Prepared by:
City of Santa Cruz
San Lorenzo Urban River Plan
Task Force

with assistance from
Rivers, Trails and Conservation
Assistance Program of the
National Park Service

Adopted June 24, 2003

A Plan for the
San Lorenzo River,
Branciforte Creek and
Jessie Street Marsh

San Lorenzo
Urban River Plan
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Introduction

In 1999 the Santa Cruz City Council initiated a new phase of planning for the San Lorenzo River, Jessie Street Marsh and Branciforte Creek. The City Council appointed a citizen committee, the San Lorenzo Urban River Plan Task Force (Task Force), to update plans for these waterways and asked the committee to undertake a planning process that would result in recommendations for programs and projects that would enhance the habitat, safety and aesthetics of these waterways within City limits. The City Council's interest in providing updated plans for the River, creek and marsh was instigated by several significant events: the initiation of the U.S. Army Corps of Engineers flood control improvement project beginning in 1999; the listing of the steelhead trout and coho salmon as federally threatened species; and federal designation of the San Lorenzo River as critical habitat for these species. The Task Force initiated a 3-year planning process to accomplish the City Council's directive with the outcome being the San Lorenzo Urban River Plan. The Task Force was assisted in its planning process by the Rivers, Trails and Conservation Assistance Program of the National Park Service.

The San Lorenzo Urban River Plan (Urban River Plan) provides an update to the San Lorenzo River Design Concept Plan (1987) and the San Lorenzo River Enhancement Plan (1989). These earlier plans guided flood control, vegetation restoration, and public access improvements along the San Lorenzo River and Jessie Street Marsh from 1989 through the late 1990s. The Urban River Plan provides a 20-year comprehensive plan for the areas of the San Lorenzo River, Branciforte Creek and Jessie Street Marsh within city limits. The Urban River Plan provides a vision for the San Lorenzo River, Branciforte Creek and Jessie Street Marsh that promotes conservation and enhancement of the river as a wildlife area with complimentary recreation and community uses. Recommendations and guidelines for habitat enhancement, public access, river trail amenities, recreational use, public art, and community programs are addressed in the Urban River Plan. The Urban River Plan includes conceptual plans for areas adjacent to the River. These conceptual plans are provided only to stimulate potential design ideas and are not required for particular properties in development applications. In general, the Urban River Plan advocates river-oriented development to promote the River as an amenity to downtown Santa Cruz.

The Plan is comprised of several components including:

Recommendations for river-wide programs including public access and recreation, management and maintenance, and community outreach and education of the river trail (San Lorenzo Riverway) and associ-
lated parkland areas (Chapter 3); Recommendations for specific sites and access points along the River (Chapter 4); Recommendations for Branciforte Creek (Chapter 5); Recommendations for Significant Riverfront Areas that require special attention with regards to development guidelines, public access and aesthetics (Chapter 6); Recommendations for implementation including funding strategies and a timeline for projects and programs (Chapter 7); The Lower San Lorenzo River and Lagoon Management Plan (Appendix A), the updated restoration and management plan for the river; Recommendations from the Jessie Street Marsh Management Plan (Appendix B).

Plan Recommendations: 
Restoration of the River is the First Priority

All of the recommendations in the San Lorenzo Urban River Plan were developed through the work of the Task Force and during several public workshops facilitated by the National Park Service. The recommendations recognize that the River is first a habitat area for fish and wildlife and second a passive recreational area for enjoyment by the community. Therefore the plan includes the Lower San Lorenzo River and Lagoon Management Plan as Appendix A. The Lower San Lorenzo River and Lagoon Management Plan provides management and restoration recommendations for improving fish and wildlife habitat along the lower 3 miles of the River. It is the intent of the Task Force that the next 15-20 years of history along the San Lorenzo is a story about restoration and recovery of fish and wildlife. Readers should review the Lower San Lorenzo River and Lagoon Management Plan in Appendix A to acquaint themselves with the goals and recommendations of this plan.

The Urban River Plan focuses on recommendations designed to integrate the San Lorenzo River, Jessie Street Marsh and Branciforte Creek into the surrounding urban fabric of the City of Santa Cruz. Recommendations are focused on system-wide themes such as public access and recreation, operations and maintenance, and community outreach and education. Site-specific recommendations regarding riverfront places that can be created and enhanced over the next 20 years are provided.

A Final Note: 
Establish a Permanent River Committee

It is the desire of the San Lorenzo Urban River Plan Task Force to witness the successful implementation of the San Lorenzo Urban River Plan over the next 20 years; bringing to reality the dream of a beautiful, natural river to Santa Cruz. To accomplish this goal, the Task Force has developed a detailed implementation plan that includes a recommendation for the establishment of a permanent River committee by the City of Santa Cruz. This is the first step in ensuring implementation of the San Lorenzo Urban River Plan and its accompanying documents the Lower San Lorenzo River and Lagoon Management Plan and the Jessie Street Marsh Management Plan.
1 Purpose, Context and Goals

1.1 Purpose of the San Lorenzo Urban River Plan

The San Lorenzo Urban River Plan (Urban River Plan) provides an update to the 1987 San Lorenzo River Design Concept Plan and the 1989 San Lorenzo River Enhancement Plan. These earlier plans guided flood control, vegetation restoration, and public access improvements along the San Lorenzo River (River) and Jessie Street Marsh from 1989 through the late 1990s. In 1999, the Santa Cruz City Council requested that the plans for the San Lorenzo River be updated due to: the initiation of the U.S. Army Corps of Engineers flood control improvement project beginning in 1999; the listing of the steelhead trout and coho salmon as federally threatened species; and federal designation of the San Lorenzo River as critical habitat for these species. The City Council appointed a citizen task force, the San Lorenzo Urban River Plan Task Force, to complete the plan update emphasizing community involvement as the foundation for plan development. The City Council requested that the San Lorenzo Urban River Plan Task Force update restoration and design plans for the River as well as address Branciforte Creek in the planning update process.

This San Lorenzo Urban River Plan articulates a community vision for the corridor encompassing the lower Lorenzo River, Branciforte Creek and Jessie Street Marsh as both a wildlife area, as well as a community recreation and public open space amenity. It contains recommendations for habitat enhancement, public access and trail improvements, public art, and community programs. It seeks to guide the City of Santa Cruz in reestablishing and improving its management of and relationship to this major, recently expanded landscape feature over the next 20 years.

"Seeing the photographs of the San Lorenzo River in the past, I realize its potential as a natural and aesthetic focus of our community."

Resident comment
May 5, 2001 Public Workshop
1.2 Goals and Benefits of the Plan

Acknowledging the validity of previous aspirations and efforts to improve the San Lorenzo River, while recognizing the nature of those efforts as ongoing, the San Lorenzo Urban River Task Force re-adopted the following goals from the 1987 and 1989 plans to guide their work:

- Enhance and restore biotic values of the River, creek and marsh as habitat for fish and wildlife
- Maintain flood control capacity of the San Lorenzo River and Branciforte Creek
- Improve the scenic and recreational value of the Riverfront
- Improve public access and pedestrian/bicycle movement to and along the River
- Improve the urban and neighborhood interface with the San Lorenzo River, Branciforte Creek, and Jessie Street Marsh
- Incorporate the San Lorenzo River, Branciforte Creek, and Jessie Street Marsh into the surrounding urban fabric of downtown and neighborhoods.

First and foremost was the Task Force’s interest in restoring the River as a functional riverine ecosystem. The Lower San Lorenzo River and Lagoon Management Plan comprises the biological restoration plan for the River and Lagoon and is included in the Urban River Plan as Appendix A. This restoration plan lays the foundation from which the remaining recommendations for the River were developed.

As the Urban River Plan aims to revitalize the San Lorenzo River and Branciforte Creek as an attractive, safe, convenient and multi-purpose community feature, economic and community health benefits can be expected to accrue from achieving these goals.

Many examples of successful river-oriented downtowns—San Luis Obispo, Sacramento, Santa Rosa, Redding, give testimony to the benefits of using waterways to enhance urban livability and character. River-oriented redevelopment can expand retail and commercial business opportunities. Designed creatively, these areas will become attractions for residents and visitors seeking riverfront dining and shopping experiences. In addition, downtown businesses can increase their revenue by catering to a wildlife-viewing, hiking, kayaking and bicycling clientele.

Connecting downtown to the Beach and Boardwalk, the improved River corridor also provides alternative transportation options for the community, lessening traffic congestion and air pollution. And, the health benefits to the City’s residents from having access to a continuous 5-mile recreation corridor adjacent to dense urban neighborhoods should not be overlooked. The National Center for Disease Control is promoting greenways and the opportunities they afford for regular exercise—walking, hiking, biking—as highly important in modern life for controlling obesity and maintaining good health among children and adults alike.

1.3 The Planning Area and River Reach Descriptions

The San Lorenzo Urban River Plan addresses the lower three miles of the San Lorenzo River, from the northern Santa Cruz City limits, to the river mouth at the Pacific Ocean, as well as Jessie Street Marsh and the lower one mile of Branciforte Creek including its confluence with the San Lorenzo. Figure 1 shows the planning area and associated planning reaches.

The project area encompasses the River channel itself, the levees to the toe of the outside slope, and certain adjacent riverfront areas (see Chapter 6). The Branciforte Creek component includes the flood control channel, along with City-owned easements west and east of the channel within City limits, from the creek’s confluence with the San Lorenzo River east to the City limits at Highway 1.

In a change from the earlier River plans, a new approach to addressing the River by reach, in order to more accurately reflect biological and hydrological conditions of the River environment, as well as distinctive adjacent neighborhood and downtown areas, was developed for this plan. A description of the River reaches follows (see Figure 1).

The Estuarine Reach, extending from the river mouth to the Laurel Street Bridge, was modified by the flood control channel and is devoid of riparian vegetation for most of its length. Due to tidal action, however, this reach is transformed into a lagoon when the sandbar at the river mouth closes in the late summer. The Estuarine Reach then becomes a nursery for young steelhead and salmon migrating out to sea from the watershed. Neighborhoods bordering this reach include Beach Flats and Lower Ocean Street. Natural resource enhancements to this reach are contained in the Lower San Lorenzo River and Lagoon Management Plan component of this document.

The Transitional Reach is located between the Laurel Street Bridge and the Water Street Bridge. The designation of this reach reflects its dual nature as a freshwater reach some of the year, and a brackish reach part of the year, depending upon tidal action and the closure of the sandbar at the river mouth. River Street South, Front Street and San Lorenzo Park border this reach. Branciforte Creek enters near the Soquel Avenue Bridge.

The Riverine Reach, from the Water Street Bridge to upstream of the Highway One Bridge, is not
Figure 1
Plan Area with River Reach Designations
influenced by tidal action, so freshwater predominates. It contains more extensive riparian growth than the lower two reaches. This reach is bordered by the Felker Street and Josephine Street neighborhoods, the El Rio Mobile Home Park, and the Gateway Shopping Center.

1.4 Relationship to Existing City Plans

This San Lorenzo Urban River Plan is the City's guide for restoring, managing, and maintaining natural resources, riverfront development, as well as recreation and public access improvements for the lower San Lorenzo River, Jessie Street Marsh and Branciforte Creek. It contains conceptual ideas, as well as site-specific recommendations, for accomplishing the goals that guided the Plan’s development. Conceptual plans are provided to stimulate potential design ideas and are not intended as requirements for development opportunities, but rather to provide ideas that promote river-oriented development. Refinements to the concepts, and specific strategies for implementing the recommendations will need to come from the community, the City Council and staff.

At present, several other adopted plans of the City of Santa Cruz also address the planning area for the San Lorenzo Urban River Plan. Described below, they include the 1991 Downtown Recovery Plan, 1998 Jessie Street Marsh Management Plan, and the City of Santa Cruz General Plan and Local Coastal Plan (1990-2005). The San Lorenzo Urban River Plan reflects the intent of these other plans, and will be incorporated into their updates as appropriate.

The Downtown Recovery Plan is an adopted specific plan providing a framework for public and private actions related to rebuilding the downtown after the 1989 Loma Prieta earthquake. The Plan identifies the River as a major downtown open space, and recognizes its potential “as a naturalistic open space, wildlife habitat, and recreational amenity: a garden promenade that can provide a more contemplative and reflective experience to the hustle and bustle of Pacific Avenue.” It recommends riverfront improvement and creation of linkages to downtown as a top priority in rebuilding downtown.

The Jessie Street Marsh Management Plan was adopted in 1998. Its recommendations are incorporated directly into the San Lorenzo Urban River Plan (see Appendix B).

The City of Santa Cruz General Plan and Local Coastal Plan (1990-2005) is a long-range, comprehensive guide for physical development of the City. It contains goals for pursuing environmental, land use, design, housing, circulation, economic, cultural and community facility needs. The Local Coastal Plan, part of the General Plan, comprises a land use plan, implementing ordinances, and maps, applicable to the City’s coastal zone areas.

Future updates of the General Plan and Local Coastal Program will incorporate recommendations from the San Lorenzo Urban River Plan for “significant riverfront areas” including Front Street, Salz Tannery, and Beach Flats, as well as bicycle and pedestrian plans, and capital improvement plans for adjacent park and recreation areas. Additionally, the recommendations of the Urban River Plan should be referenced in regional plans referring to the San Lorenzo River and watershed.

1.5 Plan Organization

The San Lorenzo Urban River Plan includes a wide range of guidance and recommendations for enhancement of the natural and urban features of the planning area. For ease of use, the plan is organized into seven chapters and two appendices. The appendices comprise other adopted plans incorporated into this plan, as described below. In addition, a Public Art Master Plan for the River was developed as a companion document to the Urban River Plan.

Chapter 1 - Presents the purpose, goals, and benefits of the Plan; describes the planning area, relationship to existing City plans and organizational structure of the plan.

Chapter 2 - A brief description of the River and its historical setting; describes River planning activities through the present, including the work of the San Lorenzo Urban River Plan Task Force in developing this plan.

Chapter 3 - Presents system-wide recommendations for the River, concentrating on public access, recreation, management and maintenance, and community outreach and education.

Chapter 4 - Provides site-specific recommendations for public areas located along the three reaches of the River described above. These include improvements to existing parks, parking areas, signage and general trail characteristics to provide for a more unified recreation experience for trail users.

Chapter 5 - Addresses Branciforte Creek, providing recommendations regarding flood control and natural resources, beautification and recreational improvements and neighborhood programs.

Chapter 6 - Discusses three “significant riverfront areas” deserving special planning attention to urban development and design, public access, and aesthetics.

Chapter 7 - Addresses implementation of the Urban River Plan; provides recommendations regarding department roles, project phasing, and funding strategies.

Appendix A - Contains the Lower San Lorenzo River and Lagoon Management Plan, which represents
the current biological plan for the River. This plan is the underpinning for the Urban River Plan, from which opportunities and constraints for recreation and community uses along the River were identified. Therefore, recommendations in the Urban River Plan are consistent with the goals of the Lower San Lorenzo River and Lagoon Management Plan.

Appendix B - Contains the recommendations of the Jessie Street Marsh Management Plan, which is incorporated by reference into the Urban River Plan.
2.1 Physical Setting

The San Lorenzo River drains a 138-square mile watershed from the steep, forested Santa Cruz mountains to the alluvial floodplain in the City of Santa Cruz (Figure 2). The San Lorenzo River was designated in 1976 as part of the State Protected Waterways Program (a program recognizing outstanding and valuable waterways within California) due to its scenic value and value as a steelhead trout fishery. The San Lorenzo River was at one time the largest steelhead fishery on the Central Coast, south of the Russian River. The San Lorenzo River watershed is also home to California's northernmost stand of Central Coast Cottonwood-Sycamore riparian forest. This unique 10-acre forest occurs in the lower floodplain at Pogonip adjacent to the River at the upstream end of the study area for this plan.

Major modifications have occurred to the San Lorenzo River over the last 50 years leading to overall decline in the health of the River. The upper River was impacted by massive timber harvesting activities in the early 1900s, the construction of Loch Lomond reservoir in 1960 and the increasing development of the San Lorenzo Valley during the 1970s through the 1990s. The most notable modification was the channelization of the lower three miles of the River into a levee flood control structure by the U.S. Army Corps of Engineers in 1957-59. Jessie Street Marsh and Branciforte Creek were also impacted by the levee project as these two waterways were modified by that project. Jessie Street Marsh was filled during the construction of the levee project and Branciforte Creek was channelized in a cement culvert in 1959.

The San Lorenzo River is currently in a state of decline as a viable river ecosystem and populations of steelhead trout and coho salmon have dwindled over the last 20 years. The River suffers from poor water quality, excessive sedimentation, loss of connectivity with its historic flood plain, loss of native riparian habitat, and reduced stream flows due to water extraction for increased urban uses. The coho salmon and steelhead trout were listed as threatened species under the federal Endangered Species Act in 1996 and 1997 respectively. Several main tributaries of the River, including Branciforte, Carbonera, Zayante and Bean Creeks, are listed as impaired waterbodies by the State Water Resources Control Board for contaminants including sediment, nutrients, and pathogens.

Because of these impairments and designations, the River is receiving increased attention by state and local governments with a goal of restoring the river for fish and wildlife. Local governments and water purveyors are also strategizing on ways to accommodate the conflicting needs of urban water use with wildlife protection. Despite its relative decline, the San Lorenzo
Figure 2
San Lorenzo River Watershed
River still supports unique resources which can be enjoyed by the Santa Cruz community and larger regional populace. The River provides habitat to over 100 species of birds, including nine species of special concern recognized by the State of California. Branciforte Creek and Jessie Street marsh are important tributaries to the San Lorenzo River. These waterways are valued as prominent features of the lower river, important to its functionality as a natural system, and a recreational feature of downtown Santa Cruz.

**Branciforte Creek**

Branciforte Creek drains approximately 17 square miles in the eastern portion of the San Lorenzo River watershed and empties into the San Lorenzo River just north of Soquel Avenue in the City of Santa Cruz. The lower mile of Branciforte Creek was channelized in 1957-1959 as part of the U.S. Army Corps of Engineers San Lorenzo River Flood Control Project (Figure 3).

Branciforte Creek supports a run of native steelhead trout and several important bird species. Although coho salmon have not spawned in Branciforte in recent years, the California Department of Fish and Game has indicated that Branciforte Creek has the potential to support coho salmon with appropriate habitat restoration in parts of the watershed (Gilchrist, 1999). The Santa Cruz Bird Club has recognized the confluence area of Branciforte Creek and Carbonera Creek as a birding “hot spot” and several rare or unusual bird species have been reported in the area over the years by the Bird Club.

**Jessie Street Marsh**

Jessie Street Marsh lies on the eastern bend of the San Lorenzo River mouth as it empties into Monterey Bay. Historically, the marsh was part of a large tidal estuary connected to the San Lorenzo River and encompassing much of what is now lower Ocean Street and downtown Santa Cruz (RRM Design Group, 1998). Jessie Street Marsh was originally a brackish saltwater marsh. It received seasonal freshwater inflows from rainfall and perennial spring flow in the Branciforte Bluff area and it was regularly inundated with saltwater when sandbars formed a lagoon at the mouth of the San Lorenzo River. Jessie Street Marsh was hydrologically cut off from the San Lorenzo River by construction of a levee during the 1957-1959 flood control project on the San Lorenzo River. The levee blocks all river flood flows and most tidal flows from entering the marsh.

Jessie Street Marsh has been the focus of a restoration and management plan completed in 1998. The plan provides recommendations to preserve and enhance the natural resources of the marsh, improve water quality, manage flood waters consistent with the protection of natural resources and provide public access and education in appropriate areas of the marsh (RRM Design Group, 1998). The Jessie Street Marsh Management Plan is incorporated into the Urban River Plan by reference (see Appendix B).

### 2.2 Social Setting: Development of the City of Santa Cruz

Spanish explorers first encountered the San Lorenzo River in 1769. Prior to this discovery, the native Ohlone Indians used the river as a resource for food gathering and hunting but constructed their reed structures well outside the floodplain of the river. An Ohlone village, “Aulina” or “place of red abalones,” was located at the river mouth near what is today called Beach Flats.

When the Spaniards arrived they began settling in the floodplain and built the Santa Cruz Mission Chapel near the river in 1791. A flood in the winter of 1792 destroyed the chapel, and it was moved to the top of Mission Hill in 1792. The mission era saw the floodplains of the San Lorenzo River used for agriculture—most notably cattle and sheep grazing (3,300 head of cattle and 3,500 sheep once grazed in the floodplain) and crops including wheat, barley, corn, and fruit trees. At the same time, the village of Branciforte was also established on the east side of the San Lorenzo River.

Between 1791 and the 1840s the town of Santa Cruz and the Villa de Branciforte were located outside of the floodplain on the tops of the bluffs to the east and west of the river. As the population of the area grew in the late Mexican and early American periods, houses and commercial buildings began to be built in the space available between the bluffs (McMahon, 1997). In 1846
Beach Flats became known as Schooner Flats and one of California’s earliest boat-building yards opened. In 1866 the new county courthouse was built on Cooper Street and the center of town development shifted away from Mission Hill bluff to the floodplain of the river. The City was incorporated by the California Legislature in March 1876 with 6,000 residents.

During the 1890s and early 1900s, Santa Cruz became known as a regional tourist attraction with the San Lorenzo River being a primary focus because of its steelhead fishery. At one point in time, 12 public docks were located along the lower River, and the opening of steelhead season would fill downtown hotels with travelers. Other events in the history of the San Lorenzo included the annual Venetian Water Carnivals that involved decorated boat parades, concerts, balls, a Water Olympics, and fireworks. The carnivals were held during the early 1900s.

The City’s largest Chinatown was also located along the river on Front Street from 1870 to 1894 when it was destroyed by fire (Lehman, 2000). Chinatown activities included market gardens grown in the San Lorenzo River bottom behind Front Street. After a fire in 1894, a second Chinatown was built on Midway Island in the San Lorenzo River (at the site of today’s Long’s/Zanotto’s parking lot). This Chinatown was eventually destroyed by floods in 1905 and 1940.

Present day conditions on the River are less than favorable with social and criminal problems being prevalent along the entire three-mile levee section. Drug dealing, prostitution, and drug use are common along the River especially during summer and fall when low water levels allow for large illegal camps to be established in the river bottom. These camps result in large amounts of trash and human waste entering the River during the summer season and with the first winter rains. Increasingly these problems have come to the attention of the community and new efforts at cleaning up the River have been initiated by the community and the City. These efforts need continued support to be successful.

2.3 The History of Flooding in Santa Cruz

As development encroached upon the floodplain of the San Lorenzo River, floods began to take their toll upon the community. Eighteen flood events occurred from 1862-1958. Some of these floods were minor events but others were quite severe and caused extensive damage. The first serious flood to hit the growing town was in the winter of 1862. This flood caused extensive damage and eroded the base of Mission Hill 30 feet. The response to this flood by the townpeople was the earliest form of flood control: they built a bulkhead to stabilize the riverbank near the base of Mission Hill and they began to change the river channel so that it would run past Mission Hill instead of straight at it (McMahon, 1997). At the same time the bulkhead was built, property owners along the western edge of the river began to fill their lots to raise the grade by as much as four feet to prevent the river from flooding their properties. The City of Santa Cruz established its first San Lorenzo River Commission in the late 1870s to address the flooding impacts of the river.

Flooding continued with events recorded in 1878, 1881, 1890, 1895, 1907, 1911, 1940, and 1941. The costliest, deadliest and most well-known flood in the history of Santa Cruz was on December 22, 1955. The river flowed down Pacific Avenue at a depth of three to four feet and caused multi-millions of dollars in damage and eight deaths. Following the 1955 flood, the lower 2.5 miles of the San Lorenzo River was channelized into a flood control structure in 1957-59 in a cooperative project of the City of Santa Cruz and the U.S. Army Corps of Engineers (Corps).

The $2.2 million flood control project constructed riprap levee banks, removed all vegetation from the river’s banks and dredged the bottom of the river channel approximately 5-8 feet. When the project was completed in 1959, the City retained maintenance responsibilities for the flood control channel. These maintenance responsibilities included annually dredging the channel bottom 5-8 feet below sea level and continued eradication of any vegetation growing on the river’s banks.

1987 and 1989 San Lorenzo River Plans

Two river planning efforts for the San Lorenzo River were undertaken during the 1980s in response to several issues requiring immediate attention - the most important being the documented reduction of flood protection for downtown Santa Cruz due to natural filling of the flood control channel with sediment. By the late 1970s, the Corps estimated sediment in the channel had reduced the flood control project’s capacity from 100-year flood protection to less than 30-year flood protection (City of Santa Cruz, 1989). Riverine habitat for native anadromous fish (salmon and steelhead) was in decline and the sterile River had become an eyesore with its denuded banks and dredged streambed.

A major flood in January 1982 provided new evidence of the River’s ability to scour the streambed during large flood events and demonstrated a larger flood capacity than previously assumed. The Corps reinitiated studies on the River following this event, concluding that replacing flow-constricting bridges at Water Street and Riverside Avenue while constructing a 3-foot high floodwall atop the levee banks would provide the necessary infrastructure for protection against a 100-year flood. The Corps also maintained that the City should
continue dredging the flood control channel of approximately 1,200 cubic yards of sediment per year.

These new findings and recommendations prompted the Santa Cruz City Council to initiate planning efforts on the San Lorenzo River. The first effort - the San Lorenzo River Design Concept Plan adopted in 1987 - described a multi-objective design for the flood control improvement project and for enhancing the river as an urban open space. A key recommendation of this plan was to develop a biological enhancement plan to maximize biological resources within the constraints of the Corps’ flood control requirements.

Consequently, the City initiated the biological planning process in 1988 with a team of consultants under the direction of a Council-appointed San Lorenzo River Restoration Committee. The 1989 San Lorenzo River Enhancement Plan provided details, specifications and techniques for:

- Planting native riparian vegetation to establish and maintain a continuous corridor of riparian habitat;
- Managing the lagoon at the river mouth;
- Implementing sediment and drainage maintenance practices that are sensitive to biological resources;
- Establishing a monitoring program to collect new data to increase knowledge of the river system and refine management plans;
- Adapting and coordinating the flood control design planning process with the Army Corps of Engineers and the City’s restoration plan.

The City approved the San Lorenzo River Design Concept Plan and the San Lorenzo River Enhancement Plan in 1988 and 1989 and both plans were incorporated into the General Plan and Local Coastal Plan. The 1989 Loma Prieta earthquake discontinued the City’s focus on the River for a time, as the City began to rebuild the downtown and repair critical public infrastructure including portions of the levee damaged in the earthquake. Reconstruction of the Riverside Avenue Bridge, Soquel Avenue Bridge, and Water Street Bridge was accomplished between 1991 and 1996.

Concurrently, the Corps began to design the flood control improvement project, proceeding with a plan to raise and rebuild the levees by 2-4 feet rather than construct a continuous floodwall. The Corps design incorporated native vegetation components recommended in the City’s 1989 San Lorenzo River Enhancement Plan and the construction of a continuous bicycle and pedestrian path the length of the levees. The Corps plan was completed in 1996 and Congress authorized funding the same year. In its authorization, Congress ordered the Corps to combine the flood protection project and vegetation improvements into one project. The San Lorenzo River Flood Control and Environmental Restoration Project commenced construction in 1999 with completion estimated by 2003.

2.4 Current Planning and the San Lorenzo Urban River Plan Task Force

In 1999 the Santa Cruz City Council appointed the San Lorenzo Urban River Plan Task Force (Task Force) to update the San Lorenzo River Design Concept Plan and the San Lorenzo River Enhancement Plan. These plans needed updating due to the federal listing of the steelhead trout and coho salmon as threatened species, the designation of the San Lorenzo River as critical habitat for coho and steelhead, and because the Corps flood control improvement project had begun construction. The 22-member citizen Task Force was charged to undertake a planning process to develop programs and projects that would further enhance the habitat, safety and aesthetics of the San Lorenzo River within City limits. The City Council gave the Task Force the following five tasks:

1. Update the River Enhancement and Design Concept Plans utilizing scientific and technical recommendations and public participation and recommend specific actions for implementation and financing of the updated Urban River Plan;
2. Coordinate and participate in activities of the County of Santa Cruz and other state and federal agencies on the improvement of the San Lorenzo River watershed and the Branciforte Creek watershed;
3. Develop a management plan including defining habitat baseline data and a monitoring program;
4. Study and analyze flood issues and the potential for habitat restoration in the Branciforte Creek watershed;
5. Work with the U.S. Army Corps of Engineers and all relevant federal, state and local agencies to ensure that the work to be conducted by the Corps is carried out in a manner consistent with habitat restoration, enhancement of water quality, improvement of aesthetics values, and all applicable federal, state, and local environmental regulations.

From 1999 to 2002 the Task Force reviewed the existing river plans, conducted public workshops and compiled public comments into recommendations for the San Lorenzo Urban River Plan. Working with a consultant team of biologists and hydrologists the Task Force completed the update to the San Lorenzo Enhancement Plan, producing the Lower San Lorenzo River and Lagoon Management Plan in January 2002. The management plan is incorporated into the Urban River Plan (see Appendix A) and provides the foundation for appropriate recreational uses and features.
along the River that are non-impacting to fisheries and wildlife resources.

For development of the Urban River Plan, the Rivers, Trails and Conservation Assistance Program of the National Park Service assisted in planning and implementing public workshops to gather information and input from the community. The National Park Service helped to produce useful products such as newsletters and plan drafts for review by the Task Force. In addition to the major tasks described above, the Task Force (with assistance from the National Park Service), completed several other activities during the planning process including the following:

- Initiated the planning process with public meetings to provide history and background on the River for Task Force members, the community and interested parties;
- Hosted field tours of the River and watershed to provide technical and scientific background for Task Force members and interested community members;
- Communicated with the Corps of Engineers regarding construction of the flood control improvement project;
- Reviewed and analyzed the existing River plans to identify recommendations implemented and not implemented;
- Hosted four public workshops to gather input from the community on opportunities and issues along the River;
- Produced newsletters that compiled comments from the public workshops and distributed the newsletters to the community;
- Partnered with the National Park Service's Rivers, Trails and Conservation Assistance Program and the Northern California Chapter of the American Society of Landscape Architects to host a design charrette for artists, designers, landscape architects, and
3
Riverwide Concepts and Programs

Introduction
Integrating the San Lorenzo River, Jessie Street Marsh and Branciforte Creek into the surrounding urban fabric of the City of Santa Cruz presented the Task Force with one of the greatest challenges during the three-year planning process that culminated with this Urban River Plan. For over five decades the San Lorenzo River has been relegated to a back alley of downtown. The height and scale of the levees provides a visual and physical barrier for accessing the river. From street level, the River cannot be seen from downtown and adjacent neighborhoods thus resulting in a lack of involvement by the community. In a sense, the river is not part of the landscape of Santa Cruz, it is hidden behind the massive earthen levees. This sense of abandonment has opened doors for undesirable activities to predominate along the River. Illegal camps and activities such as drugs and prostitution make the area inviting to some, threatening to most. Conservation and stewardship efforts are extremely challenged in this environment often resulting in complete inaction towards these complicated problems.

3.1 The San Lorenzo Riverway
The Task Force recognized that fostering a new way of thinking about the River required community involvement. The Task Force initiated a series of public workshops to gather comments about the River from the community. Each workshop focused on presenting background information on the history and planning process of the Urban River Plan and encouraged community members to express their ideas, concerns, issues, and opportunities for the River. Information from these workshops helped the Task Force discern user needs and desires for the River corridor, identify problem areas, and locate important pedestrian connections. The next step was to host a design charrette in partnership with the National Park Service and American Society of Landscape Architects to generate solutions to these specific challenges and illustrate the resulting design concepts.

This three-day workshop was held in January of 2002 and brought together artists, landscape designers, planners, citizens, and policy makers to identify a new focus for the River. The outcomes from the workshop reiterated what the Task Force had already acknowledged—that the San Lorenzo River is an important open space area in the City and that the community has many opportunities to create a new, positive relationship with the River for the future.

In January 2002, in a symbolic first step to recognize and embrace the River as part of the urban life of Santa Cruz, the Task Force renamed the levee
trail system and its related facilities and amenities (currently commonly referred to as “the levee”) as the “San Lorenzo Riverway.” In doing so, the Task Force hoped to create not only a new linear city park but a new nomenclature for referring to the River—one that recognizes its value as a recreation feature, an alternative transportation corridor, and a significant fish and wildlife habitat and an amenity worthy of community support and involvement. “San Lorenzo Riverway” captures these goals in a recognizable place name for the newly completed flood control project and trail system.

3.2 Defining the Riverway: System-wide Recommendations

The Urban River Plan recognizes the San Lorenzo Riverway as an exciting network of places to be discovered during one’s journey along the River. It can indeed become the signature of the City over the next 20 years. The Riverway includes riverfront places, river views, and river-related activities that will be developed or enhanced to integrate the River into the downtown fabric. This section of the plan provides recommendations for ongoing and future treatment of the San Lorenzo Riverway to enhance its function as an open space area, transportation corridor, a recreation feature, and an eniron for community activities. These recommendations focus on system-wide themes that are not reach specific and are both physical and programmatic in nature.

The River as an Alternative Transportation Corridor

The Corps flood control improvement project has provided substantial improvements to the trail system along the levee crest, however additional improvements such as completing bicycle and pedestrian bridges, improved access at existing ramps, and directional signage are still needed. The river pathway system provides the best opportunity to maintain an alternative transportation route accommodating pedestrians, bicycles, and wheelchairs from the beach to the River Street/Highway 1 area. This loop trail system, with its many east-west lateral access points to adjacent neighborhoods, offers alternative transportation options for residents and visitors. Increased use of the River trail system will help alleviate existing illegal activities along the Riverway.

The following system-wide recommendations meet the goals of improving public access and pedestrian/bicycle movement to and along the River, as well as improving the urban and neighborhood interface with the San Lorenzo River, Branciforte Creek and Jessie Street Marsh.

Recommendations

- Complete pedestrian/bicycle bridges at Highway One/Felker Street and the confluence of Branciforte Creek and the San Lorenzo River. Secure funding for design and construction of these projects.
- Complete the upgrade and widening of the Union Pacific Railroad Trestle at the rivermouth to provide safer pedestrian and bicycle use along this route.
- Improve pedestrian/bicycle access between the Riverway and Jessie Street Marsh and Oceanview Park.
- Identify and program parking areas for trail system users into current and future transportation planning efforts. Provide signage and facilities such as stairs and ramps leading up to the trail in order to dissuade “shortcuts” through landscapeing.
- Access and pathways in the Front Street corridor should be designed to draw people out of the downtown to the River.
- Access and pathways from the neighborhoods at Ocean Street and Barson Street should be designed to facilitate pedestrian and bicycle use.
- Continue to provide disabled access to areas and facilities of the river.

The River as a Recreation Feature

For all its current and potential contributions to the quality of life in Santa Cruz, the San Lorenzo Riverway offers perhaps the greatest opportunity for enhancing recreational use of the River. Recreational access along the River provides opportunities for public interaction with the River corridor for enjoyment, education and continued stewardship. A multitude of recreational opportunities exist along the Riverway: hiking, picnicking, bicycling, jogging, skating, birdwatching, etc. Water-based activities such as kayaking and canoeing are increasingly popular sports. Participants in public workshops organized to solicit input for this Urban River Plan advocated to allow kayaks and other small boats access to the River for at least seasonal use. While existing City policy (Santa Cruz City Municipal Code Section 9.66.090 and Section 9.66.030) prohibits the use of water sports equipment and boats in the San Lorenzo River, this plan recommends consideration of future possibilities for providing water-based recreational opportunities on a limited basis.

The following system-wide recommendations meet the plan goal of improving the scenic and recreational value of the River.

Recommendations
• Develop a San Lorenzo Riverway trail improvement program that addresses infrastructure improvements (lighting, safety, call boxes), signage, wayfinding, interpretation and trail linkages. Trail lighting should be designed to be non-intrusive to fish and wildlife and energy efficient.

• Develop a system of unpaved nature paths on the levee slopes near riparian areas to enhance wildlife viewing activities. Design bird-viewing platforms and observation decks so as not to disturb wildlife. Platforms and observation decks should be constructed so as to avoid conflicts with flood capacity.

• Develop a map of the San Lorenzo Riverway including regional trail links (Sanctuary Scenic Trail and California Coastal Trail) and key lateral access areas. Place the map at directional locations along the Riverway.

• Develop recreational guides for the river and associated activities. Investigate potential for creation of par course along the Riverway.

• Review existing City ordinances prohibiting use of the river for kayaking and canoeing; explore opportunities for establishing a seasonal boating program with appropriate launching facilities and public safety measures. The boating program should be designed so as to avoid conflicts with fish and wildlife and public safety.

System-wide Operations and Maintenance

The San Lorenzo Riverway represents one of the most significant investments of public funds over the last ten years. The Riverway includes over 3,000 native plants and 2.5 linear miles of parkland that now need to be maintained. Although past expenditures on the river have largely been directed toward flood control maintenance and operations, the Riverway is a substantial new public park and open space in the City and will require increased expenditures for staffing, operations, and capital improvements. Increased expenditures can also be expected in other departments such as police, fire, and public works (transportation) as the community makes more and more use of the Riverway.

The following system-wide recommendations meet the Urban River Plan goal maintaining the flood capacity of the River and Branciforte Creek and enhancing the biological values of the River for fish and wildlife.

Recommendations

• Establish a “River Coordinator” position to facilitate coordination of maintenance, management, restoration, and monitoring projects for the river. The River Coordinator would seek and procure project grants, coordinate with City staff and community groups, and be the lead staff for plan implementation.

• Provide adequate operations and maintenance staffing levels in the Parks and Recreation and Public Works departments to maintain existing Riverway facilities and recommended improvements of the Urban River Plan.

• Establish a staff-level “River Management and Maintenance Coordinating Group” comprised of staff from Parks and Recreation, Public Works, Water, Planning, Police, Fire, and Redevelopment to coordinate ongoing management and maintenance projects on the levee and in the river.

• The City should devote consistent attention to issues of public safety, maintenance, and enforcement of ordinances to reduce harmful effects of human activity (e.g., camping, illegal activities) that degrades environmental or recreational qualities.

• Develop and implement a litter control program on the San Lorenzo Riverway including monthly large-scale cleanups of areas that present public health hazards.

• Work with code enforcement to continue abatement of illegal dumping along the San Lorenzo Riverway.

• Evaluate conditions of landscaped areas and conditions of native vegetation installed as part of the flood control improvement project. Work with a qualified botanist to develop a replacement plant list should mortality occur in landscape areas and ensure implementation of remediation plans.

• Develop a river management and stewardship training program for City of Santa Cruz staff to inform staff of the river’s sensitive resources and unique management requirements.

• Investigate options for volunteer programs and community service programs to assist with maintenance and management responsibilities.

• Conduct annual vegetation and sediment management program for flood control maintenance.

Community Outreach and Education

Public outreach and education are a critical component of the San Lorenzo Urban River Plan. These programs will expand the community’s awareness of the San Lorenzo River, Jessie Street Marsh, and Branciforte Creek increasing community involvement and conservation of these waterways. Increased public involvement in the River will help the City meet its management responsibilities for the River. Public interest in and use of the Riverway will focus more “eyes” on the River and
its amenities, raise contributions of volunteer hours and services, and educate a new generation about the River, its natural and cultural history, and develop a sense of pride and ownership.

The following recommendations will help to achieve the plan goal of incorporating the River, marsh, and creek into downtown and neighborhood activities.

