Basin from conditions at the time of the NBHCP (2001). The proposed development at the Greenbriar site would reduce habitat by an estimated 414 acres from conditions in 2001. At the proposed Natomas 130 and Spangler reserves, habitat acreages would be increased by about 20 acres. Thus, the project as a whole would yield a net loss of 394 acres of bank swallow habitat.

Table 4-10
Change in Acreage of Bank Swallow Habitat at Project Sites and in the Natomas Basin

Land Cover Type Providing Habitat	Future Condition	Change at Each Project Site			Total Change	Future Condition with Project
		Greenbriar	Natomas 130	Spangler		
Alfalfa	368	-	14.2	45.4	59.6	428
Canals	1,162	-15.0	0.0	-1.4	-16.4	1,146
Grassland	284	26.5	-	-	26.5	311
Non-rice crops	9,533	-234.1	-28.4	-	-262.6	9,270
Pasture	494	-33.8	-	-	-33.8	460
Ponds & seasonally wet areas	2,259	2.7	14.2	184.0	200.9	2,460
Rice	11,643	-160.0	-	-228.0	-388.0	11,255
Riparian	91	0.0	0.0	-	0.0	91
Total	25,834	-413.8	0.0	20.2	-393.6	25,420

Note: Acreages are based on 2001 land cover mapping used to evaluate future condition resulting from the NBHCP and future land cover proposed at project sites.

Effects on Quality of Habitat

Areas Adjacent to Developed Land or Highways

As discussed above under Mechanisms of Habitat Degradation, the predominant effects typically associated with areas adjacent to housing developments are unlikely to negatively affect bank swallows. Effects on water quality and canal management, however, could potentially affect bank swallows.

Habitat Alteration at Proposed Reserve and Mitigation Sites

At least 345 acres of bank swallow habitat would be preserved and enhanced at the proposed reserves and at the mitigation site required by mitigation measure 6.13-2 of the DEIR. At the Spangler site, rice habitat would be converted to marsh, preserved, and managed to provide habitat values, in particular for giant garter snake. At the Spangler site, rice would also be converted to upland habitat. This upland habitat, as well as upland habitat at the Natomas 130 and the DEIR mitigation site, would be managed to provide high quality foraging habitat for Swainson's hawk. At all of these sites, habitat values for bank swallow are likely to increase as a result of the proposed management. However, because the benefits of such management for bank swallows have not been documented, a moderate level of uncertainty exists regarding their magnitude.

Effects on Connectivity

Because bank swallows do not nest in the Basin, connectivity is of less concern for this species than for less mobile species or species with limited foraging distances from breeding sites. Larger patches of more contiguous habitat are likely to be of greater value to migrating swallows, by providing more abundant food with the lower energetic cost of foraging in a contiguous area.

EFFECTS OF CONSTRUCTION-RELATED ACTIVITIES

Construction-related activities are unlikely to affect bank swallows because they do not nest in the vicinity of the Greenbriar and proposed reserve sites. Potential effects would be limited to displacement of birds foraging or roosting on the sites during the initial phases of construction when fields are graded. This impact is largely akin to temporary habitat loss.

EFFECTS OF HUMAN-WILDLIFE CONFLICTS

Direct human-wildlife conflicts are unlikely to be of concern for bank swallows in the Natomas Basin. Habitat quantity and quality are the primary concerns for this species.

OVERALL EFFECT ON POPULATION VIABILITY

Although the Greenbriar project would affect land suitable for bank swallow foraging (eliminating 394 acres and preserving and enhancing 345 acres), none of these lands are near (i.e., within a mile) bank swallow nesting habitat. Currently, bank swallows are not nesting near the Natomas Basin. Near the Natomas Basin, most of the bank length of the Sacramento River is not suitable for bank swallow nesting, in part because of extensive riprap (USFWS 2003). Even if bank swallow colonies established along the Sacramento River in the future, the project and mitigation sites are not within a mile of the river, and thus would not provide important foraging habitat for colonies along the river. Although these lands may provide foraging habitat to migrating swallows, habitat availability during migration is not considered to limit the abundance of this population, and large areas of such habitat (over 25,000 acres) would remain in the future condition of the Natomas Basin with the Greenbriar project. Therefore, the Greenbriar project is unlikely to alter the viability of bank swallow populations using the Natomas Basin.

4.10 VALLEY ELDERBERRY LONGHORN BEETLE

4.10.1 SPECIES ECOLOGY

HABITAT ASSOCIATIONS/REQUIREMENTS

Habitat Type

Valley elderberry longhorn beetles (*Desmocerus californicus dimorphus*) are dependent on elderberry bushes, which primarily occur in riparian areas. Small elderberry patches are also found in some oak groves and rural residential areas (NBHCP). The NBHCP lists riparian as the only land cover type that provides habitat for this species.

Home Range Size and Movement

Dispersal of valley elderberry longhorn beetles is extremely limited. Many adults live their entire lives on their original host plants and do not disperse at all. Dispersing individuals typically limit travel in their home drainages, limiting the ability of the species to colonize fragmented habitat (Collinge et al. 2001).

Mechanisms of Habitat Degradation

Elderberry habitat is degraded by fragmentation, pesticide and herbicide use, exotic species invasion, and hydrological alteration such as flood management, channel maintenance, and increased water diversions for urban and agricultural development (USFWS 1984; Huxel 2000; Collinge et al. 2001).

DISTRIBUTION

Information on CNDDB Occurrences

When information was compiled for the NBHCP in 2001, there were 168 known occurrences in California, all of which were considered extant. At that time, "several" occurrences were known along the southern and western edges of the Natomas Basin, along the American and Sacramento rivers. As of 2005, there are 190 known occurrences in California, all of which are considered extant. At this time, two occurrences are known in the Natomas Basin and six additional occurrences are known within a mile of the Basin. All eight of these occurrences are considered extant. CNDDB does not list valley elderberry longhorn beetle occurrences within one mile of the Greenbriar site; CNDDB lists one VELB occurrence within one mile of a proposed reserve.

Other Information on Distribution and Abundance in Natomas Basin

The TNBC Biological Effectiveness Monitoring report concurs with the CNDDB to list eight extant VELB occurrences in the Basin, none of which are within a mile of the Greenbriar site, and one of which is within a mile of a proposed reserve.

4.10.2 PROJECT EFFECTS ON SPECIES

LONG-TERM EFFECTS ON HABITAT

Effect on Quantity of Habitat

The project will not affect the quantity of elderberry habitat available to the beetle, as elderberry shrubs are not present in the vicinity of the Greenbriar or proposed reserve sites.

Effects on Quality of Habitat

Areas Adjacent to Developed Land or Highways

As no elderberry shrubs exist in proximity to the Greenbriar site, the gradient of urban influence within 800 feet of the Greenbriar site will not affect the quality of VELB habitat.

Enhancement at Reserves

The planting of elderberry shrubs is not currently planned at the proposed reserves. However, an acre of riparian habitat exists on the Natomas 130 parcel and may be suitable for shrub planting in the future.

Effects on Connectivity

Because of the beetle's limited dispersal capability, habitat connectivity is critical for the colonization of unoccupied shrubs and the maintenance of genetic diversity. However, because all of the Basin's known VELB occurrences are located in riparian habitat near the Sacramento River, the project would not affect connectivity for this species. The proposed Natomas 130 reserve is located along the Sacramento River and would contribute to the preservation of contiguous riparian habitat along the river corridor.

EFFECTS OF CONSTRUCTION-RELATED ACTIVITIES

Construction-related activities for the project are unlikely to affect this species because its habitat does not exist at the Greenbriar and Spangler sites and may not be present at the Natomas 130 site. To avoid and minimize any potential impacts at the Natomas 130 site, preconstruction surveys for elderberry shrubs would be conducted according to USFWS guidelines (USFWS 1999b). If elderberry shrubs are found, they would be preserved on site unless their preservation would significantly inhibit other habitat restoration objectives on site. Following USFWS guidelines, elderberry shrubs would be avoided during habitat construction with a 100-foot construction buffer. If avoidance is not possible, shrub loss would be mitigated by transplanting the shrubs during their dormant season and planting a specified number of seedlings.

EFFECTS OF HUMAN-WILDLIFE CONFLICTS

Human-wildlife conflicts for this species would not be affected by the project because elderberry habitat does not exist on site. Although VELB and elderberry shrubs are not known to be present on the proposed reserves, preservation of the Natomas 130 parcel may reduce human conflicts with habitat in the Sacramento River riparian corridor.

OVERALL EFFECT ON POPULATION VIABILITY

VELB is not known from the vicinity of the Greenbriar site or the proposed reserve sites. A small area of riparian vegetation, which is potentially suitable habitat for this species, exists at the Natomas 130, and would be preserved by the project. It is not known if elderberry bushes are present in this riparian vegetation, and the draft restoration plan does not include the planting of elderberry bushes. Thus, the preservation of this riparian vegetation would be a very small potential benefit to VELB that would not be sufficient to alter its population viability.

4.11 CALIFORNIA TIGER SALAMANDER

4.11.1 SPECIES ECOLOGY

HABITAT ASSOCIATIONS/REQUIREMENTS

Habitat Type

California tiger salamanders (*Ambystoma californiense*) require two major habitat components: aquatic breeding sites and terrestrial aestivation or refuge sites. Tiger salamanders breed primarily in vernal pools and other ephemeral rainwater ponds (Loredo et al. 1996). They will occasionally breed in stockponds, reservoirs and small lakes, but fail to reproduce in water bodies that support predatory fish or bullfrogs (Stebbins 1972, Zeiner et al. 1988). The highest quality breeding habitat for tiger salamanders exists in large, contiguous vernal pool complexes in a grassland matrix with pools that last for more than 10 weeks (Jennings and Hayes 1994).

California tiger salamanders spend the majority of their lives in upland habitats within one mile (1.6 km) of aquatic breeding areas (Center for Biological Diversity 2001). These upland habitats are essential for salamander foraging, aestivation, migration, and dispersal. Upland habitats used by migrating salamanders include grassland, pasture, and open woodlands. The NBHCP lists ponds and seasonally wet areas as the only land cover type providing tiger salamander habitat because these upland habitats will only be used by salamanders when in close proximity to aquatic breeding areas. Tiger salamanders depend on burrows of small mammals such as California ground squirrels and Botta's pocket gopher for shelter during aestivation.

Home Range Size and Movement

California tiger salamanders typically range within 2,200 feet (0.7 km) of breeding habitat during the breeding season (Trenham and Shaffer). During migration, however, they have been recorded as far as one mile (1.6 km) from aquatic habitats (Center for Biological Diversity 2001).

Mechanisms of Habitat Degradation

Tiger salamander habitat is frequently degraded by roads, buildings, and other barriers to migration (Shaffer and Fisher 1991; Shaffer and Stanley 1992; Barry and Shaffer 1994). Erosion because of grading for nearby developments can degrade breeding wetlands by increasing sedimentation. Tiger salamanders are also sensitive to pesticides, herbicides and fertilizers associated with suburban lawn care and agriculture. Burrowing mammal control programs and the introduction of predatory bullfrogs and nonnative fishes have also contributed to declines in tiger salamander populations (Jennings and Hayes 1994).

DISTRIBUTION

Information on CNDDB Occurrences

When information was compiled for the NBHCP in 2001, there were 465 known occurrences in California, all of which were considered extant. At that time, no occurrences were known from the Natomas Basin. As of 2005, there are 793 known occurrences in California, of which 738 are considered extant. At this time, CNDDB does not list California tiger salamander occurrences within one mile of the Natomas Basin.

Other Information on Distribution and Abundance in Natomas Basin

California tiger salamanders have not been recorded in the Natomas Basin.

4.11.2 PROJECT EFFECTS ON SPECIES

LONG-TERM EFFECTS ON HABITAT

Effect on Quantity of Habitat

The project would have no effect on the quantity of California tiger salamander habitat. Suitable breeding habitat does not exist in the maximum salamander dispersal distance from these sites. Restoration plans for the proposed reserves do not include the creation of tiger salamander habitat.

Effects on Quality of Habitat

The project would have no effect on the quality of California tiger salamander habitat, as salamander habitat does not exist in the vicinity of the Greenbriar and proposed reserve sites.

EFFECTS OF CONSTRUCTION-RELATED ACTIVITIES

The project would have no effect on tiger salamanders during construction-related activities, as salamander habitat does not exist in the vicinity of the Greenbriar and proposed reserve sites.

EFFECTS OF HUMAN-WILDLIFE CONFLICTS

The project would have no effect on human-wildlife conflicts relating to tiger salamanders, because salamander habitat does not exist in the vicinity of the Greenbriar and proposed reserve sites.

OVERALL EFFECT ON POPULATION VIABILITY

California tiger salamander is not known from the vicinity of the Greenbriar site or the proposed reserve sites, or adjacent lands. Potentially suitable habitat for this species does not exist at or in the vicinity of the Greenbriar and proposed reserve sites. Therefore, the Greenbriar project would cause no effects on the population viability of California tiger salamander.

4.12 WESTERN SPADEFOOT TOAD

4.12.1 SPECIES ECOLOGY

HABITAT ASSOCIATIONS/REQUIREMENTS

Habitat Type

Western spadefoot toads (*Scaphiopus hammondii*) breed in shallow, seasonal wetlands in a matrix of grassland, chaparral or woodland habitat, and are rarely found in creeks, drainages, and ponds. Grassland vernal pools provide optimal spadefoot habitat; the toads attach their eggs to rain pool vegetation and burrow underground after the pools become dry (Stebbins 1972). The NBHCP lists ponds and seasonally wet areas as the only land cover type that provides habitat for this species. Adults feed on insects, worms, and other invertebrates; tadpoles feed on invertebrates and algae.

Home Range Size and Movement

During the breeding season, western spadefoot toads rarely travel more than several meters from breeding pools (Jennings and Hayes 1994). Outside of the breeding season, data are not available on the dispersal distances, movement patterns, or colonization abilities of this species (Jennings and Hayes 1994).

Mechanisms of Habitat Degradation

The project would not degrade habitat for this species, as its habitat does not exist in the vicinity of the Greenbriar proposed reserve sites.

DISTRIBUTION

Information on CNDDB Occurrences

When information was compiled for the NBHCP in 2001, there were 173 known occurrences in California, of which 172 were considered extant. At that time, no occurrences were known from the Natomas Basin. As of 2005, there are 308 known occurrences in California, of which 306 are considered extant. At this time, CNDDB does not list western spadefoot occurrences within one mile of the Natomas Basin.

Other Information on Distribution and Abundance in Natomas Basin

Western spadefoot toads have not been recorded in the Natomas Basin.

4.12.2 PROJECT EFFECTS ON SPECIES

LONG-TERM EFFECTS ON HABITAT

Effect on Quantity of Habitat

The project would have no effect on the quantity of western spadefoot habitat, because habitat for this species does not currently exist in the vicinity of the Greenbriar or proposed reserve sites. Restoration plans for the proposed reserves do not include the creation of western spadefoot habitat.

Effects on Quality of Habitat

The project would have no effect on the quality of western spadefoot habitat, because habitat for this species does not currently exist in the vicinity of the Greenbriar or proposed reserve sites. Restoration plans for the proposed reserves do not include the creation of western spadefoot habitat.

EFFECTS OF CONSTRUCTION-RELATED ACTIVITIES

The project would have no effect on spadefoot toads during construction-related activities, because spadefoot habitat does not exist in the vicinity of the Greenbriar or proposed reserve sites.

EFFECTS OF HUMAN-WILDLIFE CONFLICTS

The project would have no effect on human-wildlife conflicts relating to spadefoot toads, because spadefoot habitat does not exist in the vicinity of the Greenbriar and proposed reserve sites.

OVERALL EFFECT ON POPULATION VIABILITY

Western spadefoot toad is not known from the vicinity of the Greenbriar site or the proposed reserve sites, or adjacent lands. Potentially suitable habitat for this species does not exist at or in the vicinity of the Greenbriar and proposed reserve sites. Therefore, the Greenbriar project would cause no effects on the population viability of western spadefoot toad.

4.13 VERNAL POOL FAIRY SHRIMP

4.13.1 SPECIES ECOLOGY

HABITAT ASSOCIATIONS/REQUIREMENTS

Habitat Type

Vernal pool fairy shrimp (*Branchinecta lynchi*) inhabit vernal pools (79% of observations) and other seasonal wetlands (Helm 1998). Although they may occur in larger, deeper pools, vernal pool fairy shrimp are typically found in pools less than 2,200 square feet and less than 2 inches deep (Helm 1998). The NBHCP lists ponds and seasonally wet areas as the only land cover type that provides habitat for this species.

Mechanisms of Dispersal

Vernal pool fairy shrimp rely on wind and motile species such as birds, mammals, and amphibians for their dispersal. Shrimp eggs are transported in the stomachs of waterfowl and amphibians, and in small clumps of soil attached to mammalian hooves and hair, bird feet, and feathers. Dispersal distances have not been measured, but will likely equate with movement distances of the egg-transporting animals (Silveira 1998 cited in Bay Area O&M). As such, connectivity of upland and aquatic habitat between vernal pools will benefit shrimp dispersal by increasing the opportunities for egg transport by mammals and amphibians. Dispersal may continue between disconnected pools through avian transport.

Mechanisms of Habitat Degradation

The project would not degrade habitat for this species, because its habitat does not exist in the vicinity of the Greenbriar or proposed reserve sites.

DISTRIBUTION

Information on CNDDB Occurrences

When information was compiled for the NBHCP in 2001, there were 270 known occurrences in California, all of which were considered extant. At that time, no occurrences were known from the Natomas Basin. As of 2005, there are 366 known occurrences in California, all of which are considered extant. At this time, two occurrences are known in the Natomas Basin and eight additional occurrences are known within one mile of the Basin. All ten of these occurrences are considered extant, and are located near the eastern border of the Basin. At this time, CNDDB does not list vernal pool fairy shrimp occurrences within one mile of the Greenbriar or proposed reserve sites.

Other Information on Distribution and Abundance in Natomas Basin

Vernal pool fairy shrimp were not detected by Natomas Basin Conservancy surveys, and no additional information is available regarding their distribution in the Basin.

4.13.2 PROJECT EFFECTS ON SPECIES

LONG-TERM EFFECTS ON HABITAT

Effect on Quantity of Habitat

The project would have no effect on the quantity of vernal pool fairy shrimp habitat, because habitat for this species does not currently exist in the vicinity of the Greenbriar or proposed reserve sites. Restoration plans for the proposed reserves do not include the creation of vernal pool fairy shrimp habitat.

Effects on Quality of Habitat

The project would have no effect on the quality of vernal pool fairy shrimp habitat, because habitat for this species does not currently exist in the vicinity of the Greenbriar or proposed reserve sites. Restoration plans for the proposed reserves do not include the creation of vernal pool fairy shrimp habitat.

EFFECTS OF CONSTRUCTION-RELATED ACTIVITIES

The project would have no effect on vernal pool fairy shrimp during construction-related activities, because habitat for this species does not exist in the vicinity of the Greenbriar or proposed reserve sites.

EFFECTS OF HUMAN-WILDLIFE CONFLICTS

The project would have no effect on the quantity of vernal pool fairy shrimp habitat, because habitat for this species does not currently exist in the vicinity of the Greenbriar or proposed reserve sites.

OVERALL EFFECT ON POPULATION VIABILITY

Vernal pool fairy shrimp is not known from the vicinity of the Greenbriar site or the proposed reserve sites, or adjacent lands. Potentially suitable habitat for this species does not exist at or in the vicinity of the Greenbriar and proposed reserve sites. Therefore, the Greenbriar project would cause no effects on the population viability of vernal pool fairy shrimp.

4.14 VERNAL POOL TADPOLE SHRIMP

4.14.1 SPECIES ECOLOGY

HABITAT ASSOCIATIONS/REQUIREMENTS

Habitat Type

Vernal pool tadpole shrimp (*Lepidurus packardi*) are found primarily in vernal pools; they inhabit other seasonal wetlands to a limited extent. They occupy vernal pools with a variety of depths and water volumes, and with areas ranging from 20 square feet to over 3,750,000 square feet (Helm 1998). The NBHCP lists ponds and seasonally wet areas as the only land cover type that provides habitat for this species.

Mechanisms of Dispersal

Vernal pool tadpole shrimp rely on wind and motile species such as birds, mammals, and amphibians for their dispersal. Shrimp eggs are transported in the stomachs of waterfowl and amphibians, and in small clumps of vernal pool soil attached to mammalian hooves and hair, bird feet, and feathers. Dispersal distances have not been measured, but will likely equate with movement distances of the egg-transporting animals (Silveira 1998 cited in

Bay Area O&M). As such, connectivity of upland and aquatic habitat between vernal pools will benefit shrimp dispersal by increasing the opportunities for egg transport by mammals and amphibians. Dispersal may continue between disconnected pools through avian transport.

Mechanisms of Habitat Degradation

The project would not degrade habitat for this species, because its habitat does not exist in the vicinity of the Greenbriar or proposed reserve sites.

DISTRIBUTION

Information on CNDDB Occurrences

When information was compiled for the NBHCP in 2001, there were 154 known occurrences in California, of which 153 were considered extant. At that time, no occurrences were known from the Natomas Basin. As of 2005, there are 209 known occurrences in California, of which 208 are considered extant. At this time, one occurrence is known in the Natomas Basin and one additional occurrence is known within one mile of the Basin. Both of these occurrences are considered extant, and are located near the eastern border of the Basin. At this time, CNDDB does not list vernal pool tadpole shrimp occurrences within one mile of the Greenbriar or proposed reserve sites.

