DRAFT

Lower Codornices Creek
Improvements Plan
Berkeley/Albany, California

May 1, 2001

Prepared By

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EXECUTIVE SUMMARY

The University of California, Berkeley (UCB), the City of Albany, and the City of Berkeley jointly authorized and funded this plan to improve Codornices Creek to a more natural state, including steps that can be taken in the short-term to improve the creek given existing conditions and constraints. The plan encompasses the half-mile reach of the creek that runs from the Southern Pacific Railroad Tracks east of Interstate 80 to San Pablo Avenue. The creek forms the boundary between the cities of Albany and Berkeley. University Village, 920 ± units of student family housing, is north of the creek in Albany. South of the creek in Berkeley are several commercial and light industrial uses, a United States Post Office package facility, and a newly developed City of Berkeley recreation field complex. A number of groups have an interest in this creek planning, including representatives of various creek organizations and field user groups, bicycle advocates, Village residents, and nearby property owners.

The UC Berkeley Campus is implementing the University Village Master Plan to replace its aging housing at University Village and replace or renovate related community facilities. While the existing housing and some facilities present impediments to restoring the creek, the implementation of the Master Plan will provide opportunities to increase the creek right-of-way in selected constricted reaches. Improvements to the creek to provide for flood control for the recently completed Step 1 of the redevelopment project, and to allow for the replacement of the remaining housing (Step 2), are also included in the plan.

Four sports fields at University Village will need to be relocated in order to complete implementation of the Master Plan, and the City of Albany is working with the university to insure that the field users will have continuity of field use throughout the process. The proposed plan is to relocate the existing little league fields and softball field to the Dowling Park area on the western edge of the Village, and to reconfigure the larger soccer field from an east-west to a north-south orientation. This will displace the existing University Billage garden from Dowling Park, for which an alternative location is being explored. In addition, providing sufficient land for the fields will require culverting and/or redirecting the portion of Village Creek that runs along the SPRR tracks on the western edge of Dowling Park.

The City of Albany has been active in efforts to restore the four creeks in, or forming the border of, the city, and voters approved bond funding for both creeks and fields. More recently, the City has secured funding to support efforts to develop a bike trail along Codornices Creek that would connect most of Albany's population with the relocated youth sports fields and ultimately, the Bay Trail, and another grant to fund some of the creek restoration.

The city of Berkeley has been actively involved in efforts to improve Codornices Creek, especially as it relates to flood control for adjacent and downstream properties. In the fall and winter of 1997-98, the city funded a channel restoration project between 5th and 6th Streets to relieve bank erosion and flooding problems. The city recently purchased the property on the south side of the creek from 5th Street to the railroad tracks to develop youth sports facilities and allocated a portion of that land to future creek restoration efforts. Berkeley has also adopted a bicycle plan to encourage greater bicycle use for both commuting and recreation throughout the city.

Goals

The university, cities of Albany and Berkeley, and related interest groups identified the following goals for the creek planning:

- Restore Codornices Creek to as natural a state as possible
- Develop a regional trail to link to the Bay Trail to the west and the BART trail to the east.
- Relocate softball field and reorient soccer fields to allow for housing redevelopment
- Relocate village gardens
- Relocate little league fields to provide sufficient depth along San Pablo frontage to attract appropriate commercial development
- Provide access to relocated softball and little league baseball fields
- Provide for University Village housing redevelopment flood control and flood control for properties in Berkeley south of the Creek
- Reduce, to the extent possible, flooding impacts on upstream and downstream properties
- Protect and restore steelhead and other aquatic habitat
- Correct existing stream channel instabilities
- Restore Codornices Creek channel and riparian corridor as mitigation for the loss of existing channels on Village Creek and the Codornices by-pass channel
- Avoid causing undue cost to the University Village housing redevelopment budget
- Minimize project costs to the degree feasible
- Provide some habitat for wildlife and some remnant of the historic riparian environment
- Evaluate flooding impacts of the proposed creek restoration design on adjacent properties

The Plan

The Codornices Creek plan describes the creek restoration and bicycle/pedestrian trail development in two phases: Phase1 and Phase2. In Phase 1, the plan assumes that major improvements to most of the reaches can be made as the University proceeds with its plans for redeveloping its San Pablo frontage in conjunction with a private developer. Significant work on the reach between 5th and 6th streets cannot be achieved until Step 2 of the housing redevelopment proceeds, and will require a revision to the step 2 site plan in order to avoid a loss in units. Thus, the plan would be implemented in two phases. Phase 1 work would only be accomplished when additional right-of-way becomes available. Phase 1 of the plan also assumes that the U.S. Post Office will cooperate with these efforts by making additional land available for the reach between 6th and 8th streets. There are no plans to move existing commercial buildings on the Berkeley side.

The plan does not represent the restoration of the historical conditions of the creek but it does apply geomorphic principles to restore some of the structure, functions and diversity associated with the historical creek environment.

Steps to implement the first phase of the project, by reach, include:

<u>SP Railroad Tracks to 5th Street</u>

- Remove and/or plug Codornices Creek bypass.
- Relocate softball field to Dowling Park; reorient soccer field to north-south direction
- Relocate field house
- Remove concrete culvert and restore channel to natural meander
- Construct a vehicle/bicycle/pedestrian bridge over creek at 5th Street
- Add a pedestrian path along the north side of creek

<u>5th to 6th streets</u>

- Install soil bioengineering systems [list specifics]
- Restore 200 feet of creek in location of the bypass
- Remove bypass headwall

<u>6th to 8th streets</u>

- Culvert or relocate Village Creek
- Relocate the two Little League fields to Dowling Park (north).
- Relocate the grounds storage building that is located adjacent to the creek in the San Pablo Avenue frontage commercial development.
- Relocate portion of Albany Children's Center play yard and a storage building.
- Restore Codornices Creek between 6th and 8th Streets

- Develop bike trail on south side of creek.

8th to 9th streets

- Minor trail improvements

10th Street to San Pablo Avenue

- Relocate the Little League fields (above).
- Remove existing UCB student housing units along San Pablo Avenue as part of commercial development (lease)
- Restore Codornices Creek from San Pablo Avenue to Tenth Street
- Remove 10th Street culvert
- Develop bike trail connecting San Pablo to the creek

Steps to implement the second phase are:

5th to 6th streets

- Remove University Village housing along Codornices Creek between Fifth and Sixth Streets
- Remove the Sixth Street culvert
- Increase right-of-way for creek improvements
- Add pedestrian floodplain trail

Revegetation and Monitoring Plan

The plan also includes a revegetation strategy that would emphasize removing invasive plants and establishing native riparian canopy shade trees along the north and south banks. Plantings would maximize the diversity of native species. The stand of elm trees in the 10th Street to San Pablo reach would be retained, while managing for succession to native species. The banks and floodplain would be graded to promote variations in slope and encourage species diversity. The plan also calls for encouraging volunteer participation in planting projects by University Village and residents of the larger communities. The maintenance and monitoring component is designed to insure that the creek is responding to the design parameters and the vegetation is successful.

Costs

The preliminary cost estimate for constructing the improvements is $1.38 million. These costs include final design, project management, planning, construction, and post construction management and monitoring. Costs for culvert removals need to be finalized based on alternative disposal and/or burial scenarios.

Next Steps

The city of Albany has engaged a consultant to analyze the potential environmental impacts associated with implementing the creek plan and associated field development. The consultant will prepare an Initial Study to identify potential impacts and determine the level of environmental review that will be required under the California Environmental Quality Act (CEQA) and the National Environmental Protection Act (NEPA).

Concurrently, permit applications will be submitted to the relevant agencies—the San Francisco Bay Regional Water Quality Control Board, the Army Corps of Engineers, and the Department of Fish and Game. The National Marine Fisheries Service and the U.S. Fish and Wildlife Service may provide input as part of the Army Corps of Engineers permitting process. Although the permit applications can be submitted to begin the permitting process, no permits can be issued until completion of the environmental review. Implementation of the creek plan and related bike trail improvements and field relocation will be coordinated with the field user groups so as to avoid disrupting their season. Creek restoration construction activities will also need to be scheduled according to permit requirements.

1.0 INTRODUCTION

This report was jointly authorized and funded by three public agencies--the University of California, Berkeley (UCB), the City of Albany, and the City of Berkeley--to develop both a long-range design for Codornices Creek intended to maximize restoration of the creek to a more natural state, and a short-range plan that recognizes the reality of existing conditions and constraints. This report makes recommendations regarding incremental steps that can restore reaches of the creek, provide flood protection, and respect the land use objectives of adjacent property owners.

Codornices Creek is an urbanized creek demarcating the border of the cities of Berkeley and Albany, California. The creek flows from steep drainages in the Berkeley Hills through the city flatlands and into San Francisco Bay, where it is tidally influenced in the very lower reaches. Although significantly altered over time by channelization, culverting and straightening, Codornices Creek is the only creek left in the cities of Albany and Berkeley in which the majority of its length is an open channel and has not been converted to storm drain piping, and therefore represents the best opportunity in this area to restore natural creek functions within an urban environment. It is a principal feature of parks in the Berkeley Hills (Codornices Park, the Rose Garden, Live Oak Park) and a focal interest of local creek groups at the BART greenway in Albany.