**Recommendations**

- Provide regular updates about the River and creek to the community via the newspaper and media (e.g., Community Television, local radio station, or City-based website).
- Develop an "Adopt-A-Riverbank" program for participation by local businesses, schools, community and neighborhood groups. Activities could include litter control, planting, and ecological monitoring.
- Conduct annual River tours and priority planning sessions for the City Council.
- Develop multi-lingual materials and educational products about the River.
- Participate in National River Cleanup Week annually during the second week of May as an awareness raising celebration.
- Work with local schools and outdoor education programs to utilize the River as an outdoor classroom.
- Develop and implement a docent program for natural history tours in cooperation with the Museum of Natural History or Parks Department Ranger Programs.
- Establish a "Friends of the San Lorenzo River" non-governmental organization to partner with the City of Santa Cruz and other agencies and organizations on public outreach programs and Riverway projects.
- Establish public festivals celebrating the River such as a "First Day" festival on January 1 and an au-
4
Reach Specific Recommendations

Introduction

This chapter provides reach specific recommendations for sites along the San Lorenzo Riverway. As described in Chapter 1, for planning purposes, the Riverway has been divided into three distinct reaches: the Estuarine Reach (rivermouth to Laurel Street); Transitional Reach (Laurel Street to Water Street); and the Riverine Reach (Water Street to Highway 1). This system of division reflects the biologic and hydrologic conditions of the River environment as well as the distinct neighborhood and urban areas adjacent to the River.

By dividing the River into distinct reaches, projects can be clearly defined and priorities set on improvements to the Riverway over the 20-year plan period. One of the most important components of the plan is that it be comprised of realistic projects that can be accomplished within a defined time period. It is the intent of the Task Force that the plan include aesthetic as well as functional improvements for the Riverway—that the Riverway gain a sense of unification as projects are completed in specific reaches and sites. The Riverway will then become an important recreational and transportation corridor for residents and visitors. As previously mentioned, conceptual plans are provided to stimulate potential design ideas and to encourage appropriate uses, scale and orientation in adjacent areas along the River. Conceptual plans included in this chapter are for example purposes only.

4.1 Design Improvements

The San Lorenzo Riverway consists of several existing public sites and accessways. During the development of the Urban River Plan, the Task Force collected public comment about opportunities for existing areas and sites along the Riverway. This information was compiled and presented to Task Force members, artists, landscape designers, and planners as part of the design workshop held in January 2002. The goal of the design workshop was to provide ideas for “fine tuning” the existing sites and accessways along the Riverway to provide a more unified recreation area for the community. Participants in the design workshop visited and reviewed the existing parks adjacent to the Riverway as well as parking areas (formal and informal), street connections, signage and general trail characteristics and use patterns. Taking this information, the participants developed three different types of improvements that could be done along the Riverway to provide a more unified recreation experience.

The three types of design improvements that could be implemented at existing sites along the Riverway include focus sites, access nodes, and urban interface connections.

Focus sites are public spaces within or adjacent
to the Riverway corridor that create a destination or unique Riverway experience for the Riverway user (Figure 4). Most focus sites will be located on existing Riverway land, but in some cases focus sites may involve land acquisition or easements. Focus sites are intended to increase Riverway use, increase awareness and appreciation for the Riverway, create consistency in pathway treatments and amenities and add visual focal points. Improvements to focus sites will include the following:

- Plazas and public spaces
- Entry features
- Interpretive features
- Public art Seating
- Education facilities
- Defining trail access parking areas through striping and entry markers

**Access nodes** are sites where existing streets, bridges, and/or stairways converge with the Riverway trail and provide opportunities for seating, public art, and signage (Figure 5). Access nodes are important features along the Riverway because they provide the user with a sense that they are traveling along a network of interconnected places with common landscape features such as design elements (i.e., pavement treatments, walls or vertical markers), and wayfinding elements.

Access nodes should indicate to the Riverway user that they have arrived on the Riverway and the Riverway is there to discover and explore. Access nodes will include the following elements:

- Pavement treatments (to differentiate from asphalt path and announce the connection to the Riverway corridor)
- Thematic fencing/walls/arbors
- Seating
- Directional and informational signage
- Public art features
- Riverway markers

Figures 6-9 show sample design standards for access nodes. In general, materials should be natural (i.e., stone or stucco) and designed to be vandal-proof and non-intrusive to the undeveloped feel of the Riverway. It is preferred that these features be designed build rather than selected from a catalog.

**Urban interface connections** are envisioned

**Figure 5**
Access nodes are located where ramps and the Riverway trail converge

**Figure 6**
Natural Materials Palette of Riverway Features

 prefect concrete (to look like stone) trash can

Slate bench

Sandblasted text on saltates identifies location, name of park, interpretive facts, etc.
as “fingers of green” that expand and connect the Riverway corridor into the community and neighborhoods through the installation of street trees, pavement treatments, and public art elements along specific streets and corridors. These “fingers of green” provide hints and reminders to visitors and residents that by following the routes they will end up at the River and Riverway trail. Urban interface connections may also include directional signage or orientation symbols from downtown areas and other neighborhood areas such as Beach Flats and lower Ocean Street. Public art is another element that can play on river themes and remind the community that the River is nearby.

4.2 Site Specific Recommendations in River Reaches

The following discussion addresses improvements to each of the three planning reaches and identifies focus sites, access nodes, and urban interface connections located within each reach.

The San Lorenzo Riverway currently consists of a 12-foot wide asphalt path running the length of the levee on the west and east banks for a total of five linear miles. The Riverway trail includes American Disabilities Act (ADA) accessible ramps at all major bridges. Other amenities such as seating, lighting, signage, public art, and interpretive elements do not currently exist on the Riverway. The Riverway is landscaped on the outer banks with native riparian trees and shrubs. The inner banks are not landscaped but have a mix of native and nonnative plants characteristics of streams on the Central Coast. The three planning reaches and their existing characteristics are described below. Recommendations for focus sites, access nodes, and urban interface connections follow the reach descriptions. Conceptual designs developed in the design charrette are included for each site to provide conceptual ideas for existing areas.

Estuarine Reach

The Estuarine Reach is the last segment of the San Lorenzo Riverway and runs from Laurel Street to the river mouth (Figure 10). The Estuarine Reach refers to the portion of the River where tidal action changes the aquatic environment to a brackish system and influences the types of plants that can grow in the area. The Estuarine reach also becomes a lagoon in the late summer when the sandbar at the river mouth closes and freshwater inflows cause the estuary to fill and become a lagoon. During the period of sandbar closure the lagoon slowly converts to freshwater. The Estuarine Reach is one of the most complicated areas biologically and hydrologically in the river system.

Neighborhood areas adjacent to the Estuarine Reach include Beach Flats, Seabright, and Lower Ocean Street. The neighborhoods in this reach are developed with housing and commercial land uses. The Santa Cruz Beach Boardwalk and its associated facilities including the Third Street parking lot are located in the Estuarine Reach. Jessie Street Marsh is located on the southeast bank of this reach immediately upstream of the river mouth. Existing parks in this reach include Mike Fox Tennis Park and Jessie Street Marsh Park. In this reach the Riverway can be accessed via ramps at Riverside Avenue Bridge, Canfield Avenue, Jessie Street, Third Street, and near the Trestle Bridge at the terminus of the levee. The Southern Pacific Railroad Trestle Bridge located at the terminus of the Riverway provides east-west access over the River from the Seabright area to Beach Flats.

Focus Sites—The Estuarine Reach includes four focus sites: Mike Fox Park, the Riverbend/Laurel Street Extension area, the terminus of the Riverway trail on the east bank at Jessie Street Marsh, and the Trestle Bridge area. Improvements at these focus sites include defining trail access parking with marked spaces and entry sites, creating additional river view areas through construction of small thematic plazas and informal nature trails, and enhancing recreational use.

Mike Fox Park is a large regional park located on the east side of the River on San Lorenzo Boulevard. Except for four public tennis courts and several picnic tables, much of the park is unimproved. There is no designated parking area and access to the Riverway trail is from the northern and southern ends of the park via pedestrian and maintenance vehicle access ramps (Figure 11).

Streambanks are flatter in this area and a small seasonal beach is formed along the riverbank from the Riverside Avenue Bridge upstream. Improvements proposed for Mike Fox Park include defining parking with

Figure 11
Mike Fox Park
Focus Site
Figure 12
Conceptual Plan for Mike Fox Tennis Park

- Nature Trail
  - Soft surface and low impact two-foot trail located outside floodplain. Closed seasonally.
  - Trail amenities include benches, interpretive signs and bird blinds
marked spaces and entry sites, providing additional picnic areas, and creating a seasonal events plaza at the northern end of the park on an existing turf area. Creation of an informal nature path on the inner levee bank with seasonal overlooks and seating will provide opportunities for wildlife watching and streambank and River monitoring. The park may also serve as a location for a kayak vendor if seasonal boating is ever established for the river. This park would also be appropriate for a public restroom. See Figure 12 for additional concepts that may be implemented at this focus site.

The Riverbend/Laurel Street Extension area is currently in design and construction planning as a cooperative project with the U.S. Army Corps of Engineers as Phase 3 of the San Lorenzo River Flood Control Improvement and Environmental Restoration Project. Construction is anticipated to occur in 2003/2004. Improvements will include a one-way road from Laurel Street Extension to Third Street, a River view plaza off Third Street and a pedestrian/bike trail that will complete the Riverway trail under the Riverside Bridge. The River view plaza will provide opportunities to interpret the cultural and natural history of the River. See Figures 13 and 14 for conceptual drawings of the improvements at this focus site.

The terminus of the Riverway trail on the east bank is at East Cliff Drive directly across from Jessie Street Marsh (Figure 15). The terminus is landscaped but has no other improvements. This area could be improved through providing a River view plaza area which would take advantage of the views and natural and cultural features of this site. This area should also emphasize a relationship with Jessie Street Marsh through signage, interpretation, and educational planting areas of appropriate flora. Existing site conditions and public safety constraints make it difficult to provide a formal connection to Jessie Street Marsh without major transportation improvements at this site. Conflicts with vehicular traffic going both directions on East Cliff Drive are common in this area due to the lack of a signal light or crosswalk. Original plans for the River developed in 1987 discussed the idea of a cantilevered bicycle trail above the River along East Cliff Drive. This design should be reconsidered in transportation improvement plans for this area to address public access and safety concerns. Additional consideration should be given to creating an underpass to connect the east Riverway trail with the Oceanview Park trail and Jessie Street Marsh. See Figure 16 for conceptual plans for this focus site.

The Trestle Bridge area is a confusing array of public and private property hampered by the presence of the wall along the Santa Cruz Beach Boardwalk's log ride and the private parking area at the terminus of the levee trail. Yet the Trestle Bridge area offers dramatic views of the river and Monterey Bay and the beach (see Figures 17 and 18) and is the gateway to the San Lorenzo Riv-

![Figure 13
Conceptual Plan for Riverbend/Laurel Street Extension Focus Site](image-url)
erway at its southern terminus. Goals for improvements to this focus area include 'culing' Riverway users that beach access is available and that bicycle and pedestrian access is available over the Trestle to the east side of the River. The trestle bridge could also incorporate public art features. The site would be fitting for a River view plaza that takes advantage of the views to Monterey Bay and should highlight the cultural and natural resources of the area. Another feature of the site is the large parking lot off of Third Street. This parcel should be considered for restoration to wetland habitat to lessen the visual impact of the parking lot adjacent to the River. Chapter 6 addresses this area in more detail. Figure 19 shows conceptual plans for the Trestle Bridge site.
Parking Lot Connection
Low impact foot trail that connects the parking area up to the Riverway and down to the River. Closed seasonally.

Riverway Welcome Area
A small building houses information booth staffed by volunteers—provides orientation information.

Trail Crossroads
Highlighted by special concrete surface alerts users to converging trails and Riverway feature.

Seasonal Beach Benches

Thematic Plaza
Engineered to withstand and highlight the elements and tides.

Provide safe and obvious connection to Boardwalk and Railroad Trails

Figure 19
Conceptual Plan for Trestle Bridge Focus Site
Access Nodes - The Estuarine Reach includes four sites appropriate for access nodes. These sites include (1) the Beach Hill stairway from Cliff Street where it ends at Laurel Street extension, (2) the Riverway trail access ramp at Canfield Avenue, (3) the Riverway trail access ramp at Third Street, and (4) a Riverway trail access ramp at the western end of Barson Street (Figures 20-23). Improvements to these access nodes will include pavement treatments, thematic fencing/walls/arbor, and directional and informational signage. Refer to Figures 6-9 previously for sample design treatments for use in these access nodes. Improving these nodes will help to orient users to the Riverway trail.

Urban Interface Connections - Urban interface connections should be provided at three sites in the Estuarine Reach: (1) Lower Ocean Street to East Cliff Drive, (2) Barson Street to Ocean Street, and (3) East Cliff Drive to San Lorenzo Point. Improvements to these streets should include street trees and signage indicating the location of the Riverway. These "fingers of green" will help to define connections to the Riverway from adjacent neighborhoods and arterials.

Figure 24 and Table 1 summarize all of the improvements at sites in the Estuarine Reach.

Transitional Reach

The Transitional Reach includes the area from the Laurel Street Bridge to the Water Street Bridge (Figure 25). This area changes with the closure of the sandbar during the later summer and fall. When the sandbar is
<table>
<thead>
<tr>
<th>Specific Location</th>
<th>Improvement Type</th>
<th>Recommended Improvements</th>
</tr>
</thead>
</table>
| Mike Fox Park                          | Focus Area       | • Define trail access parking with marked spaces and entry  
• Provide additional picnic areas  
• Create plaza and community gathering circle and program community events and celebrations  
• Possible future kayak vendor site  
• Install public restrooms  
• Add nature trails with seasonal overlooks  
• Add Riverway markers, directional and interpretive signage, and public art opportunities |
| Riverbend/ Laurel Street Extension     | Focus Area       | • Create Riverview plaza  
• Add interpretive features focusing on the area's history |
| Trail terminus at East Cliff Drive     | Focus Area       | • Create Riverview plaza highlighting the cultural and natural history of the River and Bay.  
• Add Seating  
• Add Riverway markers, directional and interpretive signage, and public art opportunities |
| (Jessie Street Marsh)                  |                  |                                                                                                                                                          |
| Trestle Bridge area/ Rivermouth        | Focus Area       | • Make beach access more user friendly  
• Construct River view plaza  
• Emphasize gateway to Riverway trail with Riverway markers, directional and interpretive signs, a staffed kiosk, and other public art opportunities  
• Connect to the trails over the Trestle Bridge and Boardwalk.  
• Identify opportunity to acquire parking lot for redevelopment as a River restoration area. |
| Third Street                           | Access Node      | • Pavement treatment  
• Provide orientation symbols  
• Install public art |
| Canfield Avenue                        | Access Node      | • Pavement treatment  
• Provide orientation symbols |
| Barson                                 | Access Node      | • Pavement treatment  
• Provide orientation symbols  
• Improvements for bikes and strollers |
| Beach Hill Stairway                    | Access Node      | • Pavement treatment  
• Provide orientation symbols  
• Install public art |
| Lower Ocean to East Cliff             | Urban Interface  | • Plant street trees |
|                                        | Connection       |                                                                                                                                                          |
| Barson Street to Riverside             | Urban Interface  | • Plant street trees |
|                                        | Connection       |                                                                                                                                                          |
| East Cliff to San Lorenzo Point       | Urban Interface  | • Plant street trees |
|                                        | Connection       |                                                                                                                                                          |

Table 1: Summary Table of Improvements in Estuarine Reach
closed this reach fills with freshwater and provides additional habitat for steelhead. At times of the year when the sandbar is open extreme tides can bring saltwater into this area. During most of the year this reach is freshwater and includes important riparian habitat areas along San Lorenzo Park. Branciforte Creek enters this reach just above Soquel Avenue.

The neighborhood areas adjacent to this reach include Pacific Avenue and downtown, Front Street and San Lorenzo Park. Land uses in this area of the river are largely commercial, retail, office, and recreational. The Transitional Reach includes San Lorenzo Park, a large regional park, and Mimi De Marta park, a small neighborhood park, both on the east side of the river. The Santa Cruz County Government Center is also located on the east bank. Front Street is located on the west bank in this reach. Front Street is addressed in more detail in Chapter 6 of this plan. There are many public access points throughout this reach, including ADA ramps at Laurel Street, Soquel Avenue, and Water Street Bridges. Circulation between the west and east banks is facilitated by a pedestrian bridge at San Lorenzo Park.

Focus Sites - The focus sites in the Transitional Reach include the Branciforte Creek/Dakota Avenue area, the Soquel Bridge/Royal Taj area, and Mimi de Marta Park. Improvements for focus sites in this reach emphasize providing increased educational and interpretive elements as well as enhanced recreational and access features. These focus sites are located along the eastern bank and are targeted at neighborhood and regional users of the Riverway.

Existing conditions at the Branciforte Creek/Dakota Avenue area (Figure 26) include dumpster storage, chain link fencing and non-native trees. Access to the river and creek is limited by overgrown vegetation and homeless encampments prevent safe access from San Lorenzo Park and Dakota Street. Connection to San Lorenzo Park, the Riverway trail and Branciforte Creek is undefined. The confluence area of Branciforte Creek and San Lorenzo River does provide dramatic views of the River. These opportunities, as well as defined trail connections, should be capitalized on in this focus site. Proposed improvements include a River view plaza at the north side of Branciforte Creek with a seasonal access to the creek and River via stairs and a temporary creek crossing (Figure 27). Redesign of the existing north wall of the flood control channel should also be considered to lessen the visual bluntness of the wall. A step down design of the wall may be appropriate without compromising the engineered flood control integrity. Reconfiguration of the point of land northeast of the confluence should also be explored. A seasonally opened nature path at the confluence features inter-
Nature Trail - Soft surface and low impact 2 foot trail located outside floodplain. Closed seasonally. Trail amenities include stone benches, interpretive signs and birdblinds.

Stairs to Branciforte Creek
Lead to seasonal crossing and nature trail.

Thematic Plaza:
Confluence Viewing
Relocate dumpster, interpretive kiosk and markers provide information about confluence and Riverway.

Watershed Education Center & San Lorenzo Riverway Center
Provides information and education about the San Lorenzo Watershed, the San Lorenzo Riverway, and environmental issues. Recycle water from downspouts to create a bioswale courtyard.
The Soquel Bridge/Royal Taj area suffers from an incomplete and confusing parking lot and bikeway design that conflict with vehicle and parking uses. The Riverway trail abruptly terminates at the entrance to the restaurant parking lot at Riverside Avenue. The Riverway trail is indicated only by its raised elevation from the parking area in certain areas, but is not striped and cars often park on it obstructing trail users (Figure 28). The driveway/trail area is also used by delivery trucks, creating additional confusion in the area. The area is devoid of vegetation and illegal dumping occurs here and under Soquel Bridge.

Proposals for this area include formalizing the parking area for the restaurant as two smaller lots with trees screening the bridge and Soquel Drive (Figure 29) and delineating the Riverway trail with boulders or other rock elements to carry with the theme of the river saltates (see Public Art Master Plan) thus discouraging illegal parking and undefined vehicle use. This area could also be a site for an additional public restroom but would require negotiations with property owners. If redevelopment were to occur on this area, a river oriented commercial use could be created (Figure 30) with parking and trail uses more clearly delineated at the Riverside Drive frontage. Directional and informational signs, Riverway markers, and additional plantings will help define this area.

Mimi de Marta Park is a small neighborhood park with only limited facilities (2 picnic benches). The park is located at the terminus of Broadway Avenue. A cul-de-sac provides informal parking (Figure 31) and a large ramp provides pedestrian and bicycle access to the Riverway trail. Maintenance vehicles also use this ramp. This small park is located in an area that receives significant neighborhood traffic and could be enhanced through defining trail access parking with marked spaces and an entry marker, adding additional recreational elements (i.e., sand volleyball or basketball court, picnic areas) and developing a themed river plaza area and informal nature trail for birdwatching and other wildlife viewing activities (Figure 32).

**Access Nodes** - Access nodes should be created at both sides of the existing pedestrian bridge near the County Government Center in the Transitional Reach (Figures 33 and 34) and at Cathcart Street and Maple Street off of Front Street. The bridge currently provides the main access for pedestrians and bicyclists crossing the river and is an important route from the County Government Center to downtown and Pacific
Nature Trail
Potential location for kayak access trail. Soft surface and low impact 4-foot trail leads to River's edge. Closed seasonally.

Riverway Welcome Area
Potential area for restrooms and information facility.

Riverway Information Marker

Remove asphalt slope and define Riverway Trail edge. Re-grade and revegetate with native grasses.

Saltate Boulders/Sculptural Stone Groupings
Define trail edge

Reorient and Define Parking Spots

Enclose and Screen Dumpsters

Riverway Marker

Crosswalk to alert pedestrians

Figure 29
Conceptual Plan for Royal Taq/Soquel Avenue Focus Site
Figure 30
Conceptual Plan for Royal Taj Soquel Avenue Focus Site - Redeveloped

- Riverway Information Marker
- Reorient Riverway Trail
- Riverway Welcome Area with building orientation facing River
- Remove asphalt Trail. Re-grade and revegetate with native grasses
- Reorient and Define Parking Spots
- Crosswalk: Alters pedestrians to delivery truck usage
- Riverway Marker
Nature Trail
Soft surface and low impact 2-foot trail located outside of floodplain.
Closed seasonally.
Trail amenities

Visual Marker

Thematic Plaza

Visual Marker

Trail Crossroads Defined with pavement treatment

Riverway Entry Feature

Recreation Improvement Sand Volleyball Courts

Figure 32
Conceptual Plan for Mimi De Marta Focus Site
Avenue. The access nodes should be designed to complement one another as well as provide directional and interpretive information for trail users. Improvements should include pavement treatments, directional and informational signage, and Riverway markers.

**Urban Interface Connections** - The goal of the urban interface connections in the Transitional Reach is to provide features that connect downtown areas with the River via “green corridors” of trees and landscaping. Street trees and signage should be provided from Pacific Avenue via Cathcart Street and Maple Lane to the River. Dakota Street should also be treated as an urban interface connection to draw attention to the Branciforte Creek confluence area.

Figure 35 and Table 2 summarize all of the improvements at sites in the Transitional Reach.

**Riverine Reach**

The Riverine Reach extends from the Water Street Bridge to Highway One (Figure 36). This reach is entirely freshwater during all times of the year. Extensive stands of riparian vegetation are found in this reach. The nomenclature for the reach reflects its behavior as a freshwater river system with habitat supportive of fish and wildlife. Tidal action does not affect the hydrology.
Figure 35
Summary Map of Improvements in Transitional Reach
<table>
<thead>
<tr>
<th>Specific Location</th>
<th>Improvement Type</th>
<th>Recommended Improvements</th>
</tr>
</thead>
</table>
| Branciforte Creek/ Dakota Avenue                   | Focus Area            | • Construct River view plaza  
• Provide River access through informal trail and overlook features  
• Add seasonal creek crossing  
• Incorporate future River Education Center  
• Construct pedestrian/bicycle bridge over Branciforte Creek  
• Relocate dumpster and maintenance facilities  
• Connect to Riverway and Branciforte trails and San Lorenzo Park.  
• Add Riverway markers, directional and interpretive signage, and public art opportunities. |
| Soquel Avenue Bridge/ Royal Taj                    | Focus Area            | • Define trail access parking with marked spaces and entry  
• Separate bike path from parking  
• Prevent illegal parking on bike path  
• Identify potential site for public restroom  
• Landscape parking area with trees  
• Install boulder (saltate) barrier for bike path  
• Add Riverway markers, directional and interpretive signage, and public art opportunities. |
| Mimi de Marta Park                                  | Focus Area            | • Define trail access parking with marked spaces and entry  
• Add additional recreation elements  
• Construct River view plaza at levee top  
• Create informal nature trail  
• Add Riverway markers, directional and interpretive signage, and public art opportunities. |
| Front Street Plaza @ Cathcart or Maple Lane (see Chapter 6) | Focus Area            | • Construct River view plaza  
• Add Riverway markers, directional and interpretive signage, and public art opportunities. |
| Existing pedestrian bridge                         | Access Node           | • Provide orientation signage  
• Create interpretive features |
| Cathcart Ramp                                      | Access Node           | • Provide orientation signage  
• Create interpretive features |
| Maple Lane Ramp                                    | Access Node           | • Provide orientation signage  
• Create interpretive features |
| Church/Cooper Streets via Galleria                 | Urban Interface Connection | • Plant street trees  
• Provide orientation symbols |
| Pacific Avenue via Cathcart                         | Urban Interface Connection | • Plant street trees  
• Provide orientation symbols  
• Install public art |
| Pacific Avenue via Maple Lane                      | Urban Interface Connection | • Plant street trees  
• Provide orientation symbols  
• Install public art |

Table 2  
Summary Table of Improvements in Transitional Reach
in this area of the River.

Neighborhoods and commercial areas adjacent to this reach include Felker Street, Josephine Street, the El Rio Mobile Home Park, and the Gateway Shopping Center. There are four Riverway trail access points on the east bank at Felker Street, Pryce Street, Kennan Street and Blaine Street. Felker Street is identified as a focus site connecting to the proposed bridge across the River. Three public access points are located on the west bank as well and include the Gateway Plaza commercial area, Josephine Street and El Rio Mobile Home Park. The Gateway Center access is a public plaza connected to the top of the levee.

**Focus Sites** - The focus sites along the Riverine Reach include the Felker Street cul-de-sac and the levee crest plaza located at Gateway Center (Figures 37 and 38). These two sites will be linked together with the construction of the new pedestrian bridge programmed for construction by 2005. The pedestrian bridge will be located near the terminus of Felker Street and will connect to the northern edge of the plaza at Gateway Center (Figure 39). Due to the significance of the pedestrian bridge and the east/west pedestrian link, improvements proposed for these focus sites attempt to tie the area together as a unified feature at the northern end of the Riverway. Connections to the Harvey West area via a trail from the Gateway Shopping Center under Highway 1 will also result in increased pedestrian and bicycle usage. Improvements focus on defining trail access parking with marked spaces and entry markers, enlarging the existing plaza at Gateway Center, constructing a new plaza at Felker Street, and providing thematic entry markers. Extending trail access past Highway 1 on both the west and east banks provides for regional connections up the watershed.

The Felker Street cul-de-sac will be improved through defining trail access parking in the cul-de-sac, developing a formal stair access to the Riverway, and creating a small anchor plaza at the northern terminus of the Riverway path. The parking spaces in the cul-de-sac will be screened from the surrounding neighborhood. A staircase and sloping path with provide access to a thematic plaza at the levee crest. The plaza will interpret a cultural or natural resource, for example an artistic interpretation of the logging history in the upper watershed. Vertical elements within the plaza would draw attention to this focus site from street level. Social trails would be eradicated and re-vegetated with native groundcovers and plants. Informational signage and Riverway markers are important features of this area as well. Extending the east bank trail upstream under Highway One is also proposed. Figure 40 shows conceptual plans for the Felker Street cul-de-sac.

Creating a focus in the existing plaza and uniting the
plaza with the Riverway trail will improve the Gateway Center Plaza. Developing a lower plaza with small scale retail uses such as carts is one option for creating a more public space in this area. Figure 40 shows conceptual plans for the Gateway Center Plaza. The plaza at the levee crest is an empty, vacuous space not well used at this time and has no amenities to encourage use. Efforts should be made to utilize this public space in anticipation of increased use resulting from the increased pedestrian traffic from the new pedestrian/bicycle bridge.

**Access Nodes** - Access nodes are appropriate at Josephine Street and at either end of the Water Street Bridge within the Riverine Reach (Figures 42-44). These areas would benefit from pavement treatments, thematic walls and Riverway markers. The nodes will provide Riverway users with directional information and a sense of a formal trail experience.

**Urban Interface Connections** - Felker Street should be treated as an urban interface connection in this reach. Improvements should include street trees and signage indicating the location of the Riverway. Figure 45 and Table 3 summarize all of the improvements at sites in the Riverine Reach.
<table>
<thead>
<tr>
<th>Specific Location</th>
<th>Improvement Type</th>
<th>Recommended Improvements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Felker Street</td>
<td>Focus Area</td>
<td>• Define trail access parking with marked spaces and entry</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Create stair access up levee: incorporate art into risers</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Provide handicap access side trail</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Provide vertical entry feature</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Incorporate small thematic plaza as gateway feature</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Tie to pedestrian bridge</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Revegetate social trails</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Plan for future trail connection under Highway 1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Create public art area near Highway 1 bridge for vertical announcement pieces</td>
</tr>
<tr>
<td>Gateway Center Plaza</td>
<td>Focus Area</td>
<td>• Integrate pathway into existing plaza: add local feature to plaza</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Create lower plaza in shopping center area</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Program both public spaces for events</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Tie to pedestrian bridge</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Consider formation of dog area</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Partner with Gateway businesses for joint use of facilities</td>
</tr>
<tr>
<td>Josephine Street</td>
<td>Access Node</td>
<td>• Incorporate pavement treatment</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Construct low boulder wall/saltates</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Provide orientation signage</td>
</tr>
<tr>
<td>Felker Street</td>
<td>Urban Interface</td>
<td>• Plant street trees</td>
</tr>
<tr>
<td></td>
<td>Connection</td>
<td>• Provide orientation symbols</td>
</tr>
</tbody>
</table>

Table 3
Summary Table of Improvements in Riverine Reach
Introduction

Branciforte Creek is an important feature in both the biotic and hydrologic character of the San Lorenzo River and the urban area surrounding the River. Branciforte Creek flows into the San Lorenzo River near Dakota Street and Soquel Avenue. Its natural appearance is masked by the concrete flood control structure that runs the first one-mile of the creek from its confluence with the River. The 1987 San Lorenzo River Design Concept Plan did not provide site-specific recommendations for Branciforte Creek and largely left the creek out of the planning discussion. During plan development by the San Lorenzo Urban River Plan Task Force in 2000, it was agreed that Branciforte Creek was an integral component of the river and should be included in the updated San Lorenzo Urban River Plan.

This chapter provides recommendations for Branciforte Creek and its surrounding neighborhoods. The planning area includes the Branciforte Creek corridor (including the flood control channel along with City-owned easements west and east of the channel) from the creek’s confluence east to the City limits north of Highway 1 (Figure 46). Private properties adjacent to the creek are not part of the planning area.

5.1 Area Description and Current Conditions

Branciforte Creek is the largest tributary flowing into the San Lorenzo River in the City of Santa Cruz. Branciforte Creek drains an approximate 17-square mile watershed and includes the drainage area of Carbonera Creek. The lowest one-mile of the creek was converted into a concrete flood control channel during the construction of the San Lorenzo River Flood Control Project from 1957-1959 by the U.S. Army Corps of Engineers (Corps). The flood control channel begins at the confluence with the San Lorenzo River and continues 5,200 feet upstream. The channel is trapezoidal (mostly rectangular) in shape with sidewalls varying from 13 to 22 feet in height and approximately 35 feet wide. A fish passage channel built in the center of the concrete channel is designed to provide passage for steelhead trout during low flow and drought conditions (Figure 47). Carbonera Creek enters Branciforte Creek approximately one-quarter mile upstream from the upper end of the flood control channel. Carbonera Creek drains the areas of Scotts Valley and the western area of the San Lorenzo Valley. The flood control channel is designed to convey the estimated 125-year recurrence interval flood. At the time of planning and construction, the Corps estimated the 125-year flood equal to 8,400 cubic feet per second.

The flood control channel is currently impaired due
to accumulation of sediment and vegetation throughout the channel. A flood conveyance assessment conducted in 2001 concluded that the sediment and vegetation is impacting the design flood capacity of the channel by a significant degree (Balance Hydrologics Inc., 2001). The maintenance agreement with the Corps requires the City of Santa Cruz to "prevent any encroachment in the project channel which would interfere with its proper functioning for flood control" including keeping the channel clear of debris, weeds, and wild growth and ensuring the capacity of the channel is not being reduced by the formation of shoals (U.S. Army Corps of Engineers, 1959). In recent decades, the area surrounding Scotts Valley has undergone rapid development, dramatically increasing the impervious surface present along Carbonera Creek. This land use change has modified the timing of when flood crests arrive at the flood control channel of Branciforte Creek. The increased urbanization in the watershed presumably decreases the amount of time between when rains fall to when a flood peak is generated in the creek (Balance Hydrologics Inc., 2001). City officials have estimated that the flood peak arrives approximately one and a half times sooner than when the flood control channel was first constructed in 1959 (1.5 hours versus 3 hours).

Beginning above the flood control channel near Market Street, Branciforte Creek becomes a natural channel with native riparian habitat on both streambanks. Branciforte Creek is known to support steelhead trout (a federally listed threatened species). The California Department of Fish and Game conducted a stream inventory of fishery habitat and species present in 1996. The inventory was largely focused on the natural channel of Branciforte Creek and offered little insight as to habitat conditions in the flood-control channel (Balance Hydrologics Inc., 2001). At the time of the survey steelhead were observed well above the flood control channel (between 3 and 8 miles upstream). Recommendations resulting from the 1996 Department of Fish and Game study included conducting a sediment-source study and developing management strategies based on the recommendations of the sediment source study. The report also recommended increasing woody cover in pools and flatwater habitats and continued study of water temperatures.

Additional fisheries study was completed by the Department of Fish and Game in November 2001 in the flood control channel portion of Branciforte Creek. That study concluded that although there was limited steelhead spawning and rearing habitat noted within the concrete channel, the quality of habitat was not optimal (California Department of Fish and Game, unpublished). The study concluded that although the concrete channel is providing little or no habitat for spawning and rearing, it is essential that the channel be maintained for optimal adult and juvenile salmonid passage (California Department of Fish and Game, unpublished). Passage of salmonids is both an issue for downstream migration (occurring in summer and late fall) and for upstream migration (beginning as early as January or February). Downstream migration and passage may be impeded by low flows, high temperatures and lack of escape cover. These conditions may lead to stranding of young fish or predation by birds and other predators if the fish cannot hide in deeper water. Upstream migration is complicated by high stream flows (usually associated with storm flows) and lack of resting areas for fish migrating upstream. Without off stream or in stream resting areas (slow water areas, boulders) up migrating steelhead can fall victim to exhaustion. Neighbors in the immediate area of the flood control channel have reported seeing up migrating steelhead in the flood control channel in recent years.

The natural and channelized portions of Branciforte Creek provide habitat for birds, small mammals, and amphibians and reptiles. Bird censuses performed in 1999 on the natural part of the channel (Gilchrist, 1999) identified 18 different species, although no special status species were observed during the census. Locally, Branciforte Creek is known as a birding "hot spot" and members of the Santa Cruz Bird Club visit the area frequently.

The neighborhoods immediately adjacent to the channelized creek include Market Street, Reed Way, Berkeley Way, and Dakota and May Avenues. Land use in the immediate neighboring areas is primarily residential with some office uses near Market Street. San Lorenzo Park is located at the confluence of Branciforte
Creek and the San Lorenzo River. The creek is accessed by two utility access roads. One begins at May Street and continues north to Water Street along the east bank of the creek and the other access road begins on the west bank at May Avenue and continues to Market and Grant Streets. These roads are owned and maintained by the City of Santa Cruz and provide access for maintenance of the flood control channel by City vehicles as well as emergency access.

Branciforte Creek benefits greatly from the involvement of a local neighborhood group, the Neighbors of Branciforte Watershed. This group has been instrumental in recruiting volunteers to work on creek projects including volunteer water quality monitoring. The Neighbors group has hosted several informational workshops and creek field trips and continues to host projects such as planting days and creek cleanups. Their continued involvement in the creek will be essential to the success of improving the creek as a natural and community resource.

Branciforte Creek faces many challenges in both its biological recovery and in its role as a prominent neighborhood feature. Recovering fish and wildlife species to the Creek is hampered by a lack of current studies and assessments. There is much anecdotal information concerning the Creek and its previous populations of steelhead. Current studies have been spotty and incomplete in most conclusions regarding the effects of the flood control channel on steelhead. Even less information is available regarding bird habitat. A comprehensive assessment of the watershed (biological and hydrological conditions) has not been completed nor has an examination of the physical conditions of the watershed (i.e., sediment sources). These types of studies will need to be completed for an effective watershed-wide recovery effort for Branciforte Creek.

The Creek is a prominent feature in the local neighborhood. Neighbors are especially interested in improving the appearance of the Creek and its access road and fencing. The Creek and access roads are considered an amenity by many neighbors as the route provides a safe and quiet pedestrian and bike route to the downtown. Neighbors have expressed concerns about illegal camping in the Creek and illegal dumping of trash and garbage along the access road and in the Creek. In general, neighbors have expressed an interest in keeping the Creek cleaner and healthier for enjoyment by neighbors and the community.

General Recommendations for Branciforte Creek

- Conduct a watershed-wide, sediment source investigation to develop a sediment-control plan for benefiting aquatic life and reducing sediment delivery to the flood control channel. The sediment-source investigation should focus on Carbonera Creek and mainstream Branciforte Creek.
- Continue investigations into providing enhanced habitat for steelhead trout compatible with flood protection and with added emphasis on areas upstream of the flood control channel but within City ownership (i.e., Delaveaga Park).
- Continue volunteer water quality monitoring program and expand into monitoring stream flow in summer months.
- In cooperation with federal and state agencies pursue long-term solutions for steelhead passage and habitat enhancement in the flood control channel.
- Identify opportunities for land acquisition along the creek corridor for increased flood conveyance and storage.

5.2 Reach Specific Recommendations for Branciforte Creek

For purposes of providing recommendations for the Urban River Plan, Branciforte Creek has been broken into three reaches to reflect common issues and needs in each reach. The reaches include Reach 1 (confluence of San Lorenzo River to the Water Street Bridge); Reach 2 (Water Street Bridge to beginning of the natural channel) and Reach 3 (natural channel to City limits including the confluence of Carbonera Creek and upstream reach within City limits). Recommendations for each reach are provided with regards to flood control and natural resource considerations, beautification and recreational improvements and programs for addressing neighborhood concerns and issues.

Reach 1
(Confluence of San Lorenzo River to the Water Street Bridge)

Reach 1 includes the flood control channel from the confluence with the San Lorenzo River to the Water Street Bridge. This reach includes access roads on both sides of the creek beginning at May Avenue and continuing north to Water Street. The access roads are used regularly by neighbors for walking and bicycling; however, the western access road is more heavily used. Problems with illegal camping and dumping are more common on the eastern access road and neighbors have expressed concerns about these activities in this area. The access roads are for flood control maintenance and emergency access. The roads are not recognized as formal trails by the City of Santa Cruz and so they receive no regular maintenance as would be more typical of a
City park or trail area. The access roads are maintained at 12 feet in width and the toe ditches on either side of the maintenance road are cleared of debris and garbage. A 2-acre parcel of vacant land owned by the City is located just south of Water Street on the east bank.

This reach is especially impacted by sediment and vegetation and requires maintenance for ensuring design flood capacity. Several storm drains empty into the flood control channel/creek within this reach. The County of Santa Cruz Environmental Health Department has documented high levels of fecal coliform discharging from the storm drain near Ocean Street (Ricker, 2000). This reach benefits from extensive riparian vegetation from neighboring residences. Several important species are found along this reach including box elder and California buckeye.