Other Information on Distribution and Abundance in Natomas Basin

Vernal pool tadpole shrimp were not detected by Natomas Basin Conservancy surveys, and no additional information is available regarding their distribution in the Basin.

4.14.2 PROJECT EFFECTS ON SPECIES

LONG-TERM EFFECTS ON HABITAT

Effect on Quantity of Habitat

The project would have no effect on the quantity of vernal pool tadpole shrimp habitat, because habitat for this species does not currently exist in the vicinity of the Greenbriar or proposed reserve sites. Restoration plans for the proposed reserves do not include the creation of vernal pool tadpole shrimp habitat.

Effects on Quality of Habitat

The project would have no effect on the quality of vernal pool tadpole shrimp habitat, because habitat for this species does not currently exist in the vicinity of the Greenbriar or proposed reserve sites. Restoration plans for the proposed reserves do not include the creation of vernal pool tadpole shrimp habitat.

EFFECTS OF CONSTRUCTION-RELATED ACTIVITIES

The project would have no effect on vernal pool tadpole shrimp during construction-related activities, because habitat for this species does not exist in the vicinity of the Greenbriar and proposed reserve sites.

EFFECTS OF HUMAN-WILDLIFE CONFLICTS

The project would have no effect on human conflicts with vernal pool tadpole shrimp, because habitat for this species does not exist in the vicinity of the Greenbriar or proposed reserve sites.

OVERALL EFFECT ON POPULATION VIABILITY

Vernal pool tadpole shrimp is not known from the vicinity of the Greenbriar site or the proposed reserve sites, or adjacent lands. Potentially suitable habitat for this species does not exist at or in the vicinity of the Greenbriar and proposed reserve sites. Therefore, the Greenbriar project would cause no effects on the population viability of vernal pool tadpole shrimp.

4.15 MIDVALLEY FAIRY SHRIMP

4.15.1 SPECIES ECOLOGY

HABITAT ASSOCIATIONS/REQUIREMENTS

Habitat Type

Midvalley fairy shrimp (*Branchinecta mesovallensis* n. sp.) appear to be vernal pool obligates, as 93% of observations have occurred in vernal pools and the remaining 7% have occurred in vernal swales (Helm 1998). This species is associated with the smallest (less than 2,200 square feet) and most ephemeral (average depth of 4 inches) vernal pools (Helm 1998). The NBHCP lists ponds and seasonally wet areas as the only land cover type that provides habitat for this species.

Mechanisms of Dispersal

Midvalley fairy shrimp rely on wind and motile species such as birds, mammals, and amphibians for their dispersal. Shrimp eggs are transported in the stomachs of waterfowl and amphibians, and in small clumps of vernal pool soil attached to mammalian hooves and hair, bird feet, and feathers. Dispersal distances have not been measured, but will likely equate with movement distances of the egg-transporting animals (Silveira 1998 cited in Bay Area O&M). As such, connectivity of upland and aquatic habitat between vernal pools will benefit shrimp dispersal by increasing the opportunities for egg transport by mammals and amphibians. Dispersal may continue between disconnected pools through avian transport.

Mechanisms of Habitat Degradation

The project would not degrade habitat for this species, because its habitat does not exist in the vicinity of the Greenbriar or proposed reserve sites.

DISTRIBUTION

Information on CNDDB Occurrences

When information was compiled for the NBHCP in 2001, there were 14 known occurrences in California, all of which were considered extant. At that time, no occurrences were known from the Natomas Basin. As of 2005, there are 62 known occurrences in California, all of which are considered extant. At this time, CNDDB does not list midvalley fairy shrimp occurrences within one mile of the Natomas Basin.

Other Information on Distribution and Abundance in Natomas Basin

Midvalley fairy shrimp have not been recorded in the Natomas Basin.

4.15.2 PROJECT EFFECTS ON SPECIES

LONG-TERM EFFECTS ON HABITAT

Effect on Quantity of Habitat

The project would have no effect on the quantity of midvalley fairy shrimp habitat, because habitat for this species does not currently exist in the vicinity of the Greenbriar or proposed reserve sites. Restoration plans for the proposed reserves do not include the creation of midvalley fairy shrimp habitat.

Effects on Quality of Habitat

The project would have no effect on the quality of midvalley fairy shrimp habitat, because habitat for this species does not currently exist in the vicinity of the Greenbriar or proposed reserve sites. Restoration plans for the proposed reserves do not include the creation of midvalley fairy shrimp habitat.

EFFECTS OF CONSTRUCTION-RELATED ACTIVITIES

The project would have no effect on midvalley fairy shrimp during construction-related activities, because habitat for this species does not exist in the vicinity of the Greenbriar and proposed reserve sites.

EFFECTS OF HUMAN-WILDLIFE CONFLICTS

The project would have no effect on the quantity of midvalley fairy shrimp habitat, because habitat for this species does not currently exist in the vicinity of the Greenbriar or proposed reserve sites.

OVERALL EFFECT ON POPULATION VIABILITY

Midvalley fairy shrimp is not known from the vicinity of the Greenbriar site or the proposed reserve sites, or adjacent lands. Potentially suitable habitat for this species does not exist at or in the vicinity of the Greenbriar and proposed reserve sites. Therefore, the Greenbriar project would cause no effects on the population viability of midvalley fairy shrimp.

4.16 COVERED PLANT SPECIES

Of the seven plant species covered by the NBHCP (Table 4-11), the Greenbriar project would not affect the five vernal pool-associated species because these species are not known to occur in the vicinity of the Greenbriar or proposed reserve sites (or in the Natomas Basin), nor is suitable habitat present at or near these sites. These plant species are: Boggs Lake hedge-hyssop, Sacramento Orcutt grass, slender Orcutt grass, Colusa grass and legenere. The other two covered plant species (delta tule pea and Sanford's arrowhead) are not known to occur at the Greenbriar or the proposed reserve sites, or in the Natomas Basin (Table 4-1), but potentially suitable habitat for these species does occur at or near some of these sites, which have not been surveyed for these species. Therefore, the possibility that the project could affect these species cannot be discounted; thus, the DEIR mitigation includes a rare plant survey requirement and the applicable avoidance and minimization measures from the NBHCP for these species. The project also would eliminate approximately 16 acres of canal at the Greenbriar site and would create approximately 201 acres of marsh at the proposed reserves. Thus, overall, the project would increase the acreage of potentially suitable habitat for these species (i.e., marsh and canal habitats) in the Natomas Basin by about 184 acres (or about 4%). Nonetheless, because these species are not known to occur in the Natomas Basin, the project probably would not alter the viability of any of their populations.

Table 4-11
Primary Habitats and Distribution of Plant Species Covered by the NBHCP

Species	Growth form	Primary Habitat(s)	Distribution
Delta tule pea (*Lathyrus jepsonii* var. *jepsonii*)	Biennial-perennial, herbaceous vine in the pea family (Fabaceae)	Riparian scrub, marsh (primarily tidal, fresh or brackish)	Alameda, Contra Costa, Napa, Sacramento, San Joaquin, and Solano Counties; not known from the Natomas Basin
Sanford's arrowhead (*Sagittaria sanfordii*)	Perennial, rhizomatous aquatic with emergent leaves, in the water-plantain family (Alismataceae)	Marsh and other shallow freshwater habitats	Butte, Del Norte, Fresno, Kern, Merced, Orange, Sacramento, Shasta, San Joaquin, and Tehama Counties; not known from the Natomas Basin
Bogg's Lake hedge-hyssop (*Gratiola heterosepala*)	Small semi-aquatic annual, up to 4 inches in height, in the figwort family (Scrophulariaceae)	Vernal pools and swallow lake margins	Fresno, Lake, Lassen, Madera, Merced, Modoc, Placer, Sacramento, San Joaquin, Shasta, Siskiyou, Solano, and Tehama Counties; not known from the Natomas Basin
Sacramento Orcutt grass (*Orcuttia viscida*)	Annual in the grass family (Poaceae)	Vernal pools (generally larger, deeper pools)	Sacramento County; not known from the Natomas Basin
Slender Orcutt grass (*Orcuttia tenuis*)	Annual in the grass family (Poaceae)	Vernal pools (generally larger, deeper pools)	Butte, Lake, Lassen, Modoc, Plumas, Sacramento, Shasta, Siskiyou, and Tehama Counties; not known from the Natomas Basin
Colusa grass (*Neostapfia colusana*)	Annual in the grass family (Poaceae)	Vernal pools (generally larger, deeper pools)	Colusa, Merced, Solano, Stanislaus, and Yolo Counties; not known from the Natomas Basin or Sacramento County
Legenere (*Legenere limosa*)	Annual, in the bellflower family (Campanulaceae)	Vernal pools and swales, seasonal marshes, artificial ponds, floodplains of intermittent streams, and other seasonally inundated habitats	Lake, Napa, Placer, Sacramento, San Joaquin, San Mateo, Santa Clara, Shasta, Solano, Sonoma, Stanislaus, Tehama, and Yuba Counties; not known from the Natomas Basin

5 POTENTIAL EFFECTS ON THE CONSERVATION STRATEGY OF THE NBHCP

Based on the analyses presented in sections 3 (Alteration of Population and Habitat Attributes by the Greenbriar Project) and 4 (Potential Effects of the Greenbriar Project on Covered Species), this section summarizes the effect of the Greenbriar project on the conservation strategy of the NBHCP that is described is section IV.C of the NBHCP. Overall, the Greenbriar project (with the DEIR mitigation) would not reduce the effectiveness of the NBHCP's conservation strategy because it would not alter the basis of this conservation strategy. In Section IV.C.1 (pages IV 5-15), the NBHCP describes the basis of the key components of the NBHCP's conservation strategy and how these components provide effective mitigation for 17,500 acres of urban development. These components are:

- Basis for 0.5 to 1 mitigation ratio (Section IV.C.1.a),
- Preparation of site specific management plans (Section IV.C.1.b),
- Buffers within the reserve lands (Section IV.C.1.c),
- Connectivity (Section IV.C.1.d),
- Foraging habitat (Section IV.C.1.e), and
- 2,500-acre/400-acre minimum habitat block size requirements (Section IV.C.1.f).

The effects of the Greenbriar project on each of these components is described in the following sections, and then these effects are synthesized, along with the effects on population viability of the covered species (see chapters 3 and 4) as the overall effect of the Greenbriar project on the effectiveness of the NBHCP's conservation strategy.

5.1 BASIS FOR 0.5 TO 1 MITIGATION RATIO

On pages IV-6 and IV-7, the NBHCP describes eight key considerations for determining that the 0.5 to 1 mitigation ratio mitigates the impacts of incidental take authorized under the NBHCP. These eight key considerations are summarized below.

1. Overall, reserves will provide greater habitat value than the agricultural land that will be converted to urban development. (This consideration overlaps with other considerations.)

2. Much of the land to be developed is either of limited value as habitat or serves as habitat to a limited number of species.

3. For several wetland and vernal pool-associated species, reserves will provide opportunities for reintroduction to the Basin.

4. Reserves would provide habitat for migratory bird species that have limited habitat in the Basin.

5. Reserves would be managed to minimize take related to agricultural and land management activities.

6. Reserves would provide permanent habitat for covered species.

7. Reserves would be monitored and adaptively managed.

8. Reserves would be consolidated into large blocks of habitat.

Because the Greenbriar project would not alter the habitat value of land authorized for development under the NBHCP, and would not adversely affect the habitat value of TNBC reserves established under the NBHCP, the project would not affect this basis for the 0.5:1 mitigation ratio for the 17,500 acres of urban development

authorized by the NBHCP. Similarly, the project would not adversely affect the monitoring and management of reserves, or opportunities to consolidate reserves into large blocks of habitat. (The project's effects on the habitat quality of existing reserves, water availability at TNBC reserves, and opportunities to establish additional TNBC reserves are evaluated in sections 3.7, 3.8, and 3.9, respectively.)

Although not explicitly stated in section IV of the NBHCP, the 0.5:1 mitigation ratio is related to other elements of the conservation strategy (e.g., maintenance of habitat connectivity). With the DEIR mitigation, the Greenbriar project would not adversely affect these other elements of the conservation strategy, and thus the project would not affect this basis of the 0.5:1 mitigation ratio.

The 0.5:1 mitigation ratio of the NBHCP is also related to the habitat values provided by other lands in the Natomas Basin (outside of reserves established through the NBHCP). With the DEIR mitigation, the Greenbriar project would not cause a net loss in habitat values for giant garter snake and Swainson's hawk in the Natomas Basin, and thus the project would not affect this basis of the 0.5:1 mitigation ratio.

In order to be compatible with the conservation strategy of the NBHCP, the Greenbriar project has had to propose a conservation strategy that differs in some regards from the NBHCP conservation strategy. These differences include a larger mitigation ratio, greater emphasis on measures to maintain connectivity, and more extensive restoration and enhancement of preserved land. The implementation of the Greenbriar conservation strategy will likely be more costly (on a per acre basis) than the NBHCP conservation strategy, and thus will likely require a greater endowment for NBHCP reserves.

5.2 PREPARATION OF SITE SPECIFIC MANAGEMENT PLANS

For each reserve, TNBC prepares and implements a site-specific management plan that addresses the specific resources and habitat values of each reserve site, and how these will be managed in support of the goals and objectives of the NBHCP.

The potential effects of the Greenbriar project that could affect reserve management include altering adjacent land uses, connectivity, water availability, or affecting opportunities to establish additional reserves. These effects are evaluated in sections 3.7, 3.6, 3.8, and 3.9, respectively. In brief, the project would not affect water availability, the proposed reserves and mitigation could change adjacent land uses of existing and future reserves but the effect would be beneficial, and with the DEIR mitigation it would not affect connectivity. Therefore, the Greenbriar project probably would not affect the management plans prepared for existing and future reserves with the exception of altering Swainson's hawk foraging habitat in the vicinity of the Greenbriar site and the proposed reserves, and of preserving and enhancing land that could be consolidated into current or future reserves, which could alter existing site-specific plans.

Also, where the proposed reserves could be consolidated into existing or future reserves, the site-specific management plans of these reserves would need to be revised. These revisions would reflect the beneficial effects of the increased in reserve size. This would occur, for example, at the Cummings reserve, which would probably be consolidated with the proposed Natomas 130 reserve that is immediately adjacent to it.

5.3 BUFFERS WITHIN RESERVE LANDS

Buffers are incorporated into reserves to minimize the effects of incompatible adjoining land uses. These buffers consist of a 30–70 foot wide strip of native or ruderal vegetation along the edge of the reserve. Development at the Greenbriar site would not alter the need for or effectiveness of reserve buffers at existing reserves because the Greenbriar site is not adjacent to an existing reserve. (Potential effects of the Greenbriar project on human-wildlife conflicts and reserve habitat values are evaluated in sections 3.2 and 3.7, respectively.) Also, because under the future condition of the Natomas Basin resulting from the NBHCP, the Greenbriar site would already be bordered by urban development, highways or major roads on all sides, development of the Greenbriar site could

cause only very limited effects on the effectiveness of buffers within future reserves, even if reserves were established on adjacent land to the north or southwest (i.e., adjacent land that would not be developed under the future condition of the Natomas Basin).

The proposed reserves could reduce the need for buffers at existing and future reserves. The proposed Natomas 130 reserve borders the existing Cummings reserve (Exhibit 5), and thus along their shared border, there would no longer be a need for a buffer from incompatible adjacent land uses. If in the future, reserves were established adjacent to the reserves proposed by this project, buffers would be unnecessary along their shared borders.

5.4 CONNECTIVITY

The conservation strategy of the NBHCP emphasizes the need for maintaining connectivity of reserves and the importance of existing canals and drains for providing that connectivity. But, the NBHCP would not preserve or enhance habitat along canals, although it does contemplate future needs to preserve habitat along canals in some instances. The NBHCP states (on page IV-8) that elimination of drains or canals would primarily be related to urban development, and thus would be unlikely to affect reserves. Nonetheless, the NBHCP acknowledges (on page IV-9) that once reserves are established and key connectivity corridors have been identified, changes in water delivery and drainage along these waterways could occur, and thus these changes must be considered by TNBC and measures taken to ensure connectivity. Suggested measures include MOAs, easements, or purchase of land.

Lone Tree Canal is a key connectivity corridor between existing reserves (Jones & Stokes 2005). The project's potential adverse effects on connectivity, and in particular on Lone Tree Canal, would be mitigated so that connectivity would not be reduced (and could be enhanced) along the adjacent section of Lone Tree Canal. This mitigation includes enhancing and preserving habitat within a 250-foot wide setback along the canal, installing a barrier/fencing to keep snakes out of adjacent development and to exclude humans and domestic/feral animals from the Lone Tree Canal corridor, providing an additional assurance for water flow in the canal, and creating habitat along the canal. (Both the potential effects and the mitigation that reduces or eliminates them are described in greater detail in Section 3.5 *Connectivity of Habitat in the Natomas Basin* and in Section 3.6 *Connectivity of Existing TNBC Reserves*.) This mitigation would ensure that connectivity would be maintained along this section of Lone Tree Canal, and is comparable to the measures contemplated in the NBHCP (on page IV-9) for ensuring connectivity.

The proposed reserves would likely have a beneficial effect on connectivity of TNBC reserves by enhancing and preserving habitat in between existing and future reserves. For example, the proposed Spangler reserve is located between the Ruby Ranch and Atkinson reserves to the west and the Tufts and Sills reserves to the east (Exhibit 5). Therefore, the enhancement and preservation of habitat at this site would likely enhance and preserve connectivity between these reserves.

5.5 FORAGING HABITAT

As described on pages IV-11 through IV-13 of the NBHCP, the viability of populations of covered bird species, and in particular the Swainson's hawk, depends on foraging habitat both on TNBC reserves and on unpreserved agricultural lands in the Natomas Basin. Therefore, the NBHCP includes measures to be implemented if foraging habitat outside of the permit areas (i.e., the areas authorized for urban development under the NBHCP) is converted to urban land uses without adequate provisions to maintain foraging habitat values and the effectiveness of the operating conservation program is potentially compromised. These measures include modifying acquisition criteria, substituting impacted reserves with unaffected replacement sites, modifying the percentages of habitat types at TNBC reserves, and pursuing outside funding to acquire additional reserves.

The Greenbriar project, however, would include adequate provisions to maintain foraging habitat values, and thus would not compromise the effectiveness of the operating conservation program. The effects on habitat acreage

and quality in the Natomas Basin are evaluated in Sections 3.3 and 3.4, respectively. (In addition, effects on habitat values of existing reserves are evaluated in Section 3.7.) The project would reduce the acreage of foraging habitat but would increase habitat quality at the proposed reserves and at the DEIR mitigation site. As a result, for Swainson's hawk, total foraging resources available in the Natomas Basin would not be reduced by the project. For other bird species, foraging resources of the Natomas Basin either would not be reduced or the reduction would not be sufficient to alter the viability of the species' population in the Natomas Basin (as described for each species in Section 4 *Potential Effects of the Greenbriar Project on Covered Species*).

To evaluate the effects of habitat loss and enhancement on foraging resources for Swainson's hawk in the Natomas Basin, the approach used by CH2M HILL in evaluating the NBHCP was used in this effects analysis and a new model developed by EDAW was also used. The EDAW model expresses the habitat value of different habitats, on a monthly basis, in terms of the equivalent acreage of high quality foraging habitat. The basis and structure of this model, and the scenarios evaluated, are described in detail in Section 2.2 *Methodology for Analyzing Alterations of Populations and Habitats*. Based on CH2M HILL's approach, there was a net decrease in habitat acreage, but an increase in high quality habitat and an increase in available habitat during April–August. Based on the EDAW model, during April–June, the increase in foraging habitat value at the proposed reserves and mitigation sites would be slightly greater than the value of the lost foraging habitat (the equivalent of 129 acres of high quality habitat with the project versus 122 acres without the project). During July–September, the increase in foraging habitat value at the proposed reserves and mitigation sites would not fully offset the value of the foraging habitat lost at the Greenbriar site (129 versus 140 acres during July–August and 162 acres in September). However, during these months, foraging resources in the Natomas Basin increase due to harvesting of crops, and so the project's affect on foraging resources available during July–September is not likely to affect the viability of Swainson's hawk, nor the effectiveness of the conservation strategy of the NBHCP. The results of these analyses of foraging resources are presented in Section 3.4 *Habitat Quality in the Natomas Basin*, and are displayed in Exhibits 3 and 4.

5.6 MINIMUM HABITAT BLOCK SIZE REQUIREMENTS

A requirement of the NBHCP is that by the end of the 50-year period, one habitat block within the reserve system will be at least 2,500 acres in size and the balance of reserve lands shall be in habitat blocks of at least 400 acres in size. The NBHCP (on page IV-14) provides four bases for this size requirement. These bases are:

1. large blocks minimize the "perimeter effect",
2. large blocks promote biodiversity by allowing multiple species and niches to occupy the site,
3. the benefit to genetic diversity of dispersing interconnected reserves throughout the Natomas Basin, and
4. the 400-acre reserve size is considered the minimum size to allow persistence of covered species.

