DRAFT ◦ APRIL 2017

2007 Marin Countywide Plan Supplemental EIR with a Focus on Potential Cumulative Impacts to Salmonids in San Geronimo Valley

Draft

2007 Marin Countywide Plan Supplemental EIR with a Focus on Potential Cumulative Impacts to Salmonids in San Geronimo Valley

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April 2017

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2007 Marin Countywide Plan Supplemental EIR with a Focus on Potential Cumulative Impacts to Salmonids in San Geronimo Valley

Pursuant to:
California Environmental Quality Act, P.R.C. 21000 et seq.; State of California Guidelines, California Administrative Code, 15000 et seq.

Prepared by
Stillwater Sciences

For the
Marin County Development Agency

_____
Rachel Reid
Environmental Planning Coordinator
Marin County Development Agency

Date: _____

The Draft 2007 Marin Countywide Plan Supplemental EIR with a Focus on Potential Cumulative Impacts to Salmonids in San Geronimo Valley (Draft SEIR) is being made available to the public in accordance with the California Environmental Quality Act.

Visit the Environmental Review page on the Marin County Community Development Agency's website http://www.marincounty.org/depts/cd/divisions/environmental-review where you can view and download the Draft SEIR, the 2007 CWP EIR and related materials.

Table of Contents

List of Tables

List of Figures

List of Appendices

ACRONYMS AND ABBREVIATIONS

Acroynym	Definition
ac	acre
BIO	Biological Resources
ºC	Degrees Celsius
CCR	California Code of Regulations
CD	Community Development
CDA	County Development Agency
CDFG	California Department of Fish and Game
CDFW	California Department of Fish and Wildlife
CESA	California Endangered Species Act
CEQA	California Environmental Quality Act
cfs	cubic feet per second
cm	centimeter
cm/s	centimeter per second
CWA	Clean Water Act
CWP	Countywide Plan
DBH	diameter at breast height
DPS	distinct population segment
DPW	Department of Public Works
ECR	Existing Conditions Report
EHS	Department of Environmental Health Services
EIA	Effective Impervious Area
EIR	Environmental Impact Report
ESA	Endangered Species Act
ESU	evolutionarily significant unit
eWRIMS	Electronic Water Rights Information Management System
°F	Fahrenheit
FAR	floor area ratio
ft	feet
ft/s	feet per second
IBI	Index of Biological Integrity
in	inch
km^2	kilometers squared
LID	low impact development
LWD	large woody debris
m	meter
mg/l	milligrams per liter

Acroynym	Definition
mi	miles
mi^2	miles squared
mm	millimeter
MMWD	Marin Municipal Water District
MWAT	Maximum Weekly Average Temperature
NMFS	National Marine Fisheries Service
PRC	Public Resource Code
SCA	Stream Conservation Area
SEIR	Supplemental Environmental Impact Report
SEP	Salmon Enhancement Plan
SFBRWQCB	San Francisco Bay Regional Water Quality Control Board
SMP	Standard Management Practice
SPAWN	Salmon Protection and Watershed Network
SWRCB	California State Water Resources Control Board
TIA	Total Impervious Area
TMDL	total maximum daily load
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
WCA	Wetland Conservation Area
WQCB	Water Quality Control Board
WR	Water Resources
WY	Water Year
yr	year

EXECUTIVE SUMMARY

Project Location

The San Geronimo Valley, is located in western Marin County, California, and is a subwatershed of the larger Lagunitas Creek watershed that drains to Tomales Bay and eventually the Pacific Ocean.

Proposed Project

The Proposed Project is future land use and development specific to the San Geronimo Valley, consistent with the goals, policies, and programs of the Marin Countywide Plan (Marin CWP [2007]) that serve to avoid or minimize adverse impacts on biological and wetland resources in the County. The Final Environmental Impact Report (EIR) for the Marin CWP (2007) was certified by the Marin County Board of Supervisors in November 2007 and the Marin CWP (2007) was adopted. Following the County's certification of the Final EIR, the Salmon Protection and Watershed Network (SPAWN) filed a lawsuit challenging the adequacy of the EIR. SPAWN's challenge was limited to the application of the Marin CWP and EIR to the San Geronimo Valley. On appeal, SPAWN's challenge was further narrowed to two primary contentions: that the EIR failed to properly analyze the cumulative impacts on threatended salmonids of future development in the San Geronimo Valley watershed as contemplated by the Marin CWP (2007), and that the EIR relied on inadequate mitigation measures to reduce the impacts of development to a less-than-significant level.

SEIR Requirement

This Draft Supplemental EIR (Draft SEIR) has been prepared in accordance with the decision of the Court of Appeal of the State of California First Appellate District Division Three, which directed the County to set aside its approval of the Marin CWP (2007) and certification of the EIR with respect to San Geronimo Valley, pending the following:

(1) analysis of potential cumulative impacts, and the range of potential consequences, on salmonids in San Geronimo Valley resulting from future buildout in the watershed in conformity with State California Environmental Quality Act (CEQA) Guidelines Section 15130 and the Court opinion, and

(2) a description of mitigation measures relevant to salmonids in San Geronimo Valley in conformity with State CEQA Guidelines Section 15126.4 and the Court's opinion or a description of other findings in conformity with State CEQA Guidelines Section 15091.

As specified in the Court's order, the principal action considered in this SEIR is adoption and implementation of the Marin CWP (2007) with respect to the San Geronimo Valley and the potential for effects on salmonids. The SEIR will be used to fulfill the Court's mandate, and will be used by the Marin County Board of Supervisors in considering approval of of the Proposed Project (Marin CWP [2007]) and certification of the EIR with respect to the San Geronimo Valley.

Summary of Impacts

Impact 5.1. Reduced Survival of Fry and Juvenile Salmonid Life Stages Due to Reduced Winter Rearing Habitat Quality. This impact was determined to be potentially significant due to alterations in hydrodynamic processes resulting from projected increases in total impervious area (TIA) and other urbanization effects under the Proposed Project, which would make a cumulatively considerable contribution to increased winter storm flow magnitude and frequency, in turn causing additional habitat simplification and further compromising the ability of rearing coho salmon to find adequate refuge during high flows. Implementation of ***Mitigation Measure 5.1-1: Expanded Stream Conservation Area (SCA) Ordinance*** and ***Mitigation Measure 5.1-2: Winter Habitat Enhancement Projects*** would reduce this impact to a less-than-significant level.

Impact 5.2. Reduced Salmonid Spawning Success Due to Increased High Flow Frequency and Magnitude and Elevated Sediment Delivery. This impact was determined to be potentially significant due to alterations in hydrodynamic processes resulting from projected increases in TIA and other urbanization effects under the Proposed Project, which would increase winter storm flow magnitude and frequency, and inputs of development-related fine sediment to stream channels. These conditions would further increase the risk of streambed and redd scour, thus making a cumulatively considerable contribution to the existing adverse impacts on coho salmon and steelhead spawning success. Implementation of ***Mitigation Measure 5.2-1: Control and Reduce Production and Delivery of Fine Sediment to Streams*** and ***Mitigation Measure 5.2-2: Stream Habitat Enhancement Projects*** would reduce this impact to a less-than-significant level.

Impact 5.3. Reduced Salmonid Summer Rearing Success Due to Degraded Habitat Conditions Including Reduced Habitat Complexity, Reduced Streamflow, and Increased Water Temperature. This impact was determined to be less than significant because potential reductions in stream habitat quality

and riparian function related to future development in the watershed would be relatively minor and likely too small to substantially or measurably reduce the ability of juvenile salmonids to rear and grow during the summer rearing period. The potential for impacts on salmonid summer rearing success due to development-related reductions in summer baseflows could not be determined due to uncertainties in the current understanding of the potential hydrologic and biologic effects of groundwater pumping and surface water diversions in San Geronimo Valley. While the Proposed Project is not capable of fully avoiding or eliminating impacts to water quality, sediment delivery, and instream habitat complexity associated with future development, it is unlikely that any such impacts would make a considerable contribution to the existing cumulative impacts on coho salmon and steelhead summer rearing success.

Although Impact 5.3 is less than significant, the County has nonetheless elected to pursue a number of voluntary mitigation measures consistent with its commitment to avoiding or minimizing impacts to the maximum extent practicable. ***Voluntary Mitigation Measure 5.3-1: Groundwater Study*** would provide required information to help determine whether existing and future groundwater pumping, surface water diversions, altered watershed hydrology, and other effects related to development are or would be likely to adversely impact summer baseflow in San Geronimo Creek. ***Voluntary Mitigation Measure 5.3-2: Summer Habitat Enhancement Projects*** would help facilitate improvements to stream and riparian habitat, protect summer streamflow, and improve water temperature and quality in the San Geronimo Creek watershed. These measures would improve understanding of development-related effects on salmonid summer rearing habitat in the watershed and assist with County efforts to protect and conserve habitat for these species.

Significant Unavoidable Adverse Impacts

There would be no significant and unavoidable adverse impacts due to the Proposed Project.

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1 INTRODUCTION

1.1 Project Background and History

The Marin Countywide Plan (Marin CWP [2007]) sets policy guidelines for future conservation and development in the unincorporated portion of Marin County, California. The Marin CWP (2007) is the subject of this Draft Environmental Impact Report, which supplements the Final Environmental Impact Report (EIR) for the 2007 Marin Countywide Plan (Final EIR) that was certified and adopted by the Marin County Board of Supervisors in November 2007. The Final EIR evaluated the impact of land uses and development consistent with the Marin CWP (2007) on the County's sensitive biological and wetland resources. Numerous goals, policies, and programs of the Marin CWP (2007), especially in the Natural Systems and Agricultural Element, serve to avoid or minimize adverse impacts on biological and wetland resources in the County. The Final EIR analyzed the effectiveness of the relevant goals, policies and programs in the Marin CWP (2007) to reduce or avoid adverse changes to the environment resulting from proposed land-use designations and development applications and the degree to which they would mitigate identified impacts to a less-than-significant level. Cumulative impacts were also analyzed in the Final EIR in Section 4.6 Biological Resources and Section 6.2 Cumulative Impacts.

Following the county's certification of the Final EIR, the Salmon Protection and Watershed Network (SPAWN) filed a lawsuit challenging the adequacy of the EIR. SPAWN's challenge was limited to the application of the Marin CWP and EIR to the San Geronimo Valley.

Following certification of the Final EIR, Marin County undertook the following two studies as a means to develop recommendations to improve and maintain habitat conditions that will support viable populations of salmon and steelhead trout in San Geronimo Valley:

- San Geronimo Valley Enhancement Plan Existing Conditions Report (ECR), Stillwater Sciences, January 2009.
- San Geronimo Valley Salmon Enhancement Plan: A Guidance Document (SEP), Prunuske Chatham Inc. and Stillwater Sciences, February 2010.

In March 2014, the Court of Appeal of the State of California First Appellate District Division Three issued its opinion in regard to SPAWN's challenge. The Court's opinion focused on two issues in regard to the adequacy of the EIR:

- Cumulative Impacts
- Inadequate Mitigation Measures

These two issues are discussed further in the below sections.

1.1.1 Cumulative Impacts

The Court's opinion cites information in the EIR regarding the numbers of housing units and square feet of nonresidential floor area that can be built. The opinion asserts:

> "but neither the countywide plan nor the EIR go further to estimate or evaluate in any meaningful terms by how much such construction is likely to affect the streams abutting these sites".

The opinion further states:

> The report fails to estimate the maximum potential impact, the range of potential impacts, or the likely net impact if the policies and implementation programs described in the Marin CWP (2007) are applied. What, for example, is the maximum amount of impervious surface that may reasonably be placed in the watershed under the plan? With application of the policies and programs described in the plan, will any salmonid habitat be eliminated and if so what is a reasonable estimate of the loss, and what variables will determine its extent? While the Marin CWP (2007) provides that noncompliance with Stream Conservation Area (SCA) standards may be permitted if a parcel falls entirely within an SCA or development on the parcel entirely outside the SCA is either infeasible or would have greater impacts than development within the SCA, how many and what size of lots are estimated to fall within this exception and what is the significance of such exceptions?

The opinion further states:

> What is missing in the present case, however, is not an analysis of how salmonids will be affected by the construction of a single building, but a meaningful analysis of the likely cumulative impacts of a widespread buildout, regardless of the details of individual projects.

While the opinion does appear to agree with the EIR that the policies and measures laid out in the Marin CWP (2007) will tend to reduce the adverse ecological impacts of development within the San Geronimo Valley watershed,

and that the extent of the impacts will depend on the details of future development plans, it goes on to say:

> The report provides no help to decision-makers or the public to understand the likely consequences, or at least the range of potential consequences, of a buildout within the watershed of the scope described in the countywide plan. Providing that long-term view is the point of a cumulative impact analysis and, the ability to make that analysis is one of the advantages of using a program EIR. The program EIR fails to provide the information—if no more than rationally-based estimates - necessary to make informed judgments about the advisability, so far as the San Geronimo Valley watershed is concerned, of adopting the countywide plan.

1.1.2 Inadequate Mitigation Measure

SPAWN raised a concern with the adequacy of Mitigation Measure 4.6-1 in the Final EIR. This mitigation measure adds a new policy to the Biological Resources section of the CWP to continue to actively participate in the FishNet 4C program and work cooperatively with participating agencies to implement recommendations to improve and restore aquatic habitat for listed anadromous fish species and other fishery resources. The Court opinion states that Mitigation Measure 4.6-1 is deficient in multiple respects. The opinion states:

> It defines no specific measures to be taken to reduce the impact of buildout on the threatened fish species, nor does it specify performance standards by which to evaluate measures that may be recommended by FishNet 4C. Moreover, while the county has committed itself to be cooperative, it has not committed to adopt recommendations made by FishNet 4C, whatever they may be.

The Court's direction to Marin County is as follows:

> The Court directed Marin County to set aside its approval of the Marin CWP (2007) and certification of the EIR pending preparation of a supplemental EIR and analyzes cumulative impacts in conformity with State California Environmental Quality Act (CEQA) Guidelines section 15130, subdivision (b) and the Court opinion, and that describes mitigation measures in conformity with State CEQA Guidelines section 15126.4 and the Court's opinion or make other findings in conformity with State CEQA Guidelines section 15091.

In response to a request from Marin County, the judgment clarified that the Marin CWP (2007) and EIR approvals are only set aside with respect to the San Geronimo Valley.

1.2 SEIR Requirement

This Draft Supplemental EIR (Draft SEIR) has been prepared in accordance with State CEQA Guidelines Section 15163, which states the following:

(a) The Lead or Responsible Agency may choose to prepare a supplement to an EIR rather than a subsequent EIR if:
  (1) Any of the conditions described in Section 15162 would require the preparation of a subsequent EIR, and
  (2) Only minor additions or changes would be necessary to make the previous EIR adequately apply to the project in the changed situation.

(b) The supplement to the EIR need contain only the information necessary to make the previous EIR adequate for the project as revised.

(c) A supplement to an EIR shall be given the same kind of notice and public review as is given to a draft EIR under Section 15087.

(d) A supplement to an EIR may be circulated by itself without recirculating the previous draft or final EIR.

(e) When the agency decides whether to approve the project, the decision-making body shall consider the previous EIR as revised by the supplemental EIR. A finding under Section 15091 shall be made for each significant effect shown in the previous EIR as revised.

Further, this Draft SEIR has been prepared in accordance with the Court's decision to set aside its approval of the Marin CWP (2007) and certification of the EIR with respect to San Geronimo Valley, pending the following:

(1) analysis of potential cumulative impacts, and the range of potential consequences, on salmonids in San Geronimo Valley resulting from future buildout in the watershed in conformity with State CEQA Guidelines Section 15130 and the Court opinion, and

(2) a description of mitigation measures relevant to salmonids in San Geronimo Valley in conformity with State CEQA Guidelines Section 15126.4 and the Court's opinion or a description of other findings in conformity with State CEQA Guidelines Section 15091.

For the purposes of this Draft SEIR, the Proposed Project is land use and development specific to the San Geronimo Valley under the goals, policies and programs of the Marin CWP (2007) (see also Section 1 Project Description). Marin County Development Agency (CDA) is the CEQA Lead Agency and has the principal responsibility for CEQA compliance when preparing the SEIR (Public Resource Code [PRC] Section 21067).

In accordance with CEQA ([PRC Section 21000 *et seq.*), and the State CEQA Guidelines (California Code of Regulations [CCR] Section 15000 *et seq.*), the Marin County Board of Supervisors will use the SEIR in considering approval of the Proposed Project (Marin CWP [2007]) and certification of the EIR with respect to San Geronimo Valley.

With regard to the analysis of potential cumulative impacts, Section 15130 of the State CEQA Guidelines subdivision (a) states that an EIR shall discuss cumulative impacts of a project when the project's incremental effect is "cumulatively considerable", where cumulatively considerable means that the incremental effects of an individual project are significant when viewed in connection with the effects of past projects, the effects of other current projects, and the effects of probable future projects.

Section 15130 of the State CEQA Guidelines subdivision (d) (3) states that an EIR may determine that a project's contribution to a significant cumulative impact will be rendered less than cumulatively considerable, and thus not significant, if the project is required to implement or fund its fair share of a mitigation measure or measures designed to alleviate the cumulative impact (see below, Section 1.2.2 Mitigation Measures). In this case, the analysis in the EIR must identify facts and analysis supporting its conclusion that the contribution will be rendered less than cumulatively considerable. However, the mere existence of significant cumulative impacts caused by other projects alone shall not constitute evidence that the proposed project's incremental effects are cumulatively considerable. State CEQA Guidelines Section 15064(h)(4). Further, a project's contribution to a significant cumulative impact can be rendered less than significant through project-specific mitigation measures. State CEQA Guidelines Section 15064(h)(2).

1.2.1 Program SEIR

Consistent with the Final EIR, this Draft SEIR is a program EIR under Section 15168 of the State CEQA Guidelines. As described in State CEQA Guidelines § 15168(a)(3), a program EIR "may be prepared on a series of actions that can be

characterized as one large project and are related...in connection with the issuance of rules, regulations, plans, or other general criteria to govern the conduct of a continuing program." As a program SEIR, this document focuses on the overall effect of the Marin CWP (2007) on salmonids in San Geronimo Valley. This analysis does not examine the effects of site-specific projects that may occur within the overall umbrella of this program in the future. The nature of general plans is such that many proposed policies are intended to be general, with details to be worked out during implementation. Thus, many of the impacts and mitigation measures are only intended to be described in general or qualitative terms. The analysis in this program SEIR is considered the first tier of environmental review, creating the foundation upon which future, project-specific CEQA documents can build. A program SEIR can be incorporated by reference into subsequently prepared CEQA documents to address issues such as cumulative impacts and growth inducing impacts, allowing the subsequent documents to focus on new or site-specific impacts.

1.2.2 Mitigation Measures

State CEQA Guidelines Section 15370 defines mitigation as including the following:

- Avoiding the impact altogether by not taking a certain action or parts of an action;
- Minimizing impacts by limiting the degree or magnitude of the action and its implementation;
- Rectifying the impact by repairing, rehabilitating, or restoring the impacted environment;
- Reducing or eliminating the impact over time by preservation and maintenance operations during the life of the action;
- Compensating for the impact by replacing or providing substitute resources or environments.

Further, Section 15126.4 subdivision (a) (2) of the State CEQA Guidelines states that mitigation measures must be fully enforceable through permit conditions, agreements, or other legally-binding instruments. In the case of the adoption of a plan, policy, regulation, or other public project, mitigation measures can be incorporated into the plan, policy, regulation, or project design.

In this case, since the Proposed Project is the Marin CWP (2007), mitigation to accomplish the above outcomes is in the form of:

- Modified goals, policies or implementing programs proposed in the Marin CWP (2007);
- New goals, policies or implementing programs not currently proposed in the Marin CWP (2007);
- Modified land uses (locations, type and/or amount), capable of reducing or eliminating a potentially significant impact; and
- Other actions (e.g., actions performed by another agency, other).

1.3 Information Used to Prepare the SEIR

The following are the primary information sources used to prepare the SEIR:

- Marin Countywide Plan (CWP), Marin County Community Development Agency, November 2007.
- Marin Countywide Plan Final Environmental Impact Report (Final EIR), Marin County CDA, November 2007.
- Spatial data (e.g., number of developed parcels, number of developed units, impervious area) provided by Marin County Department of Public Works (DPW), 2005−2016.
- San Geronimo Valley Enhancement Plan ECR, Stillwater Sciences, January 2009.
- San Geronimo Valley Salmon Enhancement Plan: A Guidance Document (SEP), Prunuske Chatham Inc. and Stillwater Sciences, February 2010.
- Final Recovery Plan for Central California Coast coho salmon Evolutionarily Significant Unit, National Marine Fisheries Service (NMFS), September 2012.
- Public Draft Coastal Multispecies Recovery Plan, Volume IV, Central California Coast steelhead, NMFS, October 2015.
- Lagunitas Creek watershed fine sediment reduction and habitat enhancement plan, San Francisco Bay Regional Water Quality Control Board, M. Napolitano, March 2014.
- Adult salmonid monitoring/spawner survey reports, Eric Ettlinger and others, Marin Municipal Water District, annual reports for the 2009–2010 through 2015–2016 spawning seasons.

1.4 Public Review and Comment

This Draft SEIR is being distributed to the public and affected government agencies for review and comment during a 45-day public review period (in compliance with CCR Section 15087 of the *State CEQA Guidelines*), starting on

May 1, 2107 and ending on June 15, 2017. Written comments must be received no later than 4:00 pm on June 15, 2017 at the following address:

Marin County Community Development Agency
Attention: Rachel Reid, Environmental Planning Manager
3501 Civic Center Drive, Suite 308
San Rafael, CA 94903

Comments may also be sent via e-mail to EnvPlanning@marincounty.org

At the end of the public review period, CDA will evaluate comments on environmental issues received from the public and agencies that reviewed the Draft SEIR and would prepare written responses (CCR Section 15088 of the *State CEQA Guidelines*). The comments and the responses would be added to the Final SEIR.

1.5 Report Organization

The Draft SEIR is organized as follows:

Table of Contents. Location of chapters/sections, tables, figures, and technical appendices.

Acronyms and Abbreviations. List of acronyms and abbreviations used in the SEIR.

Summary. Summary of Project description, cumulative impacts, and the potential areas of known controversy/issues to be resolved.

Section 1: Introduction. Project background and history, California Environmental Quality Act (CEQA) requirements, SEIR requirement, uses of the SEIR, and organization of the SEIR.

Section 2: Project Description. Project context including location, objectives, and description of Project components including future land use and development. Also defines the boundaries of the Area of Analysis.

Section 3: Environmental Setting. Existing conditions relevant to salmonid impact analysis, including hydrology, water quality, urbanization, life history and

habitat requirements, associated sensitive natural communities (i.e., riparian zone), and habitat quality.

Section 4: Significance Criteria. Description of criteria used to determine whether the Proposed Project would have a significant cumulative impact on anadromous fisheries in the Area of Analysis.

Section 5: Cumulative Impacts. Describes the impact analyses and associated significance calls.

Section 6: Summary of Findings. Provides a summary of findings for the Draft SEIR.

Section 7: References.

Appendix A: Draft SEIR distribution list, public comments, and Marin County responses to public comments.

Appendix B: Results of the San Geronimo Creek 2015 low-flow habitat survey.

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2 PROJECT DESCRIPTION

2.1 Project Location

The San Geronimo Valley is located in western Marin County, California. For the purposes of this SEIR, the San Geronimo Valley is often referred to more specifically as the San Geronimo Creek watershed, which is a subwatershed of the larger Lagunitas Creek watershed that drains to Tomales Bay and eventually the Pacific Ocean (Figure 2-1).

2.2 Project Overview

The Marin CWP (2007) (Proposed Project) is the latest update to the CWP, with prior updates including 1994, 2004, and 2005. The Final EIR provides an overview of the various updates to the CWP. The purpose of the Proposed Project is to set policy guidelines for future conservation and development in the unincorporated portion of Marin County and to address changed conditions since the last revision of the CWP. The CWP establishes an overall framework and set of goals for countywide development. While cities within Marin County retain control over specific development within their jurisdictions, the County is responsible for specific development decisions in the unincorporated areas. In addition, the Marin CWP (2007) has been expanded to include such social equity and cultural issues as public health, environmental justice, child care, the economy, and arts and culture.

Figure 2-1. San Geronimo Watershed Geographic Context.

2.3 Project Objectives

The objectives of the Proposed Project include the following:

- **Preserved and restored natural environment.** Marin watersheds, natural habitats, wildlife corridors, and open space shall be protected, restored, and enhanced.
- **Sustainable agriculture community.** Marin's working agricultural landscapes shall be protected and the agricultural community shall remain viable and shall successfully produce and market a variety of healthy foods and produces products.
- **High-quality built environment.** Marin's community character, architectural heritage of its downtowns and residential neighborhoods, and the vibrancy of its business and commercial centers shall be preserved and enhanced.
- **More affordable housing.** Marin's members of the workforce, the elderly, and special needs groups shall have increased opportunities to live in well-designed, socially and economically diverse affordable housing strategically located in mixed use sites near employment or public transportation.
- **Less traffic congestion.** Marin community members shall have access to flexible work schedules, car pools and additional transportation choices for pedestrians, bicycles, and transit users that reduce traffic congestion.
- **A reduced ecological footprint.** Marin residents and businesses shall increasingly use renewable energy, fuel-efficient transportation choices, and green building and businesses practices similar to the level of Western Europe.

Of the aforementioned Project Objectives, preserving and restoring the natural environment and maintaining a sustainable agricultural community are the most relevant to the assessment of cumulative impacts on salmonids in San Geronimo Valley (see also Section 2.4).

2.4 Goals, Policies, and Implementing Programs

The overarching theme presented in the Marin CWP (2007) is sustainability. To address this theme, the Proposed Project contains three main elements: the *Natural Systems and Agriculture Element*, the *Built Environment Element*, and the *Socioeconomic Element*. Multiple topics included in the *Natural Systems and Agriculture Element* and the *Built Environment Element* are germane to the

assessment of potential cumulative impacts on salmonids in San Geronimo Valley and are summarized below.

2.4.1 Natural Systems and Agriculture Element

The *Natural Systems and Agriculture Element* includes the following main topics:

- Biological Resources
- Water Resources
- Environmental Hazards
- Atmosphere and Climate
- Open Space
- Trails
- Agriculture and Food

The *Biological Resources and Water Resources* topics are the most relevant to the assessment of potential cumulative impacts on salmonids in San Geronimo Valley. Although some policies and implementing programs included under the *Environmental Hazards, Atmosphere and Climate*, *Open Space,* and *Agriculture and Food* topics are generally pertinent to salmonid habitat quality, land use designations, which include prescriptions for stewardship and management of open space and agricultural lands and thus more directly affect habitat and salmonid health, are specified in the *Built Environment Element*. Accordingly, the SEIR analyses focus on the *Built Environment Element.* The *Environmental Hazards, Atmosphere and Climate*, *Open Space,* and *Agriculture and Food* topics of the Marin CWP (2007) are not considered further in this document.

Biological Resources

This section of the Marin CWP (2007) addresses special status species (i.e., plants and animals legally protected under the State and/or federal Endangered Species Act or other regulations) and other sensitive natural communities, such as wetlands, riparian habitat, and baylands. The *Biological Resources* topic increases environmental protection and review for streamside areas, wetlands, and special status species through a series of 5 goals, 50 policies, and 49 implementing programs.

Goal Bio-4 *Riparian Conservation* is one of the most important in the Proposed Project for protection of salmonid habitat. Goal Bio-4 includes policies that define the SCA, including a development setback of at least 100 ft from the top of the bank in the inland rural corridor (including San Geronimo Valley) with certain exceptions, including driveways if no other location is feasible, utility crossings,

and the repair or retrofit of existing permitted or legal non-conforming structures or improvements within the existing footprint (CWP Policies Bio-4.1, 4.2). Exceptions may be allowed if the parcel “falls entirely within the SCA, or development outside SCA is either infeasible or would have greater impacts” provided that development does not adversely alter hydraulic capacity; cause a net loss in habitat acreage, value, or function; or degrade water quality (CWP Policy Bio 4.1). The biological resources goals, policies and implementing programs most relevant to salmonid health in San Geronimo Valley are presented in Table 2-1.

Table 2-1. Marin CWP (2007) Biological Resources (BIO) Goals, Policies, and Implementing Programs Most Relevant to Salmonid Health in San Geronimo Valley.

Policy Number	Policy	Description	Implementing Programs
GOAL BIO-1	**Enhanced Native Habitat and Biodiversity**		
BIO-1.1	Protect Wetlands, Habitat for Special-Status Species, Sensitive Natural Communities, and Important Wildlife Nursery Areas and Movement Corridors	Protect sensitive biological resources and wetlands through careful environmental review and proposed development applications, including consideration of cumulative impacts, participation in comprehensive habitat management programs, and continued acquisition and management of open space lands that provide permanent protection of important natural habitats.	• BIO-1.a*Map Natural Communities • BIO-1.b Develop Habitat Monitoring Programs • BIO-1.c Maintain a Natural Resource Information Program • BIO-1.d* Reevaluate County Native Tree Preservation and Protection Ordinance #3291 • BIO-1.e Protect Against Vegetation and Wildlife Diseases • BIO-1.f Prepare Appropriate Landscape Lists • BIO-1.g Expand Education, Outreach, and Regulatory Programs Regarding Control of Invasive Exotic Species • BIO-1.h Encourage Community Forest Programs
BIO-1.2	Acquire Habitat	Continue to acquire habitat areas containing sensitive resources for use as permanent open space, and encourage and support public and private partnerships formed to acquire and manage important natural habitat areas.	
BIO-1.3*	Protect Woodlands, Forests, and Tree Resources	Protect large native trees and forest habitats. Prevent the untimely removal of trees and encourage local agencies to adopt tree preservation ordinances to protect native trees and woodlands, regardless of whether they are located in urban or undeveloped areas.	
BIO-1.5*	Promote Use of Native Plant Species	Encourage use of a variety of native or compatible non-native, non-invasive plants species indigenous to the site vicinity as part of project landscaping to improve wildlife habitat values.	
BIO-1.6	Control Spread of Invasive Exotic Plants	Prohibit the use of invasive species in required landscaping as part of the discretionary review of proposed development.	
BIO-1.7	Remove Invasive Exotic Plants	Require the removal of invasive exotic species, to the extent feasible, when considering applicable measures in discretionary permit approvals for development projects unrelated to agriculture, and include monitoring to prevent re-establishment in managed areas.	
BIO-1.8*	Restrict Use of Herbicides, Insecticides, and Similar Materials	Encourage the use of integrated pest management and organic practices to manage pests with the least possible hazard to the environment. Encourage nontoxic strategies for pest control, such as habitat management using physical and biological controls, as an alternative to chemical treatment, and allow use of toxic chemical substances only after other approached have been tried and determined unsuccessful.	

Policy Number	Policy	Description	Implementing Programs
GOAL BIO-2	**Protection of Sensitive Biological Resources**		
BIO-2.1	Include Resource Preservation in Environmental Review	Require environmental review pursuant to CEQA of development applications to assess the impact of proposed development on native species and habitat diversity, particularly special-status species, sensitive natural communities, wetlands, and important wildlife nursery areas and movement corridors. Achieve "no net loss" of sensitive habitat acreage, values, and function.	• BIO-2.a Require Site Assessments • BIO-2.b Conduct Habitat Connectivity Assessment • BIO-2.c Facilitate Agency Review • BIO-2.d Promote Early Agency Consultation • BIO-2.e** Participate in FishNet 4C Program
BIO-2.2	Limit Development Impacts	Restrict or modify proposed development in areas that contain essential habitat for special-status species, sensitive natural communities, wetlands, baylands coastal habitat, and riparian habitats, as necessary to ensure the continued health and survival of these species and sensitive areas.	
BIO-2.3	Preserve Ecotones	Condition or modify development permits to ensure that ecotones[1] are preserved and enhanced, particularly those along the margins of riparian corridors, baylands and marshlands, vernal pools, and woodlands and forests.	
BIO-2.6*	Identify Opportunities for Safe Wildlife Movement	Ensure that existing stream channels and riparian corridors continue to provide for wildlife movement at roadway crossings, preferably through the use of bridges, or through over-sized culverts, while maintaining or restoring a natural channel bottom.	
BIO-2.8*	Coordinate with Trustee Agencies	Consult with trustee agencies during environmental review when special-status species, sensitive natural communities, or wetlands may be adversely affected.	
BIO-2.9*	Promote Early Consultation with Other Agencies	Require applicants to consult with all agencies with review authority for projects in areas supporting wetlands and special-status species at the outset of project planning.	

[1] Ecotone: The transition zone between two biotic communities, such as between oak woodlands and grasslands (Marin CWP 2007).