**Recommendations**

- Develop and implement a sediment and vegetation maintenance program within this reach consistent with Corps flood control maintenance requirements. The program should reflect necessary protections for steelhead passage requirements and water quality. Sediment and vegetation maintenance activities should be restricted to occurring only in June 15 through October to avoid impacts to steelhead.
- Conduct sediment removal downstream into the zone of confluence with the San Lorenzo River by excavating 1 to 2 feet of sediment from the bed of the existing channel before the onset of winter rains. The sediment deposited in the channel between the confluence and Ocean Street can remain if the depth does not exceed one foot and reduces to zero at Ocean Street.
- In cases where limited funding is available, maintenance activities can focus on vegetation removal and sediment bars may be left in place. However, periodic removal of sediment will be required to ensure design flood capacity.
- Improve the storm drain at Ocean Street by providing dry-weather diversion to the sewage treatment plant.
- Produce an informational door hanger for residents concerning water quality, illegal dumping, and use of native species in landscaping.
- Investigate the feasibility of constructing a pedestrian bridge linking the east and west access roads south of Water Street.
- Work with the property owners at 550 Water Street to obtain an easement for completing the access road to Water Street on the west side.
- Work with the U.S. Army Corps of Engineers to remove chain link fencing and replace with more aesthetic fencing.
- Investigate installation of wall treatments for exterior walls of the flood control channel.
- Implement native riparian planting along creekside areas in City ownership on the east bank consistent with providing necessary access for emergency and maintenance vehicles.
- Remove non-native trees in areas owned by the City of Santa Cruz and replace with appropriate native tree species.
- Post signs and enforce City ordinances regarding camping and dumping.
- Provide and maintain dispensers for dog waste disposal.

**Reach 2**

(Water Street to natural stream channel)

Reach 2 includes the flood control channel from Water Street to the beginning of the natural stream channel. The access road continues in this reach but only on the west bank, and continues to the beginning of the natural channel. A pedestrian bridge crosses the creek at Berkeley Way providing a crossing from the east side of the creek to the west side and Hubbard Street. There are several small areas of vacant city owned property along this reach including the corner of Water and Market Streets, at the pedestrian bridge, and at the Senior Center. This reach also benefits from mature riparian forest most of its length. These trees are primarily found on private properties adjacent to the flood control channel and include many native riparian species (box elder, alder, buckeye).

This reach is less impacted by sediment and vegetation in the channel except in its most southern reach near Water Street where sediment and vegetation are impairing the channel. Stormdrains also empty into this reach at Water Street and the Senior Center. These drains have not been documented with high levels of fecal coliform, however limited testing has been done on these drain outflows.

**Recommendations**

- Conduct sediment and vegetation management as necessary in the flood control channel to maintain design flood capacity.
- Conduct water quality investigation of storm drain outflows in this area.
- Improve city-owned areas with native riparian trees and shrubs.
- Provide a "Welcome to Branciforte Creek" sign at Water and Market Street on west access road. Include a watershed-wide map showing the Creek and San Lorenzo River.
- Remove non-native trees in areas owned by the City of Santa Cruz and replace with appropriate native tree species.
Post signs and enforce city ordinances regarding
camping and dumping.
Continue use of west access road by pedestrians and
bicyclists.
Provide and maintain dispensers for dog waste
disposal.

Reach 3
(Natural channel to end of City limits)

The natural channel of Branciforte Creek within
City limits provides important riparian habitat and
instream habitat for a variety of fish and wildlife spe-
cies. This area of the creek is also adjacent to residential
development and park and open space areas (Delaveaga
Park). Carbonera Creek enters Branciforte Creek in the
natural channel just above the Market Street Bridge.
There have been several streambank stabilization proj-
ects along Carbonera Creek upstream of its confluence
with Branciforte Creek. These projects have had mixed
success and dumping of cement and rip-rap continues
in this area. Delaveaga Park provides several opportuni-
ties to improve passage and habitat within Branciforte
Creek and should be considered in an overall plan for
the Branciforte watershed.

Recommendations

- Riparian buffer setback recommendations from
  the Citywide Creeks and Wetlands Management
  Plan should be observed in this reach of Branci-
  forte Creek.
- Develop a door hanger or educational brochure for
  adjacent residents regarding water quality, riparian
  trees and local ordinances regarding removal, dump-
  ing of backyard refuse, stream water diversions and
  contact information for streambank erosion man-
  agement.
- Provide signage along the creek at Delaveaga Park
  regarding fish and wildlife life cycles and protection
  needs.
- Work with the City of Santa Cruz Parks and Recre-
  ation on developing restoration plans for areas of
  the creek within Delaveaga Park and stabilization
  of upslope areas which may contribute sediment to
  the creek.
- Investigate ways to link the downstream areas with
  trails in Delaveaga Park.
- Investigate potential acquisition of property at Mar-
  ket and Goss Street for use as undeveloped flood-
  plain.
Introduction

The San Lorenzo River is a defining feature in downtown Santa Cruz. The river corridor, recently named the “San Lorenzo Riverway,” has become the City’s newest park and open space area, providing five linear miles of trails which connect the western and eastern sides of downtown and the beach to Highway One and areas north of the City limits. Previous planning efforts for the San Lorenzo River recognized that certain key downtown areas should be connected to the River. The San Lorenzo River Design Concept Plan (1987) identified Front Street between Water Street and Laurel Street as a prime location for residential and commercial development to be oriented towards the River. The Design Concept Plan also identified opportunities for improving the rivermouth area for public use and recreation.

The San Lorenzo River is also discussed in the Downtown Recovery Plan (1991). The Downtown Recovery Plan identifies the river as a major downtown open space and recognizes its potential “as a naturalistic open space, wildlife habitat, and recreational amenity: a ‘garden promenade’ that can provide a more contemplative and reflective experience to the hustle and bustle of Pacific Avenue.” The Downtown Recovery Plan is an adopted specific plan of the City that provides a framework for public and private actions related to rebuilding the downtown after the 1989 Loma Prieta earthquake. The Downtown Recovery Plan recommends that the improvement of the riverfront and the creation of linkages to the downtown should be a top priority in the rebuilding of the downtown. To date this has not been completed due to the timeline of rebuilding the levees for 100-year flood protection.

In the planning process for the San Lorenzo Urban River Plan, the river corridor north of Highway 1 also emerged as a significant opportunity to integrate the river with surrounding neighborhoods and the larger San Lorenzo River watershed. The San Lorenzo Urban River Plan therefore designates three “Significant Riverfront Areas” described below and provides recommendations for design guidelines and improvements for riverfront development, access, and aesthetics.

6.1 Front Street Riverfront Area

For the purposes of this plan, the Front Street Riverfront Area extends between the west bank of the San Lorenzo River up to and including Front Street from Laurel Street north to South River Street (Figure 48). The Front Street Riverfront Area is the prime opportunity site to engage the community with the San Lorenzo River. Improved public access is a primary goal of the San Lorenzo Urban River Plan.
As mentioned above, the 1991 Downtown Recovery Plan includes design guidelines and recommendations for this area. While commercial development and municipal parking lots are the current major land use, redevelopment is expected to occur here over the next 5-10 years providing an opportunity for encouraging development that acknowledges and interacts with the river. Two factors play a significant role in the potential for redevelopment along the Front Street area: the pressing need for housing in Santa Cruz and the pending removal of the existing floodplain designation in the Front Street area.

Prompted by high housing costs and transportation issues, in September 2000 the City Council requested an analysis of ways to facilitate the construction of new housing in the Front Street area. The City’s Planning Department conducted an opportunities and constraints analysis and quantified 449 potential housing units which may be located in the Front Street Riverfront Area. Studies to date have indicated that a parcel consolidation strategy might allow for the most efficient development of the area between Soquel and Laurel Streets. A parcel consolidation strategy looks at ways to combine properties and ownership patterns to provide contiguous development options and patterns. The City is continuing to study the Front Street corridor to determine housing development options and viability. In any case, the Front Street Riverfront Area will develop with a more dense housing and commercial development pattern in the future. Recommendations in the Urban River Plan aim to encourage new and redeveloped housing and commercial buildings to take advantage of their riverfront location.

The Front Street area is currently designated as an A-11 Federal Emergency Management Agency (FEMA) flood plain. New construction in areas with this designation must meet FEMA flood elevation and flood proofing requirements. Additionally, any new property purchases, refinances, and construction projects, which require a loan from a federally insured financial institution must purchase flood insurance. Residents and businesses in the Front Street flood plain area pay approximately $1 million in flood insurance premiums per year. A major goal of the San Lorenzo River Flood Control and Environmental Restoration Project was to improve the flood protection offered by the existing river levees so that the system would provide 100-year FEMA flood protection and eliminate the need for mandatory flood insurance on development in flood plain areas. The economic benefits resulting from removal of the flood plain designation (and the consequent elimination of flood insurance payments) for the Front Street area could translate into less expensive development requirements for construction and more flexibility for combining commercial and residential uses.

The San Lorenzo Urban River Plan acknowledges the importance of the Front Street Riverfront Area as appropriate for mixed-use, riverfront development that may include housing, commercial, retail and office uses. However, the Urban River Plan also stresses that these uses should not conflict with the recreational and wildlife values of the River. The following recommendations detail specific design guidelines for the Front Street Riverfront Area.

**Recommendations**

- Maintain existing development standards in the Downtown Recovery Plan (DRP) for the Front Street Riverfront Area including principal permitted uses for ground-level and upper-floors, conditional uses, and height and step back requirements. Maintain maximum height restriction to 50 feet with development above 35 feet in height stepping back at least 10 feet at an angle not to exceed 42 degrees. (DRP, p. 47-50)

- Maintain the ten-foot setback area between residential and commercial uses adjacent to the levee trail from the western edge of the trail. The setback area should be filled to raise the adjacent ground-level use to the same elevation as the levee trail. This area should also incorporate outdoor public seating or visually accessible garden space for residential development. Trees planted as part of the San Lorenzo Flood Control Improvement Project should be maintained and incorporated into new development. (DRP, p. 51)

- Maintain design guidelines for residential and commercial development with the exception of limiting building materials to more natural wood, brick and stone; avoid overuse of concrete and stucco. (DRP, p. 51)

- The river promenade proposed in the original San Lorenzo Design Concept Plan between Soquel Drive and Laurel Street should be reconceptualized as a more natural, less formal looking “trail” with adjacent garden space and native trees to be accommodated in the ten-foot setback area.

- Establish a river plaza or park within the Front Street Riverfront Area between Soquel Drive and Laurel Street on the west bank (upstream orientation). Redevelopment of the Metro Station affords an opportunity for connecting a plaza or park with a public area on the east side of Front Street. Other favorable sites are the terminus with Cathcart Street and the terminus with Maple Street (Figures 49 & 50).

- Maintain the wooden roof-truss buildings along Front Street as architectural artifacts to demonstrate
the "working waterfront" character of the area.

- Ensure that any parcel consolidation strategy provides for public access from the Front Street sidewalk to the levee. Maintain the ten-foot step back requirement between buildings included in the Downtown Recovery Plan for any development. Encourage pedestrian traffic through creative inviting design and incorporate water features, gardens, paving, and stairways up the levee as design features.

- Redevelop the Long's-Zanotto's site to create a true connection to the River from the downtown area. Preserve views to the River from buildings along the west side of Front Street. Concentrate development on the north and south portions of the site to allow for a transition from the public space at Front and Cooper Streets (the Octagon Museum and plaza) and the Museum of Art and History to a River promenade and the pedestrian bridge to San Lorenzo Park. Avoid large expanses of parking in project design, attempt to "green" parking areas by using trees common to the River for a more natural visual impact.

- Consider abandonment of River Street South for use as a riverfront promenade and public space for festivals and other outdoor activities once a comprehensive development plan is promoted for the Long's-Zanotto's area.

- Maintain views from both taller downtown buildings to the River and from the River trail to distant mountains and ridges, avoiding creation of a development "wall" between the downtown and the River. Preserve views along the Front Street area and from Beach Hill, a significant historic feature in this area.

- Encourage local business opportunities along Front Street and avoid "box" stores in this area.

6.2 Salz Tannery to Sycamore Grove Riverfront Area

The west bank of the San Lorenzo River north of Highway One offers immense opportunities to expand the San Lorenzo Riverway trail to the natural area of the upper River, Sycamore Grove, and Pogonip. Existing City properties at Sycamore Grove and Pogonip offer an opportunity for hikers to travel from the rivermouth north to Pogonip and Henry Cowell State Parks in Felton. Redevelopment of the Salz Tannery site will be an important component to providing these trail connections.

The Salz Tannery to Sycamore Grove Riverfront Area extends north of Highway One on the west bank of the River upstream to Sycamore Grove, a natural area along the River. The Sycamore Grove natural area is owned and maintained by the City of Santa Cruz Parks and Recreation Department. Figure 51 shows the project area.

Salz Tannery is a historic site on the City's historic register. The tannery operation was closed in late 2001 and the site and accompanying buildings are currently for sale. The City's Redevelopment Agency is assisting the property owner in investigating possible reuses for the property. The current state of the property transfer and potential reuse is unknown.

The 10-acre Sycamore Grove is included in the Pogonip Master Plan (1998) which establishes management actions in Pogonip and Sycamore Grove including removal of non-native species and revegetation. The plan also calls for passive recreation and educational uses including a nature trail, interpretive displays, and picnic tables for field trips and passive recreation. Although the Pogonip Master Plan does not call for a connector trail route south to the lower river and San Lorenzo Riverway trail, this is a logical connection and is recommended here.

Recommendations

- Negotiate a public easement along the west bank of the San Lorenzo River north of Highway One to Sycamore Grove to provide for eventual trail connection from the San Lorenzo Riverway trail to Sycamore Grove.

- Maintain the native riparian forest north of Highway One.

- Protect views of the River from Highway One bridge.

- Develop an 8'-10' wide trail north of Highway One along the top and edge of the River bank in a meandering pattern with a natural material (e.g. decomposed granite) surface.

- Provide connections from a possible park and ride lot (at Highway One and River Street) to the Riverway; provide signs and maps to north and south connecting trails.

- Encourage redevelopment of a portion of the Salz Tannery site as a river orientation center; investigate potential partnerships with California State Parks and the State Coastal Conservancy for this use.
Figure 30
Conceptual Plan for
Front Street Plaza at Cathcart Street
6.3 Beach Flats Riverfront Area

The Beach Flats Riverfront Area is the terminus for the San Lorenzo Riverway and provides the connection between the beach area and the River. The Beach Flats neighborhood has a long history of interaction with the River and its environs. This area is located along the west bank from the Riverside Avenue Bridge south to the river mouth. Figure 52 shows the boundaries of this area. Currently this neighborhood is separated from the River by Third Street and the expansive 8-acre Boardwalk parking lot extending from Uhden Street to Beach Street. The parking lot and Third Street create a physical and psychological barrier that inhibits residents from interacting with the river.

The area is densely developed with residential and commercial uses and includes the Santa Cruz Beach Boardwalk, a regional tourist attraction. Many of the homes in the area are historic buildings and longtime residents of the neighborhood recall the River prior to channelization by the U.S. Army Corps of Engineers. Stories of boating on the River, surviving floods and fishing off backyard docks capture the sense of relationship with the River that this small neighborhood had in the past. Issues with increasing crime in the area as well as traffic on Third Street, currently dissuade neighbors from utilizing the River for recreation.

The Beach Flats neighborhood is planned for regional visitor commercial uses and high density residential. Redevelopment in Beach Flats over the next 20 years should seek to re-integrate the neighborhood with the River through pedestrian linkages, park furniture and lighting, and improved access to the beach and river mouth. Spectacular views and connections to regional trail systems such as the California Coastal Trail and Monterey Bay Sanctuary Scenic Trail makes the Beach Flats Riverfront Area a potential magnet for residents and visitors.

Recommendations

The following recommendations address the Beach Flats Riverfront Area.

- When land ownership disputes are resolved for the eight-acre Third Street parking lot initiate a community process to facilitate identifying land changes and potential restoration of floodplain in this area.
- Integrate San Lorenzo River recreational and transportation opportunities in redevelopment options for the Beach Flats area. Encourage use of the Riverway trail for alternative transportation access to the beach area.
- Create access points to the levee from key streets including Raymond, Uhden, and Kaye Streets.
- Integrate the San Lorenzo Riverway Trail with the Monterey Bay National Marine Sanctuary Scenic Trail and the California Coastal Trail.
- Provide community programs which encourage participation by neighbors including natural history walks, river clean ups, and planting days. Participate with the Beach Flats Community Center on programs and projects along the River.
- Educate residents and visitors about the San Lorenzo River and estuary through the use of signage, public art and multi-lingual materials.
- Address illegal breaching activities at the river mouth and provide education and enforcement information for residents and visitors.
- Protect river levee plantings through installation and maintenance of fencing along the Boardwalk parking lot to prevent shortcut trails from the parking area to the River and beach.
- Work with the Seaside Company on litter abatement program to discourage trash and other debris from entering the River from parking areas.
Introduction

Implementation of the San Lorenzo Urban River Plan will require focused attention from the City and the community into the future, as well as dedicated financing for both maintenance/operations and capital projects. The Urban River Plan provides policies, programs and projects for the San Lorenzo River, Branciforte Creek, and Jessie Street Marsh. These policies, programs and projects include improvements for public access, riverfront amenities, and community involvement. The plan is designed for implementation over 20 years. An incremental approach to implementation is most appropriate with a concentration on identifying a sustainable financing structure as one of the most important early steps.

The San Lorenzo Urban River Plan sets a vision for the San Lorenzo River, Branciforte Creek and Jessie Street Marsh as a network of natural areas to be discovered during one’s journey along the river. It is desired that the San Lorenzo River and Riverway become a healthy and vibrant habitat for fish and wildlife and a clean, safe and enjoyable place for recreation by residents and visitors. Goals of integrating the River with adjacent neighborhoods and the downtown can be realized through a well-organized implementation plan. This implementation chapter presents a series of recommendations regarding establishment of a permanent River advisory body, establishment of a staff level coordinating group, operations and maintenance needs, project phasing and costs, and funding opportunities.

7.1 San Lorenzo River Committee

The San Lorenzo Urban River Plan would benefit from having a Council-appointed permanent San Lorenzo River Committee assigned to assure the implementation of the plan and its associated recommendations. In reviewing current management strategies for implementation of projects and maintenance along the River it is apparent that a permanent River advisory body is desirable to address the multi-departmental, multi-agency nature of managing and maintaining the River into the future. At present, San Lorenzo River management issues are split between the City’s Public Works, Parks and Recreation, Planning and Police departments and Redevelopment Agency. While all of these departments will have continuing interests and issues in management of the River and/or adjacent development areas, continuing this confusing and overlapping relationship into the future is not desirable.

A permanent advisory group that focuses on the River and takes into account the sometimes conflicting interests of Parks, Public Works, Water, Planning, Police, the U.S. Army Corps of Engineers and the public
is vital. Several other cities have followed a similar process following completion of plans for rivers and creeks including the City of Santa Rosa, the City of Napa, and Portland, Oregon. The following discussion addresses some of the primary issues that a permanent river advisory body would be helpful in addressing.

**Funding** - The establishment of a permanent River advisory group demonstrates a commitment by the City to long-term programmatic improvements on the River. This is a signal to potential funding agencies such as the State Coastal Conservancy, California Department of Fish and Game, and California State Parks that the City is committed to providing resource protection and improvements along the River. These agencies are poised to distribute over $575 million in funds for river enhancement activities over the next 5-8 years as a result of Propositions 12 & 40. Unless the City is organized to effectively pursue a share of these grant funds, the ability to capitalize on their availability to accomplish many of the proposed river improvement projects will be severely diminished. The alternatives will then be that the Council will be unable to implement these projects or will need to dedicate City funds for these improvements.

**Urban River Plan Implementation** - Along with outlining restoration priorities for the River, the San Lorenzo Urban River Plan recommends several enhancements and improvements to the existing river levee trail system and acknowledges future projects will continue to occur near and on the River levee, including the two pedestrian bridges (Highway One and Branciforte Creek), redevelopment along the Front Street corridor, redevelopment of the Salsan Tannery site and general improvements for pedestrian and bicycle access and trail connections to other areas along the River corridor. The Plan also details ways in which the City could offset some maintenance costs on the River with implementation of community programs such as Adopt-A-Riverbank, volunteer trash cleanup programs and other volunteer activities such as decent programs. All of these projects and programs will benefit from consistent direction from an advisory group focused on the River.

**Adaptive Management and Habitat Monitoring** - The Lower San Lorenzo River and Lagoon Management Plan calls for “adaptive management” of the river channel to ensure success in habitat recovery and maintenance of flood capacity. Adaptive management is a set of practices in which habitat enhancements are monitored scientifically, and modified or removed if their biological or hydrological impacts diverge from the Plan’s goals. A permanent advisory body could conduct regular reviews of the monitoring report and recommend adjustment of restoration and management procedures as appropriate.

**Watershed Focus** - The existing San Lorenzo Urban River Plan Task Force has been instrumental in developing a watershed perspective with regards to the management of the lower River and lagoon, Branciforte Creek and Jessie Street Marsh. A permanent River Committee would further provide a mechanism for the City to communicate to other watershed stakeholders on concurrent goals regarding river restoration and flood protection. This will be especially important with regards to Endangered Species Act requirements for the steelhead trout and coho salmon and will also help in offsetting potential costs regarding endangered species management.

**Clarifying River Functions Among Departments** - Past focus on the River has been the implementation of the flood control improvement project and associated levee improvements and landscaping. Currently several departments have responsibilities on the River with differing focuses and priorities (see Table 4). A River Committee could play an important role in responding to issues from staff, departments and Council regarding the River.

**Recommendations**

- Create a San Lorenzo River Committee charged with providing oversight for implementation of the San Lorenzo Urban River Plan (including Branciforte Creek and Jessie Street Marsh). This group will be advisory to the City Council and other policy-making commissions. Potential duties may include:
  - Act in an advisory capacity to the City Council in environmental matters pertaining to the San Lorenzo River within the City limits (including Branciforte Creek and Jessie Street Marsh), and the enhancement, maintenance and management thereof;
  - Draft and recommend measures to implement the policies and programs of the San Lorenzo Urban River Plan and the Lower San Lorenzo River and Lagoon Management Plan;
  - Convene a Technical Advisory Committee as necessary to serve in a scientific advisory role for adaptive management and monitoring along the San Lorenzo River, Branciforte Creek, and Jessie Street Marsh;
- Establish a River Coordinator position to coordinate implementation of projects and programs in the Urban River Plan and staff the San Lorenzo River Committee.
• Continue the staff level River Management Coordinating Group currently in operation and consisting of staff from the Public Works, Parks and Recreation, Planning, and Redevelopment departments to coordinate and implement projects and programs on the San Lorenzo River, Branciforte Creek and Jessie Street Marsh. The River Coordinator can assist in staffing this group.

7.2 Project Phasing and Projected Costs

The San Lorenzo Urban River Plan includes both policy and project recommendations for the San Lorenzo River and Riverway. Policy level recommendations will need to be adopted into appropriate planning and policy documents. Projects and programs will need to be implemented according to available funding and priorities as defined by the Plan and community.

<table>
<thead>
<tr>
<th>City Department</th>
<th>Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Public Works</td>
<td>• Channel Maintenance</td>
</tr>
<tr>
<td></td>
<td>• Permitting in-channel Vegetation Management</td>
</tr>
<tr>
<td></td>
<td>• Levee Maintenance</td>
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<tr>
<td></td>
<td>• Storm Drain Maintenance</td>
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<tr>
<td></td>
<td>• Bicycle and Pedestrian Improvements</td>
</tr>
<tr>
<td>Parks and Recreation</td>
<td>• Outer Levee Slope Maintenance</td>
</tr>
<tr>
<td></td>
<td>• Pathway Maintenance</td>
</tr>
<tr>
<td></td>
<td>• Trash Removal/Large Scale Cleanups</td>
</tr>
<tr>
<td></td>
<td>• Irrigation Maintenance</td>
</tr>
<tr>
<td>City Manager</td>
<td>• Project Management</td>
</tr>
<tr>
<td></td>
<td>• Future Studies</td>
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<tr>
<td></td>
<td>• Monitoring</td>
</tr>
<tr>
<td></td>
<td>• Permitting</td>
</tr>
<tr>
<td></td>
<td>• Staff to River Commission</td>
</tr>
<tr>
<td></td>
<td>• Obtaining Funding</td>
</tr>
<tr>
<td></td>
<td>• Community Outreach</td>
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<tr>
<td>Redevelopment Agency</td>
<td>• Flood Insurance/Certification</td>
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<tr>
<td></td>
<td>• Redevelopment Planning</td>
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<tr>
<td></td>
<td>• Property Acquisition &amp; Negotiations</td>
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<tr>
<td>Planning Department</td>
<td>• General Plan and Local Coastal Plan policy</td>
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<td></td>
<td>• Specific Plans</td>
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<tr>
<td>Fire and Police</td>
<td>• Public Safety</td>
</tr>
<tr>
<td></td>
<td>• Vandalism</td>
</tr>
</tbody>
</table>

Table 4 Department Roles

input. Table 5 provides a list of projects according to a timeline defined by the Task Force and with a priority assigned.

7.3 Funding Opportunities

Implementation of the Urban River Plan will be dependent on the availability of funds to accomplish the various projects and programs. Funding sources are available from both local sources and from state and federal funding programs. The funding strategy for implementation should focus on grouping common projects and programs comprehensively to be more competitive for grant funding. Identifying local funds that could be used for “match” funds will assist in making grant applications more competitive with the idea of leveraging local dollars for additional funds.

The Urban River Plan benefits from being a multi-focused plan and so therefore projects can be proposed to a variety of funding sources including river parkway and greenway programs, environmental education programs, native plant programs, water quality and watershed programs, restoration programs, and community stewardship programs. Partnerships with local agencies such as Santa Cruz County, the Santa Cruz County Resource Conservation District, Monterey Bay National Marine Sanctuary, California Coastal Commission, Coastal Conservancy, and local nonprofits will also make grant applications more competitive.

Grant Sources

Several federal, state and private grant funding sources are available for implementing projects and programs of the San Lorenzo Urban River Plan. A brief summary of these grant sources is discussed below.

Federal Grants

National Oceanic and Atmospheric Administration
NOAA Community Based Restoration Program - Various small grant programs focused on restoration of riparian, riverine and anadromous fisheries

National Park Service
Land and Water Conservation Fund - For development of outdoor recreation facilities and acquisitions of wetlands

Environmental Protection Agency & River Network
Watershed Assistance Grants - For general operating support and projects

Environmental Protection Agency
Wetlands Program Grants - Wetland protection efforts including monitoring, mitigation tracking and acquisitions.

U.S. Fish and Wildlife Service
Wetland Protection Program Development Grant - For restoration and acquisition of wetlands valuable to fish and wildlife

U.S. Fish and Wildlife Service

Partners for Fish and Wildlife - For on-the-ground efforts to restore or enhance native plant and animal communities

State Grants

California Department of Fish and Game

Wildlife Conservation Board - Acquisition and protection of fish and wildlife habitat

Coastal Conservancy

Coastal Access and Watershed Management Grants - Projects supporting public access, riparian restoration, watershed planning and restoration

State Water Resources Control Board

Nonpoint Source Pollution Grant Program - Projects improving water quality, watershed planning and implementation, coastal water quality

California Department of Fish and Game

Fisheries Restoration Grants Program - Restoration, planning, monitoring of native anadromous fisheries

California Transportation Commission - State and federal transportation programs for bicycle and pedestrian access

California State Parks

Habitat Conservation Fund Program - Anadromous fish habitat, wetlands habitat, riparian habitat, and trails programs

California State Parks

Recreational Trails Program - Non-motorized trails programs

California Resources Agency

Coastal Resources Grant Program - Coastal habitat protection, public access and recreation, coastal facilities, coastal management

Private Grants

National Fish and Wildlife Foundation - Provides funding through a variety of programs for fish and wildlife restoration

Santa Cruz County Fish and Game Commission - Local commission that distributes fine monies collected from local Fish and Game violations

Other Financing Strategies

Capital Improvement Program

Capital improvement projects outlined in the plan can be incorporated into the annually-updated Capital Improvement Program of the City. Projects will need to be assigned and initiated by a specific department for inclusion into the program.

Local Bond Initiatives

A local ballot measure could be drafted to identify programs and projects to be financed through the measure. The City of Santa Barbara recently passed such a measure, Measure B, which provides approximately $2 million annually for creeks restoration and water quality programs.

Special Assessment District

A benefit assessment district could be formed if supported by 51% of benefiting property owners to pay for and possibly construct improvements. Special assessments are required to be levied against property on the basis of the benefit each piece of property received, in accordance with a determination of a registered engineer.
<table>
<thead>
<tr>
<th>Recommendation Type</th>
<th>Description</th>
<th>Estimated Cost</th>
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<td>Major transportation improvement</td>
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<td><strong>Staffing, Operations and Maintenance</strong></td>
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<td><strong>Policy</strong></td>
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<td>Designate a permanent San Lorenzo River Commission</td>
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<td>Review City Code Section 9.66.090 and 9.66.030 for kayaking</td>
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References


Lower San Lorenzo River & Lagoon Management Plan
prepared for: City of Santa Cruz Redevelopment Agency

for:
San Lorenzo Urban River Task Force
City of Santa Cruz
State Coastal Conservancy

by:
Swanson Hydrology & Geomorphology
Native Vegetation Network
Hagar Environmental Science

on:
January 14, 2002
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Hydrology / Geomorphology / Restoration / Water Resources / Construction Planning & Supervision
EXECUTIVE SUMMARY

The Lower San Lorenzo River and Lagoon Management Plan (Management Plan) provides an update to the 1989 San Lorenzo River Enhancement Plan. The 1989 San Lorenzo River Enhancement Plan was developed by the City of Santa Cruz to enhance and restore riparian habitat in the river within the constraints of providing flood protection. The 1989 plan provided recommendations for maintaining better habitat values for the San Lorenzo River lagoon and provided restoration recommendations for Jessie Street Marsh. Since the adoption of the 1989 plan there have been a number of changes that have significantly altered both the landscape and the management needs of the San Lorenzo River and Lagoon:

- The 1989 Loma Prieta earthquake damaged much of the City of Santa Cruz (the City), including the Riverside Avenue Bridge. Some of the reconstruction alleviated long-standing problems along the river by increasing flood capacity by raising four of the City's bridges and eliminating the summer lagoon flooding problems by filling in the adjacent basements in connection with the Lower Ocean Street / Barson Street Storm Drain project. Other repairs created new problems, such as the destruction of much of the vegetation on the banks of the lagoon when the levee was reinforced with riprap.

- In 1996, the National Marine Fisheries Service (NMFS) listed coho salmon in the Central California Coast Evolutionary Significant Unit (ESU) as threatened. Coho south of San Francisco Bay are considered endangered by the State of California. In 1997, NMFS also listed steelhead trout in the Central California Coast ESU as threatened, as did the State of California. The San Lorenzo River downstream of Newell Dam at Loch Lomond is considered critical habitat for the survival of both species as well as other special status species. These designations significantly affect management decisions and give more impetus to restoring salmonid habitat.

- The U.S. Army Corps of Engineers San Lorenzo River Flood Control Improvement Project (1999-2003) improves flood capacity but also affects the riparian vegetation in those areas. Part of the project includes revegetating the outer slopes of the levees, but the potential of allowing vegetation on the inner slope needs to be assessed in terms of impact on flood capacity.

- While vegetation management in and along the channel has been irregular between 1989 and 2000, the riparian corridor successfully recolonized the upper and middle reaches of the lower river to the extent possible in the flood control channel. With new flood capacity provided by raising the bridges and the levees, the original 1989 hydraulic analyses needed to be re-evaluated to assess the current effect on flood capacity with existing and potential vegetation throughout the project area.

Due to these changes, the City and the San Lorenzo River Urban River Plan Task Force called for an updated plan. This new Management Plan was developed by Swanson Hydrology & Geomorphology and City staff, with funding provided by the State Coastal
Conservancy and the City. The project area covers the lower 2.2 miles of the river, from Highway 1 to the mouth of the river at Monterey Bay.

Working within the constraints of maintaining flood capacity for a 100-year storm event, the Management Plan seeks to identify recommendations to restore the biological and physical processes of a healthy and diverse ecosystem that can respond to the dynamic changes that occur on the San Lorenzo River. As outlined in its purpose statement, the Management Plan provides for “the enhancement and management of the lower San Lorenzo River as a functioning riparian corridor to increase abundance and diversity of all native species, with added focus on anadromous fish (steelhead and coho salmon) and other special status species.”

Besides documenting existing conditions and performing new hydraulic analyses, the Management Plan makes specific management and restoration recommendations for a 15-year implementation period beginning in 2002. This will require coordination of several City departments and may entail the formation of a permanent River Commission, pending City Council approval in early 2002. Restoration goals and measurable objectives have been identified (see Chapter 3) and a monitoring plan has been developed to track the habitat response to management and restoration efforts. The monitoring plan, together with management and restoration actions, will guide the adaptive management of the river corridor.

This Management Plan has been developed in collaboration with the County of Santa Cruz and federal and state planning efforts and activities throughout the watershed to improve habitat for steelhead, improve water quality and quantity, reduce sediment, and improve riparian habitat.

**SUMMARY OF MAJOR FINDINGS AND RECOMMENDATIONS**

1. **Degraded Estuary** - Of the three river reaches studied, the Estuarine Reach – from the Laurel Street Bridge to the Pacific Ocean – is the most degraded due to the presence of riprap along the slopes eliminating much of the native vegetation, the spread of invasive non-native plant species, and inconsistent management practices in the past. Estuaries are normally some of the most biologically productive habitats. Restoring this reach is considered one of the highest priorities.

2. **Lagoon Level Management** – A key factor to supporting healthy salmonid populations is maintaining a lagoon with sufficient water depth and water quality in the summer and fall seasons. In the case of the San Lorenzo River Lagoon, there are several pressing issues concerning liability and water quality that need to be addressed as soon as possible. With the completion of the State Water Resources Control Board-funded lagoon water quality study by the end of 2002, more information will be available on levels of dissolved oxygen, temperature, pH, and salinity under open and closed lagoon conditions. Potential risks of eutrophication and anoxic events that may lead to fish kills
need to be evaluated prior to making management decisions regarding lagoon closures. As these studies and decisions are being developed, the City should pursue State legislation to address the liability issues of lagoon level management procedures.

3. **Stream flow** – One obvious critical factor in salmonid survival is the amount of water present in the river. Due to water diversions, this becomes a concern particularly during drought years when flow has reached as low as 0.01 cubic feet per second (cfs). The Management Plan recommends a minimum flow requirement of 6.5 cfs beyond the Tait Street water diversion be maintained with negotiations with all appropriated users in the watershed necessary to achieve such a level of streamflow. Consideration of alternative sources of water such as reclaimed wastewater if water quality standards are acceptable should also be examined. A protocol should be developed to adaptively manage the low flow channels based on May projections of late summer and fall stream flows (see Appendix B). When there is sufficient projected stream flow, the multiple naturally braided channels should be maintained in order to provide the maximum extent of habitat. However, if low flow conditions are predicted, then a multidisciplinary team that includes staff from the City, the California Department of Fish and Game, and the National Marine Fisheries Service may decide to concentrate the flow into one channel so that there is sufficient water depth and flow to support the fishery.

4. **Vegetation Management** – A hydraulic analysis performed by Philip Williams & Associates found that the current amount of vegetation (as surveyed in 2000) upstream of the pedestrian bridge is consistent with the Corps of Engineers original design assumptions to provide for 100-year flow capacity as long as vegetation maintenance prescriptions are followed annually. Therefore, as long as overall density does not increase in this stretch to change predicted Manning’s “n” roughness values, the vegetation can be managed for additional species diversity and native plant composition. Downstream of the pedestrian bridge, particularly in the Estuarine Reach, there are many opportunities for increasing riparian vegetation without impacting flow capacity. Given the successful plant reclamation that has occurred naturally in the upper reaches, initial focus should be on controlling invasive non-natives and encouraging diversity, followed by a more active program of revegetation if necessary. The Management Plan provides detailed management and restoration guidelines for revegetation.

5. **Riverbank Shoreline and Streambed Habitat Restoration Projects** – A limiting factor identified for salmonids is the lack of habitat diversity along the riverbank shoreline and in the streambed. The proposed restoration enhancements are designed to improve existing natural geomorphic processes of scour and sediment deposition. They will aid in diversifying small-scale hydraulic conditions that have already proven successful through vegetation management and will provide additional habitat elements including deeper pools and cover areas for fish to hide under.
Log and boulder structures both instream and on the inside toe of the levee would increase habitat diversity and escape cover and assist with plant colonization. They would be designed so that the boulder segments would likely sink into the sandy bed during flood events while the cabled logs would remain buoyant and align in the direction of the flow.

Cobble and cattail bulrush structures also provide for scouring holes in the riverbed, are hosts for primary productivity (i.e. organic carbon input, insect growth and aquatic macro invertebrates), and offer escape cover for fish. They are neutral in terms of impact on flood capacity since they would be flattened or uprooted during a flood event.

The Implementation Schedule (see Chapter 5) calls for an initial pilot project of a number of these structures to test for effectiveness and impacts on flood capacity. If successful, more can be added in future phases.

6. Monitoring – Despite the recommendations in the 1989 Enhancement Plan, there has never been any consistent monitoring to determine the effect of management and restoration actions. This information is critical in terms of making future decisions. The monitoring plan is provided in Chapter 6 and is designed to measure how effectively the restoration goals and objectives are being met, as well as the overall health of the ecosystem. The monitoring plan provides for both implementation and effectiveness monitoring. This is necessary for all habitat restoration efforts as well as management actions and will require dedicated funding annually. A technical advisory committee should be formed within the first year to develop a comprehensive monitoring program.

7. Special Planning Areas – Completing enhancement projects within confining levees has limitations where the available width is less than that required to sustain a channel and adjacent flood plain surfaces. The greatest opportunity to expand habitat acreage and restore geomorphic and hydrologic function important to a self-sustaining ecosystem along the San Lorenzo River is to set levees back and restore low floodplain surfaces. This would develop the proper hydrology, flood inundation frequency, scour and fine mineral soil deposition to promote native vegetation and primary biological productivity.

A reconnaissance assessment determined that two locations, the Seaside Company/Santa Cruz Boardwalk Third Street Parking Lot and the San Lorenzo Park between the Branciforte Creek confluence and Water Street, should be investigated as special planning areas to weigh the benefits of habitat restoration against the loss of their current uses. The area on the north bank of the river between Riverside Avenue and the Broadway/Laurel Bridges was also assessed but the restoration benefits were limited compared to the overall cost.
1.0 PROJECT SETTING AND PLAN PURPOSE

1.1 HISTORICAL CONTEXT

It is important to place present environmental conditions into the context of land use history to gain the perspective required for restoring the natural processes that create and sustain habitat. Fortunately, records for the Lower San Lorenzo River in Santa Cruz are available and insightful.

Early History

Like a majority of rivers throughout California, the San Lorenzo River has experienced remarkable changes since European settlement beginning in the early 1800’s (Figure 1). The early history of European-style land use involved the establishment of the City and the gradual encroachment on the active channel area with fill and structures beginning in the 1840s. Early maps show that the width of original riverbed and flood plain extended from the present site of the Post Office on Front Street across to the site of the Santa Cruz County Government Center. An 1853 map of Santa Cruz shows a mosaic of active riverbed, forested floodplain, marsh and intertidal mudflat (Figure 2). The entire area now known as the City of Santa Cruz is located in the historic floodplain shaped by the River over tens of thousands of years.