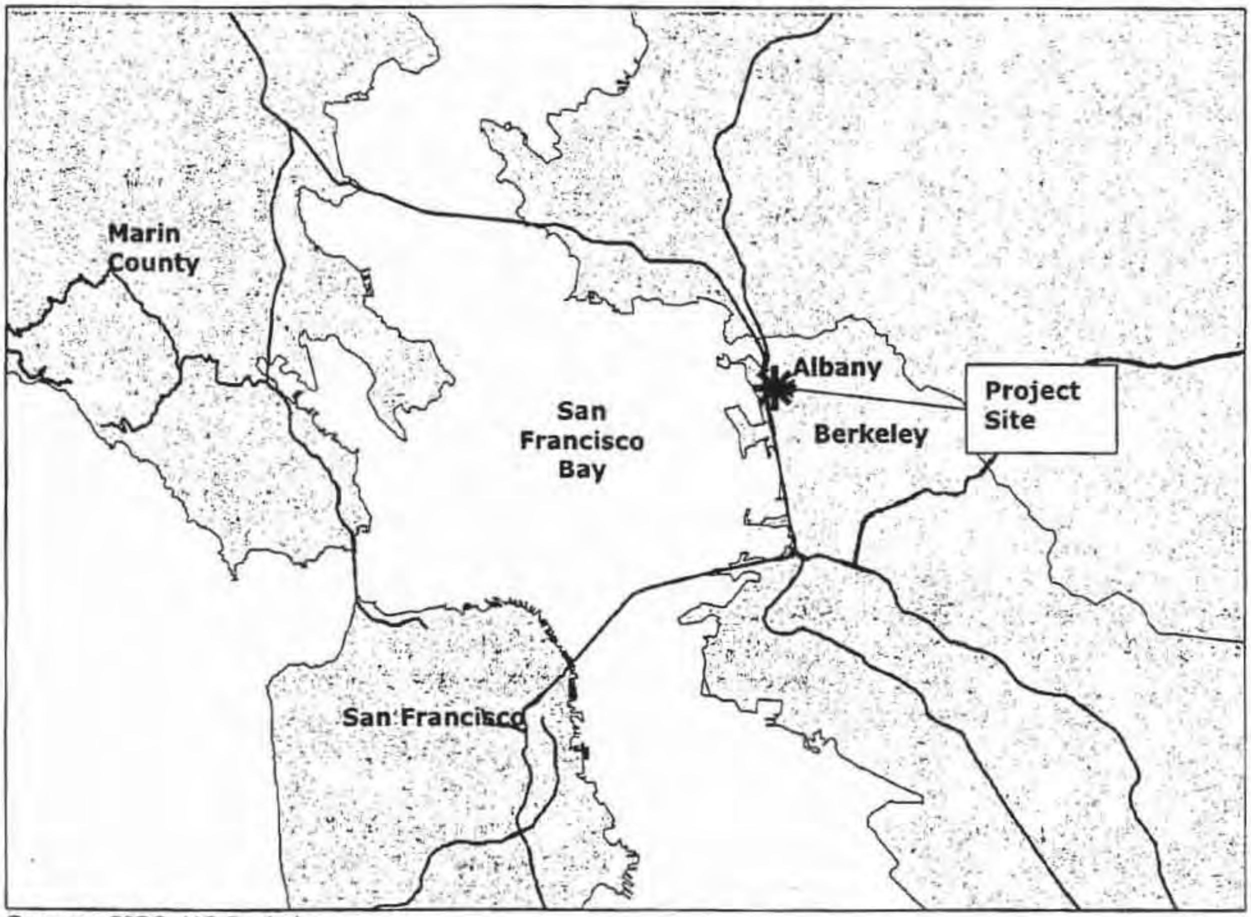
The reach of Codornices which is the subject of this report is a half mile stretch from the Southern Pacific Railroad Tracks east of Interstate 80 to San Pablo Avenue. The Regents of the University of California own the Albany side of the creek, which is developed with student family housing, known as University Village. The south side of the creek is mostly developed with commercial and light industrial uses, with a new youth sports facility complex at the lower end of the study area. The property owners on the south side include the City of Berkeley, the U.S. Postal Service, and a variety of residential, industrial, and commercial landowners. The creek drains a watershed of approximately 1.2 square miles and collects storm water from various drainage systems (Figures 1-1 and 1-2). Much of the existing development along the creek is very close to the creek bank, impeding the potential for creek restoration.

1.1 Project Participants and Objectives

The Codornices Creek team consists of representatives from UCB, the City of Albany and the City of Berkeley. The team first met in the spring of 1999 to collaborate on a creek restoration plan for Codornices Creek from San Pablo Avenue

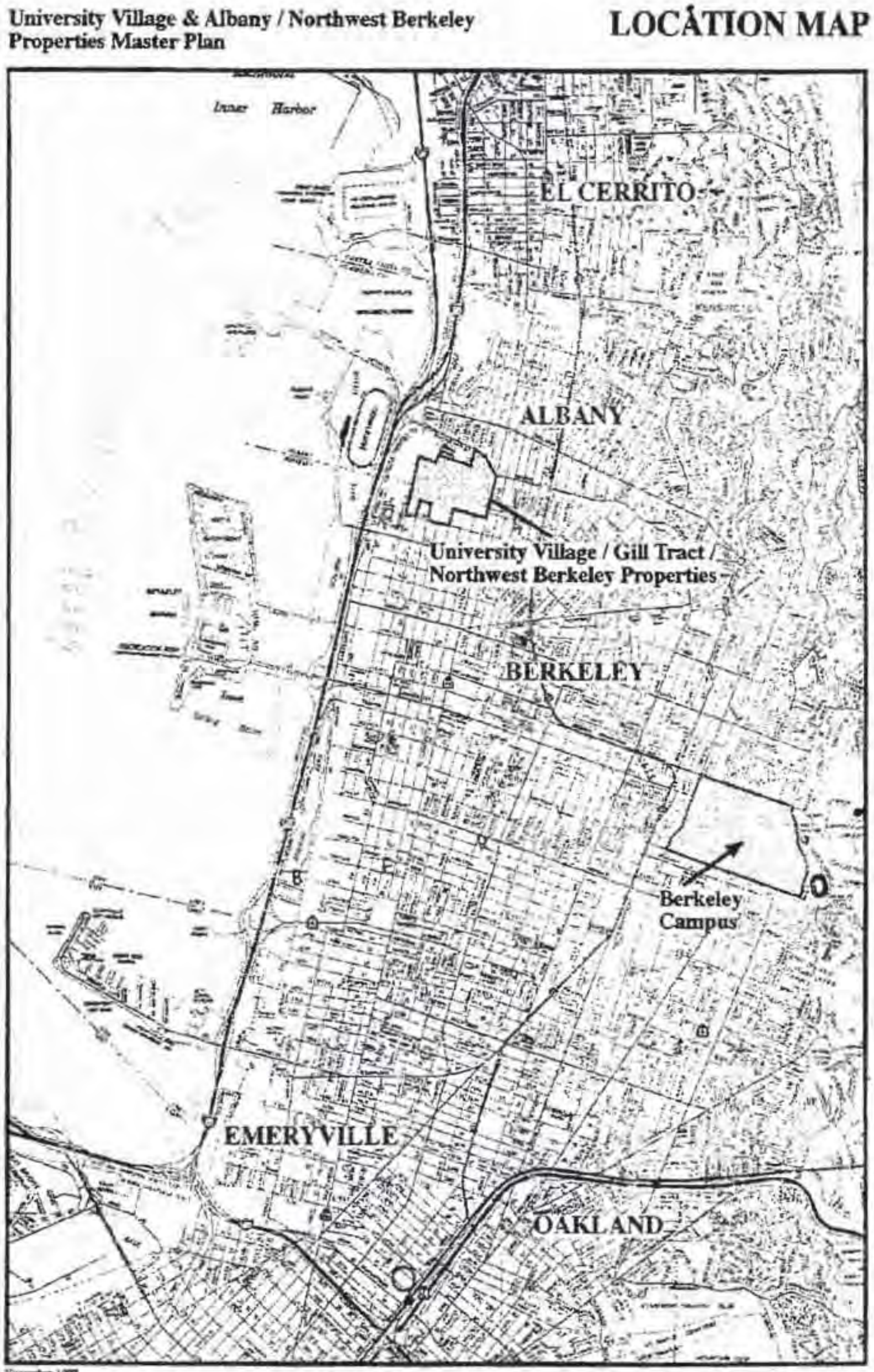
Site Location Map

Figure 1-1



Source: GISC, UC Berkeley

Project Location Map **Figure 1-2**



Source; UC Berkeley

to the Southern Pacific Railroad (SPRR) tracks above I-80. In that effort the team identified the rights-of-way needed to accomplish the plan, as well as the existing conditions that would interfere with its implementation. The team approach to planning for the creeks and channels is being continued to provide for coordinated project design, permitting and stakeholder involvement in planning and implementation. Among the stakeholders are the Associated Sports Field Users, Albany ball field advocates, representatives from Building Opportunities for Self-Support (BOSS), skateboarders, University Village community gardeners, Friends of Five Creeks, the Urban Creeks Council, University Village residents and staff, bicycle advocates, and some Berkeley private property owners.

2.0 BACKGROUND

Several recent projects and planning processes have had a direct or indirect impact on Codornices, as well as Village, Creek. These events provide an opportunity, and challenges, to make improvements to the creeks.

2.1 University Village Master Plan

The Berkeley Campus is implementing a master plan to replace 420 units of student family housing constructed during the second World War (Step 1 of University Village Housing Replacement Project) (Figure 2-1); replace and/or renovate an additional 500 units dating from the early 1960s (Step 2) (Figure 2-2); and replace or renovate related community facilities constructed in the 1940s (Step 3).

University housing projects must be self-supporting, and the university makes every attempt to offer housing below prevailing market rates. In order to contribute to this effort, the plan designated properties along Harrison Street in Berkeley to be sold and land along San Pablo Avenue leased for commercial development to generate income to help fund the new housing. Since the plan was approved, the university sold these properties to the United States Post Office and the City of Berkeley.

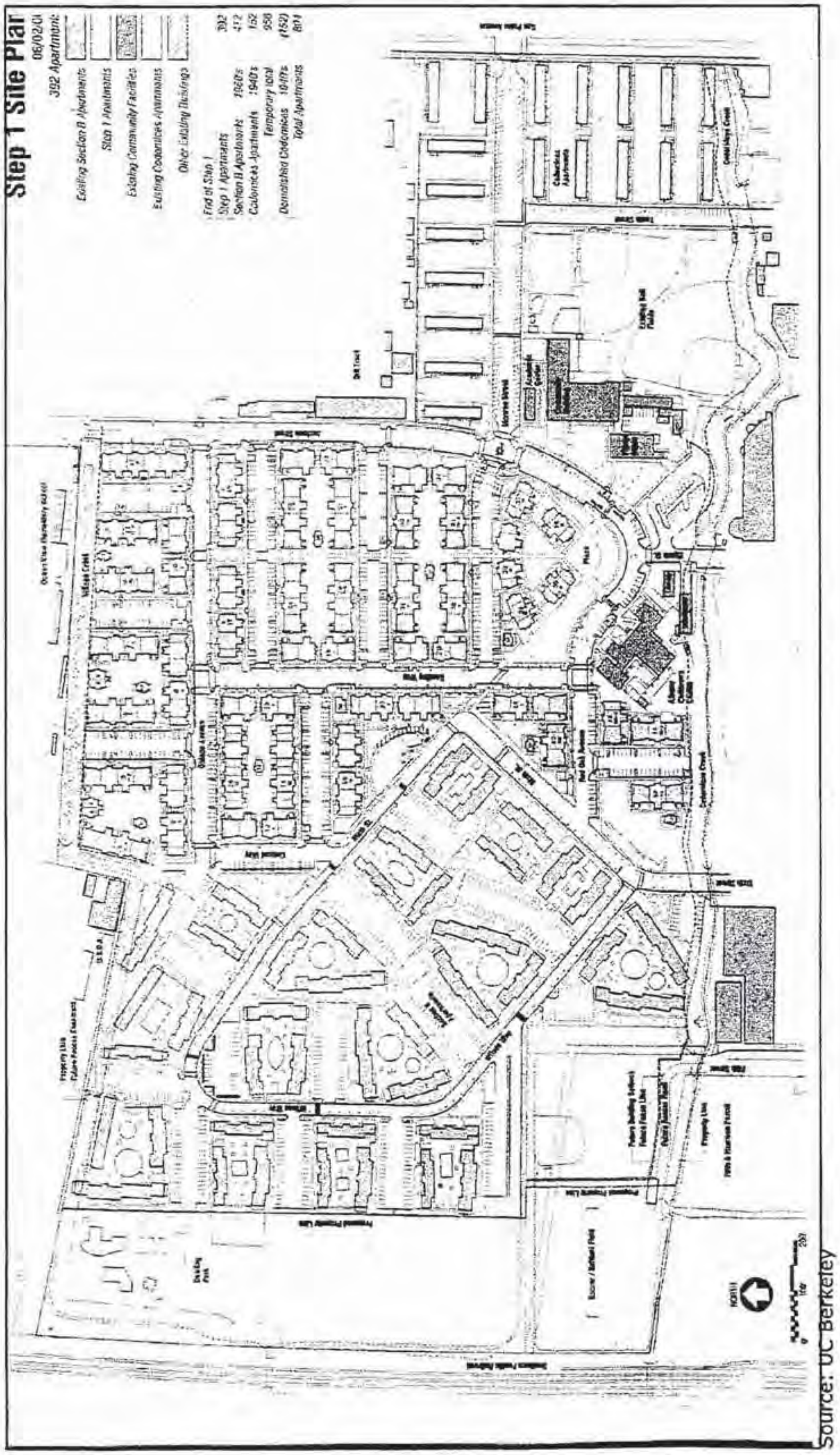
A third element of the plan, again to provide financial support for the overall housing redevelopment project, is to lease property fronting on San Pablo Avenue for private development. Step 3 of the project, replacing the Village community facilities, will become the responsibility of the private developer.