Policy Number	Policy	Description	Implementing Programs
GOAL BIO-4	**Riparian Conservation**		
BIO-4.1*	Restrict Land Use in Stream Conservation Areas	SCA is established to protect the active channel, water quality and flood control functions, and associated fish and wildlife habitat values along streams. Development shall be set back to protect the stream and provide and upland buffer, which is important to protect the significant resources that may be present and provides a transitional zone. Best management practices (BMPs) shall be adhered to in all designated SCAs and strongly encouraged in ephemeral streams not defined as SCAs.	• BIO-4.a Adopt Expanded SCA Ordinance for Parcels Traversed by or Adjacent to a Mapped Anadromous Fish Stream and Tributary) • BIO-4.b Reevaluate SCA Boundaries • BIO-4.c Prepare County Stream Map • BIO-4.d Establish Functional Criteria for Land Uses in SCAs • BIO-4.e Identify Proposals Within SCAs • BIO-4.f Identify Potential Impacts to Riparian Systems • BIO-4.g Require Site Assessment • BIO-4.h Comply with SCA Criteria and Standards • BIO-4.i Replace Vegetation in SCAs • BIO-4.j Continue Funding Fencing of Sensitive Stream Areas • BIO-4.k Locate Trails Appropriately • BIO-4.l Monitor Stream Conservation Areas • BIO-4.m Encourage Conservation Plans Within the Stream Conservation Area • BIO-4.n Provide Information to Reduce Soil Erosion and Sedimentation • BIO-4.o Consider Culvert Restoration • BIO-4.p Implement NPDES Phase II • BIO-4.q Develop Standards Promoting Use of Permeable Materials • BIO-4.r Review Septic System Setbacks in SCA and WCA (Wetland Conservation Area) • BIO-4.s Continue Collaboration with the Marin Resource Conservation District and Agricultural Commissioner • BIO-4.t Collaborate with Groups to Address Implementation of Protections to SCAs and WCAs • BIO-4.u Investigate Tax Delinquent Properties
BIO-4.2*	Comply with SCA Regulations	Implement established setback criteria for protection of SCAs through established discretionary permit review processes and/or through adoption of new ordinances. Environmental review shall be required where incursion into an SCA is proposed and a discretionary permit is required.	
BIO-4.3	Manage SCAs Effectively	Review proposed land divisions in SCAs to allow management of a stream by one property owner to the extent possible.	
BIO-4.4*	Promote Natural Stream Channel Function	Retain and, where possible, restore the hydraulic capacity and natural functions of stream channels in SCAs. Discourage alteration of the bed or banks of the stream, including filling, grading, excavating, and installation of storm drains and culverts. When feasible, replace impervious surfaces with pervious surfaces. Retain woody debris. No alterations that create barriers to fish migration in streams mapped as historically supporting salmonids.	
BIO-4.5	Restore and Stabilize Stream Channels	Pursue stream restoration and appropriate channel redesign where sufficient right-of-way exists that includes the following: a hydraulic design, a channel plan form, a composite channel cross-section that incorporates low flow and bankfull channels, removal and control of invasive exotic plant species, and biotechnical bank stabilization methods to promote quick establishment of riparian trees and other native vegetation.	
BIO-4.6	Control Exotic Vegetation	Remove and replace invasive exotic plants with native plants as part of stream restoration projects and as a condition of site-specific development approval in an SCA, and include monitoring to prevent reestablishment.	

Policy Number	Policy	Description	Implementing Programs
BIO-4.7*	Protect Riparian Vegetation	Retain riparian vegetation for stabilization of streambanks and floodplains, moderating water temperatures, trapping and filtering sediments and other water pollutants, providing wildlife habitat, and aesthetic reasons.	
BIO-4.8	Reclaim Damaged Portions of SCAs	Restore damaged portions of SCAs to their natural state wherever possible, and reestablish as quickly as possible any herbaceous and woody vegetation that must be removed within an SCA, replicating the structure and species composition of indigenous native riparian vegetation.	
BIO-4.9*	Restore Culverted Streams	Replace storm drains and culverts in SCAs with natural drainage and flood control channels wherever feasible. Detailed hydrologic analysis may be required to address possible erosion and flooding implications of reopening culverted reaches. Incentives should be provided to landowners. Modify culverts to allow fish passage when replacement of culverts is not possible.	
BIO-4.10	Promote Interagency Cooperation	Work in close cooperation with flood control districts, water districts, and wildlife agencies in the design and choice of materials for construction and alterations within SCAs.	
BIO-4.11	Promote Riparian Protection	Support agencies, organizations, and programs in Marin County that protect, enhance, and restore riparian areas.	
BIO-4.12	Support and Provide Riparian Education Efforts	Educate the public and County staff about the values, functions, and importance of riparian areas. An emphasis will be placed on public outreach to owners of developed properties encompassing or adjacent to SCAs where minimum setback distances are not provided. An updated list of regulatory agencies and their contact information should be maintained as part of the Natural Resource Information Program.	
BIO-4.13	Provide Appropriate Access in SCAs	Ensure that public access to publicly owned land within SCAs respects the environment, and prohibit access if it will degrade or destroy riparian habitat. Acquire public lands adjacent to streams where possible to make resources more accessible and usable for passive recreation, and to protect and enhance streamside habitat.	
BIO-4.14	Reduce Road Impacts in SCAs	Locate new roads and roadfill slopes outside SCAs, except at stream crossings, and consolidate new road crossings wherever possible to minimize disturbance in the SCA, and take special care to stabilize soil surfaces.	

Policy Number	Policy	Description	Implementing Programs
BIO-4.15*	Reduce Wet Weather Impacts	Ensure that development work adjacent to and potentially affecting SCAs is not done during the wet weather or when water is flowing through streams, except for emergency repairs, and that disturbed soils are stabilized and replanted, and areas where woody vegetation has been removed are replanted with suitable species before the beginning of the rainy season.	
BIO-4.16	Regulate Channel and Flow Alteration	Allow alteration of stream channels or reduction in flow volumes only after completion of environmental review, commitment to appropriate mitigation measures, and issuance of appropriate permits by jurisdictional agencies based on determination of adequate flows necessary to protect fish habitats, water quality, riparian vegetation, natural dynamics of stream functions, groundwater recharge areas, and downstream users.	
BIO-4.17	Continue Collaboration with the Marin Resource Conservation District	Continue to collaborate with, support, and participate in programs provided by the Marin Resource Conservation District and the Natural Resource Conservation Service to encourage agricultural operators who conduct farm or ranch activities within an SCA to minimize sedimentation and erosion to enhance habitat value.	
BIO-4.18	Promote the Use of Permeable Surfaces When Hardscapes Are Unavoidable in the SCA and WCA	Permeable surfaces rather than impermeable surfaces shall be required wherever feasible in the SCA and WCA.	
BIO-4.19	Maintain Channel Stability	Applicants for development projects may be required to prepare hydraulic and/or geomorphic assessment of on-site and downstream drainage ways that are affected by project area runoff. This assessment should be required where evidence that significant current or impending channel instability is present.	
BIO-4.20	Minimize Runoff	In order to decrease stormwater runoff, the feasibility of developing a peak stormwater management program shall be evaluated to provide mitigation opportunities such as removal of impervious surface or increased stormwater detention in the watershed.	

* Denotes policies and/or implementing programs that were initiated through Marin County participation in the FishNet 4C Program (see discussion of Mitigation Measure 4.6-1 below).

** The FishNet 4C Program status is discussed on pages 2-11 and 2-12.

Mitigation Measure 4.6-1 Voluntary Compliance Efforts

As part of the Biological Resources impact analysis in the Final EIR, Mitigation Measure 4.6-1 was developed to reduce potential impacts to special-status species due to land-use policies and development consistent with the updated CWP. Mitigation Measure 4.6-1 recommended adding a new policy to the Biological Resources section of the CWP as follows:

> *Participate in FishNet 4C Program. Continue to actively participate in the FishNet 4C program and work cooperatively with participating agencies to implement recommendations to improve and restore aquatic habitat for listed anadromous fish species and other fishery resources.*

The impact analysis indicated that adoption of Mitigation Measure 4.6-1, together with effective implementation of relevant programs, and oversight by regulatory agencies entrusted with enforcement of State and federal regulations that address protection and management of special-status species, would substantially reduce adverse effects to special-status species resulting from land uses and development consistent with the Draft 2005 CWP Update. The impact analysis indicated that this would be a less-than significant project impact and the project's contribution to cumulative impacts would be less than cumulatively considerable. Accordingly, implementing program *BIO-2.e Participate in FishNet 4C Program* was added to the Marin CWP (2007) (Table 2-1).

The original intent of Mitigation Measure 4.6-1, was that the Board of Supervisors would be responsible for adopting the new policy as described in the Marin CWP (2007). The Marin County CDA and the Marin County Department of Public Works (DPW) would share responsibility for ensuring adequate environmental review and avoidance of sensitive resources, for continued participation in the FishNet 4C program, and for monitoring implementation.

FishNet 4C Program Status

The Fishery Network of Central California Coastal Counties (FishNet 4C) comprised the counties of Mendocino, Sonoma, Marin, San Mateo, Santa Cruz and Monterey, where the counties worked together to implement fisheries restoration projects with a focus on recovering endangered and threatened coho salmon and steelhead trout populations. The organization functioned to bring resource agencies together (e.g., California State Water Resources Control Board [SWRCB], regional Water Quality Control Boards [WQCBs], U.S. Fish and Wildlife Service [USFWS], NMFS, CDFW), catalyzing support and raising funds for projects across the six participating counties. Marin County actively

participated in the FishNet 4C Program from 1998−2011, during which time the structural aspects of the network (e.g., administration, regular meetings) were funded by a combination of state and local grants, and a number of foundational policies were developed to protect fish habitat from development impacts, such as streamflow quantity modification, riparian vegetation and floodplain management, sedimentation, instream habitat modification, water quality impacts, and fish migration barriers. Although funding for FishNet 4C ended in 2011, the projects, policies, and programs created under FishNet 4C have continued, including the following policies and implementing programs under the Proposed Project that are relevant to salmonid Health in San Geronimo Valley (see also Tables 2-1 and 2-2):

Policies

- BIO-1.3 Protect Woodlands, Forests, and Tree Resources
- BIO-1.5 Promote Use of Native Plant Species
- BIO-1.8 Restrict Use of Herbicides, Insecticides, and Similar Materials
- BIO-2.8 Coordinate with Trustee Agencies
- BIO-2.9 Promote Early Consultation with Other Agencies
- BIO-4.1 Restrict Land Use in Stream Conservation Areas
- BIO-4.2 Comply with SCA Regulations
- BIO-4.4 Promote Natural Stream Channel Function
- BIO-4.7 Protect Riparian Vegetation
- BIO-4.9 Restore Culverted Streams
- BIO-4.15 Reduce Wet Weather Impacts

Implementing Programs

- BIO-1.a Map Natural Communities
- BIO-1.d Reevaluate County Native Tree Preservation and Protection Ordinance
- WR-1.2 Restore and Enhance Watersheds
- WR-2.3 Avoid Erosion and Sedimentation
- WR-2.5 Take Part in Water Quality Education

Water Resources

The *Water Resources* section of the Marin CWP (2007) focuses on the environmental aspects of watersheds, hydrology, flooding, septic alternative waste options, and water conservation through a series of 3 goals, 11 policies, and 22 implementing programs. The water resources goals, policies and implementing programs most relevant to salmonid health in San Geronimo Valley are presented in Table 2-2.

Table 2-2. Marin CWP (2007) Water Resources (WR) Goals, Policies, and Implementing Programs Most Relevant to Salmonid Health in San Geronimo Valley.

Policy Number	Policy	Description	Implementing Programs
GOAL WR-1	**Healthy Watersheds**		
WR-1.1	Protect Watersheds and Aquifer Recharge	Give high priority to the protection of watersheds, aquifer-recharge areas, and natural drainage systems in any consideration of land use.	• WR-1.a Support Watershed Education and Outreach • WR-1.b Establish Development Standards for Infiltration • WR-1.c Seek Watershed Assessment and Monitoring Assistance • WR-1.d Coordinate Watershed Efforts WR-1.e Require Restoration of Degraded Areas • WR-1.f Require Stream Restoration Projects
WR-1.2*	Restore and Enhance Watersheds	Support watershed restoration efforts, coordinate County watershed activities with efforts by other groups, and simplify permit acquisition for watershed restoration and enhancement projects.	
WR-1.3	Improve Infiltration	Enhance water infiltration throughout watersheds to decrease accelerated runoff rates and enhance groundwater recharge. Whenever possible, maintain or increase a site's predevelopment infiltration to reduce downstream erosion and flooding.	
WR-1.4	Protect Upland Vegetation	Limit development and grazing on steep slopes and ridgelines in order to protect download areas from erosion and to ensure that runoff is dispersed adequately to allow for effective infiltration.	

Policy Number	Policy	Description	Implementing Programs
GOAL WR-2	**Clean Water**		
WR-2.1	Reduce Toxic Runoff	Reduce the volume of urban runoff from pollutants - such as pesticides from homes, golf courses, cleaning agents, swimming pool chemicals, and road oil - and of excess sediments and nutrients from agricultural operations.	• WR-2.a Participate in Updating Standards • WR-2.b Integrate Bay Area Stormwater Management Agencies Association (BASMAA) Stormwater Quality Protection Guidelines into Permitting Requirements for All Development and Construction Activities • WR-2.c Research and Implement Safe and Effective Alternative Waste Options • WR-2.d Continue Alternative Septic/Waste System Monitoring • WR-2.e Continue Providing High-Priority Inspections • WR-2.f Continue Alternative Septic System Monitoring • WR-2.g Inspect Septage Haulers • WR-2.h Establish Additional County Service Areas • WR-2.i Establish a Septic Inspection, Monitoring, and Maintenance District • WR-2.j Continue Public Outreach Regarding Toxic Chemical Use • WR-2.k Establish Educational Partnerships to Protect Water Quality • WR-2.l Implement County Ordinances • WR-2.m Nontoxic Building Materials Standards • WR-2.n Implement Least Toxic Methods for Maintenance and Pest Control • WR-2.o Establish a Groundwater Monitoring Program for Unincorporated County Areas
WR-2.2	Reduce Pathogen, Sediment, and Nutrient Levels	Support programs to maintain pathogen and nutrient levels at or below target levels set by the SFBRWQCB, including the efforts of ranchers, dairies, agencies, and community groups to address pathogen, sediment, and nutrient management in urban and rural watersheds.	
WR-2.3*	Avoid Erosion and Sedimentation	Minimize soil erosion and discharge of sediments into surface runoff, drainage systems, and water bodies. Continue to require grading plans that address avoidance of soil erosion and on-site sediment retention. Require developments to include on-site facilities for the retention of sediments, and if necessary, require continued monitoring and maintenance of these facilities upon project completion.	
WR-2.4	Design County Facilities to Minimize Pollutant Input	Design, construct, and maintain County buildings, landscaped areas, roads, bridges, drainages, and other facilities to minimize the volume of toxics, nutrients, sediment, and other pollutants in stormwater flows, and continue to improve road maintenance methods to reduce erosion and sedimentation potential.	
WR-2.5*	Take Part in Water Quality Education	Continue to support local stormwater and community watershed group efforts to inform the public about practices and programs to minimize water pollution.	

Policy Number	Policy	Description	Implementing Programs
GOAL WR-3	**Adequate Water for Wildlife and Humans**		
WR-3.1	Conserve Water and Develop New Sustainable Sources	Reduce the waste of potable water through efficient technologies, conservation efforts, and design and management practices, and by better matching the source and quality of water to the user's needs.	• WR-3.a Support Water Conservation Efforts • WR-3.b Support and Integrate Water District Conservation Efforts
WR-3.2	Mitigate Water Demand in New Development	Assess and mitigate the impacts of new development on potable water supplies and water available for wildlife.	

* Denotes policies and/or implementing programs that were initiated through Marin County participation in the FishNet 4C Program (see discussion of Mitigation Measure 4.6-1 above).

2.4.2 Built Environment Element

The *Built Environment Element* section of the Marin CWP (2007) identifies the degree of allowable growth, sets forth a pattern for land use, and sets out standards for the density of population and the intensity of development for each type of allowable use. The *Built Environment Element* also establishes a direct tie between the timing, amount, type, design, and location of development and the traffic, service, and infrastructure resources available to serve additional demand. The *Built Environment Element* includes the following main topics:

- Community Development
- Community Design
- Energy and Green Building
- Mineral Resources
- Housing
- Transportation
- Noise
- Public Facilities and Services
- Planning Areas

The *Community Development and Planning Area* topics are highly relevant to the assessment of cumulative impacts on salmonids in San Geronimo Valley because they provide specific land-use designations and allowable development within those land-use designations. These are summarized further below.

Community Development

The *Community Development* section of the Marin CWP (2007) focuses on the urban forms that are intended to shape development in the unincorporated county and provide guidance to the cities and towns of Marin County. Four corridors are designated to shift existing development potential from environmentally constrained sites to more appropriate locations and thus protect environmental resources; San Geronimo Valley is included in the *Inland Rural Corridor*. The *Inland Rural Corridor* is located in the central and northwestern part of the county, and is designated for agriculture and compatible uses and for preservation of existing small communities.

The *Community Development* topic generally directs land use to appropriate areas, with urban areas having concentrated development, and sensitive natural areas having much less. It includes 8 development goals, 36 policies, and 62 implementing programs. The community development goals, policies and

implementing programs most relevant to salmonid health in San Geronimo Valley are presented in Table 2-3.

Although not specific to the *Community Development* topic, zoning implements the land use policies identified in the Marin CWP (2007) by dividing the county into zones, which specify allowable uses for real property and size restrictions for buildings within these areas. Regulations for the various zoning districts are defined and specified by the Development Code, Title 22 of the Marin County Code. In unincorporated Marin, there are two fundamental types of zoning districts: conventional and planned (Marin CWP 2007). Conventional zoning districts have specific numerical subdivision and development standards, including minimum lot area, minimum setbacks, height limits, and floor area ratio limits. Provided a development project conforms to those standards, no discretionary development permits are required. In contrast, planned zoning districts have few specific numerical standards. Instead, they encourage development to be clustered in the areas most suitable for development on a given site to conserve a larger portion of that site in its natural state (Marin CWP 2007).

Table 2-3. Marin CWP (2007) Community Development (CD) Goals, Policies, and Implementing Programs Most Relevant to Salmonid Health in San Geronimo Valley.

Policy Number	Policy	Description	Implementing Programs
GOAL CD-1	**Environmental Corridor Land Use Framework**		
CD-1.1	Direct Land Uses to Appropriate Areas	Concentrate urban development in the City-Centered Corridor, where infrastructure and facilities can be made available most efficiently. Emphasize agricultural uses in the Inland Rural Corridor, along with preservation of resources, habitat, and existing communities.	• CD-1.a Keep Urban Uses in the City-Centered Corridor • CD-1.c Reduce Potential Impacts • CD-1.d Maintain Agriculture in the Inland Rural Corridor
CD-1.2	Direct Urban Services	Discourage extension of urban levels of service to serve new development beyond urban service areas.	
CD-1.3	Reduce Potential Impacts	Calculate potential residential densities and commercial floor area ratio (FAR) at the lowest end of the applicable range on sites with sensitive habitat, on sites within the Ridge and Upland Greenbelt or Baylands Corridor, or on sites lacking public water or sewer systems.	
GOAL CD-8	**Land Use Categories**		
CD-8.1	Establish Land Use Plan Map Designations	Land use designations are established as shown on the Land Use Policy Maps (Figure 2-2 through Figure 2-5) based on such factors as natural resource protection, existing and surrounding land uses, and environmental hazards.	• CD-8.a Review of Development Code • CD-8.b Revise Zoning Maps
CD-8.2	Establish Land Use Categories	Established land use categories are generalized groupings of land uses that define a predominant land use type. Some listed uses will be conditional uses under zoning, will require a use permit or other discretionary approval, and may be allowed only in limited areas or under limited circumstances.	
CD-8.3	Establish Land Use Intensity Standards	Standards of building intensity expressed as floor area ratios or residential densities (dwelling units per acre) are established for each land use designation. To convert residential units to population densities, 2.3 persons per household shall be assumed.	

Policy Number	Policy	Description	Implementing Programs
CD-8.4	Establish Agriculture and Conservation Land Use Categories	Agriculture and Conservation land use categories are established for land with resource values both for agriculture production and for wetlands and wildlife habitat. These lands may also have physical constraints, such as heavily wooded hillsides and ridgelines, that limit their potential for agricultural production and deserve protection on the basis of their habitat and visual resource values.	
CD-8.5	Establish Agricultural Land Use Categories	Agriculture land use categories are established to preserve and protect a variety of agricultural uses, and to enable the potential for agricultural production and diversification. Historically, 60 ac has been the minimum parcel size for most agricultural lands in the county. Various policies regarding agricultural productivity, water availability, effects on water quality, and other factors govern the subdivision of such lands.	
CD-8.6	Establish Residential Land Use Categories and Densities	Residential development is designated at a full range of densities, with an emphasis on providing more affordable housing, while also recognizing that physical hazards, fire risk, development constraints, protection of natural resources, and the availability of public services and facilities can limit housing development in some areas.	
CD-8.9	Establish Public Facility, Quasi-Public Facility, and Open Space Land Use Categories	Lands in public ownership for open space purposes, such as recreation, watershed, and habitat protection and management, are designated Open Space. In addition, private lands may be designated Open Space when subject to deed restrictions or other agreements limiting them to open space and compatible uses. Lands designated Open Space are subject to a floor area ratio (FAR) of 0.01 to 0.09.	

Planning Areas

In addition to the four environmental corridors, there are seven planning areas that define Marin County. San Geronimo Valley is included in the West Marin Planning Area, and includes the villages of Forest Knolls, Lagunitas, San Geronimo, and Woodacre. The Marin CWP (2007) references the San Geronimo Valley Community Plan (Plan) (1997), which defines land-use and conservation guidelines for planning decisions. The Plan presents goals, objectives, policies, and programs designed to preserve the unique natural attributes of the Valley and its communities as well as the historical character of the built environment. The guidelines are used by CDA staff, the County Planning Commission and the Board of Supervisors to review specific development proposals within San Geronimo Valley. The Plan provides direction to property owners, community groups and interested individuals in formulating and reviewing new developments. The Plan sets the number of units per acre for different land-use categories (Figure 2-2).

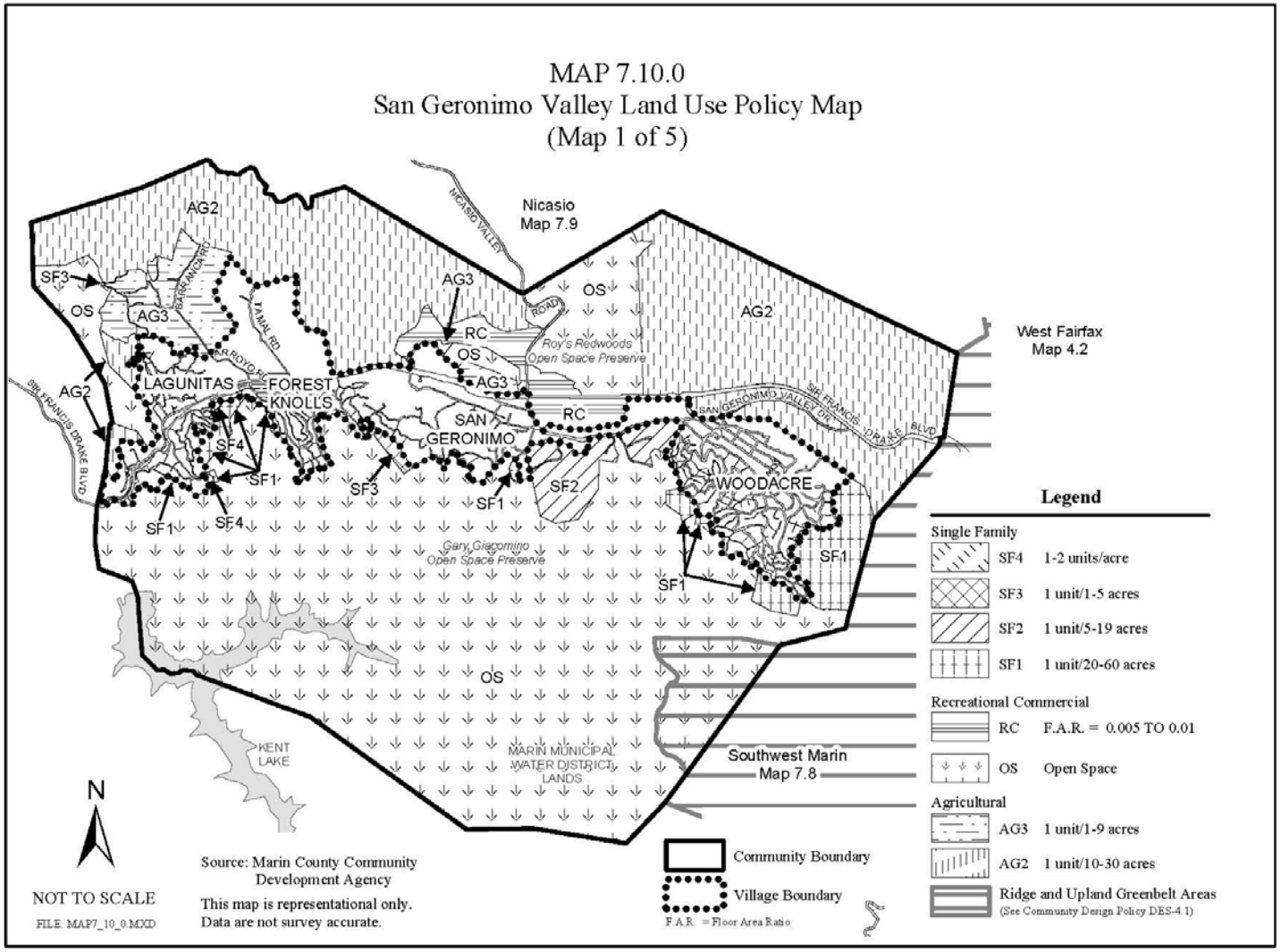

Figure 2-2. San Geronimo Valley Land Use Policy Map (Marin CWP [2007]).

2.5 Area of Analysis

The area of analysis for existing conditions and future development under the Proposed Project is the San Geronimo Creek watershed, where the downstream boundary of the watershed is defined as the confluence of San Geronimo Creek and Lagunitas Creek (Figure 2-3). Study reaches within mainstem San Geronimo Creek and the major tributary subbasins (Woodacre Creek, Larsen Creek, Montezuma Creek, and the Arroyo/Barranca/El Cerrito Complex) are also defined in Figure 2-3, consistent with the *San Geronimo Valley Existing Conditions Report* (Stillwater Sciences 2009a).

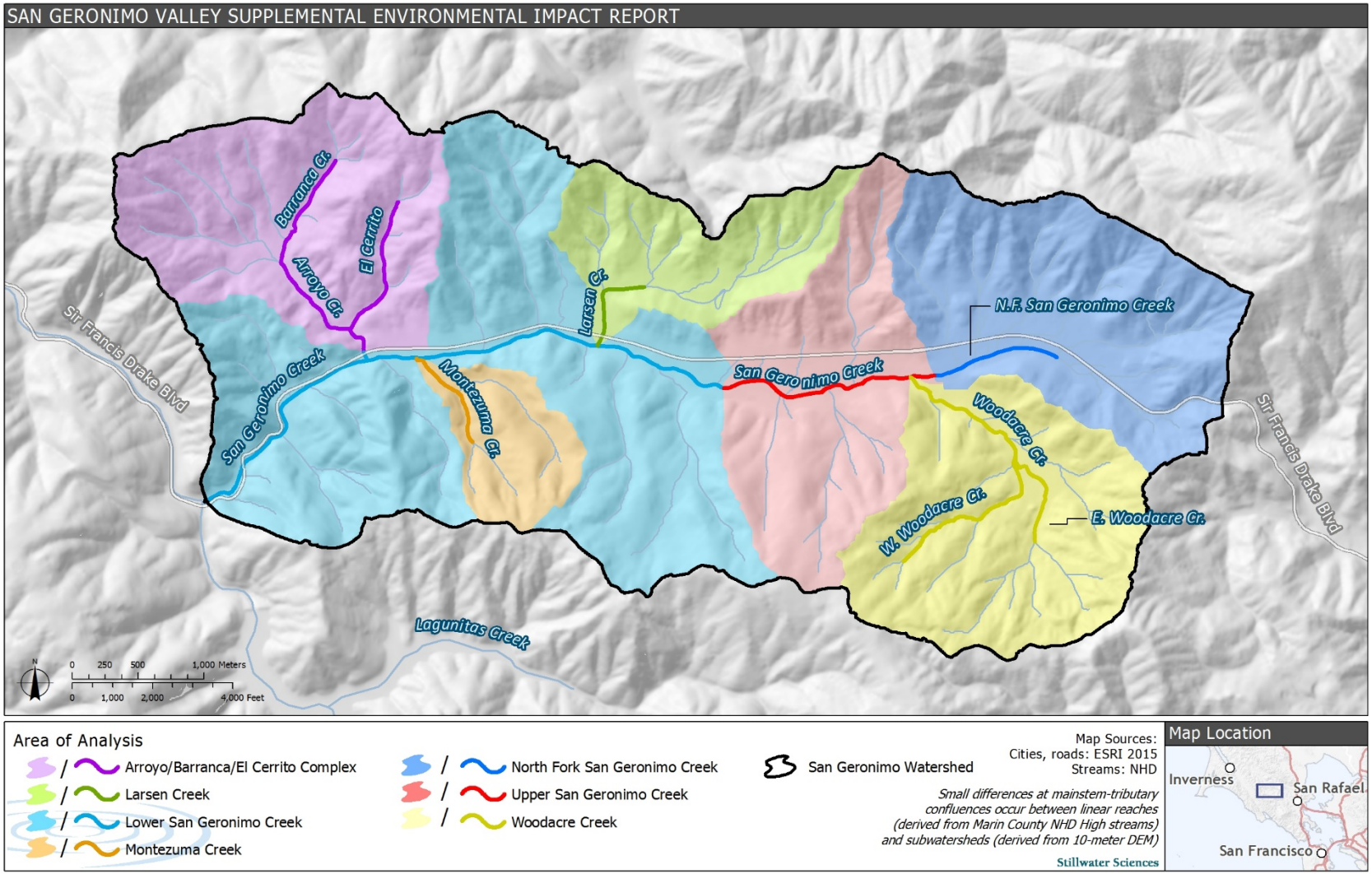

Figure 2-3. Area of Analysis.

2.6 Future Development

2.6.1 Development Metrics

Prior to development policies established in the 1994 and 2007 CWPs, buildout potential in San Geronimo Valley was based on original zoning ordinance criteria. Under the Proposed Project, specific policies have changed the amount and type of allowable development (Section 2.4.2). The following sections use several metrics to characterize existing conditions as well as future development under the Proposed Project, where the metrics have been selected based upon available data and potential relationship to habitat conditions for salmonids. The existing conditions and future development metrics used in this SEIR are briefly described below.

Number of improved parcels – the number of land parcels possessing electricity, telephone, road (paved or unpaved) access, and/or connection to potable water and wastewater services, using parcel use designation as assigned by the Marin County Assessor's Office.

Number of developed units – the number of commercial or residential buildings or structures erected according to applicable building codes, using unit designation as assigned by the Marin County Assessor's Office.

Total Impervious Area – the total area of constructed, non-infiltrating surfaces, such as rooftops, parking lots, and roads, expressed as an absolute value and a percentage of the total land area in the watershed. Additional discussion of the total impervious area (TIA) metric with respect to San Geronimo Valley is provided in Sections 2.6.2 through 2.6.4.

Number of parcels with municipal domestic water supply – the number of land parcels that are served by Marin Municipal Water District (District) as their primary water supply, using parcel associations provided by the District.

Number of parcels with groundwater wells – the number of land parcels that possess one or more active groundwater wells, as defined using parcel associations provided by the Marin County Department of Environmental Health Services (EHS).

Number of groundwater wells – the number of individual active wells, using well locations provided by the Marin County EHS.

Number of water diversions – the number of individual water diversions, as defined by the California State Water Resources Control Board Electronic Water Rights Information Management System (eWRIMS).

Using the above metrics, existing conditions and future development in San Geronimo Valley under the Proposed Project are characterized at the following three scales:

- Watershed scale, as defined by the Area of Analysis (Section 2.5);
- Scale of the subbasin or reach, consistent with study reaches defined in the *San Geronimo Valley Existing Conditions Report* (Stillwater Sciences 2009a). This scale is included in the analysis in order to best support planning efforts, because aquatic-resource problems, and their solutions, are ultimately "place-based." Note that solutions to those problems may not always be most effective at the location where the symptom is apparent—recognizing the spatial relationship between in-stream conditions and the contributing watershed is essential to identifying effective solutions.
- Stream Conservation Area (SCA), as defined by a development setback on each side of the streamside top of bank that is the greater of either (a) 50 ft landward from the outer edge of woody riparian vegetation associated with the stream or (b) 100 ft landward from the top of bank (Figure 2-4) (Marin CWP [2007]). The SCA has been established to protect the active channel, water quality and flood control functions, as well as associated fish and wildlife habitat values along streams, and development within its boundaries has the potential for relatively greater impacts. Ephemeral streams that are not otherwise subject to SCA setbacks have their own setback measurements (Figure 2-5).

In addition to the aforementioned existing conditions and future development metrics, the following metric is used in this SEIR to characterize past, current (i.e., existing) and future development in San Geronimo Valley at the scale of the watershed:

> *Population* – the number of individuals living in San Geronimo Valley by decade, as defined by the San Geronimo Community Plan (1997) for 1980 and 1990; the U.S. Census Bureau for 2000 and 2010; and the Marin CWP (2007) estimate of average household size (2.35 people/unit) multiplied times the number of units to be developed for future theoretical buildout.