Urban Development and Levees

Urban development from the late 1800s to 1955 involved additional filling and development, which further narrowed the riverbed. Severe flooding in 1938, 1941 and 1955 caused damage to many properties (Figure 3). The 1955 flood prompted the City to implement a U.S. Army Corps of Engineers (Corps) flood control project utilizing levees. The project included construction of levees (completed in 1960), straightening and dredging the river channel and elimination of the riparian corridor (Figure 4). The lagoon and estuary were narrowed considerably by the levee project and a large island was eliminated. A 1968 photo taken near the Santa Cruz County Building shows an absolutely clear riverbed with a flat braided channel (Figure 5).

Dredging for Flood Control

In the 1970s and 1980s, the riverbed was kept clear and a "fish pilot channel" was dredged along the east side of the river (Figure 6 and 7). During this time the Corps of Engineers and the City were embroiled in a dispute over dredging the riverbed of approximately 1.0 million yards of sand that had filled the flood channel. The discord continued until 1982 when the river conveyed more flow than had been calculated due to bed scour during peak flow. This new understanding of scour capacity caused a shift in focus away from dredging and directed new flood control infrastructure efforts to replace flood-constricting bridges and to increase levee heights.

1989 San Lorenzo River Enhancement Plan

During the late 1980s two citizens' advisory committees were established by the Santa Cruz City Council; the San Lorenzo River Task Force and the San Lorenzo River Restoration
**Figure 1:** Santa Cruz, California circa 1850.

**Figure 3:** The San Lorenzo River flooding Santa Cruz in 1955.

**Figure 4:** San Lorenzo River following the 1958 levee project.

**Figure 5:** San Lorenzo River in 1968 looking downstream between Water Street and Soquel Avenue. Lack of vegetation and braided channel show the degraded habitat condition.
Figure 2: Santa Cruz and the San Lorenzo River as mapped in 1853 superimposed on an orthophoto taken in 1999 show significant changes in land cover. Note the major reduction in areal extent of river bottom and conversion of floodplain areas to commercial, residential, recreational and transportation uses.
Figure 6: San Lorenzo River looking upstream from Soquel Avenue Bridge circa 1989.

Figure 7: San Lorenzo River looking upstream from Soquel Avenue Bridge in the summer of 1999.

Figure 8: Cover of the 1989 San Lorenzo River Enhancement Plan.

Figure 9: San Lorenzo River mouth in 1998. Channels across the beach are formed naturally by tidal action and scour.
Committee. The committees began to address habitat conditions in the river and their work resulted in the development of the San Lorenzo River Design Plan (1987) and the San Lorenzo River Enhancement Plan (1989) (Figure 8).

The 1989 San Lorenzo River Enhancement Plan laid the groundwork for the management and habitat enhancement of the San Lorenzo River from 1989 to 2000. The plan was developed in response to the revised Corps plan to abandon maintenance dredging, improve flood capacity by raising levees, and, in acknowledgment of the expanded capacity provided by channel bed scour that was demonstrated during the January 1982 flood. The 1989 Enhancement Plan included an engineering hydraulic modeling study of vegetation density to assess the effect of vegetation on channel flood control capacity. With this tool, the Corps and City were able to reach an agreement to allow some vegetation to remain in the channel. This work was done before replacement of the Riverside Avenue, Water Street, Soquel Avenue and Laurel Street bridges and prior to the present levee-raising project. These important changes have increased flood capacity. However, the capacity is also dependent upon scour depth and the density and hydraulic resistance of vegetation in the channel.

The 1989 plan also developed recommendations for riparian vegetation restoration along the outer levee banks, lagoon management for enhanced fisheries habitat, and operations and maintenance refinements for vegetation and sediment management within the flood control channel. The plan included recommendations for a monitoring plan to assess the effectiveness of proposed restoration and management activities. The monitoring plan for the 1989 Enhancement Plan was not implemented. Operations and maintenance refinements for vegetation and sediment management have been implemented irregularly due to funding and staffing constraints.

Finally, the 1989 plan included recommendations for habitat improvements to Jessie Street Marsh. Jessie Street Marsh improvements have been addressed through the development of the Jessie Street Marsh Enhancement Plan adopted in 1998. Restoration of the marsh will occur in 2002-2003 and will include restoration of brackish and freshwater marsh areas, tidal interchange with the river, and public access and interpretive facilities.

The lagoon management component of the 1989 San Lorenzo River Enhancement Plan called for controlling water levels in the lagoon without sandbar breaching, a practice found harmful to salmonids (Figure 9). Flooding problems occurred regularly during the summer seasons when the sandbar closed and the water level in the river through town increased. Storm drains flooded onto the streets in the lower Ocean Street neighborhood and basements in the downtown area flooded. Research found that low lagoon levels do not necessarily harm habitat conditions, but breaching degrades the water quality of the lagoon by reintroducing saltwater during normally freshwater periods. A water level control structure was proposed, but was determined to be infeasible due to liability concerns. The summer flooding problems were solved by installation of new storm drains and abandonment of basements in downtown buildings after the 1989 Loma Prieta earthquake. The lagoon has remained as a natural system since sandbar breaching was halted in 1995 when regulatory permits expired. The City of Santa Cruz has done no formal management of the lagoon since the expiration of permits due to public safety liability issues and natural resource management concerns.
1989 Loma Prieta Earthquake

The 1990s era was preceded by the Loma Prieta Earthquake (October 1989), which damaged the Riverside Avenue Bridge beyond repair and initiated its replacement. Between 1994 and 1999 three other bridges, Soquel Avenue, Water Street and Laurel / Broadway, were replaced or modified to improve flood passage and seismic safety. Other changes stemming from the earthquake included filling basements that had flooded in the summer months for seismic stability and completion of the Lower Ocean Street / Barson Street Storm Drain project in 1999. Parts of the levee were damaged and replaced, especially in the lagoon area, and new riprap slopes destroyed what little vegetation had developed. The lagoon remains largely barren in a normally rich ecological zone (Figure 10). The current lagoon habitat quality is probably well below its potential.

Endangered Species Listings for Coho Salmon and Steelhead Trout: 1996 and 1997

The San Lorenzo River has historically supported populations of the steelhead trout (Oncorhynchus mykiss) and coho salmon (Oncorhynchus kisutch). The National Marine Fisheries Service (NMFS) completed a status review of West Coast steelhead populations under the Endangered Species Act and adopted a Final Rule designating steelhead trout in the Central California Coast Evolutionary Significant Unit as a Federally threatened species effective October 17, 1997. Species identified as “threatened” are likely to become endangered within the foreseeable future throughout all or a significant portion of its range (Busby et al, 1996; National Marine Fisheries Service, 1997). The designation applies only to naturally spawned populations of anadromous forms of O. mykiss residing below long-term naturally occurring or man-made impassable barriers. The San Lorenzo River is included in critical habitat designated under the federal listing for all accessible reaches excluding reaches above Newell Dam (Loch Lomond). Critical habitat is defined as habitat key to the survival of threatened and endangered species. These areas may require special management considerations or protection (Busby et al, 1996; National Marine Fisheries Service, 1997). Steelhead south of San Francisco Bay are listed as a threatened species by the State of California under the California Endangered Species Act.

The San Lorenzo River supported coho salmon in relatively small numbers until the drought of 1987-92. Although coho salmon historically inhabited most coastal streams in San Mateo and Santa Cruz counties, presently they are only found south of San Francisco Bay in Waddell and Scott Creek. Coho salmon in the Central California Coast Evolutionary Significant Unit are protected under the Federal Endangered Species Act as a threatened species effective December 2, 1996. Accessible reaches of the San Lorenzo River are included within the critical habitat designation for Central California Coast coho salmon. Coho salmon south of San Francisco Bay are also listed as an endangered species by the State of California under the California Endangered Species Act.

Riparian and Aquatic Habitat - Present Conditions and Opportunities

There were several successes associated with the 1989 San Lorenzo River Enhancement Plan. The plan improved the management of vegetation in the river by allowing increased riparian habitat on the riverbed and on the levees. With the notable exception of the lagoon area below Riverside Avenue, riparian habitat in the lower San Lorenzo has improved
Figure 10: San Lorenzo River Lagoon looking upstream towards the Riverside Avenue bridge in June 2000.
markedly. Since 1990, extensive stands of native riparian vegetation have colonized the bed and banks of the river and have led to improved channel and substrate conditions for aquatic habitat. Development of undercut banks, waterside vegetation and instream cover have improved aquatic habitat quality. The presence of coarse substrate (gravel and cobble sizes), pools and riffles indicates the potential for improving aquatic macroinvertebrate productivity and increasing aquatic habitat diversity. This response indicates that more habitat will be created in the future by simply allowing natural geomorphic processes to take place with minimal intervention. Certain reaches, however, such as the banks along the lagoon below Riverside Avenue and the lagoon mouth, require more direct intervention to promote native vegetation, habitat development and natural lagoon processes.

1999 – 2003 Levee Raising Project

In 1994 the U.S. Army Corps of Engineers approved plans for the San Lorenzo River Flood Control and Environmental Restoration Project. The plans called for raising the levee height, replacing storm drains, and revegetating the outer levee slopes with native riparian species. Construction on the project began in 1999 and is projected for completion by 2003. Upon completion of the project, the City of Santa Cruz will be required to obtain flood certification from the Federal Emergency Management Agency (FEMA) that the levees will hold a 100-year flood as defined by FEMA. A flood control management manual will detail the management activities necessary to maintain the integrity and function of the flood control channel once completed by the Corps. Once FEMA certification is obtained, flood insurance requirements for neighboring properties will be removed.

A final component of this project is a stream bank erosion project along Laurel Street Extension and Third Street. With the realignment of the River as it flows east below the Laurel Street Bridge, the southern riverbank along Laurel Street Extension and Third Street has suffered severe erosion and portions of the bank have collapsed in this area. To prevent further erosion and street collapse, a sculptured tieback bank face and riverbank riparian plantings are proposed for approximately 900 feet of this riverbank.

1.2 PROJECT NEED

With the completion of the San Lorenzo River Flood Control and Environmental Restoration Project there are opportunities to improve riparian and aquatic habitat in the lower San Lorenzo River within the constraints of ensuring flood protection. The 1989 Enhancement Plan does not incorporate the recent and ongoing changes in infrastructure and improvements in flood capacity resulting from the San Lorenzo River Flood Control and Environmental Restoration Project. Further, the presence of the threatened steelhead trout and coho salmon in the lower San Lorenzo River necessitate a more specific approach to managing and enhancing the river environment to maintain habitat conditions for these species.

Current conditions therefore necessitate an update to the 1989 San Lorenzo River Enhancement Plan. The update must address current channel conditions and opportunities for habitat enhancement through management and active restoration. The plan must also identify important limiting factors to maintaining habitat for steelhead trout and coho salmon and other species inhabiting the river corridor. Finally the plan should identify the need for
studies which could provide additional scientific data for better management of the river corridor.

1.3 PLAN PURPOSE AND GOALS

Plan Purpose
The Lower San Lorenzo River and Lagoon Management Plan (Management Plan) is designed to update the original 1989 Enhancement Plan through a process of conducting new biologic, geomorphic and hydrologic data collection, interpretation of habitat sustaining processes and development of recommendations that will improve the physical conditions to sustain a healthy and diverse ecosystem. The plan is based on a multi-species approach to habitat enhancement and identifies the primary physical, chemical and biological processes necessary to build a framework to support a more developed biological web. Establishing appropriate habitat conditions that can adapt to the dynamic nature of the San Lorenzo River is a vital element in the success of ecosystem restoration. The plan’s thesis is that by restoring stream channel and riparian function, multiple species will benefit.

The Management Plan was developed by studying current and past geomorphic conditions, existing vegetation types, and existing fisheries habitat conditions. Current species presence/absence information was also collected. Reference areas were examined to obtain relevant information on vegetation patterns. A hydraulic analysis was performed to identify vegetation densities allowable under existing flood control infrastructure and critical levels to be maintained to ensure flood protection. Identification of limiting factors to successful recovery of threatened species was conducted through new hydrologic data and analysis. Finally, analysis of potential areas to increase floodplain habitat were identified. The following section on methods describes each of these tasks in more detail.

The plan was developed by Swanson Hydrology & Geomorphology and the City of Santa Cruz staff. The plan was reviewed and approved by the San Lorenzo Urban River Plan Task Force and appropriate agencies.

Plan Purpose Statement
The Management Plan provides for the enhancement and management of the lower San Lorenzo River as a functioning riparian corridor to increase abundance and diversity of all native species with added focus on anadromous fish (steelhead and coho salmon) and other special status species.

Plan Goals
1. Provide environmental management and enhancement prescriptions for the restoration of the Lower San Lorenzo River and Lagoon for anadromous fish and terrestrial species.

2. Maintain adequate flood capacity in the Lower San Lorenzo River to convey a 100-year flow event.

3. Provide for the adaptive management of aquatic and terrestrial resources.
4. Identify opportunities to widen the river and expand habitat into a larger floodplain consistent with an urban setting.

5. Develop a monitoring program for evaluation of success and continued adaptive management.

Plan Timeline and Implementation
The Management Plan provides management and enhancement recommendations for the Lower San Lorenzo River and Lagoon for a 15-year implementation period beginning in 2002. Implementation of plan components will necessitate coordination among several City departments including Public Works, Parks and Recreation, and Water. Overall management and implementation of plan elements will be facilitated through the City Manager’s office. A permanent River Commission will be explored by the Santa Cruz City Council in early 2002. This commission would be charged with monitoring plan implementation as well as other aspects of river management.

Relationship to Watershed-Wide Planning Efforts
The City of Santa Cruz is developing the Management Plan under the guidance of the San Lorenzo Urban River Plan Task Force, appointed by the City Council and charged with updating the 1989 San Lorenzo River Enhancement Plan. It is the desire of the San Lorenzo Urban River Plan Task Force to develop a management plan which is reflective of current regional planning efforts and activities of the County of Santa Cruz and other state and federal agencies and to ensure that recommendations are consistent with federal, state and local environmental regulations. This integrated approach will be reflected in planning documents such as the San Lorenzo River Salmonid Enhancement Plan and the San Lorenzo Watershed Plan Update being prepared by the County of Santa Cruz. The City of Santa Cruz will also integrate findings of the Lower San Lorenzo River and Lagoon Management Plan into a City-wide Habitat Conservation Plan to be prepared according to the requirements of the Federal Endangered Species Act.

The Management Plan is being developed in cooperation with watershed-wide efforts of the County of Santa Cruz and other agencies (Table 1). The commonality among all the planning efforts is the emphasis on improving habitat for endangered species such as steelhead trout. Concurrent with this goal is the desire to improve water quality and quantity, reduce sedimentation and improve riparian habitat.

1.4 METHODS
Original data collection and analysis for geomorphic, hydrologic, and biologic conditions within the river corridor was conducted in summer and fall 2000 and 2001 for the development of this report. The results from the studies are described in Section 2.0 Existing Conditions.

Geomorphologic and Hydrologic Conditions
The hydraulic and geomorphic conditions in the lower San Lorenzo River were assessed through examination of topographic data, recent hydraulic modeling and observation of field
conditions. Vegetation density on the riverbed has increased substantially and important habitat creating processes have been allowed to occur. To capture this information, a vegetation cover map was completed in 2000 and documentation of key vegetation and geomorphic processes were made. Vegetation density and mapping data was also used to conduct hydraulic analysis to estimate the effect of vegetation on channel flood capacity (PWA, 2001).

Lagoon water level conditions were monitored almost continuously between 1998 and winter 2001 as a part of other City of Santa Cruz projects and private monitoring. This data was assessed with field observations and sandbar behavior in order to gain an understanding of the dynamics of lagoon habitat conditions.

Past hydrologic data available from the U.S. Geological Survey was used to develop exceedence probability curves under different flow scenarios (i.e. – drought, dry, average, and wet years). This information can be used as a tool to predict flow conditions in the critical low-flow summer and fall months and to make preliminary estimates of bypass flow requirements (see Appendix B for more details).

<table>
<thead>
<tr>
<th>Title</th>
<th>Lead Agency</th>
<th>Focus</th>
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<tbody>
<tr>
<td>San Lorenzo Sediment Total Maximum Daily Load (TMDL), 2001</td>
<td>Central Coast Regional Water Quality Control Board &amp; County of Santa Cruz</td>
<td>Required by the Clean Water Act Section 305 (b) for impaired waterbodies. Sets total maximum loads for identified impairing pollutants.</td>
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<tr>
<td>San Lorenzo River Salmonid Enhancement Plan, 2002</td>
<td>County of Santa Cruz &amp; Coastal Conservancy</td>
<td>Strategy to protect and enhance the steelhead population and restore a viable coho salmon population in the San Lorenzo River.</td>
</tr>
<tr>
<td>City of Santa Cruz Watershed Management Plan – Newell and Zayante Subwatersheds, 2002</td>
<td>City of Santa Cruz Water Department</td>
<td>Provides management recommendations for City-owned properties in the Newell and Zayante Creek subwatersheds.</td>
</tr>
<tr>
<td>San Lorenzo Urban River Plan, 2002</td>
<td>City of Santa Cruz &amp; San Lorenzo Urban River Plan Task Force</td>
<td>Provides recommendations for urban amenities adjacent to the San Lorenzo River</td>
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<tr>
<td>City-Wide Creeks and Wetlands Master Plan</td>
<td>City of Santa Cruz Planning Department</td>
<td>Provides development regulations for creekside properties within the City of Santa Cruz</td>
</tr>
<tr>
<td>Branciforte Creek Flood Conveyance and Fish Habitat Assessment, 2001</td>
<td>City of Santa Cruz &amp; Coastal Conservancy</td>
<td>Assesses flood issues and fisheries restoration on Branciforte Creek.</td>
</tr>
<tr>
<td>Drinking Water Quality Protection, 2003</td>
<td>County of Santa Cruz &amp; U.S. Environmental Protection Agency</td>
<td>Focuses on pathogens and turbidity impacts to drinking water.</td>
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</table>

A coarse water budget model was also developed for the lagoon to estimate the amount of time that would be required to fill the lagoon with freshwater under different flow conditions. These estimates are crucial in understanding the link between streamflow, timing of lagoon closure, late summer breaching events and overall lagoon water quality (see Appendix B for more details).

**Plant Community Mapping**

Mapping of plant communities, sandbars, artificial bank stabilization (i.e. riprap), and open water areas occurring within the urban portion of the San Lorenzo River riparian corridor was conducted in Fall 2000 by Native Vegetation Network with support from Swanson Hydrology & Geomorphology. The locations of the plant communities and other ground features were mapped onto a 1999 aerial photograph (scale 1 inch = 75 feet; photo base from digital orthophoto). Each mapped unit/polygon was assigned a unique polygon number, and had the following information recorded on a field data sheet: overstory plant community, understory plant community, and the three most common plant species present in the overstory and/or understory, as applicable. To facilitate recording the data, codes were entered for the plant communities, plant species, and ground features observed. Data was entered and analyzed for a total of 105 different mapped units. The mapped information was digitized and entered into a geographic information system (GIS), enabling the determination of areas for each plant community type or ground feature and the mapping these areas.

An effort was made to identify plant communities and habitats from appropriate reference sites on less disturbed and urbanized lagoon systems on the Central Coast. This included topographic surveys of the elevation range of individual plant species occurrence in the Lower San Lorenzo River Estuary Reach and Lower Scott Creek, a stream located 10 miles north of Santa Cruz (see Appendix C for results).

**Fisheries Assessment**

The initial assessment of fisheries in the Lower River included habitat typing and population sampling in the Riverine Reach between Water Street and Highway 1. Initial habitat typing indicated that the bifurcated channel occurring in this reach was an important feature for fisheries habitat that needed to be documented and compared to a similar reach that lacked this characteristic. Based on the initial assessment, habitat and population surveys were continued upstream of Highway 1 to the vicinity of Paradise Park. The habitat and population surveys were completed by D.W. Alley and Associates using standard sampling
techniques described in the *California Salmonid Stream Habitat Restoration Manual* (Fosi et al., 1998).

Visual observations were also made with regards to habitat conditions, fish presence, and fish behavior from April to August of 2001.

**Integrated Habitat Analysis**

The river corridor was divided into three segments based upon similar geomorphic and hydrologic conditions and habitat types. Within each reach, vegetative and wildlife habitat were assessed in light of the hydraulic assessment of flood capacity. Conditions unfavorable to habitat development were identified and ranked according to severity. Enhancement actions were then identified to improve native vegetation and habitat within the constraints of maintaining flood control capacity.
2.0 LOWER RIVER & LAGOON EXISTING CONDITIONS

2.1 PROJECT AREA

The San Lorenzo River drains an approximately 137 square mile watershed of forested, as well as urbanized areas on the Central Coast of California. The River drains to the Pacific Ocean at the north end of the Monterey Bay. The City of Santa Cruz is located adjacent to the lower 3 miles of the River and encompasses much of the River's historic floodplain. The City limits within the area of the River extend to Sycamore Grove and Pogonip on the west side of the River along Highway 9 and to the lower 1 mile of Graham Hill Road on the east side of the River. The County of Santa Cruz has jurisdictional authority of the area of the watershed outside of the City limits.

2.2 HYDROLOGIC OVERVIEW

Streamflow conditions in the Lower San Lorenzo River below Highway 1 are characterized by low baseflows that seasonally decline from winter to fall, punctuated by intervening or "flashy" increases in flow in response to winter rain storm events (Figure 11). Rainfall in the upper watershed averages over 50 inches per year with individual storms resulting in a quick rise in water level in the Lower River on the order of 6-12 hours. Peak winter flows can be four orders of magnitude greater than summer baseflow. On December 3, 1955 the river peaked at 30,400 cubic feet per second (cfs), whereas, in an average flow year, baseflow in September will range between 5 and 20 cfs. During drought years the Lower River may also dry up completely, resulting in loss of hydraulic connectivity between the River above Highway One and the Lower River and estuary.

In most years, winter storms end in late March to early April and do not return until late October. During the dry months baseflow declines over time, reaching a minimum in August and September. Baseflow characteristics of the San Lorenzo River have not been fully studied and effects on Lower river streamflow are not fully documented at this time. Diurnal fluctuations in flow occur due to evapotranspiration and upstream water diversions.

The San Lorenzo River watershed has been fully appropriated for water supply between the months of June and October by the California State Department of Water Resources. The watershed has dozens of appropriative users, as well as dozens of riparian rights on record. All of the appropriative rights are junior to the City of Santa Cruz's water rights. The largest potential impact to flow in the Lower River is from water diversions, most notably from the City of Santa Cruz diversion at Tait Street. The City's water right allows diversion of up to 12.2 cfs with no requirement for bypass flows at the Tait Street diversion. However, in below normal rainfall years, due to current operational constraints with pumps at Tait Street it is unlikely that the City can take their full water right at Tait Street. The Tait Street diversion provides as much as 75% of the daily summer water demand in the City of Santa Cruz.

During the low-flow months, especially in dry or drought years, there is always the risk of dewatering portions of the Lower River. The City Water Department has documented that
Figure 11: Hydrograph for the San Lorenzo River at Santa Cruz (USGS gage #11161000) showing the average daily flow in cubic feet per second (cfs) for the period of record from 1988-1999. Typical daily average flows for the dry season range from 6-10 cfs with most precipitation and runoff occurring between early December and late March.
flows in the Lower River have progressively declined over the years. USGS gauges indicate 1977 flows (the lowest rainfall year in recorded history) at the San Lorenzo River gauge at Felton were no lower than 1988 flows (categorized as only a below-average rainfall year). Currently, efforts are made by the City to maintain reasonable bypasses to the Lower River at Tait Street. This unwritten policy has been helped by above average winters in the mid and late-1990’s that have kept baseflows relatively high. The City of Santa Cruz Water Department is required to provide bypass flows at Loch Lomond and the Felton Diversion but not at Tait Street. It would be difficult for the City to maintain bypass flows in years of drought as demand for residential water supplies increase in late summer. Moreover, with modest system growth through 2020, unless current supplies are augmented, the City will be unable to meet average annual demands in normal rainfall years. The City of Santa Cruz Water Department recognizes that existing water supplies are inadequate to meet the health and safety needs of its current users in drought conditions.

2.3 GEOLOGIC OVERVIEW

The project area is located at the terminus of the San Lorenzo River on the southwestern side of the Santa Cruz Mountains. The lower 3 miles of the River comprise the watershed’s floodplain and is characterized by alluvial soils. The potential for seismic activity in the area is high due to nearby active faults (San Andreas) and the liquefaction potential of soils. Slope instability and erosion potential are low in the study area due to the urbanized nature of the surrounding land areas.

2.4 ECOLOGICAL RESOURCES

The Lower San Lorenzo River and Lagoon supports many important aquatic, avian and terrestrial species. Management for the enhancement of habitat for these species is a critical focus of the plan (Appendix A). Special status aquatic species, which are known to occur in the lower San Lorenzo River include steelhead trout, coho salmon (now thought to be extirpated from the watershed), threespine stickleback (Gasterosteus aculeatus williamsoni), and southwestern pond turtle (Clemmys marmorata pallida).

Avian species of special concern according to the California Department of Fish and game and Point Reyes Bird Observatory include Swainson’s Thrush (Catharus ustulatus), Warbling Vireo (Vireo gilvus), Black-headed Grosbeak (Pheucticus melanocephalus), Common Yellowthroat (Geothlypis trichas), Song Sparrow (Melospiza melodia), Wilson’s Warbler (Wilsonia pusilla), Yellow Warbler (Dendroica petechia), Peregrine Falcon (Falco peregrinus anatum), and Brown Pelican (Pelecanus occidentalis) (Scoggin, 2001). These species represent seven of the 14 focal species identified by the California Partners in Flight and Riparian Habitat Joint Venture for the riparian Bird Conservation Plan (CPIF & RHJV, 2000). Focal species are utilized to assess the relative health of a riparian system.

Recent surveys for reptile and amphibian species within the river corridor have not been conducted. However, a survey of the Lower San Lorenzo River and Lower Brancciforte Creek for California red legged frog (Rana aurora draytonii) conducted in 1997 did not find any present (Mori, 1997).
The Lower San Lorenzo River has new stands of riparian vegetation and riverbed features and channels formed primarily by natural processes (flood scour, sediment deposition and native vegetation colonization). This indicates that more habitat will be created in the future by simply allowing natural geomorphic processes to take place with minimal intervention. Certain reaches, however, such as the banks along the lagoon below Riverside Avenue and the lagoon mouth, require more direct intervention to promote native vegetation, habitat development and natural lagoon processes.

2.5 FLOOD CONTROL CONSTRAINTS

The San Lorenzo Flood Control Improvement Project is designed to provide 100-year Federal Emergency Management Agency (FEMA) equivalent flood protection for the downtown areas of the City of Santa Cruz designated as floodway or floodplain. Any restoration plans proposed for the lower reach of the river must be compatible with the authorized project purpose of flood control. Proposed restoration work cannot adversely affect the flow conveyance capacity or the flood protection level. Any restoration or management work must also be compatible with maintenance operations and inspections during flood events.

2.6 RIVER REACHES - EXISTING CONDITIONS

For the purposes of planning enhancement features along the lower 2.2 miles of the river, the area was divided into three reaches: Estuarine Reach, Transitional Reach, and Riverine Reach (Figure 12). This demarcation is different than that used in the 1989 Enhancement Plan, where the river was divided into seven reaches with bridges acting as divisions. The new system of division more accurately reflects geomorphic and hydrologic conditions, substrate, periodicity of inundation, salinity influences and resultant vegetation and habitat cover. The new system is consistent with findings of vegetation mapping conducted in the summer of 2000.

2.7 RIVERINE REACH (HIGHWAY 1 TO WATER STREET BRIDGE)

Plant Community Distribution

The three most prevalent plant communities in the upstream reach are ruderal grassland, mixed riparian forest, and a mosaic of willow thicket and freshwater marsh, which occurs in the channel bottom (Figure 13). Downstream of Highway 1, the open water splits into two channels, which flow past a central “island”.
Figure 13
Vegetation Community Types
Riverine Reach  San Lorenzo River
Santa Cruz, California

LEGEND
U Storm Drain Outfalls
Vegetation Community Type
- brackish marsh
- cottonwood riparian
- fresh marsh
- fresh marsh/willow riparian
- mixed riparian
- mixed riparian/fresh marsh
- non-native
- open water
- ruderal grassland
- ruderal scrub
- sandbar
- sandbar/bulrush
- sandbar/willow
- urban landscape
- willow riparian
- willow shrub
- willow thicke/fresh marsh

Scale: 1:3,600 or 1 inch = 300 feet
Aerial photo base: Fall 1999

200 Feet
0 200
The Riverine Reach looking upstream from Water Street during Winter Conditions

This island is composed of a mosaic of willow thicket and freshwater marsh. Due to the dynamic nature of the channel and periodic scour from high water flows, the island is composed of short-statured vegetation. To a lesser extent, sandbars vegetated with arroyo willow (*Salix lasiolepis*) and species representative of freshwater marsh occur along the channel edges and include cattail (*Typha latifolia*), bulrush (*Scirpus californicus*), matted water primrose (*Ludwegia peploides ssp. peploides*), and water smartweed (*Polygonum amphibium*) (Native Vegetation Network, 2001).

Narrow bands of mixed riparian forest occur along the toe of the inner levee banks. The width (5 to 10 feet) of the mixed riparian forest is influenced by the City of Santa Cruz maintenance activities, which include vegetation thinning each year. The dominant species in the mixed riparian forest are arroyo willow and white alder (*Alnus rhombifolia*). Small amounts of yellow willow (*Salix lucida ssp. lasiandra*) black cottonwood (*Populus trichocarpa*), and box elder (*Acer negundo*) were also observed. The ruderal grassland areas mostly occur on the upper levee banks, where the substrate has shallow soils covering riprap. Ruderal grasslands are characterized by the presence of weedy and invasive non-native plant species. Common species observed in the ruderal grassland were wild oat (*Avena spp.*), ripgut brome (*Bromus inermis*), field mustard (*Brassica rapa*), red valerian (*Centranthus ruber*), rice/smilo grass (*Piptatherum miliaceum*), fennel (*Foeniculum vulgare*), wild lettuce (*Lactuca serriola*), and iceplant (*Carpobrotus edulis*) (Native Vegetation Network, 2001).

**Geomorphic and Hydrologic Conditions**

The Riverine Reach averages approximately 150 feet in width. This reach is characterized by the Corps as a zone of sediment deposition, where the river gradient flattens and width increases as it enters the flood control project. Sediment deposition occurs in this reach as sediment-laden water leaves the upstream gorge and the channel gradient becomes flatter.
The Riverine Reach occurs on the coastal plain downstream of a higher-gradient, bedrock controlled section of the San Lorenzo River known as the Gorge. Higher gradients allow more sediment to be carried in the river. Once the river leaves the Gorge, the gradient becomes less and the flow spreads across the valley floor, no longer confined by the mountain valley. The result is a lower capacity of the river to carry sediment resulting in sediment deposition.

In most cases, sediment deposition occurs on the river floodplain during the falling limb of the hydrograph as the flow recedes into the bankfull channel. When bankfull channels are not allowed to form or are over-widened, in the case of dredging, the entire channel will tend to aggrade under most flow conditions.

The Riverine Reach has been in a state of transition since the last dredging operation of the mid 1980s. A range of flows have allowed formation of a bankfull channel which consists of two primary channels with a mid channel bar that is acting as a floodplain surface for the confined river. Growth of riparian vegetation along the banks and on the mid channel bar have maintained this configuration and encouraged scouring of the bankfull channel. The result has been exposure of coarser sediment on the channel bed.

An important geomorphic feature that is present throughout the Riverine Reach is the presence of cross-channels that flow between the two primary channels. These channels connect the higher elevation channel to the lower elevation channel and maintain hydraulic connectivity between them. They also allow for bar scour during higher flows and provide variability in velocities along the channel.

The Riverine Reach receives urban runoff drainage from the neighboring areas. The Reach includes drainage from five storm drains, all maintained by the City of Santa Cruz Public Works Department. All five storm drains were part of a sampling analysis conducted by Santa Cruz County Environmental Health Services during 1995-1997 (Ricker, unpublished report, 2001). The storm drains were sampled during both wet weather and dry weather periods. Initial analysis of the data collected for the storm drains indicates the presence of fecal coliform, total coliform, E. coli and Enterococcus at storm drain discharge points during both dry and wet weather, although increases were seen during wet weather. Nitrate was also present but not at levels considered significant. In general the data shows a high level of variability, depending on the drain location and the timing of sampling. In general storm drains on the west side of the river seemed to have more frequent elevated bacteria levels during dry weather. The data suggest management measures for protection of human health but do not necessitate actions for aquatic organisms at the levels recorded.

**Fisheries Habitat Conditions**

The Riverine Reach between Water Street and Highway One is characterized by a meandering, braided stream channel with adjacent riparian vegetation. Runoff conditions in 1996-2000 resulted in a bifurcation of the single channel upstream of Hwy 1 with deep, swift water in each channel. In low water years or drought conditions the channel becomes shallow and braided and can inhibit fish passage or create conditions (high water temperatures, lack of cover) that reduce the viability of the reach for salmonid rearing. The channel bed in this reach is prone to modification each winter by scour and deposition; the
depth and alignment of the low flow channel and the density and the vegetation cover can change annually.

During fisheries surveys conducted in fall 2000 (Alley 2001), the two parallel channels of approximately the same length provided close to 4,000 linear feet of fish habitat. The surveys indicate that the bifurcated channel provides enhanced rearing habitat compared to the reach above Highway 1 where a single, wide channel exists. The bifurcated channel includes significant amounts of escape cover, primarily due to the presence of emergent vegetation along the edges. The reach supports more varied habitat with greater complexity, including more fast riffles, swift runs, and fast water areas at heads of pools. The riparian growth was more continuous and the floating primrose provided additional cover habitat along the length of the split channel.

Maintenance of a bifurcated channel is important because it provides more vegetated channel edge which results in more shade and escape cover for fish per unit area of stream channel. For example, if two eight foot wide channels exist compared to one 16 foot wide channel, overhanging vegetation will typically shade a larger percent of the area in the two channel system compared to the one channel system due to the presence of twice the bank length. Therefore, maintenance of split channels during average flow conditions will generally provide more shaded habitat, escape cover, coarser bed substrate and higher flow velocities.

Based on fish sampling of selected habitat units, the overall juvenile steelhead densities in the Riverine Reach were estimated at 4.5 fish/100 feet. Extrapolated over the entire reach, the estimated densities are approximately 170 smolt-sized juvenile steelhead (Alley, 2001). Based on the fish monitoring results from the rest of the San Lorenzo River, it is suspected that steelhead densities were especially low in all of the Lower River reaches in Fall 2000 though the cause for this is currently unknown (Alley, 2001). Other fish that were captured during fish sampling include coastrange sculpin (Cottus aleuticus), largemouth bass (Micropterus salmoides), pacific lamprey (Lampetra virens), prickly sculpin (Cottus asper), sacramento sucker (Catostomus occidentalis), staghorn sculpin (Leptocottus armatus), starry flounder (Platichthys stellatus) and threespine stickleback (Gasterosteus aculeatus) (Alley 2001).

During low flow or drought conditions the river can create a shallow, braided channel. To improve fish passage and provide juvenile steelhead rearing habitat, the City has in the past created a low flow channel from Highway One downstream. This low flow channel is normally created on the east side of the flood control channel (Gilchrist, 2001; see Figure 7). Under normal flow conditions, the benefits gained from diverting all of the flow to a single channel may not be enough to offset the short-term impacts to the aquatic resources in the abandoned channel. Conversely, under dry and drought conditions, habitat conditions may be greatly improved by diverting all of the flow into a single, low-flow channel.

To better manage a low-flow channel, an adaptive management strategy was developed as part of this project to determine the timing and flow regime of implementing a single channel flow. The management strategy is based on a hydrologic analysis of past flows at the Tait Street Gage (USGS Gage #11161000, San Lorenzo River at Santa Cruz) and development of exceedence probability values. This information could be used to predict flow conditions for
late summer and fall months by using equivalent exceedence probabilities and measured flow values from May (see Appendix B for further detail). Based on the results of the flow analysis, active management of the low flow channel (i.e. – diversion into a single low-flow channel) should occur when flows are less than the 70% exceedence value for an average September (approximately 3 cfs). That would translate to a flow of 21 cfs in May. Changes to this strategy would need to be assessed on a yearly basis depending upon the conditions found in the bifurcated channel.

**Previous Management Measures Applied to the Riverine Reach**

This reach has been maintained the most extensively of the three reaches for flood control purposes. Because this section of the flood control channel is known to aggrade sediment, maintenance is necessary within this reach to ensure bed scour during higher flows. According to the 1989 Enhancement Plan this reach was to be managed to allow a 10-foot wide buffer of riparian vegetation along the toe of the levee and a 5-foot wide buffer on either side of the low flow channel. Volunteer alders and willows were to be allowed in groves and individual trees greater than 6 inches diameter at breast height were to be removed.

These management prescriptions have been applied to some extent within this reach, however, the width of buffer strips has not been protected and individual groves of trees have not been allowed to develop. Larger trees exceeding the diameter at breast height requirement have been removed. In general the channel in this area is characterized by vegetation of the same height and density with little variability in density and structure. Buffer strips are narrower than the agreed width in the management plan and provide less canopy cover to the low flow channel.

The City of Santa Cruz has removed sediment in this reach in accordance with the original 1958 Corps flood control project maintenance agreement up to the mid-1980’s, resulting in removal of approximately 7,500 cubic yards on a biannual basis. Since the mid 1980’s the City has not conducted sediment removal in the channel bed in this reach. The channel bed in this reach also has been plowed to maintain loose sediments that are easily mobilized during heavy flows.

**2.8 TRANSITIONAL REACH (WATER STREET BRIDGE TO LAUREL STREET BRIDGE)**

**Plant Community Distribution**

The three most prevalent plant communities in the middle reach are urban landscape, ruderal grassland, and mixed riparian forest (Figure 14). The wide east bank and flood plain by San Lorenzo Park supports a more developed stand of mixed riparian forest compared to the upstream reach. Groves of mature black cottonwood trees (60 to 80 feet tall) occur adjacent to the arroyo willow and white alder trees. The willows tend to be distributed at the toe of the bank or channel edge, often in association with small strips of freshwater marsh dominated by bulrush. The urban landscape areas mainly occur at San Lorenzo Park on the east bank and along River Street South on the west bank.
Figure 14 Vegetation Community Types
Transitional Reach  San Lorenzo River
Santa Cruz, California

LEGEND

Storm Drain Outfalls
Vegetation Community Type
- brackish marsh
- cottonwood riparian
- fresh marsh
- fresh marsh/willow riparian
- mixed riparian
- mixed riparian/fresh marsh
- non-native
- open water
- ruderal grassland
- ruderal scrub
- sandbar
- sandbar/bulrush
- sandbar/willow
- urban landscape
- willow riparian
- willow shrub
- willow thicket/fresh marsh

Scale 1:3,600 or 1 inch = 300 feet
Aerial photo base: Fall 1999
The ruderal grassland is distributed on the upper levee banks, and is prevalent on the levee between Soquel Avenue and the Laurel Street Bridge. The plant species composition is similar to that found in the grassland of the riverine reach; however, the following non-native weedy species become more prevalent in the ruderal grassland: kikuyu grass (*Pennisetum clandestinum*), white sweet clover (*Melilotus albus*), and fennel (Native Vegetation Network, 2001).