No aspect of the Greenbriar project would alter any of these bases for the minimum habitat block size requirements of the NBHCP. The project could however affect opportunities to establish additional TNBC reserves, and thus affect the ability to consolidate reserves into habitat blocks that satisfy the size requirements. The Greenbriar project's potential affect on opportunities to establish additional TNBC reserves was evaluated in Section 3.9. In brief, the project would adversely affect the preservation of large blocks of habitat at or adjacent to the Greenbriar site, but elsewhere it would enhance and preserve additional habitat (296 acres plus at least 49 acres of DEIR mitigation), increasing opportunities to establish additional reserves; The project also would reduce the quantity of land available to provide mitigation under the NBHCP, but the remaining acreage of land potentially suitable for preservation would substantially exceed the acreage required for the NBHCP's reserve system. Overall, the project would probably have a beneficial effect on the fulfillment of the requirement for minimum habitat block size.

Interestingly, the Greenbriar project does illustrate the need for smaller reserves in some instances to preserve connectivity. The Greenbriar project necessitates enhancement and preservation of land along a waterway to maintain connectivity for the giant garter snake. This land would be partially isolated by major roads and both

existing and proposed development, and would not become part of a larger habitat block in the future. In general, corridors along canals and drains near roads and development will be more difficult to incorporate into larger blocks of habitat because of the adverse effects of roads and development on reserves. Yet, it is in precisely these locations that preserving and managing corridors would be most beneficial or even necessary. Though it acknowledges that evidence may be discovered in support of smaller reserves, the NBHCP does not address the effects of preserving corridors on the attainment of its minimum habitat block size requirements.

Overall, the project would beneficially affect the establishment of large blocks of preserved habitat. It would enhance and preserve 296 acres of additional habitat, most of which would be adjacent to or near existing TNBC reserves; the DEIR mitigation would increase this benefit by requiring the preservation of at least an additional 49 acres of land. The project would adversely affect the preservation of large blocks of habitat by developing existing habitat at the Greenbriar site. However, under the future condition of the Natomas Basin, this land would be surrounded by major roads and urban development, and the project would preserve the most ecologically important portion of the site, which is the corridor of land along Lone Tree Canal.

5.7 EFFECTIVENESS OF THE CONSERVATION STRATEGY OF THE NBHCP

As described in the preceding sections, effects on the key components of the NBHCP's conservation strategy resulting from the Greenbriar project (with the DEIR mitigation) would be minor, and some of these effects would be beneficial. Therefore, the Greenbriar project would not reduce the effectiveness of the conservation strategy, and thus no changes in the conservation strategy would be necessitated by the project.

In large part, the project would avoid affecting the effectiveness of the conservation strategy because of its mitigation of effects on connectivity and foraging habitat. This mitigation of effects on connectivity (through substantial investment in wide setbacks, barriers, and habitat management in perpetuity) and foraging habitat (by increasing habitat values on mitigation lands sufficiently to replace habitat values lost on development sites) could serve as a general approach for future projects to avoid reducing the effectiveness of the conservation strategy of the NBHCP.

6 POTENTIAL EFFECTS OF THE GREENBRIAR PROJECT ON NBHCP GOALS AND OBJECTIVES

For each applicable goal and objective in the NBHCP, this section summarizes the effects of the Greenbriar project on attainment of that goal or objective. These effects were analyzed in the preceding sections of this report that addressed effects on covered species, habitat acreage, human-wildlife conflicts, connectivity, habitat values at TNBC reserves, water availability at TNBC reserves, and the opportunity to establish additional reserves.

Because the Greenbriar project would be located outside of the areas where urban development was authorized by the NBHCP, and thus would result in a net increase of land potentially developed in the NBHCP plan area, the project's avoidance, minimization and mitigation measures could be consistent with the measures of the NBHCP and yet the project could still detrimentally affect attainment of the NBHCP's goals and objectives, or otherwise reduce the likelihood of sustaining populations of covered species in the Natomas Basin.

For example, the 0.5 to 1 ratio of developed to conserved land in the NBHCP was not necessarily intended to apply to development outside the 17,500 acre permit area (as described on page IV-12 of the NBHCP), and was based, in part, on the interpretation that on average habitat quality was lower in the areas permitted for development than in the areas that would be preserved (City of Sacramento et al. 2003).

Similarly, the NBHCP conservation strategy was based in part on the assumption that most of the Natomas Basin in agricultural use at the time of the NBHCP's approval would remain in agricultural land uses that provide habitat for most covered species (e.g., as described on page IV-11 of the NBHCP). The retention of a substantial acreage of existing agricultural habitats limits the risks associated with relying on enhancement and restoration efforts to offset habitat losses. It also retains, largely unaltered, the canals and upland corridors that connect habitats; and it would leave reserves surrounded by agricultural lands that increase the benefits of reserves for covered species. Therefore, development outside of areas permitted by the NBHCP could eliminate higher quality habitats, reduce habitat connectivity, and detrimentally affect reserves to a much greater degree than the development permitted by the NBHCP. Such development also could create conflicts with the continued use of adjacent lands for agriculture.

These examples illustrate that both the types and magnitudes of effects caused by development outside of the areas permitted by the NBHCP can differ from those caused by comparable development inside of the areas permitted by the NBHCP; thus, mitigation comparable to that in the NBHCP may not adequately offset these effects. This situation was anticipated during the development of the NBHCP and is reflected in the text of the NBHCP, BO, Final EIR/EIS and the implementation agreement for the NBHCP (e.g., page IV-12 of the NBHCP).

Therefore, interpretations of the Greenbriar project's effects on the NBHCP were based primarily on the sum of the anticipated effects on the TNBC reserve system, and on the sum of anticipated effects on the viability of populations of covered species using the Natomas Basin. An overall negative effect on the existing reserve system was considered adverse to the attainment of the NBHCP's goals and objectives. Effects that would preclude attainment of a goal or objective, reduce the viability of a covered species or otherwise necessitate a change in the NBHCP's conservation strategy were considered substantial effects that would conflict with the NBHCP.

Overall, the Greenbriar project would not conflict with attainment of the goals and objectives of the NBHCP. Through most mechanisms by which a project could affect the NBHCP, the Greenbriar project causes adverse and beneficial effects on the goals and objectives of the NBHCP. However, many of these effects are small relative to the acreages of development authorized by the NBHCP and of habitats in the Basin. Also, most beneficial and adverse effects would be reduced by opposing effects, and the DEIR mitigation further reduces adverse effects. Consequently, the Greenbriar project would not cause an overall adverse effect on attainment of any of the goals or objectives of the NBHCP, and the project could provide an overall benefit towards the attainment of several goals. (For example, the project [with DEIR mitigation] would preserve 345 acres of land and this preserved land

would contribute to the connectivity and quality of habitat preserved through the NBHCP.) In the following sections of text, the project's effects are assessed for each potentially affected goal and objective of the NBHCP. These assessments, in turn, are based on the analyses presented in Chapter 3 *Alteration of Population and Habitat Attributes by the Greenbriar Project* and Chapter 4 *Potential Effects of the Greenbriar Project on Covered Species*.

6.1 OVERALL GOALS

6.1.1 OVERALL GOAL 1

Establish and manage in perpetuity a biologically sound and interconnected habitat reserve system that mitigates impacts on Covered Species resulting from Covered Activities and provides habitat for existing, and new viable populations of Covered Species. (NBHCP, p. I-15)

A project could potentially affect attainment of this goal by affecting the:

- acreage of habitat in the Natomas Basin,
- quality of habitat in the Natomas Basin,
- connectivity of habitat in the Natomas Basin,
- connectivity of TNBC reserves,
- habitat value of TNBC reserves,
- water availability at TNBC reserves, and opportunities to establish additional TNBC reserves.

The Greenbriar project would cause both adverse and beneficial effects on the attainment of this goal through all of these mechanisms, except for water availability at TNBC reserves (which the project would not affect). The project's beneficial effects would include increased habitat quality resulting from the preservation, creation, and enhancement of habitats, increased connectivity of existing TNBC reserves and of habitats, and increased opportunities to establish additional TNBC reserves. Without mitigation, the project's adverse effects would include a reduction in the acreage of upland and wetland habitats in the Natomas Basin, reduced foraging habitat values within a mile of an existing TNBC reserve, fragmented upland habitats in the vicinity of the Greenbriar site, degraded habitat quality of adjacent agricultural lands to the north and southwest, and possibly reduced connectivity along Lone Tree Canal (despite preserving and enhancing a corridor of habitat along the canal). A detailed assessment of these effects is provided in sections *3 Alteration of Population and Habitat Attributes by the Greenbriar Project* and *4 Potential Effects of the Greenbriar Project on Covered Species*.

The mitigation proposed in the DEIR would reduce the project's adverse effects by incorporating additional measures to ensure that connectivity along Lone Tree Canal is sustained (as described in Sections 3.5, 3.4, 4.1, and 4.2.), and to preserve and enhance an additional 49 acres of foraging habitat within a mile of existing TNBC reserves (as described in Sections 3.4, 3.7, and 4.3). This mitigation also would cause additional beneficial effects (as described in Sections 3.6, 3.7, and 3.8), because the preserved and enhanced foraging habitat would not only mitigate effects on foraging habitat and on TNBC reserves, but also could increase connectivity of habitat and of TNBC reserves. Similarly, by ensuring that connectivity along Lone Tree Canal would be maintained, the project (with its proposed mitigation) would conserve a portion of an important corridor connecting reserves and habitats of the southern and central Natomas Basin. (The connectivity of upland habitats, however, would still be reduced at the Greenbriar site.)

As described in Section 3.9, the project (with the DEIR mitigation) would have an overall beneficial effect on the establishment and management of reserves for the NBHCP. Because the acreage of land in the Natomas Basin that is potentially available and suitable for preservation substantially exceeds the 8,750 acres that will be preserved by the NBHCP, the project would not preclude the preservation of sufficient land to attain the NBHCP's goals and objectives. It would provide 345 acres of additional reserve lands, with much of this acreage adjacent to or near existing reserves, which would increase the connectivity of habitats and the resources available

to covered species using reserves established by the NBHCP; in addition, it would conserve an important corridor of canal habitat along Lone Tree Canal. The project also would increase opportunities to establish new reserves, particularly to create larger reserves by preserving additional land adjacent to existing TNBC and project's proposed reserves. (Sections 3.6–3.9 provide a detailed assessment of effects on the management and establishment of TNBC reserves.)

Although the project would cause a net reduction in the acreage of upland and wetland habitats, the preservation and enhancement of habitat by the project would adequately mitigate for its impacts on upland and wetland habitats for covered species. Effects on the acreage and quality of habitats are summarized below, and a detailed assessment of these effects is presented in Sections 3.3 and 3.4. (These effects are also evaluated separately for each covered species in Chapter 4 *Potential Effects of the Greenbrier Project on Covered Species*.)

For wetland land cover (i.e., rice, canal, and ponds and seasonally wet areas), the net reduction in acreage resulting from the project would be offset by an increase in the habitat quality by creating marsh habitat at the project's proposed reserves. Based on 2001 land cover mapping, the Greenbriar project would eliminate 388 acres of rice and 16 acres of canal habitats, but would increase the acreage of marsh by 201 acres, creating a net loss of 204 acres of these wetland land cover types and of the habitats they provide. An acre of marsh, however, provides a greater quantity and variety of habitat than does an acre of rice, and thus the additional habitat values provided by the created marsh offsets the habitat lost in the rice and canal land cover types. Managed marsh provides substantially greater habitat values for giant garter snakes than rice for several reasons. These reasons include:

- Giant garter snakes use the full extent of managed marshes, whereas they primarily use the margins of rice fields;

- Marshes provide habitat throughout the active period of the snake, whereas rice fields do not provide habitat during early and mid-spring, and are typically drained before the end of the snake's active period; and

- Marsh provides habitat in all years, whereas rice is fallowed periodically.

In addition, the project would preserve, and manage for its habitat values, 201 acres of marsh (i.e., about 1.0 acre for each acre lost) and approximately 6 acres of canal habitat. This preservation and management would increase the habitat value of these lands because:

- Habitat would be preserved in perpetuity;
- Habitat would be monitored and actively managed for the benefit of covered species;
- Habitat would not be subject to continuous disturbance caused by farming or canal maintenance activities; and
- Habitat would be relatively free of human intrusion (USFWS 2003).

Therefore, the loss of wetland habitats (i.e., those provided by land cover mapped as rice, canal, and ponds and seasonally wet areas) is more than offset by the creation of a comparable area of marsh (from rice and upland land cover), and the preservation and management of this marsh. These effects are described in detail in Sections 3.3–

3.4 and 4.1–4.2. As described in Section 3.5, the project with its mitigation would also conserve an important corridor of canal and adjacent upland habitat at the Greenbriar site.

For upland land cover (i.e., alfalfa, grassland, idle, non-rice crop, pasture, and ruderal), the net reduction in acreage resulting from the project also would be offset by an increase in the habitat quality of preserved and enhanced habitat. Based on 2001 land cover mapping, the Greenbriar project would cause a net reduction of 281 acres of upland land cover providing habitat for covered species, but would enhance the habitat value of 14 acres at the proposed Natomas 130 site and 45 acres at the Spangler site, and the DEIR mitigation for loss of Swainson's hawk would enhance at least an additional 49 acres; thus, a total of 109 acres of upland habitat would be enhanced. This habitat would be preserved, as would 27 acres of grassland along Lone Tree Canal and 60 acres of upland components within created marshes; thus, a total of 195 acres of upland habitat would be preserved. For

some covered species associated with uplands (including Swainson's hawk, burrowing owl, and loggerhead shrike) the additional habitat values provided by the preservation and enhancement of this upland habitat (i.e., 0.7 acres preserved for each acre lost and over half of this enhanced) would fully offset the habitat values of the upland acreage lost as a result of the project. For other covered species (including Aleutian Canada goose, tricolored blackbird, and bank swallow), the additional habitat values provided by the preservation and enhancement of this 195 acres of upland habitat would only partially offset the habitat values of the upland acreage lost as a result of the project. (The analysis of the foraging habitat value lost at the Greenbriar site and of the value gained at the proposed reserve and mitigation sites is summarized in Section 3.4 *Habitat Quality in the Natomas Basin*.) For example, based on the methods used by CH2M HILL, the upland habitats that would result from the project would provide a greater acreage of available foraging habitat during April–August, when Swainson's hawks are nesting in the Basin. Based on EDAW's model of habitat values, the enhancement of uplands by the project (with the DEIR mitigation) would provide foraging habitat values during the months of April–June that are slightly greater than the habitats that would be eliminated by the project (Exhibits 3b and 4). During July–August, the project's enhancement of habitat would not fully offset the lost habitat values, but during these months foraging habitat values increase in the Natomas Basin as a result of crop harvest.

On the basis of the project's establishment of reserves that provide habitat for covered species and mitigate the project's impacts to those covered species, implementing the proposed project (with the DEIR mitigation measures) would either not alter or would improve the connectivity of the NBHCP reserve system and provide habitat for viable populations of covered species. In addition, because the viability of covered species would either be unaltered or improved (e.g., giant garter snake, northwestern pond turtle), the project would not adversely affect attainment of this goal.

6.1.2 OVERALL GOAL 3

Preserve open space and habitat that may also benefit local, non-listed and transitory wildlife species not identified within the NBHCP. (NBHCP, page I-16)

A project could potentially affect attainment of this goal by affecting the:

- Acreage of habitat in the Natomas Basin,
- Quality of habitat in the Natomas Basin,
- Connectivity of habitat in the Natomas Basin,
- Connectivity of TNBC reserves,
- Habitat value of existing TNBC reserves,
- Water availability at TNBC reserves, and
- Opportunities to establish additional TNBC reserves.

The Greenbriar project would cause both beneficial and adverse effects on the attainment of this goal through most of these mechanisms. By preserving, enhancing, and creating habitat, the project would increase the quality of habitats, increase the connectivity of habitats and TNBC reserves, and create additional opportunities to establish additional TNBC reserves. By developing most of the Greenbriar site, the project would reduce the acreage of habitat in the Natomas Basin, and it would fragment, degrade, and reduce the connectivity of adjacent habitats, reduce the foraging habitat available at an existing TNBC reserve, and without the DEIR mitigation, it could reduce connectivity along Lone Tree Canal (despite preserving a corridor along it.)

The DEIR mitigation reduces the project's adverse effects by incorporating additional measures to ensure that connectivity along Lone Tree Canal is sustained (including additional requirements for fencing and barriers), and to preserve and enhance an additional 49 acres of upland foraging habitat within a mile of existing TNBC reserves. This additional foraging also could increase connectivity of habitat and of TNBC reserves. Similarly, by ensuring that connectivity along Lone Tree Canal would not be reduced, the project (with the DEIR mitigation)

would conserve a portion of an important corridor connecting reserves and habitats of the southern and central Natomas Basin. (The connectivity of upland habitats, however, would still be reduced at the Greenbriar site.)

As described in Sections 3.6–3.9, the project (with the DEIR mitigation) would have an overall beneficial effect on the establishment and management of reserves for the NBHCP. Because the acreage of land in the Natomas Basin that is potentially available and suitable for preservation substantially exceeds the 8,750 acres that will be preserved by the NBHCP, the project would not preclude the preservation of sufficient land to attain the NBHCP's goals and objectives. It would provide reserve lands adjacent to or near existing reserves, increasing the connectivity of habitats and the resources available to covered species using reserves established by the NBHCP; in addition, it would conserve a portion of an important corridor of canal habitat along Lone Tree Canal. The project also would increase opportunities to establish new reserves, particularly to create larger reserves by preserving additional land adjacent to existing TNBC and project's proposed reserves.

Because the project would cause both beneficial and adverse effects on the attainment of this goal, and because the project's adverse effects would not reduce the likelihood that the NBHCP would be able to preserve sufficient habitat for non-listed species to attain this goal, the Greenbriar project would not adversely affect the attainment of this goal.

6.1.3 OVERALL GOAL 4

Ensure that direct impacts of Authorized Development upon Covered Species are avoided or minimized to the maximum extent practicable. (NBHCP, page I-16)

A project could potentially affect attainment of this goal by causing construction-related effects on the survival or reproduction of individuals that are using the project or mitigation sites and adjacent lands.

Development of the Greenbriar site would likely affect giant garter snake, Swainson's hawk, burrowing owl, and loggerhead shrike, and could affect several other covered species including northwestern pond turtle, tricolored blackbird, white-faced ibis, Aleutian Canada goose, Sanford's arrowhead, and Delta tule pea. These potential effects (which are described in detail in Chapter 4) would be comparable to the construction-related effects that could be caused by development permitted by the NBHCP.

The avoidance and minimization measures incorporated into the project and into the DEIR mitigation would substantially reduce these effects. These measures include all of the applicable avoidance and minimization measures that were included in the NBHCP to avoid and minimize construction-related effects, which are a comprehensive set of effective measures for reducing these effects. (An assessment of the applicability of these measures is in Appendix A.) In addition, the DEIR mitigation would include several more stringent minimization measures. Therefore, with its proposed mitigation, the project would not adversely affect attainment of this goal because it would implement a comprehensive set of measures to avoid and minimize effects on covered species. The Greenbriar project also would not alter the effectiveness of any NBHCP conservation measures for avoiding and minimizing the effects of development authorized by the NBHCP (Appendix A).

6.2 OVERALL OBJECTIVES

6.2.1 OVERALL OBJECTIVE 1

Minimize conflicts between wildlife and human activities, including conflicts resulting from airplane traffic, roads and automobile traffic, predation by domestic pets, and harassment by people. (NBHCP, page I-16)

A project could potentially affect attainment of this objective by causing construction-related effects on survival or reproduction of individuals using project sites and adjacent lands, or by altering the area, types of habitats, or level of conflicts in zones with high levels of human-wildlife conflicts.

Without the DEIR mitigation, the project would reduce the overall area in zones with high levels of human-wildlife conflicts, but it would increase the area of rice habitat and the level of conflicts within such zones, and it would cause construction-related effects in these zones. (Section 3.2 provides a detailed description of effects on zones with high levels of human-wildlife conflicts.) These human-wildlife conflicts and construction-related effects would be comparable to those resulting from the development authorized by the NBHCP.

The DEIR mitigation includes avoidance and minimization measures that would substantially reduce these effects. These measures include all of the applicable measures that were included in the NBHCP to avoid and minimize construction-related effects and to reduce human-wildlife conflicts. (An assessment of the applicability of these measures is included as Appendix A.) As described in Section 3.1, these measures represent a comprehensive set of effective measures for avoiding and minimizing the project's effects. In addition, the project also incorporates additional measures (e.g., fencing and barriers) to reduce human-wildlife conflicts along Lone Tree Canal.

Therefore, with the DEIR mitigation, the project would not adversely affect attainment of this objective because it would implement a comprehensive set of measures that would minimize human-wildlife conflicts. The Greenbriar project also would not alter the effectiveness of any NBHCP conservation measures for minimizing human-wildlife conflicts (Appendix A).

6.2.2 OVERALL OBJECTIVE 3

Ensure connectivity between TNBC reserves to minimize habitat fragmentation and species isolation. Connections between reserves will generally take the form of common property boundaries between reserves, waterways (primarily irrigation and drainage channels) passing between reserves, and/or an interlinking network of water supply channels or canals. (NBHCP, page I-16)

A project could potentially affect attainment of this goal by affecting:

- Connectivity of habitat in the Natomas Basin,
- Connectivity of TNBC reserves,
- Habitat value of TNBC reserves, and
- Water availability at TNBC reserves.