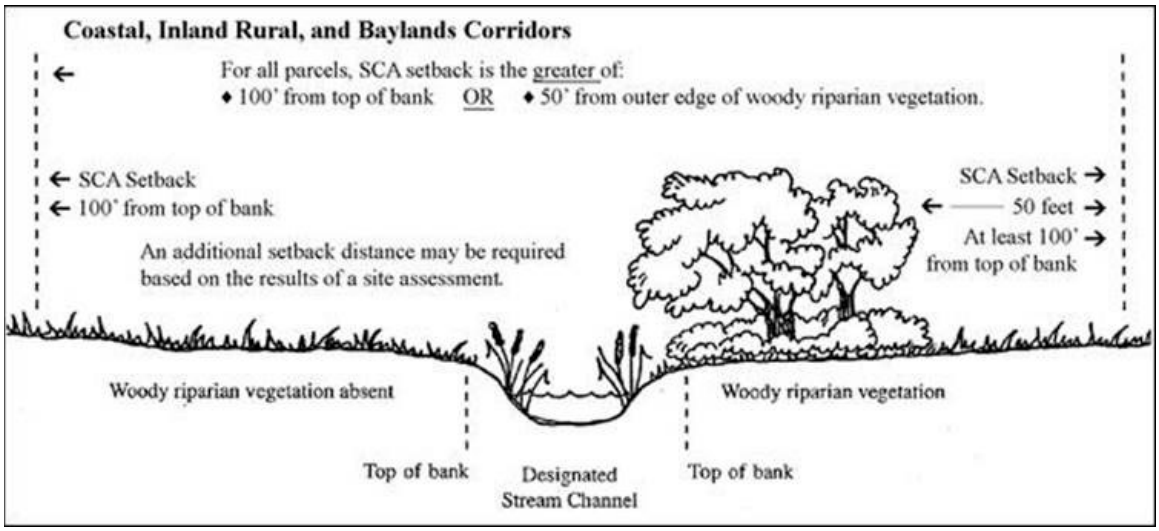

Figure 2-4. Marin CWP (2007) Stream Conservation Area Development Setback.

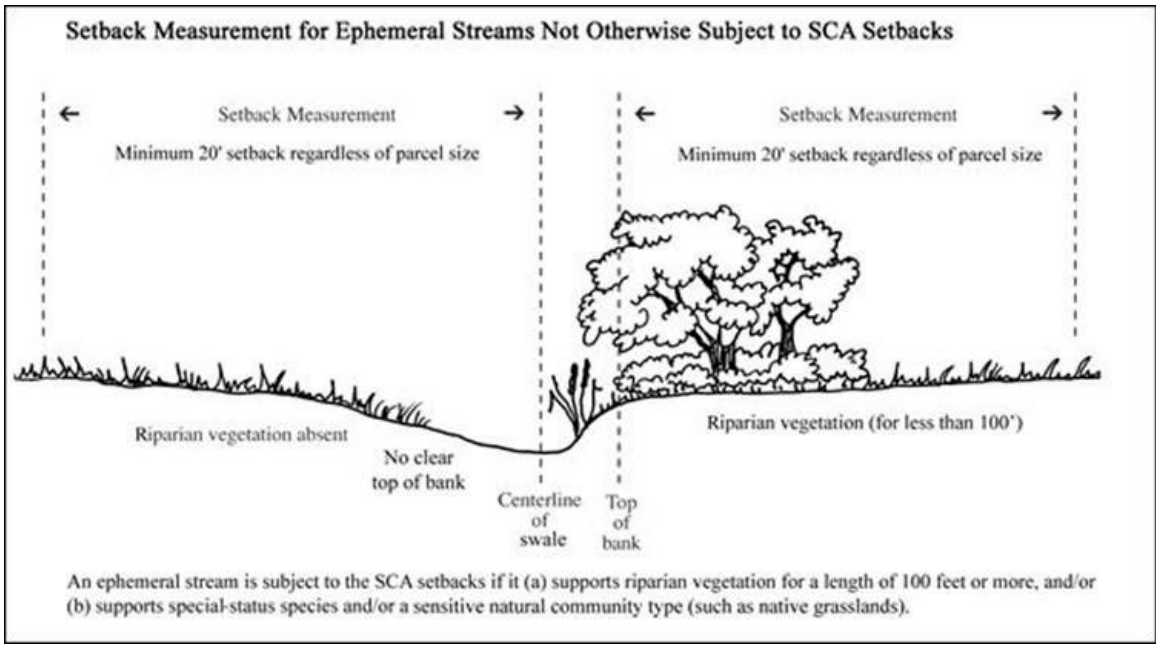

Figure 2-5. Setback Measurement for Ephemeral Streams not Otherwise Subject to SCA Setbacks (Marin CWP [2007]).

Total Impervious Area

"Imperviousness" has long been recognized as an important determinant of the health of an urban watershed, whether measured by physical, chemical, or biological metrics (USEPA 1983, Booth and Jackson 1997, Jones et al. 2005). Over the last decade, a number of correlations have been drawn between watershed imperviousness and stream conditions, initiated by the definition of generalized classifications of instream habitat quality as "sensitive" at 1–10%

imperviousness; “impacted” at 11–25% imperviousness; and “non-supporting” at greater than 25% imperviousness (Center for Watershed Protection 1998). However, these thresholds are not site-specific and the boundaries between the different conditions are not absolute, such that even at low levels of residential and commercial development (urbanization), impacts to stream ecosystems can be recognized (Booth et al. 2002, National Academy of Sciences 2008, Stillwater Sciences 2009a). An overview of urbanization effects on stream ecosystem function is presented in Section 3.2, followed by a discussion of hydrology, water quality, the riparian zone, and habitat quality, as these topics pertain to anadromous fish habitat in the San Geronimo Valley (Sections 3.3−3.6).

Not all studies use identical methods for determining “imperviousness,” and a review of the literature (Booth et al. 2002) found that not every study makes the fundamental discrimination between TIA and effective impervious area (EIA). The latter, defined as the impervious surfaces with direct hydraulic connection to the downstream drainage (or stream) system, is the parameter normally used to characterize urban development in hydrologic models and excludes any part of the TIA that drains onto pervious (i.e., “green”) ground allowing for interception and infiltration of runoff. Direct connection of impervious surfaces to streams, which is better represented by EIA, means that even small rainfall events can produce sufficient surface runoff to cause frequent disturbance through regular delivery of water and pollutants. Although TIA and EIA offer important analysis distinctions, the commonalities are far more dramatic than the differences—imperviousness is a coarse but powerful predictor of stream condition and there is little to be gained by a highly precise delineation of TIA versus EIA in San Geronimo Valley (Stillwater Sciences 2009a).

The methodology for estimating TIA in the San Geronimo Valley followed the standard U.S. Geological Survey (USGS) approach, as described by Tilley and Slonecker (2007) and previously reported in Stillwater Sciences (2009a). TIA for San Geronimo Valley includes the area of of buildings, roads (paved, gravel, other), parking lots, driveways, and sidewalks (via a conservative buffer on paved roads), which should characterize more than 90% of the impervious areas found in the watershed (Stillwater Sciences 2009a). More specifically, future potential TIA for buildings (units) was estimated by:

1) Determining existing TIA for each unit in a given parcel; parcels with existing units, determining the average TIA of a single unit by parcel and land use type, multiplying the average by the number of additional units allowable for that parcel, and adding it to the existing TIA;

2) For parcels without existing units, applying the average unit size for the associated landuse category (based on the parcel land use).

Table 2-4. Average Building (Unit) Footprint by Land Use Category.

Land Use Category	Existing Conditions (2005) (ft^2) [1]
Commercial	1,289
Community Open Space & Facilities	1,840
Institutional	2,955
Multi Family Commons	242
Multi Family Residential	1,096
Open Space – Public	2,113
Road	1,099
Rural	550
Single Family Residential	1,190
Utility	2,065

[1] Data provided by Marin County (2005). There has been no substantial development in San Geronimo Valley since 2005 and therefore no change to estimated TIA under existing conditions.

Road density in the San Geronimo Creek watershed (7.4 mi/mi^2) is the highest of any Lagunitas Creek tributary. Approximately half of the roads in the watershed are unpaved (SFBRWQCB 2014a) and are not maintained by Marin County DPW. While unpaved roads contribute a substantial amount of sediment to San Geronimo Creek (Stillwater Sciences 2010, SFBRWQCB 2014a), dirt roads or unclassified segments were not included in the TIA analysis because they do not conform to the standard USGS definition of impervious roads.

2.6.2 Watershed Scale

Under the Proposed Project, there is potential for an increased number of improved parcels within the watershed as a whole, as well as an increased number of developed units (Table 2-5). Despite this, remaining parcels zoned for future development tend to have significant environmental constraints, which either substantially increase construction costs or preclude development altogether (e.g., inadequate percolation for on-site septic systems, lack of access via paved roads, steep topography necessitating engineered foundation designs). For example, in 2016 Marin County issued 19 building permits in San Geronimo Valley, compared with approximately 1,200 buiding permits issued for the County as a whole. The San Gernonimo Valley 2016 building permits were issued for remodels of existing buildings, and construction of decks and retaining walls, which as a group represent a mixture of projects that may or may not

extend respective development footprints. While it is not possible to quantitatively reduce the estimate of improved parcels under the Proposed Project without a parcel-by-parcel analysis that assumes specific design attributes for future development, the relatively low number of San Geronimo Valley building permits issued by Marin County in recent years (e.g., 2016) indicates that the number of additional improved parcels and developed units anticipated under the Proposed Project (Table 2-5) is likely to be a conservative estimate (i.e., an overestimate).

Table 2-5. Development Metrics for San Geronimo Valley at the Scale of the Watershed.

Metric	Existing Conditions (2005)	Proposed Project	Difference (and % change)
Improved parcels [1]	1,415	1,738	323 (+22%)
Unimproved parcels [1]	474	151	-323 (-22%)
Other parcels [1,2]	144	144	0 (0%)
Developed units [1]	1,598	1,956	358 (+22%)
TIA (ac) [1]	301.4	315.5	14.1 (+5%)
%TIA [1]	5.0%	5.3%	0.3% (+6%)
Parcels with municipal domestic water supply [3]	1,305	1,617 [4]	312 (+24%)
Parcels with groundwater wells [5]	36	≥ 36	–
Groundwater wells [5]	36	≥ 36	–
Water diversions [6]	6	≥ 6	–

[1] Data provided by Marin County CDA in 2005. There has been no substantial development in San Geronimo Valley since 2005 and therefore no change to the number of improved parcels, unimproved parcels, other parcels, units, or TIA under existing conditions.

[2] The following land use designations are included in 'Other': Common Area; Exemption – Vacant; Mobile Homes; Road; Tax Exempt; Blank.

[3] Data provided by Marin Municipal Water District in 2016.

[4] This analysis assumes that all new improved parcels under the Proposed Project would possess municipal domestic water supply. Existing information indicates that there are currently a small number of unimproved parcels that already possess municipal domestic water supply; some of these parcels would be improved under the Proposed Project, while others would not. The net effect is that the number of parcels that would possess municipal water supply (n=312) under the Proposed Project is less than the number of parcels that would be improved (n=323).

[5] Data provided by Marin County Department of Environmental Health Services in 2016. Only groundwater wells likely to be active are included in the analysis.

[6] Data Source: California State Water Resources Control Board eWRIMS. Data downloaded September 2016. https://waterrightsmaps.waterboards.ca.gov/ewrims/gisapp.aspx

As described in the *San Geronimo Valley Existing Conditions Report* (Stillwater Sciences 2009a), San Geronimo Valley as a whole displays modest imperviousness at levels that have been well correlated with various measures of resource degradation throughout the western United States and in temperate regions across the globe. Under the Proposed Project, there would be a small increase in TIA (14.1 ac) and %TIA (0.3%, reflecting a 6% increase from the

existing TIA level of 5%) resulting from the maximum amount of allowable buildout in the Marin CWP (2007) (Table 2-5). Because the number of additional improved parcels and developed units anticipated under the Proposed Project would likely be lower than those those presented in Table 2-5, the projected TIA and %TIA estimates are also conservative.

Available data indicate that the vast majority of parcels in San Geronimo Valley currently possess municipal water supply, and under the Proposed Project all new improved parcels would also possess municipal water supply (Table 2-5). Available data also suggest that there are 36 parcels possessing the same number of wells that are likely to be active for domestic and/or irrigation use. While it is reasonable to assume that groundwater wells (or springs) are the current designated source of water for sites that do not have municipal water supply connections, it is not reasonable to assume that all of the presumed active groundwater wells have adequate full-year capacity. Marin County currently does not possess sufficient information regarding groundwater sources that temporarily or permanently dry up. Additionally, the County is not notified if common water systems (e.g., groundwater wells that are shared by multiple units within a parcel, or across parcels) are created without permits. Consistent with the assumption that all new improved parcels would possess municipal water supply, this analysis assumes that new development under the Proposed Project would be unlikely to use groundwater as the designated source of water for the parcel (Table 2-5). As a conservative assumption, the number of existing active groundwater wells would represent the minimum number of wells for San Geronimo Valley under the Proposed Project.

Available data indicate that there are six appropriative water rights for surface water diversions in San Geronimo Valley (Table 2-5). There is no known information regarding surface water diversions created without a permit for the Area of Analysis. It is not known whether any of the six surface water diversions are typically active, nor the rate of diversion for each. As a conservative assumption, the number of existing permitted surface water diversions would represent the minimum number of such diversions for San Geronimo Valley under the Proposed Project.

Lastly, the total population in the San Geronimo Valley (Census Tract 1130) has grown from 2,952 in 1970 to an estimated 4,149 in 2010 (Table 2-6). Countywide population growth between 1980 and 2000 averaged 0.6% per year (Marin CWP 2007), whereas growth in San Geronimo Valley between 1980 and 2000 averaged 0.9% per year.

Table 2-6. Total Population for San Geronimo Valley by Decade (1980–2010) and for Theoretical Buildout Under the Proposed Project.

Year	Total Population
1970 Actual[1]	2,952
1980 Actual[2]	3,200
1990 Actual[2]	3,345
2000 Actual[1]	3,797
2010 Actual[1]	4,149
Theoretical Buildout[3]	4,814

1 Data from the U.S. Census Bureau for Census Tract 1130 (https://factfinder.census.gov).
2 Data from San Geronimo Community Plan (1997) for Census Tract 1130.
3 Calculated using Marin CWP (2007) estimate of average household size at 2.35 people/unit x 358 additional units to be developed beyond 2005 existing conditions (Table 2-5).

2.6.3 Subbasin/Reach Scale

Under the Proposed Project, all subbasins and/or reaches of the mainstem creek would experience an increase in the number of improved parcels (Table 2-7), as well as an increase in the number of developed units (Table 2-8). Lower San Geronimo Creek and Woodacre Creek would experience the largest increase in number of parcels and units under the Proposed Project; however, since these reaches exhibit the greatest number of parcels and units under existing conditions, their relative increase under the Proposed Project would be moderate. The largest relative increase in both parcels and units under the Proposed Project would occur in Upper San Geronimo Creek. As noted for the watershed scale (Section 2.6.2), the number of additional improved parcels and developed units anticipated under the Proposed Project represents a conservative estimate due to a number of environmental constraints that are likely to reduce the number of buildable parcels at the subbasin/reach scale.

Table 2-7. Number of Improved Parcels by Subbasin or Mainstem Reach for San Geronimo Valley[1].

Subbasin or Mainstem Reach	Existing Conditions (2005)	Proposed Project	Difference (and % change)
North Fork San Geronimo Creek	17	19	2 (+12%)
Woodacre Creek	554	648	94 (+17%)
Upper San Geronimo Creek	46	67	21 (+46%)
Larsen Creek	12	14	2 (+17%)
Montezuma Creek	108	141	33 (+31%)
Arroyo/Barranca/El Cerrito Complex	142	164	23 (+16%)
Lower San Geronimo Creek	536	679	144 (+27%)

[1] Data provided by Marin County CDA (2005).

Table 2-8. Number of Improved Units by Subbasin or Mainstem Reach for San Geronimo Valley[1].

Subbasin or Mainstem Reach	Existing Conditions (2005)	Proposed Project	Difference (and % change)
North Fork San Geronimo Creek	60	66	6 (+10%)
Woodacre Creek	586	685	99 (+17%)
Upper San Geronimo Creek	40	66	26 (+65%)
Larsen Creek	11	15	4 (+36%)
Montezuma Creek	113	147	34 (+30%)
Arroyo/Barranca/El Cerrito Complex	159	191	32 (+20%)
Lower San Geronimo Creek	629	786	157 (+25%)

[1] Data provided by Marin County CDA (2005).

TIA in the tributary subbasins and mainstem reaches of San Geronimo Creek would increase under the Proposed Project, assuming maximum buildout, with percent increases ranging from +<1% to +10% (Table 2-9). Woodacre Creek, which exhibits the greatest %TIA by subbasin or mainstem reach under existing conditions, would experience a moderate (+5%) increase in %TIA under the Proposed Project. Montezuma Creek, which exhibits a moderate amount of %TIA under existing conditions, would experience the greatest potential increase (+10%) in %TIA. Under the Proposed Project, all subbasins and mainstem reaches would exhibit less than 10% TIA within their respective contributing areas (Table 2-9).

Table 2-9. TIA and Percent TIA by Subbasin or Mainstem Reach for San Geronimo Valley[1].

Subbasin or Mainstem Reach	Contributing Area (acre) [2]	Existing Conditions (2005)		Proposed Project		Difference (acre) (and % change)
		TIA in Contributing Area (acre) [2]	% TIA [2]	TIA in Contributing Area (acre) [2]	% TIA [2]	
North Fork San Geronimo Creek	942.8	20.6	2.2%	20.8	2.2%	0.2 (+1%)
Woodacre Creek	893.4	80.7	9.0%	84.6	9.5%	3.9 (+5%)
Upper San Geronimo Creek	2,617.7	140.8	5.4%	146.0	5.6%	5.1 (+4%)
Larsen Creek	438.3	18.0	4.1%	18.1	4.1%	0.1 (+<1%)
Montezuma Creek	244.2	9.4	3.9%	10.4	4.3%	1.0 (+10%)
Arroyo/Barranca/El Cerrito Complex	898.6	35.1	3.9%	36.3	4.0%	1.2 (+3%)
Lower San Geronimo Creek	5,969.9	301.4	5.0%	315.5	5.3%	14.1 (+5%)

[1] Data provided by Marin County CDA (2005).
[2] Contributing areas and TIA estimates are cumulative.

There are currently a total of 36 parcels within the San Geronimo Valley possessing the same number of groundwater wells likely to be active. A majority of the parcels and wells (29 of 36) are located in the lower portion of the watershed, with most of the parcels and wells located in the Arroyo/Barranca/El Cerrito Complex (16 of 36, or 44%) and Lower San Geronimo Creek (11 of 36, or 31%) (Table 2-10). As noted for the watershed-scale analysis, it is assumed that all new improved parcels at the reach scale would possess municipal water supply. However, as it is not known whether groundwater wells would be added under the Proposed Project, the number of existing active groundwater wells is assumed to represent the minimum number of such wells by reach under the Proposed Project (Table 2-10).

Additionally, based on available information there are six appropriative water rights for surface water diversions in the San Geronimo Valley (Table 2-10). Four of these are located at a single site along the Larsen Creek reach, at a small pond on the San Geronimo National Golf Course, adjacent to Nicasio Valley Road. At this location, Larsen Creek is subsumed within the pond and then becomes a grassy swale perennially connected to the pond, progressing west through the golf course and eventually becoming a distinct stream channel with a

riparian zone (Stillwater Sciences 2009a). Two other appropriative water rights for surface water diversions are located in the Arroyo/Barranca/El Cerrito Complex and in Lower San Geronimo Creek. It is not known whether any of the six surface water diversions are typically active, nor the rate of diversion for each.

Table 2-10. Number of Parcels with Groundwater Wells and/or Surface Water Diversions by Subbasin or Mainstem Reach for San Geronimo Valley.

Subbasin or Mainstem Reach	Existing Conditions (2005)		Proposed Project	
	Number of Parcels with Wells[1]	Number of Parcels with Diversions[2]	Number of Parcels with Wells	Number of Parcels with Diversions
North Fork San Geronimo Creek	0	0	≥ 0	≥ 0
Woodacre Creek	5	0	≥ 5	≥ 0
Upper San Geronimo Creek	2	0	≥ 2	≥ 0
Larsen Creek	1	4	≥ 1	≥ 4
Montezuma Creek	1	0	≥ 1	≥ 0
Arroyo/Barranca/El Cerrito Complex	16	1	≥ 16	≥ 1
Lower San Geronimo Creek	11	1	≥ 11	≥ 1

[1] Parcels with wells include improved (n=34), unimproved (n=1), and other (n=1).
[2] Data Source: California State Water Resources Control Board eWRIMS. Data downloaded September 2016. https://waterrightsmaps.waterboards.ca.gov/ewrims/gisapp.aspx

2.6.4 Scale of the Stream Conservation Area (SCA)

Under the Proposed Project, all subbasins and/or reaches of mainstem San Geronimo Creek except Larsen Creek would experience an increase in the number of improved parcels either completely or partially within the SCA (Table 2-11). The distribution of parcel sizes and location relative to the SCA would vary by subbasin and/or reach, with relatively few parcels small enough to lack significant flexibility in development placement (0−0.5 ac) located completely within the SCA (Figure 2-6a,b). The majority of smaller parcels would be located only partially within the SCA, such that development within the SCA itself could be avoided, or they would be located outside the SCA (Figure 2-6a,b). Very few larger parcels (>0.5 ac) would be located completely within the SCA, since the SCA itself only extends 100 ft from the top of bank on either side of the stream.

All subbasins and/or reaches would experience an increase in the number of developed units either completely or partially within the SCA (Table 2-12). Lower San Geronimo Creek and Woodacre Creek would experience the largest increase in number of parcels and units under the Proposed Project either

completely or partially within the SCA; however, since these reaches exhibit the greatest number of parcels and units within the SCA under existing conditions, their relative increase under the Proposed Project would be moderate. Large relative increases in parcels and units either completely or partially within the SCA under the Proposed Project would occur in Upper San Geronimo Creek and Montezuma Creek.

As noted for both the watershed and subbasin/reach scale (Sections 2.6.2 and 2.6.3, respectively), the number of additional improved parcels and developed units anticipated under the Proposed Project represents a conservative estimate due to a number of environmental constraints that are likely to significantly reduce the total number of buildable parcels. Within the SCA in particular, additional policies (BIO-4.1 to BIO-4.20, see Table 2-1) would further limit development activities, with *Policy BIO-4.2 Comply with SCA Regulations* requiring individual projects to undergo a discretionary permit process that involves design review for development within the SCA. Design review involves a detailed review by County staff of the design and placement of the proposed development on a site. Design reviews are the most common type of discretionary planning permit and are an important tool used to implement the policies contained within the Proposed Project.

However, the discretionary permit process, including design review, would only routinely apply to parcels in planned zoning districts; design review would be required to a significantly lesser extent in conventionally zoned districts (see Section 2.4.2 for discussion of zoning districts). Of the total number of SCA parcels to be developed under the Proposed Project, approximately 21% are in a planned zoning district (Marin County CDA 2013) and thus would be subject to design review under Policy BIO-4.2 for projects such as new residences, detached storage buildings, swimming pools, and retaining walls.
The remaining 79% of SCA parcels to be developed under the Proposed Project are in a conventional zoning district (Marin County CDA 2013) and would not require design review or another discretionary permit, such as a Variance from minimum conventional zoning standards of height, setback, or floor area ratio. One notable exception is the requirement for Design Review for proposed development within the SCA of anadromous fish creeks on vacant, conventionally-zoned properties. Unless design review or another discretionary permit is triggered, development activities on a conventionally-zoned property within the SCA would not be subject to the SCA policies. Additionally, several types of development, such as sitework that does not exceed 18 in above grade (decks, platforms, driveways), utility lines, water supply facilities (water supply

lines), septic tanks (but not leachfields), vegetation removal (except native and heritage trees), and erosion control structures do not require a County building permit regardless of zoning district.

Lastly, of the 36 parcels in San Geronimo Valley possessing groundwater wells that are likely to be active, most (21 of 36, or 58%) are located near a stream channel and approximately 58% of these parcels are located at least partially within the SCA (i.e., within 100 ft [30.5 m]) of the stream channel) (Table 2-14). While the precise location of each groundwater well is not known, those parcels that are partially or completely within the SCA are more likely to have groundwater wells in relatively closer proximity to the steam channel than those that are completely outside the SCA (although this may not be true for larger parcels that are only partially within the SCA).

Table 2-11. Number of Improved Parcels by Subbasin or Mainstem Reach and Location Relative to the SCA for San Geronimo Valley[1].

Subbasin or Mainstem Reach	Existing Conditions (2005)			Proposed Project			Difference (and % increase)		
	Completely within the SCA	Partially within the SCA	Outside the SCA	Completely within the SCA	Partially within the SCA	Outside the SCA	Completely within the SCA	Partially within the SCA	Outside the SCA
North Fork San Geronimo Creek	1	9	7	1	11	7	0 (0%)	2 (+22%)	0 (0%)
Woodacre Creek	24	198	332	31	223	394	7 (+29%)	25 (+13%)	62 (+19%)
Upper San Geronimo Creek	0	25	21	0	34	33	0 (0%)	9 (+36%)	12 (+57%)
Larsen Creek	0	9	3	0	9	5	0 (0%)	0 (0%)	2 (+67%)
Montezuma Creek	15	50	43	17	69	55	2 (+13%)	19 (+38%)	12 (+28%)
Arroyo/Barranca/El Cerrito Complex	1	83	58	1	95	68	0 (0%)	12 (+14%)	10 (+17%)
Lower San Geronimo Creek	52	274	210	68	326	285	16 (+31%)	52 (+19%)	75 (+36%)

[1] Data provided by Marin County CDA (2005).

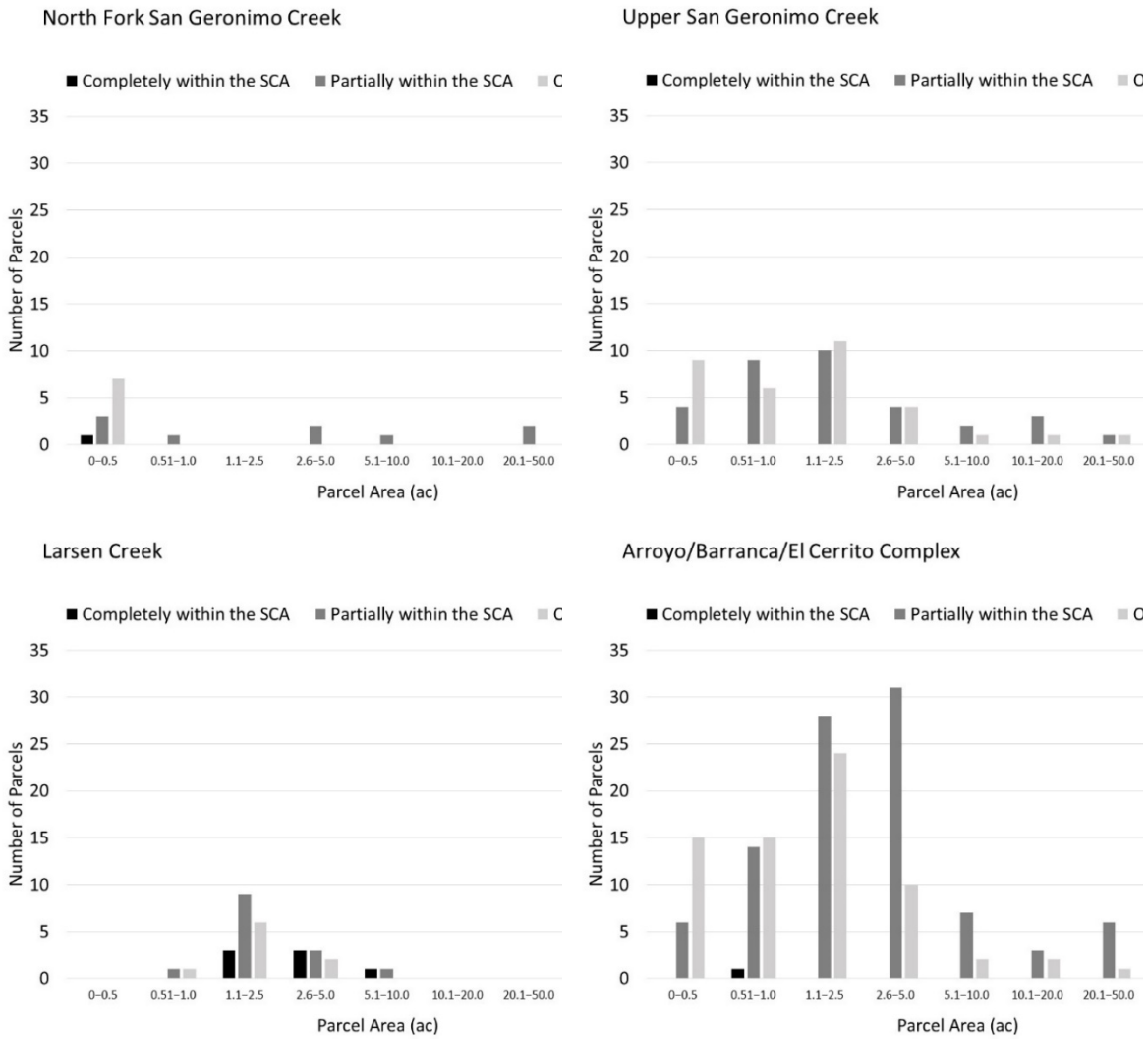

Figure 2-6a. Improved Parcel Size Distribution by Subbasin or Mainstem Reach and Location Relative to the SCA for San Geronimo Valley.

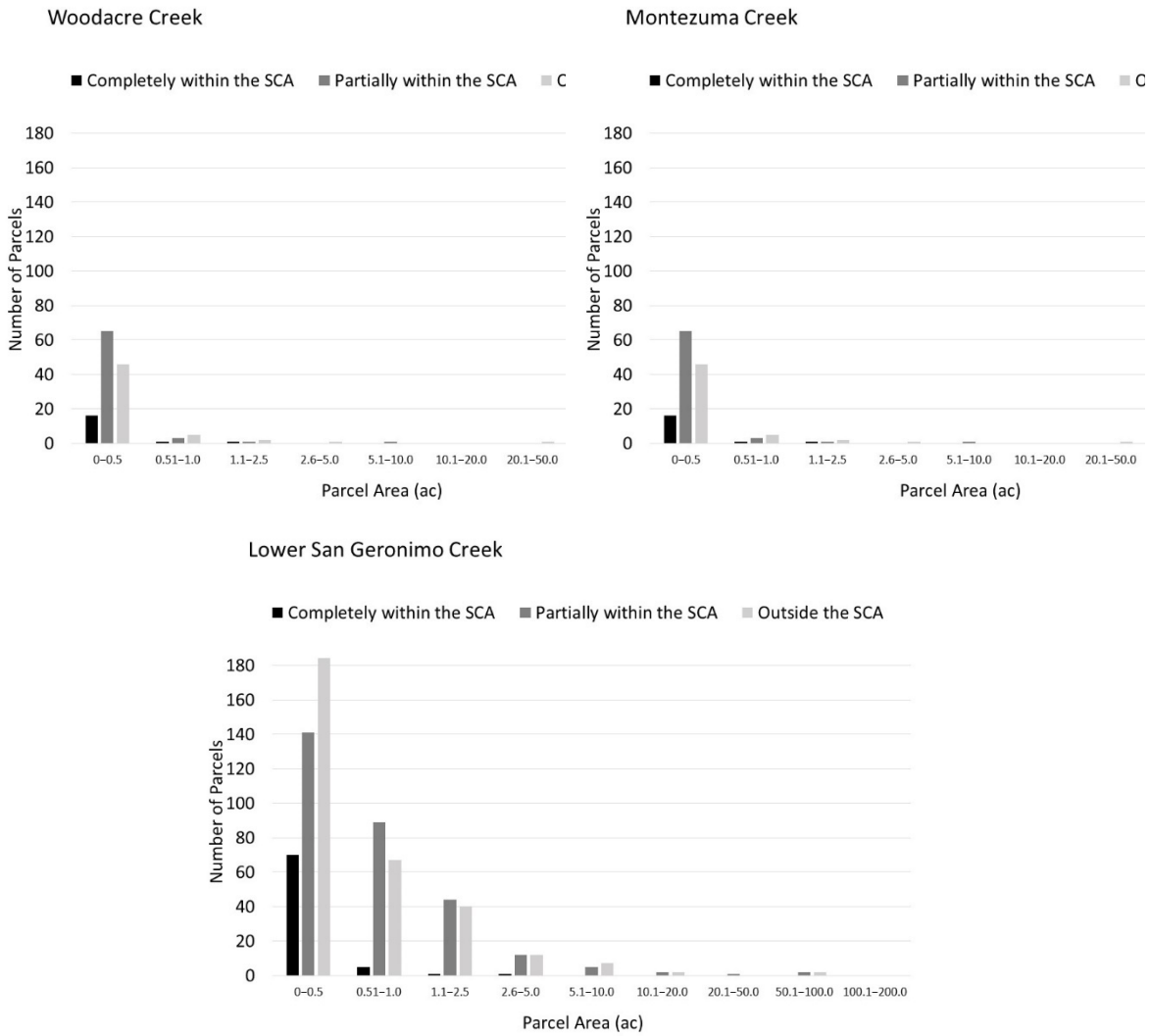

Figure 2-6b. Improved Parcel Size Distribution by Subbasin or Mainstem Reach and Location Relative to the SCA for San Geronimo Valley.

Table 2-12. Number of Improved Units by Subbasin or Mainstem Reach and Location Relative to the SCA for San Geronimo Valley[1].

Subbasin or Mainstem Reach	Existing Conditions (2005)			Proposed Project			Difference		
	Completely within the SCA	Partially within the SCA	Outside the SCA	Completely within the SCA[2]	Partially within the SCA[2]	Outside the SCA	Completely within the SCA	Partially within the SCA	Outside the SCA
North Fork San Geronimo Creek	0	56	4	0	62	4	0 (+0%)	6 (+11%)	0 (+0%)
Woodacre Creek	27	208	351	34	235	416	7 (+26%)	27 (+13%)	65 (+19%)
Upper San Geronimo Creek	0	23	17	0	33	33	0 (+0%)	10 (+43%)	16 (+94%)
Larsen Creek	0	7	4	0	8	7	0 (+0%)	1 (+14%)	3 (+75%)
Montezuma Creek	16	56	41	18	76	53	2 (+13%)	20 (+36%)	12 (+29%)
Arroyo/Barranca/El Cerrito Complex	2	97	60	2	116	73	0 (+0%)	19 (+20%)	13 (+22%)
Lower San Geronimo Creek	59	333	237	76	390	320	17 (+29%)	57 (+17%)	83 (+35%)

[1] Data provided by Marin County CDA (2005).