A gently sloping riverbank occurs next to a large vegetated sandbar along the west bank near the Long’s shopping center. Low stature arroyo willows 4 to 6 feet tall are the dominant species with clumps of bulrush along the channel edge. Scattered white alders (5 to 12 feet tall) and a few black cottonwoods also occur on the large sandbar. The vegetation appears more established on this sandbar compared to the other vegetated sandbars observed. A patch of arroyo willow trees occurs at the confluence with the Branciforte Creek channel. The willows mingle with bulrushes at the water’s edge. Of interest, is the tall Hooker’s primrose (*Oenothera elata ssp. hookeri*) that ranges from 3 to 5 feet tall. This showy plant is common in the willow riparian understory.

**Geomorphic and Hydrologic Conditions**

The term, Transitional Reach, stems from the fact that part of the time this reach functions as a riverine system and part of the time it functions as an estuarine system. The timing of the transition from riverine to estuarine varies from year to year. Typically, this reach will function as riverine during winter and spring months from December to May. Between June and November the reach alternates between riverine and estuarine depending upon the status of the sand bar at the mouth of the River. When the sand bar is open, the reach functions as a riverine system. When the bar is closed, the reach is flooded and functions as an estuarine system.

From a purely geomorphic perspective, this reach functions in a similar way to the riverine system described above. Channel and bar features are formed during winter months when the mouth is open forming a primary bankfull channel with several secondary side channels that only have water during high flow events. The secondary channels will tend to scour during high flow events as flow converges into them and around the stable bar features. This process is evidenced by coarse substrate (gravels and cobbles) found in the secondary channels.
Example of Transitional Reach looking *downstream* from the pedestrian bridge

Example of Transitional Reach looking *upstream* from the pedestrian bridge

If scour objects are present in the secondary channels, deep scour holes may form and develop into back channel pools as flows recede.

Branciforte Creek, a major tributary to the San Lorenzo River, enters the San Lorenzo River at the lower end of the Transitional Reach. Branciforte Creek also includes the Carbonera Creek drainage. Both Branciforte and Carbonera contribute a significant amount of fine
sediment to the Transitional and Estuarine Reach. Evidence of high sediment loads from Branciforte Creek can be seen at the mouth as bar features that fluctuate in size depending upon sediment supply from Branciforte and flow levels in the San Lorenzo River.

When the mouth is closed and the transitional reach begins to function as an estuarine system, sediment supply to the transitional reach is fairly low resulting in minimal sediment deposition with very little alteration of riverine-type channel and floodplain features. When converted to an estuarine system, floodplain channels become inundated and may provide additional aquatic habitat.

Water level data collected over the past several years in the San Lorenzo River estuary suggests that the bar at the mouth of the River does not persist. Though the source of the bar breaching is unknown, the impact to the transitional reach is quite significant. In August-October of 2000 the bar was on a 5–6 day cycle of forming and breaching. This consisted of the bar forming and flooding of the River back to Water Street over the course of one day. After five days the bar would breach and the transitional reach would convert back to a riverine system (Figure 15). Though the cycle of bar formation and breaching appeared to be natural, an initial human-induced breaching of the bar when it first appears in early summer can cause weaknesses in the bar that limit subsequent formation for the summer-fall season.

The Transitional Reach receives urban runoff drainage from Branciforte Creek and a storm drain located on the west side of the river at Soquel Avenue. These areas were a part of the sampling analysis conducted by Santa Cruz County from 1995-1997. Dry weather monitoring was not conducted at these sites during the sampling period because the drains were dry. These drains also showed presence of fecal coliform, E. coli, total coliform, and enterococcus. Nitrates were also present at slightly higher levels than the riverine reach storm drains. The County identified through sampling that fecal coliform levels did increase downstream of the Branciforte Creek confluence in both wet and dry weather.

**Fisheries Habitat Conditions**

The Transitional Reach is characterized by a single channel that begins below a significant riffle complex downstream of the Water Street Bridge. The riffle complex provides diversity for the upper end of the reach and the channel continues to be somewhat braided until it parallels the streambank along San Lorenzo Park. Two significant pools are associated with this riffle complex. Additionally, velocities are relatively high through this reach resulting in scour along the eastern streambank. This type of scour induces the development of undercut banks and cover habitat for steelhead. The riparian corridor along San Lorenzo Park is the most significant of any section within the Lower River and provides an important area for steelhead rearing and cover. The western edge of this reach is characterized by a wide, flat, sandy bank, which extends for almost 75-feet from the west bank. The edges of this bank are not well vegetated due to manual cutting and winter storm scour and it is expected that steelhead do not use this area because of the lack of cover. A notable exception on this bank is a significant grove of alders, which have established in the upper third of the reach. This grove does provide protection for the streambank and has resulted in significant pool development around its edges. Tules and cattail provide further cover along the edges of the pool.
Figure 15: Records of water surface stage on the San Lorenzo River Lagoon at the Jessie Street Marsh outlet through August and September 2000 show a pattern of lagoon filling and breaching. Filling occurs when waves push sand into the mouth of the river forming a barrier to outflow. Breach events (♂) break through the beach barrier and reestablish tidal influence in the lagoon. In the absence of mixing, the differing densities between river and sea water creates layering or stratification in the water column. Significant differences between salinity levels at the surface and along the bottom are common.
Visual observations in June through August of 2001 noted approximately 10-15 smolt-size steelhead using shallow pool and glide areas just upstream of the Pedestrian Bridge. This area may provide good rearing habitat since it is just downstream of the large riffle at Water Street and adjacent to adequate escape cover from overhanging vegetation.

A significant impact to steelhead in the Transitional Reach is the unpredictability of habitat and flow conditions. In a closed-bar condition at the mouth, the lagoon could potentially flood upstream to the Water Street Bridge producing deep, slack water habitat with adequate escape cover (e.g., riparian vegetation, undercut banks) and food production from zooplankton. Under an open-bar situation, the Transitional Reach becomes riverine habitat with characteristic pool and riffle sequences and shallower water depths. Though each system provides steelhead habitat, rapid changes between lagoon and riverine systems results in a high frequency of disturbance on the system with very little response time for the biotic communities to react to the new hydrologic regime.

**Previous Management Measures Applied to Transitional Reach**

The Transitional Reach has been managed according to the management prescriptions outlined in the 1989 Enhancement Plan. Management prescriptions on the west bank have allowed small groves of alders to become established, with periodic trimming and removal of alders greater than 6 inches diameter at breast height. An irregular buffer of smaller willows has been allowed along the stream channel south of the pedestrian bridge. Willows on the west bank at the toe of the slope have been allowed to develop with periodic trimming necessary for dissuading use of the area for illegal camping. Tule and cattails have been maintained in wetted areas throughout the reach. Sporadic attempts to manage non-natives on the east bank adjacent to San Lorenzo Park have not succeeded and this area is still impacted by non-natives. Management has not been effective in this effort. Occasionally, limbs overhanging the water have been trimmed to prevent breakage in high flows.

In 2000 and 2001 the sediment bar located along the west bank was disked with a plow to loosen sediments and root wads in an attempt to better mobilize these materials during high flows.

### 2.9 ESTUARINE REACH (LAUREL STREET BRIDGE TO PACIFIC OCEAN)

**Plant Community Distribution**

The following plant communities occur in the downstream reach: ruderal scrub, non-native vegetation, brackish marsh, ruderal grassland, and small areas of arroyo willow riparian forest (Figure 16). Ruderal scrub is the most prevalent plant community type in the downstream reach. The dominant plant species in the ruderal scrub are pincushion flower, red valerian, fennel, and Tangier pea (*Lathyrus tingitanus*). Scattered coyote brush, pampas grass, and French broom plants also occur on the upper levee banks.

Downstream of the Laurel Street Bridge the riparian forest is dominated by arroyo willow. Fewer white alders and black cottonwoods occur compared to upstream of the Laurel Street Bridge. This may be partially explained by changes in water salinity, as conditions become more brackish downstream. The freshwater marsh is reduced in size, and occurs as a narrow
strip along the west bank between Soquel Avenue and Laurel Street. More open water occupies the channel below the Laurel Street Bridge. Vegetated “islands” and freshwater marsh areas in the center of the channel disappear.

Arroyo willows grow in narrow bands along the river channel in several areas. One representative location occurs adjacent to the tennis courts on Riverside Avenue. As noted in the middle reach, there are scattered individuals of white alder in the willow riparian forest. The white alders tend to have brownish leaves, perhaps as a result of salt burn and the brackish water present. The white alders are larger and more vigorous in the upper reaches compared to the downstream reach.

The Estuarine Reach is the main reach where brackish marsh occurs. A narrow strip of brackish marsh is located along the channel edge between the Riverside Avenue Bridge and the Bixby Street pump station. The main indicator plant species for this community type is coast gumplant (*Grindelia stricta*), which grows on the inner levee toe. A few bulrushes and red-root cypress (*Cyperus erythrorhizos*) also grow along the channel. Another rush species was observed at the channel edge. Due to few flowering structures being present, the species identification is still in question, perhaps prairie bulrush (*Scirpus robustus*), which grows in salt or fresh water marshes.

![Example of Estuarine Reach looking downstream from vicinity of Laurel Street Bridge](image)

The levees in the downstream reach have been stabilized with riprap, which has resulted in the establishment of weedy and/or opportunistic species. The majority of the vegetation below the Riverside Bridge is composed of non-native species. A large grove of blue gum eucalyptus (*Eucalyptus globulus*) is located on the steep eastern bank by the railroad trestle. The trees are helping to stabilize the steep bank. Upstream of the eucalyptus grove, there is a small area of ruderal grassland, which is dominated by wild oats, pincushion flower...
(Scabiosa atropurpurea), and the native species, California fuschia (Epilobium canum). Just upstream of Riverside Avenue Bridge on the south bank, there is a large grove of tree-of-heaven (Ailanthus altissima) trees, which is an invasive, non-native species. The invasive non-native species, fennel, pampas grass, and kikuyu grass are also prevalent on the riverbanks in the estuarine reach (Native Vegetation Network, 2001).

**Geomorphic and Hydrology Conditions**

The Estuarine Reach consists of a single, slack water channel that has been heavily modified in the past. Historically, the Estuarine Reach included a wide floodplain with island features and tributary back channels such as Jessie Street Marsh. During summer and fall months, deep water conditions would occur due to bar development at the mouth that allowed the estuary to convert to freshwater.

Significant modifications have been made to the Estuarine Reach including encroachment, filling, fragmentation, levee construction and rock lining of the lower estuary. These impacts may have an impact on the average depth of the current estuary by reducing the tidal prism. Loss of the tidal prism reduces scour on the bed and may potentially reduce the overall circulation patterns of the estuary.

The Estuarine Reach includes the majority of storm drain infrastructure sampled as part of the Santa Cruz County study. This reach has 10 storm drains within its vicinity. Water quality in this area is generally in exceedence of State requirements for safe body contact for fecal coliform. There are also several factors which may influence water quality in this reach including tidal action, congregations of water fowl on sandbars which are intermittently exposed and flooded, and influence of higher groundwater. County sampling found presence of fecal coliform, E. coli, total coliform, and enterococcus in both wet and dry samples in this reach. The 1995-1997 County study also included toxicity testing for common urban runoff contaminants (heavy metals, pesticides and PCBs, and oil and grease). The study utilized resident freshwater clams and transplanted freshwater clams for a bioaccumulation study. The Lower River had a site at Soquel Avenue that was analyzed for heavy metals. The results of the study did not show any unusually high concentrations of trace metals. Metals, which were found, include zinc and copper. Lead and nickel were found but in trace amounts, significantly lower than in the upper river.

**Fisheries Habitat Conditions**

The Estuarine Reach is a dynamic part of the Lower River system and is a critical component for juvenile steelhead rearing. The size and water quality of the lagoon is influenced by the amount of freshwater inflows and the condition of the sandbar at the mouth of the river. During winter months the sandbar is open and the river is subject to tidal exchange. In the summer months, the combined effect of declining river flows and the creation of a sandbar by summer wave action can result in sandbar closure, thus eliminating tidal effects on the lagoon. During these conditions, the lagoon can convert to freshwater over time through inflow from the river. The lack of comprehensive studies on the amount of streamflow that is required to convert and maintain the freshwater lagoon limits our understanding of the hydrologic requirements.
The timing of freshwater conversion of the lagoon is a function of the quantity of freshwater inflows, the rate of seepage of saltwater through the sandbar, summer wave action, and overtopping or breaching of the sandbar either from too much freshwater inflow or human-induced breaching. All of these factors need to be understood before a clear plan can be developed to manage water levels in the lagoon.

A coarse water balance model was developed, using these parameters, to understand the relationship between freshwater inflows into the lagoon and the time it takes for the lagoon to fill (see Appendix B for further details). Estimation of filling rates under different flow scenarios is important when considering breaching scenarios, habitat value for aquatic organisms and minimum bypass requirements. Based on the results from this model, it would take approximately 4 days for the lagoon to fill under a flow rate of 12 cfs. Conversely, it would take approximately 31 days for the lagoon to fill under a flow rate of 3 cfs.

A deep, properly functioning, freshwater lagoon is important to steelhead as it provides an area where the steelhead can make the transition from freshwater to saltwater, provide adequate food resources to grow quickly and allow fish to escape from predators by maintaining refuge habitat. It has been estimated that the lagoon could support approximately 5,000 juveniles under natural conditions based on comparisons with Pescadero, San Gregorio and Scott Creek lagoons north of the San Lorenzo River (Alley, 2001). Though this estimate may be overly optimistic due to the high level of impacts that are occurring in the upper watershed of the San Lorenzo relative to these other more-protected watersheds, the potential still exists for a healthy population of juvenile steelhead in the San Lorenzo River lagoon.

In addition to the physical and biological factors that limit juvenile steelhead production in the lagoon, chemical factors also play a role in steelhead survival. These factors include water quality parameters necessary for juvenile survival and optimal rearing. Parameters such as pH, dissolved oxygen (DO), water temperature and salinity all influence the viability of the lagoon as habitat for juvenile salmonids.

**Previous Management Measures Applied to Estuarine Reach**

The Estuarine Reach includes a “no maintenance zone” in the channel bottom area and maintenance in this reach has been minimal, concentrating primarily on vegetation management on the levee slopes. Vegetation along the levee toe is maintained in a 10-foot buffer, although buffer widths have been irregular due to limited management of maintenance crews. Removal of non-natives has not occurred in any organized manner in this reach. The City of Santa Cruz does not presently implement a sandbar management or breaching program for the mouth of the San Lorenzo River, but did so prior to 1995. Breaching activities were ceased following issues with public safety and natural resource management (i.e., steelhead). The sandbar across the mouth of the river forms naturally through wave action in the late spring and summer. The sand bar closes the mouth of the river and forms a seasonal summer lagoon; in wetter years it appears that the sand bar self-breaches when the lagoon fills and spills over the sandbar. However, unregulated breaching of the sandbar may occur by the hand of others during the summer months. No enforcement or regulations are posted at the mouth of the river regarding illegal breaching, endangered species or habitat requirements.
3.0 FINDINGS, OPPORTUNITIES & CONSTRAINTS, AND RESTORATION & MANAGEMENT GOALS & OBJECTIVES

3.1 FINDINGS

The following findings are provided based on review of data collection and analysis for geomorphic, hydrologic, and biologic conditions within the river corridor during summer and fall 2000 and 2001. These findings provide the basis for identification of problems affecting the viability of the Lower River for aquatic and terrestrial species, as well as conditions of the riparian and aquatic habitat throughout the corridor. The findings also identify habitat areas in the Lower River that are serving as adequate or good habitat for aquatic and terrestrial species.

Riverine Reach (Highway 1 to Water Street)

- The Riverine Reach is a critical reach in achieving flood control and needs to be managed to ensure the passage of the FEMA 100-year flood level.

- The Riverine Reach is an area where the river bed aggrades and sediments accumulate. Periodic sediment removal may be necessary in this reach.

- The Riverine Reach is geomorphically diverse, supporting two channels during higher flow years and one channel during lower flow years.

- An important geomorphic feature that is present throughout the Riverine Reach is the presence of cross-channels that flow between the two primary channels. These bars allow for bar scour during higher flows and provide variability in velocities along the channel.

- The Riverine Reach has smaller stands of riparian vegetation and an irregular riparian buffer due to past management actions. Riparian vegetation has little structural diversity and is composed mostly of willow species of similar height and density.

- The Riverine Reach has been in a state of geomorphic transition since the last dredging operation of the mid 1980s.

- The Riverine Reach supports more varied fisheries habitat than other areas of the Lower River. Habitat includes fast riffles, swift runs, and fast water areas at heads of pools.

- The Riverine Reach can be enhanced through application of management measures and restoration actions which enhance channel complexity and establish riparian buffers consistent with flood control constraints.
Transitional Reach (Water Street to Laurel Street Bridge)

- The Transitional Reach functions as both a riverine and an estuarine system depending on whether the rivermouth has a sand bar in place or not.

- The Transitional Reach supports the most significant stand of mixed riparian forest in the study area. This stand is located in San Lorenzo Park and should be managed to promote species diversity and structural diversity, as well as cover for steelhead.

- Geomorphically the Transitional Reach is characterized by channel and bar features that are formed during winter months when the rivermouth is open and includes a primary bankfull channel with several secondary side channels that only have water during high flow events. The secondary channels tend to scour during high flow events and can provide back channel pools as flows recede.

- The impact from sandbar breaching is significant to the Transitional Reach because of the rapid change from estuarine, deep water to shallow freshwater conditions. These rapid changes allow very little response time for biotic communities to react to the new hydrologic regimes.

- One of the few significant riffles in the study area is located in the Transitional Reach. This riffle does provide a food source to steelhead as shown by a mayfly hatch witnessed during summer 2001.

- Steelhead have been observed to utilize the eastern bank of this reach which includes shallow pool and glide areas and significant cover from undercut banks and overhanging vegetation.

- The west bank of the Transitional Reach should be a focus of prescribed vegetation management and restoration actions.

Estuarine Reach (Laurel Street to Pacific Ocean)

- The Estuarine Reach contains the most degraded riparian area due to invasion of non-natives, the presence of riprap and past management actions.

- Vegetation in this reach is influenced by the presence of saltwater and saline soils.

- The Estuarine Reach contains the most degraded fisheries habitat (refugia) of the entire study area due to lack of cover and in-stream diversity.

- Alterations to the Estuarine Reach have been significant and may have impacted the average depth of the current estuary by reducing the tidal prism. Loss of the tidal prism reduces scour on the streambed and may potentially reduce the overall circulation patterns of the estuary.
A properly functioning lagoon is essential to young steelhead as it provides an area where young steelhead can make the transition from freshwater to saltwater, provide adequate food resources to grow quickly and allow fish to escape from predators by maintaining refuge habitat.

Past water quality data collected in the lagoon showed very low dissolved oxygen levels and temperatures in ranges lethal to steelhead. Management measures proposed for lagoon management must be developed with consideration of water quality parameters and their relationship to steelhead and coho life stages.

3.2 OPPORTUNITIES AND CONSTRAINTS

The foregoing discussion of findings with regards to habitat conditions provides a starting point for defining opportunities for potential management measures and restoration actions in the Lower River and Lagoon. As described in the Existing Conditions discussion, current conditions within the Lower River are a result of past management activities and natural hydrologic processes.

An opportunities and constraints analysis provides a way of identifying known problems, developing answers to those problems (opportunities) and evaluating those answers in the context of constraints (Tables 2, 3, 4). The final outcome of such an evaluative process is the identification of opportunities that are realistic and able to be implemented. The following tables summarize problems, opportunities and constraints for the three reaches of the Lower River. The outcome of this synthesis is an identification of the management and restoration actions available to improve habitat conditions for aquatic and terrestrial species within the Lower River corridor.

<table>
<thead>
<tr>
<th>Problem</th>
<th>Opportunity</th>
<th>Constraints</th>
</tr>
</thead>
<tbody>
<tr>
<td>The reach is a sediment deposition area and may require periodic sediment removal which could affect fisheries habitat, especially pools at heads of bars</td>
<td>A sediment management plan can be developed that recognizes important habitat areas to avoid during sediment removal operations.</td>
<td>Flood capacity must be maintained and may require removal of sediment in conflict with habitat areas.</td>
</tr>
<tr>
<td>Existing riparian vegetation is narrow and lacks species and structural diversity.</td>
<td>Vegetation management can focus on protecting volunteer groves of diverse riparian species.</td>
<td>Large vegetation and groves can impede flood flows and result in loss of flood capacity.</td>
</tr>
<tr>
<td>Riverine reach can be impacted by low flows in drought years leading to fish stranding</td>
<td>Flows can be modified during these conditions to favor a single, deeper channel.</td>
<td>Creation of a low flow channel can result in short term impacts to aquatic organisms.</td>
</tr>
<tr>
<td>Instream habitat lacks large roughness objects to encourage scour holes</td>
<td>Install large roughness objects and encourage channel diversity such as cross-channels and smaller bars to favor accelerated flow conditions during higher flows.</td>
<td>Potential loss of flood capacity depending on site chosen for installation.</td>
</tr>
</tbody>
</table>
### Table 3: Problems, Opportunities, and Constraints for Transitional Reach

<table>
<thead>
<tr>
<th>Problem</th>
<th>Opportunity</th>
<th>Constraints</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sediment bars can form in this reach and colonize riparian vegetation in mid-channel.</td>
<td>A sediment management plan can be developed which recognizes important habitat areas to avoid during sediment removal operations.</td>
<td>Flood capacity must be maintained and may require removal of sediment in conflict with habitat areas.</td>
</tr>
<tr>
<td>Channel morphology is flat and shallow with little deep cover areas along west bank, especially during low flows and following breach events.</td>
<td>Install large roughness objects. Manage low water channel vegetation to encourage shoreline scour and deep pool development.</td>
<td>Potential loss of flood capacity depending on site chosen for installation and management.</td>
</tr>
<tr>
<td>The Transitional Reach is impacted by sandbar breaching.</td>
<td>A sandbar and lagoon management program needs to be developed.</td>
<td>Active management of lagoon could result in removal of legal immunity for the City.</td>
</tr>
<tr>
<td>West shoreline lacks complexity and deep pools.</td>
<td>Install boulder and log structures along with shoreline native plantings to promote scour holes and provide live cover.</td>
<td>Potential loss of flood capacity depending on site chosen for installation.</td>
</tr>
<tr>
<td>Riparian vegetation on the west bank is sparse and contains exotic/invasive species.</td>
<td>Remove invasives and exotics. Encourage native colonizers or actively plant. Manage volunteer groves for overstory canopy and cover.</td>
<td>Potential loss of flood capacity, levee slope and internal stability. Management and restoration must fit with design flood capacity.</td>
</tr>
</tbody>
</table>

### Table 4: Problems, Opportunities, and Constraints for Estuarine Reach

<table>
<thead>
<tr>
<th>Problem</th>
<th>Opportunity</th>
<th>Constraints</th>
</tr>
</thead>
<tbody>
<tr>
<td>Riparian corridor is the most degraded in this reach due to exotic/invasive species and presence of rip rap.</td>
<td>Remove invasives and exotics. Encourage native colonizers or actively plant. Manage volunteer groves for overstory canopy and cover.</td>
<td>Large vegetation and groves can impede flood flows and result in loss of flood capacity.</td>
</tr>
<tr>
<td>Fisheries habitat is the most degraded in this reach due to lack of shoreline complexity, lack of cover and instream diversity.</td>
<td>Install boulder and log structures along with shoreline native plantings to promote scour holes and provide live cover.</td>
<td>Potential loss of flood capacity depending on site chosen for installation and management.</td>
</tr>
<tr>
<td>Loss and degradation of floodplain and lagoon habitat.</td>
<td>Levee setbacks for regaining floodplain habitat and function should be explored at Third Street parking lot.</td>
<td>Levee setback areas are largely in private ownership.</td>
</tr>
<tr>
<td>There is a lack of deep water cover in the estuary.</td>
<td>A sandbar and lagoon management program needs to be developed.</td>
<td>Active management of lagoon could result in removal of legal immunity for the City.</td>
</tr>
<tr>
<td>Water quality of the lagoon needs to be better understood with regards to potential sandbar management.</td>
<td>A water quality monitoring program should be administered to provide information for sandbar and lagoon management plan. An initial water quality study is currently underway.</td>
<td>Not applicable</td>
</tr>
</tbody>
</table>
3.3 MANAGEMENT AND RESTORATION GOALS AND OBJECTIVES

The findings and opportunities and constraints analysis provides the context for identifying goals and objectives for management and restoration in the Lower River and Lagoon. The following goals and objectives also reflect information provided in the existing conditions analysis. In order to evaluate conditions such as degraded riparian habitat, degraded fisheries habitat, degraded wildlife habitat, and management issues with lagoon breaching and adequate stream flows the following goals and objectives have been identified.

While the Management Plan goals were detailed in Chapter 1, the following goals and objectives identify the desired restoration outcomes on the Lower River and Lagoon over the 15-year plan period. Immediate management and restoration actions will focus on improving vegetation and geomorphic and hydrologic conditions in the hopes that these will improve habitat conditions for wildlife species (including vertebrate and invertebrate species).

VEGETATION

Goal: To increase abundance and diversity of native plant species above baseline (2000) levels (including special status species).

Objective #1: Restore and manage native riparian forest to promote species diversity, structural diversity and density along inner and outer levee banks.

Objective #2: Increase width of riparian corridor consistent with flood protection constraints to provide increased stream shading and instream cover for aquatic organisms.

Objective #3: Enhance native populations of riparian species via natural recruitment and an active planting program.

Objective #4: Control non-native, invasive species.

Objective #5: Emulate reference (historic and extant) vegetation structure (diversity, age, community composition) and function (nutrient cycling, habitat values).

GEOMORPHOLOGY/HYDROLOGY

Goal: To restore geomorphic and hydrologic form and function to the Lower San Lorenzo River so as to improve channel and habitat conditions that will support and sustain native flora and fauna.

Objective #1: Manage instream riparian vegetation to encourage geomorphic form and function.

Objective #2: Maintain a stable bankfull channel to improve channel substrate conditions.
Objective #3: Maintain adequate baseflow through the Lower San Lorenzo River and maintain hydrologic connectivity between the estuary and the Upper San Lorenzo River.

Objective #4: Improve quality of waters entering river from stormdrains and nonpoint sources through public education, structural retrofits and pollutant source reduction.

Objective #5: Improve and maintain lagoon water quality and quantity at levels consistent with steelhead and coho salmon rearing needs.

Objective #6: Reduce water temperature to optimal levels for aquatic species rearing and reproduction.

Objective #7: Restore floodplain function through levee setbacks in areas determined to be feasible.

WILDLIFE (Vertebrate and Invertebrate Species)

Goal: To enhance habitat conditions for native and special status wildlife species (listed under federal or state endangered species acts, the Migratory Bird Act, or any other relevant legislation) dependent upon the San Lorenzo River, above baseline (2000) levels.

Objective #1: Enhance native resident and migratory fish, bird, mammal, reptile, and amphibian species abundance and richness.

Objective #2: Enhance habitat for breeding/nesting populations.

Objective #3: Sustain and increase populations of steelhead trout (*Oncorhynchus mykiss*).

Objective #4: Provide functional habitat for Western Pond Turtle (*Clemmys marmorata*) to increase potential occurrence of this species.

Objective #5: Create adequate habitat conditions to allow for migration of coho salmon (*Oncorhynchus kisutch*) into the upper watershed.

Objective #6: Enhance diversity and abundance of aquatic invertebrates, particularly sensitive indicator species.

Objective #7: Enhance diversity and abundance of terrestrial invertebrates.
4.0 MANAGEMENT AND RESTORATION RECOMMENDATIONS

4.1 CRITERIA FOR RECOMMENDATIONS

The following criteria were used to develop the management and restoration recommendations based on the opportunities and constraints and goals and objectives identified in Chapter 3.

1. Recommended management and restoration actions must acknowledge constraints such as maintenance of flood control capacity and public safety.

2. Recommended management and restoration actions should address ecosystem degradation identified in this study; and

3. Recommended management and restoration actions should work within the natural geomorphic and hydrologic processes of the river in creating and sustaining habitat.

Given these criteria the following set of recommendations for management and restoration actions listed below were developed to address specific problems related to ecosystem function and vitality in the Lower River and Lagoon. Specific recommendations may be species specific (i.e. – suggested improvements to steelhead habitat) but also include measures that address improvements to food web dynamics and physical habitat improvement that are ultimately multi-species actions, thus accomplishing the management and restoration goals identified in Chapter 3.

4.2 MANAGEMENT RECOMMENDATIONS

Management Recommendation 1:
Develop Annual Vegetation and Sediment Management Plan for Flood Control Maintenance

In an effort to evaluate the effectiveness of the current vegetation management per the 1989 Enhancement Plan and how it might be modified, the City of Santa Cruz contracted with Philip Williams & Associates (PWA) to conduct a hydraulic analysis of the channel given current (2000) conditions upstream of the lagoon. The analysis, which used similar techniques as those in the 1989 Enhancement Plan, found that the current vegetation cover, at its present density above the pedestrian bridge, is consistent with the Corps’ design assumptions and that the vegetation management is effective (PWA, 2001). Therefore, vegetation cover can be modified, but its density cannot be increased. Below the pedestrian bridge, the hydraulic analysis indicates that there are opportunities to enhance the vegetation buffer and install shoreline enhancements without affecting flood capacity. The following management recommendation recognizes these findings and presents new management prescriptions to be carried out beginning in fall 2002.
In the fall of each year the Department of Public Works and the river coordinating staff from the City Manager's Office should meet to develop a vegetation management plan for implementation during the following summer prior to winter flood flows to meet the Corps flood channel maintenance requirements. Vegetation maintenance should be conducted August – October to avoid the nest season. The plan should include the following components:

1. A 1601 Streambed Alteration Permit Application to the California Department of Fish and Game including appropriate CEQ; a 401 water quality certification form the Central Coast Regional Water Quality Control Board; and a 404 nationwide permit from the U.S. Army Corps of Engineers. Section 7 consultation (Endangered Species Act) may also be required.

2. A map or aerial photo of each reach detailing current important habitat areas to be avoided during maintenance operations.

3. For seasons where sediment removal or grading is proposed, equipment entry and exit areas should be labeled on the map or photo.

4. A list of vegetation cutting and thinning prescriptions by reach (Estuarine, Transitional, and Riverine) including delineation of required buffer areas along stream edges and toe of levee slope, as well as prescriptions for volunteer riparian grove areas (see detailed description in Tables 5 and 6 for prescriptions by reach). A 50-foot area on either side of all bridges should be kept clear of vegetation on the toe of the bank.

5. Identification of exotic/nonnative treatment areas and type of removal techniques.

6. Delineation of storm drain clean out areas.

7. List of field managers to be present or available during maintenance operations by City staff or hired contractors.

8. Description of actions to be followed if species of special concern are located during maintenance activities.
### Table 5: Recommended Vegetation Thinning Prescriptions by Reach

<table>
<thead>
<tr>
<th>Reach</th>
<th>Vegetation Management Prescription</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bankfull Channel Area</td>
<td>Remove riparian vegetation that exceeds accepted Corps Manning’s “n” roughness coefficient for the flood control channel. A 5-foot edge of stream buffer area should be maintained on either side of the wetted edge.</td>
<td>Annually</td>
</tr>
<tr>
<td>Instream Channel Bed</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Riverine Reach</td>
<td>Allow 10-foot wide strip of willow and alder along toe of levee. Willows allowed to grow to 3” dbh. Alders allowed to grow to 6” dbh. The lower limbs of the alder trees should be trimmed. The willows should be thinned to favor providing overhanging cover to the low flow channel. Maintain a 5-foot buffer along wetted edges of channel, but thin groves and limb up trees. Remove any trees in 5-foot buffer area that are greater than 6” dbh.</td>
<td>Annually</td>
</tr>
<tr>
<td>Transitional Reach</td>
<td>A 10-foot wide strip of woody riparian vegetation and tules and cattails should be maintained on the west bank. The east bank should be maintained to keep trees overhanging water. Trees or branches that fall in the water should be assessed for cutting into smaller pieces and may be removed entirely if they cause an immediate safety hazard. Sandbars should be maintained to allow volunteer groves to establish but remove all trees greater than 6” dbh.</td>
<td>Annually</td>
</tr>
<tr>
<td>Estuarine Reach</td>
<td>A 5-foot wide strip of willow, cattail and tule should be maintained at the levee toe. Willows should have stem diameter of no greater than 0.5 inches and be limbed up and periodically thinned to create defined groves.</td>
<td>Annually</td>
</tr>
</tbody>
</table>

### Table 6: Recommended Sediment Management Prescriptions by Reach

<table>
<thead>
<tr>
<th>Reach</th>
<th>Sediment Management Prescription</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Riverine Reach</td>
<td>Instream bars should be disked annually to loosen root materials and promote scour. Existing cross-channel scour areas should be encouraged through disking and manipulation of discarded root wads/vegetation material. Sediment removal areas should be defined by cross section and HEC-6 analysis and should avoid important salmonid habitat areas including riffles, pools, and runs.</td>
<td>Annually</td>
</tr>
<tr>
<td>Transitional Reach</td>
<td>Disking on the west bank should occur east of levee toe up until outside edge of 5-foot vegetation buffer. Existing cross-channel scour areas should be encouraged through disking and manipulation of discarded root wads/vegetation material.</td>
<td>As determined by cross-section monitoring</td>
</tr>
<tr>
<td>Estuarine Reach</td>
<td>Sediment management or removal is not necessary in this reach.</td>
<td>NA</td>
</tr>
</tbody>
</table>
Management Recommendation 2:
Summer Lagoon Water Level Management

Key factors for physical fish habitat are lagoon depth and water quality during the summer and fall seasons. Smith (1989) and Alley (2001) cite the artificial management of the sandbar in a closed condition at the lagoon mouth as the most effective method to maintain a freshwater lagoon and deepwater cover. The recommendation is based upon limited water quality measurements and fish population surveys conducted when the lagoon was artificially opened in the late 1980s. The hypothesis is that a closed summer lagoon is a natural condition that supports more productive habitat for steelhead, and that this closure has been disrupted by human breaching of the sandbar. This hypothesis has not been tested on the lagoon, even after sandbar breaching was halted by regulatory agencies in 1995 due to public safety concerns and natural resource management issues.

A key management recommendation in the 1989 San Lorenzo River Enhancement Plan is to regulate summer water levels in the lagoon through a manual program of sandbar creation and control. This would allow for conversion of the estuary to freshwater during the later summer, providing a more productive estuary for steelhead rearing. While this plan has merits biologically for the steelhead, the water quality conditions resulting from such a program need to be assessed in order to provide for sound management of the lagoon. Unlike a natural lagoon without anthropogenic influences, the San Lorenzo River Lagoon is influenced by surrounding land uses and water quality contaminants, including nutrients and pathogens. Water quality data collected for the estuary and its input points (stormdrains) have demonstrated high temperatures, very low dissolved oxygen (DO) levels, and the presence of nitrates (Ricker, 2001; Smith, 1989).

Due to the stratified conditions (freshwater top layer and saltwater bottom-layer) in the lagoon during most summers, DO levels and high temperatures (combined with nutrient and bacteria inputs) are more of a concern for the steelhead trout at this time. Water quality data collected in 1987-1989 documented dissolved oxygen levels in the lagoon at 5.0 mg/l and lower. Sampling was conducted in the afternoon (1:00-3:00pm) in most cases when DO levels are expected to be higher due to photosynthesis. The lowest dissolved oxygen levels corresponded to depths of 0.5 meters and deeper. These depths are the preferred depths for steelhead during rearing (Smith, 1987). The low levels of DO would therefore be expected to drive the steelhead to the shallower depths where less protection from predation is available. Congruent with low DO values, data also showed increased temperatures with increasing depth and higher salinities. This is to be expected due to the stratified conditions within the estuary with the denser saltwater remaining at the lower depths.

Documented occurrences of fish kills resulting from anoxic events are well known. Recent research completed in estuaries that become seasonally closed along the California central coast and the U.S. demonstrate that estuaries receiving high nutrient inputs may be at risk of experiencing anoxic events due to reduced circulation and mixing, elevated phytoplankton growth, and stratified photosynthesis (surface waters) and respiration (bottom waters) conditions (Beck and Bruland, 2000; D'Avanzo and Kremer, 1994). These conditions result in bottom waters becoming anoxic. Anoxic bottom waters experience a dramatic increase in
hydrogen sulfide concentrations. Hydrogen sulfide is known to be toxic to aerobic organisms. The first storm event of the season will mix the water column and expose resident fish populations to high levels of hydrogen sulfide previously isolated in bottom waters and sediments. While never officially documented in the San Lorenzo River Estuary, these conditions could hinder implementation of enhancement measures in the lower lagoon.

While there is little question that deeper water would create superior cover for rearing steelhead, there remain questions regarding lagoon closure effects on water circulation and potential eutrophication. It is also unclear whether conditions in the San Lorenzo River lagoon can be correlated to other less impacted central coast lagoons such as Pescadero Creek, Waddell, Scott and Soquel. Hydrologic and ecosystem conditions are far different in these lagoons than the urban dominated San Lorenzo River Lagoon and watershed.

The 1989 San Lorenzo River Enhancement Plan recommended a water level control structure that was subsequently designed but never installed. The main reason for not installing the structure was the liability the City would acquire if it changed the natural lagoon conditions. Natural immunity protection would not be available to the City in the case of accidents due to high water levels or during breaches. Secondly, there are questions regarding the impacts of managing the lagoon at a higher level with less circulation than if it periodically opened. There is currently insufficient data to address the water quality issues, mainly whether eutrophication would occur if the lagoon remained closed (this issue is the subject of the San Lorenzo River Estuary Water Quality Assessment currently being conducted by the City of Santa Cruz with a grant from the Central Coast Regional Water Quality Control Board).

The liability and technical questions surrounding artificial lagoon closure could not be resolved during this study. However, since there could be significant direct benefits to steelhead, further study and investigation should be a high priority to attempt to resolve the outstanding issues.

The specific recommended measures for lagoon water level management are:

i. Conduct year 2 of the San Lorenzo River Estuary Water Quality Assessment to estimate impacts of summer lagoon closure. This study and accompanying recommendations will be completed in Fall 2002 under a grant from the Central Coast Regional Water Quality Control Board. The study will evaluate dissolved oxygen, temperature, pH, salinity and the potential for eutrophic events under open and closed lagoon conditions.

ii. Seek State legislation to address liability issues for river lagoon management projects.

iii. Assess differences in conditions at other central coast lagoons and the applicability of recommended management measures of these systems to the San Lorenzo River Lagoon.

iv. Determine alternative management strategies to address Steelhead needs in case it is not feasible to control summer lagoon water levels artificially (Note: some of the measures described below will aid Steelhead habitat whether the lagoon water level is managed or not).
Implementation of Recommendation 2 is contingent upon completion of the water quality assessment and resolution of the City’s liability concerns, the timeline of which is unknown. Completion of assessments of other lagoons and their applicability to the San Lorenzo River Lagoon, as well as identifying what other management actions could create similar benefits, is unknown. If all of the outstanding issues were resolved it could potentially take two years to implement structural control of water levels in the lagoon.