The Greenbriar project would cause beneficial and adverse effects on the attainment of this objective through most of these mechanisms. The main beneficial effect would be increased connectivity of habitats and TNBC reserves due to preservation, creation, and enhancement of habitat at the project's proposed reserves, two of which are adjacent to or near (i.e., within a half mile of) existing TNBC reserves. Adverse effects would include reducing the foraging habitat within a mile of a TNBC reserve, fragmenting and reducing the connectivity of upland habitats adjacent to the Greenbriar site, and possibly reducing the connectivity of wetland habitats and TNBC reserves because of effects on Lone Tree Canal (despite preserving a corridor along the canal). (Sections 3.4–3.7 provide detailed descriptions of these effects.)

The DEIR mitigation reduces the project's adverse effects by incorporating additional measures to ensure that connectivity along Lone Tree Canal is sustained, and to preserve and enhance foraging habitat within a mile of existing TNBC reserves. This mitigation also would cause additional beneficial effects because the preserved and enhanced foraging habitat would not only mitigate effects on TNBC reserves, but also could increase connectivity of habitat and of TNBC reserves. Similarly, by ensuring that connectivity along Lone Tree Canal will not be reduced, the project (with the DEIR mitigation) would conserve a portion of an important corridor connecting reserves and habitats of the southern and central Natomas Basin. (The connectivity of upland habitats, however, would still be reduced at the Greenbriar site.)

In the absence of an adverse effect on connectivity along Lone Tree Canal, the project would cause only small effects on the attainment of this objective, and most of these effects would be beneficial. Therefore, the project's overall effect on the attainment of this objective would not be adverse.

6.3 WETLAND SPECIES/HABITAT GOALS AND OBJECTIVES

6.3.1 WETLAND SPECIES/HABITAT GOAL/OBJECTIVE 1

Acquire, enhance and create a mosaic of wetland habitats with adjacent uplands and connecting corridors to provide breeding, wintering, foraging, and cover areas for wetland species in the Plan Area. (NBHCP, page I-17)

A project could potentially affect attainment of this goal by affecting:

- Acreage of habitat in the Natomas Basin,
- Quality of habitat in the Natomas Basin,
- Connectivity of habitat in the Natomas Basin,
- Connectivity of TNBC reserves,
- Habitat value of TNBC reserves,
- Water availability at TNBC reserves, and
- Opportunities to establish additional TNBC reserves.

The Greenbriar project with the DEIR mitigation would cause beneficial and adverse effects on the attainment of this goal/objective through several of these mechanisms. By acquiring, enhancing, and creating wetland habitats, the project would increase the area of preserved land in the Natomas Basin, which would increase the connectivity of habitats and create additional opportunities to create larger reserves. By developing most of the Greenbriar site, the project would reduce the acreage of wetland habitats in the Natomas Basin (by approximately 204 acres), and without the DEIR mitigation, could reduce the connectivity of wetland habitats because of effects on Lone Tree Canal, and could cause some degradation of wetland habitats on lands to the north and southwest of the Greenbriar site. With its proposed mitigation, however, the project would not adversely affect connectivity of habitats along Lone Tree Canal. (Section 3.5 provides an assessment and more detailed description of the anticipated effects on connectivity.) Therefore, the main adverse effect of the project on attainment of this goal would be due to the reduction of the acreage of wetland habitats.

This reduction in wetland acreage would not cause an effect on attainment of this goal/objective that would necessitate changes to the conservation strategy of the NBHCP. First, the effect would be offset by the enhancement of 204 acres of wetland habitats on the project's proposed reserves (which is described in Section 3.4). Second, as described in Section 3.3, only a small percentage of the Basin's wetland habitats would be lost (approximately 1%). Third, as described in Section 3.5, no reduction in the connectivity of wetland habitats or in opportunities to preserve, enhance, and acquire wetland habitats would result. Fourth, as described in Section 4, the population viability of covered species using these habitats would not be reduced.

Because the project would contribute directly to the attainment of this goal, and would not cause any adverse effects on the goal's attainment that would need to be offset by changes in the conservation strategy of the NBHCP, the project's overall effect on the attainment of this goal is not adverse.

6.3.2 WETLAND SPECIES/HABITAT GOAL/OBJECTIVE 2

Provide habitat to maintain, attract and sustain viable populations of the Covered Species. The habitat areas should be configured to encompass natural species migration areas, minimize species isolation, and prevent future habitat fragmentation. (NBHCP, page I-17)

A project could potentially affect attainment of this goal by affecting:

- Zones with human-wildlife conflicts,
- Acreage of habitat in the Natomas Basin,
- Quality of habitat in the Natomas Basin
- Connectivity of habitat in the Natomas Basin,
- Connectivity of TNBC reserves,
- Habitat value of TNBC reserves,
- Water availability at TNBC reserves, and
- Opportunities to establish additional TNBC reserves.

The Greenbriar project, with the DEIR mitigation, would cause beneficial and adverse effects on the attainment of this goal/objective through several of these mechanisms. Based on the analyses presented in Section 3 *Alteration of Habitat and Population Attributes by the Greenbriar Project*, the project (with the DEIR mitigation) would cause a net loss in the acreage of wetland habitats, improve the habitat quality of some wetlands, and could improve connectivity of habitat and TNBC reserves, and increase opportunities to establish additional TNBC reserves. Overall, the project would not adversely affect attainment of this goal.

The net loss of habitat acreage resulting from the project would be offset by the creation of marsh at the project's proposed reserves. Based on 2001 land cover mapping, the Greenbriar project would eliminate 388 acres of rice and 16 acres of canal habitats, but would increase the acreage of marsh by 201 acres, creating a net loss of 204 acres of these wetland land cover types and of the habitats they provide. An acre of marsh, however, provides a greater quantity and variety of habitat than does an acre of rice, and thus the additional habitat provided by the created marsh offsets the habitat lost in the rice and canal land cover types. In addition, the project would preserve, and manage for its habitat values, 201 acres of marsh (i.e., about 1.0 acre for each acre lost). This preservation and management would increase the habitat quality of these lands because:

1. Habitat would be preserved in perpetuity;
2. Habitat would be monitored and actively managed for the benefit of covered species;
3. Habitat would not be subject to continuous disturbance caused by farming or canal maintenance activities; and
4. Habitat would be relatively free of human intrusion (USFWS 2003).

Therefore, the loss of wetland (i.e., land cover mapped as rice, canal, and ponds and seasonally wet areas) is more than offset by the creation of a comparable area of marsh (from rice and upland land cover) and the preservation, and management of the created marsh. Because the project would increase the acreage of land preserved in the Natomas Basin, it would provide opportunities to increase the size and connectivity of TNBC reserves (which are described in Sections 3.6 and 3.9). The project with the DEIR mitigation would also conserve an important corridor of canal and adjacent upland habitat at the Greenbriar site (as described in Section 3.5).

Consequently, as described in Section 4 *Potential Effects of the Greenbriar Project on Covered Species*, the project would either benefit or be unlikely to alter the viability of covered species using wetland land cover (i.e., rice, canal, or ponds and seasonally wet areas). Because the project would not reduce the viability of covered species, and creates additional reserves that contribute to efforts to sustain viable populations and prevent fragmentation of habitat, the project does not adversely affect this goal/objective.

6.4 UPLAND SPECIES/HABITAT GOALS AND OBJECTIVES

6.4.1 UPLAND SPECIES/HABITAT GOAL/OBJECTIVE 1

Acquire, enhance and create a mosaic of upland habitat types for breeding, foraging, and cover for species dependent on upland habitats. (NBHCP, page I-17)

A project could potentially affect attainment of this goal by affecting:

- Acreage of habitat in the Natomas Basin,
- Quality of habitat in the Natomas Basin,
- Habitat value of existing TNBC reserves, and
- Opportunities to establish additional TNBC reserves.

For upland habitats, the Greenbriar project would affect the attainment of this goal through each of these mechanisms. The project's beneficial effects on the attainment of this goal/objective would include the preservation, creation and enhancement of habitats that increase habitat quality and contribute to the connectivity of existing TNBC reserves and of habitats, and increase opportunities to establish additional TNBC reserves. The project's adverse effects on the attainment of this goal/objective would include reduced acreage of upland habitats in the Natomas Basin, reduced foraging habitat within a mile of an existing TNBC reserve, fragmented and reduced connectivity of upland habitats in the vicinity of the Greenbriar site, and probably degraded quality of adjacent habitat to the north and southwest of the Greenbriar site. Sections 3 *Alteration of Population and Habitat Attributes by the Greenbriar Project* and 4 *Potential Effects of the Greenbriar Project on Covered Species* provide detailed assessments of these effects.

The DEIR mitigation reduces the project's adverse effects by incorporating a measure to preserve and enhance additional foraging habitat within a mile of existing TNBC reserve(s) that would be sufficient to offset the loss of habitat values due to the Greenbriar project. This mitigation also would cause additional beneficial effects because the preserved and enhanced foraging habitat would not only mitigate effects on TNBC reserves, but also could increase connectivity of habitat and of TNBC reserves.

The project would not cause effects on habitat acreage, quality, and connectivity sufficient to alter the likelihood of attaining this goal/objective. Under the future condition of the Natomas Basin resulting from the NBHCP, approximately 12,000 acres of upland habitats would remain in the Natomas Basin. To attain this goal/objective of the NBHCP, under the future condition of the NBHCP, 18% of this remaining upland habitat would need to be preserved and enhanced as part of the TNBC. The project would reduce the acreage of upland habitat in the Natomas Basin (under the future condition) by about 2.5%. To offset effects resulting from the reduction in upland acreage, the project would preserve and enhance much of another 1.7% of the upland habitats that would remain under the future condition. This land would be unavailable for the NBHCP. Thus, the Greenbriar project would reduce the upland habitat available for preservation through the NBHCP by several percent, which would not be sufficient to affect the attainment of this goal/objective.

In contrast, as described in Section 3.9, the land preserved by this project could increase opportunities to establish reserves. For example, the NBHCP has minimum size requirements for habitat blocks within the reserve system. At least two of the reserves resulting from this project (the proposed Natomas 130 and Spangler reserves) would be adjacent to or near (i.e., within a half mile or less of) existing reserves (Exhibit 5); these lands would provide opportunities additional to create larger reserves by preserving additional land connected to existing TNBC reserves and/or the project's proposed reserves. Therefore, the Greenbriar project could contribute directly to preserving, creating, and enhancing blocks of habitat of sufficient size for effective conservation of upland habitats by the NBHCP.

Overall, the project would not adversely (and could beneficially) affect this goal/objective. Because the acreage of upland habitat in the Natomas Basin that is potentially available and suitable for preservation is substantially more than the acreage of upland habitat that would be preserved and enhanced by the NBHCP, and the project would affect only a small percentage of this land, the project would not preclude the preservation of sufficient land to attain the NBHCP's goals and objectives. The project would, however, increase opportunities to establish new reserves, which would aid the attainment of this goal/objective.

6.4.2 UPLAND SPECIES/HABITAT GOAL/OBJECTIVE 2

Ensure reserve land connectivity with travel corridors for upland-dependent species. The habitat areas should encompass grasslands, agricultural croplands, riparian habitats, and shelter and nesting habitat areas (fence rows, clusters of shrubs and small trees), as well as wetland areas to provide a year-round source of water for upland species. The upland areas should be configured to enhance natural species migration, minimize species isolation, and prevent future habitat fragmentation. (NBHCP, page I-17)

A project could potentially affect attainment of this goal by affecting:

- Connectivity of habitat in the Natomas Basin,
- Connectivity of existing TNBC reserves,
- Habitat value of existing TNBC reserves, and
- Opportunities to establish additional TNBC reserves.

The Greenbriar project, with the DEIR mitigation, would affect the attainment of this goal/objective through each of these mechanisms. Beneficial effects would include the preservation, creation, and enhancement of upland habitats that contribute to the connectivity of existing TNBC reserves and of habitats, and increase opportunities to establish additional TNBC reserves. Adverse effects would include reduced foraging habitat within a mile of an existing TNBC reserve, and fragmented and reduced connectivity of upland habitats in the vicinity of the Greenbriar site. Sections 3.5–3.7 and 3.9 provide a detailed assessment of these effects.

The DEIR mitigation would reduce the project's adverse effects by incorporating a measure to preserve and enhance foraging habitat within a mile of existing TNBC reserves (or of the Swainson's hawk zone along the Sacramento River). This mitigation also would cause additional beneficial effects because the preservation and enhancement of at least an additional 49 acres of foraging habitat would not only mitigate effects on TNBC reserves, but also could increase connectivity of habitat and of TNBC reserves.

The project's proposed reserves at the Spangler and Natomas 130 sites would contribute to travel corridors connecting reserve lands. The proposed Natomas 130 site would contain upland and wetland habitats, and would be immediately adjacent to a TNBC reserve, Fisherman's Lake, and the Sacramento River (Exhibit 5). The proposed Spangler reserve would contain mainly wetland habitats, but upland habitats would be a component of the created marshes and reserve buffers, and this site is within a quarter mile of an existing reserve and would connect to habitat on buffer lands surrounding Sacramento International Airport to the south (Exhibit 5).

The proposed reserve on the Greenbriar site, along Lone Tree Canal, would contain grassland, marsh, and canal habitats managed to sustain connectivity of habitat for giant garter snake. This would also provide some benefit as a travel corridor for upland species; however, the partial isolation of the site by Elkhorn Boulevard to the north and Interstate 5 to the south would limit this benefit.

The project would, however, reduce connectivity of upland habitats adjacent to the Greenbriar site, and this could reduce dispersal and movement of upland species between reserves in the central and southern Natomas Basin. Under the future condition of the Natomas Basin resulting from the NBHCP, the Greenbriar site would be a corridor of upland habitat between the Metro Air Park and the City of Sacramento. At Interstate 5, this corridor would be about 0.4 miles wide and at the northern end of the Greenbriar site it would be almost a mile wide. The Greenbriar project would reduce this to a 250-foot wide and approximately one-mile long corridor of grassland, marsh, riparian, and canal habitats that would be preserved and managed as part of the TNBC reserve system. A moderate level of uncertainty exists regarding the attributes necessary for wildlife use of corridors, and this much narrower corridor surrounded by urban development may not be used, or may be used less frequently, by upland wildlife.

However, as described in Section 3.5, a reduction in connectivity of upland habitats at and adjacent to the Greenbriar site, would affect relatively few upland species. First, most upland species in the Natomas Basin are abundant, widely distributed and highly mobile. (The species observed during monitoring for TNBC support this characterization [Jones & Stokes 2005].) Second, Interstate 5 (which is along the entire southern border of the site), adjacent urban development, and in the future a six lane Elkhorn Boulevard along the site's northern border, limits use of the site by animals that are less mobile or are highly sensitive to human disturbance.

Based on the assessments presented in Section 4 *Potential Effects of the Greenbriar Project on Covered Species*, a reduction in connectivity of upland habitats at the Greenbriar site also would be unlikely to alter the viability of the populations of covered species using upland habitats in the Natomas Basin. Of the covered species, Swainson's hawk, burrowing owl, and loggerhead shrike all could be affected, because they probably use the Greenbriar site. These are highly mobile animals that could fly over or around the site, though they may not choose to do so, may do so less frequently, or doing so may expose them to additional risks. Development at the Greenbriar site would reduce and fragment upland habitats, and this could reduce the survival or reproduction of individuals using the site and adjacent lands. However, habitat would be enhanced and preserved along Lone Tree Canal and at the proposed reserves, and the DEIR mitigation would enhance and preserve additional upland habitat within a mile of existing TNBC reserves. This enhanced and preserved land would likely improve connectivity of upland habitats, and could increase the survival or reproduction of individuals using those sites. Also, burrowing owls and loggerhead shrikes using the Natomas Basin are part of large populations, a reduction of connectivity at the Greenbriar site would affect a very small portion of their range and numbers, and their loss of habitat would be mitigated by habitat preservation, creation, and enhancement at the proposed reserve and DEIR mitigation sites. Thus, the project is unlikely to alter the viability of populations of covered species using the Natomas Basin.

A moderate level of uncertainty exists regarding the overall effect of the Greenbriar project on this goal/objective. The proposed changes at the Greenbriar site would have an uncertain effect on the movement and dispersal of upland species; also there is some uncertainty regarding the project's contributions to connectivity elsewhere in the Basin because the location of the DEIR mitigation site has not been determined.

However, because the project would cause adverse and beneficial effects that are similar in nature and magnitude, and because it would affect only a small portion of the Basin's land area, the project would have only a small overall effect on the attainment of this goal/objective, whether it was beneficial or adverse. This effect would not alter the viability of any covered species using upland habitats, and would not necessitate any changes in the conservation strategy of the NBHCP.

7 CUMULATIVE EFFECTS

For the Greenbriar project, this section evaluates cumulative effects as defined by NEPA and ESA. In Section 7 of the Greenbriar DEIR, *Other CEQA-Required Analyses*, projects contributing to potential cumulative effects are described and the cumulative impacts of these projects, and the Greenbriar project, are analyzed. That analysis evaluates cumulative effects as defined by Section 15130 of the California Environmental Quality Act Guidelines (State CEQA Guidelines). Because that analysis addresses a range of resources and issues, it is broader and includes more detail on proposed projects than does the following analyses, which only address effects on species covered by the NBHCP.

7.1 ANALYSIS OF CUMULATIVE EFFECTS UNDER NEPA

NEPA defines cumulative impacts as those that result "from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (federal or nonfederal) or person undertakes such other actions" (40 CFR 1508.7).

7.1.1 CUMULATIVE CONTEXT

The Natomas Basin includes much of the American Basin, which is one of the nine major basins in the Central Valley. Basins are flat, low-lying areas adjacent to the natural levees that form along the major rivers. Theses basins fill with flood waters and over time they accumulate the fine sediments carried by these waters. Prior to urban development, the Natomas Basin would regularly become inundated by the winter river flows, and remain inundated for weeks to months during most years (Kelley 1989; Smith and Verrill 1996). The predominant vegetation was probably seasonal wetland with marsh growing at the lowest elevations, and riparian forest and scrub growing at higher elevations on alluvial soils near the Sacramento and American Rivers.

The City of Sacramento has developed over the past 150-plus years beginning in the late 1840s immediately following the discovery of gold. Over this time the City, and the Sacramento region, has shifted largely, though not entirely, from natural habitat to agriculture and urban development.

Reclamation of the Natomas Basin through a series of levees and drains was first attempted in the 1860s after the state created a Board of Swampland Commissioners. The Board's appointed engineer estimated that the construction of this system of levees and drains would cost only about $38,000, which was far less than the $1 per acre fee that had been established to fund such reclamation. This estimate was inaccurate and the project ran out of funds within a year, and inundation of the Natomas Basin continued. It was not until 1915 that a system of levees and drainage and irrigation canals was completed, and the Natomas Basin drained. At that time, virtually the entire basin was converted to agricultural land uses.

In the Natomas Basin, urbanization occurred much later than agricultural uses. In 1924, after almost the entire Natomas Basin had been converted to agricultural land uses, developed land uses were still almost nonexistent. There were few structures, and few roads, most of which were not paved (McClure 1925). By the 1960s, Sacramento International Airport, and major highways had been constructed, and some urban development had begun in the southern Basin, adjacent to Sacramento. Over the next 40 years, this urban development continued, primarily in the southern basin, and by 2001 approximately 21% of the Basin was occupied by developed land cover.

7.1.2 PROJECTS CONTRIBUTING TO CUMULATIVE IMPACTS

DEVELOPMENT AUTHORIZED BY THE NBHCP

The NBHCP authorized 17,500 acres of land in the Natomas Basin for development. About two-thirds of this land has yet to be developed. Once this land is developed it is projected to contain over 50,000 homes as well as a variety of other retail, commercial and industrial uses; to date, about 15,000 homes have been constructed (McCarthy and Lamb 2006). This development is occurring in three areas authorized by the NBHCP: North Natomas and Metro Air Park in Sacramento County, and the Measure M area of Sutter County. Authorized development includes projects sponsored by either private developers or public entities that occur within these permitted areas.

This development is described in more detail below, and the effects of this development have previously been analyzed in conjunction with the NBHCP (CH2M HILL 2002). Additional information on the effects caused by this development is also provided in Section 3.3 *Habitat Acreage in the Natomas Basin*, and Appendix B *Change in Natomas Basin Land Cover in 2001–2004*.

North Natomas Community Plan

Development projects in the North Natomas community that have been approved but are yet to be fully built out have been identified and evaluated by the NNCP and the associated environmental review documents prepared in compliance primarily with CEQA.

The North Natomas community is bounded by Elkhorn Boulevard to the north, I-80 to the south, the Natomas East Main Drainage Canal to the east, and the West Main Drain Canal to the west, covering more than 9,000 acres in the northwest portion of the city that was predominantly in agricultural use prior to development. The NNCP provides a long-term vision for the development of the North Natomas community. The environmental consequences from implementation of the NNCP were addressed in the 1986 NNCP EIR (certified by the Sacramento City Council in May 1986) as well as the 1993 Supplement to the 1986 NNCP EIR. Development within the NNCP started to take off in 1999.