As part of the Step 1 housing project, the university opened up a reach of Village Creek in the spring of 1999, relocating it to the northern edge of University Village from Jackson Street west to the eastern border of the USDA property. Possible flood control improvements to Codornices Creek in support of the recently completed Step 1 housing project are included in this report.

2.2 City of Albany Creek-Related Planning and Projects

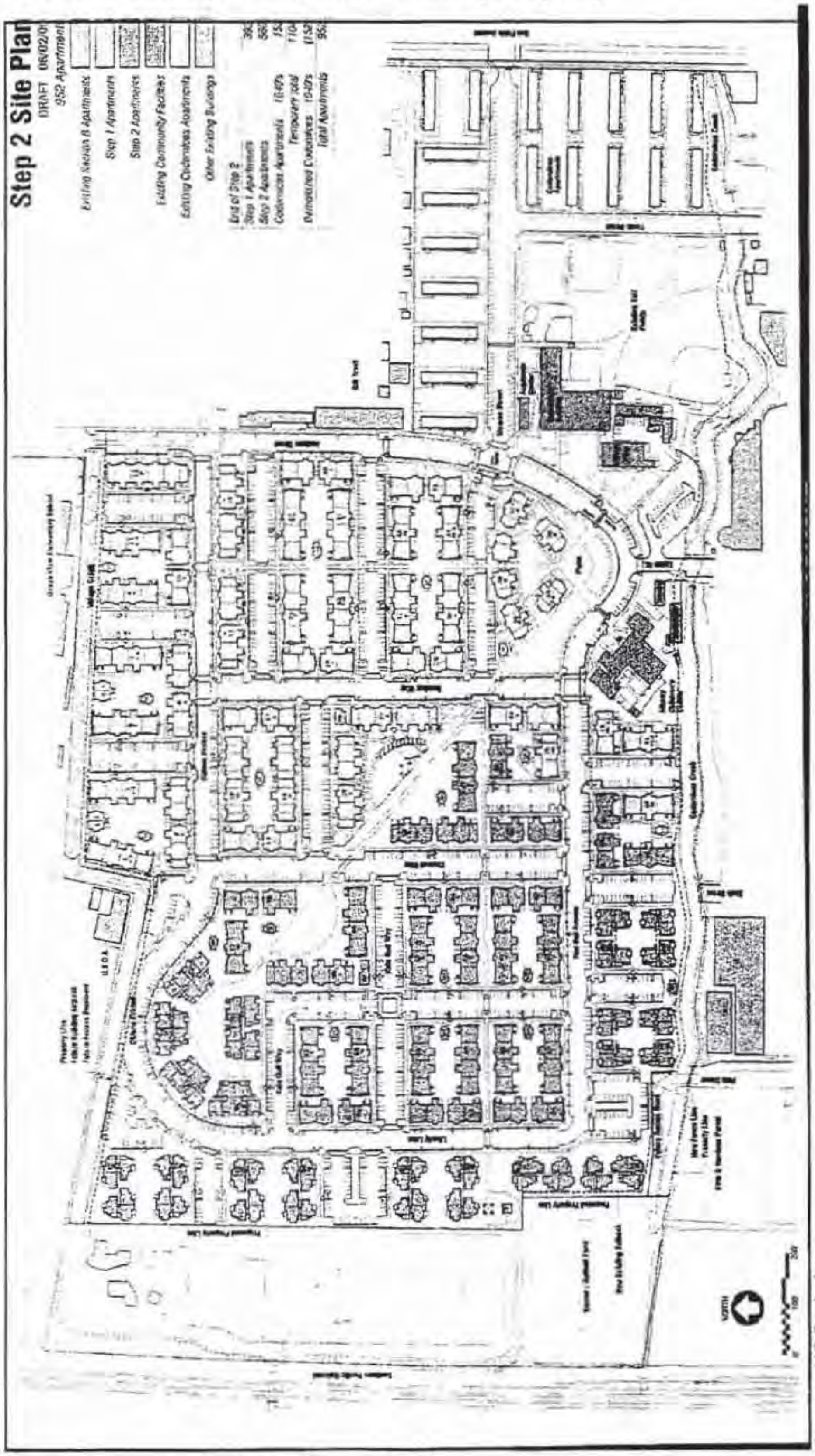
The City of Albany has always been an avid supporter of maintaining existing, and where possible increasing, the amount of field space available for youth. Similarly, the city has been active in efforts to restore the four creeks in, or forming the border of, the city. The City's Watershed Management Plan recommends stream restoration of Codornices Creek. In 1996, Albany voters passed a measure providing funds for both fields and creek restoration efforts. The city is currently participating in an effort to restore Codornices Creek between San Pablo Avenue and Kains Street at the Resources for Community Development affordable housing development.

UCB Development Site Plan (Step 1) — Figure 2-1



UCB Development Site Plan (Step 2)

Figure 2-2



Source: UC Berkeley

AR 007431

More recently, the city has secured funding to support efforts to develop a bike trail along Codornices Creek that would connect most of Albany's population with the relocated youth sports fields and provide an important link between the Ohlone Greenway (BART trail) and the Bay Trail. Such a trail would contribute to Albany's efforts to provide access to the creek while encouraging the use of alternative forms of transportation through their proposed bike trail system. (Figure 2-3)

The University in the past allowed community youth sports fields to be developed on its property in Albany when the demand for use of that property was not as great as it is today. There are currently two little league baseball fields, one softball field with an overlapping practice soccer field, and one soccer field on the university property within the City of Albany. In response to concerns from the city and sports field users, the university included in its University Village Master Plan a commitment to make land available to replace youth sports fields that would need to be relocated to allow for the housing redevelopment and associated commercial development.

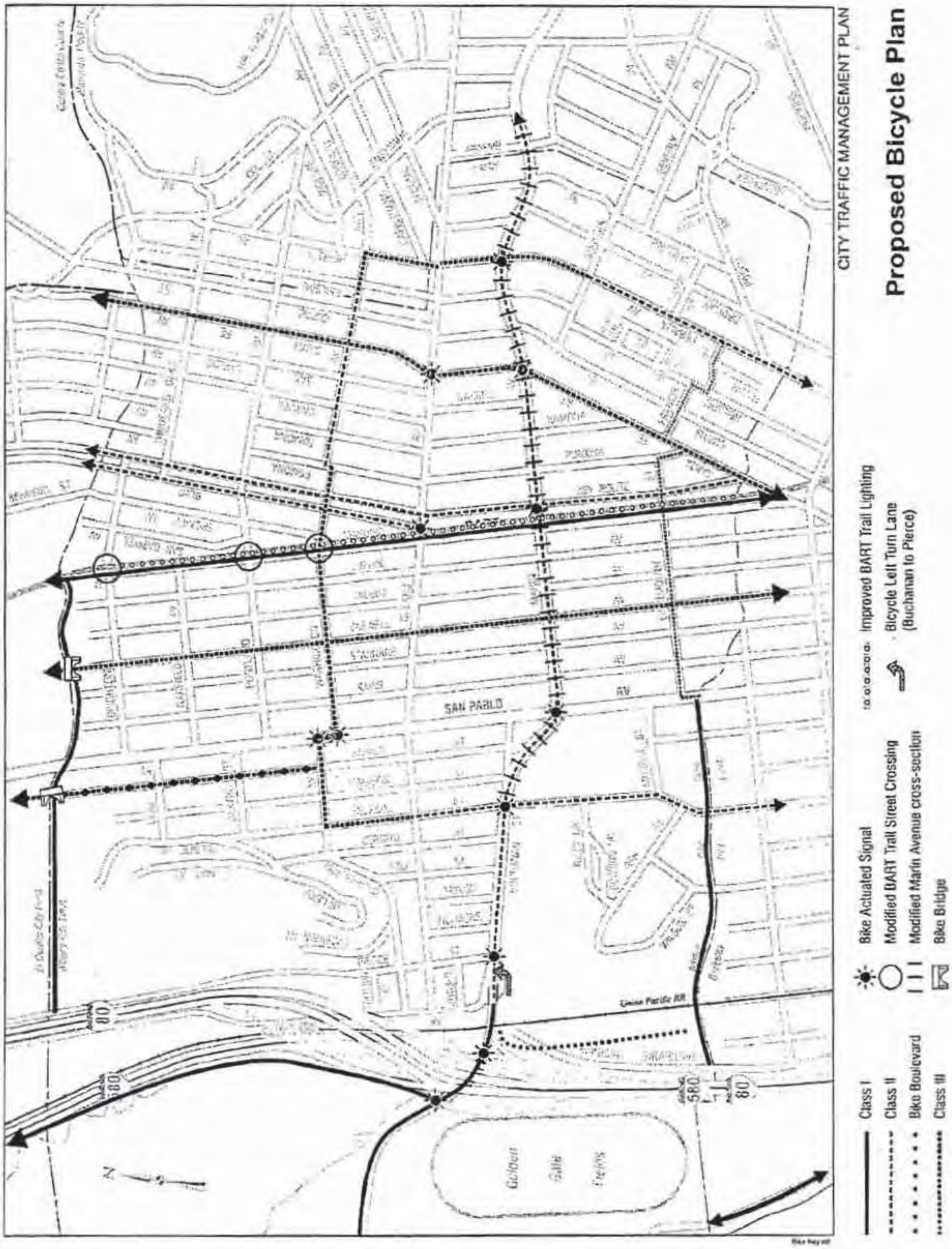
Step 2 of the housing replacement project includes the construction of housing on the soccer and softball fields site. Providing an appropriate site (sufficiently deep) for commercial development along the San Pablo frontage will require the relocation of the two Berkeley-Albany Little League fields located in Albany. In 1998 the City of Albany established a Recreational Playfield Task force to coordinate a large group of Albany's sports groups and creek organizations to resolve land use issues at Dowling Park and the existing softball and soccer fields. A schematic master plan is still under consideration. The proposed plan is to relocate the baseball and softball fields to the Dowling Park area on the western edge of the Village, and to reconfigure the larger soccer field from an east-west to a north-south orientation. Negotiations between the university and the City of Albany to resolve outstanding issues, such as access to the fields, are underway. Providing sufficient land for the fields will require culverting and/or redirecting the portion of Village Creek that runs along the SPRR tracks on the western edge of Dowling Park. The field relocation will also displace the University Village communal gardens, for which an alternative location is being sought.