Management Recommendation 3:
Establish a Streamflow Standard for Inflow into the Lagoon and Maintenance of a Low Flow Channel

Adequate streamflow into the lagoon is an essential element in maintaining a productive freshwater lagoon to improve habitat conditions for steelhead and overall aquatic ecosystem health. Maintenance of a freshwater lagoon is dependent upon stream flow and the configuration and geomorphic characteristics of the low water channel. Key factors are the seasonal and life cycle needs of key aquatic organisms, the hydrologic character of the waterway, the amount of precipitation and its timing year-to-year (i.e. drought, average, or wet). The two key management issues relate to the amount and timing of streamflow, and the need to maximize habitat value with the amount of flow available through enhancement of the low water channel condition.

During dry periods, streamflow to the Lower River has been reduced significantly due to drought conditions and water diversion. Little information is known about the relationship between inflows to the Lower River and lagoon, flow losses to percolation from stream gaging points, and water diversion impacts. Streamflow data taken below the City’s diversion at Tait Street indicate flow levels as low as 0.01 cfs during some late summer days during drought periods (USGS Gage #11161000).

The Tait Street Diversion is a primary component of the City’s water supply system and is the primary water source during the summer and fall months. The City Water Department is in the process of developing a long-term water supply plan to address a potential 48 percent shortfall during a drought period. The Water Department is presently involved in the development of a Habitat Conservation Plan (HCP) for steelhead and coho salmon, which will examine diversion issues; its development and implementation is several years away. In the nearer term, the County of Santa Cruz is preparing a Steelhead Enhancement Plan for the San Lorenzo River Watershed (a companion project to the Management Plan), which includes an examination of long term water supply, facilities and operations throughout the watershed for the dual objectives of enhancing stream flow for steelhead and providing greater reliability for supply.

Management Recommendation 3 addresses the low flow habitat issues through adaptive management of the low flow water channel as part of the annual maintenance plan, and through developing the preliminary technical basis for determination of a recommended inflow for the Lower River. The recommendations provided below are designed to make the best use of streamflow entering the Lower River and lagoon, and to develop a preliminary bypass flow recommendation to be further developed by additional water balance modeling.
i. Adaptively manage the low flow channels and habitat in the reaches between Highway One and the mouth through annual inspections and implementation of enhancement measures from early spring through late summer. An adaptive strategy should be developed for annual management of the low water channel based upon May projections of late summer and fall streamflow and the conditions of channel(s) in the Riverine and Transitional Reaches (see Appendix B). Based upon an examination of channels and streamflow in May, a team consisting of a fisheries biologist, riparian biologist, construction contractor (one specializing in stream work), City staff and representatives of the California Department of Fish and Game and National Marine Fisheries Service (NMFS) will formulate that year’s plan for low water channel management and consider the following actions:

a) Establish one channel as the main low flow channel when it appears that summer and fall stream flow will result in less habitat in multiple channels. Use low impact methods to achieve single flow establishment and assess whether fish salvage operations are needed and if the risks associated with salvage are outweighed by the projected benefits of a single channel. Results from an analysis of historic streamflow records and additional data collected in the spring and summer of 2001 suggest that at flows less than 3 cfs, steps should be taken to direct the flow into a single channel. This is an interim recommendation that would require further analysis as conditions in the Riverine Reach change due to winter flows (see Appendix B). Flow measurements, taken in May can be used in conjunction with developed exceedence values to predict late summer flow conditions.

b) Consider installation of instream cover elements such as logs, transplanted willows and other objects.

ii. Consider alternative additional sources of water for streamflow entering the Lower River and lagoon, such as reclaimed wastewater, if water quality standards are acceptable.

iii. Attempt to maintain a minimum flow requirement to the Lower River and lagoon of 6.5 cfs during the period designated for lagoon filling. This would allow the lagoon to fill with freshwater in approximately 7 days based on the water balance model developed in this report (see Appendix B). A seven-day filling period seems reasonable considering the frequent breach events that have occurred at the mouth the past few years. If less frequent breaches occur (as is hoped once a lagoon water level management program is in place), this minimum flow requirement can be reduced to account for a single summer filling. A minimum flow requirement of 6.5 cfs through the Lower River would also reduce the need to manage the bifurcated channel in the Riverine Reach except in below average flow years.

This recommendation is based on a preliminary water balance model developed for the Management Plan (see Appendix B) and should be considered an interim
recommendation until a more detailed water balance model can be developed. The model has not been tested and a more comprehensive model should be developed with the assistance of appropriate resource agencies. Flow records show that in below normal rainfall years such a flow is not available as far upstream as Felton and so the implementation of the 6.5 bypass will be a complicated exercise. Maintenance of the minimum bypass will require negotiations with existing water users watershed wide. As described in Chapter 2, Existing Conditions, the San Lorenzo River has been fully appropriated between the months of June and October for water supply by the California State Department of Water Resources. There are currently dozens of appropriative users and riparian rights in the watershed. In order to achieve greater flows downstream, it will be important to look for solutions that include every appropriator in the San Lorenzo system.

Based on current water demand and water supply shortfalls, the City of Santa Cruz Water Department presently cannot guarantee that a 6.5 cfs bypass could be provided due to the fact that the Tait Street diversion provides as much as 75% of the summer daily water demand for City users. Appropriative water rights at the Tait Street diversion currently allow for diversion of 12.2 cfs, however the diversion is currently operated to allow as much bypass as feasible.

The City of Santa Cruz will ultimately need to consult with state and federal agencies, such as the California Department of Fish and Game and the National Marine Fisheries Service to determine an appropriate minimum bypass to maintain a freshwater lagoon.

4.3 RESTORATION RECOMMENDATIONS

As described previously, enhancement of the Lower River and Lagoon will require both management actions and restoration projects to restore ecosystem function. The following restoration projects are recommended for implementation in the Lower River corridor.

Restoration Recommendation 1:
Enhance Streambed Aquatic Cover and Substrate in Estuarine and Transitional Reaches

Many aquatic organisms require a narrow range of substrate conditions for different phases of their life cycle along with the presence of organic matter and substrate to maintain low water temperatures, and provide cover and food. Steelhead require adequate cover in order to escape predators such as waterfowl and humans. Besides maintaining the water level of the lagoon at a higher level in the summer months, cover can be provided by:

- Undercut banks, usually formed by scour in the low water channel against root bound soils;
- Scour holes around large roughness objects such as wood stumps, root wads, rocks, patches of tules or cattails, bridge piers or logs;
Pools resulting from natural bar forms and meandering in alluvial materials, riffles and pools.

The dominance of a sandy streambed in the San Lorenzo River allows filling of pools during low flows when sand is still mobile but scouring action against roughness objects is limited. Sand also fills the interstices of coarse substrate often embedding potential rearing areas and escape cover.

Primary productivity of aquatic invertebrates, essential for food production for steelhead, is very limited in a streambed dominated by sand substrate. Coarse gravels and cobbles generally free of fine sediments are necessary for good primary productivity. Large roughness objects (see Figure 17) also benefit the sorting of sediment loads by hydraulically concentrating the hydraulic force of available flow. Scour holes are generally flushed of fine sediments and a sorting to fine gravels occurs at the scour hole tail out. The presence of large roughness objects is essential to overcoming the abundant supply of fine sediment in the San Lorenzo River system.

The improvements in riparian vegetation cover over the past 12 years since implementation of the first Enhancement Plan has dramatically increased root bound soils and undercut banks and has concentrated flow and bed scour to the point where cobbles and gravel substrates have been exposed. Natural processes of bar formation and meandering has allowed for pool development. Further improvements in fish habitat and ecosystem diversity can be realized if geomorphic and vegetative processes are enhanced.

The proposed enhancements are designed to improve existing natural geomorphic processes of scour and sediment deposition. They will aid in diversifying small-scale hydraulic conditions that have already proven successful through vegetation management.

Improvement of aquatic habitat cover and substrate can be accomplished by installing log and boulder structures as well as vegetation plantings and placement of additional substrate material. These improvements could be implemented from 2001-2005 with improvements to channel and habitat conditions monitored to assess their effectiveness.

Two types of structures are recommended:

- **Log / boulder structures** (Figure 17) consist of large logs, in excess of 30 inches in diameter, at least 15 feet long and with root wad attached, cabled to large boulders, in excess of 30 inches mean diameter or 1.5 tons. These are commonly used as naturalistic large roughness objects to promote bed scour for pool formation and to flush sand leaving coarser particles of cobbles and gravels (CDFG, 1998; Rosgen 1993). In the example shown (see photo), the hydraulic effect of the log/boulder structure was sufficient to move large cobbles and small boulders leaving a deep 3+ foot hole and wood cover. These structures would be placed along the edge of the low water channel in the upper estuarine and transitional reaches. In the San Lorenzo River, the boulder segments of these structures would likely sink into the sandy bed during flood events, but the log would be buoyant, align in the direction of flow and should persist on the channel bed surface up to 20 years. They could be
Figure 17: Plan and profile depictions of log and boulder large roughness objects placed on streambed to induce bed scour and enhance instream habitat.
periodically rehabilitated using large logs washed onto the City’s beaches in the winter (these are normally removed at an expense).

Large virgin timber logs, including conifers from the watershed and riparian trees from the riverbanks upstream, were once an important source of large roughness objects in the Lower River and lagoon. The City's efforts to remove large conifer logs from bridges during large floods (1982 and at the Soquel Avenue bridge in 1999) and from beaches after moderate flood events are evidence of the abundance of logs in the watershed. The proposed log / boulder structures would help replace the original large woody and roughness objects. An effort could be made to use beach logs as a replenishment source in the river. Natural recruitment of woody debris should also be encouraged through policies designed to limit log removal in the upper watershed.

![Image of log / boulder habitat enhancement structure for streambed and shoreline enhancement.]

- Cobble and cattail bulrush structures: One type of large roughness object observed on the streambed of the project reach are stands of emergent clumps of bulrush or cattails found at the base of the low water channel banks or at the head of islands. In some instances, these clumps are rooted into a cobble substrate. These clumps provide a large roughness object for scouring holes in the riverbed, a host for primary productivity and escape cover for fish. Tules and cattails are also neutral for flood capacity impact as they are pushed down to the streambed quite easily in small floods.

Figure 18 shows a sketch of the proposed structures. These can be placed directly on the streambed, or at the base of banks that are lacking riparian cover. Plant materials are abundant in the Riverine Reach and could be scavenged for the structures.
Figure 18: Plan and profile depictions of tule / cattail clumps placed on streambed to induce bed scour and enhance instream habitat.
Restoration Recommendation 2: Enhance Riverbank Shoreline Habitat in Transitional and Estuarine Reaches

Shoreline conditions are degraded along reaches of the Transitional and Estuarine Reaches due to a lack of vegetation and rooted soil mass in the banks and straight rock rip rap slopes, especially below Riverside Avenue. These measures will help create diversity along the shoreline, increase shoreline hydraulic roughness to induce fine sediment deposition on the shoreline slope and provide opportunities for soil development and plant colonization.

Three shoreline treatments are proposed for enhancement measures. Installation of these treatments will require detailed plans for access and construction techniques including types of equipment. These treatments could be implemented from 2002-2005. They include:

i. Log boulder structures similar to those proposed for the streambed enhancements but laid on the shoreline slope;

ii. Install bulrush/cattail cobble structures at shoreline.

- Log Boulder Structures along the Shoreline: Figure 19 shows log boulder structures for shoreline placement. The priority sites are the Estuarine Reach and the lower Transitional Reach below Soquel Avenue. These are designed to provide cover, encourage hydraulic variability and induce scouring on the streambed at the toe of the bank. These are similar in materials as the streambed placed structures, however placement is along the interior slope of the levees, especially rip-rap sections in the Estuarine Reach below Riverside Avenue.

- Bulrush/Cattail cobble structures at Shoreline: The bulrush/cattail cobble structures are identical to the streambed versions with the exception that placement should occur at the shoreline. The structures should be placed where bank vegetation is degraded or non-existent and should be used as a stopgap for bank vegetation enhancement projects to provide cover and scour hole opportunities.
Figure 19: Plan and profile depictions of log/boulder structures placed along shoreline to induce bed scour and enhance in-stream habitat. Not to scale.
**Restoration Recommendation 3:**
Enhance Riverbank Shoreline and Riparian Corridor Vegetation

Recommendation 3 involves vegetation management with the goal of improving the aquatic habitat value of the shoreline for improved fisheries habitat and expansion of the riparian corridor for overall ecosystem health. Improvement will be achieved by expanding native vegetation with improvement projects and modifications to the City's vegetation maintenance plan. Both of these actions are designed to improve species diversity and structure. The focus of the improvement project areas are the toe-of-levee to shoreline zone of the Estuarine and Lower Transitional Reaches, where cover is thin and exotic vegetation dominates. Modifications to the current vegetation maintenance removal procedures will allow for natural plant succession and species diversification.

A phased approach is recommended to improve the shoreline and riparian corridor vegetation. The plan should be phased in between 2002 and 2005 and include the following elements:

- Phase one concentrates on reducing levels of invasive, non-native plant species;
- Phase two would monitor the rate of natural recruitment of native plant species and levels of invasive non-native plants, including tracking the effectiveness of earlier removal efforts;
- The third phase would consist of active revegetation methods such as planting container stock or seeding.
- A fourth phase would be the maintenance and monitoring of restoration and revegetation efforts (addressed as part of Chapter 6).
The phasing is designed to accomplish enhancement by first creating conditions where the existing riparian vegetation can expand by natural recruitment. This would reduce intervention efforts to a low level. Where this is not feasible, or where natural recruitment proves insufficient, active revegetation would then be applied.

**Phase 1: Control of Invasive Non-native Plant Species**

Control and/or eradication of invasive, non-native species is essential to restoring the riparian corridor to a more natural condition than presently exists. At present, invasive, non-native species are displacing and out-competing native vegetation, especially on the levee slopes. The elimination of such invasive species would encourage an increase in the number and diversity of native plant species. The following discussion primarily addresses controlling the invasive non-native species that occur on the inner levee slopes and channel edge.

- **Non-herbicide Methods for the Control of Invasive Non-native Plants:**
  
  i. Mechanical control such as mowers, flaming equipment, and weed trimmers,
  
  ii. Manual methods such as hand pulling and hoeing
  
  iii. Biological control (use of natural enemies/insect predators),
  
  iv. Maintenance practices such as mulching and solarization with plastic sheeting
  
  v. Physical controls such as traps and barriers.

- **Integrated Pest Management.** The control of invasive non-native plants should have an integrated approach, and should be performed in accordance with the City of Santa Cruz Pesticide Use Policy, as adopted on November 10, 1998 and updated annually. The urban riparian corridor is located on City property. According to the Pesticide Use Policy, City departments and City contractors should “eliminate or reduce pesticide applications on City property to the maximum extent feasible”. City departments should give first priority to available non-pesticide, alternative control methods, when considering the use of pesticides on City property, especially near watercourses and riparian areas. “The application of pesticides may remain an option if alternative control methods are not effective” (ibid) especially for situations where extreme invasive non-native species (i.e., *Arundo sp.*) may be present. Current scientific literature and study should guide the use of any chemical controls of non-native species.

- **Priority Ranking for Control.** The invasive, non-native plants occurring within the study area have been assigned a priority ranking for control of high, medium or low (Table 7). High priority species are considered the most invasive and in need of control or eradication. The majority of the high priority species listed in Table 7 are perennial and spread aggressively (i.e., French broom, pampas grass, fennel, English ivy, kikuyu grass, and acacia). These species are recommended for removal/control as soon as possible. It is expected that control/eradication of high priority species will continue for up to five years, depending on available funding and staffing.
Table 7: Existing Invasive, Non-Native Plants Observed in the Urban San Lorenzo River Riparian Corridor

<table>
<thead>
<tr>
<th>Invasive, Non-Native Species</th>
<th>Priority for Control</th>
<th>Riverine Reach</th>
<th>Transitional Reach</th>
<th>Estuarine Reach</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bindweed (Convolvulus arvensis)</td>
<td>High</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Blue Gum (Eucalyptus globulus)</td>
<td>High</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Bull Thistle (Cirsium vulgare)</td>
<td>Medium</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Cape Ivy (Senecio micranoides)</td>
<td>High</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Cocklebur (Xanthium strumarium)</td>
<td>Low</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>English Ivy (Hedera helix)</td>
<td>High</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Fennel (Foeniculum vulgare)</td>
<td>High</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Field Mustard (Brassica rapa)</td>
<td>Medium</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>French Broom (Genista monspessulana)</td>
<td>High</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Green Wattle Acacia (Acacia decurrens)</td>
<td>High</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Himalayan Blackberry (Rubus procerus)</td>
<td>Low</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Iceplant or Sea Fig (Carpobrotus edulis)</td>
<td>Medium</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Italian Ryegrass ( Lolium multiflorum)</td>
<td>Medium</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Johnson Grass (Sorghum halepense)</td>
<td>Low</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Kikuyu Grass (Pennisetum clandestinum)</td>
<td>High</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Nasturtium (Tropaeolum majus)</td>
<td>Low</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pampas Grass (Cortaderia jubata)</td>
<td>High</td>
<td>X</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Periwinkle (Vinca major)</td>
<td>High</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pin Cushion (Scabiosa atropurpurea)</td>
<td>Low</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Prickly Wild Lettuce (Lactuca serriola)</td>
<td>Medium</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Rabbit’s Foot Grass (Polypogon monspelensis)</td>
<td>Medium</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Rice Grass (Piptatherum miliecum)</td>
<td>Medium</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Ripgut Brome (Bromus diandrus)</td>
<td>Low</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Tangier Pea (Lathyrus tingitanus)</td>
<td>Low</td>
<td>X</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Tree-of-Heaven (Ailanthus altissima)</td>
<td>Medium</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Red Valerian (Centranthus ruber)</td>
<td>Low</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Velvet Grass (Holcus lanatus)</td>
<td>High</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>White Sweet Clover (Melilotus albus)</td>
<td>Medium</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Wild Radish (Raphanus sativus)</td>
<td>Low</td>
<td>X</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Yellow Dock (Rumex crispus)</td>
<td>Medium</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
</tbody>
</table>

Key:  
E = Eastside  
W = Westside  
NE = Northeast Side  
SW = Southwest Side
Medium priority species for control are also aggressive and may create large stands. Given site conditions, these species are not considered as invasive as the high priority species listed, but also should be reduced to lower levels. Medium priority invasive plant species are often annuals or biennials. Examples of invasive non-native species having medium priority for control include: bull thistle, white sweet clover, prickly wild lettuce, Italian ryegrass, rice grass, and ice plant. Medium priority species should be removed once high priority invasive plant species are under control, and have either been contained or significantly reduced, depending on the particular species.

As described above, the control of invasive, non-native species should have an integrated pest management plan that employs a variety of control measures, including: manual, mechanical, physical, and chemical (last resort). The use of herbicides is best restricted to high priority species, especially rhizomatous (spreads by underground stems) plants such as kikuyu grass and stump-sprouting trees that are difficult to eradicate (e.g., green wattle acacia and blue gum eucalyptus). Herbicides should only be applied by personnel who are trained and licensed to do so. Most medium priority species can be removed mechanically by uprooting, pulling, and hoeing below the ground. As control measures are implemented, it is important to minimize disturbance to the soil, since invasive species establish readily in open disturbed areas. Non-chemical methods are preferred whenever possible.

- **Size of Treatment Areas.** In order to minimize soil erosion and sedimentation into the river, it is recommended that invasive non-native plants be removed from small areas (less than 3 meters in diameter) at a time. In some locations, it may be possible to have longer treatment areas/strips that are oriented with the long side along the contour of the riverbank. The treatment strip would be placed so that there would be vegetation below the removal area to trap the loosened soil. Once the areas have been cleared of invasive plant species, the resulting barren soil should be seeded or stabilized with a layer of weed-free mulch and/or fiber rolls to shorten the run of the inner levee slope. The specific type of erosion control needed after invasive non-native species removal should be determined on a case-by-case basis for each restoration area.

- **Containment versus Eradication.** In some instances, it may not be feasible to eradicate all of an invasive non-native species, but the species could be reduced to an acceptable level. A success criterion of a maximum of 10% vegetative cover of invasive non-native plant species is suggested. Kikuyu grass is particularly difficult to eradicate, and may be a species that needs to be contained to smaller patches, especially if herbicides are not used. Kikuyu grass is rhizomatous, and easily reproduces from stem fragments. This invasive grass species spreads to form thick patches of woven turf. Deep scalping is necessary to remove the turf, and consequently leaves disturbed soil surfaces. The resulting barren slopes may be subject to soil erosion, which could cause sedimentation into the river.

- **Documentation.** Photographs should be taken of the specific restoration sites both before and after removing the invasive non-native plants present. Ideally the locations will also be mapped onto an aerial photograph, so that monitoring and follow-up removal may be accurately conducted. Notes should be recorded on the
types of control methods used (hand-pulling, hoeing, etc.), frequency, the number of labor hours involved, and whether erosion control measures were implemented. This information will help the City determine the level of future maintenance needed to control/remove invasive non-native plants.

**Phase 2: Monitor Natural Recruitment of Native Plant Species**

Once the invasive plant species have been removed, the restoration sites should be monitored in spring and fall for 1 to 2 years to see which native plant species re-establish naturally. A qualified botanist should conduct monitoring of natural recruitment.

The effectiveness of removal methods for invasive non-native plants should also be monitored. Notes recorded on naturally recruiting native species will guide the active revegetation of the restoration sites, if revegetation is deemed necessary. The proposed planting lists in this plan (Tables 8, 9 and 10) are therefore subject to refinement according to the monitoring results.

**Phase 3: Revegetation Program to Promote the Establishment of Native Plants**

In general, a conservative approach is recommended for active revegetation. Natural processes that allow recruitment of native plant species are preferred and likely to be more successful than planting. If planting is desired or needed, it is recommended that smaller revegetation areas should be implemented first, as field tests. The estuarine area is anticipated to be one area where active revegetation will need to occur due to the condition of riprap slopes. Once field-testing proves successful, revegetation activities may be increased in scope. The revegetated areas may require periodic removal of invasive non-native plants, or the expansion of existing plant communities. Vegetated islands or upper portions of sandbars, having more stable conditions, may also be an option for planting, if compatible with the results of the hydraulic studies. The amount of planting will also be limited in that too much vegetation/roughness can impede water flows and compromise flood control measures. In general, areas close to the bridges should not be planted, as these constriction points need to be kept clear for flood capacity.

**Native Plant Species Proposed for Revegetation**

As mentioned above, monitoring areas for natural recruitment of native plants will provide information that may be used to refine the planting lists presented in this report (Tables 8, 9, and 10). A proposed planting list has been prepared for the Riverine Reach, Transitional Reach, and Estuarine Reach. The species listed and their bank locations have been determined through field surveys along the river and at coastal reference sites.

- **Riverine Reach (Highway 1 to Water Street Bridge).** The plant species proposed for revegetation in the Riverine Reach are listed in Table 8. All of the tree species listed, including white alder, black cottonwood, box elder, and yellow willow, have been observed along the urban riparian corridor. Many of the listed shrubs (California blackberry, coffeeberry, wild rose, and thimbleberry) have berries that may be utilized by wildlife. Sandbar willow (*Salix exigua*) has been observed at the Pajaro River in Watsonville, but not at the San Lorenzo River. Sandbar willow may have been present historically and is a good species to plant in sandbars and along
Table 8: Species List for Revegetation in the Riverine Reach

<table>
<thead>
<tr>
<th>Common Name</th>
<th>Scientific Name</th>
<th>Bank Location</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Trees:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Arroyo Willow</td>
<td><em>Salix lasiolepis</em></td>
<td>Channel edge</td>
</tr>
<tr>
<td>Black Cottonwood</td>
<td><em>Populus trichocarpa</em></td>
<td>Levee Slope</td>
</tr>
<tr>
<td>Box Elder</td>
<td><em>Acer negundo</em></td>
<td>Upper Levee Slope</td>
</tr>
<tr>
<td>California Sycamore</td>
<td><em>Platanus racemosa</em></td>
<td>Levee Slope</td>
</tr>
<tr>
<td>Red Willow</td>
<td><em>Salix laevigata</em></td>
<td>Upper Levee Slope</td>
</tr>
<tr>
<td>White Alder</td>
<td><em>Alnus rhombifolia</em></td>
<td>Toe of Levee Slope</td>
</tr>
<tr>
<td>Yellow Willow</td>
<td><em>Salix lasiandra</em></td>
<td>Toe of Levee Slope</td>
</tr>
<tr>
<td><strong>Shrubs:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>California Blackberry</td>
<td><em>Rubus ursinus</em></td>
<td>Levee Slope</td>
</tr>
<tr>
<td>Coffeeberry</td>
<td><em>Rhamnus californica</em></td>
<td>Levee Slope</td>
</tr>
<tr>
<td>Creek Dogwood</td>
<td><em>Cornus californica</em></td>
<td>Toe of Levee Slope</td>
</tr>
<tr>
<td>Hooker’s Primrose</td>
<td><em>Oenothera elata ssp. hookeri</em></td>
<td>Channel edge</td>
</tr>
<tr>
<td>Mugwort</td>
<td><em>Artemisia douglasiana</em></td>
<td>Levee Slope</td>
</tr>
<tr>
<td>Sandbar Willow</td>
<td><em>Salix exigua</em></td>
<td>Channel edge</td>
</tr>
<tr>
<td>Thimble Berry</td>
<td><em>Rubus velatinus</em></td>
<td>Levee Slope</td>
</tr>
<tr>
<td>Wild Rose</td>
<td><em>Rosa californica</em></td>
<td>Levee Slope</td>
</tr>
<tr>
<td>Yellow Bush Lupine</td>
<td><em>Lupinus arboreus var. arboreus</em></td>
<td>Levee Slope</td>
</tr>
<tr>
<td><strong>Herbs &amp; Grasses:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bee Plant</td>
<td><em>Scrophularia californica</em></td>
<td>Levee Slope</td>
</tr>
<tr>
<td>Bog Rush*</td>
<td><em>Juncus effusus ssp.</em></td>
<td>Channel edge</td>
</tr>
<tr>
<td>Bulrush</td>
<td><em>Scirpus californicus</em></td>
<td>Channel edge</td>
</tr>
<tr>
<td>Cattail</td>
<td><em>Typha latifolia</em></td>
<td>Channel edge</td>
</tr>
<tr>
<td>Creeping Wild Rye Grass</td>
<td><em>Levmus triticoides</em></td>
<td>Levee Slope</td>
</tr>
<tr>
<td>Matted Water Primrose**</td>
<td><em>Ludwegia peploides</em></td>
<td>Channel edge</td>
</tr>
<tr>
<td>Pacific Silverweed</td>
<td><em>Potentilla anserina ssp. pacifica</em></td>
<td>Toe of Levee Slope</td>
</tr>
<tr>
<td>Slough Sedge*</td>
<td><em>Carex obnupta</em></td>
<td>Channel edge</td>
</tr>
<tr>
<td>Water Parsley*</td>
<td><em>Oenanthe sarmentosa</em></td>
<td>Channel edge</td>
</tr>
<tr>
<td>Yarrow</td>
<td><em>Achillea millifolium</em></td>
<td>Levee Slope</td>
</tr>
</tbody>
</table>

* Good for slow back water areas.
** Good for aquatic cover.
# Table 9: Species List for Revegetation in the Transitional Reach

<table>
<thead>
<tr>
<th>Common Name</th>
<th>Scientific Name</th>
<th>Bank Location</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Trees:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Arroyo Willow</td>
<td><em>Salix lasiolepis</em></td>
<td>Channel edge</td>
</tr>
<tr>
<td>Black Cottonwood</td>
<td><em>Populus trichocarpa</em></td>
<td>Levee Slope</td>
</tr>
<tr>
<td>Box Elder</td>
<td><em>Acer negundo</em></td>
<td>Levee Slope</td>
</tr>
<tr>
<td>Red Willow</td>
<td><em>Salix laevigata</em></td>
<td>Levee Slope</td>
</tr>
<tr>
<td>White Alder</td>
<td><em>Alnus rhombifolia</em></td>
<td>Toe of Levee Slope</td>
</tr>
<tr>
<td>Yellow Willow</td>
<td><em>Salix lasiandra</em></td>
<td>Toe of Levee Slope</td>
</tr>
<tr>
<td><strong>Shrubs:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Coffeeberry</td>
<td><em>Rhamnus californica</em></td>
<td>Levee Slope</td>
</tr>
<tr>
<td>Coyote Brush</td>
<td><em>Baccharis pilularis</em></td>
<td>Levee Slope</td>
</tr>
<tr>
<td>Hooker’s Primrose</td>
<td><em>Oenothera elata</em> ssp. hookeri</td>
<td>Channel edge</td>
</tr>
<tr>
<td>Marsh Baccharis</td>
<td><em>Baccharis douglasii</em></td>
<td>Levee Slope</td>
</tr>
<tr>
<td>Mugwort</td>
<td><em>Artemisia douglasiana</em></td>
<td>Levee Slope</td>
</tr>
<tr>
<td>Sandbar Willow</td>
<td><em>Salix exigua</em></td>
<td>Channel edge</td>
</tr>
<tr>
<td>Yellow Bush Lupine</td>
<td><em>Lupinus arboreus var. arboreus</em></td>
<td>Levee Slope</td>
</tr>
<tr>
<td><strong>Herbs &amp; Grasses:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Baltic Rush</td>
<td><em>Juncus balticus</em></td>
<td>Channel edge</td>
</tr>
<tr>
<td>Bee Plant</td>
<td><em>Scrophularia californica</em></td>
<td>Levee Slope</td>
</tr>
<tr>
<td>Bog Rush*</td>
<td><em>Juncus effusus</em> ssp.</td>
<td>Channel edge</td>
</tr>
<tr>
<td>Bulrush</td>
<td><em>Scirpus californicus</em></td>
<td>Channel edge</td>
</tr>
<tr>
<td>California Aster</td>
<td><em>Aster chilensis</em></td>
<td>Levee Slope</td>
</tr>
<tr>
<td>Cattail</td>
<td><em>Typha latifolia</em></td>
<td>Channel edge</td>
</tr>
<tr>
<td>Creeping Wild Rye Grass</td>
<td><em>Leymus triticoides</em></td>
<td>Levee Slope</td>
</tr>
<tr>
<td>Matted Water Primrose**</td>
<td><em>Ludwegia peploides</em></td>
<td>Channel edge</td>
</tr>
<tr>
<td>Pacific Silverweed*</td>
<td><em>Potentilla anserina</em> ssp. pacifica</td>
<td>Toe of Levee Slope</td>
</tr>
<tr>
<td>Sky Lupine</td>
<td><em>Lupinus nanus</em></td>
<td>Levee Slope</td>
</tr>
<tr>
<td>Slough Sedge*</td>
<td><em>Carex obnupta</em></td>
<td>Channel edge</td>
</tr>
<tr>
<td>Three Square</td>
<td><em>Scirpus americanus</em></td>
<td>Channel edge</td>
</tr>
<tr>
<td>Western Golden Rod</td>
<td><em>Euthamia occidentalis</em></td>
<td>Levee Slope</td>
</tr>
</tbody>
</table>

* Good for slow back water areas.
** Good for aquatic cover.
Table 10: Species List for Revegetation in the Estuarine Reach

<table>
<thead>
<tr>
<th>Common Name</th>
<th>Scientific Name</th>
<th>Bank Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trees:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>White Alder</td>
<td><em>Alnus rhombifolia</em></td>
<td>Toe of Levee Slope</td>
</tr>
<tr>
<td>Arroyo Willow</td>
<td><em>Salix lasiolepis</em></td>
<td>Channel edge</td>
</tr>
<tr>
<td>Shrubs:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>California Blackberry</td>
<td><em>Rubus ursinus</em></td>
<td>Levee Slope</td>
</tr>
<tr>
<td>California Wild Rose</td>
<td><em>Rosa californica</em></td>
<td>Levee Slope</td>
</tr>
<tr>
<td>Coffeeberry</td>
<td><em>Rhamnus californica</em></td>
<td>Levee Slope</td>
</tr>
<tr>
<td>Coyote Brush</td>
<td><em>Baccharis pilularis</em></td>
<td>Levee Slope</td>
</tr>
<tr>
<td>Gumplant</td>
<td><em>Grindelia stricta</em></td>
<td>Levee Slope</td>
</tr>
<tr>
<td>Lizard Tail</td>
<td><em>Eriophyllum staechadifolium</em></td>
<td>Levee Slope</td>
</tr>
<tr>
<td>Yellow Bush Lupine</td>
<td><em>Lupinus arboreus var. arboreus</em></td>
<td>Levee Slope</td>
</tr>
<tr>
<td>Spear Oracle</td>
<td><em>Atriplex patula var. patula</em></td>
<td>Levee Slope</td>
</tr>
<tr>
<td>Herbs &amp; Grasses:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Baltic Rush</td>
<td><em>Juncus balticus</em></td>
<td>Channel edge</td>
</tr>
<tr>
<td>Bee Plant</td>
<td><em>Scrophularia californica</em></td>
<td>Levee Slope</td>
</tr>
<tr>
<td>Bulrush</td>
<td><em>Scirpus californicus</em></td>
<td>Channel edge</td>
</tr>
<tr>
<td>California Poppy*</td>
<td><em>Eschscholzia californica</em></td>
<td>Channel edge</td>
</tr>
<tr>
<td>Coast Buckwheat</td>
<td><em>Eriogonum latifolium</em></td>
<td>Levee Slope</td>
</tr>
<tr>
<td>Lindley’s Varied Lupine</td>
<td><em>Lupinus variicolor</em></td>
<td>Levee Slope</td>
</tr>
<tr>
<td>Paint Brush</td>
<td><em>Castilleja foliosa</em></td>
<td>Levee Slope</td>
</tr>
<tr>
<td>Salt Grass</td>
<td><em>Distichlis spicata</em></td>
<td>Toe of Levee Slope</td>
</tr>
<tr>
<td>Salt Rush</td>
<td><em>Juncus leseurii</em></td>
<td>Channel edge</td>
</tr>
<tr>
<td>Slough Sedge**</td>
<td><em>Carex obnupta</em></td>
<td>Channel edge</td>
</tr>
<tr>
<td>Three Square</td>
<td><em>Scirpus americanus</em></td>
<td>Channel edge</td>
</tr>
</tbody>
</table>

* Coastal ecotype of California poppy.
** Good for slow back water areas.
channel edges. The proposed bank locations may be refined after monitoring natural recruitment of native plants. Matted water primrose (currently prevalent in the channel) provides aquatic cover that is beneficial for fish habitat. Water parsley (Oenanthe sarmentosa) and common yarrow (Achillea millefolium) have small flowers in clusters that attract insects, which may be in turn be consumed by fish.

- **Transitional Reach (Water Street Bridge to Laurel Street Bridge).** The plant species proposed for planting in the transitional reach are listed in Table 9. The listed tree and shrub species are similar to those proposed for planting in the upstream reach. Hooker’s primrose, a short-lived perennial, is common in the transitional reach, and produces copious amounts of seed that may be collected for revegetation. Creeping wild ryegrass (Leymus triticoides) provides forage for waterfowl and its creeping habit helps to stabilize the soil. Several species have also been included in Table 9 that were recorded at the Scott Creek reference site near Highway 1 including western golden aster (Euthamia occidentalis), California aster (Aster chilensis), marsh baccharis (Baccharis douglasii), and Baltic rush (Juncus balticus). The marsh at Scott Creek is composed primarily of native plant species.

- **Estuarine Reach (Laurel Street Bridge to rivermouth).** Table 10 lists the plant species proposed for revegetation in the Estuarine Reach, where there are brackish water conditions. Arroyo willow and white alder are the main tree species recommended, as they are the dominant trees already present in this reach. Additional salt tolerant species listed are gumplant, salt grass (Distichlis spicata), salt rush (Juncus leucoides), and spear oracle (Atriplex patula var. patula). Most of the shrub species listed are appropriate for planting on the upper bank and include California blackberry, coyote brush, yellow bush lupine (Lupinus arboreus var. arboreus), and lizard tail (Eriophyllum staechadifolium).

**Other Revegetation Projects outside the Riverbank Shoreline Zone**

There are many other native riparian vegetation enhancement measures away from the shoreline zone that are valuable in expanding riparian corridor width and continuity. These measures include:

- Expanding the existing mature mixed riparian forest that occurs along the riverbank of San Lorenzo Park and improve the habitat value of the existing understory. This would involve exotic plant removal and revegetation with native trees and shrubs.

- Revegetate the upper bank just upstream of the Soquel Street Bridge near the confluence with Branciforte Creek. Eucalyptus trees and acacia trees currently occupy this area. This would provide for a more continuous wildlife corridor connecting to the mature riparian forest at San Lorenzo Park.

- Preserve and enhance the wide riverbank along River Street south by the pedestrian bridge. Revegetate with native plant species listed in Table 6 and include black
cottonwoods (tall at maturity) to provide fish shade, and arroyo willow and box elder trees with branching lateral canopies that are good for bird habitat.

- Plant native trees and shrubs on the upper bank of the Riverine Reach at selected locations that are compatible with the desired flood capacity.

- Remove/control high priority invasive, non-native plant species on the inner levee slopes and river banks from Highway 1 to the river mouth. Removal efforts should start at the east bank of the river along San Lorenzo Park. Intensive efforts are likely for up to five years and periodic follow-up removal efforts are likely in perpetuity, depending on the results of monitoring surveys.

**Restoration Recommendation 4:**

**Develop Planning for Floodplain and Marsh Restoration in Special Planning Areas**

The scope of this Management Plan includes a reconnaissance assessment of potential areas where the natural flood plain or marsh plain areas could be expanded, including setting back levees. The scope of the assessment includes an estimate of project features and benefits to natural resources and opportunities and constraints for development.

Completing enhancement projects within confining levees has limitations where the available width is less than that required to sustain a channel and adjacent flood plain surfaces. The greatest opportunity to expand habitat acreage and restore geomorphic and hydrologic function important to a self-sustaining ecosystem along the San Lorenzo River is to set levees back and restore low floodplain surfaces adjacent to the river channel. This action would develop the proper hydrology, flood inundation frequency, scour and fine mineral soil deposition to promote native vegetation and primary biological productivity (i.e., organic carbon input, insect growth and aquatic macroinvertebrates).

Three areas along the San Lorenzo River, all formerly low floodplain surfaces, were researched in this study for feasibility of restoration:

1. The Seaside Company/Santa Cruz Boardwalk Third Street Parking Lot,
2. The area on the north bank of the river between Riverside Avenue and Broadway/Laurel Bridges, which includes some City tennis courts;
3. San Lorenzo Park between the Branciforte Creek confluence and Water Street.

Restoration of these areas for floodplain requires modification of their current uses: Seaside Company land as a parking lot; San Lorenzo Park lawn as a recreation area; and the tennis courts at Broadway to Riverside Street site for active recreation. Converting these uses to habitat restoration is the first step for designing specific plans. This could not be accomplished during the preparation of the Plan, however it should be the focus of future planning efforts by the City.
The Seaside Company / Santa Cruz Boardwalk Parking Lot

There is no doubt from a scientific standpoint that a levee setback and marsh restoration project at the Seaside Company Parking Lot would have significant benefits to the ecosystem of the River and Lagoon. The estuarine marsh and island were destroyed in 1958 by the levee construction project and converted to a parking lot. It is clear from an examination of historical photos that this area supported a range of aquatic and terrestrial habitats not seen within the river system today. Restoring it would bring these habitats back into the system physically, but just as important would be the reintroduction of natural geomorphic processes that sustain habitat and ecosystem vitality. The benefits anticipated with this project would be:

- Restored vegetation communities native to the estuarine environment replacing bare riprap slopes;
- Restored primary production for fish and waterfowl where such production is now severely limited;
- Improved food sources and habitats for waterfowl and songbirds, including possible areas for breeding;
- Improved habitat for fish including improved depth and object cover refugia and production of food sources; and
- Dramatically improved visual aesthetics with substantial opportunities for improved public access between the Main Beach and the trails on the levees.