There are several development projects that have been approved in the North Natomas community. Some of these projects are fully built-out and occupied at this juncture, while others are still in development phases. These projects are generally located to the south and east of the project site and include: the Westborough project, Cambay West, Natomas Crossing, Natomas Town Center, Panhandle, and Natomas Creek. In 2000, there were approximately 2,002 people, occupying 740 housing units in North Natomas (SACOG 2001). Currently, there are about 15,000 homes (McCarthy and Lamb 2006). At buildout (year 2016), the NNCP estimates a population of 66,495 in the North Natomas community occupying 33,257 housing units on approximately 9,038 acres, and 72,016 employees. Buildout has been rapid since approval of the NNCP and NBHCP, and this trend is expected to continue as a result of high demand for developed uses near downtown Sacramento.

Metro Air Park

In addition to development anticipated within the North Natomas community, the Metro Air Park is a newly developing project located adjacent to the Sacramento International Airport and along the westerly edge of the Greenbriar site. The Metro Air Park totals 1,983 acres and has been approved for development of approximately 20 million square feet of commercial and industrial development, and off-site infrastructure. This off-site infrastructure includes the widening of Elkhorn Boulevard along the northern border of the Greenbriar site. The project is located in an area that has historically been dominated by agricultural uses. Construction of the Metro Air Park began in September 2003.

Development within the Metro Air Park (authorized by the MAP HCP and NBHCP) will eliminate several canals connecting habitats north and south of Interstate 5, and connecting habitats from the Sacramento International Airport to Highway 99. It will eliminate the Powerline Ditch, No. 4 and 4a ditches, and Meister Canal. It also will eliminate water sources to the Airport East Ditch, and replace the open Central Main Canal with an underground pipe, and will affect habitat along Lone Tree Canal by reducing the area of land draining into Lone Tree Canal and placing urban development along one side of the canal (Thomas Reid Associates 2001, USFWS 2002).

Measure M

In 2004, Sutter County voters passed Measure M, an advisory measure intended to provide the Board of Supervisors with an indication of how the citizens of Sutter County feel about the types and level of development in the 7,500-acre area of the South Sutter County Industrial / Commercial Reserve. The southern boundary of the Measure M area forms the Sutter/Sacramento county line, approximately 4 miles north of Greenbriar. The vote did not approve any specific development proposals, but did provide guidance on how development may be viewed in the future. Measure M included potential development for the South Sutter area of the following uses:

- At least 3,600 acres for commercial/industrial development;
- At least 1,000 acres for schools, parks, other public uses, and retail; and
- No more than 2,900 acres for residential development, with a population cap of 39,000.

Applications for the Measure M area have not been submitted to Sutter County, as of December 2005, so the specifics of development proposals are not known beyond the parameters outlined above.

OTHER PROPOSED PROJECTS CONTRIBUTING TO CUMULATIVE EFFECTS

Several other projects are being planned in the Natomas Basin outside of that areas permitted for development by the NBHCP. These projects are described below.

Sacramento International Airport Development Plan

The Airport Development Plan will include the major improvements that are needed over a 20-year planning period. These improvements are safety, security, and capacity enhancement projects that will enable the Sacramento County Airport System to meet customer service goals at increased levels of activity in passengers, air cargo, and aircraft operations.

The plan is still under development; but, the Sacramento International Airport Master Plan Study (PB Aviation 2004) contains a recommended Airport Development Plan that illustrates the type, location, and scale of projects under consideration. Most projects would be within the existing Airport Operations Area (AOA) Outside of the APA, potential projects include roughly 400 acres of development (parking and commercial development) on adjacent land along Interstate 5, and roughly 500 acres of development (aviation-related and commercial development) on adjacent land to the north of the AOA.

The recommended Airport Development Plan also would eliminate several waterways, including:

- 4.4 miles of the drainage ditch north of Elverta Road,
- 2.0 miles of the drainage ditch west of Power Line Road,
- 1.0 miles of the canal adjacent to the access road west of Power Line Road, and
- 0.5 miles of the drainage ditch along Bayou Road.

Together with the elimination of canals permitted by the MAP HCP, the elimination of these waterways could further reduce connectivity of habitats within the Natomas Basin. However, the effect on connectivity would be addressed during environmental review of development projects at the airport, and avoidance, minimization, and mitigation measures would likely reduce the effect on connectivity to an insignificant level.

Sacramento Area Flood Control Levee Upgrade Project

To assess the risk of levee failure and to identify potential remedies, SAFCA commissioned the Natomas Levee Evaluation Study in 2005. This study indicated that the risk of flooding at the 100-year level was greater than previously assumed (SAFCA 2006). A variety of remedies were proposed for identified problems. Most of these remedies involve levee improvement and bank protection techniques, including construction of cutoff walls within existing levees, and placement of toe rock and revegetation of banks at locations along existing levees that pose erosion problems. These remedies would cause an estimated 8 acres of permanent habitat loss for species covered by the NBHCP (EDAW 2005).

As a potential remedy, the study also assessed constructing a secondary levee along the upper 5 miles of the east levee of the Sacramento River. This levee would be set back about 1,000 feet from the existing levee. Under this alternative the existing levee would continue to confine the river; the new levee would ensure safe containment of a 200-year flood if the existing levee were to fail. The construction of this levee would directly affect roughly 133 acres of habitat for species covered by the NBHCP. (This estimate assumes a 175-foot wide footprint and is based on additional information in SAFCA 2006, EDAW 2005.) The levee also would bisect several canals and existing TNBC reserves. The overall affect of this potential remedy on covered species also would depend on the future condition of the land between the secondary levee and the Sacramento River, and the future habitat quality of the levee slopes. The design of the secondary levee alternative has not yet been developed to this level of detail.

Natomas Mutual Water Company American Basin Fish Screen and Habitat Improvement Project (ABFSHIP)

The Natomas Mutual Water Company (Natomas Mutual) annually diverts nearly 100,000 acre feet of water from the Sacramento River and the Natomas Cross Canal and distributes that water throughout the Natomas Basin. Natomas Mutual is currently planning and designing two new diversions to replace its existing five diversions. These pumps would be located along the Sacramento River near Sankey Road and between Elverta Road and Elkhorn Road, respectively. These new diversions would retain the same pumping capacity of the existing diversions (630 cfs), plus an additional 14 cfs to accommodate the Bolen Ranch, which would then eliminate its existing, independent diversion. The new pumps, however, would be variable frequency drive pumps that would facilitate the management of water levels throughout the canal system. Other changes to the current infrastructure would include:

- Construction of a new highline canal between the proposed Sankey Diversion along the landside of the Natomas Cross Canal south Levee to the existing Northern Pumping Plant;
- Relocation and extension of the existing Vestal Drain adjacent to the new highline canal between RD 1000's Pumping Plant No. 4 and the new Sankey Diversion site;
- Decommissioning and removal of the existing Verona Diversion Dam and Lift Pumps;
- Additional capacity for the internal re-lift pumps at RD 1000 Pumping Plant No. 3 in place of the removed Riverside Pumping Plant;
- Re-grading the Riverside Main Highline Canal from RD 1000 pumping Plant No. 3 to the existing Riverside Pumping Plant;
- Upgrading of two control structures, the County Line Check and Lift Pump and the Elkhorn Check and Lift Pumps;
- Removing the five pumping plants (two along the Natomas Cross Canal and three along the Sacramento River);

- Re-grading the North Drainage Canal from the V Drain to Highway 99 in order to improve conveyance; and,

- Re-grading the Elkhorn Main Highline Canal between the existing Prichard Pumping Plant and the existing Elkhorn Pumping Plant.

The design and environmental review of these infrastructure improvements have not been completed, and thus it would be speculative and possibly misleading to assess the effects on covered species based on current information. However, many of these improvements are also being considered as part of the Sacramento River Water Reliability Study, for which we have used available information to make a rough estimate of their effects. This estimate is provided in the section below that describes the Sacramento River Water Reliability Study.

Sacramento River Water Reliability Study

The Sacramento River Water Reliability Study (SRWRS) was initiated in 2002 by the Bureau of Reclamation, Placer County Water Agency (PCWA), Sacramento Suburban Water District (SSWD), City of Roseville (Roseville), and City of Sacramento (Sacramento). Its goal is to develop a water supply plan that is consistent with the Water Forum Agreement (The Water Forum 2000). It would fulfill this goal by provide additional water supply to PCWA for planned urban growth, to SSWD for groundwater stabilization, to Roseville for planned urban growth and a local conjunctive use program, and to Sacramento for water supply reliability and wheeling services with neighboring water purveyors to meet their water supply demands and to reduce their reliance on groundwater. It also would increase the interconnectivity and source redundancy to the water supply system to maximize long-term water supply reliability.

An initial alternatives report has been prepared for this study (USBR 2005) that developed four alternatives. These alternatives are:

- **SRWS Elverta Diversion Alternative.** This alternative consists of a diversion on the Sacramento River with an associated pump station and water treatment plant, and treated water pipelines to water distribution systems of the SRWRS partners. Water pipelines would extend from the Sacramento River across the Natomas Basin along or adjacent to Elverta Road, and from Elverta Road south to the City of Sacramento. Their total length would be approximately 9 miles.

- **Joint SRWS-ABFSHIP Elverta Diversion Alternative.** This alternative consists of a consolidated diversion on the Sacramento River and associated facilities to accommodate the needs of the SRWRS partners and the NMWC from the Elkhorn Diversion planned under the ABFSHIP. Water pipelines would extend from the Sacramento River across the Natomas Basin along or adjacent to Elverta Road, and from Elverta Road south to the City of Sacramento. Their total length would be approximately 9 miles.

- **ARPS-Elverta Diversion Alternative.** This alternative consists of facility expansions by PCWA in Placer County, increased use of groundwater by Roseville, and construction of a diversion on the Sacramento River and of associated treatment and transmission facilities by Sacramento. (Under this alternative, NMWC would construct and operate its planned Elkhorn Diversion independent of the SRWRS, or continue to divert from its existing diversion.) Water pipelines would extend from the Sacramento River along or adjacent to Elverta Road for approximately 5 miles, and from Elverta Road south to the City of Sacramento. Their total length would be approximately 6.5 miles.

- **ARPS-Joint Sacramento-ABFSHIP Elverta Diversion Alternative.** This alternative would include the same facilities as the ARPS-Elverta Alternative plus additional diversion capacity and facilities at the diversion if the ABFSHIP lead agencies select the Sankey/Elkhorn Diversions alternative for the ABFSHIP. Water pipelines would extend from the Sacramento River along or adjacent to Elverta Road for approximately 5 miles, and from Elverta Road south to the City of Sacramento. Their total length would be approximately 6.5 miles.

The effects of these alternatives have been assessed qualitatively relative to each other, but have not yet been quantified. Similarly, specific designs for these pipelines have not been developed and the likely mitigation is not known. Therefore, their potential effects on existing canals, Jacob's slough are not known.

However, a rough estimate of the acreage of affected habitat can be made. Assuming a 100-foot wide corridor of habitat would be permanently eliminated along these pipelines, and that the water treatment plant and associated facilities would eliminate 100 acres of habitat, these alternatives would eliminate from 179 to 209 acres of habitat for covered species. This, however, is probably an overestimate, because the corridor of permanently eliminated habitat would probably be much less than 100 feet wide, particularly if pipelines follow existing roads, which may be the case for most of their length.

Downtown Sacramento-North Natomas-Airport Light Rail Line

Since the early 1990s, the Sacramento Regional Transit District has been considering a light rail line that would connect downtown Sacramento, North Natomas, and the Sacramento International Airport (SACOG 2000). The route proposed for this rail line would pass through areas permitted for development in North Natomas, cross the Greenbriar site, the Metro Air Park, and then run along Interstate 5, and enter the Sacramento International Airport. This project would affect only a small area of habitat for covered species because most of this route is within existing development, areas permitted for development by the NBHCP, or the likely footprint of other proposed projects.

Assuming a 100-foot wide corridor of habitat was lost along this route, the project would eliminate roughly 21 acres outside of areas permitted for development by the NBHCP. About half of this acreage (10 acres) would be on the Greenbriar site, and a portion of the remainder may be within areas considered for development under the recommended Airport Development Plan for Sacramento International Airport (PB Aviation 2004).

Because this rail line has not been designed nor has any environmental review been performed, it is not known what the effects on canals and connectivity would be. Based on the general location of the proposed route, however, these effects appear to be limited. At the Greenbriar site, the rail line would cross Lone Tree Canal on the Meister Way Road crossing proposed by the Greenbriar project. On the north side of Interstate 5 between MAP and Sacramento International Airport, the only canal is adjacent to the off ramp from the interstate, and this canal is currently unsuitable as habitat for giant garter snake.

West Lakeside

An application for development within the Joint Vision area is on file for the West Lakeside project. No other applications for the Joint Vision area have been filed and its future development potential is in its early consideration stage by the City and County. As such, development of the Joint Vision is considered separately in this analysis. The West Lakeside project is a proposal located approximately 0.25 mile south of the project site adjacent to the eastern border of West Main Drain Canal. This project would develop 133 acres resulting in 524 residential units, a 10-acre elementary school, and approximately 33 acres of open space land uses (e.g., parks and detention basins). Thus, this project could eliminate up to 133 acres of habitat for species covered by the NBHCP. These effects could include habitat along canals that subsequently drain in to the West Drainage Canal.

FUTURE POTENTIAL CUMULATIVE PROJECT: CITY/COUNTY JOINT VISION

Joint Vision

The Joint Vision Plan is a collaborative effort between the City and County of Sacramento to develop a vision for the 10,000-acre area of the County between the northern city limits and Sutter County. Concepts for development have been considered and include a mixture of residential densities, an industrial park (in addition to Metro Air Park), and open spaces throughout, including most extensively in the northern extent separating development from the Sutter County boundary. In fact, a large amount of open space is anticipated to be dedicated (for habitat

preservation and farmland retention) in this area. To date, no land use plans have been adopted, and all considerations to date have been conceptual.

The ultimate development scenario that will be proposed for the Joint Vision area is not known and likely will not be known within the time that this analysis and development are being considered. However, because the development potential of the area is large and it is being actively studied, the Greenbriar EIR and this analysis includes disclosure of the plan to the extent it can be known. It is considered as future potential cumulative development, and because this is a speculative development proposal at this time, it is considered separately and less extensively than the cumulative development that is currently planned and proposed (i.e., specific development proposals have been submitted). The Joint Vision plan will be the subject of extensive CEQA review and consideration by the City and County, neighboring jurisdictions, regulatory agencies including DFG and USFWS, local service providers and the Sacramento County Local Agency Formation Commission (LAFCO), and its likely implementation is best described as unknown.

Cumulative Effects of Proposed and Potential Projects

Because the extent of habitat prior to conversion to agriculture is unknown, and the location and design of proposed projects has not been fully determined, the total percentage reduction in habitat acreage for covered species cannot be calculated. But, the percentage of the Natomas Basin that has been converted to developed land uses provides a rough approximation of the percentage of habitat for covered species that has been lost.

In 2001, 21% (11,243 acres) of the Basin was in developed uses. By 2004, developed land cover had increased to 24% (12,849 acres). Under the future condition permitted by the NBHCP, 50% (26,769 acres) of the Natomas Basin would be developed or otherwise unsuitable for providing habitat for covered species (e.g., canals and open space inside urban areas). Estimated changes in habitat acreage from 2001 to this future condition are provided by CH2M HILL (2002) and in Section 3.3 *Habitat Acreage in the Natomas Basin*.

In addition to the development permitted by the NBHCP, other projects proposed in the Natomas Basin (and described in the section *Other Proposed Projects Contributing to Cumulative Effects*) would increase the extent of developed land cover in the Natomas Basin (Table 7-1). These projects would likely increase developed land cover from 50% (26,769 acres) of the Natomas Basin (under the NBHCP) to 51.8–52.1% (27,733–27,893 acres) of the Natomas Basin. With the Greenbriar project, this change would increase to 52.9– 53.2% (28,322–28,482 acres).

Concurrent with this change in developed land cover, would be an increase in the area preserved and managed for covered species. Assuming that the mitigation ratio for the proposed projects would be between 0.5 and 3 acres preserved for each acre developed, the extent of preserved habitat would increase from 16% (8,566 acres) of the Natomas Basin under the NBHCP to 17.5–24.2% (9,369–12,956 acres) with mitigation land from the additional proposed projects (not including the Greenbriar project). With the additional proposed projects and the Greenbriar project, the portion of the Natomas Basin preserved as habitat for covered species would be 18.3– 25.0% (9,797–13,385 acres).

Because design, and even the location, of some proposed projects has not been determined, and the quantity, location, and type of mitigation land (e.g., agricultural land, managed marsh) are not known, detailed assessments of their effects on habitat for each covered species would be somewhat speculative, and possibly misleading.

It is important to note that proposed projects would be required to comply with the federal Endangered Species Act and the California Endangered Species Act. Both of these acts require that impacts to endangered species are minimized and fully mitigated. This minimization and mitigation would lessen the impacts of the proposed projects on biological resources, to the extent that they are not considerable. These projects, therefore, would not be expected to contribute substantially to a cumulatively significant impact on these biological resources.

Table 7-1
Potential Loss of Agricultural and Natural Vegetation Due to Additional Proposed Projects[1, 2]

Project	Acres[3]	Notes
Sacramento International Airport Development Plan	900	Based on recommended Airport Development Plan in the Sacramento International Airport Master Plan; does not include drainage and stormwater projects outside of development areas.
Sacramento Area Flood Control Levee Upgrade Project	8–133	Based on project description in SAFCA 2006, supplemental information in EDAW 2005, and an assumed 175-foot wide footprint for the secondary levee considered as an alternative in this project.
Natomas Mutual Company American Basin Fish Screen and Habitat Improvement Project (ABFSHIP)	—	Most components of this project were included in the acreages estimated for the Sacramento River Water Reliability Study.
Sacramento River Water Reliability Study	179–209	Based on USBR 2005, and an assumption of a 100-foot wide corridor of permanent habitat loss along pipelines, and 100 acres of habitat loss due to facilities at diversions.
Downtown Sacramento-North Natomas-Airport Light Rail Line	21	Based on SACOG 2000, and an assumed 100-foot wide corridor of permanent habitat loss along sections of the route outside of areas permitted for development by the NBHCP or under consideration for development by Sacramento International Airport.
West Lakeside	133	Acreage is the proposed project footprint.
Subtotal	1,241–1,396	
Greenbriar	546	This is the acreage of the Greenbriar site minus the 30.6 acre preserve proposed along Lone Tree Canal
Total	1,794–1,949	

Notes:
[1] – Proposed projects outside of areas authorized for development by the NBHCP.
[2] – Proposed projects do not include the Joint Vision, which was considered a potential proposed project.
[3] – Permanent loss of agricultural and natural vegetation based on estimates of project footprints.

Similarly, the Greenbriar project also must minimize and fully mitigate impacts to biological resources to comply with the federal Endangered Species Act and California Endangered Species Act. Because this minimization and mitigation would lessen the Greenbriar project's impacts on biological resources, to the extent that they are not considerable, the Greenbriar project would not contribute substantially to a cumulatively significant impact on these biological resources.

In addition to the development authorized by the NBHCP and additional proposed projects, the development in the Joint Vision area represents a potential proposed project. Development within the Joint Vision area could result in the conversion of several thousand acres of open space land that provides various levels of habitat for Swainson's hawk, giant garter snake, and other species that are currently covered by the NBHCP. It would create a landscape in which it would be more difficult to maintain connectivity among TNBC reserves and to sustain the habitat quality of TNBC reserves. It also would create the need to preserve most other privately owned agricultural land in the Natomas Basin as mitigation for species covered by the NBHCP.

It is very likely, and expected, that any development within this area would require a new habitat conservation plan, consistent with the federal Endangered Species Act and the California Endangered Species Act. As stated above, compliance with these laws requires that impacts to endangered species are minimized and fully mitigated.

However, it must be recognized that this level of additional development would be expected to have residual environmental impacts to the various species in the area.

While the extent of potential mitigation for development within this area is not currently known, there is the potential that mitigating all of the effects of the Joint Vision on populations of covered species in the Natomas Basin may not be feasible, and some other means of mitigation could be proposed for consideration. For example, sufficient land may not be available in the Natomas Basin to preserve and enhance as mitigation for the effects of developing the Joint Vision, and out of basin mitigation could be proposed for consideration. However, this possibility is entirely speculative and cannot be evaluated until development of the Joint Vision area is actually proposed. To date, and as described above, there are no formal proposals for development of the Joint Vision area, and there are no proposals to consider for mitigation of species under the ESA or CESA.

7.2 CUMULATIVE EFFECTS UNDER ESA

For the purposes of Federal Endangered Species Act compliance, cumulative effects include the effects of future state, tribal, or private actions that are reasonably certain to occur in the action area considered in this biological opinion (USFWS and NMFS 1998). Future Federal actions that are unrelated to the proposed action are not considered because they require separate consultation pursuant to Section 7 of the Endangered Species Act. In addition, once the Section 7 consultation for a Section 10(a)(1)(B) permit has been completed, non-Federal proposals for development within that Section 10(a)(1)(B) planning area are considered part of the environmental baseline for future consultations. Therefore, for this analysis of cumulative effects, as defined for the Endangered Species Act, development projects within those portions of the Natomas Basin that were authorized for development by the NBHCP are considered part of the environmental baseline. The other currently planned and proposed projects described in the cumulative effects analysis in the Greenbriar DEIR and in the NEPA cumulative effects analysis (presented in the preceding section) will require Federal actions and therefore are also not considered in this ESA cumulative effects analysis. (For example, these potential future projects would require a permit to fill wetlands under Section 404 of the Clean Water Act.)