[2] The assignment of additional improved units relative to the SCA under the Proposed Project follows that of improved parcels (i.e., if the improved parcel is completely within the SCA, then the improved unit would be completely within the SCA; if the improved parcel is partially within the SCA, then the improved unit would be practically within the SCA).

Table 2-13. TIA and Percent TIA by Subbasin or Mainstem Reach and Location Relative to the SCA for San Geronimo Valley.[1]

Subbasin or Mainstem Reach	SCA Contributing Area (acre) [2]	Existing Conditions (2005)		Proposed Project		Difference (acre) (and % change)
		TIA in SCA Contributing Area (acre) [2]	% TIA in SCA [2]	TIA in SCA Contributing Area (acre) [2]	% TIA in SCA [2]	
North Fork San Geronimo Creek	213.6	12.3	5.8%	12.3	5.8%	0.0 (0%)
Woodacre Creek	171.5	19.8	11.5%	20.1	11.7%	0.3 (2%)
Upper San Geronimo Creek	525.3	40.7	7.8%	41.2	7.8%	0.4 (1%)
Larsen Creek	98.9	6.1	6.2%	6.1	6.2%	0.0 (0%)
Montezuma Creek	48.9	4.3	8.8%	4.7	9.6%	0.4 (9%)
Arroyo/Barranca/El Cerrito Complex	174.0	11.7	6.7%	11.7	6.7%	0.0 (0%)
Lower San Geronimo Creek	1,185.2	94.5	8.0%	96.4	8.1%	1.9 (2%)

[1] Data provided by Marin County CDA (2005).
[2] Contributing areas and TIA estimates are cumulative.

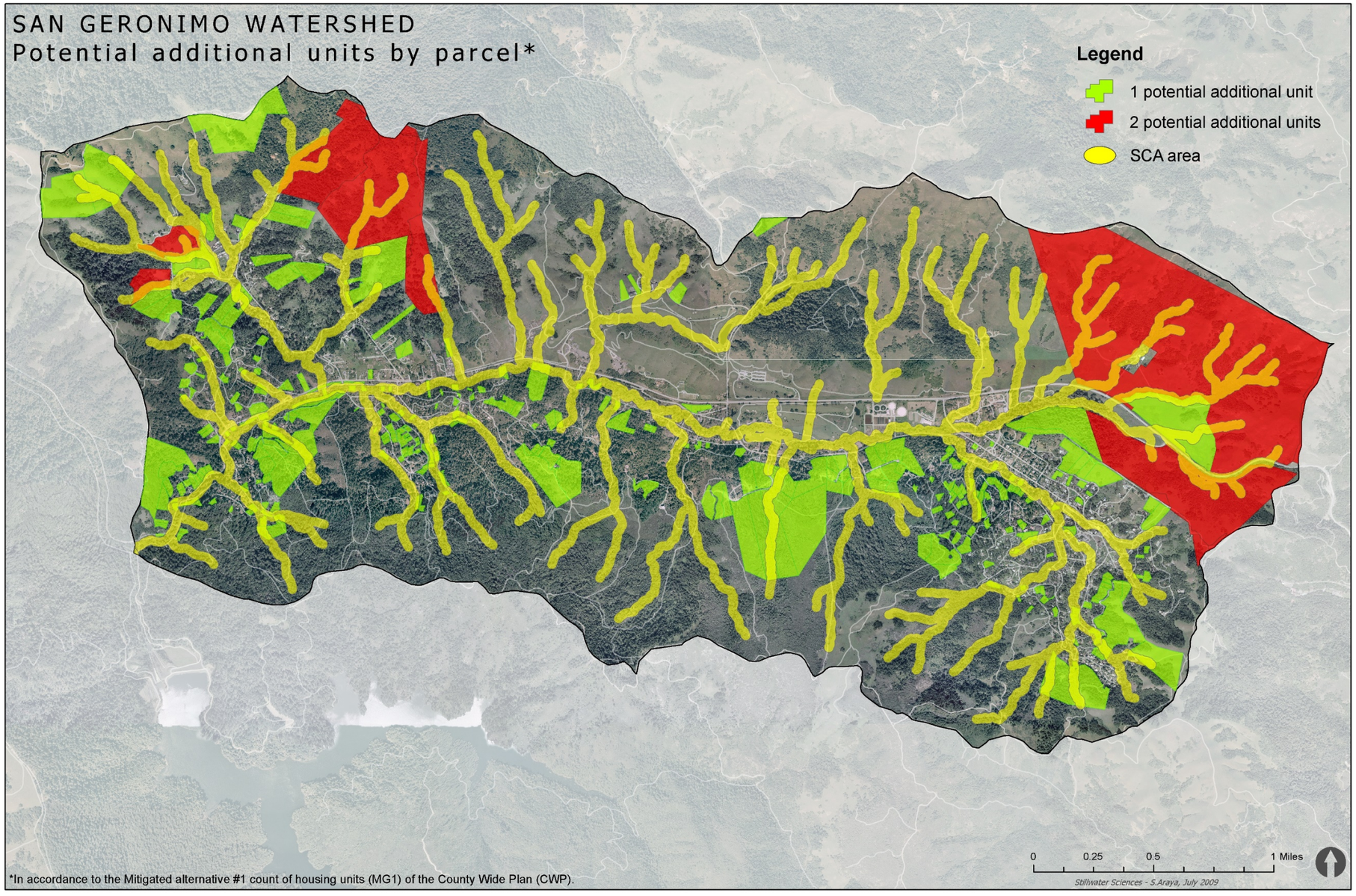

Figure 2-7. Map of parcels within San Geronimo Valley with additional potential development units and number of units under the Proposed Project. The SCA boundaries are shown for reference.

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Table 2-14. Number of Parcels with Groundwater Wells by Subbasin or Mainstem Reach and Location Relative to the SCA for the San Geronimo Valley.

Subbasin or Mainstem Reach	Existing Conditions (2005)[1]			Proposed Project		
	Completely within the SCA	Partially within the SCA	Outside the SCA	Completely within the SCA	Partially within the SCA	Outside the SCA
North Fork San Geronimo Creek						
Woodacre Creek	1	3	1	1	3	1
Upper San Geronimo Creek		1	1		1	1
Larsen Creek		1			1	
Montezuma Creek			1			1
Arroyo/Barranca/El Cerrito Complex		10	6		10	6
Lower San Geronimo Creek		5	6		5	6

[1] 12 wells are identified as domestic, 18 as domestic and irrigation, and 6 as irrigation (Marin County 2016).

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3 ENVIRONMENTAL SETTING

3.1 Special-Status Anadromous Fish Species

Coho salmon, steelhead, and Chinook salmon are the three anadromous salmonid species that occur in the San Geronimo Creek watershed. These fish migrate between the ocean and freshwater streams and rivers to complete their remarkable life cycle, a phenomenon known as “anadromy” for species that spawn in freshwater and reach adulthood in saltwater. Populations of these species have experienced major declines along the central California coast and throughout California, leading to their listing as threatened or endangered at the federal and state levels (NMFS 2016a, CDFW 2016). Coho salmon in San Geronimo Valley streams, which belong to the Central California Coast evolutionarily significant unit (ESU), are listed as endangered under the federal Endangered Species Act (ESA) and the California Endangered Species Act (CESA). Steelhead in the San Geronimo Valley are part of the Central California Coast distinct population segment (DPS), which is listed as threatened under the ESA. The Chinook salmon that occur sporadically in San Geronimo Creek have been tentatively grouped as part of the California Coastal ESU, which is listed as threatened under the ESA.

Coho salmon in the Lagunitas Creek watershed (including San Geronimo Creek) have declined from an estimated historical population of 4,000 adults to approximately 300 in the 2014–2015 spawning season (Ettlinger et al. 2015) and approximately 580 in the 2015–2016 spawning season (Ettlinger et al. 2016). Although these counts suggest modest improvements in recent years, regional abundance is well below the NMFS recovery targets and the population segment as a whole remains severely depressed (NMFS 2012). In its recent status reviews, NMFS (2016b, 2016c) reaffirmed that the Central California Coast coho salmon population is currently in danger of extinction. Despite this, the coho salmon population in the Lagunitas Creek watershed, including the San Geronimo Valley, is currently the largest and most stable population south of the Noyo River in Mendocino County (Ettlinger et al. 2015, NMFS 2012).

Estimates of historical and current steelhead and Chinook salmon abundance in the Lagunitas Creek watershed are not available, but recent counts of redds made by spawning adult steelhead throughout the watershed have ranged from a low of approximately 16 in 2010–2011 (Ettlinger and Andrew 2012) to a high of approximately 239 in 2011–2012 (Ettlinger et al. 2012). Steelhead redd counts have generally declined since 2011–2012, with only 120 redds observed throughout the watershed in the 2015–2016 spawning season (Ettlinger et al.

2016). In the recent status reviews, NMFS (2016b, 2016c) reaffirmed that the Central California Coast steelhead population is also likely to become extinct in the foreseeable future.

Annual surveys in the Lagunitas Creek watershed documented no Chinook salmon redds between the 2009–2010 and 2012–2013 spawning seasons, with eight redds in 2013–2014, 20 redds in 2014–2015, and only two redds in 2015–2016 (Ettlinger and Andrew 2013, Ettlinger et al. 2016).

3.1.1 Life History and Habitat Requirements

As with most native Pacific Coast anadromous fish, coho and Chinook salmon spend the majority of their life rearing to adulthood in the Pacific Ocean, but they spawn and rear as juveniles in freshwater coastal streams. Steelhead may spend the majority of their life in the ocean, but they display wide variations in life history and can also spend a considerable fraction of life in freshwater. Spawning and rearing periods differ among the three species, as do the particular ways in which they take advantage of habitats within streams and estuaries. Salmon occupy a fairly narrow range of environmental conditions, especially in their freshwater phase where they do best in streams with cold, clean, free-flowing water rich in dissolved oxygen. Other habitat requirements include suitably sized gravels in which to allow spawning and egg incubation, adequate flow to provide prey and allow movement among suitable habitats, and instream habitat structure to provide cover from predators and refuge from high-velocity flows. A detailed description of the life cycles and habitat requirements of coho and steelhead specific to this region is presented in Stillwater Sciences (2008), as part a limiting factors analysis recently conducted for Lagunitas Creek (of which San Geronimo Creek is a major tributary).

The information in the following sections is summarized from the San Geronimo Valley Existing Conditions Report (Stillwater Sciences 2009a) to provide a brief and generalized overview of salmonid life stages and physical habitat requirements for coho, steelhead, and fall-run Chinook (species consistently observed in San Geronimo Creek) to set the stage for analysis of potential cumulative effects under the Proposed Project. A general discussion of water quality requirements for salmonids supports later discussion of existing water quality conditions and provides context for the assessment of potential impacts on salmonids related to water quality.

Coho salmon (*Oncorhynchus kisutch*)

Adult coho salmon typically migrate to the vicinity of their natal stream during the fall of their third year (Sandercock 1991), following a single year spent in fresh water and a single year spent in the Pacific Ocean. In response to increased stream flow resulting from fall and winter storm events, adult coho salmon move up into their natal stream throughout the spawning season (Shapovalov and Taft 1954). In the Lagunitas Creek watershed, coho generally enter spawning streams from November through January with peak spawning occurring during December (Ettlinger et al. 2008). Spawning sites are typically located in stream reaches with moderate gradients (i.e., < 3%); loose, silt-free, coarse gravel; and instream cover (Moyle et al. 1989). Eggs are deposited and fertilized in nests called “redds,” which are usually located in the transitional area at the downstream end (or tail) of pools and the upstream end of riffles where water becomes more turbulent (Hazzard 1932, Hobbs 1937, Smith 1941, Briggs 1953, Stuart 1953). Coho salmon egg incubation requires 35–50 days at temperatures of approximately 9 to 11°C (48 to 52°F) (Shapovalov and Taft 1954), with incubation time being inversely related to water temperature. In laboratory experiments, Murray and McPhail (1988) found that 14°C (57°F) is the upper water temperature limit for normal coho salmon embryo development. After hatching, salmon larvae (alevins) remain in the gravel while undergoing further development and absorption of the yolk sac, with emergence of the fry beginning about 2–3 weeks after hatching.

Upon emergence from the gravels, coho salmon fry begin feeding and seek low-velocity areas along shallow stream margins (Shapovalov and Taft 1954). As they grow with time, juvenile coho move to deeper habitats, although they continue to prefer low-velocity habitat throughout the freshwater rearing period. During winter, both instream cover and off-channel areas providing slow water are essential for protection against displacement by high flows, and for cover from predation (Bustard and Narver 1975, Mason 1976, Hartman et al. 1982, Bell 2001). Deep (> 18 in [> 45 cm]), slow (< 15 cm/s [< 0.5 ft/s]) areas within or near (< 3 ft [<1 m]) cover of roots, large wood, and flooded brush appear to constitute preferred habitat (Hartman 1965, Bustard and Narver 1975), especially during freshets (Tschaplinski and Hartman 1983, Swales et al. 1986, McMahon and Hartman 1989). When temperatures drop and base streamflows rise, juvenile coho residing within the stream channel may make seasonal or temporary shifts to off-channel habitats (Scarlett and Cederholm 1984), a strategy that apparently increases their chances for survival. Following winter peak flows, juvenile coho salmon emerge from winter hiding areas and feed heavily to grow in size in preparation for downstream migration.

Coho smolt outmigration generally occurs in the spring approximately one year after they emerge from gravels (an age referred to as “1+”). A smaller portion of the outmigration is made up of age 0+ fish migrating downstream as fry, but these fish are believed to have low probability of surviving to adulthood (Otto 1971, Crone and Bond 1976, Hartman et al. 1982). Size at smolting has been correlated with ocean survival of anadromous salmonids (Peterman 1982, Bilton et al. 1982, Ward et al. 1989) and studies have associated higher smolt survivals with juvenile coho salmon migrating at sizes of at least 100 mm fork length (Drucker 1972, Crone and Bond 1976).

Steelhead (*Oncorhynchus mykiss*)

Steelhead return to spawn in their natal stream, usually in their fourth or fifth year of life (Shapovalov and Taft 1954, Behnke 1992). Steelhead are unique among salmon in that they can return to spawn multiple times over the course of their life. Winter-run steelhead, the species occurring in the Lagunitas Creek watershed and San Geronimo Valley, generally enter spawning streams from late fall through spring and spawn in late winter or spring (Roelofs 1985, Meehan and Bjornn 1991, Behnke 1992). Spawning in the Lagunitas Creek watershed occurs primarily from January through March (Ettilinger et al. 2008) but may begin as early as late December and may extend through April (Hallock et al. 1961). Female steelhead construct redds in gravels located in pool tailouts and heads of riffles, or in isolated patches in cobble-bedded streams. Steelhead egg incubation lasts for 3–14 weeks and is a function of water temperature (Shapovalov and Taft 1954, Barnhart 1991). Preferred incubation temperatures range from 9 to 11°C (48 to 52°F) (Bell 1986, McEwan and Jackson 1996, NMFS 2000) and temperatures >15°C (59°F) are lethal to incubating eggs (Myrick and Cech 2001). After hatching, alevins remain in the gravel for an additional 2–5 weeks while absorbing their yolk sacs, and then emerge in spring or early summer (Barnhart 1991). After emergence, steelhead fry move to shallow-water, low-velocity habitats, such as stream margins and low-gradient riffles, and forage in open areas lacking instream cover (Hartman 1965, Fontaine 1988). As fry grow and improve their swimming abilities in the late summer and fall, they increasingly use areas with cover and show a preference for higher velocity, deeper mid-channel areas near the thalweg (the deepest part of the channel) (Hartman 1965, Everest and Chapman 1972, Fontaine 1988).

Juvenile steelhead occupy a wide range of habitats, using deep pools as well as higher-velocity riffle and run habitats (Bisson et al. 1982, Bisson et al. 1988). They tend to ascend farther into channel networks than coho salmon, using

steeper reaches and more complex habitats. During high winter flows, juvenile steelhead reside mainly in low-velocity pool habitats with large rocky substrate or woody debris for cover, often seeking refuge in interstitial spaces in cobble and boulder substrates (Hartman 1965, Bustard and Narver 1975, Raleigh et al. 1984, Swales et al. 1986, Fontaine 1988).

Juvenile emigration from freshwater to the ocean typically occurs from March through June. Depending partly on growing conditions in their rearing habitat, steelhead may migrate downstream to estuaries as age 0+ juveniles or may rear in streams for up to four years before outmigrating to the estuary and ocean (Shapovalov and Taft 1954). The duration of time juvenile steelhead spend in fresh water appears to be related to growth rate, with larger, faster-growing members of a cohort smolting earlier (Peven et al. 1994). Steelhead in northern and central California typically spend two years in freshwater prior to smolting (Shapovalov and Taft 1954). Steelhead migrating downstream as juveniles may rear for one month to a year in the estuary before entering the ocean (Shapovalov and Taft 1954, Barnhart 1991).

Chinook salmon (*Oncorhynchus tshawytscha*)

In the Lagunitas Creek system, adult fall-run Chinook migrate upstream in the fall, with peak spawning generally occurring in December, but occasionally in November or October (Ettlinger et al. 2007). Like other salmon, adult females dig shallow depressions or pits in suitably sized gravels, deposit eggs in the bottom during the act of spawning, and cover them with additional gravel (Healey 1991).

Most Chinook salmon generally spawn in the mainstem and lower reaches of low gradient (< 3%) large rivers or tributaries, although spawning has been observed over a broad range of smaller stream sizes (Vronskiy 1972, Healey 1991). Also like other salmon, their redds are typically located near pool tailouts (i.e., heads of riffles) where intragravel dissolved oxygen levels are high (i.e., greater than 7 mg/l [milligrams per liter]) and temperatures are low (less than approximately 14°C [57.2°F]). Chinook are capable of spawning within a wide range of water depths and velocities, provided that intragravel flow is adequate (Healey 1991). Depths and velocities most often recorded over Chinook redds range from 10 to 200 cm and 15 to 100 cm/s, respectively, although criteria may vary between races and stream basins.

Substrates sizes selected for spawning likely reflect a balance between flow and depth occurring at the spawning location, as well as the size of the fish. Gravels used by spawning Chinook salmon have been found to range from a D_{50} (median

size) of 10.8 mm (Platts et al. 1979, as cited in Kondolf and Wolman 1993) to a D_{50} of 78.0 mm (Chambers et al. 1954, 1955, as cited in Kondolf and Wolman 1993). For fall-run Chinook salmon, egg incubation in the gravel extends from October through January (Fisher 1994) and generally lasts between 40–90 days at water temperatures of 6–12°C (42.8–53.6°F) (Vernier 1969, Bams 1970, Heming 1982, all as cited in Bjornn and Reiser 1991). The alevins remain in the gravel for two to three weeks after hatching and absorb their yolk sac before emerging from the gravels into the water column.

Following emergence, fry occupy low-velocity, shallow water areas near stream margins, including backwater eddies and areas associated with bank cover such as large woody debris (Lister and Genoe 1970, Everest and Chapman 1972, McCain 1992), although larger fish may move into higher velocity water. Chinook fry are observed in small numbers in virtually all habitats sampled in early summer (Everest and Chapman 1972). As fry increase in size, they typically move to higher velocity, deeper areas farther from banks (Lister and Genoe 1970, Everest and Chapman 1972, Hillman et al. 1987). In general, fall Chinook fry (length < 50 mm [< 2.0 in]) and juveniles (length > 50 mm [> 2.0 in]) outmigrate from spawning areas between January and May, though the outmigration period for larger juveniles may extend into June in some stream systems. Juvenile Chinook salmon tend to use mainstem reaches and estuaries as rearing habitat more extensively than juvenile coho salmon and steelhead.

3.1.2 Basic Water Quality Requirements for Salmonids

As related to salmonid habitat requirements, “water quality” broadly defines the suitability of fresh and marine waters to meet the most fundamental physiological requirements of salmon and trout. The summary provided here is focused on water temperature and dissolved oxygen, which are the water quality parameters previously identified as most likely to limit salmonid populations in San Geronimo Creek (Stillwater Sciences 2009a) and most likely to be affected by the Proposed Project. Fine sediment deposition, while not a water quality parameter, is also discussed here because it affects delivery of dissolved oxygen to incubating salmonid eggs and other aspects of habitat quality, and was identified by Stillwater Sciences (2009a) as a potential limiting factor for salmonids in San Geronimo Creek.

While upper incipient lethal temperature for salmonids is reported to be 26.6°C (Brett 1952) and critical thermal maximum is 24.6°C (McGeer et al. 1991), adverse effects on early life history stages can occur at much lower temperatures. For salmonids, the development rate (in terms of days to hatching

or complete yolk sac absorption) is typically faster in warmer water than in colder water, for all species. Review of the literature suggests that 5.8–14.2°C (42–58°F) is the optimum temperature range for incubating Chinook salmon eggs (Donaldson 1955, Combs and Burrows 1957, Combs 1965, Eddy 1972, Bell 1973, Healey 1979, Reiser and Bjornn 1979, Garling and Masterson 1985). This corresponds closely to the upper temperature limit for normal coho salmon embryo development (14°C [57°F]) reported from laboratory studies by Murray and McPhail (1988) and is slightly less (i.e., more protective) than the temperature at which steelhead eggs begin to experience significant mortality (15°C [59°F]; Myrick and Cech 2001). Based on this information, sub-lethal stress and/or mortality of incubating anadromous salmonid eggs resulting from elevated temperatures would be expected to begin at temperatures above approximately 14°C (57°F) for constant exposures.

For rearing juvenile coho salmon, Sullivan et al. (2000) has reported a 10% mean reduction in growth at 14.8°C Maximum Weekly Average Temperature (MWAT) for coho and 17°C (63°F) MWAT for steelhead (Sullivan et al. 2000). The MWAT (defined as maximum seasonal 7-day moving average of the daily mean temperature) is only one of several possible indices for assessing fish temperature thresholds (USEPA 1977, Sullivan et al. 2000), with the scientific rationale for its application based on data showing that moderate temperature fluctuations can be tolerated as long as the incipient lethal temperature is not exceeded for long periods. The method also assumes that optimum temperatures are neither necessary nor realistic at all times to maintain viable fish populations (NAS/NAE 1973).

Although temperature exerts the strongest influence on the rate of development for the embryos, dissolved oxygen also plays a key role. Delivery of dissolved oxygen to the egg pocket is the major factor affecting survival-to-emergence. Several studies have correlated reduced dissolved oxygen levels with mortality, impaired or abnormal development, delayed hatching and emergence, and reduced fry size at emergence in anadromous salmonids (Wickett 1954, Alderdice et al. 1958, Coble 1961, Silver et al. 1963, McNeil 1964, Cooper 1965, Shumway et al. 1964, Koski 1981). Silver et al. (1963) found that low dissolved oxygen concentrations are related to mortality and reduced size in Chinook salmon and steelhead embryos. Data suggest that growth may be restricted at oxygen levels below saturation (Silver et al. 1963). Dissolved oxygen varies as a function of temperature, decreasing with increasing water temperature (e.g., from 14.2 mg/L at 1°C [34°F]; 11.3, 10.2, 9.2 and 8.4 mg/L at 5, 10, 15, 20, and 25°C

[77°F]. Delivery of dissolved oxygen to the egg pocket is also impacted by the deposition of fine sediment in the spawning substrate.

Fine sediments in the gravel interstices can also physically impair the ability of fry to emerge through the gravel layer, trapping (or entombing) them within the gravel (Phillips et al. 1975, Hausle and Coble 1976). Elevated levels of fine sediment deposition in coarser bed substrates can adversely affect growth and survival of juvenile salmonids during the summer rearing period by reducing prey availability and increasing competitive interactions (Suttle et al. 2004, Harvey et al. 2009). The magnitude and duration of turbidity (i.e., suspended sediment) in the water column are two important characteristics used to gauge the overall influx of fine grained particles to stream channels. Direct measures of fine particles and their relationship to egg-to-emergent survival suggest that as the fine material exceeds 15–20% of the total of all substrate, there is a dramatic reduction in survival.

Effects of temperature and dissolved oxygen on salmonids are not limited only to these early developmental stages. When elevated stream temperatures persist, adult salmon migrating upstream can encounter thermal barriers that hinder their upstream quest, and impose additional metabolic requirements that sap resources that otherwise would be used to further their reproductive success (Berman and Quinn 1991, McCullough 1999, Quinn 2005). Juvenile salmonids rearing in streams with elevated temperatures in the summer may be so stressed that they lose weight or are forced to migrate downstream in search of cooler areas (Stillwater Sciences 2007). These premature downstream migrations may result in much lower survival (McCullough 1999, Poole et al. 2001, Quinn 2005).

3.2 Overview of Urbanization Effects on Stream Function

Consideration of residential and commercial development (urbanization) effects on stream function in the San Geronimo Valley is important because throughout California and the Pacific Northwest, urbanization is recognized as a major threat to the persistence and recovery of anadromous salmonid populations. Studies in the Pacific Northwest have shown that coho salmon abundance is significantly lower in rural, urban, and agricultural areas, and areas with high road density, than in watersheds with fewer human land uses (Sharma and Hilborn 2001, Pess et al. 2002). Of 14 potential threats to coho salmon in the greater Lagunitas Creek watershed evaluated by NMFS (2012), residential and commercial development was ranked as the greatest overall threat (“very high”) to the viability of the coho salmon population. For steelhead in the Lagunitas Creek

watershed, residential and commercial development and roads were considered the greatest threats to population viability, both ranked as “high” (NMFS 2015). Urbanization results in stresses on all salmonid life stages, but its most damaging impacts stem from the high potential for impairment of the watershed processes described below, the high level of resulting stress on rearing juvenile salmonids during winter and summer, and the irreversibility of these effects (without successful mitigation) (NMFS 2012).

The most common and obvious environmental effect of urbanization is an increase in impervious surface area and the corresponding loss of natural vegetation (Booth and Jackson 1997, Booth et al. 2002, Konrad and Booth 2005). Associated land clearing, forest cutting, soil compaction, road building, encroachment on riparian corridors, and modifications to the surface-water drainage network all typically accompany urbanization (Horner et al. 1997). Changes in land cover, particularly reduced forest cover and increased TIA, affect the characteristics of streamflow, especially the frequency, magnitude and duration of flows associated with storm events, and the consequent geomorphic changes as the channel adapts to altered hydraulic forces (Dunne and Leopold 1978, Booth 1991, Konrad and Booth 2005). The net effect of these changes is typically a significant increase in basin water yield and, correspondingly, an increase in the magnitude of peak flow events. Additionally, the flashiness of stream flow, or rate at which the flow rises during storms and recedes after storms, increases in response to reduced infiltration and a longer and more efficient drainage network (e.g., via culverts, roadside ditches, storm drains) (Konrad and Booth 2005). Analysis from the Pacific Northwest indicates that this results in an increase in the frequency of historical 2-year flow events to approximately four or five times that expected under forested watershed conditions in many streams (Booth 1991). Under the climate of central California, increases of a similar magnitude are also likely to occur (Stillwater Sciences 2009a).

Wet-season flow reversals were also recently identified as a robust indicator for characterizing the flashy nature of the urban hydrograph (Stillwater Sciences 2016, Booth and Konrad, in review), where this indicator is defined as the number of times that the daily average flow changes from an increase to a decrease or vice versa during October through April of a water year (DeGasperi et al. 2009). The hydrologic metric of wet-season flow reversals is calculated on a water year by water year basis (i.e., from October 1 of the prior year to April 30 of the named year). Each day’s flow is compared to the prior day and the subsequent day, where day-to-day changes of less than a small threshold (2%

as recommended by King County [2012]) are designated as “no change.” Any reversal through three days’ record (e.g., 5→10→8 cfs, or 100→75→81 cfs) is tallied as such for that middle day. The total number of reversals over the 7 wet months of the water year provide an indication of the flashiness of the stream’s hydrology. This parameter has been shown in other applications to be closely tied to the degree to which land cover in the watershed encourages rapid runoff responses to rainfall (e.g., Stillwater Sciences 2016), primarily as a consequence of impervious surfaces and an efficient drainage network.

As a result of urbanization-related hydrologic changes, flow velocities within the channel during storms may exceed the ability of fish to occupy the stream channel, especially where off-channel (e.g., floodplain) and velocity refuge habitat is lacking. Under such conditions, juvenile salmonids may be unable to maintain their position in the channel and can be swept downstream, with potential adverse effects including injury or mortality from physical trauma, increased susceptibility to predation, and reduced ocean survival.

Changes to flow conditions in streams that drain urbanized watersheds cause simplification of instream habitat, and this damage is exacerbated by bank armoring and encroachment by buildings, bridges, and other structures which minimize or eliminate connections between streams and their floodplains. Urbanization alters both stream discharge and sediment supply in ways that are commonly observed to progress from an initial phase of increased sediment delivery from upland disturbances to a long-term erosional phase where increases in discharge from impervious areas overwhelm any remaining increase in sediment delivery and result in a scoured, incised channel form (Wolman and Schick 1967). Ongoing construction and the associated land disturbance can represent a chronic source of sediment delivery to streams. Effects of stream sedimentation on salmonids and other aquatic organisms include reduced pool volume, reduced cover complexity, degraded spawning gravel quality, increased redd scour, and depressed macroinvertebrate production. Streambed scour of sufficient depth can have direct adverse impacts on incubating salmonid eggs (see also Section 3.6.1).

As they adjust to the altered flow characteristics (increased frequency and magnitude of storm flows) and sediment fluxes, channels in urbanized watersheds typically downcut into their beds, creating deeply incised channels with steep, raw banks, reduced habitat complexity, and loss of floodplain connectivity (Booth and Fischenich 2015). Incised channels experience an increase in the amount of energy focused on the streambed (shear stress) during

peak flows, particularly where stream habitat has been further simplified by channelization, removal of large woody debris (LWD) and riparian vegetation, and other alterations that accompany urbanization and are pervasive in the San Geronimo Valley (Stillwater Sciences 2009a, SFBRWQCB 2014a).

Urbanization and hardening of the landscape may reduce infiltration and aquifer recharge, thereby reducing the amount of water supplied to streams via groundwater inputs during the low flow season. Urbanization can also reduce base flows as a result of increased surface drainage (through storm sewers and ditches), surface water diversions, and groundwater pumping (Konrad and Booth 2005), although effects on dry season base flows are less clear cut than those on winter base flows (Konrad and Booth 2002, Fitzpatrick and Peppler 2010). California's Mediterranean climate results in naturally low flows in most streams during the summer and fall salmonid rearing period (Stillwater Sciences 2007, NMFS 2012). Water diversions, groundwater pumping, and reduced groundwater input to streams from depleted aquifers further reduce natural low flows during the summer-fall rearing period, with potentially significant impacts to juvenile survival (NMFS 2012). The effects of climate change, which are projected to include increased summer air temperatures and longer dry seasons (DWR 2015), are likely to magnify these effects.

3.3 Hydrology

This section presents a broad overview of hydrology in the San Geronimo Creek watershed. The implications of observed hydrologic patterns with respect to salmonid health are discussed in Section 3.6 and the impact analyses (Section 1).

The San Geronimo Valley experiences a mild Mediterranean climate, dominated by dry summers and wet winters, with winter periods exhibiting periodic intense rainfall events (Fischer et al. 1996). Annual precipitation is approximately is 43 in, with about 85 percent of the annual total typically occurring during the months of November through April (Questa Engineering 2011). Discharge within San Geronimo Creek, as measured in the mainstem at the Marin Municipal Water District (MMWD) stream gage located on Lagunitas Road Bridge near the outlet of the San Geronimo Creek watershed (approximately 0.7 mi upstream of the Lagunitas Creek confluence), corresponds to regional precipitation patterns, with flows during November through April typically one to two orders of magnitude greater than those reported during May through October. Winter peak flow events range approximately approximately 1,000−4,000 cfs (Stillwater Sciences

2009a), and travel relatively quickly through the watershed such that peak flow durations are typically on the order of hours to days (Owens et al. 2000, 2001, 2002), depending on location in the watershed. Monthly averaged maximum daily mean flows during the 'high flow' period (November through March) range approximately 90−320 cfs over the period of record (water year [WY]1982−WY2005), with individual daily mean flow values during this period ranging 0.1−2,200 cfs (Figure 3-1).

Minimum flows typically occur in late summer and early fall (i.e., August and September) (Figure 3-2). Monthly averaged minimum daily mean flows for the 'low flow' period (June through October) range 0.1−0.8 cfs over the period of record (WY1982−WY2005), with individual daily mean flow values during this period ranging 0.03−2.2 cfs (Figure 3-2).