2.3 City of Berkeley Creek-Related Planning and Projects

The City of Berkeley has been actively involved in efforts to improve Codornices Creek, especially as it relates to flood control for adjacent and downstream properties. The city constructed a storm sewer addition under Harrison Street from Fifth Street to connect with the Gilman Street sewer in fall 1997 to alleviate storm water based flooding from Fifth Street to the SPRR tracks. In the fall and winter of 1997-98, Berkeley sponsored and funded a channel restoration project between Fifth

City of Albany Bicycle Plan

Figure 2-3



and Sixth Streets to relieve bank erosion and flooding problems. The cross-sectional area was increased by over 100 square feet, for a 40-50% increase, and as much channel length as possible was restored. The project required excavating layers of "sackcrete", old pipes, rubble and debris that had been thrown into the channel over time.

The City of Berkeley purchased the property on the south side of the creek from 5th Street to the railroad tracks to develop additional youth sports facilities. The field design included using the property as a short-term flood plain to handle creek overflows, balancing the need to control downstream flooding with that of draining the fields within a short time frame so as not to damage the turf. The field layout was designed to allow for a wide creek meander where possible, particularly towards the western half of the property, anticipating future restoration.

The City of Berkeley has also adopted a bicycle plan to encourage greater bicycle use for both commuting and recreation throughout the city. They share Albany's interest in providing a bike/pedestrian trail as alternative transportation access and an amenity for the new sports complex and the Bay Trail.

2.4 Trail

One of the important objectives of this project for the cities of Albany and Berkeley is to provide a trail and public access along the creek. This trail can serve as a viable alternative transportation link from the now completed Bay Trail immediately downstream of this site. A study is underway to assess the feasibility of locating an East Bay ferry terminal at the foot of Gilman Street. This possibility magnifies the benefits of a trail that can link this transportation system to the Ohlone Greenway trail in Albany leading to the North Berkeley BART and ultimately to the University of California, Berkeley campus. The plan contains a 12-foot right-of-way for a pedestrian/bicycle trail, which meets CalTrans design requirements that would also serve as access for creek maintenance, along most of the restored creek. Due to limited right-of-way, there would only be a pedestrian path provided between 5th and 6th Streets to provide access to the athletic field located west of 5th Street.

2.5 Community-Sponsored Creek Improvements

Beginning in the fall of 1995, several nonprofit groups (Urban Creeks Council, Friends of Five Creeks, Americorps, Urban Ecology and Ecocity Builders) removed the underground culvert between Eighth and Ninth Streets and restored this reach of Codornices Creek to an open channel. The university cooperated with these efforts by eliminating parking spaces to allow for a better channel meander than would have otherwise been impossible, and completed fencing and creek access projects. However, the creek restoration did not meet basic channel stability needs and serious erosion problems have resulted. Despite efforts to widen and vegetate the channel using soil bioengineering planting methods, the channel continues to show head cutting and erosion problems. Despite these problems, this reach of the creek has become a well-used community resource.

3.0 GOALS

Each entity has specific issues that need to be considered in a creek restoration plan. The goal of the planning process is to develop consensus and permitable plans to restore the channels, floodplains and wetlands of lower Codornices Creek and address Village Creek issues while meeting the priority land use objectives of the stakeholders. Combining the goals of the university and the cities of Albany and Berkeley with those of the various stakeholders resulted in the following creek-related goals:

- Restore Codornices Creek to as natural a state as possible.
- Develop a regional trail along Codornices Creek that links to the Bay Trail to the west and the BART trail corridor to the east.
- Relocate the softball field and reorient the soccer field in Albany for housing redevelopment.
- Relocate the University Village communal gardens from Dowling Park
- Relocate little league fields to provide sufficient depth along San Pablo frontage to attract appropriate commercial development.
- Provide access to relocated softball and little league baseball fields.
- Provide for University Village housing redevelopment flood control.
- Reduce, to the extent possible, flooding impacts on upstream and downstream properties.
- Protect and restore steelhead and other aquatic habitat.
- Correct existing stream channel instabilities.
- Restore Codornices Creek channel and riparian corridor as mitigation for the loss of existing channels on Village Creek and the Codornices by-pass channel.
- Avoid causing undue cost to the University Village housing redevelopment budget.
- Miminize project costs to the degree feasible.
- Provide some habitat for wildlife and some remnant of the historic riparian environment.

- Evaluate flooding impacts of the proposed creek restoration design on adjacent properties.
- Work with Union Pacific Railroad and CalTrans to increase culvert capacity downstream.

4.0 HYDROLOGY AND STREAM DYNAMICS

4.1 Equilibrium or "Stable" Channel Conditions

The basis of any design alternative must start with the knowledge required to achieve a stable channel. The restoration parameters described in this report were calculated to correct the existing instabilities of the creek and provide a creek channel that is more in balance with its environment. In this case, the term "stable" refers to an active, meandering stream channel as you would find in nature. It is in "quasi equilibrium," or stable, in the sense that the channel width and depth are in balance with the size of the watershed. The discharges and the sediment load transported by the creek are in balance, and the channel slope and sinuosity are correctly matched with the creek's valley. The proposal strives to achieve design equilibrium so that over time Codornices Creek will not create problems by either excessively eroding or depositing sediment. A stable creek channel will be more resilient to future adjustments from natural and human-created changes and will minimize future maintenance costs.

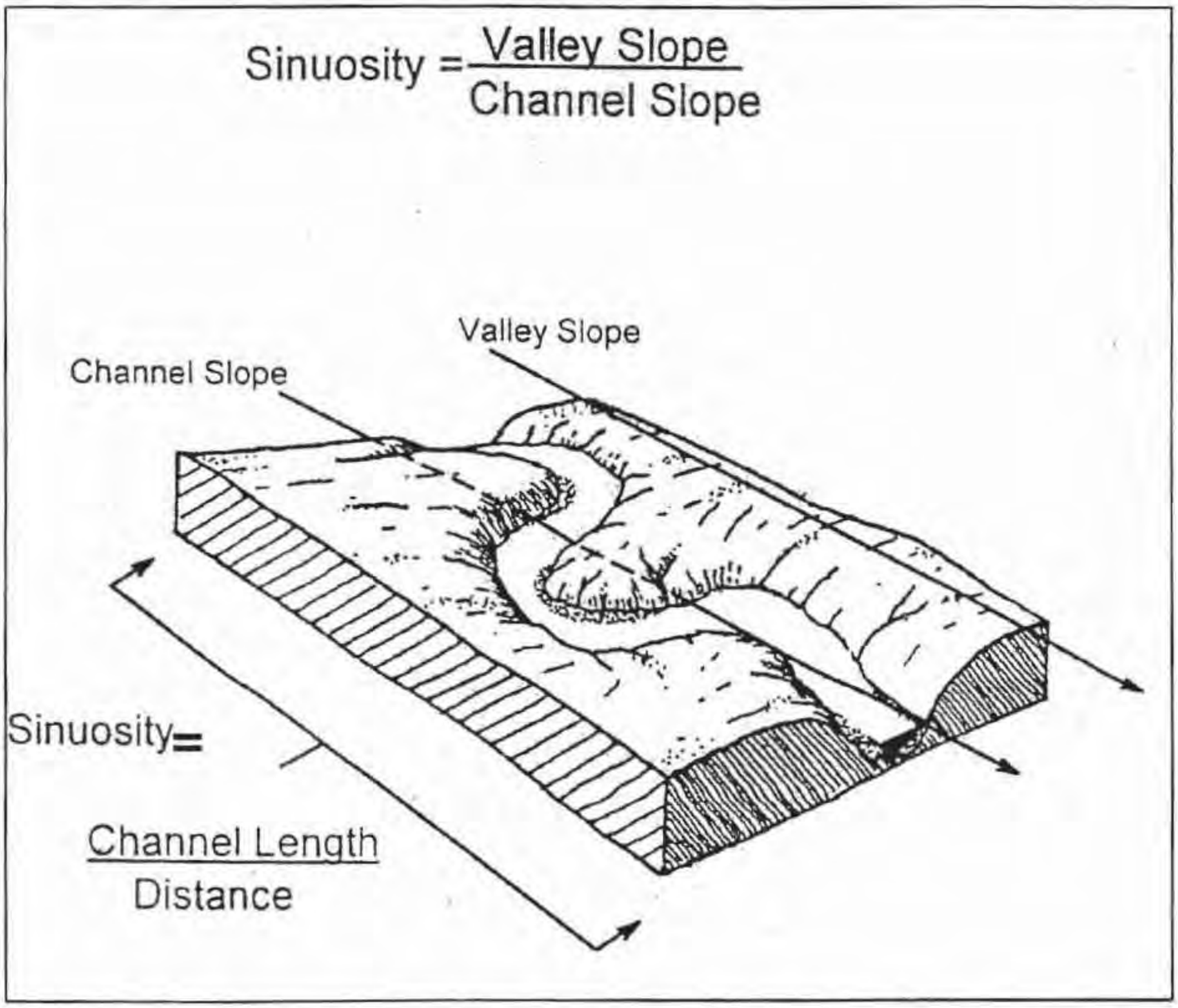
Although watershed conditions can change over time, even in this already very densely built urban environment, a channel designed with the correct width and depth will help avoid the problem of the creek attacking its banks with destabilizing erosion and/or the problem of the creek channel filling in and choking with sediment. The channel also needs to have the correct length and sinuosity to have this desired stability. A channel in this quasi-equilibrium is one in which its sinuosity and the slope of the bottom of the channel is matched correctly to the overall slope of the stream valley. Sinuosity refers to how long a path the stream travels over a given straight line of the meandering stream which is called the meanderbelt. The design meanderbelt refers to the width of project area needed to provide for the correct channel slope, sinuosity and width (Figures 4-1 and 4-2).

These project design features have been quantitatively derived and are described in greater detail in Appendix B, Stable Channel Design Process.