An undetermined number of future State or private actions could occur in the Natomas Basin without a 404 permit to fill wetlands or an ITP through Section 10 of the ESA. Future state or private actions that could potentially affect species covered by the NBHCP include actions that affect:

- herbicide or pesticide applications,
- vegetation management along canals or drains,
- agricultural practices (including crop types cultivated, and fallowing or abandonment of land),
- discharge of contaminants into waterways,
- presence of humans along waterways or on agricultural lands,
- canal flow regimes, or
- traffic levels on local roads.

All of these activities can degrade habitat or cause the injury or death of covered species. Changes in these activities can be caused by state and private actions on agricultural lands. Such changes regularly occur, for example, in response to market conditions and new technologies. For example, the recent increase in water prices in the Natomas Basin is likely to result in changes in crop acreages in the Natomas Basin. Also, in anticipation of development, rice may be fallowed (although land use changes during 2001-2004 do not indicate this has occurred during that time period [Appendix B]). However, attempting to predict the changes in agricultural practices that are likely to occur in the Natomas Basin over long periods of time, and their consequences for species covered by the NBHCP, would be speculation.

Similarly, numerous state and private actions in developed areas also could affect covered species through the same set of mechanisms (herbicide or pesticide applications, vegetation management along canals or drains, etc.), and not all of these actions would involve a federal action and future consultation under Section 7 of the ESA.

Yet, attempting to predict the changes in activities in developed areas that are likely to occur in the Natomas Basin, and their consequences for species covered by the NBHCP, also would be speculation. We are not aware of any state or private actions (for which there is no related federal actions) that are reasonably certain to occur in developed areas of the Natomas Basin and whose effects will significantly affect covered species.

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Appendix A

Assessment of Avoidance and Minimization of Construction-Related Effects and Human Wildlife Conflicts

APPENDIX A
ASSESSMENT OF AVOIDANCE AND MINIMIZATION OF CONSTRUCTION-RELATED EFFECTS AND HUMAN-WILDLIFE CONFLICTS

The effects analysis evaluates the overall effect of the Greenbriar project on the viability of species covered by the NBHCP, on the effectiveness of the NBHCP conservation strategy, and on the attainment of the goals and objectives of the NBHCP. As part of that evaluation, this appendix evaluates the effectiveness and completeness of the Greenbriar project's avoidance and minimization measures.

The NBHCP includes a goal and objective that address avoidance and minimization of direct impacts and of human wildlife conflicts. These are listed below.

Overall Goal 4. Ensure that direct impacts of Authorized Development upon Covered Species are avoided or minimized to the maximum extent practicable. (NBHCP, page I-16)

Overall Objective 1. Minimize conflicts between wildlife and human activities, including conflicts resulting from airplane traffic, roads and automobile traffic, predation by domestic pets, and harassment by people. (NBHCP, page I-16).

To attain this goal and this objective, the NBHCP includes a set of avoidance and minimization measures to be implemented where applicable. For these measures, we assessed the effects of the Greenbriar Project on their effectiveness as avoidance and minimization measures for activities covered by the NBHCP. We also used this set of measures from the NBHCP to assess the effectiveness and completeness of the Greenbriar project's avoidance and minimization measures.

EFFECTIVENESS OF NBHCP MEASURES WITH THE GREENBRIAR PROJECT

For each of the NBHCP's land use agency's conservation measures, the potential for the Greenbriar project to reduce the measure's effectiveness as a means of avoiding or minimizing construction-related effects or human-wildlife conflicts was evaluated. The Greenbriar project would not alter the effectiveness of any of these measures. Most of these NBHCP measures are seasonal avoidance or exclusion zone measures based on the ecology of the species and the nature of construction activities. Because no individual construction project alters this basis, there are few means by which one construction project could affect the effectiveness of these measures. For example, the effectiveness of pre-construction surveys for a particular species is largely unaffected by the extent or location of development. Similarly, the effectiveness of requiring that developers consult with the USFWS regarding covered species observed during preconstruction surveys also is unaffected by development on other sites. Similarly, the ability to apply these measures to a development project in general would not be altered by the effects of another development project.

It is possible, however, that by fragmenting habitat, a development project can create barriers to animal movement to and from a future development site. In this instance, the effectiveness measures that reduce construction-caused mortality by allowing animals to leave construction sites would likely be reduced because animals may no longer be able to move to habitat outside of the construction site. For example, NBHCP measures 3 and 7 are intended to increases the movement of giant garter snakes off of construction sites. If a construction site is isolated from other giant garter snake habitat, these measures would be ineffective. The Greenbriar project is not more likely to cause this set of circumstances than are projects permitted by the NBHCP. The Greenbriar site is isolated from the development authorized by the NBHCP by Interstate 5 and SR 99, and development of the Greenbriar site

therefore would not reduce the connectivity of areas authorized for development by the NBHCP to habitat in the remainder of the Natomas Basin.

The assessment of all of the land use agency's conservation measures of the NBHCP is summarized below.

MEASURES FOR PRE-CONSTRUCTION SURVEYS

The effectiveness of pre-construction surveys is based on each species' ecology and on the attributes of the site being surveyed and the biologist's conduct of the survey. The Greenbriar project would not affect this basis of the effectiveness of pre-construction surveys, nor would it affect the ability to implement pre-construction surveys for development authorized by the NBHCP.

MEASURE FOR PRESERVATION OF THE AREA ADJACENT TO FISHERMAN'S LAKE

This measure consists of the City agreeing to initiate a North Natomas Community Plan amendment to potentially widen the agricultural buffer along the City side of Fisherman's lake to 800 feet wide. The Greenbriar site is not in or adjacent to this zone. The project would, however, preserve the Natomas 130 site, which is in and adjacent to this zone. The preservation of the Natomas 130 site is unlikely to affect the City's initiation of an amendment to potentially widen an agricultural buffer along Fisherman's Lake. The project also would not otherwise affect the City's initiation of an amendment to potentially widen an agricultural buffer at this site.

GENERAL MEASURES TO MINIMIZE TAKE

The NBHCP includes four general measures to minimize take. These measures are to 1) protect large trees, 2) incorporate native plants into buffers, developed areas and parks, 3) schedule construction activities to avoid the raptor nesting season, and 4) conduct pre-construction surveys at an appropriate time of year. The Greenbriar project would not affect the ability to implement these measures. But, development at the Greenbriar site might affect the habitat value of protected trees or native vegetation incorporated into landscaping.

In general, additional development could affect the value for wildlife of preserved trees and natural vegetation incorporated into landscaping by increasing the isolation of these features from natural or agricultural vegetation that provides habitat. To do so, additional development would have to reduce connectivity between the preserved tree or native vegetation inside a developed area and habitat outside of the developed area. Because Interstate 5 and SR 99 already separate the Greenbriar site from the City of Sacramento, this potential effect would be limited to possible consequences for Swainson's hawks nesting in a preserved tree within the City of Sacramento adjacent to the Greenbriar site. While this effect is conceivable, no Swainson's hawk nests are known within 1 mile to the east of the Greenbriar site, and a future nest in this portion of the City of Sacramento, while possible is unlikely and would not have limited access to foraging habitat even if the Greenbriar site remained undeveloped.

Conversely, the Greenbriar project's preservation, enhancement, and restoration of the Natomas 130 and Spangler sites, which are adjacent to areas authorized for development under the NBHCP, could increase the effectiveness of the measures to preserve large trees in developed areas and to incorporate native vegetation into buffers and landscaping. Because trees may not be preserved and native species may not be planted in the vicinity of these sites, this effect may not occur.

MEASURES TO MINIMIZE TAKE OF VERNAL POOL SPECIES

The Greenbriar project would not affect vernal pool habitat, is not near vernal pool habitat, and would not affect the ability to implement the measures in the NBHCP. Therefore, the Greenbriar project would not alter the effectiveness of measures for minimizing the take of vernal pool-associated species or alter the effectiveness of these measures.

MEASURES TO REDUCE TAKE FOR INDIVIDUAL SPECIES

MEASURES TO REDUCE TAKE OF GIANT GARTER SNAKE

The NBHCP includes twelve measures to reduce take of giant garter snake by construction activities. Construction of the Greenbriar project will not reduce the effectiveness of these measures at sites authorized for development by the NBHCP. These measures include a seasonal restriction on site preparation and grading, preconstruction surveys, dewatering of canals prior to excavation, minimization of grading, construction monitoring, a restriction on the use of materials that could entangle giant garter snakes, and measures for fences and barriers along the North Drainage Canal and the East Drainage Canal to restrict the movement of giant garter snake into adjacent development.

The effectiveness of seasonal restrictions, preconstruction surveys and of restrictions on materials that could entangle snakes are based on the ecology of giant garter snakes, site attributes, how the conduct of the survey is conducted, and the nature of construction activities. Individual construction projects, including the Greenbriar project, would not alter this basis, or otherwise affect the effectiveness of these measures.

Measures for dewatering of canals or to cease development if a construction monitor locates a giant garter snake on-site also, in general would not be affected by other development projects. But, if another development project were to fragment habitat and thus reduce the ability of a snake to move from a construction site to suitable habitat off-site, then the effectiveness of these measures would be reduced. The Greenbriar project is not likely to cause this situation for development projects authorized by the NBHCP. The Greenbriar site is isolated from the development authorized by the NBHCP by I-5 and SR 99, and development of the Greenbriar site therefore would not reduce the connectivity of areas authorized for development by the NBHCP to habitat in the remainder of the Natomas Basin. Thus, the effectiveness of these measures would not be reduced.

The Greenbriar site is not adjacent to the North Drainage Canal or the East Drainage Canal. Therefore, it is unlikely to affect the effectiveness of measures for fences and barriers along these waterways.

MEASURES TO REDUCE TAKE OF SWAINSON'S HAWK

The NBHCP includes a measure to reduce cumulative effects on Swainson's hawk foraging habitat, five measures to reduce disturbance of nest trees, and seven measures to prevent or mitigate the loss of nest trees.

The measure to reduce cumulative effects established a 1 mile-wide Swainson's hawk zone along the Sacramento River along within which there would be no development. This zone was established because Swainson hawk nests are concentrated along the Sacramento River. The Greenbriar project is not in or adjacent to this zone, and thus it would not alter its effectiveness.

The measures to reduce disturbance of nest trees are based on the ecology of Swainson's hawk and the nature of construction activities; this basis would not be altered by the Greenbriar project. The Greenbriar project also would not affect the ability to implement these measures.

MEASURES TO REDUCE TAKE TO VALLEY ELDERBERRY LONGHORN BEETLE (VELB)

These measures include the avoidance of VELB habitat, and measures for the transplanting of elderberry bushes and for the planting and monitoring of elderberry bushes. The Greenbriar project would not affect the ability to avoid, transplant, plant, or monitor elderberry bushes, nor would it affect the effectiveness of those measures for reducing the take of VELB. (The project does not affect VELB habitat except for preserving a small area of land [at the Natomas 130 site] at which planting or natural establishment of elderberry could provide suitable habitat for VELB at a desirable location.)

MEASURES TO REDUCE TAKE ON TRICOLORED BLACKBIRD

Measures for pre-construction surveys and exclusion zones around nesting colonies are included in the NBHCP as measures to reduce the take of tricolored blackbird. The Greenbriar project would not affect the ability to conduct pre-construction surveys or establish exclusion zones at construction sites in areas that were authorized for development by the NBHCP.

MEASURES TO REDUCE TAKE ON ALEUTIAN CANADA GOOSE

Measures for pre-construction surveys and consultation with USFWS and CDFG (if Aleutian Canada goose is present) are included in the NBHCP as measures to reduce the take of Aleutian Canada goose. The Greenbriar project would not affect the ability to conduct pre-construction surveys at construction sites in areas that were authorized for development by the NBHCP or to consult with USFWS or CDFG if Aleutian Canada goose is present.

MEASURES TO REDUCE TAKE ON WHITE-FACED IBIS

Measures for pre-construction surveys and a seasonal restriction on construction activities within a ¼ mile of active nests were included in the NBHCP. The Greenbriar project would not affect the ability to conduct pre-construction surveys at construction sites in areas that were authorized for development by the NBHCP or to seasonally restrict construction at sites authorized for development by the NBHCP.

MEASURES TO REDUCE TAKE ON LOGGERHEAD SHRIKE

Measures for pre-construction surveys and exclusion zones around active nests are included in the NBHCP as measures to reduce the take of loggerhead shrike. The Greenbriar project would not affect the ability to conduct pre-construction surveys or establish exclusion zones at construction sites in areas that were authorized for development by the NBHCP.

MEASURES TO REDUCE TAKE OF BURROWING OWL

Several measures to reduce the take of burrowing owls are included in the NBHCP. These measures include, pre-construction surveys, establishment of exclusion zones, seasonal restrictions on the disturbance of occupied nests, relocation of owls, and mitigation for disturbed nests. The Greenbriar project would not affect the ability to conduct preconstruction surveys, restrict activities, or establish exclusion zones at construction sites in areas that were authorized for development by the NBHCP. The Greenbriar project also would not affect the feasibility or potential benefits of relocating owls or of mitigating effects on burrowing owls. Therefore, the Greenbriar project would not affect the effectiveness of measures for reducing the take of burrowing owl.

MEASURES TO REDUCE TAKE ON BANK SWALLOW

Pre-construction surveys and establishment of an exclusion zone (if a bank swallow colony is present) are included in the NBHCP as measures to reduce the take of bank swallow. The Greenbriar project would not affect the ability to conduct pre-construction surveys or establish exclusion zones at construction sites in areas that were authorized for development by the NBHCP.

MEASURES TO REDUCE TAKE ON NORTHWESTERN POND TURTLE

The only measure included in the NBHCP to reduce take of northwestern pond turtle is the canal dewatering requirement that was included for giant garter snake. The Greenbriar project would not affect the dewatering of canals in areas authorized for development by the NBHCP, or the ability of animals to move from dewatered canals to suitable habitat off-site. (The Greenbriar site is only directly connected to areas authorized for

development through the Lone Tree Canal crossing of I-5, and the ability of turtles to use this crossing and to move up Lone Tree Canal would not be reduced by the Greenbriar project.)

MEASURES TO REDUCE TAKE ON CALIFORNIA TIGER SALAMANDER

The Greenbriar project would not affect California tiger salamander habitat, is not near California tiger salamander habitat, and would not affect the ability to implement the measures in the NBHCP. Therefore, the Greenbriar project would not alter the effectiveness of measures for minimizing the take of California tiger salamander.

MEASURES TO REDUCE TAKE ON WESTERN SPADEFOOT TOAD

The Greenbriar project would not affect western spadefoot toad habitat, is not near western spadefoot toad habitat, and would not affect the ability to implement the measures in the NBHCP. Therefore, the Greenbriar project would not alter the ability to implement measures for minimizing the take of western spadefoot toad.

MEASURES TO REDUCE TAKE OF VERNAL POOL FAIRY SHRIMP, VERNAL POOL TADPOLE SHRIMP, AND MIDVALLEY FAIRY SHRIMP

The Greenbriar project would not affect habitat for these branchiopod species, is not near habitat for these branchiopod species, and would not affect the ability to implement the measures in the NBHCP. Therefore, the Greenbriar project would not alter the effectiveness of measures for minimizing the take of vernal pool fairy shrimp, vernal pool tadpole shrimp, and midvalley fairy shrimp.

MEASURES TO REDUCE TAKE OF DELTA TULE PEA

The NBHCP includes a pre-construction survey and the opportunity to transplant any Delta tule pea located during the survey as measures to reduce take of Delta tule pea. The Greenbriar project would not affect the ability to conduct pre-construction surveys of sites authorized for development by the NBHCP, or to transplant Delta tule pea to suitable habitat elsewhere. Therefore, the Greenbriar project would not affect the effectiveness of these measures at reducing take of Delta tule pea.

MEASURES TO REDUCE TAKE ON SANFORD'S ARROWHEAD

The NBHCP includes a pre-construction survey and the opportunity to transplant any Delta tule pea located during the survey as measures to reduce take of Sanford's arrowhead. The Greenbriar project would not affect the ability to conduct pre-construction surveys of sites authorized for development by the NBHCP, or to transplant Sanford's arrowhead to suitable habitat elsewhere. Therefore, the Greenbriar project would not affect the effectiveness of these measures at reducing take of Sanford's arrowhead.

MEASURES TO REDUCE TAKE ON BOGGS LAKE HEDGE-HYSSOP, SACRAMENTO ORCUTT GRASS, SLENDER ORCUTT GRASS, COLUSA GRASS, AND LEGENERE

The Greenbriar project would not affect habitat for these vernal pool-associated plant species, is not near vernal pool habitat, and would not affect the ability to implement the measures in the NBHCP for minimizing the take of these species. Therefore, the Greenbriar project would not alter the effectiveness of these measures.

ASSESSMENT OF AVOIDANCE AND MINIMIZATION BY THE GREENBRIAR PROJECT

For this assessment, the avoidance and minimization measures in the NBHCP were considered a comprehensive set of effective measures to avoid and minimize the construction-related effects and human-wildlife conflicts potentially resulting from the NBHCP.

Development at the Greenbriar site is comparable to the development permitted by the NBHCP, and the construction-related effects and human-wildlife conflicts potentially caused by the Greenbriar are the same as those potentially caused by the development permitted by the NBHCP.

Therefore, for comparable effects potentially caused by the Greenbriar project, incorporation of the applicable measures from the NBHCP was considered to be avoidance and minimization to the maximum extent practicable. The NBHCP's avoidance and minimization measures related to development were reviewed to determine the measures that were applicable to the Greenbriar project, and if the measure or a comparable (but more specific or stringent) measure was incorporated into the Draft Environmental Impact Report (DEIR). All applicable measures (or comparable but more stringent measures) were incorporated into the DEIR. The results of this assessment are summarized in Table A-1.

In addition, the Greenbriar project could cause other effects that differ from those addressed by the avoidance and minimization measures of the NBHCP. These effects are the construction and human-wildlife conflict-related effects on giant garter snakes and giant garter snake habitat along Lone Tree Canal. Avoiding and minimizing these effects to the maximum extent practicable requires measures in addition to the applicable measures from the NBHCP. The DEIR mitigation for the Greenbriar project contains a comprehensive set of such measures to avoid, minimize, and mitigate human disturbance and other related effects on giant garter snake use of Lone Tree Canal. These measures include:

a. To ensure that the project does not diminish habitat connectivity for giant garter snake between the southwest and northwest zones identified in the NBHCP, approximately 30.6 acres along Lone Tree Canal shall be protected and managed as giant garter snake habitat. This on-site habitat preservation shall protect an approximately 250-foot wide corridor of giant garter snake habitat that includes the canal and approximately 200 feet of adjacent uplands. Uplands within the linear open space/buffer area shall be managed as perennial grassland as described below. Additional aquatic habitat for giant garter snake shall be created along the east bank of Lone Tree Canal by construction and maintenance of a 2.7 acre tule bench. The habitat shall be managed in perpetuity as high-quality habitat for giant garter snake. Compliance and biological effectiveness monitoring shall be performed and annual monitoring reports prepared within six months of completion of monitoring for any given year. This monitoring, reporting, and adaptive management shall be performed as described in Section IV of the NBHCP.

b. To ensure that the project does not diminish giant garter snake movement along Lone Tree Canal, all new road crossings of Lone Tree Canal shall be designed to minimize obstacles to giant garter snake movement. The use of culverts under new road crossings on Lone Tree Canal shall be prohibited unless it can be demonstrated that the culverts will not diminish the potential for giant garter snake movement through the section of Lone Tree Canal protected by the setback fence and conservation easement. .

c. Upland giant garter snake habitat within the Lone Tree Canal linear open space/buffer area shall be created and managed to provide cover, basking areas, and refugia during the winter dormant period. Hibernaculae would be constructed at regular intervals by embedding concrete or coarse rock in the bank or in a berm along the Lone Tree Canal corridor to provide additional winter refugia. Upland habitat with the linear open space/buffer areas shall be converted to native perennial grassland and managed, in perpetuity, as perennial grassland habitat.

d. Aquatic habitat shall be maintained throughout the giant garter snake active season in Lone Tree Canal, in perpetuity. This is the legal responsibility and obligation of Metro Air Park property owners (MAP). The MAP HCP includes provisions for maintaining water in the canal such that the basic habitat requirements of the giant garter snake are met. The MAP HCP also provides a road map, through "Changed Circumstances", to address procedures to follow if water is not being maintained in the canal to meet these requirements. As described in the MAP HCP, the MAP is legally obligated to assure these requirements are met, and financial and procedural mechanisms are included in the MAP HCP to enforce this. It is, therefore, assumed that MAP

will provide water to Lone Tree Canal, as required by the MAP HCP and ITP, in perpetuity. It is also assumed that USFWS will use all reasonable means available to it, to enforce this MAP HCP requirement. If water is not provided to Lone Tree Canal by the MAP to meet the habitat requirements of giant garter snake, as required by the MAP HCP, and USFWS exhausts its enforcement responsibilities, the project applicant shall assume the responsibility of providing suitable giant garter snake aquatic habitat throughout the section of Lone Tree Canal protected by the fence and conservation easement. However, as stated herein, the project applicant shall only assume this responsibility if it has been sufficiently demonstrated to the City that USFWS has exhausted all reasonable means to compel MAP to comply with the relevant conditions of the MAP ITP. Specific requirements related to ensuring suitable aquatic habitat in Lone Tree Canal is present, in perpetuity, throughout the giant garter snake active season shall be developed through consultation with DFG and USFWS, and included in the new or amended HCP for Greenbriar, and may include mechanisms, such as installation of a well, to assure water is provided in the canal to meet habitat requirements.

e. A barrier shall be installed between the giant garter snake habitat linear open space/buffer area and the adjacent Greenbriar development to ensure that giant garter snakes do not enter the development area, and to prohibit humans and pets from entering the giant garter snake habitat. The design of this barrier shall be subject to USFWS and CDFG review and approval. The entire length of the barrier, which shall be bordered by yards rather than roadways, shall be maintained on the preserve side by a nonprofit land trust to ensure that vegetation or debris does not accumulate near the barrier and provide opportunities for wildlife and pets to climb over the barrier. On the development side, Covenants, Codes and Restrictions (CCRs) shall prohibit accumulation of vegetation or debris adjacent to the barrier. Chain link fencing shall be placed at both ends of the corridor, with locked gates permitting entry only by RD 1000 and NMWD for channel maintenance, and by the preserve manager for habitat monitoring and maintenance purposes.

f. Specific requirements associated with the barrier shall be developed through consultation with USFWS and DFG, and may include the following and/or other specifications that DFG and USFWS consider to be equally or more effective:

   - Adequate height and below-ground depth to prevent snakes or burrowing mammals from providing a through-route for snakes by establishing burrows from one side to the other crossing;
   - Constructed using extruded concrete or block construction extending a minimum of 36-inches above ground level;
   - Maintenance to repair the barrier and to prevent the establishment of vegetation or collection of debris that could provide snakes with a climbing surface allowing them to breech the barrier;
   - A cap or lip extending at least two-inches beyond the barrier's vertical edge to prevent snakes from gaining access along the barrier's top edge; and
   - Signage to discourage humans and their pets from entering the area.

g. The Lone Tree Canal linear open space/buffer area shall be protected in perpetuity under a conservation easement and managed to sustain the value of this area for giant garter snake habitat connectivity. Compliance and biological effectiveness monitoring shall be performed and annual monitoring reports prepared. This monitoring, reporting, and adaptive management shall be performed as described in Section IV of the NBHCP or following procedures developed in formal consultation with USFWS and DFG and contained in an ESA Incidental Take Permit for the Greenbriar project.