The estimated cost of the project would be approximately $6-8 million. The City should continue efforts to pursue funding for this project. Detailed planning should proceed once the project area is defined and negotiations with the Seaside Company are complete.

Laurel Street Extension/Third Street Bank Erosion Control Project

The realignment of the San Lorenzo River by the Corps of Engineers 1960 flood control project resulted in increased riverbank erosion along the southern riverbank adjacent to Laurel Street Extension and Third Street. To prevent further erosion and street collapse, a sculptured tieback bank face and riverbank riparian planting is proposed for approximately 900 feet of this riverbank. A design concept plan for this section of riverbank has been developed through a public participation process, which contains the following elements:

- A connection of the bike path between the Riverside Avenue and Laurel Street bridges;
- River bank vegetation;
- A sculptured concrete wall to mimic the existing visual appearance of the riverside cliff; and
- A river viewing area at the intersection of Third Street and Laurel Street Extension which avoids impacting the deep river pools adjacent to Third Street and Laurel Street Extension

Implementation of this plan is estimated to cost approximately $4.7 million, of which Congress has authorized the Corps of Engineers to fund $3.1 million. To construct the project and avoid the related street collapse impact on the San Lorenzo River, the City needs to secure $1.6 million in local or state grant funding. Construction of this project will complete the last remaining element in the levee bike and pedestrian pathway.

**San Lorenzo Park**

For the “benchland” at San Lorenzo Park, there are many possible projects for environmental enhancement including fully dredging backwater wetlands to yield an island along the east bank of the river, to expansion of the native riparian corridor without any grading. Significant issues related to park use and urban planning are complex and could not be resolved to provide a clear direction. Given these circumstances, the City should designate a Special Planning Areas for this potential restoration site where enhancement options could be considered in light of park use issues.

**Riverside Avenue and Laurel / Broadway Tennis Courts**

The area between Broadway and Riverside Avenue was considered during the levee raising project and the benefits were found to be too limited for the cost ($2-4 million; Joe Hall, personal communication, 2001). As a result, the other two areas are of higher priority and no further planning work for removing the tennis courts is recommended.
5.0 IMPLEMENTATION PLAN

Implementation of the Management Plan will require integrating management measures with restoration actions as outlined in Chapter 4. As has been discussed in this report, the Lower San Lorenzo River and Lagoon are limited by several key factors that have resulted in degraded habitat for threatened species and other species common to the river corridor.

The management measures, restoration projects and special planning areas listed in Chapter 4 require an approach that acknowledges the interrelatedness of the recommendations. The recommendations cannot be thought of as "either/or" choices but rather as a cumulative approach to providing enhancement of the Lower San Lorenzo River and Lagoon. Therefore it is important to provide an implementation plan which is flexible enough for management and projects to proceed but which recognizes that factors such as funding and community support may delay or offset the timing of particular actions.

5.1 IMPLEMENTATION RESPONSIBILITIES

Implementation of the plan also requires clear identification of responsible parties for each recommendation. The following table outlines the current management structure utilized for implementing projects on the San Lorenzo River. This structure is proposed to continue the implementation of the Management Plan and its recommendations.

<table>
<thead>
<tr>
<th>City Department</th>
<th>Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Public Works</td>
<td>• Channel Maintenance</td>
</tr>
<tr>
<td>(Administrative Analyst)</td>
<td>• 1601 Permitting</td>
</tr>
<tr>
<td></td>
<td>• In-channel Vegetation Management</td>
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<tr>
<td></td>
<td>• Levee Maintenance</td>
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<tr>
<td>Parks and Recreation</td>
<td>• Storm Drain Maintenance</td>
</tr>
<tr>
<td>(Parks Superintendent)</td>
<td>• Outer Levee Slope Maintenance</td>
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<tr>
<td>(Parks Maintenance Worker)</td>
<td>• Pathway Maintenance</td>
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<td></td>
<td>• Trash Removal</td>
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<tr>
<td></td>
<td>• Irrigation Maintenance</td>
</tr>
<tr>
<td>City Manager</td>
<td>• Restoration Projects</td>
</tr>
<tr>
<td>(River Coordinator/Manager)</td>
<td>• Future Studies</td>
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<td></td>
<td>• Management Measures</td>
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<tr>
<td></td>
<td>• Monitoring Program</td>
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<tr>
<td></td>
<td>• 1601 Permitting</td>
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<td></td>
<td>• Staff to River Commission</td>
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<tr>
<td></td>
<td>• Obtaining Funding</td>
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<td></td>
<td>• Community Outreach</td>
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<tr>
<td>City Attorney</td>
<td>• Permit Assistance</td>
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<td></td>
<td>• Legal</td>
</tr>
<tr>
<td>Water Department</td>
<td>• Streamflow</td>
</tr>
<tr>
<td>Redevelopment Agency</td>
<td>• Flood Insurance/Certification</td>
</tr>
</tbody>
</table>
It is proposed that a permanent advisory body or commission be created to oversee the implementation of the Management Plan during the next 15 years. This body should be appointed by the City Council and charged with implementing recommendations from the Management Plan. Recommendations for the structure of this body will be developed by the San Lorenzo Urban River Plan Task Force and forwarded to the Santa Cruz City Council in March 2002. At this time the permanent river oversight body is proposed to be staffed from the City Manager’s office.

5.2 SCHEDULE OF IMPLEMENTATION

The Management Plan provides a 15-year plan for the management and restoration of the Lower San Lorenzo River and Lagoon. Year 1 of the plan will be established as 2002. The plan will most effectively be completed in 5-year increments with management and restoration actions being implemented simultaneously as funding permits.

Adaptive Management and Monitoring

As stated in the findings and conclusions portion of this report, the River is responding to natural processes. New stands of riparian vegetation, riverbed features and channels are now present. This indicates that more habitat will be created in the future by simply allowing natural geomorphic processes to take place with minimal intervention and by following the management recommendations in Chapter 4 consistent with flood control. Restoration actions will help to enhance natural channel features and will provide additional habitat areas for use by targeted species.

Due to these factors, monitoring of management prescriptions and restoration projects will be critical to the success of the Management Plan. A technical advisory committee should be formed within the first year to develop a comprehensive monitoring program. It will be important that the plan be implemented according to an adaptive management strategy that responds to monitoring results and findings. A monitoring program for the Management Plan is included as Chapter 6. Funding will be one of the largest obstacles to ensuring implementation of the management and restoration actions. For this reason, it will be important to demonstrate the success of restoration projects with regards to improving or providing additional habitat, documenting increases in the population of a species, or use of an area by a species previously not present. In the same context, monitoring will also provide an assessment of whether management and restoration actions are not working as predicted and what kinds of adjustments need to be done with regards to design or implementation.

Feasibility of Proposed Measures

Many of the proposed restoration actions are feasible today given public land ownership of the river channel, levees and San Lorenzo Park and the probable minor impact to operation of the flood control system. These include riparian vegetation enhancement and installation of instream and shoreline structures to improve aquatic habitat diversity. In fact, all of the proposed management and restoration actions can be designed in a manner that does not impact the flood control system.
Some actions such as management of the summer lagoon, levee setbacks or modifying the use of San Lorenzo Park are not currently feasible due to complex environmental and land ownership issues but may become so in the future and should be examined further as Special Study Areas. Since the 1989 Enhancement Plan, implementation of lagoon and sandbar management by the City continues to be constrained by liability concerns and, as identified in this report, potential eutrophication and water quality concerns. Although lagoon and sandbar management have been identified as a primary means to enhance steelhead habitat, it cannot be implemented until these issues are resolved.

The greatest opportunity to restore geomorphic and hydrologic function lies in setting back the levees and restoring a functional floodplain. This action would help develop the proper inundation, scour and fine sediment deposition regime to promote native vegetation growing on mineral soil and promote primary productivity (i.e. organic carbon input, insect growth and aquatic macroinvertebrates). Restoration of floodplain function would require levee setbacks (Santa Cruz Boardwalk/Third Street Parking Lot) or modification of uses (San Lorenzo Park), issues that could not be resolved during the preparation of the Plan. They should be the focus of continued planning efforts and eventual implementation.

The process for implementing restoration projects includes the preparation of construction plans and specifications and bidding documents, acquisition of the necessary permits, sending the project out for bidding, and executing a construction contract. Permit applications should be completed with the 50 percent complete plans in order to allow enough time for obtaining permits and going out to bid. It is anticipated that a qualified restoration specialist, acting on behalf of the City, will direct the construction work in the field. The City should screen potential contractors for experience and qualifications in similar projects of working within the environmentally sensitive areas of a river.

The following tables outline management and restoration actions to be implemented during years 1-5, 6-10 and 11-15.

### 5.3 PROJECTED COSTS

The projected costs for Years 1-5, 6-10, and 11-15 are included below (Tables 11-14). Restoration includes costs for revegetation (non-native, natural recruitment and active planting, and shoreline and streambed structures). The Laurel Street Extension/Third Street Stream Bank Erosion Control Project is estimated to cost $1.6 million and is anticipated to be constructed in 2003.

#### Table 11: Projected Costs for Management and Restoration Recommendations

<table>
<thead>
<tr>
<th>Time Frame</th>
<th>Management</th>
<th>Restoration</th>
<th>Monitoring</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Years 1-5</td>
<td>$350,000</td>
<td>$500,540</td>
<td>$150,000</td>
<td>$1,000,540</td>
</tr>
<tr>
<td>Years 6-10</td>
<td>$350,000</td>
<td>$405,000</td>
<td>$150,000</td>
<td>$905,000</td>
</tr>
<tr>
<td>Years 11-15</td>
<td>$350,000</td>
<td>$405,000</td>
<td>$150,000</td>
<td>$905,000</td>
</tr>
<tr>
<td>Total</td>
<td>$1,050,000</td>
<td>$1,310,540</td>
<td>$450,000</td>
<td>$2,810,540</td>
</tr>
<tr>
<td>Timeframe</td>
<td>Reach</td>
<td>Management Actions</td>
<td>Management Focus</td>
<td>Restoration Actions</td>
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</tr>
<tr>
<td><strong>YEARS 1-3 Estuarine</strong></td>
<td></td>
<td>Phase 1 riparian vegetation restoration: control non-natives</td>
<td>Vegetation</td>
<td>Install 10 streambed structures per hydrologist identified location</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Establish 10 foot riparian buffer along stream edge measured from wetted edge in summer</td>
<td>Vegetation</td>
<td>Install 10 shoreline structures per hydrologist identified location</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Avoid disturbance to emergent vegetation growing in channel bottom within 10 feet of toe of slope</td>
<td>Geomorphology</td>
<td>Phase 3: Revegetation program to promote natives</td>
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<tr>
<td></td>
<td></td>
<td>Allow volunteer riparian trees to establish in groves</td>
<td>Vegetation</td>
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<td></td>
<td>Every two years remove woody vegetation between established groves</td>
<td>Vegetation</td>
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<td></td>
<td>Limb up vegetation 6-8 feet from base</td>
<td>Hydrology</td>
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<td></td>
<td></td>
<td>Remove all trees greater than 6 inches diameter at breast height</td>
<td>Hydrology</td>
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<td></td>
<td>Establish by-pass flow of 6.5 cfs in July to allow for lagoon filling - flow should be available for 7 days</td>
<td>Hydrology/Wildlife</td>
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<tr>
<td></td>
<td></td>
<td>Phase 2: Monitor natural recruitment</td>
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<tr>
<td><strong>Transitional</strong></td>
<td></td>
<td>Phase 1 riparian vegetation restoration: control non-natives</td>
<td>Vegetation</td>
<td>Install 10 streambed structures per hydrologist identified location</td>
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<tr>
<td></td>
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<td>Establish 5 foot riparian buffer along stream edge measured from wetted edge in summer</td>
<td>Vegetation/Wildlife</td>
<td>Install 10 shoreline structures per hydrologist identified location</td>
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<tr>
<td></td>
<td></td>
<td>Establish 10 foot riparian buffer along toe of levee slope measured from base of levee</td>
<td>Vegetation/Wildlife</td>
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<td></td>
<td></td>
<td>Allow volunteer riparian trees to establish in groves on west bank</td>
<td>Vegetation</td>
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<td></td>
<td>Every two years remove woody vegetation between established groves</td>
<td>Vegetation/Hydrology</td>
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<td>Limb up vegetation 6-8 feet from base on west bank</td>
<td>Hydrology</td>
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<td>Along San Lorenzo Park remove trees that fail in water</td>
<td>Hydrology</td>
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<td></td>
<td>Select for and maintain overhanging trees along San Lorenzo Park</td>
<td>Wildlife</td>
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<td></td>
<td>Maintain 50 foot vegetation break on either side of pedestrian bridge</td>
<td>Hydrology</td>
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<td></td>
<td>Remove young willows on east bank (San Lorenzo Park)</td>
<td>Vegetation</td>
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<td></td>
<td>Phase 2: Monitor natural recruitment</td>
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<tr>
<td><strong>Riverine</strong></td>
<td></td>
<td>Conduct sediment mining to bosen sediment bars in mid channel</td>
<td>Hydrology</td>
<td>No restoration actions recommended</td>
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<tr>
<td></td>
<td></td>
<td>Allow volunteer riparian trees to establish in groves</td>
<td>Vegetation</td>
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<td>Every two years remove woody vegetation between established groves</td>
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<td>Remove all trees greater than 6 inches diameter at breast height</td>
<td>Hydrology</td>
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<td>Establish 5 foot riparian buffer along stream edge measured from wetted edge in summer</td>
<td>Vegetation/Wildlife</td>
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<td></td>
<td>Establish 10 foot riparian buffer along toe of levee slope measured from base of levee</td>
<td>Vegetation/Wildlife</td>
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<td></td>
<td>Determine flow characteristics of channel based on review of flow duration curve. Establish plan with resource agencies for maintaining the presence of one or two channels through the summer season.</td>
<td>Geomorphology/Wildlife</td>
<td></td>
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<tr>
<td>Timeframe</td>
<td>Reach</td>
<td>Management Actions</td>
<td>Management Focus</td>
<td>Restoration Actions</td>
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<tr>
<td>YEARS 6-10</td>
<td>Esturian</td>
<td>Phase 2: Monitor natural recruitment of native plant species</td>
<td>Vegetation</td>
<td>Install 12 streambed structures per hydrologist identified location</td>
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<tr>
<td></td>
<td></td>
<td>Establish 10 foot riparian buffer along stream edge measured from wetted edge in summer</td>
<td>Vegetation</td>
<td>Install 20 shoreline structures per hydrologist identified location</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Avoid disturbance to emergent vegetation growing in channel bottom within 10 feet of toe of slope</td>
<td>Geomorphology</td>
<td>Begin investigation of special planning areas</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Allow volunteer riparian trees to establish in groves</td>
<td>Vegetation</td>
<td>Phase 3: Revegetation Program to Promote Natives</td>
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<td>Every two years remove woody vegetation between established groves</td>
<td>Vegetation</td>
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<td></td>
<td>Limb up vegetation 6-8 feet from base</td>
<td>Hydrology</td>
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<td></td>
<td>Remove all trees greater than 6 inches diameter at breast height</td>
<td>Hydrology</td>
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<tr>
<td>Transitional</td>
<td></td>
<td>Phase 2: Monitor natural recruitment of native plant species</td>
<td>Vegetation</td>
<td>Install 20 streambed structures per hydrologist identified location</td>
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<td></td>
<td></td>
<td>Establish 5 foot riparian buffer along stream edge measured from wetted edge in summer</td>
<td>Vegetation/Wildlife</td>
<td>Install 20 shoreline structures per hydrologist identified location</td>
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<td>Establish 10 foot riparian buffer along toe of levee slope measured from base of levee</td>
<td>Vegetation/Wildlife</td>
<td>Begin investigation of special planning areas</td>
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<td>Allow volunteer riparian trees to establish in groves on west bank</td>
<td>Vegetation</td>
<td>Phase 3: Revegetation Program to Promote Natives</td>
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<td>Every two years remove woody vegetation between established groves</td>
<td>Vegetation/Hydrology</td>
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<td>Limb up vegetation 6-8 feet from base on west bank</td>
<td>Hydrology</td>
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<td>Along San Lorenzo Park remove trees that fall in water</td>
<td>Hydrology</td>
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<td></td>
<td>Select for and maintain overhanging trees along San Lorenzo Park</td>
<td>Wildlife</td>
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<td></td>
<td>Maintain 50 foot vegetation break on either side of pedestrian bridge</td>
<td>Hydrology</td>
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<td></td>
<td>Remove young willows on east bank (San Lorenzo Park)</td>
<td>Vegetation</td>
<td></td>
</tr>
<tr>
<td>Riverine</td>
<td></td>
<td>Conduct sediment disking to loosen sediment bars in mid channel</td>
<td>Hydrology</td>
<td>Phase 3: Revegetation Program to Promote Natives</td>
</tr>
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<td></td>
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<td>Allow volunteer riparian trees to establish in groves</td>
<td>Vegetation</td>
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<td>Every two years remove woody vegetation between established groves</td>
<td>Vegetation</td>
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<td>Remove all trees greater than 6 inches diameter at breast height</td>
<td>Hydrology</td>
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<td></td>
<td>Establish 5 foot riparian buffer along stream edge measured from wetted edge in summer</td>
<td>Vegetation/Wildlife</td>
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<td></td>
<td>Establish 10 foot riparian buffer along toe of levee slope measured from base of levee</td>
<td>Vegetation/Wildlife</td>
<td></td>
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<td></td>
<td></td>
<td>Phase 2: Monitor natural recruitment of native plant species</td>
<td>Vegetation</td>
<td></td>
</tr>
<tr>
<td>Timeframe</td>
<td>Reach</td>
<td>Management Actions</td>
<td>Management Focus</td>
<td>Restoration Actions</td>
</tr>
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</tr>
<tr>
<td><strong>YEARS 11-15 Estuarine</strong></td>
<td>Phase 1 &amp; 2 riparian corridor management</td>
<td>Vegetation</td>
<td>Install 10 streambed structures per hydrologist identified location</td>
<td>Geomorphology/Wildlife</td>
</tr>
<tr>
<td></td>
<td>Establish 10 foot riparian buffer along stream edge measured from wetted edge in summer</td>
<td>Vegetation</td>
<td>Install 24 shoreline structures per hydrologist identified location</td>
<td>Geomorphology/Wildlife</td>
</tr>
<tr>
<td></td>
<td>Avoid disturbance to emergent vegetation growing in channel bottom within 10 feet of toe of slope.</td>
<td>Geomorphology</td>
<td>Define outcome of special planning areas study and proceed</td>
<td>Wildlife/vegetation</td>
</tr>
<tr>
<td></td>
<td>Allow volunteer riparian trees to establish in groves</td>
<td>Vegetation</td>
<td>Phases 1: Revegetation Program to Promote Natives</td>
<td>Vegetation</td>
</tr>
<tr>
<td></td>
<td>Every two years remove woody vegetation between established groves</td>
<td>Vegetation</td>
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<td></td>
<td>Limb up vegetation 6-8 feet from base</td>
<td>Hydrology</td>
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<td>Remove all trees greater than 6 inches diameter at breast height</td>
<td>Hydrology</td>
<td></td>
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</tr>
<tr>
<td><strong>Transitional</strong></td>
<td>Phase 1 &amp; 2 riparian corridor management</td>
<td>Vegetation</td>
<td>Install 12 streambed structures per hydrologist identified location</td>
<td>Geomorphology/Wildlife</td>
</tr>
<tr>
<td></td>
<td>Establish 5 foot riparian buffer along stream edge measured from wetted edge in summer</td>
<td>Vegetation/Wildlife</td>
<td>Install 34 shoreline structures per hydrologist identified location</td>
<td>Geomorphology/Wildlife</td>
</tr>
<tr>
<td></td>
<td>Establish 10 foot riparian buffer along toe of levee slope measured from base of levee</td>
<td>Vegetation/Wildlife</td>
<td>Define outcome of special planning areas study and proceed</td>
<td>Wildlife/vegetation</td>
</tr>
<tr>
<td></td>
<td>Allow volunteer riparian trees to establish in groves on west bank</td>
<td>Vegetation</td>
<td>Phases 1: Revegetation Program to Promote Natives</td>
<td>Vegetation</td>
</tr>
<tr>
<td></td>
<td>Every two years remove woody vegetation between established groves</td>
<td>Vegetation/Hydrology</td>
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<tr>
<td></td>
<td>Limb up vegetation 6-8 feet from base on west bank</td>
<td>Hydrology</td>
<td></td>
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<tr>
<td></td>
<td>Along San Lorenzo Park remove trees that fall in water</td>
<td>Hydrology</td>
<td></td>
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<tr>
<td></td>
<td>Select for and maintain overhanging trees along San Lorenzo Park</td>
<td>Wildlife</td>
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<td></td>
<td>Maintain 50 foot vegetation break on either side of pedestrian bridge</td>
<td>Hydrology</td>
<td></td>
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<tr>
<td></td>
<td>Remove young willows on east bank (San Lorenzo Park)</td>
<td>Vegetation</td>
<td></td>
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<tr>
<td><strong>Riverine</strong></td>
<td>Conduit sediment tanking to loosen sediment bars in mid channel</td>
<td>Hydrology</td>
<td>Phases 1: Revegetation Program to Promote Natives</td>
<td>Vegetation</td>
</tr>
<tr>
<td></td>
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<tr>
<td></td>
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<td>Vegetation/Wildlife</td>
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</table>
Financing and Potential Funding Sources
Management and restoration recommendations included in the Management Plan will be implemented as funding becomes available through City funds and resource grants. The City established a stormwater utility fund for the purpose of financing improvements to the River levee system and its associated infrastructure. The fund is an enterprise fund and is limited in the types of projects which may be funded through it. The City utilizes the fund for management and maintenance projects and the annual vegetation maintenance activities required by the Corps. Installation of the restoration projects and vegetation enhancement projects are considered capital improvement projects and will require dedicated funding from the City’s general fund or funding from resource grants. It is anticipated that grants will be sought from the following resource agencies during the implementation period of the Management Plan.

National Oceanic and Atmospheric Administration – National Marine Fisheries Service
Environmental Protection Agency
California State Coastal Conservancy
California Department of Fish and Game
California State Water Resources Control Board
Central Coast Regional Water Quality Control Board
National Fish and Wildlife Foundation
County of Santa Cruz

Implementation projects should allow for at least one year for grant funding to be acquired and confirmed. Multiple projects that compliment one another should be packaged in grant requests as often as possible.
6.0 MONITORING PLAN

6.1 PURPOSE OF MONITORING PLAN

The monitoring plan for the Management Plan will assess the performance of the management and restoration recommendations relative to the stated goals of the plan. The monitoring plan will provide information that will be used to improve the performance of the management and restoration actions and the long-term success of the actions. For a true evaluation of ecological conditions, the monitoring program needs to provide information on physically, chemically and biologically functional responses to restoration or active management. These responses will then be compared with identified expectations for management and restoration projects (i.e., presence of specific species, increased productivity) and a feedback loop will be created to adjust management and restoration as necessary.

6.2 RESTORATION GOALS AND OBJECTIVES

The restoration goals defined for the Management Plan include increasing the abundance and diversity of native flora and fauna above baseline 2000 levels; enhancing habitat conditions for special status species to improve populations above baseline 2000 levels; restoring geomorphic and hydrologic form and function to improve channel and habitat conditions; and maintaining adequate flood capacity to convey a 100-year flow.

Objectives for the plan focus on the following riverine conditions and biological communities:

- Vegetation
- Vertebrates (fish, birds, small mammals, herptiles)
- Invertebrates (aquatic)
- Water Quality
- Geomorphology and Hydrology

The defined timeline for the plan is 15 years with recommended restoration actions occurring in five-year increments. Monitoring will occur in the first year after plan adoption and will focus on implementation and effectiveness monitoring. Implementation monitoring will evaluate actual implementation of plan recommendations. Effectiveness monitoring will evaluate whether the restoration recommendations and projects are meeting the objectives of the restoration plan. Effectiveness monitoring will be more long term and will provide the necessary data for adaptive management.

6.3 BASELINE CONDITIONS

The baseline conditions for measurement of restoration effectiveness will be based on data collected during 1999-2001. During this period the following studies and monitoring activities occurred. Additional data from past surveys and monitoring activities provide a dataset of historic conditions.
Vegetation

Mapping of plant communities, sandbars, artificial bank stabilization (i.e., riprap) and open water areas occurring from Highway 1 south to the river mouth were mapped in Fall 2000 by Native Vegetation Network. The locations of plant communities and other ground features were mapped onto a 1999 aerial photograph (scale 1 inch equals 75 feet; photo base from digital orthophoto). Each mapped unit included overstory plant community, understory plant community, and the three most common species present in the overstory and/or understory as applicable. The mapped information was digitized and entered into a geographic information system, which enables determination of each plant community type or ground feature. A more detailed discussion of this mapping procedure and resulting GIS maps are included in Chapter 2 of the Management Plan.

Wildlife

Fish – Population estimates for steelhead trout have been prepared by D.W. Alley and Associates from 1994-2000 for the San Lorenzo River mainstem. The study involved fish sampling and habitat evaluation for juvenile steelhead production and rearing habitat conditions. Steelhead density was sampled at 13 mainstem sampling sites. Habitat typing was conducted in 12 reaches of the mainstem. Fish sampling was also conducted on 20 tributary sites. Densities determined by habitat type were combined with habitat proportion data by reach to estimate juvenile steelhead production in the mainstem river and its major tributaries. An estimate of an index of adults returning to the system was extrapolated from mainstem and tributary juvenile steelhead production by use of a model based on survival rates of three juvenile size classes. Data from this study was also compared to data collected in 1981. An additional dataset is available from work conducted by Dr. Jerry Smith on fish trapping conducted in spring 1987, spring 1988 and spring 1989. This study also documented other fish species present in the lagoon following a seine sampling conducted on June 20, 1986.

Birds – The Point Reyes Bird Observatory has conducted point count censuses and area searches for riparian birds during the spring and summer from 1999-2001. Area searches were conducted on three plots in and around Henry Cowell State Park and on three plots from Highway 1 to the Laurel/Broadway Bridge. One point count transect was visited three times per season from the mouth of the river through the Sycamore Grove area. The area between the Highway 1 bridge and the south end of the Sycamore Grove area was excluded from this point count. Territory mapping was conducted in 1999 at two plots; one from the Water Street bridge to Soquel Avenue bridge and one within the Sycamore Grove area. The point count censuses began one year prior to the U.S. Army Corps of Engineers Flood Control Project and provide a relatively robust dataset to evaluate wildlife responses to the project. Bird species identified within the riparian area are included in Appendix A-3 of the Management Plan.

Herptiles – Professional reptile and amphibian surveys have been limited in the San Lorenzo River corridor from Sycamore Grove south to the river mouth. A California red-legged frog assessment was conducted by Brian Mori Biological Consulting Services in 1997. The assessment included a site reconnaissance, literature review, access to the California Natural Diversity Database map overlays for the Santa Cruz and Soquel quadrangles, as well as
consultations with other local consulting biologists and local resource agency personnel to
document red-legged frog occurrences within a 5-mile radius of the project site.
Reconnaissance-level field surveys recorded aquatic habitats within the flood control channel
including size, water depth, qualitative assessment of turbidity, characteristic plant species,
and amphibians and aquatic invertebrates observed. The upland and aquatic habitats in the
river corridor were photo-documented. A sample of pool habitats observed in the flood
control channel was delineated on a site map. All aquatic habitats within a 1-mile radius of
the project site were mapped on a section of the USGS Santa Cruz Quadrangle. The study
concluded that due to the channelization of the river together with ongoing channel
maintenance activities and the magnitude of urban development surrounding the channelized
portion of the river, the likelihood of red-legged frogs inhabiting the Lower River is very low
(Mori, 1997). Surveys for other amphibians and reptiles have not been conducted by
professional biologists in the Lower River.

Aquatic Macroinvertebrates – Extensive macroinvertebrate sampling was conducted by a
San Jose State University student during the summer of 1999. These samples could serve as
a baseline dataset from which to build a continuing data set on macroinvertebrates in the
restoration project area. Laboratory analysis and identification of the samples still needs to
be conducted.

Water Quality

Water quality data from 1995-2001 is available from Santa Cruz County Environmental
Health Department Water Quality Laboratory for the lagoon area and storm drain outlets
along the Lower River. Water quality parameters available include bacteria, nitrate-nitrogen,
dissolved oxygen, pH, temperature, turbidity, and conductivity. Historic data on water
quality conditions is available through this agency back to 1953. Sediment sampling
conducted from 1995-1997 also provides a dataset on nutrients and bacteria in sediments in
the Lower River. Trace metals and synthetic trace organic compound levels in tissues from
resident clams and transplanted freshwater clams was documented in a 1996 study at four
sites in the San Lorenzo watershed including one site in the Lower River.

Geomorphologic and Hydrologic Conditions

Geomorphic and hydrologic data is available from 1982 through the present as the result of
various studies conducted by the U.S. Army Corps of Engineers, the University of California
Santa Cruz Geology Department and the City of Santa Cruz. This dataset is probably the
most robust dataset available for the river channel in the enhancement plan area. Pertinent
baseline data sets include the cross-sections completed for the HEC-RAS model in 2000, the
thalweg profile completed in 2000, and the thalweg profile completed for the Corps design
on the flood control improvement project. Stream flow measurements conducted in 2001
will provide baseline information for streamflow and the development of a flow duration
curve will provide an additional management tool for stream flow based on rain year. Finally
the United State Geological Survey (USGS) streamflow gauge at Big Trees station provides a
historic dataset for discharge from 1937 through the present. An additional USGS gauge at
the Tait Street Diversion also documents discharge in the Lower River. Finally data
collected on lagoon water levels during 1998-2001 will provide lagoon water surface
elevations in a closed sandbar and open sandbar condition.
6.4 MONITORING PARAMETERS

Vegetation

Vegetation Monitoring Objectives
1. Assess the success of planted riparian and grassland areas on the outer levee banks
2. Assess enhancement of the natural riparian area on the inner levees through natural recruitment, management prescriptions, and active planting.

Restoration objectives identified for vegetation include promoting structural diversity and density of the inner channel and outer levee riparian corridor; increasing the width of the riparian corridor consistent with flood control constraints; and enhancing populations of native riparian species. Restoration recommendations for vegetation focus on enhancing shoreline and riparian corridor vegetation through controlling non-native plant species (phase 1), natural recruitment (phase 2), and active revegetation in specific areas (phase 3). Reference areas north of Highway One on the east bank will help guide vegetation structure (diversity, age, species composition) and function (nutrient cycling, habitat values).

Baseline Data Set
Baseline data used for effectiveness evaluation will be the 2000 vegetation map and associated plant lists and field datasheets described in the baseline conditions discussion above.

Success Criteria for Evaluation

Plant Survival. On the levee landscape areas plant replacement should be at 100% in the case of failure of planted trees and shrubs during years 1 and 2 of the establishment period;

Vegetative Cover. Maximum of 10% vegetative cover of high priority/perennial, invasive non-native plants;

Bare Ground. Maximum of 10% bare ground;

Species Richness. Minimum of three different native tree species, a minimum of three native shrub species, and a minimum of 5 different herbaceous species.

Monitoring Methods

Planted Riparian and Grassland Areas – Outer Levee Banks
The following monitoring procedures will be used during the five years following installation of plants along the outer levee banks. This planting was completed as part of the flood control levee raising project constructed from 1999-2003. Monitoring will document the success of planted and seeded areas per specifications of the flood control project. Monitoring will be conducted by a qualified botanist or revegetation specialist.
Establishment period monitoring will include monitoring of plant survival, growth, percent vegetative cover of native vegetation versus non-native vegetation, percent cover of invasive non-native species, species richness, and any noted erosion or site disturbance problems. Monitoring during the 5-year establishment period after installation will help to insure that the planted restoration area will proceed toward long-term vegetation restoration goals, and will allow for remedial action as needed.

_Reconnaissance Surveys._ A qualified botanist or revegetation specialist will survey the restoration area a minimum of 6 times each of the first 3 years after planting, and a minimum of 3 times each year during Years 4 and 5. The purpose of the reconnaissance visits will be to assess how the revegetation is proceeding, and to identify problems or potential problems that may exist. During these surveys, the monitor will look for plant damage, pests and diseases, and will make recommendations to correct any significant problems or potential problems. These visits will also be used to document the need to change or adjust revegetation plan activities (i.e., altering the maintenance schedule, adding extra weed control visits, increasing or reducing the frequency or amount of irrigation water, etc.).

_Plant Survival and Growth._ In addition to the reconnaissance surveys, one additional monitoring visit will be made in summer for the five years following installation. The summer monitoring will verify plant health, plant survival, and vegetative cover.

_Photodocumentation._ During the summer monitoring, photographs will be taken to document the success of restoration area. Photographs will be taken from the same vantage point (photostation) and in the same direction every year.

_Vegetation Mapping._ Vegetation mapping will be conducted every three years to document changes in plant communities. Baseline data for comparison will be the 2000 vegetation mapping at 1:75 scale.

**Natural Riparian Areas Inside Bankfull Channel**

The natural riparian areas along the bankfull channel will be managed primarily through removal of non-native species and natural recruitment through restored hydrologic function. Installation or planting of trees, shrubs, and herbs will be kept to a minimum within the bankfull channel. Management for identified riparian species will be conducted during the annual vegetation management program for flood control and conveyance.

The following monitoring parameters will be used to assess restoration effectiveness in the natural riparian area inside the bankfull channel. The goal of the monitoring will be to document the enhanced structure and diversity of the riparian area resulting from adaptive management and active restoration. These monitoring techniques should be completed on a 3-year schedule throughout the life of the project (25 years) on geographically referenced (latitude/longitude) transects or an appropriately defined unit area.

_Foliage Density._ Foliage density refers to the amount of green foliage present or to the amount of leaf bearing stems and leaves per unit area (Cooperrider et al, 1986). Foliage
density is not the same as plant density, which is a measure of the number of plants per
unit area. Foliage density is taken at various vertical levels along a measured transect.

Species Composition by Size Class and Condition. Identification and count of each
tree/shrub species present along with documentation of size class and condition or health.
Compared to unit area, tree density estimates can be derived from the data collected.

Structural Type. Documents the transition from bare soil to mature riparian forest.
Recognizing and classifying structural stages (young through mature) allows a quick
assessment of the riparian ecosystem’s health.

Vegetation Mapping. The information collected above should be mapped and available
for comparison to the 2000 plant community baseline map.

Wildlife

Wildlife Monitoring Objectives

1. Determine species diversity
2. Determine species abundance
3. Calculate species density

Due to the size of the project area and limited funding available for monitoring of wildlife
species, monitoring for restoration effectiveness will focus primarily on species diversity,
abundance and density. Species diversity provides an evaluation of the biodiversity of the
River and its habitats. Multiple-year diversity studies are preferred rather than one time
studies. Species abundance provides a direct method of determining abundance of wildlife in
certain areas or habitats. Species density provides a measure of number of animals per unit
area. Combined with the vegetation monitoring described above, wildlife monitoring for
birds, small mammals, and herptiles will help to ascertain whether habitat types are
supporting the microhabitats used by these species.

It should be noted that wildlife monitoring is complex and should be developed with the
assistance of a Technical Advisory Committee once research questions have been identified.
The determination of wildlife monitoring protocols was beyond the scope of this Management
Plan and due to the depth of scientific literature in this area. It is recommended that once
the Technical Advisory Committee is developed a series of acceptable and preferred wildlife
monitoring protocols be developed and provided in requests for monitoring by professional
consultants.

Baseline Data Sets
The steelhead population and habitat monitoring conducted cooperatively by the City of
Santa Cruz, County of Santa Cruz and San Lorenzo Valley Water District will provide a
baseline data set for fisheries monitoring.

The baseline data set developed by the Pt. Reyes Bird Observatory will be utilized for
monitoring comparisons for birds.
Data sets for small mammals, herptiles and macroinvertebrates are not available. These data sets should be developed within the first three years of plan implementation.

**Success Criteria**

Wildlife species success criteria will include continued use of river habitat areas as denoted by diversity data; increases in populations above baseline levels, and increases in species density per unit area.

**Monitoring Methods**

*Fish* — The restoration techniques applied in the river channel are designed to provide enhanced habitat for steelhead trout and coho salmon (if present). Since salmonids utilize various areas of the entire watershed during their lifecycle, monitoring for presence/absence, abundance and diversity should be coordinated with the watershed wide salmonid monitoring conducted by the Santa Cruz City Water Department, San Lorenzo Valley Water District, Santa Cruz County, Department of Fish and Game, and National Marine Fisheries Service. Three monitoring stations within the restoration area should be established (one in each reach of the restoration plan area). Monitoring of salmonid populations should be conducted annually or every other year.

*Birds* — The City of Santa Cruz should continue to work with the Point Reyes Bird Observatory to conduct point count censuses and area searches for birds during migrational and breeding periods. Nest monitoring should be initiated where feasible. Data collected for birds will be especially important for comparison to vegetation monitoring described above to help in assessing the success in restoring riparian habitat.

*Small Mammals* — Data on small mammals is lacking for the restoration area. An initial survey should be conducted within the first three years of restoration plan adoption to establish a baseline data set for these species. Monitoring over the life of the plan should be conducted every five years.

*Herptiles* — Aquatic amphibians are good indicators of the health of aquatic systems. These animals are especially sensitive to pollution and loss of aquatic habitat (Hall, 1980). However, it is also difficult to monitor and assess herptile populations because these animals’ activities and reproduction vary with natural environmental fluctuations such as precipitation and temperature (Cooper, 1986). An existing dataset on herptiles is not available for the restoration area addressed in this plan. There is an immediate need to conduct monitoring and develop a species list for herptiles in the restoration area. This baseline monitoring should be conducted within the first year of implementation of the plan.

*Aquatic Macroinvertebrates* — Partly because of their importance within the stream community as a fundamental link in the food web between organic matter resources (e.g. leaf litter, algae, detritus) and fishes, and partly because of their diversity and ubiquity, the study of macroinvertebrates has been a central part of stream ecology (Hauer, 1996). Macroinvertebrates are aquatic insects that live on the channel bottom (e.g. bedrock, cobble) or other stable surfaces (e.g. roots, snags). The types and numbers of macroinvertebrates present in the stream can provide clues to the health of the stream.
The California Department of Fish and Game and the United States Environmental Protection Agency advocate the use of benthic macroinvertebrate monitoring as an approach to assess restoration effectiveness and recovery of stream health. Protocols for macroinvertebrate collection and rapid bioassessment are available and should be followed for the monitoring period of the plan. It is recommended that an initial macroinvertebrate data set be established for the San Lorenzo River during the first year of plan implementation. Following the initial inventory and analysis in the first year, macroinvertebrate monitoring should be conducted biannually.