Flood Discharges

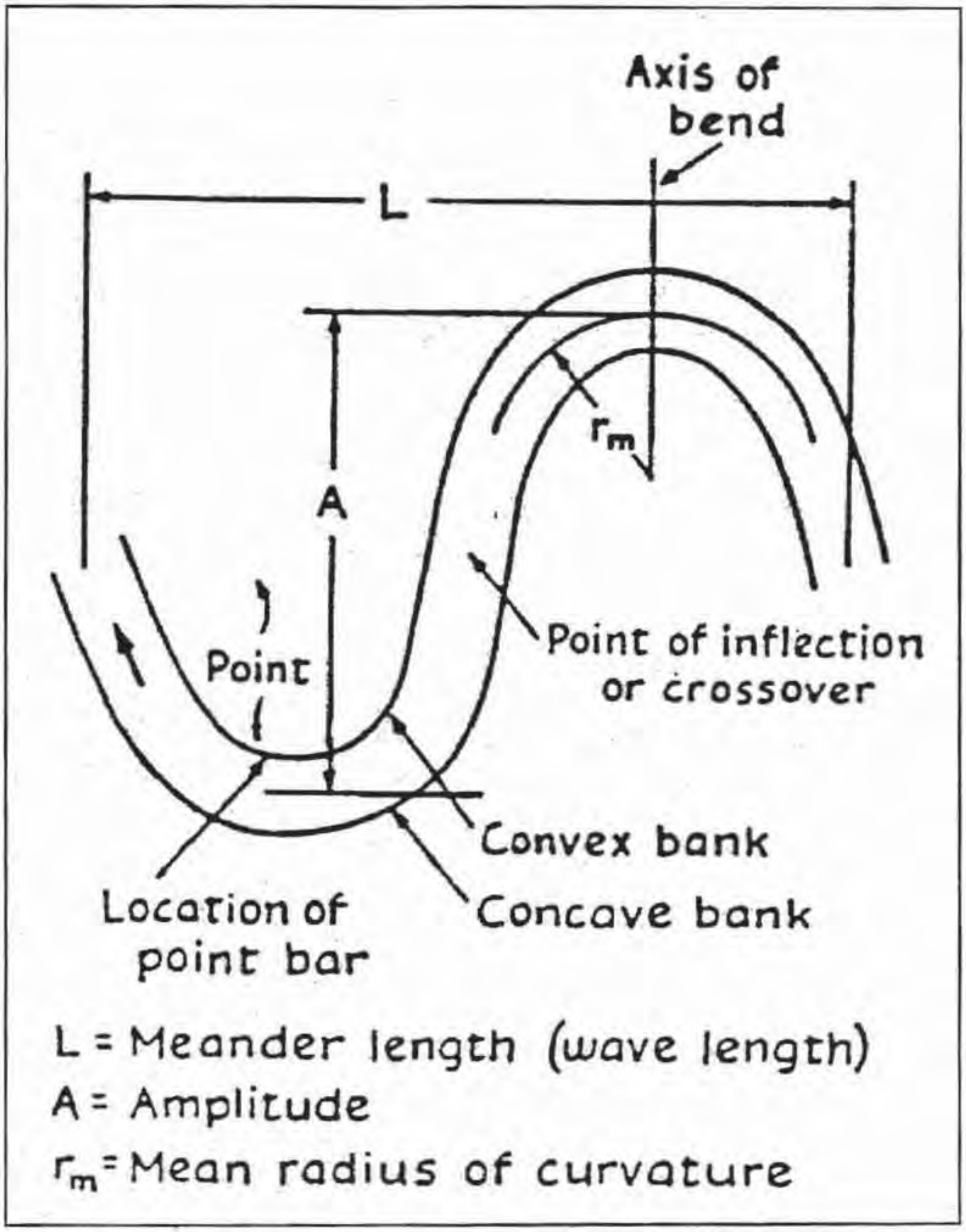
The Codornices Creek project also takes into consideration the goal to reduce flood risks to the new University Village redevelopment project. The project described in this report was designed with the objective to reduce the risk of flood damage from the relatively large and rare 1 in 100 year flood. Usually this design objective is tied to flood insurance standards.

Additional flood studies will be conducted to evaluate this restoration plan once public comment has been incorporated into the design. The studies will evaluate the ability of the restored creek to convey the 1 in 100 year flood that ranges from 900 cfs to 1185 cfs. (Flood Peak Table, Appendix C.) Design features such as 1-2 foot high landscaping berms will be added to the BOSS center area, between 5th and 6th Streets and between the 8th Street culvert and the street. The final flood modeling will determine the exact height and layout of the landscaping berms.



Source: Waterways Restoration Institute

Geometry of Meanders **Figure 4-2**



Source: *Fluvial Processes in Geomorphology*
Leopold, Miller, Wolman (1956)

5.0 PHASED CREEK RESTORATION PLAN

This section describes the design basis for the creek enhancement phasing plan. The plan assumes that major improvements to most of the reaches can be made as the University proceeds with its plans for developing its San Pablo frontage in conjunction with a private developer. Significant work on the reach between Fifth and Sixth Streets cannot be achieved until Step 2 of the housing redevelopment proceeds. Thus, the plan is described in two phases which can be accomplished as additional right-of-way becomes available. Phase 1 also assumes that the U.S. Post Office will cooperate with these efforts by moving their parking lot wall 12 feet to the south. There are no plans to move existing commercial buildings on the Berkeley side. The plan does not, of course, represent the restoration of the historical conditions of the creek, but it does represent the application of geomorphic principles to restore some of the structure, functions and diversity associated with the historical creek environment.

The plan is described in reaches, beginning at the railroad tracks and going east to San Pablo Avenue. Each of these sections describes the opportunities and constraints, historic and existing conditions, steps to accomplish the improvements, design parameters, and stream channel design for that particular reach.

5.1 Phase One Creek Improvements

Railroad Tracks to Fifth Street Reach

Opportunities and Constraints

The right-of-way is constricted at Fifth Street because of the requirements of the playing field dimensions on the south side, the need for an access road to the relocated sports fields in Albany, and the new UCB housing on the north side. The rest of this reach provides a significant restoration opportunity. The inadequately sized and maintained railroad culvert directly west of the City of Berkeley property creates an on-going backwater condition and associated flooding problem.

Historical and Existing Conditions

Historical maps and drawings indicate that this channel entered a low gradient marsh environment (Figure 5-1 through 5-3). A recent history publication, Berkeley 1900 (Schwartz 2000), describes the historic environment in this area as the Codornices lagoon. The channel was most likely narrower, deeper and more sinuous than the channel upstream of Fifth Street. The historical channel conditions were probably what are known as a Rosgen E-Channel type given the indications from historic information that the creek flowed through a wetlands on very flat gradient with the channel narrowing and becoming very sinuous below Fifth Street.

Currently the creek in this reach is straightened with portions lined in concrete which is cracking and failing. The creek has been bounded to the west by the railroad tracks since the 1800s. In recent history (1947 photo; Figure 5-2) the creek was diverted around, into and out of the now demolished steel factory. The current condition of the creek banks and concrete channel are very unstable. The area has been filled over time and the riparian vegetation consists of sparse remnants of mostly willow species.

The origins of the bypass channel involved creation of a ditch dug prior to 1930 to drain and/or irrigate an agricultural field. This bypass channel, which flows north and joins the lower Village Creek Channel to a culvert under the railroad tracks, continues to divert some flow from Codornices Creek. The bypass is an undesirable feature for channel stability because it splits flows away from the main channel of Codornices Creek. This in part contributes to the clogging of the lower Codornices creek channel with sediment because there are not sufficient discharges to transport the sediment load. It is also undesirable for migrating steelhead which can follow the Village Creek flows up to this by-pass channel where they can become trapped. The culvert at the railroad tracks controls the discharges which can run off this lower section, creating a significant backwater and ponding of flood flows.

Phase 1 Improvements

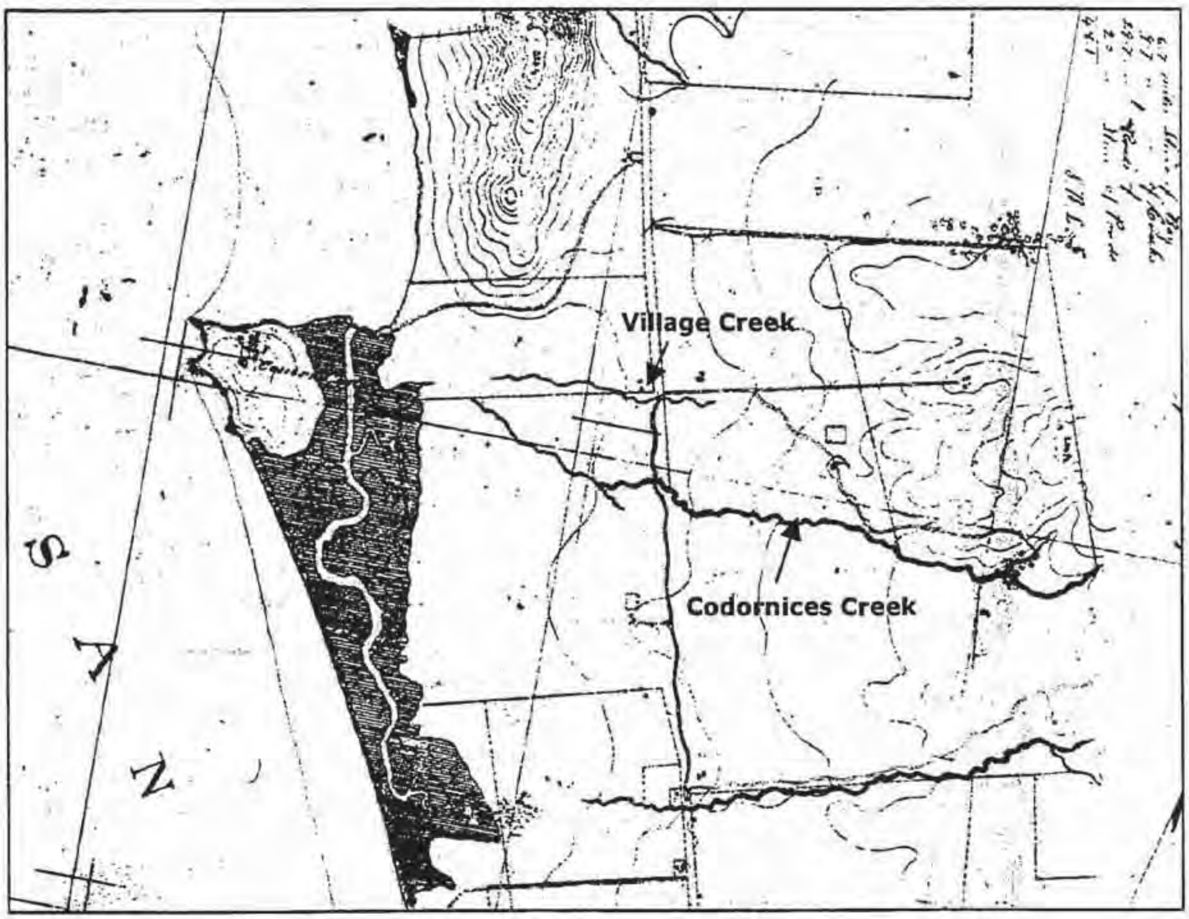
The steps to the Phase 1 improvements in this area are:

- Remove Codornices Creek bypass
- Relocate softball field to Dowling Park; reorient the Albany soccer field to north-south direction
- Remove concrete culvert at 5th Street and restore channel to natural meander
- Relocate fieldhouse facility in Albany Relocate fieldhouse facility in Albany
- Provide a vehicular/pedestrian access bridge over the creek at 5th Street