The need for, and purpose and effectiveness of, these additional measures are described in Section 3.5 *Connectivity of Habitat in the Natomas Basin* and in Section 4.1 *Giant Garter Snake*.

Table A-1
Inclusion of NBHCP Measures to Reduce Construction-related Effects and Human-Wildlife Conflicts in the Greenbriar Project or the DEIR Mitigation for the Project

Natomas Basin HCP Measure	Applicability	Inclusion	Rationale
1. Pre-construction Surveys (p V-1) shall be conducted not less than 30 days or more than 6 months prior to commencement of construction activities, to determine the status and presence of, and likely impacts to, all Covered Species on the site. Pre-construction surveys for an individual species may be completed up to one year in advance if the sole period for reliable detection of that species is between May 1 and December 31.	Applicable	Included	Comparable and more stringent measures have been included in the mitigation proposed in the project's DEIR for each species with potential to occur on-site.
2. Preservation of the Area Adjacent to Fisherman's Lake (p V-2): Pursuant to the Settlement Agreement, the City has agreed to initiate a North Natomas Community Plan amendment to potentially widen the agricultural buffer along the City side of Fisherman's lake to 800 feet wide.	N/A		This measure is specific to locations outside the project area.
3. General Measures to Minimize Take (p V-3)			
a. Tree Preservation: Valley oaks and other large trees should be preserved whenever possible. Preserve and restore stands of riparian trees used by Swainson's hawks and other animals for nesting, particularly adjacent to Fisherman's Lake.	N/A	Included	The Greenbriar site currently has not large trees.
b. Native Plants: Improve the wildlife value of landscaped parks, buffers, and developed areas by planting trees and shrubs which are native to the Natomas Basin and therefore are used by native animals.	Applicable	Included	The NBHCP measure has been included in the mitigation proposed in the project's DEIR.
c. Protect Raptor Nests: Avoid the raptor nesting season when scheduling construction near nests. Specific avoidance criteria are set forth in the species specific measures later in this chapter.	Applicable	Included	The NBHCP measure has been included in the mitigation proposed in the project's DEIR.
d. Protected Plant/Animal Species, also referred to as "Special Status Species": Search for protected plant species during flowering season prior to construction and protected animal species during the appropriate season.	Applicable	Included	Comparable and more specific measures have been included in the mitigation proposed in the project's DEIR for each species with potential to occur on-site.
4. Measures to Minimize Take of Vernal Pool Species (p V-3)	N/A		No vernal pool habitat exists on site.
a. General Biological Survey and Information Required (p V-4): In the event a biological reconnaissance survey or the pre-construction survey identifies that vernal pool resources are on-site, a vernal pool species specific biological assessment must be provided during the appropriate season (as established by USFWS) to determine the type	N/A		No vernal pool habitat exists on site.

Table A-1
Inclusion of NBHCP Measures to Reduce Construction-related Effects and Human-Wildlife Conflicts in the Greenbriar Project or the DEIR Mitigation for the Project

Natomas Basin HCP Measure	Applicability	Inclusion	Rationale
and abundance of species present.			
1. Where site investigations indicate vernal pool species may occur, the developer shall notify the Land Use Agency regarding the potential for impacts to vernal pool species.	N/A		No vernal pool habitat exists on site.
2. USFWS and CDFG shall identify specific measures required to avoid, minimize and mitigate impacts to vernal pool species to be implemented prior to disturbance and in accordance with adopted standards or established guidelines.	N/A		No vernal pool habitat exists on site.
3. The requirement by USFWS to preserve a vernal pool within development would be based on identification of an intact vernal pool with minimal disturbance where the presence of one or more of the following species is recorded: slender orcutt grass, Sacramento orcutt grass, Colusa grass, or vernal pool tadpole shrimp. No such preservation requirement shall be made unless the vernal pool is a suitable site for TNBC Mitigation Lands.	N/A		No vernal pool habitat exists on site.
4. Such vernal pool areas, including any required buffer land dedication, shall apply toward the Land Acquisition Fee component of the development project's NBHCP mitigation obligation.	N/A		No vernal pool habitat exists on site.
b. Mitigation Strategies (p. V-5)	N/A		No vernal pool habitat exists on site.
1. Avoidance and Preservation On-Site to Minimize Impacts: In the event USFWS requires on-site preservation in accordance with Section a.3 above, on-site mitigation shall be required. In the event USFWS does not require on-site mitigation, a developer or private land owner may still propose to dedicate fee title or conservation easement for that portion of the property with vernal pool resources and an associated 250-foot buffer surrounding the vernal pool resource to the TNBC. If the dedication is accepted, a reduction in the Land Acquisition Fee portion of the habitat Mitigation Fee shall be granted the developer for the portion (calculated on an acreage basis) of the site permanently preserved by easement or dedication. However, habitat Mitigation Fees, in full, must be paid on the remaining developable acreage on the site, and all fees other than Land Acquisition Fees shall be paid	N/A		No vernal pool habitat exists on site.

Table A-1
Inclusion of NBHCP Measures to Reduce Construction-related Effects and Human-Wildlife Conflicts in the Greenbriar Project or the DEIR Mitigation for the Project

Natomas Basin HCP Measure	Applicability	Inclusion	Rationale
for all acres on the site. Additional conditions to preserve the biological integrity of the site (such as reasonable drainage conditions) may be imposed by the Land Use Agency in consultation with TNBC and the TAC.			
2. Construction Period Avoidance and Relocation of Vernal Pool Resources (p. V-6).	N/A		No vernal pool habitat exists on site.
a. No grading, development or modification of the vernal pool site or the buffer area extending 250 feet around the perimeter of the vernal pool site may occur during the vernal pool "wet" season as identified by USFWS. Protective fencing shall be established around the perimeter of the vernal pool site and the buffer area during the vernal pool wet season.	N/A		No vernal pool habitat exists on site.
b. In consultation with TNBC and the TAC, soils and cysts from the vernal pool may be relocated as soon as practicable during the dry season to a suitable TNBC or other reserve site provided the relocation/recreation site is approved by TNBC, and the USFWS.	N/A		No vernal pool habitat exists on site.
3. Payment Into a USFWS Approved Conservation Bank (p. V-6). In the event all of the above approaches are not appropriate for the site, the Land Use Agency shall require the developer to purchase credits from a USFWS-approved mitigation bank in accordance with the following mitigation ratios: 2:1 for preservation in mitigation banks, 1:1 for creation in mitigation banks, 3:1 for preservation in acres outside of mitigation banks, 2:1 for creation in acres outside of mitigation banks.	N/A		No vernal pool habitat exists on site.
5. Measures to Reduce Take for Individual Species (p. V-7)			
a. Measures to Reduce Take of Giant Garter Snake (p. V-7)			
1. Within the Natomas Basin, all construction activity involving disturbance of habitat, such as site preparation and initial grading, is restricted to the period between May 1 and September 30. This is the active period for the giant garter snake and direct mortality is lessened, because snakes are expected to actively move and avoid danger.	Applicable	Included	A comparable and more detailed measure has been included in the mitigation proposed in the project's DEIR.

Table A-1
Inclusion of NBHCP Measures to Reduce Construction-related Effects and Human-Wildlife Conflicts in the Greenbriar Project or the DEIR Mitigation for the Project

Natomas Basin HCP Measure	Applicability	Inclusion	Rationale
2. Pre-construction surveys for giant garter snake, as well as other NBHCP Covered Species, must be completed for all development projects by a qualified biologist approved by USFWS. If any giant garter snake habitat is found within a specific site, the following additional measures shall be implemented to minimize disturbance of habitat and harassment of giant garter snake, unless such project is specifically exempted by USFWS.	Applicable	Included	The NBHCP measure has been included in the mitigation proposed in the project's DEIR, combined with measure 4 below.
3. Between April 15 and September 30, all irrigation ditches, canals, or other aquatic habitat should be completely dewatered, with no puddled water remaining, for at least 15 consecutive days prior to the excavation or filling in of the dewatered habitat. Make sure dewatered habitat does not continue to support giant garter snake prey, which could detain or attract snakes into the area. If a site cannot be completely dewatered, netting and salvage of prey items may be necessary. This measure removes aquatic habitat component and allows giant garter snakes to leave on their own.	Applicable	Included	The NBHCP measure has been included in the mitigation proposed in the project's DEIR.
4. For sites that contain giant garter snake habitat, no more than 24-hours prior to start of construction activities (site preparation and/or grading), the project area shall be surveyed for the presence of giant garter snake. If construction activities stop on the project site for a period of two weeks or more, a new giant garter snake survey shall be completed no more than 24-hours prior to the re-start of construction activities.	Applicable	Included	The NBHCP measure has been included in the mitigation proposed in the project's DEIR.
5. Confine clearing to the minimal area necessary to facilitate construction activities. Flag and designate avoided giant garter snake habitat within or adjacent to the project as Environmentally Sensitive Areas. This area shall be avoided by all construction personnel.	Applicable	Included	The NBHCP measure has been included in the mitigation proposed in the project's DEIR.
6. Construction personnel completing site preparation and grading operations shall receive USFWS approved environmental awareness training. This training instructs workers on how to identify giant garter snakes and their habitats, and what to do if a giant garter snake is encountered during construction activities. During this training an on-site biological monitor shall be	Applicable	Included	The NBHCP measure has been included in the mitigation proposed in the project's DEIR.

Table A-1
Inclusion of NBHCP Measures to Reduce Construction-related Effects and Human-Wildlife Conflicts in the Greenbriar Project or the DEIR Mitigation for the Project

Natomas Basin HCP Measure	Applicability	Inclusion	Rationale
designated.			
7. If a live giant garter snake is found during construction activities, immediately notify the USFWS and the project's biological monitor. The biological monitor, or his/her assignee, shall do the following:	Applicable	Included	The NBHCP measure has been included in the mitigation proposed in the project's DEIR.
a. Stop construction in the vicinity of the snake. Monitor the snake and allow the snake to leave on its own. The monitor shall remain in the area for the remainder of the work day to make sure the snake is not harmed or if it leaves the site, does not return. Escape routes for giant garter snake should be determined in advance of construction and snakes should always be allowed to leave on their own. If a giant garter snake does not leave on its own within one working day, further consultation with USFWS is required.	Applicable	Included	The NBHCP measure has been included in the mitigation proposed in the project's DEIR.
8. Upon locating dead, injured or sick threatened or endangered wildlife species, the Permittees or their designated agents must notify within one working day the Service's Division of Law Enforcement and Sacramento Fish and Wildlife Office. Written notification to both offices must be made within 3 calendar days and must include the date, time, and location of the finding of a specimen and any other pertinent information.	Applicable	Included	The NBHCP measure has been included in the mitigation proposed in the project's DEIR.
9. Fill or construction debris may be used by giant garter snake as an over-wintering site. Therefore, upon completion of construction activities remove any temporary fill and/or construction debris from the site. If this material is situated near undisturbed giant garter snake habitat and it is to be removed between October 1 and April 30, it shall be inspected by a qualified biologist to assure that giant garter snake are not using it as hibernaculae.	Applicable	Included	A comparable and more stringent measure has been included in the mitigation proposed in the project's DEIR.
10. No plastic, monofilament, jute, or similar erosion control matting that could entangle snakes will be placed on a project site when working within 200 feet of snake aquatic or rice habitat. Possible substitutions include coconut coir matting, tactified hydroseeding compounds, or other material approved by the Wildlife Agencies.	Applicable	Included	The NBHCP measure has been included in the mitigation proposed in the project's DEIR.

Table A-1
Inclusion of NBHCP Measures to Reduce Construction-related Effects and Human-Wildlife Conflicts in the Greenbriar Project or the DEIR Mitigation for the Project

Natomas Basin HCP Measure	Applicability	Inclusion	Rationale
11. Fences will be constructed along the shared boundary of urban development and the North Drainage Canal and the East Drainage Canal within Sutter County's Permit Area.	N/A		This measure is specific to locations outside the project area.
a. A minimum of 100 feet will be provided from fence-to-fence and access to the canals shall be limited by gates.	N/A		This measure is specific to locations outside the project area.
b. A snake deterrent will be placed along the fences on the North Drainage Canal and the East Drainage Canal (i.e., fence construction that restricts snake movement or an appropriate vegetative barrier either inside or outside of the boundary fence). The design of the deterrent shall be subject to approval by the Wildlife Agencies.	N/A		This measure is specific to locations outside the project area.
c. The specific fence/snake barrier design adjacent to a given development will be determined within Sutter County's review of the proposed development and the fence/barrier shall be installed immediately after site grading is completed.	N/A		This measure is specific to locations outside the project area.
12. At the time of urban development along the North and East Drainage Canals, Sutter County shall consult with the Wildlife Agencies to determine design strategies that would enhance conditions for giant garter snake movement through the North and East Drainage Canals. Possible strategies may include expanded buffer areas and modified canal cross sections if such measures are, in the determination of Sutter and the Water Agencies, found to be feasible.	N/A		This measure is specific to locations outside the project area.
b. Measures to Reduce Take of Swainson's Hawk (V-9)			
1. Measures to Reduce Cumulative Impacts to Foraging Habitat (V-9): Sutter County and the City of Sacramento will not will not grant development approvals within the one-mile wide Swainson's Hawk Zone adjacent to the Sacramento River.	N/A		This measure is specific to locations outside the project area.
2. Measures to Reduce Nest Disturbance (V-10)			
1. Pre-construction surveys shall be completed by the respective developer to determine whether any Swainson's hawk nest trees will be removed on-site, or active Swainson's hawk nest sites occur on or within ½ mile of the	Applicable	Included	The NBHCP measure has been included in the mitigation proposed in the project's DEIR.

Table A-1
Inclusion of NBHCP Measures to Reduce Construction-related Effects and Human-Wildlife Conflicts in the Greenbriar Project or the DEIR Mitigation for the Project

Natomas Basin HCP Measure	Applicability	Inclusion	Rationale
development site.			
2. If breeding Swainson's hawks (i.e. exhibiting nest building or nesting behavior) are identified, no new disturbances (e.g., heavy equipment operation associated with construction) will occur within ½ mile of an active nest between March 15 and September 15, or until a qualified biologist, with concurrence by CDFG, has determined that young have fledged or that the nest is no longer occupied. Routine disturbances such as agricultural activities, commuter traffic, and routine facility maintenance activities within ½ mile of an active nest are not restricted.	Applicable	Included	The NBHCP measure has been included in the mitigation proposed in the project's DEIR.
3. Where disturbance of a Swainson's hawk nest cannot be avoided, the nest tree may be destroyed during the non-nesting season. For purposes of this provision the Swainson's hawk nesting season is defined as March 15 to September 15. If a nest tree (any tree that has an active nest in the year the impact is to occur) must be removed, tree removal shall only occur between September 15 and February 1.	Applicable	Included	The NBHCP measure has been included in the mitigation proposed in the project's DEIR.
4. If a Swainson's hawk nest tree is to be removed and fledglings are present, the tree may not be removed until September 15 or until the California Department of Fish and Game has determined that the young have fledged and are no longer dependent upon the nest tree.	Applicable	Included	The NBHCP measure has been included in the mitigation proposed in the project's DEIR.
5. If construction or other project related activities which may cause nest abandonment or forced fledgling are proposed within the 1/4 mile buffer zone, intensive monitoring (funded by the project sponsor) by a Department of Fish and Game approved raptor biologist will be required. Exact implementation of this measure will be based on specific information at the project site.	Applicable	Included	The NBHCP measure has been included in the mitigation proposed in the project's DEIR.
3. Measures to Prevent the Loss of Nest Trees	Section heading		
1. Valley oaks, tree groves, riparian habitat and other large trees will be preserved wherever possible, particularly near Fisherman's Lake and elsewhere where large oak groves,	N/A		There are currently no large trees at the Greenbriar site.

Table A-1
Inclusion of NBHCP Measures to Reduce Construction-related Effects and Human-Wildlife Conflicts in the Greenbriar Project or the DEIR Mitigation for the Project

Natomas Basin HCP Measure	Applicability	Inclusion	Rationale
tree groves and riparian habitat have been identified.			
2. The raptor nesting season shall be avoided when scheduling construction near nests in accordance with applicable guidelines published by the Wildlife Agencies or through consultation with the Wildlife Agencies.	Applicable	Included	A comparable and more detailed measure has been included in the mitigation proposed in the project's DEIR, combined with measure 2.2 above.
4. Measures to Mitigate the Loss of Nest Trees (V-11)			
1. Fifteen trees (five gallon container size) must be planted, maintained and monitored within the habitat reserves for every Swainson's hawk nesting tree anticipated to be impacted by Authorized Development.	N/A		No Swainson's hawk nesting trees exist on site.
2. The Land Use Agency Permittee approving a project that impacts an existing Swainson's hawk nest tree shall provide funding sufficient for monitoring survival success of trees for a period of 5 years. For every tree lost during this time period, a replacement tree must be planted immediately upon the detection of failure. Trees planted to replace trees lost shall be monitored for an additional 5-year period to ensure survival until the end of the monitoring period. A 100% success rate shall be achieved. All necessary planting requirements and maintenance (i.e., fertilizing, irrigation) to ensure success shall be provided. Trees must be irrigated for a minimum of the first 5 years after planting, and then gradually weaned off the irrigation in an approximate 2-year period. If larger stock is planted, the number of years of irrigation must be increased accordingly. In addition, 10 years after planting, a survey of the trees shall be completed to assure 100% establishment success. Remediation of any dead trees shall include completion of the survival and establishment process described.	N/A		No Swainson's hawk nesting trees exist on site.
3. Of the replacement trees planted, a variety of native tree species will be planted to provide trees with differing growth rates, maturation, and life span. This will ensure that nesting habitat will be available quickly (5-10 years in the case of cottonwoods and willows), and in the long term (i.e., valley	N/A		No Swainson's hawk nesting trees exist on site.