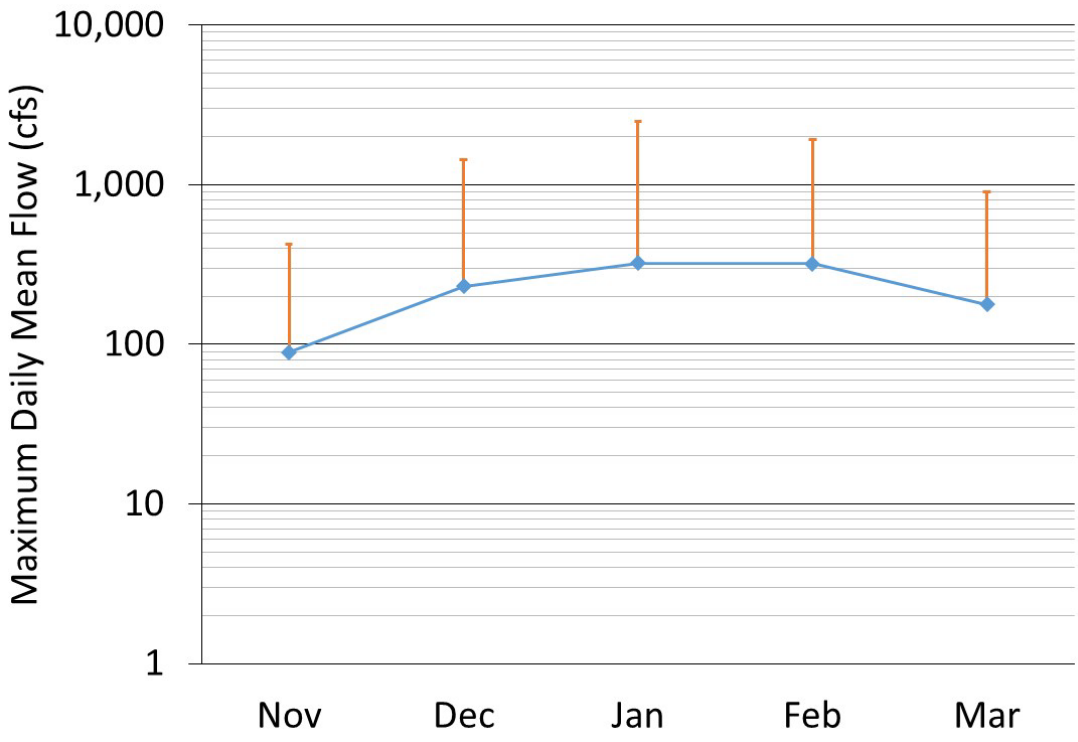

Figure 3-1. Monthly averages of maximum daily mean flows during November through March for WY1982–WY2005 at San Geronimo Creek at Lagunitas Road Bridge. Bars show the range of maximum daily mean flows for each month. Data for WY 2004 are unavailable.

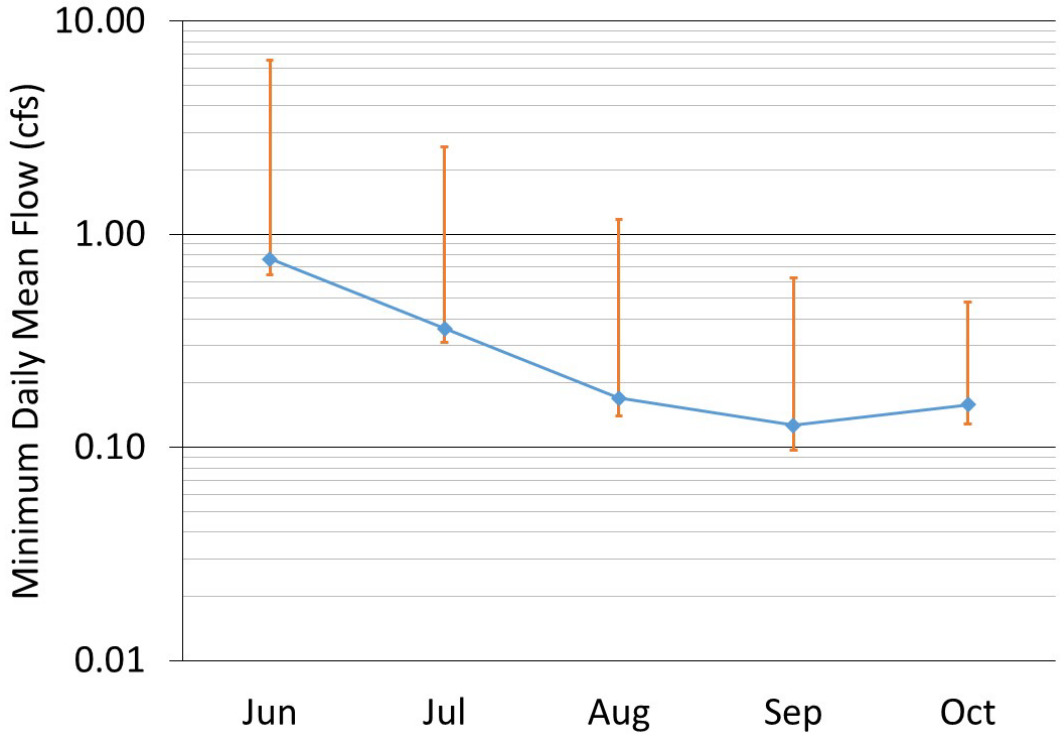

Figure 3-2. Monthly averages of minimum daily mean flows during June through October for WY1982–WY2005 at San Geronimo Creek at Lagunitas Road Bridge. Bars show the range of minimum daily mean flows for each month. Data for WY 2004 are unavailable.

In order to evaluate the past and potential future influence of watershed-scale land-cover changes on instream hydrology, the wet-season flow reversals indicator was calculated for San Geronimo Valley for each year for the period 1980−2016, using daily flows averaged from the raw 15-minute data collected at the MMWD stream gage and organized by water year (October 1−September 30) (J. Owens, Balance Hydrologics Inc., pers. comm., 2016). Only the wet-season flows (October through April) were used in the analysis, based on the assumption that flows during other times of the year are generally of much smaller magnitude and whose day-to-day changes have less significance for both biota and stream geomorphology.

Plotting the tally of flow reversals by year (Figure 3-3) shows a clear pattern of increasing reversals over time for San Geronimo Valley, a trend that is widely recognized in urbanizing watersheds (DeGasperi et al. 2009, Larson et al. 2009, Schoonover et al. 2006, King County 2012, Hasenmueller et al. 2016, Stillwater Sciences 2016, Booth and Konrad, in review). Results also indicate substantial scatter, with one standard deviation around the mean (i.e., the limits around the

central trend of the data that encompass about 2/3 of all points) being approximately ±13 reversals/year.

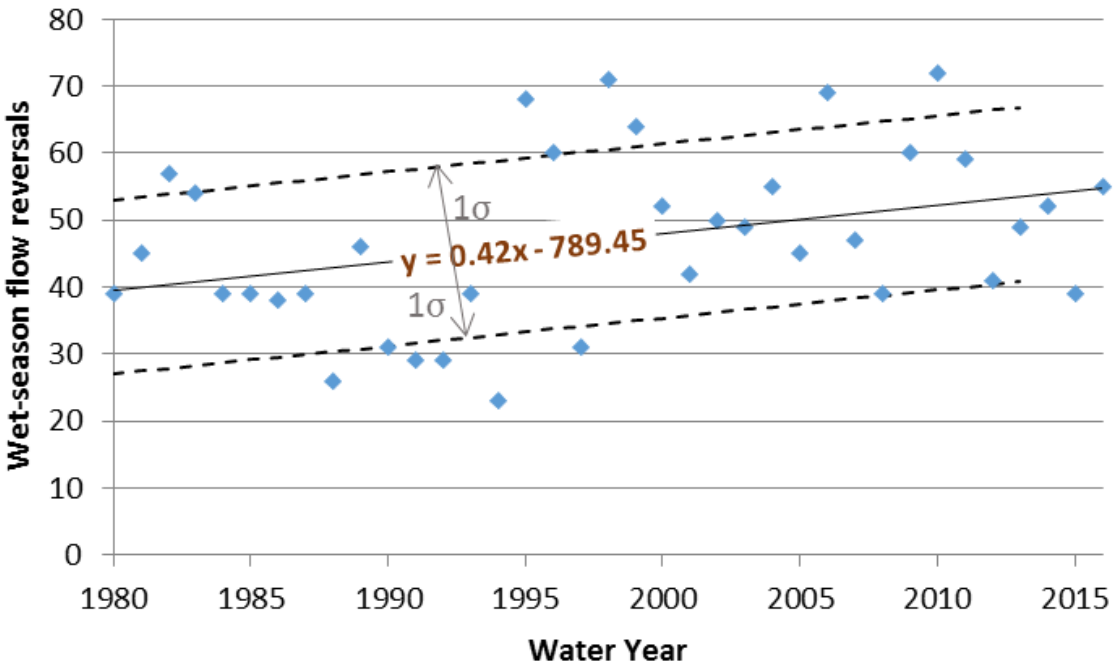

Figure 3-3. Plot of wet-season flow reversals over the full period of record (water year 1980-2016). Dotted lines show the boundaries of one standard deviation above and below the central trend (solid line), indicating the magnitude in year-to-year variability in this indicator. The equation of this trend suggests that about 4 additional reversals in the flow record occur with every passing decade.

Lastly, with respect to groundwater, soils in the valley floor were primarily formed by accumulated erosion from the surrounding upland slopes and ridges, and in some places are quite deep, ranging from 6 to 72 in. In general, valley floor soils are poorly to very poorly drained. Reported groundwater levels in Woodacre during winter months are typically less than three feet below the ground surface; however, localized soil saturation and ponding can occur during the wet season (Questa Engineering 2011). Poorly drained soils lead to less infiltration and more surface runoff.

3.4 Water Quality

This section presents a brief summary of water quality in the San Geronimo Creek watershed, as relevant to salmonids. More detailed discussion of the implications of observed patterns with respect to salmonid health are presented in Section 3.6 and the SEIR impact analyses (Section 1).

Reported water temperatures in mainstem San Geronimo Creek and at least two of its major tributaries (i.e., Woodacre Creek, Montezuma Creek) have consistently been below the maximum thresholds for salmonids salmonid upper incipient lethal temperature (26.6ºC, Brett 1952) and the critical thermal maxima (24.6ºC; McGeer et al. 1991), although they have been observed to exceed optimal ranges for coho, steelhead, and Chinook salmon during summer low-flow periods (Stillwater Sciences 2009a). Winter temperatures currently appear to support spawning and egg incubation requirements (see also Section 3.6.1).

Reported dissolved oxygen levels do not consistently meet the Basin Plan minimum criterion of 7.0 mg/L for the cold freshwater habitat ("COLD") or spawning ("SPAWN") beneficial uses in San Geronimo Creek, with occasional levels below this threshold in tributaries to the mainstem (Montezuma and Woodacre creeks) during late fall/early winter, and in tributaries (North Fork San Geronimo Creek, Woodacre Creek, Arroyo Creek) as well as several locations in mainstem San Geronimo Creek (Roy's Pools, Meadow Way, and Castro Pools) during late summer/early fall (see also Section 3.6.1).

Lagunitas Creek (of which San Geronimo Creek is a major tributary) is included on the 2010 (current) and 2016 (proposed) Federal Clean Water Act (CWA) Section 303(d) list of impaired waters for sedimentation/siltation, pathogens, and nutrients. Accordingly, the San Francisco Bay Regional Water Quality Control Board (SFBRWQCB) developed a total maximum daily load (TMDL) allocation for sedimentation and channel incision in the Lagunitas Creek watershed, described causes and sources of sediment, established numeric targets for sediment and habitat complexity, and defined a course of action to restore water quality and habitat conditions (i.e., an implementation plan) (SFBRWQCB 2014a) The SFBRWQCB also established a TMDL for pathogens in the Tomales Bay watershed (2005) and developed the Conditional Waiver of Waste Discharge Requirements for Grazing Lands in the Tomales Bay Watershed (2008, 2013 Grazing Waiver). Within San Geronimo Valley, water quality sampling of Woodacre Creek and local storm drains has shown elevated levels of coliform bacteria, nitrate, ammonia, and surfactants, in some cases exceeding receiving water quality standards (Questa Engineering 2011). Coliform and nitrate levels are high in San Geronimo Creek, particularly during storm events, with septic tank leakage into the creek as a likely cause (Questa Engineering 2011). While high coliform levels are not expected to affect salmonids, excessive algal growth from high nutrient levels may decrease dissolved oxygen levels in the creek

(Stillwater Sciences 2009a). A nutrient TMDL is required for the Lagunitas Creek watershed (including San Geronimo Creek) by 2022.

3.5 Riparian Zone

This section presents an overview of riparian habitat in the San Geronimo Creek watershed. The implications of observed habitat conditions with respect to salmonid health are discussed in Section 3.6 and the SEIR impact analyses (Section 1).

Riparian habitat conditions in the San Geronimo Valley have been most recently inventoried and described by MMWD (Ettlinger et al. 2013) and Stillwater Sciences (2009a). Data summarized by Ettlinger et al. (2013) from 1998, 2003, 2006, and 2011 indicate a decline in vegetation covering the stream banks (bank cover) from 1998 to 2006, followed by an increase from 2006 (53% bank cover) to 2011 (> 70% bank cover). Much of the recent increase was driven by an increase in deciduous and evergreen riparian trees. As a result of the increased riparian tree coverage, the stream shading function of the riparian corridor along mainstem San Geronimo Creek has shown an increase since the first data were reported in 2003 (Ettlinger et al. 2013). Field survey data from 2008 show that the riparian forest along San Geronimo Creek and its four major tributaries (North Fork San Geronimo Creek, Woodacre Creek, Larsen Creek, and the Arroyo/El Cerrito/Barranca Complex) is composed almost entirely of native trees (Stillwater Sciences 2009a). While the herbaceous understory vegetation in 2008 included a high percentage of non-native invasive species (Stillwater Sciences 2009a), the non-native vegetation did not appear to be preventing the establishment or growth of native riparian trees. More recent data collected by Ettlinger et al. (2013) showed reduced bank coverage of shrub vegetation from 2006 to 2011, and near elimination of herbaceous bank vegetation during the same period.

Despite the recent increase in bank cover for the San Geronimo Valley, field survey data from 2008 show a high frequency (i.e., degree of occurrence) and stem density of smaller riparian trees and a very low frequency of large trees, indicating that the riparian forests along San Geronimo Creek and its major tributaries are in an early- to mid-seral stage and are likely still responding to past and ongoing disturbances including logging, grazing, and housing development (Stillwater Sciences 2009a), as well as a major flood in December, 2005. Overall, the very low number and density of large (> 76 cm [> 29.9 in] diameter at breast height [DBH]) trees in the riparian corridor suggests that existing conditions do not support an adequate supply of future LWD to provide high-quality rearing and

overwintering habitat for salmonids. For the recent Lagunitas Creek Watershed Fine Sediment Reduction and Habitat Enhancement Plan, SFBRWQCB (2014a) developed a historical reference model for channel and floodplain habitat conditions in the watershed. Information compiled for this reference model indicates that hardened banks along many stream channels in the San Geronimo Valley have reduced the rate of LWD recruitment that otherwise would result from bank erosion and tree-fall (SFBRWQCB 2014a).

Development, as measured by impervious area, in the San Geronimo Creek watershed is concentrated in the riparian zone under existing conditions. This is shown by the %TIA in the SCA in portions of each subbasin or the mainstem reach, which exceeds the watershed-scale TIA of 5.0% and TIA for all subbasins and mainstem reaches (Figure 3-4). Percent impervious areas in the SCA range from 5.8% for North Fork San Geronimo Creek to 11.5% for Woodacre Creek. In the North Fork San Geronimo Creek and Montezuma Creek subbasins, the concentrations of impervious area within the SCA are a little more than twice the amount found in the subbasins as a whole (2.2% in the SCA vs. 5.8% in the North Fork San Geronimo Creek subbasin, and 3.9% in the SCA vs. 8.8% in the Montezuma Creek subbasin) (Figure 3-4).

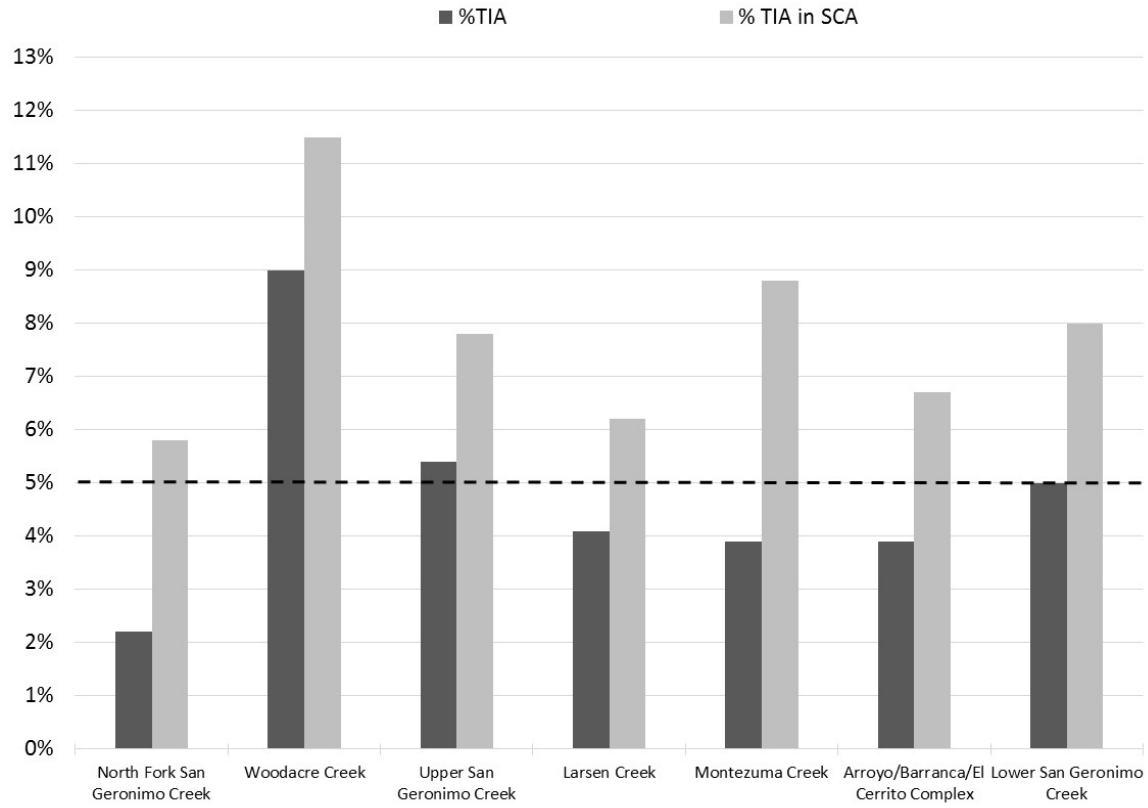

Figure 3-4. Percent TIA versus percent TIA in the SCA for each sub-watershed/reach. Dashed line indicates watershed-scale TIA fromTable 2-5. Other data from Table 2-9 and Table 2-13.

Development-related effects on salmonid habitat in the San Geronimo Valley riparian zone include changes in stormwater runoff patterns, reduced stream shading and nutrient input, and reduced LWD recruitment. As development (i.e., imperviousness) along stream corridors increases and the spatial extent of vegetated riparian areas is reduced, an increasing proportion of runoff is routed directly to streams. This increased “hydrologic connectivity” can increase the magnitude and duration of storm flows, potentially reducing salmonid spawning and rearing success by scouring incubating eggs in the gravel and displacing rearing juveniles due to excessively high water velocities. These effects are exacerbated in streams that provide little high-flow refuge habitat due to reductions in the extent of functional floodplains and the amount of complex instream cover. The reduced extent of riparian vegetation can also contribute to increased bank erosion, increase solar heating and thus stream temperatures above those tolerated by salmonids, and reduce inputs of nutrients and terrestrial insects fed upon by salmoids. Fewer trees in the riparian zone mean fewer trees (i.e., LWD) entering the stream channel and contributing to habitat complexity.

3.6 Habitat Quality for Anadromous Fish Species

The following sections provide a summary of spawning habitat, overwintering habitat, and summer rearing habitat conditions in the San Geronimo Creek watershed based on existing data collected by MMWD, CDFW, and others, including a salmonid habitat survey conducted in 2011 by Ettlinger et al. (2013) and a low-flow habitat survey by Stillwater Sciences conducted in October and November 2015 (Appendix B). When available, data on existing habitat conditions are compared with targets recommended in the San Geronimo Valley Salmonid Enhancement Plan (PCI 2010).

3.6.1 Spawning Habitat

Spawning habitat conditions for the San Geronimo Creek mainstem and its tributaries are characterized qualitatively, based primarily on observations of gravel and habitat type frequency, and fine sediment in channel bed substrates. Observations related to water quality (e.g., water temperature) conditions that support salmonid spawning requirements, and the relative frequency of observed coho salmon spawning activity, are also reported below.

The most recent spawning habitat information indicates little change in the proportion of riffle habitat from 2003–2011, but a decline in the amount of potential spawning gravel in the upper mainstem of San Geronimo Creek (Larsen Creek to Dixon Weir) during this period (Ettlinger et al. 2013). The loss of gravel in the upper mainstem was accompanied by a dramatic increase in fine sediment from 2003–2011. In 2011, fine sediment was dominant in 65% of the streambed in the upper mainstem of San Geronimo Creek, which is similar to what was observed in 1998 (Ettlinger et al. 2013). The amount of gravel remained relatively unchanged in the lower mainstem of San Geronimo Creek from 1998–2011, with the exception of 2003 when the proportion of gravel (> 60%) was greatest of any year surveyed. These trends indicate that spawning habitat targets for sediment size and the percentage of fine sediment recommended in the San Geronimo Valley Salmonid Enhancement Plan (PCI 2010) are being met in the lower mainstem of San Geronimo Creek but not in the upper mainstem (Table 3-1). Pool tail embeddedness, a measure of fine sediment impacts on spawning gravel quality, in 2011 was approximately 38% in the lower mainstem of San Geronimo Creek and 47% in the upper mainstem, representing increases relative to 2006 and 2003 (Ettlinger et al. 2013). Based on measurements since 1998/1999 (Ettlinger et al. 2013), pool tail embeddedness throughout the mainstem of San Geronimo Creek has remained above the target of <25% gravel embeddedness

recommended in the San Geronimo Valley Salmonid Enhancement Plan (Table 3-1; PCI 2010) to support successful egg incubation and emergence (higher values indicate lower quality spawning habitat). High rates of fine sediment delivery can cause increased embeddedness of spawning gravel and entobmbent (smothering) of incubating salmonid eggs and emerging alevins, substantially reducing spawning success. While these effects have not been studied in the San Geronimo Creek watershed, recent research has documented elevated fine sediment delivery to San Geronimo Creek and its major tributiaries that could contribute to these impacts (Stillwater Sciences 2010, SFBRWQCB 2014a, O'Connor Environmental 2015). SFBRWQCB (2014a) estimated that the average annual sediment delivery to San Geronimo Creek from 1983–2008 (450 tons/km^2/yr) was greater than in any other Lagunitas Creek sub-watershed, with 240 tons/km^2/yr (53%) of the total originating from channel processes, 130 tons/km^2/yr (29%) originating from road erosion, and 80 tons/km^2/yr (18%) originating from hillslope processes.

Table 3-1. Targets for Critical Elements of Salmonid Spawning Habitat to Support Returning Adults, Successful Egg Hatching, and Emergence. Source: San Geronimo Valley Salmonid Enhancement Plan (PCI 2010).

Critical Habitat Element	Indicators	Targets	Do Current Conditions Meet Targets? [1]
Bed Sediment Quality	Sediment size	D_{50} = gravel w/increasing trend	Yes (downstream of Larsen Creek); No (upstream of Larsen Creek)
	Gravel permeability	TBD – increasing trend	Unknown
	Gravel embeddedness	<25% with decreasing trend (pending basin TMDL determinations)	No
	% fine sediment	TBD – decreasing trend	Yes (downstream of Larsen Creek);[2] No (upstream of Larsen Creek)[3]
Water Quality	Temperature	<14ºC	Yes
	Dissolved oxygen	7.0-9.0 mg/L or ≥85% of saturation[4]	Yes (mainstem); No (Montezuma and Woodacre Creeks)
Passage	Man-made barriers to migration	90-100% of suitable habitat unimpeded	No

[1] Based on analysis presented in Stillwater Sciences (2009a) and conditions and trends reported by Ettlinger et al. (2013)
[2] Fine sediment in mainstem San Geronimo Creek downstream of Larsen Creek decreased from 2006 to 2011 (Ettlinger et al. 2013)
[3] Fine sediment in mainstem San Geronimo Creek upstream of Larsen Creek increased from 2003 to 2011 (Ettlinger et al. 2013)
[4] Regional Board Basin Plan (SFBRWQCB 2007)

Redd scour during the winter incubation period may also reduce spawning success, and there is some evidence that high flows during this period may affect the subsequent summer abundance of juvenile coho (Ettlinger 2008, Stillwater Sciences 2008). While the frequency and occurrence of redd scour in San Geronimo Creek and its tributaries is currently unknown, channel incision, elevated sediment delivery to streams, and other impacts related to historical and current land uses have resulted in conditions that likely contribute to substantially increased streambed mobility and redd scour potential in the watershed. As shown locally by Cover (2012) in Woodacre Creek and by Lisle et al. (2000) in gravel-bedded channels elsewhere, the potential for redd scour is increased when sediment supply is relatively high and erosive power is sufficient to mobilize spawning gravels. Based on a comprehensive review of existing information, SFBRWQCB (2014a) predicts a “high risk” of redd scour in mainstem San Geronimo Creek and a “very high risk” in Woodacre Creek, due to the elevated supply of sediment entering these reaches and the effects of historical channel incision and LWD removal. The risk of redd scour is concentrated in reaches where the channel is narrow and floodplains are absent. In Woodacre Creek, the high sediment supply and incised, simplified channel contribute to high streambed mobility at bankfull flow (the channel-forming flow, with about a 1.5-year return interval) (Cover 2012).

Winter water temperatures in the San Geronimo Creek watershed appear to support salmonid spawning and egg incubation requirements (Table 3-1). During 2004 and 2006, winter temperatures ranged from 5–14°C (Bouley and Lim 2005, SPAWN 2008), which is below the expected threshold (14.4°C [58°F]) for temperature induced sub-lethal stress and/or mortality of constantly exposed incubating salmonid eggs (Section 3.1.2). While the upper end of the range observed winter temperatures (5–14°C) may be slightly greater than optimal egg incubation temperatures of 9–11°C (48–52°F) reported for steelhead and coho salmon, it does not represent a constant exposure to warm temperatures and is thus not expected to significantly affect salmonid incubation and emergence in San Geronimo Creek (Stillwater Sciences 2009a).

Reported dissolved oxygen levels do not consistently meet the Basin Plan minimum criterion of 7.0 mg/L for the cold freshwater habitat (“COLD”) or spawning (“SPAWN”) beneficial uses in San Geronimo Creek (SFBRWQCB 2007, Bouley and Lim 2005, Bouley et al. 2006, SPAWN unpubl. 2008 data), both of which are relevant to salmonids (Table 3-1). For example, while dissolved oxygen in winter 2004–2005 was generally greater than 7.0 mg/L in mainstem

San Geronimo Creek, during four instances in November and December dissolved oxygen was measured between 5.2 mg/L and 6.6 mg/L in tributaries to the mainstem (Montezuma Creek and the East and West Forks of Woodacre Creek) (Bouley and Lim 2005). Low dissolved oxygen levels during late fall/early winter are particularly problematic for attainment of the spawning beneficial use ("SPAWN"), which is based upon the assumption that dissolved oxygen in spawning areas should ideally approach saturation levels in order to maintain well-oxygenated conditions around eggs deposited in sediments.

Observed Salmonid Spawning Activity

The San Geronimo Creek watershed provides habitat for spawning and rearing by coho salmon, steelhead, and occasionally Chinook salmon. However, salmonid access is currently blocked by culverts or other passage barriers in several locations throughout the watershed and the target of unimpeded access to 90–100% of suitable habitat is not currently met (Table 3-1). These include, but are not limited to, barriers to Creamery Creek, Sylvestris Creek, and Treatment Plant Creek, as well as all three major tributaries to the North Fork (i.e., Spirit Rock, Horse, and Flanders Creeks) due to the presence of Dickson weir (Stillwater Sciences 2009a). In Larsen Creek, steelhead access to significant stretches of potential upstream habitat is restricted by a large pond in the San Geronimo Golf Course and road crossings at Nicasio Valley Road and Meadow Way, while both coho and steelhead presence are restricted by an impassable culvert on Montezuma Road just upstream of the confluence between Montezuma and Candelero Creeks.

Since 2002, Marin County has undertaken efforts to reduce fish passage barriers in San Geronimo Valley in order to restore unimpeded salmonid access to stream habitat for coho salmon and steelhead. Under the Countywide Fish Passage and Creek Restoration Program, Marin County conducted an inventory and fish passage evaluation of county-maintained stream crossings (Taylor and Associates 2003). Based on recommendations presented in Taylor and Associates (2003), Marin County has since completed nine fish passage projects in San Geronimo Valley and developed designs for three projects:

Fish Passage Projects Completed to Date

- Silvestris Creek at Meadow Way (2004)
- Willis Evans Canyon at San Geronimo Valley Dr. (2005)
- E. Fork Woodacre Creek #3 Woodacre Improvement Club (2005)
- Woodacre Creek #2 at Park St. (2006)

- Spring Creek at Mountain View Ave. (2006)
- Woodacre Creek #1 at San Geronimo Valley Dr. (2007)
- Woodacre Creek #3 at Carson Rd. (2008)
- Arroyo Creek at Castro St. (2010)
- San Geronimo Creek at Railroad (2016)

Fish Passage Projects Designed and Seeking Funds for Construction

- Larsen Creek at Sir Francis Drake Blvd. (design complete 2014)
- Montezuma Creek at Guadalupe Road (design complete 2015)
- San Geronimo Creek at San Geronimo Valley Dr. Bridge/Roy's Pools (design complete 2017)

Recent surveys have documented spawning coho salmon, steelhead, and Chinook salmon in mainstem San Geronimo Creek downstream of the confluence with Treatment Plant Creek, while coho and steelhead have spawned in the mainstem as far upstream as Dickson Weir on the North Fork and within the low gradient (0–4%) reaches of the four major tributaries (Woodacre, Larsen, Montezuma, and Arroyo creeks) (Ettlinger and Andrew 2012, Ettlinger et al. 2012, Ettlinger and Andrew 2013, Ettlinger and Andrew 2014, Ettlinger et al. 2015, Ettlinger et al. 2016). In accessible tributary reaches, steelhead presence extends upstream of coho presence into higher gradient reaches (4–8%). Spawning by each species may occur in any accessible reach with suitable habitat.

Since 2010, the upper and lower mainstem of San Geronimo Creek, particularly the reaches immediately downstream of Woodacre and Montezuma creeks, have consistently been among the most heavily used spawning locations for coho salmon and steelhead in the watershed (Ettlinger and Andrew 2012, Ettlinger et al. 2012, Ettlinger and Andrew 2013, Ettlinger and Andrew 2014, Ettlinger et al. 2015, Ettlinger et al. 2016). Most rearing is expected to take place in the same reaches where spawning occurred or in downstream reaches. Woodacre Creek also provides a substantial amount of spawning and rearing habitat and was heavily used by spawning coho salmon between 2000 and 2008, though spawning activity in Woodacre Creek and other tributaries to San Geronimo Creek since the 2007–2008 spawning season has been negligible (Ettlinger et al. 2015).

3.6.2 Overwintering Habitat

Habitat features such as alcoves, side-channels, backwaters, LWD, and deep pools formed by rootwads and large wood provide refuge from high winter flows (Bustard and Narver 1975, Tschaplinski and Hartman 1983, Nickelson et al. 1992). Without these types of habitats, newly emerged salmonid fry and older juveniles that cannot find refuge from high flows are likely to be displaced downstream and experience higher rates of injury and mortality. Those that survive displacement and end up prematurely in the estuary or ocean are at increased risk of predation due to their relatively small size. Size at outmigration has been correlated with ocean survival of anadromous salmonids (Peterman 1982, Bilton et al. 1982, Ward et al. 1989), and coho salmon that enter the ocean prior to their second year of life (i.e., at a substantially smaller size than typical 1-year old outmigrants) are believed to have low probability of surviving to adulthood (Otto 1971, Crone and Bond 1976, Hartman et al. 1982).

A salmonid limiting factors analysis (LFA) for the entire Lagunitas Creek system (Stillwater Sciences 2008) found that overwintering habitat is likely to be limiting salmonid production under present conditions. The low abundance of LWD and other complex habitat features such as root wads and undercut banks, and the lack of floodplains or disconnection of inset floodplains from the channel in much of the watershed, results in poor habitat conditions for juvenile salmonids seeking refuge during high-velocity winter flows (NMFS 2012, 2015). In the San Geronimo Creek watershed, impacts related to development in the SCA, including bridges and culverts, bank armoring, clearing of riparian vegetation, removal of LWD from channels, and the increasing amount of impervious area within the SCA, have contributed disproportionately to reductions in salmonid overwintering habitat quality and quantity (Stillwater Sciences 2009a, SFBRWQCB 2014a). Data collected by Ettlinger et al. (2008) and SPAWN (2008) in San Geronimo Creek are consistent with the LFA findings for the greater Lagunitas Creek watershed, showing a pattern of increased winter mortality with increasing summer coho salmon abundance. However, salmonid use of San Geronimo Creek mainstem and tributary habitat during wintertime high flows has not yet been documented, and data gaps remain as to the types and arrangements of in-channel habitats (e.g., wood jams) and tributary habitat that promote winter fidelity in the San Geronimo Valley.

The following description of existing overwintering habitat conditions and recent trends in San Geronimo Creek and major tributaries is summarized from the Existing Conditions Report (Stillwater Sciences 2009a) and MMWD habitat surveys summarized by Ettlinger et al. (2013). Habitat data reported by Ettlinger

et al. (2013) for surveys in 1998/1999, 2003, 2006, and 2011 is for mainstem San Geronimo Creek only.

In Woodacre Creek, there is a low accumulation of LWD and low potential for long-term LWD recruitment, and no apparent high-flow velocity refuge at the confluence with mainstem San Geronimo Creek. Despite this, limited high-flow velocity refuge is present in the form of localized undercut banks, complex root bases, and meanders with woody debris. The overall low number and density of large (> 76 cm [> 29.9 in] DBH) riparian trees in Woodacre Creek may not provide a sufficient long-term supply of LWD to meet salmonid overwintering habitat targets for increasing LWD loading, pool frequency, and shelter complexity (Table 3-2). No data are available on the amount or quality of high-flow refugia for winter rearing salmonids in North Fork San Geronimo Creek downstream of Dickson Weir.