Design Parameters

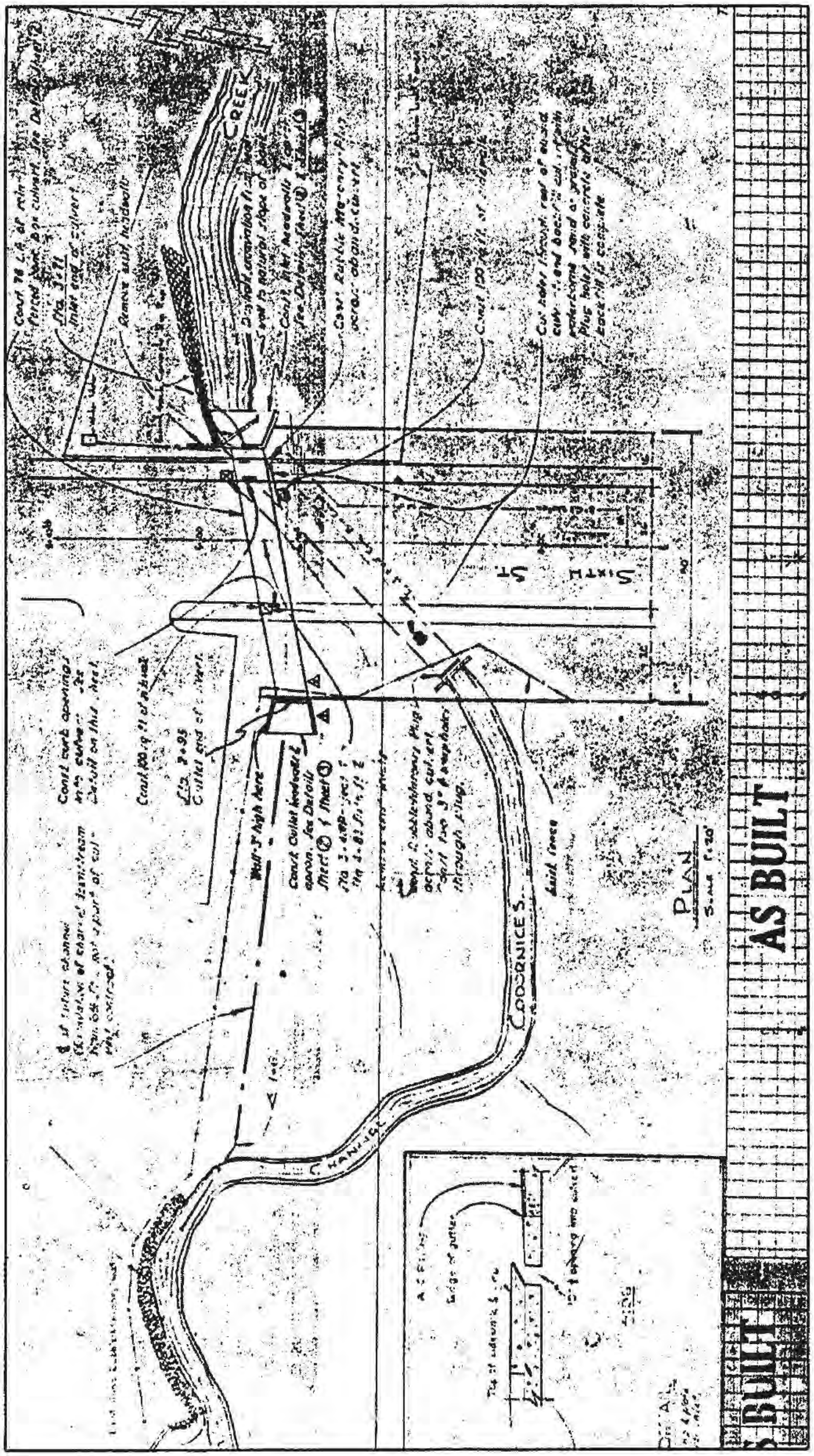
Downstream of Fifth Street the channel type changes as the creek negotiates a flatter gradient as it transitions towards the Bay's wetlands. The carefully rendered 1964 sketch at Fifth Street indicates that the channel changes to a narrower channel in this area. This information corroborates with historic maps and accounts which indicate that the location of the creek entering a marsh is a low gradient Rosgen E-type channel. These channel types have a much lower width-depth ratio than the upstream channels. The regional graphs used to help guide the design in the upper reaches do not apply to this channel type because there are no known gauge stations on this stream channel type in the region. However, directly 2000 feet to the north, Village Creek is situated in the same gradient and soils. There, historic photos indicate that before Village Creek was culverted, it entered wetlands in this area

1865 U.S. Coast Survey **Figure 5-1**



1947 Aerial Survey **Figure 5-2**

City of Berkeley Dept. of Engineering Meander **Figure 5-3**
5th to 6th Streets



with a sinuous (1.6) channel. The Village Creek restoration project was completed in the Fall 1998 with a design sinuosity of 1.6 and a width-depth ratio of 4-5. This restoration seems to reasonably match this landscape and is thus far resulting in an equilibrium channel. Therefore the channel design parameters used for the channel below Fifth Street are the following:

Channel forming or bankfull discharge - 80 cfs
Bankfull width - 12 ft
Bankfull depth - 3 ft
Width/depth ratio - 4

Stream Channel Design

This entire stretch of the creek is being designed with a 12 foot wide, 3 foot deep channel. The project right-of-way up to old Fourth Street enables the restoration of a substantial floodplain environment and creek meanderbelt within a 135 foot right-of-way. The design sinuosity is 1.69. The stream channel right-of-way is narrowed between the proposed new residential buildings to the north and the new soccer field to the south below Fifth Street to a corridor 40-70 feet wide. An average sinuosity of 1.36 can be attained for the 275-foot reach below Fifth Street. This reach should have an average sinuosity of about 1.5, but the overall average channel sinuosity from Fifth to the Railroad tracks is 1.5. The overall channel length in this area should help prevent future headcutting. The constrained meander below Fifth Street will need to be treated with rock buried two feet behind the outside meander bends and the outside bends will need substantial soil bioengineering plant systems. The buried rock should not be present on the channel surface. This constrained section will need steeper 2:1 channel side slopes.

Removing the Fifth Street culvert and the bypass will have substantial benefits to the stabilization of the creek by enabling a corrected stream channel slope to be constructed. The removal of the split flows will correct sedimentation problems on the main channel and greatly benefit restoration of steelhead and other aquatic fauna.

Fifth to Sixth Streets Reach

Opportunities and Constraints

This reach is the most problematic because of the existing housing on the north side of the creek, and the commercial buildings on the south side that are close to the top of the bank. Any "restoration" in the short-term will be limited by the existing 1960's units on the north bank. There should be an opportunity for significant improvements in the future when the university undertakes Step 2 of its housing redevelopment program.

Historic and Existing Conditions

The historic records (Figure 5-3) indicate that the creek used to meander under the Ehret Plumbing Building and parking lot to the south as late as the 1960s. The sinuosity was a value of 1.3 (the channel meandered a distance of 130 feet every 100 feet). The creek was straightened in 1994 and a culvert put in at Fifth Street.

Surveys of existing conditions indicate that the Fifth Street culvert was likely installed well below the natural grade of the creek. This has resulted in a chronic maintenance problem in which the culvert and channel fill with sediment, thereby impeding the passage of flood flows. Flood flows over the Fifth Street culvert are common.

A restoration project completed by the City of Berkeley in 1996-97 significantly increased the channel capacity in this reach. Efforts to achieve the historic channel sinuosity fell short of the design goal of 1.27-1.3. Attempts to direct more flow away from the bypass culvert have been frustrated by the chronic sediment deposition at the Fifth Street culvert which creates a backwater co ndition and encourages flow into the deeper pass. To date there is evidence of headcutting due to the inability to achieve the adequate channel length (Figure 5-4).

The 1996-1997 project's design bankfull width of 16 feet and bankfull depth of 1.5-2 feet near the Sixth Street culvert appear to be aiding channel stability above the area influenced by the by-pass and Fifth Street culvert (Figure 5-5).

Phase 1 Improvements

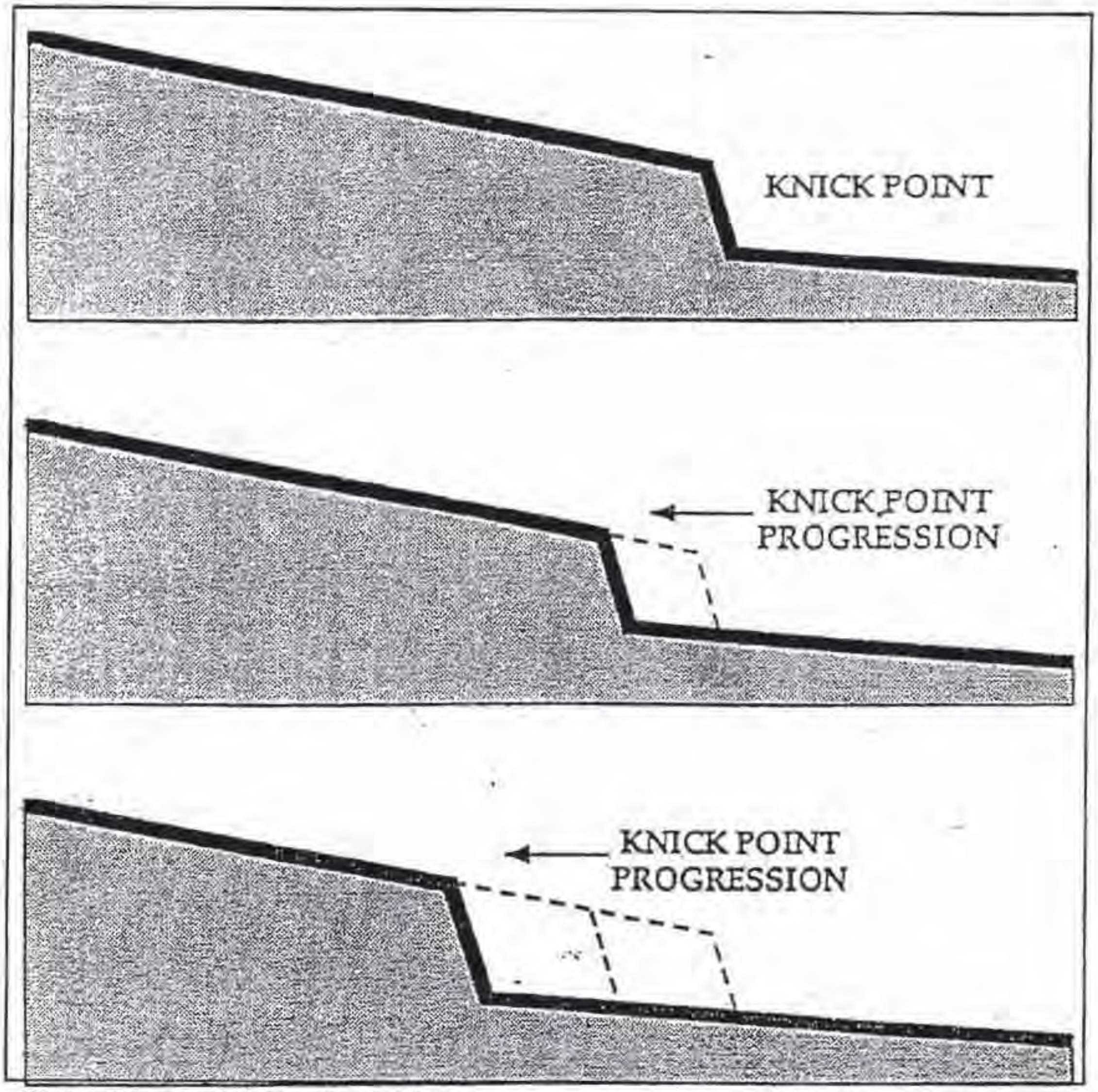
- Restore 200 feet of stream channel
- Remove by-pass and plug remaining section
- Realign channel away from structure on south bank

The by-pass culvert and headwall can be removed and the remaining section of the underground by-pass plugged. Two hundred feet of channel can be restored in this area linking to the restoration channel downstream and the existing channel contrained by Ehret Plumbing on the south bank and the 1960's university housing on the north bank. When the 1960's university housing requires replacement, Phase 2 of the restoration project will be able to complete the channel modifications up to 6th Street.