Table A-1
Inclusion of NBHCP Measures to Reduce Construction-related Effects and Human-Wildlife Conflicts in the Greenbriar Project or the DEIR Mitigation for the Project

Natomas Basin HCP Measure	Applicability	Inclusion	Rationale
oaks, black walnut and sycamores). Trees shall be sited on reserves in proximity to hawk foraging areas. Trees planted shall be planted in clumps of 3 trees each. Planting stock shall be a minimum of 5-gallon container stock for oak and walnut species.			
4. In order to reduce temporal impacts resulting from the loss of mature nest trees, the City of Sacramento will fund mitigation planting within 14 months of permit of the NBHCP and ITP's, to be reimbursed by private developers at the time of approval of their development projects that impact mature nest trees.	N/A		No Swainson's hawk nesting trees exist on site.
5. For each additional nesting tree removed by Land Use Agencies' Covered Activities, the Land Use Agency shall fund and provide for the planting of 15 native sapling trees of suitable species with differing growth rates at suitable locations on TNBC preserves. Funding for such plantings shall be provided by the applicable Permittee within 30 days of approving a Covered Activity that will impact a Swainson's hawk nesting tree.	N/A		No Swainson's hawk nesting trees exist on site.
c. Measures to Reduce Take to Valley Elderberry Longhorn Beetle (VELB) (p. V-13): developers must comply with conservation practices for VELB set forth in the conditions of the "USFWS Compensation Guidelines for the Valley Elderberry Longhorn Beetle," dated 1999. This policy assumes that any elderberry bushes found within the range of the species are likely to provide beetle habitat, and any destruction or loss of such elderberry shrub habitat must be mitigated according to the Guidelines. The principle conditions of the Guidelines are summarized below.	N/A		No elderberry shrubs exist on site.
1. Any direct or indirect impacts to VELB habitat will be avoided whenever possible. To the maximum extent practicable, projects will be designed to avoid stands of elderberry bushes and to avoid isolation of the plants from other nearby populations. Pre-construction surveys at the construction impact site will be conducted to assess the appropriate amount of mitigation.	N/A		No elderberry shrubs exist on site.
2. If elderberry plants cannot be avoided, they shall be transplanted	N/A		No elderberry shrubs exist on site.

Table A-1
Inclusion of NBHCP Measures to Reduce Construction-related Effects and Human-Wildlife Conflicts in the Greenbriar Project or the DEIR Mitigation for the Project

Natomas Basin HCP Measure	Applicability	Inclusion	Rationale
during the dormant season (November 1 to February 15) to an area protected in perpetuity and approved by the USFWS.			
3. Replacement seedling plants will be provided at a ratio between 2:1 and 5:1 depending on the extent of beetle utilization of the plants moved or lost. A 1,800-square-foot area will be provided for each transplanted elderberry shrub or every five elderberry seedling plants.	N/A		No elderberry shrubs exist on site.
4. Annual monitoring of VELB habitat will be provided in the planted mitigation sites for a ten year period.	N/A		No elderberry shrubs exist on site.
5. Replacement elderberry shrubs will meet a 60% survival rate by the end of the ten year period and the 60% survival rate shall be required for the term of the applicable permit.	N/A		No elderberry shrubs exist on site.
d. Measures to Reduce Take on Tricolored Blackbird (V-13)	Section heading		
1. A pre-construction survey is required for potential nesting habitat and presence of nesting tricolored blackbirds.	Applicable		Suitable tricolored blackbird nesting habitat does not exist on site.
2. If surveys determine tricolored blackbirds are present, the following measures shall be implemented in accordance with the Migratory Bird Treaty Act, to avoid disturbance to occupied nesting colonies during the nesting season. A boundary shall be marked by brightly colored construction fencing that establishes a boundary 500 feet from the active colony. No disturbance associated with Authorized Development shall occur within the 500 foot fenced area during the nesting season to July 1, or while birds are present. A qualified biologist, with concurrence of USFWS, must determine young have fledged and nest sites are no longer active before the nest site may be disturbed.	Applicable		Suitable tricolored blackbird nesting habitat does not exist on site.
e. Measures to Reduce Take on Aleutian Canada Goose (V-14)			
1. A pre-construction survey for Aleutian Canada geese will be required. If geese are present, the developer must consult with USFWS and CDFG to determine appropriate measures to avoid and minimize take of individuals. Such measures shall be appropriate for the use (e.g., foraging, roosting, etc.) and activity of the species, since this species is a seasonal visitor to the Basin.	Applicable		This subspecies is not expected to occur on site.

Table A-1
Inclusion of NBHCP Measures to Reduce Construction-related Effects and Human-Wildlife Conflicts in the Greenbriar Project or the DEIR Mitigation for the Project

Natomas Basin HCP Measure	Applicability	Inclusion	Rationale
f. Measures to Reduce Take on White-faced Ibis (V-14)			
1. Prior to approval of an Urban Development Permit, a pre-construction survey will be required.	N/A		Suitable white-faced ibis nesting habitat does not exist on site.
2. If surveys determine the presence of active nest sites of White-faced ibis, disturbance by Authorized Development within 1/4 mile of nests will be avoided within the nesting season of May 15 through August 31 or until a qualified biologist, with concurrence of Wildlife Agencies, has determined that young have fledged or that the nest is no longer occupied.	N/A		Suitable white-faced ibis nesting habitat does not exist on site.
g. Measures to Reduce Take on Loggerhead Shrike (V-14)			
1. Prior to approval of an Urban Development Permit, a pre-construction survey will be required.	Applicable	Included	The NBHCP measure has been included in the mitigation proposed in the project's DEIR.
2. If surveys identify an active loggerhead shrike nest that will be impacted by Authorized Development, the developer shall install brightly colored construction fencing that establishes a boundary 100 feet from the active nest. No disturbance associated with Authorized Development shall occur within the 100 foot fenced area during the nesting season of March 1 through July 31. A qualified biologist, with concurrence of USFWS must determine young have fledged or that the nest is no longer occupied prior to disturbance of the nest site.	Applicable	Included	The NBHCP measure has been included in the mitigation proposed in the project's DEIR.
h. Measures to Reduce Take of Burrowing Owl (V-15)			
1. Prior to the initiation of grading or earth disturbing activities, the applicant/developer shall hire a CDFG approved qualified biologist to perform a pre-construction survey of the site to determine if any burrowing owls are using the site for foraging or nesting. The preconstruction survey shall be submitted to the Land Use Agency with jurisdiction over the site prior to the developer's commencement of construction activities and a mitigation program shall be developed and agreed to by the Land Use Agency and developer prior to initiation of any physical disturbance on the site.	Applicable	Included	A comparable and more stringent measure has been included in the mitigation proposed in the project's DEIR.

Table A-1
Inclusion of NBHCP Measures to Reduce Construction-related Effects and Human-Wildlife Conflicts in the Greenbriar Project or the DEIR Mitigation for the Project

Natomas Basin HCP Measure	Applicability	Inclusion	Rationale
2. Occupied burrows shall not be disturbed during nesting season (February 1 through August 31) unless a qualified biologist approved by the CDFG verifies through noninvasive measures that either: 1) the birds have not begun egg-laying and incubation; or 2) that juveniles from the occupied burrows are foraging independently and are capable of independent survival.	Applicable	Included	A comparable and more stringent measure has been included in the mitigation proposed in the project's DEIR.
3. If nest sites are found, the USFWS and CDFG shall be contacted regarding suitable mitigation measures, which may include a 300 foot buffer from the nest site during the breeding season (February 1 - August 31), or a relocation effort for the burrowing owls if the birds have not begun egg-laying and incubation or the juveniles from the occupied burrows are foraging independently and are capable of independent survival. If on-site avoidance is required, the location of the buffer zone will be determined by a qualified biologist. The developer shall mark the limit of the buffer zone with yellow caution tape, stakes, or temporary fencing. The buffer will be maintained throughout the construction period.	Applicable	Included	A comparable and more stringent measure has been included in the mitigation proposed in the project's DEIR.
4. If relocation of the owls is approved for the site by USFWS and CDFG, the developer shall hire a qualified biologist to prepare a plan for relocating the owls to a suitable site. The relocation plan must include: (a) the location of the nest and owls proposed for relocation; (b) the location of the proposed relocation site; (c) the number of owls involved and the time of year when the relocation is proposed to take place; (d) the name and credentials of the biologist who will be retained to supervise the relocation; (e) the proposed method of capture and transport for the owls to the new site; (f) a description of the site preparations at the relocation site (e.g., enhancement of existing burrows, creation of artificial burrows, one-time or long-term vegetation control, etc.); and (g) a description of efforts and funding support proposed to monitor the relocation. Relocation options may include passive relocation to another area of the site not subject to disturbance through one way doors on burrow openings, or construction of artificial burrows in accordance with the CDFG's October 17, 1995, Staff Report on Burrowing Owls Mitigation (see Appendix	Applicable	Included	The NBHCP measure has been included in the mitigation proposed in the project's DEIR.

Table A-1
Inclusion of NBHCP Measures to Reduce Construction-related Effects and Human-Wildlife Conflicts in the Greenbriar Project or the DEIR Mitigation for the Project

Natomas Basin HCP Measure	Applicability	Inclusion	Rationale
D).			
5. Where on-site avoidance is not possible, disturbance and/or destruction of burrows shall be offset through development of suitable habitat on TNBC upland reserves. Such habitat shall include creation of new burrows with adequate foraging area (a minimum of 6.5 acres) or 300 feet radii around the newly created burrows. Additional habitat design and mitigation measures are described in the CDFG's October 17, 1995, Staff Report on Burrowing Owl Mitigation (see Appendix D).	Applicable	Included	A comparable and more stringent measure has been included in the mitigation proposed in the project's DEIR.
i. Measures to Reduce Take on Bank Swallow (V-16)			
1. Disturbance to bank swallows nesting colonies will be avoided within the nesting season of May 1 through August 31 (or until a qualified biologist, with concurrence of USFWS and CDFG, has determined that young have fledged or that the nest is no longer occupied) during all Authorized Development activities conducted in the Permit Areas.	N/A		Suitable bank swallow nesting habitat does not exist on site.
2. If surveys identify an active bank swallow nesting colony that will be impacted by Authorized Development, the developer shall install brightly colored construction fencing that establishes a boundary 250 feet from the active nesting colony. No disturbance associated with Authorized Development shall occur within the 250 foot fenced area during the nesting season of May 1 through August 31. Additionally, disturbance within ½ mile upstream or downstream of the colony will be avoided if the colony is located upon a natural waterway.	N/A		Suitable bank swallow nesting habitat does not exist on site.
j. Measures to Reduce Take on Northwestern Pond Turtle (V-16)			
1. Take of the northwestern pond turtle as a result of habitat destruction during construction activities, including the removal of irrigation ditches and drains, and during ditch and drain maintenance, will be minimized by the dewatering requirement described above for giant garter snake (see Section 5.a.(3)).	Applicable		The NBHCP measure has been included in the mitigation proposed in the project's DEIR.
k. Measures to Reduce Take on California Tiger Salamander (V-16)			
1. Prior to approval of an Urban Development Permit, the involved	N/A		Suitable California tiger salamander

Table A-1
Inclusion of NBHCP Measures to Reduce Construction-related Effects and Human-Wildlife Conflicts in the Greenbriar Project or the DEIR Mitigation for the Project

Natomas Basin HCP Measure	Applicability	Inclusion	Rationale
Land Use Agency shall require a pre-construction survey. If a future survey determines the presence of California tiger salamander, the Land Use Agency shall require the developer to consult with USFWS and CDFG to determine appropriate measures to avoid and minimize take of individuals.			habitat does not exist on site.
l. Measures to Reduce Take on Western Spadefoot Toad (V-16)			
1. Prior to approval of an Urban Development Permit, the involved Land Use Agency shall require a pre-construction survey. If such survey determines western spadefoot toad are present, the Land Use Agency shall require the developer to consult with CDFG and USFWS to determine appropriate measures to avoid and minimize take of individuals.	N/A		Suitable western spadefoot toad habitat does not exist on site.
m. Measures to Reduce Take of Vernal Pool Fairy Shrimp, Vernal Pool Tadpole Shrimp, and Midvalley Fairy Shrimp (V-17)			
1. Prior to approval of an Urban Development Permit, the involved Land Use Agency shall require a pre-construction survey. If such survey determines vernal pool fairy shrimp, vernal pool tadpole shrimp, and midvalley fairy shrimp are present, the Land Use Agency shall require the developer to consult with USFWS to determine appropriate measures to avoid and minimize take of individuals. Procedures for reviewing projects that could affect vernal pools and vernal pool species are discussed under Section V.A.4 above.	N/A		No vernal pool habitat exists on site.
n. Measures to Reduce Take of Delta Tule Pea (V-17)			
1. If Delta tule pea plants are identified through a pre-construction survey, the involved Land Use Agency shall provide notice to USFWS, CDFG and the California Native Plant Society. Under such circumstances, the development proponent shall allow the transplantation of plants prior to site disturbance.	Applicable	Included	The NBHCP measure has been included in the mitigation proposed in the project's DEIR.
o. Measures to Reduce Take on Sanford's Arrowhead (V-17)			

Table A-1
Inclusion of NBHCP Measures to Reduce Construction-related Effects and Human-Wildlife Conflicts in the Greenbriar Project or the DEIR Mitigation for the Project

Natomas Basin HCP Measure	Applicability	Inclusion	Rationale
1. If Sanford's arrowhead plants are identified through a pre-construction survey, the involved Land Use Agency shall provide notice to USFWS, CDFG and the California Native Plant Society. Under such circumstances, the development proponent shall allow the transplantation of plants prior to site disturbance.	Applicable	Included	The NBHCP measure has been included in the mitigation proposed in the project's DEIR.
p. Measures to Reduce Take on Boggs Lake Hedge-Hyssop, Sacramento Orcutt Grass, Slender Orcutt Grass, Colusa Grass, and Legenere (V-17)			
1. Prior to approval of an Urban Development Permit, the involved Land Use Agency shall require a pre-construction survey. If such survey determines Boggs Lake hedge-hyssop, Sacramento orcutt grass, Slender orcutt grass, Colusa grass, or legenere are present, the Land Use Agency shall require the developer to consult with USFWS to determine appropriate measures to avoid and minimize loss of individuals. If Authorized Development is proposed for areas containing vernal pools, the applicant will be required to complete additional review, permitting and mitigation as described under Section V.A.4.	N/A	Included	The NBHCP measure has been included in the mitigation proposed in the project's DEIR.

Appendix B

Change in Natomas Basin Land Cover in 2001–2004

APPENDIX B
CHANGE IN NATOMAS BASIN LAND COVER IN 2001–2004

INTRODUCTION

EDAW analyzed 2001 and 2004 land cover of the Natomas Basin to describe changing conditions in the Natomas Basin and their bearing on analyses of the Natomas Basin Habitat Conservation Plan (NBHCP) and on analyses of the Greenbriar project.

The NBHCP used 2001 land cover as a primary data source in analyses of the anticipated future condition. For example, change in habitat availability for covered species was analyzed by evaluating the change in land cover types providing suitable habitat. This was done by subtracting 2001 acreages in areas permitted for development from total 2001 acreages.

In 2004, land cover in the Natomas Basin was mapped by Jones & Stokes for TNBC (Jones & Stokes 2005). This land cover data provides useful information about more recent conditions.

A comparison of 2001 and 2004 land cover could provide useful information regarding on-going changes. Unfortunately, the mapping of 2001 land cover by CH2M Hill (CH2M Hill 2002) and the mapping of 2004 land cover by Jones & Stokes (Jones & Stokes 2005) used different land cover classifications and different mapping methods. Consequently, changes in land use and habitat availability cannot be interpreted by directly comparing them. For example, more intensively developed land was mapped as airport, highway, other, rural residential, and other in 2001; but as developed in 2004. Also, many areas mapped as urban in 2001 were mapped as natural or urban vegetation in 2004, apparently because the 2004 mapping was done with much more conservative boundaries around structures and pavement.

Therefore, EDAW processed each data set to increase their compatibility, and then evaluated changes in land cover during 2001–2004 in: 1) areas permitted for development, 2) The Natomas Basin Conservancy (TNBC) reserve system, and 3) in the remainder of the Natomas Basin.

METHODS

Data layers for the 2001 and 2004 land cover mapping were provided by CH2M Hill and Jones & Stokes, respectively. Analyses of these data layers were performed using ArcInfo 9.1.

Several steps were taken to make these two maps more comparable and to facilitate an informative comparison of land cover change from 2001 to 2004. First, we developed a cross-walk between the 2001 and 2004 land cover classifications and a derived classification. Table B-1 presents this crosswalk and the derived classification. Second, land mapped in developed land cover types in 2001 was considered to still be developed. Thus, the 2001 land cover classification of these areas was retained for 2004. Third, land cover acreages were adjusted to incorporate habitat along canals and drains as a distinct type (i.e., canal in Table B-1). This was done by transferring acreage from each land cover category to a canal category based on the acreages intersecting buffers placed around canals in a GIS analysis. (Buffer widths were based on the widths used in Table 4-3 of CH2M Hill [2002].) Canals passing through developed land cover types, however, were included in the developed category.

RESULTS AND DISCUSSION

Table B-2 provides a comparison of 2001 and 2004 land cover overall, and within development areas, TNBC reserves, and the rest of the Natomas Basin. (Development areas include the Sutter County, City of Sacramento, and MAP permit areas.) This subdivision of the Natomas Basin allows changes due to management of TNBC

reserves and changing land use in areas authorized for development to be distinguished from changes in the remainder of the Natomas Basin.

Changes in land cover from 2001 to 2004 were most substantial on TNBC reserves. In areas incorporated into the TNBC reserve system, the creation of managed marshes increased the acreage of ponds, marsh, and seasonally wet areas by over 500 acres, while the acreage of rice decreased by less than 100 acres. This indicates that most managed marsh has been created from land mapped as non-rice cropland or idle in 2001. If this pattern continues more total habitat for species using marshes and wetlands will exist in the future condition than estimated because more conversion of rice to marsh was anticipated (CH2M Hill 2002). Grassland and pasture has also increased on reserve lands, while non-flooded cropland decreased by approximately 900 acres during 2001–2004 within the current TNBC reserve system. Interestingly, there has been no increase in alfalfa on reserve lands. Overall, the proportions of marsh, rice and upland land cover types are consistent with those specified by the NBHCP.

Within areas permitted for development by the NBHCP, developed land cover has increased and so has the acreage of grassland, while disturbed areas and non-flooded crops have decreased in extent. Interestingly, the acreage of rice within developed areas did not decrease during 2001–2004. This rice is primarily in the Sutter County's permit area, and to a lesser extent in the Metro Air Park. Almost no rice was present in the City of Sacramento's permit area in either 2001 or 2004. Thus, as of 2004, there is no evidence that rice has been fallowed in anticipation of development. Non-flooded cropland has been fallowed or abandoned, however. Non-flooded cropland decreased in acreage, and the corresponding increase in grassland acreage is likely due to the increase in idle cropland.

Outside of TNBC reserves and areas authorized for development, the primary change in land cover has been a 42% decrease in the acreage of non-flooded cropland, and a concurrent increase in the acreage of grassland and rice. Because both grassland and rice have increased, there has not been a substantial change in the acreage of habitat for either upland-associated or wetland-associated species covered by the NBHCP. This change in the proportions of the different agricultural land cover types outside of reserves and areas undergoing development does illustrate the dynamic nature of agricultural landscapes over short periods of time, in this case just three years. Recent concerns over water prices and the viability of rice cultivation in the Natomas Basin also indicate this dynamism.

Table B-1
Crosswalk between CH2M Hill and Jones & Stokes Land Cover Classifications and a Combined Classification

Combined Classification	CH2M Hill	Jones & Stokes
Alfalfa	Alfalfa	Alfalfa
Canal	Canal, small portions of other land cover types that canals passed through (except for developed land cover)	Open Water [in part], Riparian Scrub [in part], Grassland [in part], Rice [in part], Row Crops [in part] and small amounts of other land cover types
Developed	Airport, Highway or Major Road, Other, Urban	Developed [in part], and small portions of other land cover types
Grassland	Grassland	Grassland [in part]
Orchard	Orchard	Orchard
Pasture	Pasture	Irrigated Grassland, Grass Hay
Ponds, Marsh and Seasonally wet areas	Ponds and Seasonally Wet Areas	Fresh Emergent Marsh, Managed Marsh, Open Water [in part], Seasonal Wetland
Rice	Rice	Rice [in part]
Riparian	Riparian	Riparian Scrub [in part], Riparian Woodland
Non-rice Crops	Non-rice Crops, idle	Row Crops [in part]
Ruderal	Ruderal	Disturbed / Bare
Rural Residential	Rural Residential	Developed [in part], and small portions of other land cover types
Tree Grove	Tree Grove	Non-riparian Woodland
Valley Oak Woodland	Oak Grove	Valley Oak Woodland

Note: CH2M Hill classification used in mapping 2001 land cover as described in CH2M Hill 2002; Jones & Stokes classification used in mapping 2004 land cover as described in Jones & Stokes 2005.

Table B-2
Land Cover Change in the Natomas Basin 2001–2004

Land Cover Type	Development Areas[1]		TNBC Reserves[2]		Rest of Basin		Total	
	2001	2004	2001	2004	2001	2004	2001	2004
Alfalfa	0	0	64	67	305	529	369	596
Canal	508	436	113	111	830	833	1,451	1,380
Developed	8,353	9,766	26	42	2,931	3,173	11,311	12,980
Grassland	564	2,328	13	349	225	2,179	802	4,856
Orchard	0	0	0	0	165	145	165	145
Pasture	165	255	80	164	423	315	668	734
Ponds, Marsh and Seasonally Wet Areas	21	60	0	514	73	106	94	680
Rice	7,562	8,363	2,499	2,414	11,360	13,308	21,421	24,085
Riparian	23	24	4	12	87	86	114	122
Non-flooded Cropland	3,214	939	1,096	291	9,374	5,427	13,683	6,657
Ruderal	2,825	1,111	66	0	378	28	3,269	1,139
Tree Grove	56	8	7	1	37	48	100	56
Valley Oak Woodland	13	14	0	3	77	89	90	106
Total	23,303	23,303	3,968	3,968	26,266	26,266	53,537	53,536

Notes: All values are in acres.
1 – Areas authorized for development by the NBHCP.
2 – Areas in TNBC reserve system in 2005.