A minimum of six sampling sites should be selected within the three reaches of the restoration area. Sampling should occur twice annually, in the spring and fall. Samples should be analyzed by a qualified laboratory. Trained volunteers can be used to do the sample collection and associated habitat assessment procedures.

**Water Quality**

*Water Quality Monitoring Objectives*

1. Document seasonal and diurnal water quality conditions in the Lower River and lagoon.

2. Provide an ongoing dataset for comparison as water quality Best Management Practices are implemented in the Lower River and Lagoon.

*Baseline Data Sets*

Baseline data sets for nutrients and bacteria include data from 1995-2001 from the Santa Cruz County Environmental Heath Department Water Quality Laboratory. Dissolved oxygen, pH, temperature, and salinity will be evaluated against data collected in 2001 – 2003 as part of a water quality study of the lagoon during low flow periods.

*Success Criteria*

Water quality conditions will be evaluated against the water quality objectives for cold water fisheries defined in the Central Coast Basin Plan, prepared by the Central Coast Regional Water Quality Control Board. Other scientifically published criteria for salmonid and herptile life stages will be used for evaluation as well.

*Monitoring Methods*

*Water Quality Sampling* - Water quality samples for nutrients and bacteria are regularly collected by the Santa Cruz County Environmental Health Department. The City will request that this data be forwarded to the City for review and evaluation. The City of Santa Cruz recently purchased the necessary equipment to also monitor dissolved oxygen, pH, temperature, and salinity in the lagoon and river. These water quality parameters should be continued annually during low flow periods. Monitoring will be conducted according to the Quality Assurance/Quality Control Plan developed by Swanson Hydrology & Geomorphology and approved by the Central Coast Regional Water Quality Control Board.
Geomorphic and Hydrologic

Monitoring Objectives

1. To evaluate changes in physical habitat resulting from management and restoration actions.
2. To document flow conditions.

Baseline Data Set
Geomorphic and hydrologic data is available for the three reaches of the channel as a result of analysis conducted in the preparation of this plan. The data from 2000 channel conditions will be utilized as a baseline for comparison.

Success Criteria
The overall health of the habitat and the plants and animals that use it depends upon the hydrologic and geomorphic condition of the channel. The goal of enhancing the Lower River's geomorphic character is to create a self-sustaining, natural system that can support a native flora and fauna.

Hydrologically, the system should maintain adequate flow to support the habitat and the lagoon should be allowed to function naturally (i.e., natural closing and breaching of the lagoon mouth).

Monitoring Methods

Streamflow and Water Level - The variables that would be required to monitor these factors would be streamflow in the Riverine and Transitional Reaches and water level in the lagoon. Streamflow in the Riverine and Transitional Reaches should be measured twice per month during the summer low-flow period to monitor potential impacts on aquatic habitat. Water levels in the lagoon should also be monitored using a continuously recording depth gage. An attempt should be made to reoccupy a site established by Swanson Hydrology and Geomorphology at the mouth of Jessie Street Marsh. This site was abandoned in the summer of 2000 due to lack of funding and construction activities on the levee.

Geomorphic Conditions - Important variables that should be used to determine adequate geomorphic conditions in the Lower River to sustain healthy habitat include substrate conditions, bankfull widths and depths, and channel roughness. These parameters should be monitored through a program of establishing approximately 10-15 permanent cross-sections along the Lower River. The cross-sections should be surveyed in the fall and spring of each year. Substrate measurements should include pebble counts, embeddedness and percent fines.

Data Management and Triennial Reports
One of the challenges of initiating a comprehensive monitoring plan is the large amount of data that is generated. This data, vital to understanding and quantifying the success of the
recommended and implemented management actions, needs to be organized in a manner that allows for easy access, manipulation and reporting of the results. In addition to managing data generated from this monitoring plan, large amounts of data will become available from other government agencies, consulting firms and private individuals. Managing all this data needs to be centralized and coordinated to maximize the potential benefit of the collected information.

To accomplish the goal of managing large amounts of data from different scientific disciplines, an initial effort has to be made to outline a data management strategy and construct. The final database must be all encompassing as well as being flexible enough to integrate new data sources. The initial development phase will dictate future success and manageability. The developed data management strategy should consider the following issues:

- **Spatial context or location of data sources (GIS database development):** Cross-section information should be treated differently than a vegetation map of the entire Lower River because they are different types of features (lines versus polygons). The associated data, stored in a database, should have cross-referencing to the spatial features.

- **Temporal context of data sources:** Many observations or measurements are time dependent and need to be carefully considered in that context. For example, migratory birds may only be present during brief periods of time. This information must be documented and captured in the developed database.

- **Metadata:** Information about the source, lineage, scale, etc. needs to be collected and managed along with the actual data records.

- **Database updates and security:** Issues regarding location, update frequency, access, and who will be the database manager need to be considered.

Since it is often difficult for individual database users to understand, sort through, and synthesize all the information that exists within a database, summary reports should be generated every three years. These reports should analyze the data collected over the three previous years. The results should describe existing conditions, discuss implementation actions completed to date, make comparisons to the results from the previous summary report and assess the current conditions in the context of the goals and priorities of the management plan.
## Monitoring Plan
### Parameters and Schedule

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<tr>
<th>Restoration Plan Component</th>
<th>Monitoring Parameter</th>
<th>Prescribed Schedule</th>
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<tr>
<td></td>
<td>Vegetation</td>
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<tr>
<td>Outer Levee</td>
<td>Reconnaissance Surveys (documented plant damage, pests, disease, changes and adjustments needed in maintenance, weeding)</td>
<td>Years 1-3&lt;br&gt;6 visits per year</td>
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<td>Plant Survival &amp; Growth (documents plant health, plant survival, and vegetative cover)</td>
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<td>Photodocumentation</td>
<td>Years 1-5&lt;br&gt;Once annually in summer</td>
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<td>Presence/Absence</td>
<td>Annually or biannually</td>
</tr>
<tr>
<td></td>
<td>Population Abundance</td>
<td>Annually or biannually</td>
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<tr>
<td></td>
<td>Population/Species Density</td>
<td>Annually or biannually</td>
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<tr>
<td>Macrowinvertebrates</td>
<td>Initial Inventory</td>
<td>2002</td>
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<td></td>
<td>Habitat Survey and BMI</td>
<td>Biannually</td>
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<td>Collection for IBI Analysis</td>
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</tr>
<tr>
<td>Physical Variables</td>
<td>Nutrients</td>
<td>Weekly – get data from Santa Cruz County</td>
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<tr>
<td></td>
<td>Bacteria</td>
<td>Weekly – get data from Santa Cruz County</td>
</tr>
<tr>
<td>Water Quality</td>
<td>Dissolved Oxygen</td>
<td>Weekly during July – October</td>
</tr>
<tr>
<td></td>
<td>PH</td>
<td>Weekly during July – October</td>
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<tr>
<td></td>
<td>Temperature</td>
<td>Weekly during July – October</td>
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<tr>
<td></td>
<td>Salinity</td>
<td>Weekly during July through October</td>
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<tr>
<td>Geomorphic and Hydrologic</td>
<td>Streamflow in Riverine Reach</td>
<td>Twice per month from April to October</td>
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<td>Lagoon Water Level</td>
<td>Continuous measurements using a pressure transducer</td>
</tr>
<tr>
<td></td>
<td>Substrate Conditions - Pebble counts, riffle and pool embeddedness and percent fines</td>
<td>Annually (at same time every year) – June to October</td>
</tr>
<tr>
<td></td>
<td>Channel Roughness</td>
<td>Annually (at same time every year) – June to October</td>
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<tr>
<td></td>
<td>Cross-sections</td>
<td>Biannually – Spring and Fall</td>
</tr>
</tbody>
</table>
7.0 REFERENCES CITED


APPENDICES

Lower San Lorenzo River & Lagoon Management Plan
APPENDIX A-1

Lower San Lorenzo River Riparian Corridor
(Highway 1 to Lagoon)

Vascular Plant Checklist

**Ferns and Fern Allies**

**EQUISETACEAE**
- *Equisetum laevigatum* (smooth scouring rush)

**Conifers**

**TAXODIACEAE**
- *Sequoia sempervirens* (coast redwood)

**Flowering Plants-Dicots**

**ACERACEAE**
- *Acer negundo var. californicum* (box elder)

**AIZOACEAE**
- *Carpobrotus edulis* (sea fig)

**ANACARDIACEAE**
- *Toxicodendron diversilobum* (poison oak)

**APIACEAE**
- *Conium maculatum* (poison hemlock)
- *Foeniculum vulgare* (fennel)

**APOCYNACEAE**
- *Vinca major* (greater periwinkle)

**ARALIACEAE**
- *Hedera helix* (English ivy)

**ASTERACEAE**
- *Achillea borealis* (yarrow)
- *Artemisia douglasiana* (mugwort)
- *Artemisia pycnocephala* (coastal sagewort)
- *Aster chilensis* (Chilean aster)
- *Baccharis douglasii* (marsh baccharis)
- *Baccharis pilularis* (coyote brush)
- *Carduus pycnocephalus* (Italian thistle)
- *Carduus tenuiflorus* (slender-flowered thistle)
- *Cirsium vulgare* (bull thistle)
- *Conyza canadensis* (horseweed)
- *Erigeron glaucus* (seaside daisy)
- *Eriophyllum staechadifolium* (seaside woolly sunflower)
- *Gnaphalium luteo-album* (weedy cudweed)
- *Gnaphalium palustre* (lowland cudweed)
- *Grindelia stricta var. platyphylla* (Pacific grindelia)
- *Helenium puberulum* (sneezeweed)
- *Hypochaeris glabra* (smooth cat's ear)
- *Hypochaeris radicata* (rough cat's ear)
- *Jaumea carnosa* (jaumea)
- *Lactuca serriola* (prickly lettuce)
- *Lasthenia californica* (California goldfields)
- *Layia platyglossa* (tidy tips)
- *Picris echioides* (bristly ox-tongue)
- *Senecio mikanioides* (Cape ivy)
- *Senecio vulgaris* (common groundsel)
- *Silybum marianum* (milk thistle)
- *Solidago californica* (California goldenrod)
- *Sonchus asper* (prickly sow thistle)
Swanson Hydrology & Geomorphology

Sonchus oleraceus* (common sow thistle)
Taraxacum officinale* (dandelion)
Xanthium spinosum (spiny cocklebur)
Xanthium strumarium (cocklebur)

BETULACEAE
Alnus rhombifolia (white alder)

BORAGINACEAE
Heliotropium curassavicum (heliotrope)

BRASSICACEAE
Brassica rapa* (field mustard)
Cardamine oligosperma (few-seeded bitter-cress)
Hirschfeldia incana* (black mustard)
Raphanus sativus* (radish)
Rorippa nasturtium-aquaticum (water cress)

CAPRIFOLIACEAE
Sambucus mexicana (mexican elderberry)

CARYOPHYLLACEAE
Spergularia rubra* (red sand-spurrey)
Stellaria media* (common chickweed)

CHENOPODIACEAE
Chenopodium californicum (California goosefoot)

CORNACEAE
Cornus sericea ssp. occidentalis (american dogwood)

CUCURBITACEAE
Marah oreganum (coast man-root)

DIPSACEAE
Scabiosa atropurpurea* (pincushion flower)

ERICACEAE
Arbutus menziesii (madrone)

EUPHORBIACEAE
Euphorbia peplus (petty caps)
Ricinus communis* (castor bean)

FABACEAE
Acacia dealbata* (silver wattle)
Acacia decurrens* (green wattle)
Acacia melanoxylon* (blackwood acacia)
Genista monspessulana* (French broom)
Lathyrus tingitanus (Tangier pea)
Lotus corniculatus* (birdfoot trefoil)
Lotus scoparius var. scoparius (California broom)
Lupinus bicolor (miniature lupine)
Lupinus nanus (annual lupine)
Medicago polymorpha* (California burclover)
Meliotus alba* (white sweet clover)
Trifolium angustifolium* (Mediterranean clover)
Trifolium dubium* (shamrock)
Trifolium hirtum (rose clover)
Trifolium repens* (white clover)
Vicia sativa ssp. nigra* (narrow-leaved vetch)
Vicia sativa ssp. sativa* (spring vetch)

FAGACEAE
Quercus agrifolia (coast live oak)

FRANKENIACEAE
Frankenia salina (alkali heath)

GERANIACEAE
Erodium botrys* (long-beaked filaree)
Erodium cicutarium* (red-stemmed filaree)
Geranium dissectum* (cut-leaved geranium)

LAMIACEAE
Marrubium vulgare* (horehound)
Mentha pulegium* (pennyroyal)
Salvia melifera (black sage)
<table>
<thead>
<tr>
<th>Family</th>
<th>Species</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>LYTHRACEAE</strong></td>
<td><em>Lythrum hyssopifolium</em> (hyssop loosestrife)</td>
<td><em>Eriogonum latifolium</em> (coast buckwheat)</td>
</tr>
<tr>
<td><strong>MALVACEAE</strong></td>
<td><em>Malva nicaeensis</em> (bull mallow)</td>
<td><em>Polygonum amphibium</em> (water smartweed)</td>
</tr>
<tr>
<td></td>
<td><em>Malva parviflora</em> (cheeseweed)</td>
<td><em>Polygonum arenastrum</em> (common knotweed)</td>
</tr>
<tr>
<td><strong>MYRTACEAE</strong></td>
<td><em>Eucalyptus globulus</em> (blue gum)</td>
<td><em>Polygonum persicaria</em> (lady's thumb)</td>
</tr>
<tr>
<td><strong>ONAGRACEAE</strong></td>
<td><em>Camissonia cheiranthifolia</em> (beach evening primrose)</td>
<td><em>Rumex acetosella</em> (sheep sorrel)</td>
</tr>
<tr>
<td></td>
<td><em>Epiobium brachycarpum</em> (paniculate fireweed)</td>
<td><em>Rumex crispus</em> (curly dock)</td>
</tr>
<tr>
<td></td>
<td><em>Epiobium ciliatum ssp. ciliatum</em> (ciliate willow herb)</td>
<td></td>
</tr>
<tr>
<td></td>
<td><em>Ludwigia peploides</em> (water primrose)</td>
<td></td>
</tr>
<tr>
<td></td>
<td><em>Oenothera elata ssp. hookeri</em> (Hooker's evening primrose)</td>
<td></td>
</tr>
<tr>
<td><strong>OXALIDACEAE</strong></td>
<td><em>Oxalis pes-caprae</em> (Bermuda buttercup)</td>
<td></td>
</tr>
<tr>
<td><strong>PAPAVERACEAE</strong></td>
<td><em>Eschscholtzia californica</em> (California poppy)</td>
<td><em>Heteromeles arbutifolia</em> (toyon)</td>
</tr>
<tr>
<td><strong>PLANTAGINACEAE</strong></td>
<td><em>Plantago coronopus</em> (cut-leaved plantain)</td>
<td><em>Potentilla anserina ssp. pacifica</em> (Pacific silverweed)</td>
</tr>
<tr>
<td></td>
<td><em>Plantago lanceolata</em> (English plantain)</td>
<td><em>Rosa californica</em> (California rose)</td>
</tr>
<tr>
<td></td>
<td><em>Plantago major</em> (common plantain)</td>
<td><em>Rubus discolor</em> (Himalaya blackberry)</td>
</tr>
<tr>
<td><strong>PLATANACEAE</strong></td>
<td><em>Platanus racemosa</em> (western sycamore)</td>
<td><em>Rubus ursinus</em> (California blackberry)</td>
</tr>
<tr>
<td><strong>POLEMONIACEAE</strong></td>
<td><em>Navarretia squarrosa</em> (skunkweed)</td>
<td></td>
</tr>
<tr>
<td><strong>POLYGONACEAE</strong></td>
<td></td>
<td><em>Salix laevigata</em> (red willow)</td>
</tr>
<tr>
<td></td>
<td></td>
<td><em>Salix lasiolepis</em> (arroyo willow)</td>
</tr>
<tr>
<td></td>
<td></td>
<td><em>Salix lucida ssp. lasiandra</em> (yellow willow)</td>
</tr>
<tr>
<td><strong>SCROPHULARIACEAE</strong></td>
<td></td>
<td><em>Castilleja foliolosa</em> (woolly Indian paintbrush)</td>
</tr>
<tr>
<td></td>
<td></td>
<td><em>Scrophularia californica ssp. californica</em> (California figwort)</td>
</tr>
<tr>
<td></td>
<td></td>
<td><em>Veronica americana</em> (american brooklime)</td>
</tr>
</tbody>
</table>
TROPAEOLACEAE
   Tropaeolum majus* (nasturtium)

URTICACEAE
   Urtica dioica ssp. holosericea (hoary nettle)

VALERIANACEAE
   Centranthus ruber* (red valerian)

VERBENACEAE
   Verbena bonariensis* (cluster-flowered verbena)

FLOWERING PLANTS - MONOCOTS

CYPERACEAE
   Carex densa (dense sedge)
   Cyperus erythrhizos (red-rooted cyperus)
   Cyperus esculentus (yellow nutgrass)
   Eleocharis macrostachya (pale spikerush)
   Scirpus americanus (american bulrush)
   Scirpus californicus (California bulrush)

JUNCACEAE
   Juncus bufonius var. bufonius (toad rush)
   Juncus effusus var. brunneus (common rush)
   Juncus effusus var. pacificus (Pacific rush)
   Juncus patens (spreading rush)

LEMNACEAE
   Lemma minor (small duckweed)

POACEAE
   Avena fatua* (wild oat)
   Avena sativa* (cultivated oat)
   Briza maxima* (rattlesnake grass)
   Briza minor* (quaking grass)
   Bromus diandrus* (ripgut grass)
   Bromus hordeaceus* (soft chess)
   Cortaderia jubata* (pampas grass)
   Cynodon dactylon* (Bermuda grass)
   Digitaria sanguinalis* (crab grass)
   Festuca rubra (red fescue)
   Holcus lanatus* (velvet grass)
   Hordeum jubatum (foxtail barley)
   Lolium multiflorum* (Italian ryegrass)
   Lolium perenne* (perennial ryegrass)
   Paspalum dilatatum* (dallis grass)
   Pennisetum clandestinum (kikuyu grass)
   Piptatherum millaceum* (smilo grass)
   Poa annua* (annual bluegrass)
   Polygono monspeliensis* (rabbit's foot grass)
   Vulpia bromoides* (six-weeks fescue)
   Vulpia myuros var. myuros* (zorro fescue)

TYPHACEAE
   Typha latifolia (broad-leaved cattail)

1 Special status plants (RTE's) appear in **bold type** (Skinner & Pavlik, 1994).
* Non-native species.
# APPENDIX A-2

## Fish Species List

<table>
<thead>
<tr>
<th>Common Name</th>
<th>Scientific Name</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Native</strong></td>
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</tr>
<tr>
<td>steelhead trout</td>
<td><em>Oncorhynchus mykiss</em></td>
</tr>
<tr>
<td>coho salmon</td>
<td><em>Oncorhynchus kisutch</em></td>
</tr>
<tr>
<td>Pacific lamprey</td>
<td><em>Lampetra tridentata</em></td>
</tr>
<tr>
<td>prickly sculpin</td>
<td><em>Cottus asper</em></td>
</tr>
<tr>
<td>coastrange sculpin</td>
<td><em>Cottus aleuticus</em></td>
</tr>
<tr>
<td>Pacific staghorn sculpin</td>
<td><em>Leptocottus armatus</em></td>
</tr>
<tr>
<td>starry flounder</td>
<td><em>Platichthys stellatus</em></td>
</tr>
<tr>
<td>threespine stickleback</td>
<td><em>Gasterosteus aculeatus</em></td>
</tr>
<tr>
<td>Sacramento sucker</td>
<td><em>Catostomus occidentalis</em></td>
</tr>
<tr>
<td>topsmelt</td>
<td><em>Atherinops affinis</em></td>
</tr>
<tr>
<td><strong>Non-Native</strong></td>
<td></td>
</tr>
<tr>
<td>largemouth bass</td>
<td><em>Micropterus salmoides</em></td>
</tr>
<tr>
<td>yellowfin goby</td>
<td><em>Acanthogobius flavimanus</em></td>
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**Appendix A-3: Birds Detected along the San Lorenzo River during PRBO point counts, 1999 and 2000**

<table>
<thead>
<tr>
<th>Bird Species</th>
<th>Bird Species</th>
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<tbody>
<tr>
<td>Acorn Woodpecker</td>
<td>European Starling</td>
</tr>
<tr>
<td>Allen's Hummingbird</td>
<td>Great Blue Heron</td>
</tr>
<tr>
<td>American Coot</td>
<td>Greater White-fronted Goose</td>
</tr>
<tr>
<td>American Crow</td>
<td>Green Heron</td>
</tr>
<tr>
<td>American Goldfinch</td>
<td>Heerman's Gull</td>
</tr>
<tr>
<td>American Kestrel</td>
<td>House Finch</td>
</tr>
<tr>
<td>American Robin</td>
<td>House Sparrow</td>
</tr>
<tr>
<td>Anna's Hummingbird</td>
<td>Killdeer</td>
</tr>
<tr>
<td>Barn Swallow</td>
<td>MacGillivray's Warbler</td>
</tr>
<tr>
<td>Belted Kingfisher</td>
<td>Mallard</td>
</tr>
<tr>
<td>Bewick's Wren</td>
<td>Mourning Dove</td>
</tr>
<tr>
<td>Black-crowned Night Heron</td>
<td>Northern Mockingbird</td>
</tr>
<tr>
<td>Black-headed Grosbeak</td>
<td>Northern Rough-winged Swallow</td>
</tr>
<tr>
<td>Black Phoebe</td>
<td>Orange-crowned Warbler</td>
</tr>
<tr>
<td>Bonaparte's Gull</td>
<td>Pied-billed Grebe</td>
</tr>
<tr>
<td>Brewer's Blackbird</td>
<td>Purple Finch</td>
</tr>
<tr>
<td>Brown Creeper</td>
<td>Red-tailed Hawk</td>
</tr>
<tr>
<td>Brown-headed Cowbird</td>
<td>Red-winged Blackbird</td>
</tr>
<tr>
<td>Brown Pelican</td>
<td>Rock Dove</td>
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<tr>
<td>Bushtit</td>
<td>Snowy Egret</td>
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<tr>
<td>California Gull</td>
<td>Song Sparrow</td>
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<td>California Quail</td>
<td>Spotted Towhee</td>
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<tr>
<td>California Towhee</td>
<td>Steller's Jay</td>
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<tr>
<td>Caspian Tern</td>
<td>Swainson's Thrush</td>
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<tr>
<td>Cedar Waxwing</td>
<td>Tree Swallow</td>
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<tr>
<td>Chestnut-backed Chickadee</td>
<td>Violet-green Swallow</td>
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<tr>
<td>Cliff Swallow</td>
<td>Warbling Vireo</td>
</tr>
<tr>
<td>Common Merganser</td>
<td>Western Gull</td>
</tr>
<tr>
<td>Common Raven</td>
<td>Western Scrub-Jay</td>
</tr>
<tr>
<td>Common Yellowthroat</td>
<td>Western Wood-pewee</td>
</tr>
<tr>
<td>Dark-eyed Junco</td>
<td>Wilson's Warbler</td>
</tr>
<tr>
<td>Double-crested Cormorant</td>
<td>Wrenlit</td>
</tr>
<tr>
<td>Downy Woodpecker</td>
<td>Yellow Warbler</td>
</tr>
</tbody>
</table>
APPENDIX B

HYDROLOGIC ASSESSMENT

Technical Memorandum to the
Lower San Lorenzo River & Lagoon Management Plan

September 20, 2001

OVERVIEW

The quality of aquatic habitat conditions in the Lower River depend heavily on the quantity of water flowing through the system, especially during the low flow months of August, September and October. The amount of water available to the lower River can be significantly impacted by water diversions occurring upstream of the Highway 1 Bridge. This is especially true in the Riverine and Estuarine reaches. A City of Santa Cruz Water Department diversion on the San Lorenzo River, located at Tait Street, has the potential to significantly reduce streamflow to the lower River through the use of water for municipal supplies. During the low flow summer months and periods of drought, diversions at Tait Street can impact the lower River aquatic ecosystem by reducing available habitat, increasing water temperatures, and limiting conversion of the lagoon to freshwater.

In the Riverine reach, aquatic habitat surveys have shown that the presence of a bifurcated channel has improved habitat conditions by increasing the amount of vegetated edge, therefore increasing the amount of escape cover for fish per unit area of habitat. The bifurcated channel also allows higher flows to converge into narrow channels, improving bed scour and exposing coarser sediments that ultimately improve substrate conditions for macro invertebrate production.

In the Estuarine reach, the quantity of water flowing into the estuary dictates the amount of time required for conversion from saltwater to freshwater, following closure of the sand bar at the estuary mouth sometime in the summer months. If there is not enough streamflow, it is more difficult for the freshwater to displace the saltwater, resulting in a lagoon that is poorly mixed with potentially anoxic bottom waters. In addition, the amount of time required to convert the lagoon to freshwater has an impact on the primary and secondary producers in the food chain that require that hydrologic conditions remain relatively stable.

Management of the lower River to improve population numbers and aquatic habitat conditions requires a good understanding of the hydrologic conditions, both in a given year and seasonally. A flow conditions summary should be a key element in any adaptive management strategy for the lower River. Appropriate hydrologic information will need to ask questions regarding what the minimum flow requirements are for healthy aquatic habitat, what flows are necessary to convert the lagoon to freshwater, and what are the historical range of flows for any given month on the Lower River. The remainder of this technical memo will attempt to answer these questions by using a combination of historical hydrologic data and recent field measurements to statistically assess monthly and seasonal flow conditions and provide a framework to make predictions that would feed into an adaptive management strategy. In addition, a coarse water balance model of lagoon filling will be described with output that will assist managers in determining minimum flow requirements into the lagoon to maintain a functioning freshwater ecosystem.
METHODS

Exceedence Probability Estimates – Flow Predictions

The primary dataset used in this analysis is the mean daily flow values from the USGS gage site #1161000, San Lorenzo River at Santa Cruz. Data for this gage site is available from 1988 to 1999, which is an 11-year record that spans periods of significant drought as well as several high flow years. Additional streamflow data was collected in the spring and summer of 2001 at the Tait Street Gage and below Highway 1.

The USGS streamflow data was used to generate monthly exceedence probability flow values under different climatic conditions, namely wet, average, dry, and drought year conditions. Exceedence probabilities can be defined as the percent chance that a certain flow is exceeded under a specified criteria. For example, in July during a wet year, the flow may exceed 39 cfs, 70% of time but only exceed 42 cfs, 60% of the time.

The initial step required to generate the exceedence probabilities for each month is to separate all the available flow data into wet, average, dry, and drought. The data was sorted by month and then sorted further into percentiles with a wet year being daily flow values greater than the 75th percentile, an average year ranging from the 75th to the 25th percentile, a dry year ranging from the 25th to the 10th percentile and a drought year being values occurring below the 10th percentile. Once sorted by month and flow-type the data within each class was analyzed to determine the exceedence probability using standard statistical techniques.

Additional flow data was collected for the lower River on three different dates in order to verify flow predictions and to determine conditions in the bifurcated channel. Standard USGS flow estimate techniques were used that included a pygmy or Price-AA flow meter and the velocity-area technique. Measurements were made near the USGS Tait Street gage and adjacent to the Gateway Shopping Center just downstream of the Highway 1 bridge in the west and east branches of the San Lorenzo River.

Water Balance Model – Lagoon Filling

A simple water balance model was developed for the lagoon to get a better understanding of the time required to fill the lagoon under different bypass flow scenarios. The water balance model took the simple form of:

\[ S_{f1} - E_{t1} - P_{r1} = S_c \quad \text{and} \quad S_c + S_e = S_t \]

where:
- \( S_{f1} \) = Streamflow (Input Variable)
- \( E_{t1} \) = Evapotranspiration (Output Variable)
- \( P_{r1} \) = Percolation Loss (Output Variable)
- \( S_c \) = Change in Storage
- \( S_e \) = Existing Storage
- \( S_t \) = Total Storage

Total potential water storage in the lagoon was calculated using digital topographic contours provided by the U.S. Army Corp of Engineers based on conditions present in 1999. Contours were converted to a Triangular Integrated Network (TIN) to develop a continuous topographic surface. The lagoon was assumed to be full when it reached an elevation of 4.5 feet NGVD or the elevation of the top of the riffle under the Water Street Bridge. This elevation was then used to calculate a total volume for the lagoon of 4,385,340 ft³. An initial lagoon volume of 1/3rd the total volume is assumed since a
breached lagoon does not empty completely. Therefore, the total lagoon volume to potentially be filled by streamflow is 3,297,250 ft³.

Water loss from the lagoon comes primarily from evapotranspiration (ET) and percolation through the sand bar at the mouth. Since much of the lagoon is essentially an open body of water with a fringe of vegetation around the edge, ET is likely to be dominated by the evaporation component. The surface area of the lagoon that is affected by evaporation is relatively constant from Soquel Avenue down to the mouth, but changes from Soquel Avenue up to Water Street depending upon the water level of the lagoon. Since modeling of a changing water surface adds complicating factors to the model, we assumed that the surface area is constant at all water levels (Table B-1). Assumptions were also made regarding percolation of water through the sand berm at the river mouth. In theory, the rate of percolation would change with water depth as the hydraulic head increased. In this analysis we assumed a constant rate of percolation (Table B-1).

### Table B-1: Model Parameter Values

<table>
<thead>
<tr>
<th>Model Parameter</th>
<th>Surface Area</th>
<th>Input Rate (from Dunne and Leopold, 1978)</th>
<th>Volume Loss</th>
</tr>
</thead>
<tbody>
<tr>
<td>Evaporation¹</td>
<td>1,425,265 ft²</td>
<td>40 inches/year</td>
<td>534 ft³/hr</td>
</tr>
<tr>
<td>Percolation²</td>
<td>700 ft²</td>
<td>10 meters/day</td>
<td>2268 ft³/hr</td>
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</table>

1. Evaporation rate from a lake surface based on an isolynal map for the entire U.S.
2. Percolation rate for dune sand based on a porosity of 35% according to Dunne and Leopold (1978).

Based on the parameter values described in Table B-1 the model was run on an hourly timestep using constant flow rates of 12, 7, and 3 cfs.

### RESULTS AND DISCUSSION

**Exceedence Probabilities**

Table B-2 shows the results of the exceedence probability analysis using the USGS Tait Street gage. Exceedence probability values are shown for 50, 60, 70, 80, 90, and 95 percent since these are the values that are likely to be of most importance when considering low flow conditions. The data are presented in tabular format. If necessary, curves are available showing the range of flow conditions for each month.

Results from the analysis suggest that during the low flow summer months, the difference in flow between a wet and drought year is very significant. For example, the 90% exceedence between a wet and drought year for August is 22.8 and 0.6 cfs respectively. Habitat conditions in the lower River would also be quite different under those different flow scenarios. In the Riverine reach, under a flow condition of 0.6 cfs, habitat conditions would be significantly reduced if it were split amongst two separate channels instead of the flow being concentrated into one.

With flow exceedence values available for each month and under different flow-types, estimated flow values could be predicted given a known flow value for an earlier time of the year. For example, if a flow measurement is taken below Highway 1 of 14 cfs in the month of May (assuming the River is flowing at baseflow conditions), Table B-2 shows that the lower River is statistically experiencing a dry year between the 60 and 70% exceedence probability, based on historic flow values. Using the predictive power of the exceedence probability chart, the lower River should be flowing at approximately 1.3 to 1.4 cfs in August. This information is very valuable from both a habitat management perspective and a municipal water use perspective.
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Table B-2: Exceedence probabilities for the San Lorenzo River at Santa Cruz from 1988-1999 (USGS Gage ID #11161000). Wet, average, dry and drought years are based on percentiles of >75, 75-25, 25-10, <10, respectively.
Field Measurements of Flow

Flow measurements were taken at two locations on the Lower San Lorenzo River on May 15th, May 22nd, and August 2nd to understand the predictive capabilities of the exceedence probability method described above and to understand the dynamics of the bifurcated channel system in the Riverine reach of the lower San Lorenzo River. The results from the flow measurements are shown in Table B-3.

Table B-3: Flow Measurements for Spring/Summer 2001

<table>
<thead>
<tr>
<th>Date-Time</th>
<th>Tail Street (cfs)</th>
<th>Exceedence Probability</th>
<th>East Channel (cfs)</th>
<th>% of Total River</th>
<th>West Channel (cfs)</th>
<th>% of Total River</th>
<th>Total Lower River (cfs)</th>
<th>Exceedence Probability</th>
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<td>50-60% avg year</td>
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<td>50-60% avg year</td>
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<td>50-60% avg year</td>
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<td>4.8</td>
<td>64.2</td>
<td>7.5</td>
<td>50-60% avg year</td>
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Adaptive Management Strategy

The exceedence probability curves and filed measurements of flow are vital when trying to decide when, and if, to concentrate the entire flow of the lower River into a single channel or to not intervene and let the flow remained split. The missing piece of information that would be required to have a definitive answer on the subject is a rating curve that describes habitat conditions in each channel for different flow values. Since the habitat rating curve is not available to us, our estimates will be based on the statistics of the flow data and a general understanding of the width, depth and habitat conditions in the Riverine reach.

According to Table B-2, September (along with August and October) experiences the lowest baseflows for the year. The 50% exceedence value for September in an average year is estimated to be 7.5 cfs. Assuming a 2:1 ratio between the west and east channel, flows would be on the order of 5.0 and 2.5 cfs, respectively. On the other hand, the 50% exceedence for a dry year would have a flow of 1.0 cfs, with 0.67 flowing in the west channel and 0.33 flowing in the east channel. Based on known habitat conditions in the two separate channels, 1.0 cfs would be better served in a single channel rather than being split into two. An appropriate flow in a single channel would be on the order of 1.0 cfs in order to maintain adequate habitat depth and cover, and maintain reasonable velocities over the riffles for macro invertebrate productivity. Based on this assumption, 3.0 cfs in September would be an appropriate threshold between maintaining a single versus a bifurcated channel. A flow of 3.0 cfs would translate to an exceedence probability of 70% for an average year.

Using this information as a general rule, streamflow measurements could be taken in May and decisions could be quickly made about whether or not modification to the channel would be required to maintain a single-channel flow. Taking the flow measurements in May would provide adequate time to obtain necessary permits and allocate the required funding.

Since the lower River is a very dynamic stream system, the general rules discussed in this report may not apply following significant changes to the bed of the channel due to a high flow winter. Fortunately, the exceedence probability values will still be relevant and will provide useful information when designing new rules that will aid in the summer low-flow adaptive management of the lower San Lorenzo River.
Water Balance Model

As mentioned previously, the water balance model was run on an hourly timestep for flows of 12, 7, and 3 cfs. The filling time for each of these flows were estimated to be 3.4, 6.2, and 17.2 cfs, respectively. This information was then used to generate a relationship between streamflow and the number of days required to fill the lagoon (Figure B-1). The result is a power function with the following form:

\[ 61.899 \times \text{Streamflow}^{-1.1726} \quad \text{or} \quad 33.711 \times \text{Days}^{-0.8525} \]

Though the model has not been rigorously tested, observation during the summer of 2001 have supported the validity of the model based on 3 periods of breaching and refilling from July to September.

The City of Santa Cruz will ultimately need to consult with state and federal agencies, such as the California Department of Fish and Game and the National Marine Fisheries Service, to determine an appropriate minimum bypass to maintain a freshwater lagoon. This decision will need to involve not only the results of this model and the previous discussion of minimum bypass to maintain a bifurcated channel, but include information about lagoon breaching and water quality.

Based on the results of the model and knowledge about the frequent sand bar breaches that have occurred in the summer of 2000 and 2001, it is clear that the lagoon requires quick filling in order to reduce excessive transition times from a shallow, tidal system affected by saltwater inflows, to a freshwater system that can support a healthy aquatic and terrestrial food chain. Therefore, our interim recommendation would be to maintain adequate bypass flows to allow the lagoon to fill within 7 days of mouth closure or a flow of approximately 6.5 cfs, according to the model.

REFERENCE CITED

Figure B-1: Relationship between streamflow and number of days required to fill the lagoon. Both plots are shown so that future management can use either streamflow or number of days as input to determine the result in question.
Appendix C: Elevation ranges for occurrences of riparian vegetation species from surveys at the San Lorenzo River and Scott Creek, Santa Cruz County, California. The water surface elevation at the time of the survey is shown. Hydric conditions at Scott Creek tend to create a perched system due to the narrow bridge where Highway 1 crosses the creek downstream of the marsh.
# APPENDIX D

## Estimated Costs for Restoration Structures

<table>
<thead>
<tr>
<th>Item</th>
<th>Cost</th>
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<td>Log/Boulder Streambed or Shoreline Structure</td>
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<tr>
<td>Tule/Cattail Streambed or Shoreline Structure</td>
<td>$1,200 per structure</td>
</tr>
<tr>
<td>Riparian Revegetation Shoreline to Levee</td>
<td>$0.42/square feet)</td>
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</table>

* Log/Boulder costs assume $3,000 per tree/rootwad; lower costs may be realized by investigating sources or through recovery program from main Beach storm debris.
Appendix B

Jessie Street Marsh Management Plan, 1998

Summary of Management Plan Actions
Incorporated by reference

Hydrology Actions

- Action H-1: Modify Operation of Existing Slide Gate at East Cliff Drive and San Lorenzo River
- Action H-2: Create Tidal Channel between East Cliff Drive and Lemos Avenue
- Action H-3: Fill Existing Channel between East Cliff and Lemos Avenue
- Action H-4: Create new Salt/Brackish Marsh plain between East Cliff Drive and Lemos Avenue
- Action H-5: Create New Freshwater Channel between Lemos Avenue and Barson Street
- Action H-6: Create Open Water Areas between Lemos Avenue and Barson Street
- Action H-7: Create Sediment Retention Basin near Barson Street
- Action H-8: Partially fill Existing drainage swale between Lemos Avenue and Barson Street

Habitat Restoration and Enhancement Actions

- Action R-1: Create New Salt/Brackish Water Marsh between East Cliff Drive and Lemos Avenue
- Action R-2: Enhance Existing Eucalyptus Grove near East Cliff Drive
- Action R-3: Create New Raised Berm and Vegetative Screening near Residences between East Cliff Drive and Lemos Avenue
- Action R-4: Retain and Enhance Freshwater Marsh Habitat between Lemos Avenue and Barson Street
- Action R-5: Create New Freshwater Marsh Habitat
- Action R-6: Retain and Enhance Existing Riparian Habitat
- Action R-7: Create New Riparian Habitat between Lemos Avenue and Barson Street
- Action R-8: Retain and Enhance Existing Oak Woodland
- Action R-9: Create New Oak Woodland
- Action R-10: Retain and Enhance Existing Saltgrass Grassland
- Action R-11: Remove/Control Invasive, Non-native species

Public Access Actions

- Action P-1: Construct bridge and Boardwalk across Marsh Channel near Lemos Avenue and Jessie Street
- Action P-2: Construct Footpaths within Upper and Lower Marsh Areas
- Action P-3: Construct Gates and Split-Rail Fences and Install Boulders
• Action P-4: Construct Trail and Steps to Oceanview Park
• Action P-5: Install Interpretive and Public Access Sign
• Action P-6: Install benches, Bicycle Racks, and Trash Containers
• Action P-7: Long-Term Site Maintenance
• Action P-8: Improve Existing Trail to Oceanview Park