The 6th Street culvert would remain during Phase 1, leaving the channel subject to 6-7 feet per second velocities in a large storm. Soil bioengineering systems can

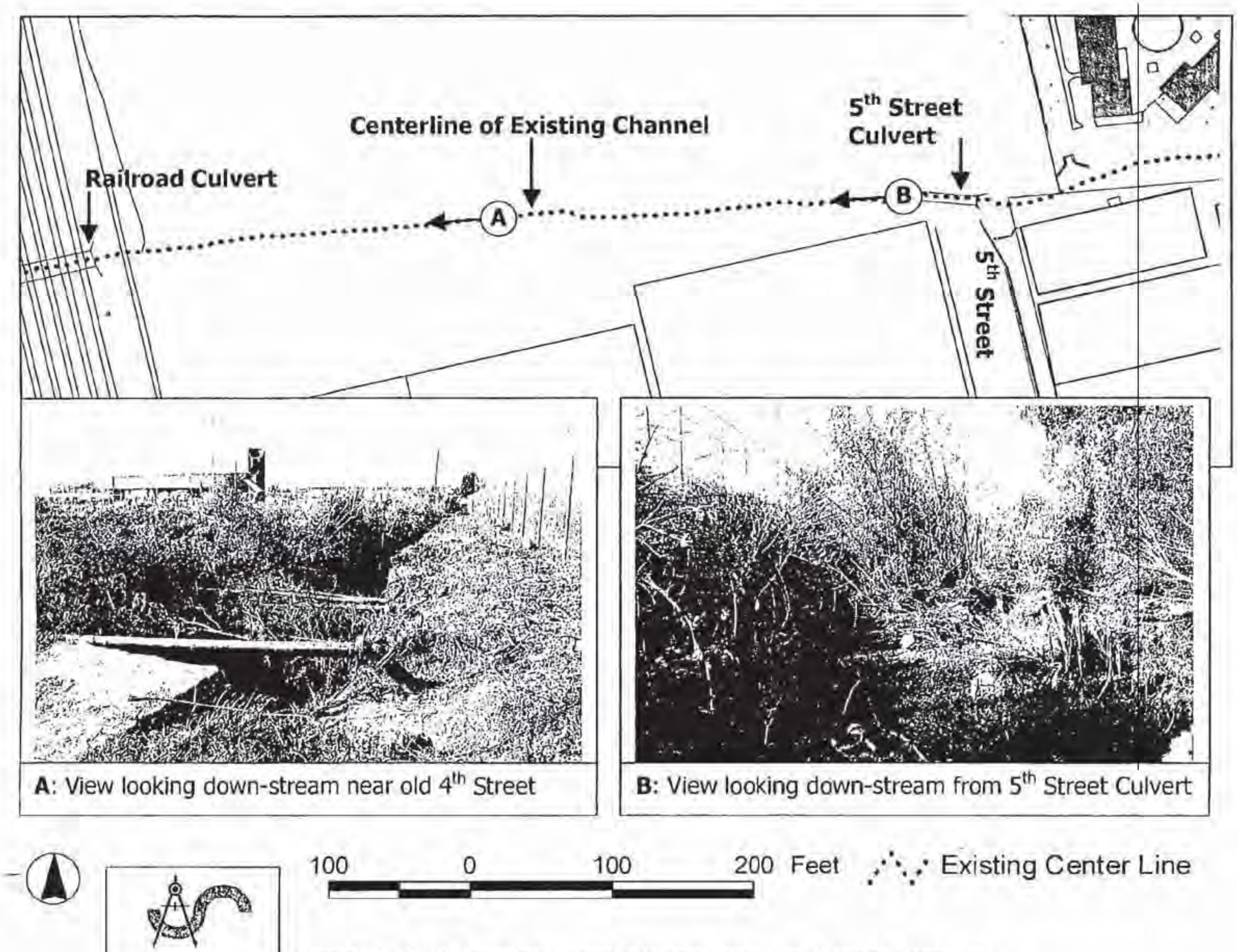
Headcutting

Figure 5-4



Source: Waterways Restoration Institute

Existing Conditions: Railroad Tracks to 5th Street Figure 5-5



A: View looking down-stream near old 4th Street

B: View looking down-stream from 5th Street Culvert

Source: GISC, UC Berkeley/ Photos: Katherine Mortimer, Planning Consultant perform well under these velocities. This is recommended as a long-term channel condition because the channel length will still allow some headcutting and the Sixth Street culvert will create some backwater conditions on the 6th to 7th Street reach upstream. The Phase 1 channel has a sinuosity of 1.14 and should have a channel length of 1.3 in this reach. Channel width will continue the 16-foot width used in the 1996 project. The outside bends will require rock and vegetation reinforcement. The channel alignment can be pulled away somewhat from the south bank commercial buildings with the removal of the 5th Street culvert, providing some south bank stability benefits (Figures 5-6 and 5-7).

Sixth to Eighth Streets Reach

Opportunities and Constraints

The goal is to provide sufficient right-of-way to allow for a natural meander plus bike/pedestrian trail on the south side of the creek. Attaining this goal is dependent on relocating facilities (the grounds maintenance facility, a storage shed used by the Albany Children's Center, and a portion of the Albany Children's Center play yard) as part of the commercial development portion of the property fronting on San Pablo Avenue. There are as yet no plans for relocating the Albany Children's Center, so this building and its needs for outdoor play space will remain as a given constraint. The U.S. Post Office may be a project participant with the possibility of moving its parking lot wall to the south to allow for the needed flood damage reduction benefits of the floodway along the creek corridor.

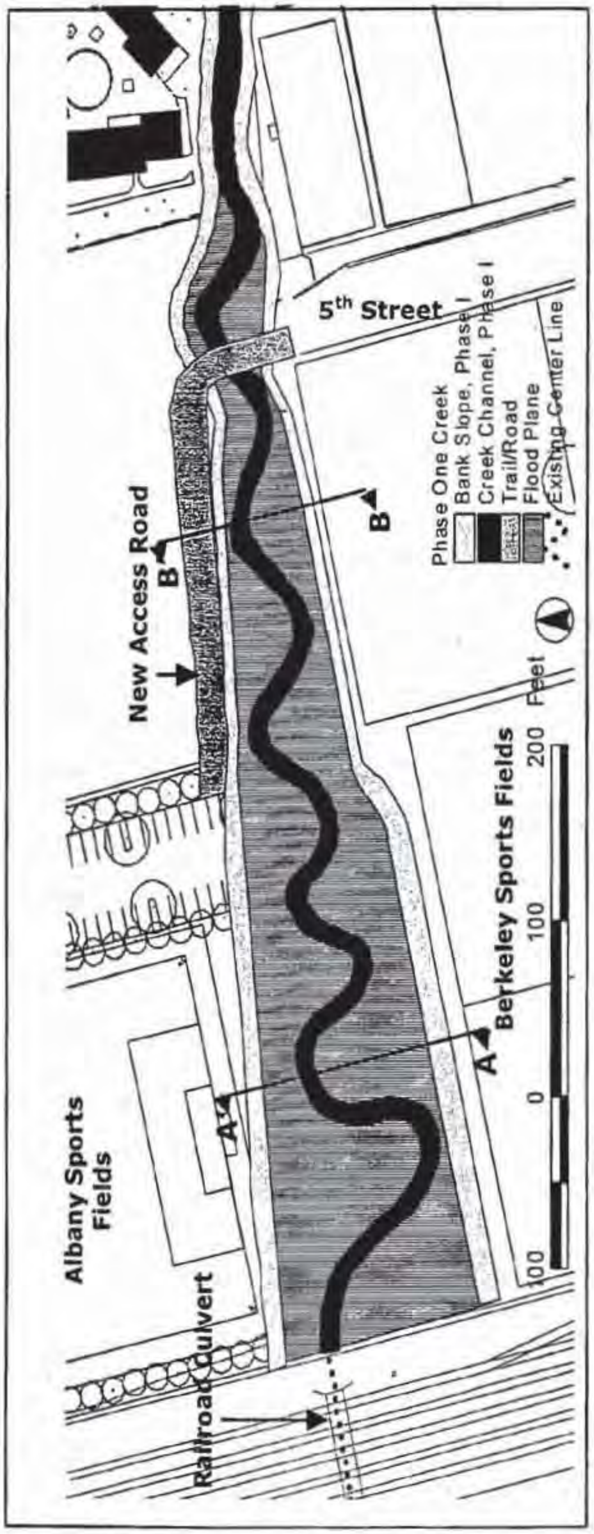
Historic and Existing Conditions

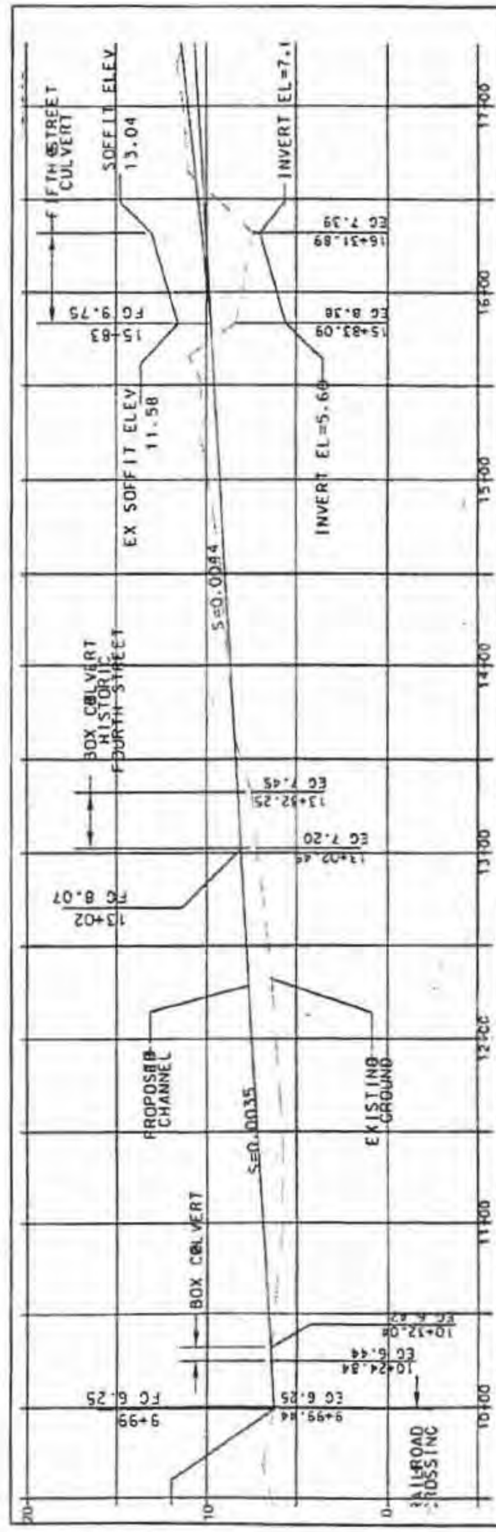
This reach of creek has been straightened and filled. It exhibits bank failure along the entire reach and there is evidence of significant channel incision. In order to provide sufficient channel slope to match the valley slope and achieve the historical, stable 1.3 sinuosity, the channel slope should be steepened some. The Sixth Street culvert creates a back watering of flood flows and also hinders achieving the correct slope for the creek bottom because it is too low.