Table 3-2. Targets for Critical Habitat Elements of Salmonid Overwintering Habitat to Support Emergent Fry Survival and Juvenile Survival to Smolting. Source: San Geronimo Valley Salmonid Enhancement Plan (PCI 2010).

Critical Habitat Element	Indicators	Targets	Do Current Conditions Meet Targets? [1]
Channel Bed Form	Pool frequency (# of pools/channel width)	0.25-0.5	No (mainstem)
	Pool/riffle ratio	1:1	Unknown
	Residual pool depths	Increasing trend >2ft [6]	Unknown
	Shelter	Increasing trend	Unknown
	Large wood frequency	Increasing trend in loading and forced pool-riffle units (reach based) or 6-11 pieces/100m [7]	No (mainstem upstream of Larsen Creek); Yes (mainstem downstream of Larsen Creek)
	Floodplain connectivity	> 80% in low gradient streams (<2.5%)[8]	Unknown

Critical Habitat Element	Indicators	Targets	Do Current Conditions Meet Targets? [1]
Water Quality	Turbidity	Peak: <100-500 mg/L TSS Chronic: trend toward sub-lethal concentrations by duration[2]	Data inconclusive
	Temperature	<14ºC [3]	Yes
	Dissolved oxygen	7.0-9.0 mg/L or ≥85% of saturation [4]	Yes (mainstem); No (Montezuma and Woodacre Creeks)

[1] PCI (2010)
[2] Appendix B in Stillwater Sciences (2009b) for peak value; Newcombe and Jensen (1996) for chronic value.
[3] Stillwater Sciences (2009a)
[4] Regional Board Basin Plan
[5] Johnston and Slaney (1996)
[6] Appendix B in Stillwater Sciences (2009b) citing Bjornn and Reiser (1991) and Ralph et al. (1994)
[7] From Lisle and Church (2002) and Recovery Plan for Central California Coast coho salmon (NMFS 2012).
[8] Recovery Plan for Central California Coast coho salmon (NMFS 2012).

In upper mainstem San Geronimo Creek (Figure 2-3), much of the channel is incised and disconnected from its floodplain, with limited high-flow refugia for salmonid winter rearing. Pool frequency in this reach (measured from Larsen Creek to Dixon Weir), which ranged from a high of approximately 0.24 pools per channel width in 1998/1999 to a low of 0.17 in 2011 (Ettlinger et al. 2013), has consistently been below the recommended target of 0.25–0.5 (Table 3-2). While this reach was described by Stillwater Sciences (2009a) as having a “relatively high density” of LWD in the channel (0.095 m^3/m), LWD frequency declinded from 2006 to 2011 (Ettlinger et al. 2013). As a result, this reach does not meet the recommended overwintering habitat target of an increasing trend in LWD loading (Table 3-2). In addition, the overall low number and density of large (> 76 cm [> 29.9 in] DBH) riparian trees may not provide a sufficient long-term supply of LWD to meet salmonid overwintering habitat targets in this reach (Table 3-2).

Overwintering habitat quality in lower Larsen Creek (downstream of the golf course) currently appears to be among the best in the San Geronimo Valley. During surveys in summer 2008, Stillwater Sciences (2009a) documented high quality overwintering habitat in lower Larsen Creek that includes relatively deep, complex pool habitat with undercut stream banks and large woody material that likely provides velocity refuge to rearing salmonids during high winter flows. The low number and density of large (> 76 cm [> 29.9 in] DBH) riparian trees in lower

Larsen Creek indicates that the future LWD recruitment potential may not be adequate to create complex habitat and pool scour that would help meet overwintering habitat targets including increased LWD loading, pool frequency, and instream shelter (Table 3-2).

Lower Montezuma Creek, downstream of the impassible culvert located just above the Candelero Creek confluence, has no inset floodplains and contains very little LWD or other complex habitat structure that would provide salmonid overwintering habitat. However, the relatively high density of large (> 76 cm [> 29.9 in] DBH) riparian trees in lower Montezuma Creek may be adequate to support future LWD recruitment and provide increased LWD loading, pool development, and complex shelter to meet targets for overwintering habitat (Table 3-2).

In Arroyo, Barranca, and El Cerrito creeks, overwintering habitat is provided by undercut banks and root complexes, and LWD is present in El Cerrito Creek. Although inset floodplains are present in Barranca and Arroyo creeks, the channel in most of this sub-basin is incised and disconnected from the floodplain. The low number and density of large (> 76 cm [> 29.9 in] DBH) riparian trees in the sub-basin indicates that future LWD recruitment potential may not be adequate to create complex habitat and pool scour that would help meet overwintering habitat targets including increased LWD loading, pool frequency, and instream shelter (Table 3-2).

The channel of lower San Geronimo Creek (Figure 2-3) is moderately incised and disconnected from the few inset floodplains that are present. This reach has some root complexes and LWD structures and a “relatively high” LWD frequency (0.095 m^3/m), providing localized but limited high-flow refugia for overwintering salmonids (Stillwater Sciences 2009a). The frequency of LWD increased modestly from 2006 to 2011 in mainstem San Geronimo Creek downstream of Larsen Creek (Ettlinger et al. 2013), meeting the “increasing trend” criterion of the recommended LWD target for overwintering habitat (Table 3-2). The pool frequency in the mainstem downstream of Larsen Creek, which ranged from a high of approximately 0.19 pools per channel width in 2003 to a low of 0.11 in 2006, is below the recommended target of 0.25–0.5 (Table 3-2). The low number and density of large (> 76 cm [> 29.9 in] DBH) riparian trees in lower San Geronimo Creek indicates that future LWD recruitment potential may not be adequate to create complex habitat and pool scour that would help meet overwintering habitat targets including increased LWD loading, pool frequency, and instream shelter (Table 3-2).

3.6.3 Summer Rearing Habitat

Limited information on summer rearing habitat quality or quantity is available for San Geronimo Creek because few studies or monitoring efforts have been conducted. Accordingly, summer rearing habitat was identified as a data gap in the Existing Conditions Report (Stillwater Sciences 2009a). With respect to flow, in its recovery plans for Central California Coast coho salmon and steelhead, NMFS (2012, 2015) rates summer baseflow conditions in the Lagunitas Creek watershed, including San Geronimo Creek, as “fair” for rearing juveniles and describes existing summer habitat complexity, shelter, and riparian tree canopy ratings as providing “poor” summer rearing conditions for juveniles.Trends in pool frequency and the amount of fish cover (i.e., shelter) present in pools in San Geronimo Creek between 1995 and 2011, reported by Ettlinger et al. (2013), indicate declines in both metrics between 1995 and 2006, followed in 2011 by increases in pool frequency downstream of Larsen Creek and continued decreases upstream of Larsen Creek. Fish cover in pools increased throughout San Geronimo Creek between 2006 and 2011, driven largely by increases in LWD and root masses, as well as increased density of overhanging vegetation in the channel upstream of Larsen Creek (Ettlinger et al. 2013). While the recent increase in pool cover meets the recommended summer rearing habitat target of increasing shelter, pool frequency has consistently been below the recommended target of 0.25–0.5 (Table 3-3). As described above for overwintering habitat, the 2006–2011 increase in LWD frequency in the mainstem of San Geronimo Creek downstream of Larsen Creek meets the criterion for increased LWD loading, but the decreasing trend upstream of Larsen Creek does not meet the LWD loading criterion for this summer rearing habitat target (Table 3-3).

Table 3-3. Targets for Critical Elements of Salmonid Summer Rearing Habitat to Support Optimal Juvenile Growth and Survival. Source: San Geronimo Valley Salmonid Enhancement Plan (PCI 2010).

Critical Habitat Element	Indicators	Targets	Do Current Conditions Meet Targets? [1]
Channel Bed Form	Pool frequency (# of pools/channel width)	0.25–0.5 [1]	No (mainstem)
	Pool/riffle ratio	1:1	Unknown
	Residual pool depths	Increasing trend >2ft	Unknown
	Shelter	Increasing trend	Yes (mainstem)
	Large wood frequency	Increasing trend in loading and forced pool-riffle units (reach based) or 6–11 pieces/100m^2	No (mainstem upstream of Larsen Creek); Yes (mainstem downstream of Larsen Creek)
Water Quality	Temperature	MWAT <15°C	No (not all locations)
	Dissolved oxygen	7.0–9.0 mg/L or ≥85% of saturation [3]	No (not all years or all locations)
	Nutrients	Nitrates: 0.155 mg/L Orthophosphates: 0.03 mg/L[4]	No
	Toxicity	No acute, sub-lethal, or chronic toxicity concentrations[4]	No
	Riparian canopy	85–95%[14]	No
Food Availability	Macroinvertebrates	"minimally disturbed" Index of Biological Integrity (IBI) value[3]	Unknown
	Riffle embeddedness	<25% with decreasing trend (pending basin TMDL determinations)[5]	No (based on pool tail embeddedness data)
Passage	Man-made barriers to migration	90-100% of suitable habitat unimpeded[3]	No
	Flooded riffle	Increasing trend	Unknown

[1] Johnston and Slaney (1996)
[2] From Lisle and Church (2002) and NOAA Fisheries Draft Coho Recovery Plan (NOAA Fisheries, in press)—indicator of "Properly Functioning Conditions"
[3] SFBRWQCB (2007)
[4] Stillwater Sciences (2009a), ECR Section 3.5.5
[5] Appendix B in Stillwater Sciences (2009b)

Most water quality targets recommended to support summer rearing for juvenile salmonids are not being met in the San Geronimo Creek watershed (Table 3-3). Available data indicate that low dissolved oxygen levels at some locations in combination with relatively warm water temperatures during summer months do

not appear to support habitat for rearing juvenile salmonids in San Geronimo Creek and its tributaries (Stillwater Sciences 2009a). Nutrients and toxicity, as well as temperature-moderating shade provided by the riparian canopy, are also not meeting recommended targets for salmonid summer rearing habitat (Table 3-3).

Conditions to support production and availability of benthic macroinvertebrates used as food by rearing salmonids appear somewhat degraded in San Geronimo Creek, but specific indicators have not been monitored. An evaluation of the benthic macroinvertebrate community by the SFBRWQCB (2007) found evidence of reduced biological integrity at sampling sites in Woodacre Creek and San Geronimo Creek near the wastewater treatment plant, but the analysis did not include values for the IBI and attainment of this recommended target cannot be evaluated (Table 3-3). Embeddedness of gravel substrates in riffle habitats has not been systematically evaluated in the San Geronimo Creek watershed. However, pool tail embeddedness, which is used as an indicator of fine sediment impacts on spawning gravel quality, is a closely related metric measured periodically by MMWD since 1998/1999 (Ettlinger et al. 2013). As described above for spawning habitat, pool tail embeddedness throughout the mainstem of San Geronimo Creek has remained above the target of <25% recommended in the San Geronimo Valley Salmonid Enhancement Plan (PCI 2010) for both spawning habitat quality (Table 3-1) and benthic macroinvertebrate food production (Table 3-3).

To provide a greater understanding of current influences on salmonid summer habitat conditions and to establish a baseline for a qualitative cumulative assessment of habitat conditions under the Proposed Project, Stillwater Sciences conducted low-flow aquatic habitat surveys in October and November, 2015. The following information is summarized from observations made during the 2015 low-flow habitat surveys (Appendix B), conducted in the following reaches (see also Figure 2-3):

- North Fork San Geronimo Creek
- Woodacre Creek
- Upper San Geronimo Creek
- Larsen Creek
- Montezuma Creek
- Arroyo/Barranaca/El Cerrito Complex
- Lower San Geronimo Creek

Drought conditions were apparent during the surveys, with measured stream flows less than 0.03 cfs at all locations and no surface flow (i.e., 0 cfs) in each major tributary except Woodacre Creek. Flow at the MMWD stream gage located on Lagunitas Road Bridge (approximately 0.7 mi upstream of the Lagunitas Creek confluence) averaged 0.05 cfs during the surveys. The low streamflow conditions provided insufficient inundation and water velocity in riffle habitats to support production and transport of benthic macroinvertebrates preferred as prey by rearing juvenile salmonids.

Upper and lower mainstem reaches of San Geronimo Creek were largely intermittent during the 2015 survey, with pool and run habitats separated by dry riffles. Age-0 salmonid rearing habitat in the lower mainstem San Geronimo Creek (Figure 2-3) was relatively abundant, with greater habitat area per unit length than in the upper mainstem. Water velocity in the upper and lower mainstem reaches of San Geronimo Creek and the tributaries surveyed was too low to provide summer rearing habitat for age-1 (yearling) salmonids, which generally require velocities of at least 0.25–0.5 ft/s to support feeding and growth (Shirvell 1990). Juvenile salmonids were observed during the survey at several locations in the upper mainstem of San Geronimo Creek. Although only non-salmonid fish species were observed during the survey in the lower mainstem, electrofishing surveys by MMWD documented juvenile coho salmon and steelhead in lower mainstem San Geronimo Creek during late summer 2015 (E. Ettlinger, MMWD, pers. comm., 2015) indicating that salmonids were likely present during the Stillwater Sciences surveys despite the lack of confirmed observations. Water quality conditions appeared to be marginal where surface flow was intermittent, but water quality parameters were not measured during the surveys. Overall, summer rearing habitat availability in the mainstem reaches of San Geronimo Creek is sensitive to small changes in flow, with any reductions in flow expected to reduce suitable habitat area, food availability, and growth for rearing salmonids.

Lower Woodacre Creek and the upper mainstem reaches of San Geronimo Creek immediately downstream of the confluence with Woodacre Creek contained surface flow sufficient to provide connectivity between aquatic habitats (e.g., pools and riffles), and had the best summer rearing habitat conditions observed in the San Geronimo Creek watershed during the 2015 surveys. Although juvenile salmonids (young-of-the-year, or age-0) were observed in lower Woodacre Creek and San Geronimo Creek immediately downstream of Woodacre Creek during the surveys, flow in this area appeared to be near the lower limit of suitability for age-0 salmonid rearing. Summer rearing habitat under

these conditions is considered extremely sensitive to small changes in flow, where the latter could cause surface flow to become intermittent and deeper habitats such as pools and runs to become disconnected, with reductions in suitable rearing habitat area, food availability, and salmonid growth.

The channels of North Fork San Geronimo Creek, Larsen Creek, Montezuma Creek, and the Arroyo/Barranaca/El Cerrito creeks complex were dry at the time of the survey and did not provide summer rearing habitat for salmonids. Due to the lack of surface water, summer rearing habitat in these reaches would not be sensitive to further reductions in flow during dry conditions such as those observed during 2015. However, these reaches could be sensitive to small dry-season flow reductions during wetter years when juvenile rearing habitat is present during summer and fall.

4 SIGNIFICANCE CRITERIA

The Draft SEIR has been prepared to analyze potential cumulative impacts on salmonids in the San Geronimo Valley in conformity with State CEQA Guidelines Section 15130 and the Court opinion (Section 1.2).

State CEQA Guidelines require that cumulative impacts be analyzed in an EIR when the resulting impacts are cumulatively considerable, and, therefore, potentially significant. (CCR 15130(a).) “Cumulatively considerable” means that the incremental effects of an individual project are significant when viewed in connection with the effects of past projects, the effects of other current projects, and the effects of probable future projects. (15064(h)(1); 15065(a)(3).) The mere existence of significant cumulative impacts caused by other projects alone does not constitute substantial evidence that the proposed project’s incremental effects are cumulatively considerable. (CCR 15064(h)(4).) Instead, it must be shown that the project will contribute to an environmental impact to be characterized as a project-related cumulative impact. (See *Sierra Club v. West Side Irrig. Dist.* (2005) 128 CA4th 690.) Additionally, a lead agency may determine that the project will not have a significant cumulative impact because its incremental contribution to a cumulative effect is not cumulatively considerable. (CCR 15130(a); See *Save the Plastic Bag Coalition v. City of Manhattan Beach* (2011) 52 C4th 155 [An agency has discretion to find a project’s incremental effects less than significant when its contribution to a cumulative impact is insubstantial.]) Accordingly, CEQA requires that the lead agency analyze whether the project’s incremental effect should be considered significant by assessing both whether the cumulative impact is significant and whether the project’s incremental effect is cumulatively considerable. (*Communities for a Better Environment v. California Resources Agency* (2002) 103 CA4th 98, 120.)

Pursuant to the Guidelines and the court opinion, the analysis in the SEIR is focused specifically on cumulative impacts and thus the criteria defining an impact’s significance are likewise specific to cumulative impacts. Accordingly, the significance criteria used in the analysis have been modified from the criteria found in Appendix G of the State CEQA Guidelines to evaluate the principal action considered in the SEIR, namely the adoption and implementation of the Marin CWP (2007) with respect to the San Geronimo Valley and the potential for cumulative effects on salmonids.

The Proposed Project would have a potentially significant cumulative impact on anadromous fisheries in San Geronimo Valley if it would:

- Have a cumulatively considerable adverse effect, either directly or through habitat modifications, on coho salmon, steelhead, or Chinook salmon, where the populations have already been significantly adversely impacted;
- Have a cumulatively considerable adverse effect on riparian habitat, where the habitat has already been significantly adversely impacted; or
- Substantially interfere with coho salmon, steelhead, or Chinook salmon migration patterns or impede the use of native spawning sites, where the latter have already been significantly adversely impacted.

5 CUMULATIVE IMPACTS AND MITIGATION MEASURES

5.1 Introduction and Approach to Impact Analyses

Anadromous salmonid populations along the central California coast have experienced major declines in the last century resulting from the loss and degradation of freshwater and estuarine habitat due to impacts from logging, grazing, agriculture, urbanization, dams and water diversions, as well as overfishing and many other influences (NMFS 2012, 2016b–d). The cumulative effects of historical and current stressors have reduced the abundance, distribution, and life history diversity of these populations to the point where, without human intervention, their natural resilience and adaptability may no longer provide a means for their recovery (NMFS 2012). Coho salmon regional abundance is well below the NMFS recovery targets and the population segment as a whole remains severely depressed (Section 3.1.1). Additional habitat alterations, if they are of sufficient magnitude, have the potential to make a cumulatively considerable contribution to the existing significant cumulative adverse impacts affecting salmonid populations.

The cumulative impacts analysis in this SEIR evaluates the effects of future residential development (urbanization) on anadromous salmonids and their habitat in the San Geronimo Valley. While urbanization is only a single factor among many that have contributed to the decline of California's salmon and steelhead, it is the only impact that is directly affected by the Proposed Project. The attention is warranted, because the effects of urbanization on rivers, floodplains, and the surrounding watersheds are particularly impactful and largely permanent. As described previously (Section 3.2), effects of urbanization include fundamental changes to the nature of a watershed's hydrology (both surface flow and groundwater recharge), sediment inputs, channel form, streamside vegetation, nutrient inputs, water quality, solar inputs and primary productivity, the physical characteristics and suitability of instream habitats, and the biotic communities that rely on these habitats (Booth and Jackson 1997, Walsh et al. 2005, Fitzpatrick and Peppler 2010).

This cumulative impacts analysis considers incremental increases in several development metrics (i.e., number of parcels, units, %TIA, wet-season flow reversals, groundwater wells, diversions) in the assessment of future urbanization in the San Geronimo Valley (Section 2.6). With respect to %TIA in particular, while this metric can provide a useful indicator of multiple forms of human disturbance in a watershed that are potentially correlated with stream condition, it alone is not an appropriate predictor of stream health or the fate of

individual species, nor should it be used to define “acceptable” levels of development (Center for Watershed Protection 2003, Booth et al. 2004). Numerous studies have demonstrated that stream ecosystem health is influenced by a complex interplay of factors that may not be adequately reflected by a threshold of impervious surface (Karr and Chu 2000, Alberti et al. 2003, Booth et al. 2004), and substantial biological impairment can occur at TIAs below the commonly cited 10% “threshold” level (Booth and Jackson 1997, May and Horner 1999, Karr and Chu 2000, Booth et al. 2001, Booth et al. 2004). Thus, the analysis considers additional factors related to the Proposed Project that could cumulatively impact anadromous salmonids in the San Geronimo Valley, with a focus on alterations that would reduce habitat quality and/or function. More specifically, this analysis evaluates the potential for cumulative impacts on the anadromous salmonid life stages that are most likely to be affected by future development in the watershed: incubating eggs and juveniles rearing during winter and summer. The analysis is based on the potential impacts of future development in the San Geronimo Creek watershed on habitat conditions that support these life stages, in combination with the impacts that have resulted or could result from other past, present, and reasonably foreseeable future influences on these conditions.

The cumulative impact analysis implicitly acknowledges the difficulties of showing direct links between land-use activities and instream conditions, and so the predictions of impacts are of necessity qualitative and conservative (i.e., potentially overestimated), except where sufficient quantitative information is readily available. This task is further complicated by the variety of stream, riparian, and watershed conditions that can also cause adverse impacts on salmonid habitat but that are not a direct consequence of development activities under the Proposed Project. Further, because incremental changes in the salmonid populations that utilize San Geronimo Creek during their freshwater life stages may not be discernible at the scale of the population (e.g., coho salmon in the Lagunitas Creek watershed) or ESU (e.g., Central California Coast coho salmon), this SEIR analysis seeks to evaluate the potential effect of alterations in habitat, riparian function, and watershed processes on three important aspects of salmonid habitat as a result of the Proposed Project: winter rearing (Impact 5.1), spawning (Impact 5.2), and summer rearing (Impact 5.3).

For the purpose of this analysis, additional alterations of stream habitat, riparian habitat, and watershed hydrology resulting from the Proposed Project have the potential to cause significant impacts if, based on the best available information, the alterations would prevent salmonids in the San Geronimo Creek watershed

from completing essential behaviors (migrating, reproducing, feeding, and sheltering) or substantially interfere with their ability to do so. The impacts evaluated herein are considered “indirect” impacts because they affect habitat conditions but do not directly impact individual fish. Because habitat requirements for each of the three anadromous salmonid species in the watershed and the threats to their persistence are very similar, the analysis generally considers them together as a group.

5.2 Impact Analyses

Impact 5.1. Reduced Survival of Fry And Juvenile Salmonid Life Stages Due to Reduced Winter Rearing Habitat Quality

Low abundance and quality of overwintering habitat has been identified as the freshwater habitat condition that is most likely limiting salmonid production in Lagunitas Creek and its tributaries, including the San Geronimo Creek watershed, under existing conditions (Section 3.6.2). The primary causes of the degraded winter rearing habitat are simplification of instream habitat, loss of off-channel (e.g., floodplain) habitat, and reduced connectivity between the stream channels and the little remaining floodplain. With the reduction in winter rearing habitat, juvenile salmonids have less available refuge from high winter flows, increasing their susceptibility to downstream displacement and reducing survival.

Additional development in the San Geronimo Creek watershed under the Proposed Project would increase the number of developed parcels, units, and TIA beyond existing conditions (Section 2.6). However, existing levels of development and the projected level of future development are not equally distributed among subbasins and reaches (Figure 5-1, Figure 5-2, see also Section 2.6.3). Woodacre Creek, which exhibits the greatest %TIA of any subbasin or mainstem reach, would experience a moderate increase in TIA acreage (3.9 ac) and %TIA (5%) under the Proposed Project, resulting in 9.5% TIA for the subbasin (Figure 5-3, see also Section 2.6.3). Woodacre Creek would remain the most impermeable subbasin in terms of % TIA, approaching the range of %TIA at which many indicators of water quality, instream habitat, and aquatic ecosystem function may become notably impacted (Center for Watershed Protection 1998, Beach 2002, Morse et al. 2003, Walsh et al. 2005). Montezuma Creek, which exhibits a moderate amount of %TIA, would experience a relatively small increase in TIA acreage (1 ac) but a relatively larger increase in %TIA (10%). Overall however, TIA in the Montezuma Creek subbasin would remain moderate at 4.3% (Figure 5-3, see also Section 2.6.3). Lower San Geronimo Creek, which also has a moderate amount of %TIA under existing

conditions, would experience the largest increase in TIA acreage (14.1 ac). Since Lower San Geronimo Creek presently exhibits a relatively large amount of TIA (approximately 300 ac), the increase in %TIA under the Proposed Project would be moderate (5%) and the %TIA for the subbasin would remain moderate (5.3%) (Figure 5-3, see also Section 2.6.3).

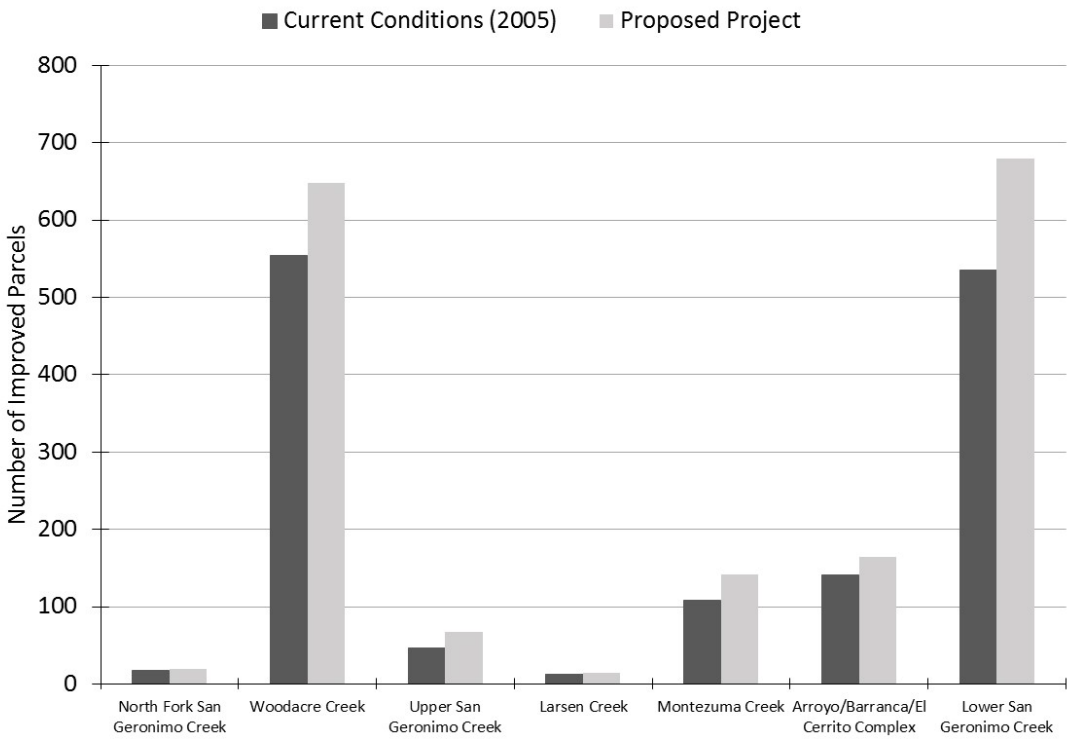

Figure 5-1. Number of Improved Parcels by Subbasin or Mainstem Reach.

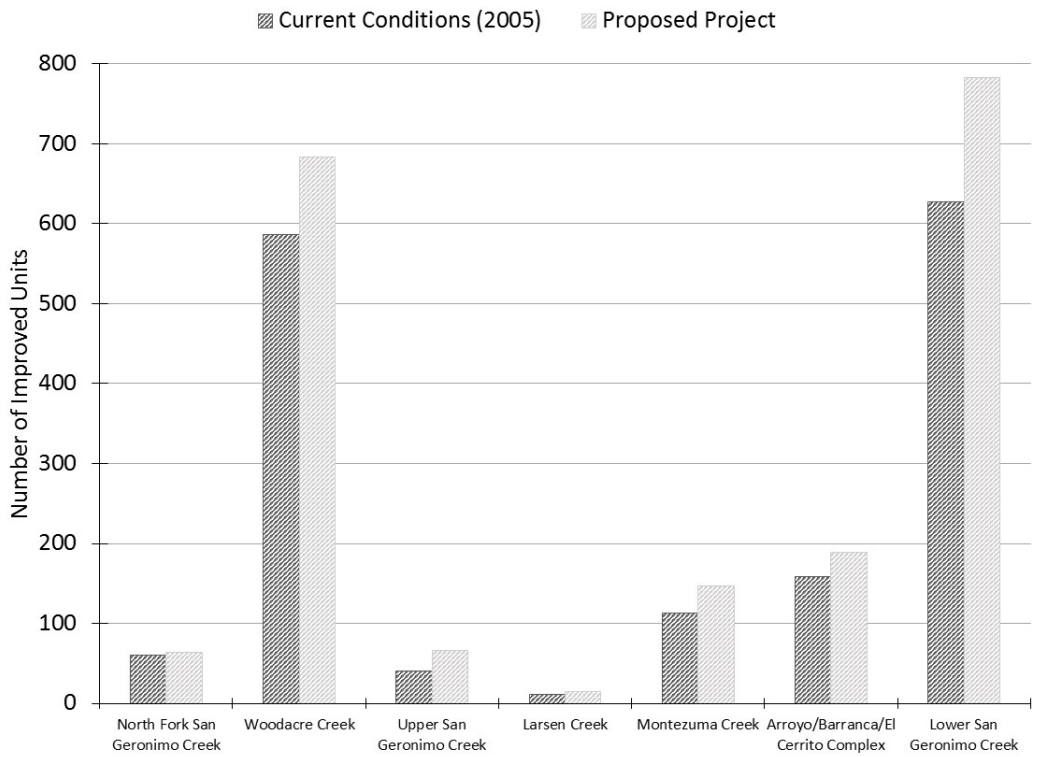

Figure 5-2. Number of Improved Units by Subbasin or Mainstem Reach.

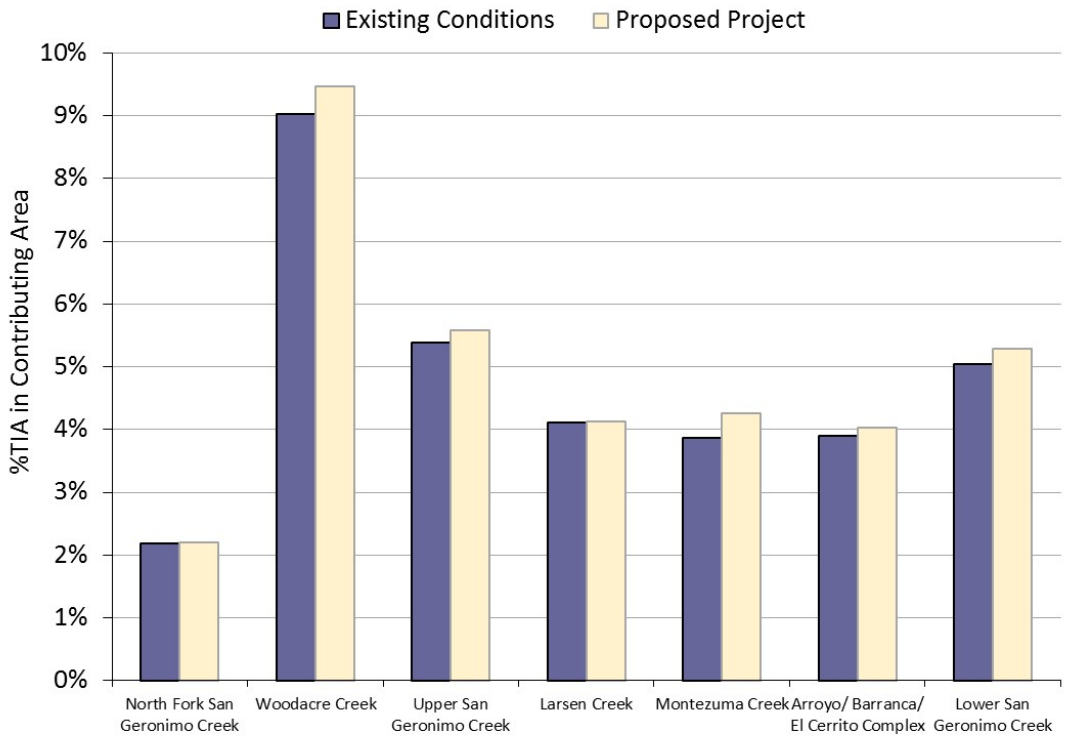

Figure 5-3. Percent TIA in Contributing Area by Subbasin or Mainstem Reach.

Within the SCA, the number of improved parcels would increase under the Proposed Project in the mainstem reaches of San Geronimo Creek and in all subbasins except Larsen Creek (Figure 5-4, see also Section 2.6.4). Marin County SCA setback policies (Figure 2-7), riparian conservation policies under Goal BIO-2 *Protection of Sensitive Biological Resources* (Table 2-1) and Goal BIO-4 *Riparian Conservation* (Table 2-1), and water resources policies under Goals WR-1 *Healthy Watersheds* and WR-2 *Clean Water* (Table 2-2) would help protect instream and riparian habitat and riparian function, and would reduce the potential for adverse impacts to runoff and sediment delivery related to future development under the Proposed Project, including parcels to be developed either completely or partially within the SCA (Table 2-11). These protections, however, would primarily apply to parcels in planned zoning districts (approximately 21% of parcels), since parcels in conventionally zoned districts (approximately 79% of parcels) would be largely exempt (Section 2.6.4). Further, for all parcels, exceptions to the policies would include allowing development in the SCA if the parcel is completely within the SCA or if development outside the SCA is infeasible or would have greater impacts, and allowing utility crossings and construction of driveways in the SCA if no other location is feasible.

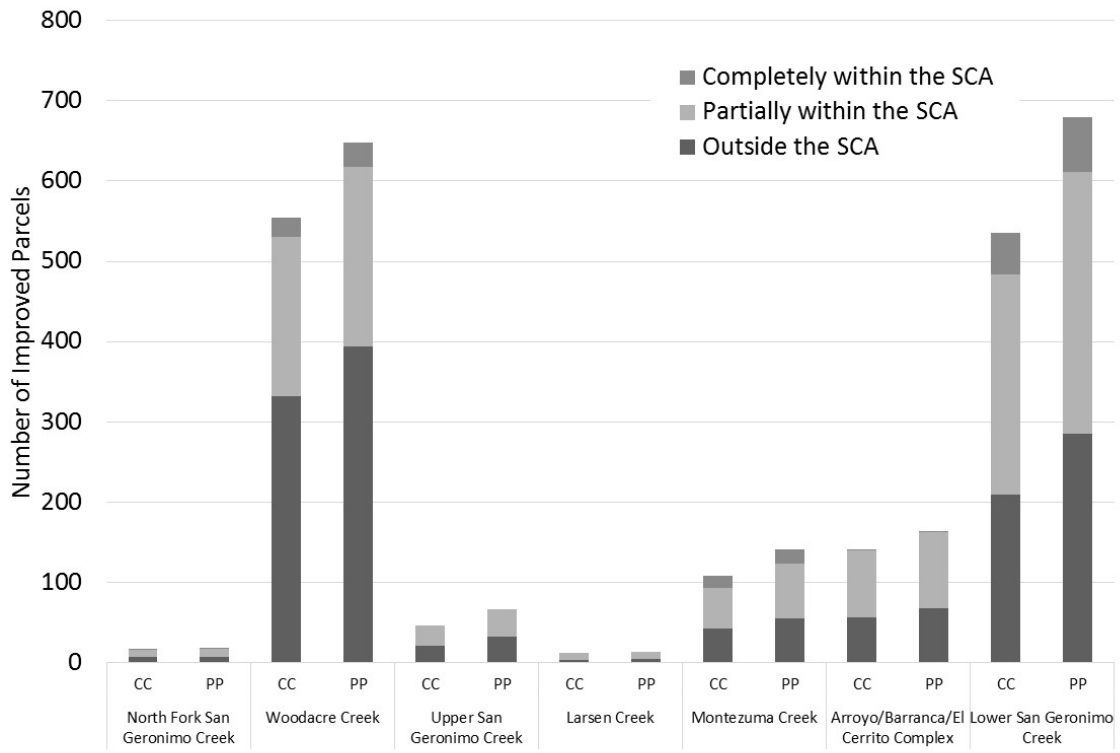

Figure 5-4. Number of Improved Parcels by Subbasin or Mainstem Reach and Location Relative to the SCA for the San Geronimo Valley. CC = Current Conditions (2005); PP = Proposed Project.

Several other types of development activities, such as irrigation lines, septic tanks (but not leachfields), water supply facilities (water supply lines), sitework that does not exceed 18 in above grade (decks, platforms, driveways), erosion control structures, and similar improvements that do not require a permit are currently allowed in the SCA and would not require compliance with SCA provisions. Similarly, new residences, additions, and other construction in conventionally zoned districts that meet all conventional standards (e.g., setback to property line, floor area ratio, height limits) and do not trigger a discretionary permit (such as Design Review) are also allowed in the SCA and do not require compliance with SCA provisions. Although new development, regardless of zoning district or its location relative to a SCA, would be subject to policies intended to help avoid or minimize impacts to stream and riparian habitat such as those included under Goals BIO-1, BIO-2, WR-1, and WR-2 (Table 2-1 and Table 2-2), many of these policies do not require site review or impose mandatory conditions, thus resource protections are not guaranteed. With these exemptions and allowances, future development under the Proposed Project would result in

additional land disturbance, increased TIA and storm runoff, and modification of stream banks and riparian habitat.

Although the effects of land disturbance and stream and riparian habitat modification cannot be quantified, it is reasonable to expect further reduction of LWD recruitment potential due to localized clearing of riparian vegetation, and further reduction in the quality and extent of floodplain terraces or other off-channel habitat used by salmonids during high flow events. These effects would be particularly likely in the most heavily developed reaches and subbasins including Woodacre Creek (up to seven improved parcels completely within the SCA), lower San Geronimo Creek (up to 16 improved parcels completely within the SCA), and Montezuma Creek (up to two improved parcels completely within the SCA) (Table 2-11). Increased surface erosion and fine sediment production from developed areas would also be likely, but overall delivery of sediment to streams would be minimized through the County's recent and ongoing fine sediment reduction program pursuant to the Basin Plan Amendment (SFBRWQCB 2014b), and adverse impacts on stream habitat and function are not expected.

With the projected future development, the estimated amount of TIA in the SCA under the Proposed Project would exceed that of the subbasin/reach as a whole (Figure 5-5, see also Section 2.6.4). The largest potential increase in TIA acreage in the SCA (1.9 ac, or 2%) would occur in lower San Geronimo Creek where salmonid spawning and rearing activity are high and overwintering habitat and floodplain/riparian functions are poor (Sections 3.6.1 and 3.6.2). Montezuma Creek would also experience a potential increase of 0.4 ac of TIA in the SCA, which would equate to a 9% increase in this small subbasin and result in a relatively high (9.6%) percentage of TIA in the SCA. Woodacre Creek, although projected to have a relatively modest increase in TIA in the SCA (0.3 ac, or 2%), has the highest existing (11.5%) and expected (11.7%) percentages of TIA in the SCA. The reach of San Geronimo Creek immediately downstream of Woodacre Creek is another heavily used salmonid spawning and rearing reach, and Woodacre Creek has recently been a major spawning and rearing tributary for coho salmon and steelhead (Sections 3.6.1 and 3.6.2).

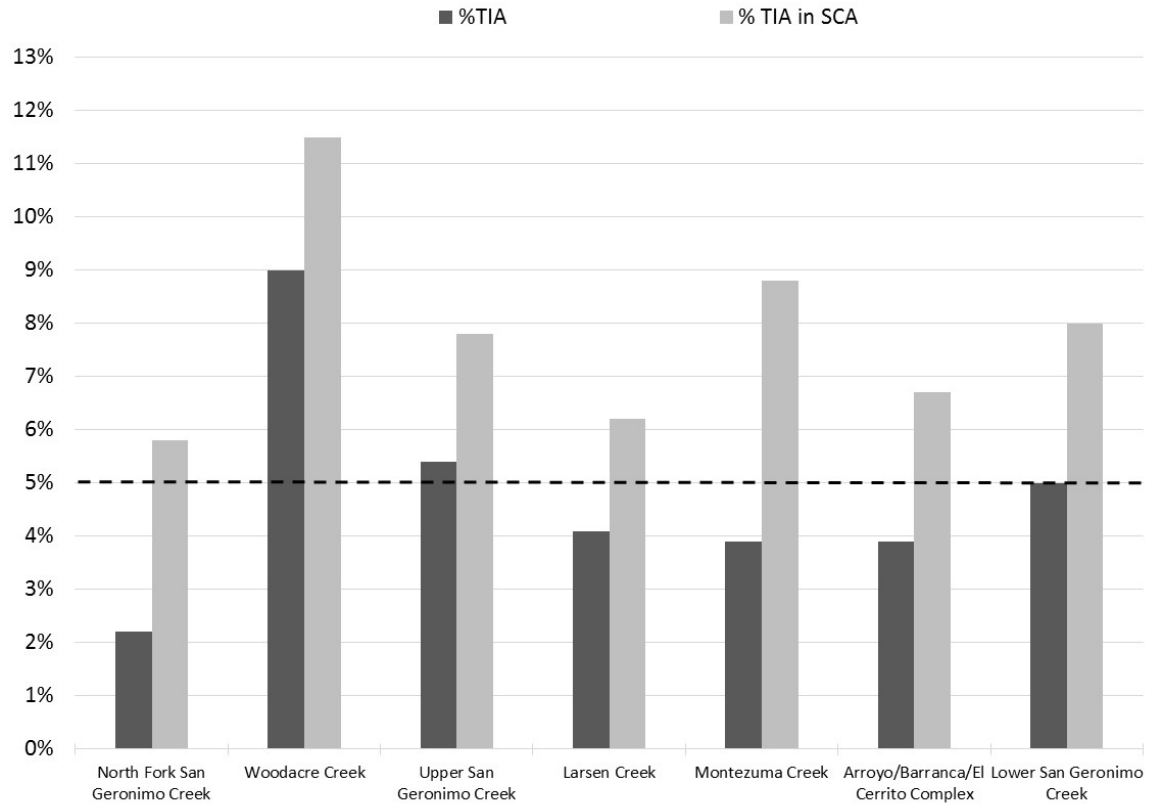

Figure 5-5. Percent TIA Versus Percent TIA in the SCA for each Subbasin/Reach. Dashed line indicates watershed-scale TIA from Table 2-5. Other data from Table 2-9 and Table 2-13.

Although the projected relative increases in TIA are small to moderate when considered individually, their cumulative contribution to the increasingly modified hydrology of the San Geronimo Creek watershed and to additional degradation of already adversely impacted salmonid habitat conditions would be considerable. Analysis of hydrologic response to increasing urbanization, as indicated by the projected trend in wet-season flow reversals (Figure 5-6; see also Section 3.2 and 3.3), strongly suggests that development under the Proposed Project (i.e., theoretical buildout; see Section 2.6) would continue to increase flow flashiness and the magnitude of winter storm flows in the watershed. Although much urban growth has already occurred in the watershed, the tally of remaining buildable lots suggests that a 16% increase in population, and thus presumably in additional impervious surface, could still occur (Section 2.6). By analogy to the hydrologic changes that accompanied population growth from 1980 to 2010, this additional future growth is projected to result in additive hydrologic changes to those that have already occurred over the prior two decades. Such changes, if unmitigated, would likely contribute to the existing adverse impacts on salmonid habitat.

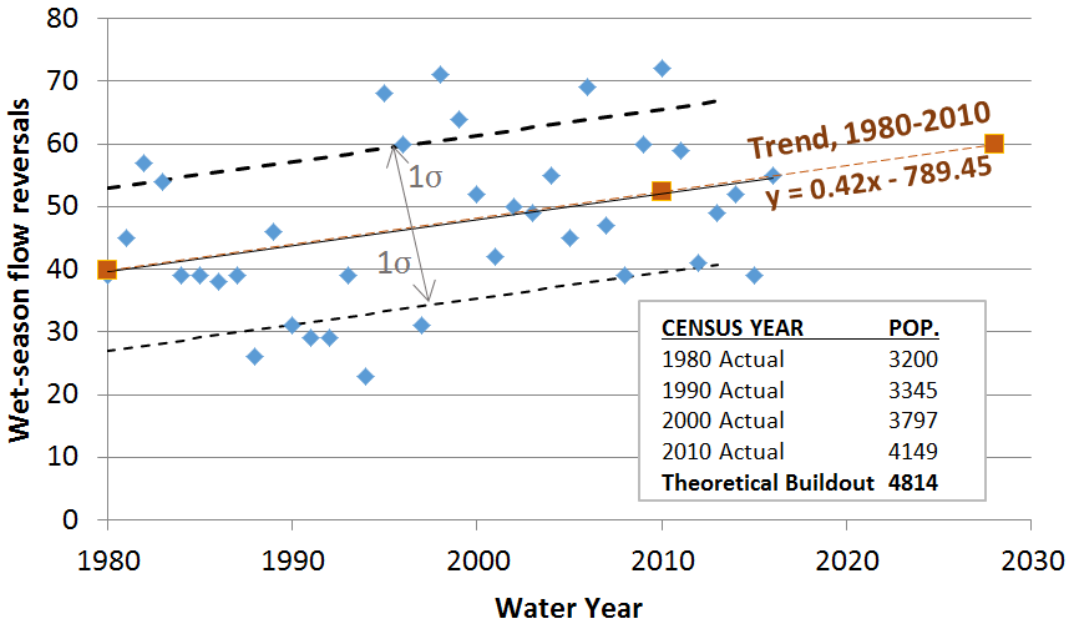

Figure 5-6. Extrapolation of the measured trend in wet-season flow reversals from the gage record (plotted in Figure 3-3) forward to the time of future buildout. On a consistent trend of population growth, buildout would occur around 2030. Note that, regardless of when that buildout actually occurs, the central trend at buildout falls somewhat below the upper 1σ limit (i.e., 1 standard deviation) of the current data, approximately equivalent to the magnitude of hydrologic change that has already occurred between any two prior decades (e.g., the change that occurred between 1990 and 2010). This suggests the likelihood of modest additional hydrologic change that could be recognized despite year-to-year variability, if these relationships were to continue without change or mitigation.

An increased frequency and magnitude of winter storm flows, particularly in a watershed that already experiences winter peak flow events of 1,000−4,000 cfs over short periods (i.e., peak flow durations of hours to days, depending on location) (Section 3.3), would further increase the frequency with which rearing juvenile salmonids encounter water velocities that exceed their swimming ability, thus requiring them to find refuge in order to avoid downstream displacement and reduced survival. With the low abundance and degraded condition of winter rearing habitat in the watershed, the likelihood of downstream displacement and reduced survival under these conditions is substantial. In addition, the increased frequency and erosive power of the winter storm flows would likely cause additional bank erosion and simplification of instream habitat, thus exacerbating the already low abundance and poor quality of winter refuge habitat and the resulting effects on survival during high winter flows. The effects of climate change, which are projected to include increased frequency and magnitude of extreme precipitation events (DWR 2015), would magnify the hydrologic effects and increase the likelihood of further habitat simplification and the potential for

juvenile salmonids to be displaced downstream during high flows. Effects are expected to be particularly pronounced in the Woodacre Creek subbasin, mainstem San Geronimo Creek from Woodacre Creek downstream to Roy's Pools, and the lower mainstem of San Geronimo Creek—locations in which salmonid spawning and rearing are concentrated (Section 3.6.2) and future development and/or its effects on hydrologic and other watershed processes would be greatest (Section 2.6.3).

Impact Significance

Under the Proposed Project, alterations in hydrodynamic processes resulting from the projected increases in TIA and other urbanization effects would, in combination, make a cumulatively considerable contribution to increased winter storm flow magnitude and frequency, in turn causing additional habitat simplification and further compromising the ability of rearing coho salmon to find adequate refuge during high flows. Continued degradation of winter rearing habitat in the San Geronimo Creek watershed would conflict with Policy BIO-2.1 *Include Resource Preservation in Environmental Review*, which calls for "no net loss" of sensitive habitat acreage, values, and function (Table 2-1), and would make a cumulatively considerable contribution to the existing cumulative effect on coho salmon winter rearing success that has resulted from previous and current land and water uses. Given the currently low abundance of LWD, functional floodplains, and other complex habitat that would provide shelter and velocity refuge during high flows, these effects are likely to have adverse impacts on the ability of rearing juvenile coho salmon to occupy preferred habitat and would increase the frequency with which they experience downstream displacement resulting in low survival, injury, or mortality. As a result, the Proposed Project would have a **potentially significant cumulative impact** on winter survival of juvenile coho salmon. Equivalent impacts on steelhead are also likely, but the factors that limit their production in the watershed remain unclear and there is insufficient information to determine whether effects on winter habitat quality and quantity would be significant for steelhead. Similar effects on Chinook salmon are not expected because Chinook salmon in San Geronimo Creek and the Lagunitas Creek watershed exhibit an "ocean-type" life history in which juveniles rear in stream habitats for only a few months before emigrating to the ocean during their first spring or summer, and are therefore not present in streams during the winter high flow period.

Mitigation Measures

The following measures would mitigate for the potentially significant impact on coho salmon winter rearing success by avoiding, minimizing, or compensating for adverse impacts to the watershed processes and functions that create and maintain essential winter rearing habitat.

Mitigation Measure 5.1-1: Expanded SCA Ordinance

The County shall adopt an Expanded SCA Ordinance consistent with Goal BIO-4 and associated Implementing Programs under the Proposed Project. In developing the Expanded SCA Ordinance, the County will include provisions that would:

- Expand the set of development activities that require a permit and site assessment to include any activity within the SCA that requires vegetation clearing, increases impermeable area, alters surface runoff, or results in exposed soil.
- Enact consistent permit and site assessment requirements for development in planned zoning districts and conventional zoning districts.
- Require site assessments to be conducted by a qualified professional who has received training and certification by CDFW or NMFS in assessing potential impacts to stream ecology, riparian ecology, and hydrology and the potential for impacts to salmonids from changes to these processes and conditions. Training and certification by NMFS and/or CDFW would be consistent with Action Step 22.2.1.2. from the Central California Coast coho salmon recovery plan (NMFS 2012) ("Provide technical and staff support to counties to encourage general plan updates to include measures to protect coho salmon [CDFG 2004])" and the California Department of Fish and Game (CDFG) (2004) *Recovery Strategy for California Coho Salmon*.
- Require Standard Management Practices (SMPs) to be incorporated into all projects for the protection of hydrologic processes, stream and riparian habitat, and water quality within SCAs. SMPs shall be reviewed and approved by CDFW or NMFS to ensure the SMPs are adequate to avoid or minimize impacts to salmonids.
- Require discretionarypermits for projects in priority stream reaches (the reaches most heavily impacted and potentially most important for salmonid winter rearing) to include low impact development (LID) practices and designs that are demonstrated to prevent offsite discharge from events up to the 95th percentile 24-hour rainfall event and approved by a qualified professional. Priority reaches are currently considered to be Woodacre Creek, upper San Geronimo Creek, lower San Geronimo

Creek, and Montezuma Creek but may be modified based on the results of future studies and monitoring by MMWD and others.

Mitigation Measure 5.1-2: Winter Habitat Enhancement Projects

The County shallprovide funding to a third party, such as the Marin County Resource Conservation District, to facilitate small enhancement projects on private property that are designed to help achieve targets set forth in the San Geronimo Valley Salmonid Enhancement Plan (PCI 2010; see Table 3.2) and are consistent with the following recommended salmonid habitat enhancement goals, also from the Salmonid Enhancement Plan:

- Protect and enhance the riparian corridor to create healthy, self-sustaining habitat (Recommendation #2);
- Minimize and reduce streambank armoring (Recommendation #10);
- Promote increased watershed-wide stormwater retention and disconnection (Recommendation #12); and
- Reduce fine sediment delivery from roads and upland erosion (Recommendation #15).

Projects shall be designed to enhance floodplain/winter habitat for coho salmon and other anadromous salmonids in the San Geronimo Valley and be consistent with guidelines and requirements included in Action Steps LaC-CCC-3.1.4 and LaC-CCC-4.2.2.1 from the Central California Coast coho salmon recovery plan (NMFS 2012) and TMDL implementation actions recommended by the SFBRWQCB to attain water quality objectives and ecological objectives for improving populations of coho salmon and steelhead (SFBRWQCB 2014a). Specific criteria, design specifications, and guidelines for habitat enhancement projects shall be developed in coordination with and approved by CDFW and/or NMFS.

Habitat enhancement projects shall be focused in priority stream reaches (the reaches most heavily impacted and potentially most important for salmonid winter rearing), which are currently considered to be Woodacre Creek, Lower San Geronimo Creek, and Montezuma Creek but may be modified based on the results of future studies and monitoring by MMWD and others.

Significance After Mitigation

Implementation of Mitigation Measures 5.1-1 and 5.1-2 would avoid or substantially reduce adverse impacts associated with future development in the SCA and throughout the watershed. The expanded SCA ordinance under

Mitigation Measure 5.1-1, including more rigorous permitting and compliance requirements and resource agency training and approval, would considerably improve protections for hydrologic processes, stream and riparian habitat, and water quality within SCAs and prevent additional impacts to salmonid rearing habitat by minimizing future alteration to these processes and conditions. Similarly, the consistent permit and site assessment requirements that would be enacted for planned zoning districts and conventional zoning districts under Mitigation Measure 5.1-1 would greatly reduce permitting and compliance exemptions and expand protections for stream and riparian habitat and hydrologic processes throughout the watershed.

The requirement to include LID practices (i.e., “drainage controls”) as specified under Mitigation Measure 5.1-1 would reduce or nearly eliminate the heretofore close coupling of population growth and increasing impervious area with increasing hydrologic flashiness and storm flow intensity. Given the modest increases in these hydrology indicators that historical urban development with little or no drainage control has imposed (see Figure 3-4), the successful application of effective drainage controls on future development should result in future flows that fall well within the range of recent historical variability. As such, they would constitute less than significant impacts to the stream hydrology, and thus to the stream habitat that is largely controlled by these flows.

Habitat improvements implemented under Mitigation Measure 5.1-2, particularly in the reaches most heavily impacted and potentially most important for winter rearing (i.e., Woodacre Creek, Lower San Geronimo Creek, and Montezuma Creek), would increase habitat complexity and provide crucial high-flow refuge habitat for overwintering coho salmon and steelhead to help compensate for remaining impacts related to future development and climate change. These improvements would be consistent with Action Steps LaC-CCC-3.1.4 and LaC-CCC-4.2.2.1 from the Central California Coast coho salmon recovery plan (NMFS 2012) and TMDL implementation actions recommended by the SFBRWQCB to attain water quality objectives and ecological objectives for improving populations of coho salmon and steelhead (SFBRWQCB 2014a).

With the above measures to minimize the impacts of future increases in TIA and increase riparian and stream habitat protections, the impacts of the Proposed Project on salmonid winter rearing habitat would be unlikely to contribute considerably to the existing cumulative effects that limit survival and production in the watershed. By substantially reducing the potential for future habitat degradation and improving winter rearing conditions, Mitigation Measures 5.1-1

and 5.1-2 may increase survival and production of coho salmon and steelhead from the watershed. As a result, the Proposed Project with these mitigations would have a **less than significant impact**, both individually and cumulatively, on winter survival of juvenile salmonids in the San Geronimo Creek watershed.

Impact 5.2. Reduced Salmonid Spawning Success Due to Increased High Flow Frequency and Magnitude and Elevated Sediment Delivery

Hydrologic effects and sedimentation resulting from development under the Proposed Project may reduce salmonid spawning success by increasing scour of gravels containing incubating eggs. If the streambed at spawning locations is scoured to a depth greater than the egg burial depth, it can cause substantial mortality of incubating salmonid eggs and alevins (Montgomery et al. 1996, Shellberg 2010). Gravel-bedded channels like those in portions of the San Geronimo Creek watershed naturally experience some degree of scour and deposition of gravel and other sediment in the channel bed during high flow events. The depth of streambed scour is directly related to the force exerted by flowing water on the streambed, the presence or absence of flow obstructions or channel restrictions (e.g., LWD, vegetation, bank armoring, bridge abutments), and the amount and size of sediment moving through the channel. Although redd scour has not been considered a major limiting factor for anadromous salmonids in the Lagunitas Creek watershed (Stillwater Sciences 2008; NMFS 2012, 2015), recent evidence indicates that the likelihood of redd scour in the San Geronimo Creek watershed is high, particularly in Woodacre Creek and the lower mainstem of San Geronimo Creek (Section 3.6.1).

The land uses and altered watershed processes that accompany urbanization (Section 3.2) have increased sediment delivery to streams in the San Geronimo Creek watershed and contributed to an increased frequency and depth of streambed mobilization and redd scour (Section 3.6.1). Average annual sediment delivery to San Geronimo Creek from 1983–2008 was greater than in any other Lagunitas Creek subbasin (Section 3.6.1). Elevated fine sediment deposition in San Geronimo Creek is in part evidenced by spawning gravel embeddedness, which at approximately 32% currently exceeds the target of <25% gravel embeddedness recommended in the Salmonid Enhancement Plan (Table 3-1) to support successful egg incubation and emergence. Substantial delivery of fine sediment to San Geronimo Creek and the portion of Lagunitas Creek upstream of Devil's Gulch is partly the result of road-related erosion in the San Geronimo Creek watershed (29% of total supply), which has the highest road density (7.4 mi/m^2) of any subbasin or reach of the greater Lagunitas Creek watershed (Sections 2.6.1 and 3.6.1).

Other land uses related to development, such as vegetation removal, roadbuilding, paving, increased storm drainage, stream channelization, and bank armoring are known to increase storm runoff frequency and intensity, deliver fine sediment to streams, and increase the hydraulic energy focused on the streambed (Section 3.2). Resulting effects have included incision of stream channels and disconnection from their floodplains, elevated sedimentation in the streambed, and greater peak flow magnitude and flashiness resulting from increased TIA and storm drainage efficiency. The increasing trend in wet-season flow reversals in San Geronimo Creek, as discussed in Sections 3.2 and 3.3 and shown in Figure 3-4, strongly suggests that the increased frequency and magnitude of peak flow events is a direct result of past development in the San Geronimo Valley and the resulting increases in TIA and drainage efficiency. All of these effects increase the stream's sediment transport capacity and the likelihood of redd scour. The elevated sediment delivery rates in the San Geronimo Creek watershed and Woodacre Creek in particular (Sections 3.2 and 3.6), combined with the aforementioned increases in storm runoff frequency and intensity, have resulted in a predicted "high risk" of redd scour in mainstem San Geronimo Creek and a "very high risk" in Woodacre Creek (Section 3.6.1).

Recent (2015−2017) efforts by Marin County have addressed road-related fine sediment delivery to stream channels in the San Geronimo Valley and elsewhere in the county, pursuant to the Basin Plan Amendment (SFBRWQCB 2014b). These efforts include an inventory and description of the road network; identification of erosion and sediment control measures to achieve performance standard(s) specified in the Basin Plan Amendment; a schedule for implementation of identified control measures; and development and implementation of guidelines for road maintenance. The goal of the measures and guidelines is to protect water quality and protect and improve stream and riparian habitat for salmonids. While these efforts will substantially reduce road-related stream sedimentation in the watershed and its effects on salmonid spawning habitat, there are few current or proposed measures to similarly mandate the control or reduction of fine sediment originating from development in the SCA or elsewhere in the watershed.

While SCA setback policies (Figure 2-7) and several of the policies for conservation of Biological Resources and Water Resources under the Proposed Project (Table 2-1, Table 2-2) would help minimize erosion and sedimentation by protecting riparian habitat and hydrologic function, the protections would primarily apply to parcels in planned zoning districts (approximately 21% of parcels), since

parcels in conventionally zoned districts (approximately 79% of parcels) would be largely exempt (Section 2.6.4). Further, for all parcels, exceptions to the policies would include allowing development in the SCA if the parcel is completely within the SCA or if development outside the SCA is infeasible or would have greater impacts, and allowing utility crossings and construction of driveways in the SCA if no other location is feasible. Several other types of development activities that do not require a permit (see description under Impact 5.1) are currently allowed in the SCA and would not require compliance with SCA provisions. Similarly, new residences, additions, and other construction in conventionally zoned districts that meet all conventional standards (e.g., setback to property line, floor area ratio, height limits) and do not trigger a discretionary permit (such as Design Review) are also allowed in the SCA and do not require compliance with SCA provisions. With these exemptions and allowances, future development under the Proposed Project would result in additional land disturbance and modification of riparian habitat, increased TIA and storm runoff, and continued delivery of fine sediment to streams. Thus, the Proposed Project is not capable of substantially avoiding or eliminating all impacts to hydrology and sediment delivery associated with future development, even though planned development would be relatively modest compared with existing conditions.

Under the Proposed Project, additional development in the San Geronimo Creek watershed would result in up to 323 improved parcels (22% increase) and 14.1 additional acres of TIA (5% increase) (Table 2-5). At the subbasin/reach scale, future development would increase the number of improved parcels and units (Figure 5-1, Figure 5-2, see also Section 2.6.3), with corresponding estimated increases in TIA acreage ranging from less than 1% (Larsen Creek) to 10% (Montezuma Creek) (Figure 5-3, see also Section 2.6.3). At the scale of the SCA, estimates are relatively greater (with the exception of Larsen Creek), with future development resulting in additional improved parcels and units either completely or partially within the SCA (Figure 5-4, see also Section 2.6.3). Estimated increases in TIA within the SCA would range 0.3 ac (2% increase, Woodacre Creek) to 1.9 ac (2% increase, Lower San Geronimo Creek) (Table 2-13). North Fork San Geronimo Creek, Larsen Creek, and the Arroyo/Barranca, El Cerrito creeks complex are projected to experience no increases in TIA within the SCA.

Although the projected relative increases in TIA at the subbasin/reach scale are small to moderate when considered individually, their cumulative contribution to the increasingly modified hydrology of the San Geronimo Creek watershed and to an increased risk of redd scour would be considerable. Analysis of hydrologic response to increasing urbanization, as indicated by the projected trend in wet-season flow reversals (Figure 5-6; see also Section 3.2 and 3.3), strongly

suggests that development under the Proposed Project would continue to increase flow flashiness and the magnitude of winter storm flows in the watershed. Such changes would further increase the frequency and magnitude of redd scour, thus making a cumulatively considerable contribution to the existing adverse impacts on spawning success. The effects of climate change, which are projected to include increased frequency and magnitude of extreme precipitation events (DWR 2015), can be expected to magnify these effects.

Impact Significance

Under the Proposed Project, increased winter storm flow magnitude and frequency due to an increase, albeit modest, in the number of developed parcels, units, and TIA at the subbasin/reach scale and the scale of the SCA, along with continued inputs of development-related fine sediment to stream channels, would further increase the risk of streambed and redd scour in important salmonid spawning reaches (e.g.,Woodacre Creek, mainstem San Geronimo Creek from Woodacre Creek downstream to Roy's Pools, Lower San Geronimo Creek). The increased redd scour risk would very likely reduce coho salmon and steelhead spawning success, thus making a cumulatively considerable contribution to the existing adverse cumulative impact. Given the uncertainty in exactly how development would occur, particularly for parcels partially or completely within the SCA, it is not possible to assess whether, where, or how much spawning habitat would be lost under the Proposed Project. However, this impact would exacerbate the currently degraded spawning habitat conditions for salmonids in the watershed as indicated by spawning gravel embeddedness, which at approximately 32% currently exceeds the target of <25% gravel embeddedness recommended in the Salmonid Enhancement Plan (PCI 2010) to support successful egg incubation and emergence.

Increased redd scour resulting from further alterations to hydrology and additional sediment inputs under the Proposed Project would conflict with Policy BIO-2.1 *Include Resource Preservation in Environmental Review,* which calls for "no net loss" of sensitive habitat acreage, values, and function (Table 2-1). These mechanisms would similarly affect Chinook salmon spawning habitat and, despite the paucity of information on Chinook salmon population dynamics in San Geronimo Creek, impacts are likely to be equivalent to those described for coho salmon and steelhead due to the similarity of their spawning habitat requirements. Given the numerous existing stressors and constraints on salmonid production in the San Geronimo Creek and Lagunitas Creek watersheds, an increased risk of redd scour in San Geronimo Creek and its tributaries is likely to make a cumulatively considerable contribution to existing

adverse effects on spawning success for anadromous salmonids. Such adverse effects would jeopardize recovery efforts, which include a projected future recovery trajectory with annual increases in coho salmon and steelhead abundance watershed-wide (NMFS 2012, 2015). As a result, the Proposed Project would have a **potentially significant cumulative impact** on coho salmon, steelhead, and Chinook salmon in the San Geronimo Creek watershed due to reduced spawning success.

Mitigation Measures

The following measures would mitigate for the potentially significant impact on salmonid spawning success by avoiding, minimizing, or compensating for adverse impacts to the watershed processes and functions that provide suitable spawning and egg incubation conditions in San Geronimo Creek and its major tributaries.

Mitigation Measure 5.2-1: Control and Reduce Production and Delivery of Fine Sediment to Streams

The provisions of the Expanded SCA Ordinance described under Migitation Measure 5.1-1 shall avoid or minimize the hydrologic effects and stream sedimentation associated with additional development in the watershed, helping reduce the potential for redd scour.

In addition, Marin County DPW shall continue to develop and implement measures and guidelines to control and reduce production and delivery of fine sediment to streams and minimize its effects on redd scour and other components of salmonid habitat, in keeping with the requirements of the Basin Plan Amendment (SFBRWQCB 2014b). These actions, many of which are underway or substantially complete, include measures that will achieve the following performance standards within 20 years of Basin Plan amendment adoption:

- Achieve and maintain the target for road-related sediment delivery to channels of ≤ 350 cubic yards per mile per 20-year period; and
- Minimize delivery of sediment to channels from unstable or potentially unstable areas by managing existing roads and other infrastructure to prevent additional erosion of legacy sediment delivery sites, and/or delivery from other potentially unstable areas.

To this end, Marin County DPW shall submit, by 2019, a Report of Waste Discharge to the SFBRWQCB that provides, at a minimum, the following:

- Description of the road network and/or segments;

- Identification of erosion and sediment control measures to achieve performance standard(s) specified in Table 4.2 of the Basin Plan Amendment;
- A schedule for implementation of identified control measures; and
- Development and implementation of guidelines for road maintenance, as needed to protect water quality, stream-riparian habitat, and salmonid fisheries.

The Marin County DPW shall also comply with applicable waste discharge requirements (WDRs) or waiver of WDRs, and report progress on development and implementation of best management practices to control road-related erosion.

Mitigation Measure 5.2-2: Stream Habitat Enhancement Projects

Marin County, or nonprofits in partnership with reach-based landowner stewardships, shall develop and implement projects to enhance stream habitat complexity and connectivity, enhance riparian function and LWD loading/recruitment, increase natural hydraulic sediment sorting and gravel retention, and reduce development-related erosion in the watershed. The objectives of these enhancement projects will be to:

- Support self-sustaining populations of coho salmon and steelhead and to enhance the overall health of the native fish community; and
- Reduce rates of sediment delivery to channels (associated with incision and accelerated bank erosion) by 67% in San Geronimo Creek.

If approved by the SFBRWQCB, these enhancement projects may include the floodplain/winter habitat enhancement projects described above under Mitigation Measure 5.1-2. As specified in the Basin Plan Amendment (SFRWQCB 2014b), specific actions shall include the following:

- Within 10 years of Basin Plan Amendment adoption, develop and implement plans to enhance LWD loading and restore natural rates of recruitment to channels, as needed to achieve numeric targets for LWD loading (≥ 300 m^3/ha in Redwood Channels and ≥ 100 m^3/ha in Hardwood Channels) and to achieve load allocations for sediment (Basin Plan Amendment Tables 3a and 3b). These plans will include a survey to quantify baseline values for LWD loading.
- Within five years of Basin Plan Amendment adoption, develop detailed technical studies to characterize reach-specific opportunities and priorities for floodplain restoration.

To help meet targets for salmonid spawning habitat quality, the actions described above shall be consistent with the following salmonid habitat enhancement goals, as described in the San Geronimo Valley Salmonid Enhancement Plan (PCI 2010):

- Protect and enhance the riparian corridor to create healthy, self-sustaining habitat (Recommendation #2);
- Promote increased watershed-wide stormwater retention and disconnection (Recommendation #12); and
- Reduce fine sediment delivery from roads and upland erosion (Recommendation #15).

Specific criteria, design specifications, and guidelines for habitat enhancement projects shall be developed in coordination with and approved by CDFW and/or NMFS.

Significance After Mitigation

With implementation of Mitigation Measures 5.1-1, 5.2-1, and 5.2-2, future development under the Proposed Project would include measures to avoid or minimize future increases in peak flow frequency and magnitude that can scour spawning gravels and cause mortality of incubating salmonid eggs. Implementation of measures to control sediment production and delivery from roads, landslides, gullies, and future urban development would reduce the amount of fine sediment moving through stream channels and lower the potential for redd scour in key salmonid spawning reaches. To compensate for impacts of future development within the SCA, riparian enhancement and LWD augumentation projects in degraded reaches would reduce streambed scour through improved sediment storage and metering. These projects may also improve spawning habitat quantity and quality by promoting deposition of spawning gravels and beneficial sorting of sediment to reduce gravel embeddedness, potentially increasing spawning success by coho salmon and other salmonids from the watershed. These enhancement and augmentation projects would be consistent with Action Step LaC-CCC-3.1.4 and with Recovery Action 4.2.2. (“Minimize redd scour”) and subsidiary Action Steps from the Central California Coast coho salmon recovery plan (NMFS 2012), as well as TMDL implementation actions recommended and required by the SFBRWQCB to attain water quality objectives and ecological objectives for improving populations of coho salmon and other anadromous salmonids (SFBRWQCB 2014a, b).

With measures to avoid or substantially minimize future increases in redd scour, the impacts of the Proposed Project on salmonid spawning success would be

unlikely to contribute considerably to the existing cumulative effects that limit coho salmon and steelhead production in the watershed. As a result, the Proposed Project would have a **less than significant impact**, both individually and cumulatively, on spawning success of coho salmon and steelhead in the San Geronimo Creek watershed.

Impact 5.3. Reduced Salmonid Summer Rearing Success Due to Degraded Habitat Conditions Including Reduced Habitat Complexity, Reduced Streamflow, and Increased Water Temperature

Summer rearing habitat conditions for juvenile salmonids in the San Geronimo Creek watershed are degraded as a result of historical and ongoing land and water uses that have reduced pool frequency and depth, reduced instream habitat complexity, and reduced the abundance of in-channel LWD and large riparian trees. Channel incision due to altered watershed hydrology, as well as increased sediment delivery to channels from roads, grazing, and forest clearing, have simplified stream habitats in the watershed, degrading summer rearing conditions for salmonids. Several of the above conditons (e.g., instream shelter, LWD frequency, habitat complexity, and LWD recruitment potential) are currently rated by NMFS (2012, 2015) as providing “poor” habitat quality for summer rearing by juvenile coho salmon and steelhead in the Lagunitas Creek watershed.

Groundwater pumping and surface water diversions can reduce summer baseflows and contribute to elevated summer water temperatures, degraded water quality, and reductions in summer rearing habitat area and connectivity. While summer baseflow conditions are currently rated by NMFS (2012, 2015) as “fair” for juvenile coho salmon and steelhead in the Lagunitas Creek watershed, groundwater and surface water withdrawals or impoundments are considered potential threats to summer rearing success of juvenile coho salmon and steelhead in the greater Lagunitas Creek watershed (NMFS 2012, 2015). Further, low summer streamflows periodically compromise habitat connectivity, prey availability, and rearing habitat quantity and may contribute to elevated water temperature and degraded water quality (Section 3.6.3 and Appendix B).

While summer rearing conditions are believed to be of lesser importance to salmonids than poor overwintering conditions (Impact 5.1) and redd scour (Impact 5.2) and are not currently considered to be limiting the production of coho salmon or steelhead in the watershed (Stillwater Sciences 2008, 2009), degraded summer habitat contributes to overall adverse conditions for juvenile coho salmon and steelhead in the San Geronimo Creek watershed and may

reduce summer rearing success (though not necessarily the production of smolts from the watershed[2]). Accordingly, the potential for impacts related to summer rearing habitat and salmonid summer rearing success under the Proposed Project are considered below.

Effects of reduced summer base flows on salmonids and the stream ecosystem include a reduction in wetted habitat area available for rearing and feeding, restricted habitat connectivity and diversity, reduced production and delivery of invertebrate prey, increased sedimentation, and degraded water quality (Hayes and Young 2001, Spina et al. 2006, Deitch et al. 2009, Rolls et al. 2012). As a result, carrying capacity is reduced, fish growth may be reduced or cease, and fish become more susceptible to predation, competition, and physiological stressors (Suttle et al. 2004, Stillwater Sciences 2007, Harvey et al. 2009, Rolls et al. 2012). These effects can be exacerbated in streams where pool depth and frequency are low and instream habitat complexity and riparian cover are degraded by impacts related to urbanization or other land and water uses (Hayes and Young 2001), which is currently the case in the Lagunitas Creek watershed, and the San Geronimo Valley in particular (Section 3.6.3).

Degraded water quality resulting from low summer streamflows can also be a major stressor for rearing juvenile salmonids. Summer rearing coho salmon and steelhead require cool water temperatures and adequate levels of dissolved oxygen to maintain positive growth and avoid physiological stress that can compromise survival and fitness (Section 3.1.2). During periods of very low surface flow, stream water temperatures, dissolved oxygen, and other water quality parameters can reach levels that are unsuitable for rearing salmonds, particularly in areas where the amount of temperature-moderating stream shade is reduced due to a compromised riparian forest canopy. Riparian canopy intercepts solar radiation and moderates the effects of high summer temperatures, particularly in the relatively small tributary streams where juvenile coho salmon and steelhead predominantly rear (NMFS 2012, 2015). In San Geronimo Creek, dissolved oxygen levels do not consistently meet the generally accepted requirement of 7 mg/L for salmonid rearing (and spawning) habitats and water temperature does not meet the target of <15°C (MWAT) in all locations (Section 3.6.3). Because water temperature and dissolved oxygen conditions are

[2] Under the hypothesis that conditions other than summer rearing habitat (e.g., overwintering habitat) are the primary factors limiting the production of salmonid smolts from the watershed, it is plausible that modest reductions in summer rearing success would not affect overall smolt production.

currently degraded, the quality of summer rearing habitat is susceptible to further adverse impacts that could result from riparian canopy removal, reduced baseflow and groundwater inflow, and climate change.

In addition to suitable water quality, coho salmon and other salmonids also require sufficient space for rearing and connectivity between stream habitats for feeding and escape from predators. By reducing habitat area and connectivity, low summer flows can reduce feeding and growth, increase competitive interactions, and increase predation on juvenile salmonids.

Under the Proposed Project, the projected increases in the number of developed parcels, units, and TIA at the subbasin/reach scale and the scale of the SCA could cause minor increases in stream sedimentation and bank erosion, and may slightly reduce LWD recruitment potential. However, despite the aforementioned exemptions and allowances, SCA setback policies (Figure 2-7) and riparian conservation policies (Table 2-1, Table 2-2) under the Proposed Project offer some protections for riparian trees and other bank vegetation, as well as riparian function and instream habitat. Further, as the estimated increases in developed parcels, units, and TIA at all spatial scales (i.e., watershed, subbasin/reach, SCA) are small to moderate, their incremental contribution to reduced habitat complexity would be relatively minor and likely too small to substantially or measurably reduce the ability of juvenile salmonids to forage or find shelter during the summer rearing period.

With respect to the potential for summer baseflow impacts, currently there are 36 parcels possessing the same number of groundwater wells likely to be active in the San Geronimo Valley (Section 2.6). Of these, most are located in the lower portion of the watershed (Arroyo/Barranca/El Cerrito Complex, Lower San Geronimo Creek) (Table 2-10) and are at least partially within the SCA (Table 2-14). While these data give some indication that groundwater wells are likely to affect creek flow and salmonid habitat under existing conditions, particularly during summer low-flow periods, additional information would be required to ascertain the hydrologic and biologic effects of groundwater pumping, including a complete inventory of well locations, and known or estimated water use from each well. There are also six surface water diversions in the watershed; four are located at a single site along the Larsen Creek reach (i.e., small pond on the San Geronimo National Golf Course), and two are located in the Arroyo/Barranca/El Cerrito Complex and in Lower San Geronimo Creek (Table 2-10). It is not known whether any of the six surface water diversions is typically active, nor the rate of diversion for each (Section 2.6).

Due to the uncertainties in current understanding of the potential hydrologic and biologic effects of groundwater pumping and surface water diversions in San Geronimo Valley, the impact determination necessarily relies upon the aforementioned analysis of the incremental contributions of reduced habitat complexity on summer rearing conditions for salmonids. However, it is noted that under the Proposed Project, implementation of Policy WR-1.1 *Protect Watersheds and Aquifer Recharge* and Implementing Program WR-2.o, *Establish a Groundwater Monitoring Program for Unincorporated County Areas* (Table 2-2) would help to quantify the potential effects of groundwater pumping and surface water diversions on instream flows and salmonid summer rearing habitat quantity and quality. Additionally, development of a peak stormwater runoff and detention program (per Policy BIO-4.20), and protection or creation of appropriately designed aquifer-recharge areas (per Policy WR-1.1) under the Proposed Project would also increase opportunities for groundwater recharge and potentially increase summer streamflow.

Impact Significance

Salmonid rearing habitat, both winter and summer, has been degraded and simplified by historical and existing development and other land and water uses in the San Geronimo Creek watershed. While the Proposed Project is not capable of fully avoiding or eliminating impacts to hydrology, sediment delivery, and instream habitat complexity associated with future development, planned development impacts are not expected to contribute considerably to the existing degradation of salmonid summer rearing habitat or measurably reduce coho salmon and steelhead summer rearing success in the watershed. Despite the currently low abundance of LWD, low pool quantity and quality, and paucity of other complex habitat that would provide suitable summer rearing habitat, effects of the Proposed Project are unlikely to have adverse impacts on the ability of juvenile salmonids to successfully rear and grow. As a result, the Proposed Project would have a **less than significant cumulative impact** on summer rearing success by juvenile coho salmon and steelhead as a result of reduced habitat complexity. Impacts on Chinook salmon are considered unlikely because Chinook salmon in the watershed are believed to exhibit an “ocean type” life history in which juveniles migrate downstream to the ocean during their first spring and are not subject to summer stream habitat conditions.

While the potential impact of the Proposed Project on salmonid summer rearing success due to a reduction in habitat complexity in the San Geronimo Valley is less than significant, the County has elected to pursue a number of voluntary

mitigation measures consistent with its commitment to avoiding or minimizing impacts to the maximum extent practicable. The latter will also improve upon available information related to assessing potential impacts of shallow groundwater withdrawals and riparian water diversions on summer baseflows in San Gernonimo Valley.

Voluntary Mitigation Measures

The mitigation measures described above under Impacts 5.1 and 5.2 would minimize and compensate for hydrologic effects and control and reduce production and delivery of fine sediment to streams associated with additional development in the watershed, helping to protect, enhance, and reduce future impacts to summer rearing habitat for salmonids in streams of the San Geronimo Valley. Riparian and instream habitat enhancement projects in degraded reaches would improve summer rearing conditions and may increase salmonid summer rearing success in the watershed. These improvements would be consistent with recovery actions under Objectives LaC-CCC-3.1, LaC-CCC-8.1, LaC-CCC-9.1, and LaC-CCC-13.1 from the Central California Coast coho salmon recovery plan (NMFS 2012) and TMDL implementation actions recommended by the SFBRWQCB to attain ecological objectives for improving populations of coho salmon and steelhead (SFBRWQCB 2014a).

Further, requirements for LID practices and stormwater infiltration that would be implemented as part of the Expanded SCA Ordinance required under Mitigation Measure 5.1-1 would also contribute to groundwater recharge and may benefit summer rearing habitat by increasing summer baseflow.

Voluntary Mitigation Measure 5.3-1: Groundwater Study

The County shallundertake a voluntary study to determine whether existing and future groundwater pumping, surface water diversions, altered watershed hydrology, and other effects related to development are or would be likely to adversely impact summer baseflow in San Geronimo Creek. This study would be consistent with Goal WR-2 *Clean Water*, which includes Implementing Program WR-2.o, *Establish a Groundwater Monitoring Program for Unincorporated County Areas* (Table 2 2). This study would include periodic water level measurement and water quality sampling with annual reporting. Data collection under this measure (WR-2.o or similar studies) shall be structured to allow a better understanding of the links between groundwater pumping, surface water diversions, and summertime stream flow and water temperatures in mainstem San Geronimo Creek and its major tributaries.

Voluntary Mitigation Measure 5.3-2: Summer Habitat Enhancement Projects

The County shall provide funding to a third party, such as the Marin County Resource Conservation District, to facilitate small habitat enhancement projects on private property that have the following salmonid habitat enhancement goals, consistent with the San Geronimo Valley Salmonid Enhancement Plan (PCI 2010):

- Protect and enhance the riparian corridor to create healthy, self-sustaining habitat (Recommendation #2); and
- Protect and enhance summer streamflow (Recommendation #16).

Project objectives shall include reducing fine sediment production and delivery to streams, increasing aquatic habitat complexity, protecting summer baseflow, reducing summer water temperature, and improving summer water quality in San Geronimo Creek and its major tributaries. These enhancement projects shall be designed to help achieve targets contained in the San Geronimo Valley Salmonid Enhancement Plan (PCI 2010) (see Table 3.2) and be consistent with TMDL implementation actions recommended and required by the SFBRWQCB to attain water quality objectives and ecological objectives for improving populations of coho salmon and other anadromous salmonids (SFBRWQCB 2014a, b). Specific criteria, design specifications, and guidelines for habitat enhancement and flow and water quality improvement projects shallbe developed in coordination with and approved by CDFW and/or NMFS.

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6 SUMMARY OF FINDINGS

This Draft SEIR has been prepared in accordance with the decision of the Court of Appeal of the State of California First Appellate District Division Three to set aside its approval of the Marin CWP (2007) and certification of the Final EIR with respect to San Geronimo Valley, pending the following:

(1) analysis of potential cumulative impacts, and the range of potential consequences, on salmonids in San Geronimo Valley resulting from future buildout in the watershed in conformity with State CEQA Guidelines Section 15130 and the Court opinion, and

(2) a description of mitigation measures relevant to salmonids in San Geronimo Valley in conformity with State CEQA Guidelines Section 15126.4 and the Court's opinion or a description of other findings in conformity with State CEQA Guidelines Section 15091.

The cumulative impacts analysis in this Draft SEIR evaluates the potential effects of future development (i.e., urbanization) on anadromous salmonids and their habitat in the San Geronimo Valley under the Marin CWP (2007). Based on the analyses in this Draft SEIR, two new potentially significant cumulative impacts and one new less-than-significant cumulative impact could occur.

As summarized below, four new mitigation measures have been identified. These new mitigation measures will reduce the new potentially significant cumulative impacts to a less-than-significant level. Additionally, two new voluntary mitigation measures have been identified, consistent with the County's commitment to avoiding or minimizing impacts to the maximum extent practicable. There would be no significant and unavoidable impacts.

Impact 5.1. Reduced Survival of Fry and Juvenile Salmonid Life Stages Due to Reduced Winter Rearing Habitat Quality. This impact was determined to be potentially significant due to alterations in hydrodynamic processes resulting from projected increases in TIA and other urbanization effects under the Proposed Project, which would make a cumulatively considerable contribution to increased winter storm flow magnitude and frequency, in turn causing additional habitat simplification and further compromising the ability of rearing coho salmon to find adequate refuge during high flows. Implementation of ***Mitigation Measure 5.1-1: Expanded SCA Ordinance*** and ***Mitigation Measure 5.1-2: Winter Habitat Enhancement Projects*** would reduce this impact to a less-than-significant level.

Impact 5.2. Reduced Salmonid Spawning Success Due to Increased High Flow Frequency and Magnitude and Elevated Sediment Delivery. This impact was determined to be potentially significant due to alterations in hydrodynamic processes resulting from projected increases in TIA and other urbanization effects under the Proposed Project, which would increase winter storm flow magnitude and frequency, and inputs of development-related fine sediment to stream channels. These conditions would further increase the risk of streambed and redd scour, thus making a cumulatively considerable contribution to the existing adverse impacts on coho salmon and steelhead spawning success. Implementation of ***Mitigation Measure 5.2-1: Control and Reduce Production and Delivery of Fine Sediment to Streams*** and ***Mitigation Measure 5.2-2: Stream Habitat Enhancement Projects*** would reduce this impact to a less-than-significant level.

Impact 5.3. Reduced Salmonid Summer Rearing Success Due to Degraded Habitat Conditions Including Reduced Habitat Complexity, Reduced Streamflow, and Increased Water Temperature. This impact was determined to be less than significant because potential reductions in stream habitat quality and riparian function related to future development in the watershed would be relatively minor and likely too small to substantially or measurably reduce the ability of juvenile salmonids to rear and grow during the summer rearing period. The potential for impacts on salmonid summer rearing success due to development-related reductions in summer baseflows could not be determined due to uncertainties in the current understanding of the potential hydrologic and biologic effects of groundwater pumping and surface water diversions in San Geronimo Valley. While the Proposed Project is not capable of fully avoiding or eliminating impacts to water quality, sediment delivery, and instream habitat complexity associated with future development, it is unlikely that any such impacts would make a considerable contribution to the existing cumulative impacts on coho salmon and steelhead summer rearing success.

Although Impact 5.3 is less than significant, the County has nonetheless elected to pursue a number of voluntary mitigation measures consistent with its commitment to avoiding or minimizing impacts to the maximum extent practicable. ***Voluntary Mitigation Measure 5.3-1: Groundwater Study*** would provide required information to help determine whether existing and future groundwater pumping, surface water diversions, altered watershed hydrology, and other effects related to development are or would be likely to adversely impact summer baseflow in San Geronimo Creek. ***Voluntary Mitigation Measure 5.3-2: Summer Habitat Enhancement Projects*** would help facilitate

improvements to stream and riparian habitat, protect summer streamflow, and improve water temperature and quality in the San Geronimo Creek watershed. These measures would improve understanding of development-related effects on salmonid summer rearing habitat in the watershed and assist with County efforts to protect and conserve habitat for these species.

This supplement to the Final EIR for the Marin CWP (2007) now contains the information necessary to make the Final EIR adequate for the project as revised (State CEQA Guidelines Section 15163(b)). This SEIR may be circulated by itself without recirculating the Final EIR (State CEQA Guidelines Section 15163(c)).

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APPENDIX A

Distribution List, Comments, and Response to Comments

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APPENDIX B

San Geronimo Creek 2015 Low-flow Habitat Survey

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1 INTRODUCTION

Available summer rearing habitat for juvenile coho salmon and steelhead (*O. mykiss*) in the San Geronimo Creek watershed was evaluated in October and early November 2015 to document existing habitat conditions. Available summer rearing habitat is generally most limiting during the late summer and fall period, particularly for age-1 and older steelhead, since flow is typically lower during this period than the remainder of the year. 2015 was the third consecutive year of drought in the region, resulting in lower than average flow conditions for the period.

Available rearing habitat was documented at a variety of locations selected to represent a range of habitat conditions in San Geronimo Creek and its major tributaries. Summer rearing habitat availability was quantified using a field mapping approach based on life-stage-specific habitat criteria. Habitat conditions were documented, but not mapped, at locations that were dry at the time of the survey, or had no suitable habitat based on the criteria.

2 METHODS

2.1 Field Observations

Locations for conducting field observations (survey reaches) were identified in mainstem San Geronimo Creek and its major tributaries to characterize flow and habitat conditions at a range of locations throughout the watershed. Seven sampling areas were identified in the San Geronimo Creek watershed including two mainstem reaches (upper and lower) and five major tributary basins (Arroyo/Barranaca/El Cerrito, Montezuma, Larsen, Woodacre, and North Fork San Geronimo creeks). Reaches within these sampling areas were selected based on the following considerations:

- Fish distribution
- Channel gradient
- Access
- Contributing drainage area (and/or flow)
- Site length

Survey reaches within the seven sampling areas were generally selected to be within documented fish distribution (Chinook salmon, coho salmon, and steelhead), and downstream of permanent natural barriers to migration. Survey reaches were also identified for each of the major gradient classes present within

each sampling area. The length and distribution of channel gradient categories (0–1%, 1–2%, 2–4%, 4–8%) were determined using GIS, and used a guidance for site selection. Channels within the different gradient categories are expected to be controlled by different geomorphological processes, which directly influence channel bed morphology and aquatic habitat conditions. Survey reach characteristics are presented in Table 1. Multiple reaches were surveyed (or observations made) within most of the sampling areas.

Table 1. Survey reach characteristics.

Sampling Area	# of Survey Reaches or Observations	Gradient Class	Fish Distribution
Lower mainstem San Geronimo Creek (downstream of Roy's Pools)	3	0–1%	Coho/steelhead/Chinook
Upper mainstem San Geronimo Creek (upstream of Roy's Pools)	2	0–1%	Coho/steelhead/Chinook
Arroyo/Barranca/El Cerrito creeks	2	1–2%, 2–4%	Coho/steelhead
Montezuma Creek	1	2–4%	Coho/steelhead
Larsen Creek	1	1–2%	Coho/steelhead
Woodacre Creek	4	1–2%, 2–4%	Coho/steelhead
North Fork San Geronimo Creek (upstream of Woodacre Creek)	2	1–2%, 2–4%	Coho/steelhead

2.2 Habitat Mapping

Summer rearing habitat availability was quantified in locations with suitable rearing habitat and surface flow using a habitat criteria mapping approach. Suitable habitat was mapped in the field based on life stage specific habitat criteria. The criteria included depth and velocity thresholds used to define suitable habitat based on habitat preferences reported in the scientific literature (Table 2).

Table 2. Habitat criteria values for mapping coho salmon and steelhead habitat in San Geronimo Creek.

Life Stage	Species	Velocity		Depth		Supporting Literature
		Min (ft/s)	Max (ft/s)	Min (ft)	Max (ft)	
Age-0+ summer rearing	Coho salmon & Steelhead	none	0.5	0.3	none	Everest and Chapman (1972), Johnson and Kucera (1985), Sheppard and Johnson (1985)
Age-1+ summer rearing	Steelhead	0.25	2.7	1.0	none	Everest and Chapman (1972), Shirvell (1990), Smith and Li (1983)
Riffle production [a]	Benthic macroinvertebtra tes	1.0	3.5	0.1	none	Orth and Maugham (1983), Gore et al. (2001), Taylor et al. (2009)

[a] Depth and velocity criteria for flow required to inundate substrate d50 in coarse gravel or cobble riffles.

A to-scale sketch map of the active channel bank, water's edge, and polygons delineating suitable rearing habitat based on the criteria presented in Table 2 was developed for sites with suitable habitat. Field mapping sites were generally 20–40 active channel widths in length in order to capture a variety of habitats and multiple pool-riffle sequences. A measuring tape and stadia rod were used to measure distances in the field to guide sketch mapping within a scaled grid. The measuring tape was run in a straight line lengthwise along the channel, and the stadia rod was sequentially placed perpendicular to the tape allowing the accurate measurement of relative distances within the grid. The grid scale used was determined by the size of the channel to maximize detail within the sketch map grid, where narrow channels were sketched at a larger scale than wider channels. Sketch maps were digitized and areas of suitable habitat calculated using GIS. Mapping area results were used to estimate available rearing habitat per unit length (ft^2/ft) of stream.

3 RESULTS

Field sites in San Geronimo Creek were visited on October 7–8 and November 11, 2015. Observations of summer rearing habitat conditions are summarized below for the two mainstem reaches and five major tributary subbasins surveyed.

3.1 Lower Mainstem San Geronimo Creek

Streamflow in lower mainstem San Geronimo Creek was intermittent, but with visible surface flow in certain sections; especially those areas with bedrock control. Measured flow at the locations surveyed ranged from 0.0 to 0.03 cfs. Flow at the gage near the downstream end of the reach averaged 0.05 on the date of the survey (10/7/2015). Pool habitats, some relatively large, were separated by riffles that were mostly dry, restricting the possibility of fish migration or movement between habitats. Potential for macroinvertebrate production and drift from riffles to pools was low in these intermittent reaches. Gravel/cobble substrates were relatively abundant and within a size range suitable for spawning. Water quality appeared to be marginal and approaching stagnant in some isolated pools, evidenced by black sediment and a scum/sheen on the water surface. Fish were observed in multiple pools including small cyprinids (possibly California Roach) and one young lamprey. Salmonid presence was not confirmed during our low-flow habitat mapping surveys, however, late summer electrofishing surveys performed by MMWD documented juvenile steelhead (age-0+ and age-1+) and coho in lower mainstem San Geronimo Creek in 2015 (E. Ettlinger, pers comm., 2015).

Based on habitat mapping Age-0 rearing habitat was relatively abundant and ranged from 3.1 to 9.5 ft^2/ft and averaged 6.7 ft^2/ft. No suitable habitat for age-1 steelhead rearing or benthic macroinvertebrate production was documented based on the mapping criteria (Table 2). Larger pools were sufficiently deep for age-1 rearing (>1.0 ft), although flow was too low to meet or exceed the minimum velocity criteria threshold (0.25 ft/s). Similarly, flow was too low to meet the minimum velocity criteria threshold for productive benthic macroinvertebrate habitat (1.0 ft/s), suggesting that food availability was likely lacking. Habitat complexity was low overall. Observed large woody debris (LWD) frequency and volume was low, although where present, LWD created local scour and contributed to habitat complexity.

MMWD survey data for 2015 indicated that juvenile steelhead and coho abundance was near average at the two regular monitoring sites (SG1 and SG2) in lower San Geronimo Creek, with the exception of age 0+ steelhead abundance at one site (SG2) where abundance was the lowest observed in 16 years of sampling. The MMWD survey data suggest that juvenile fish were able to use the limited habitat available, and survive in the isolated pools that remained in the late summer and fall, despite drought conditions and low streamflow.

Habitat availability in lower mainstem San Geronimo Creek is sensitive to small changes in flow, particularly when flow is reduced to 0.0 cfs and conditions become intermittent. Under these intermittent conditions fish can persist, but food resources are limited, and growth is expected to be reduced.

3.2 Upper Mainstem San Geronimo Creek

Streamflow in upper mainstem San Geronimo Creek was generally intermittent with isolated pools separated by dry riffles with visible flow only in relatively small sections at the upstream and/or downstream ends of riffles. Measured flow at surveyed locations ranged from 0.0 to 0.025 cfs. Flow at the gage near the downstream end of the lower mainstem reach averaged 0.05 cfs on the date of the surveys (10/7 and 10/8/2015). Pools in the upper mainstem reach were generally relatively large and separated by dry riffles, restricting the possibility of fish migration or movement between habitats. Potential for macroinvertebrate production and drift from riffles to pools was extremely low in these intermittent reaches. Gravel/cobble substrates were relatively abundant and within a size range suitable for spawning, although potentially suitable spawning substrates were generally highly embedded. Water quality appeared to be marginal and approaching stagnant in some isolated pools. Fish including small cyprinids (possibly California Roach) and young salmonids (thought to be *O. mykiss*) were observed in multiple pools.

Age-0 rearing habitat based on habitat mapping was abundant and ranged from 2.7 to 5.4 ft^2/ft and averaged 4.0 ft^2/ft. No suitable habitat for age-1 steelhead rearing or macroinvertebrate production was documented based on the mapping criteria (Table 2). Larger pools were sufficiently deep for age-1 rearing (>1.0 ft), although flow was too low to meet or exceed the minimum velocity criteria threshold (0.25 ft/s). Similarly, flow was too low to meet the velocity criteria for productive benthic macroinvertebrate habitat (1.0 ft/s), suggesting that potential food availability was low. Habitat complexity was moderate overall, and created by LWD and boulders (rip rap).

MMWD survey data for 2015 indicated that age-0 steelhead and coho abundance was near average at the two regular monitoring sites (SG3 and SG4) in upper San Geronimo Creek. Age-1 steelhead abundance was below average, but within the range observed in previous years. The MMWD survey data suggest that juvenile fish were able to use the limited habitat available, and survive in the isolated pools that remained in the late summer and fall, despite drought conditions and low streamflow.

Habitat availability in upper mainstem San Geronimo Creek is sensitive to small changes in flow, particularly where flow is reduced to 0.0 cfs, and conditions become intermittent. Similar to conditions observed in the lower mainstem reach, under intermittent conditions, fish can persist, but food resources are limited and growth is likely reduced.

See description of Woodacre Creek for discussion of the uppermost subreaches of upper mainstem San Geronimo Creek influenced by flow from Woodacre Creek.

3.3 Arroyo/Barranca/El Cerrito creeks

Flow conditions were generally dry throughout Arroyo, Barranca, and El Cerrito creeks, with the exception of a few small areas with very shallow (<1 in) standing water in the middle mainstem of Arroyo Creek. No surface flow was observed. Habitat criteria mapping was not performed due to the lack of water and mostly dry conditions. No fish habitat was present.

Habitat availability in Arroyo, Barranca, and El Cerrito creeks may be sensitive to small changes in flow during some (wetter) years. However, during dry conditions such as those observed during 2015, these streams provided no fish habitat, and low-flow summer rearing habitat availability would not be sensitive to further reductions in flow.

3.4 Montezuma Creek

Flow conditions were dry throughout Montezuma Creek. No fish habitat was present during the survey and habitat criteria mapping was not performed due to the absence of water.

Habitat availability in Montezuma Creek may be sensitive to small changes in flow during some (wetter) years. However, during dry conditions such as those observed during 2015, Montezuma Creek was dry and provided no aquatic habitat. Low-flow summer rearing habitat availability in Montezuma Creek would not be sensitive to further reductions in flow.

3.5 Larsen Creek

Flow conditions were dry throughout Larsen Creek. No fish habitat was present during the survey and habitat criteria mapping was not performed due to the absence of water.

Habitat availability in Larsen Creek may be sensitive to small changes in flow during some (wetter) years. However, during dry conditions such as those observed during 2015, Larsen Creek was dry provided no aquatic habitat, and low-flow summer rearing habitat availability would not be sensitive to further reductions in flow.

3.6 Woodacre Creek

Flow conditions were generally dry throughout the upper Woodacre Creek basin, including East Woodacre and West Woodacre creeks. Small pockets of standing water were observed in the middle mainstem reaches of Woodacre Creek. Surface flow was observed in the lower reaches of Woodacre Creek with flow increasing downstream toward the confluence with mainstem San Geronimo Creek. Measured flow in Woodacre Creek near the confluence with North Fork San Geronimo Creek was estimated at approximately 0.009 cfs. Water quality appeared to be good (i.e., clear, flowing, not stagnant). North Fork San Geronimo Creek was dry upstream of Woodacre Creek, and flow from Woodacre Creek extended downstream into upper mainstem San Greronimo Creek.

Fish, including age-0 salmonids, were observed in lower Woodacre Creek and upper mainstem San Geronimo Creek immediately below the confluence with Woodacre Creek. Habitat criteria mapping was not performed due to landowner access limitations.

Habitat availability in lower Woodacre Creek (and upper mainstem San Geronimo Creek) would be sensitive to small changes in flow during dry conditions such as those observed during 2015. Further reductions in flow would be expected to reduce habitat availability, food resources, and growth.

Habitat availability in upper Woodacre Creek may be sensitive to small changes in flow during some (wetter) years. However, during dry conditions such as those observed during 2015, upper Woodacre Creek was dry, and provided no aquatic habitat.

4 CONCLUSIONS

Locations surveyed that were dry during 2015 including North Fork San Geronimo, Arroyo/Barranaca/ElCerrito, Montezuma, and Larsen creeks, did not provide suitable summer rearing habitat for salmonids. These reaches are not expected to be sensitive to reduced flow during dry conditions such as those observed during 2015; however, these reaches could be sensitive to small changes in flow during some (wetter) years.

Upper and lower mainstem reaches of San Geronimo Creek were largely intermittent with pool and run habitats separated by dry riffles. Age-0 rearing habitat was relatively abundant with greater habitat area per unit length in the lower mainstem compared with the upper mainstem. Age-1 habitat was not documented in the mainstem reaches (or major tributaries surveyed), and was primarily limited by low water velocity (less than 0.25 ft/sec). MMWD juvenile salmonid surveys in 2015 indicated that juvenile coho (age-0) and steelhead (age-0 and age-1) were able to persist in mainstem reaches throughout the summer. Water quality conditions appeared to be marginal where surface flow was intermittent, although water quality parameters were not measured during the surveys. Habitat availability in these mainstem reaches are sensitive to small changes in flow. Reduced flow would be expected to reduce suitable habitat area, food availability, and growth.

Reaches of lower Woodacre Creek and the upper mainstem reaches of San Geronimo Creek immediately downstream of the confluence with Woodacre Creek had connected surface flow, and the best summer rearing habitat conditions observed in the San Geronimo Creek basin during our surveys. Flow in this area appeared to be near the lower limit of suitability for age-0 rearing, and is likely extremely sensitive to small changes in flow, since further reduction could change flow conditions from having continuous surface flow to being intermittent.

Based on the habitat criteria presented in Table 2, no productive BMI habitat was identified in San Geronimo Creek during the summer rearing habitat surveys.

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