Between where Seventh Street would be logically located and Eighth Street, the channel has been lined with sackcrete on the north bank (Figure 5-8). A concrete apron extends for approximately 80 feet downstream from the Eighth Street culvert. This has caused bank caving directly downstream. Historically this channel appears to have been a sinuous, meandering flat slope (Rosgen C-channel type) (Figure 5-9).

Channel Design: RR Tracks to 5th Street Plan and Profile: Phase 1

Figure 5-6



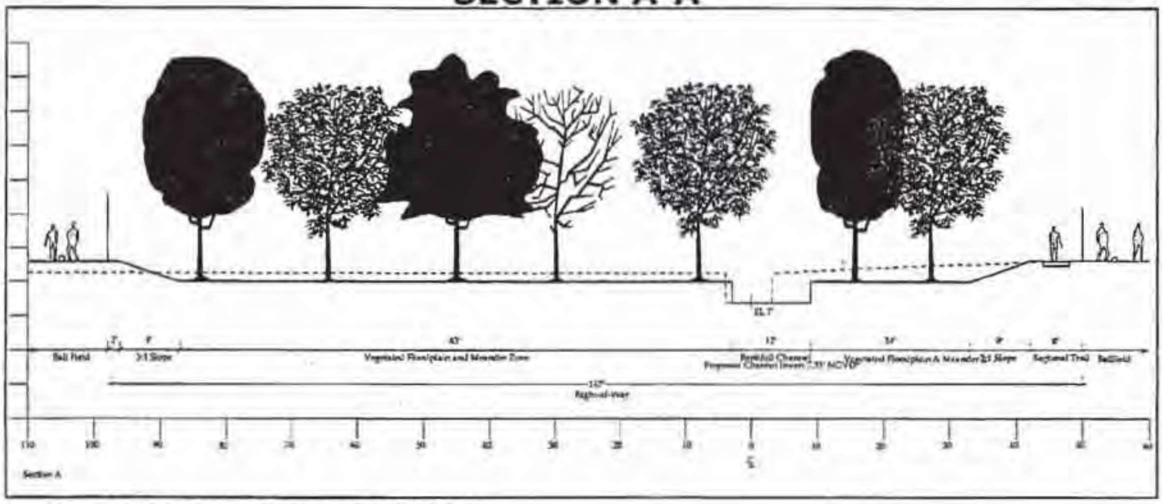


Source: GISC, UC Berkeley and WRI

Channel Design RR Tracks to 5th Street Cross Sections: Phase 1

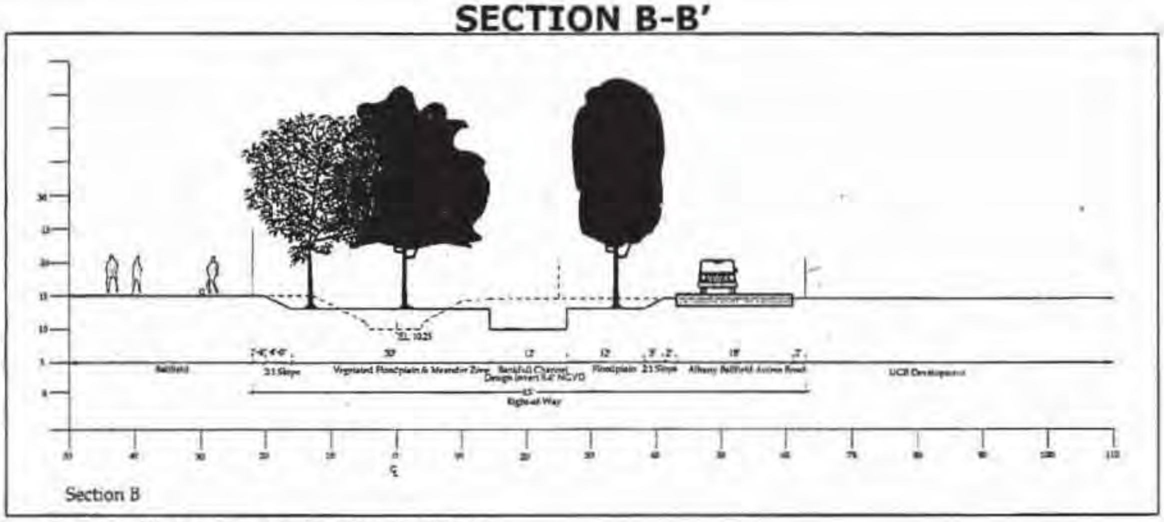
Figure 5-7

SECTION A-A'



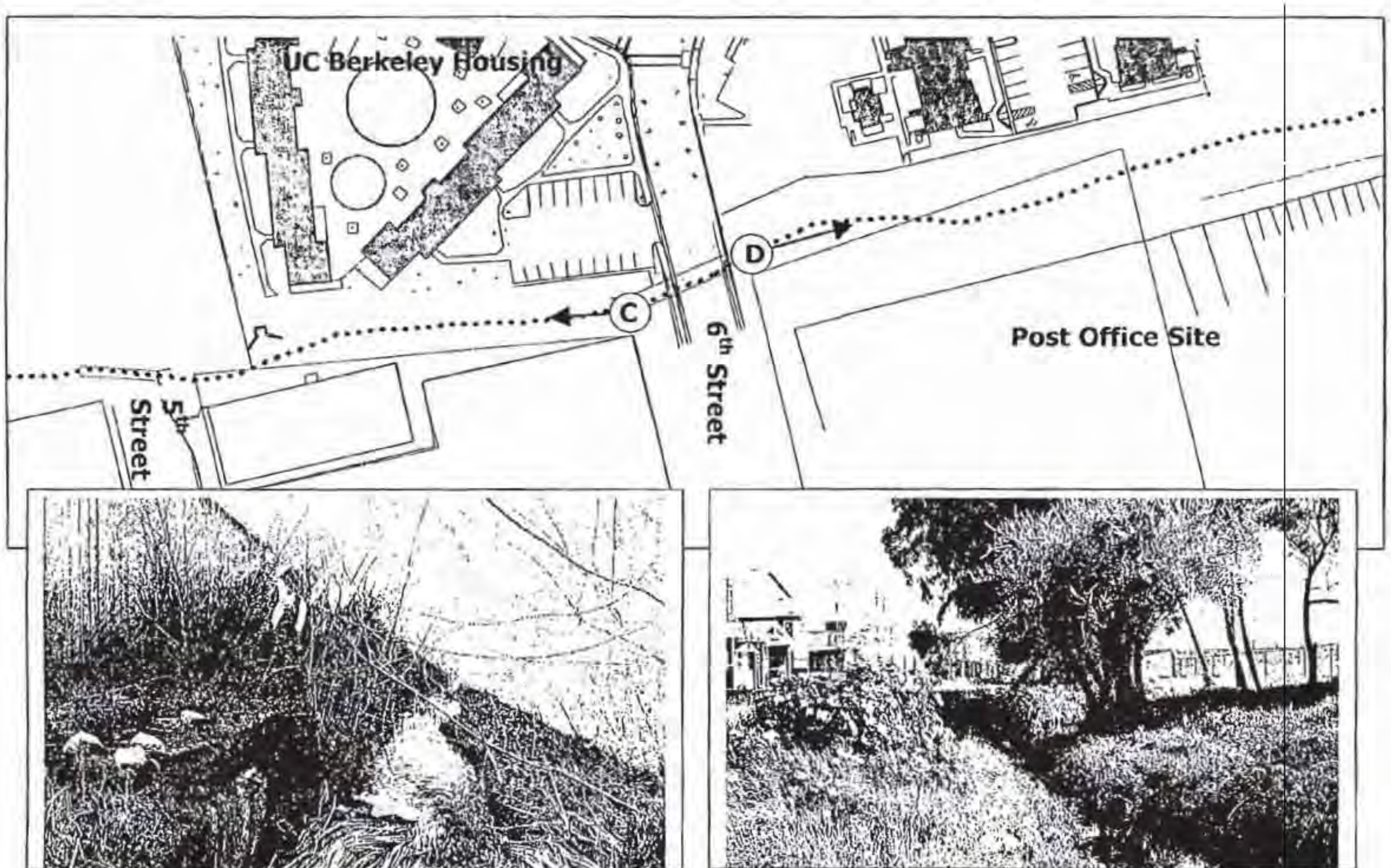
Source: Waterways Restoration Institute

SECTION B-B'



Source: Waterways Restoration Institute

Existing Conditions: 5th to 7th Streets



C: View looking downstream from 6th Street

D: View looking upstream from 6th Street

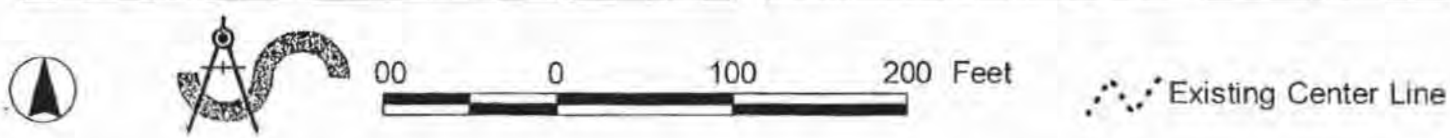
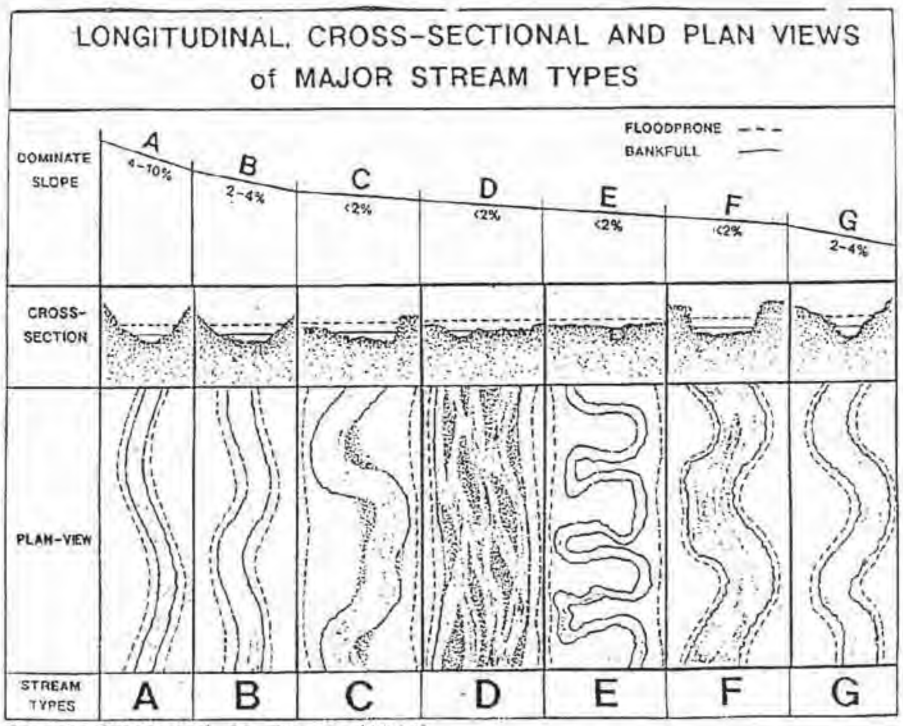


Figure 5-8

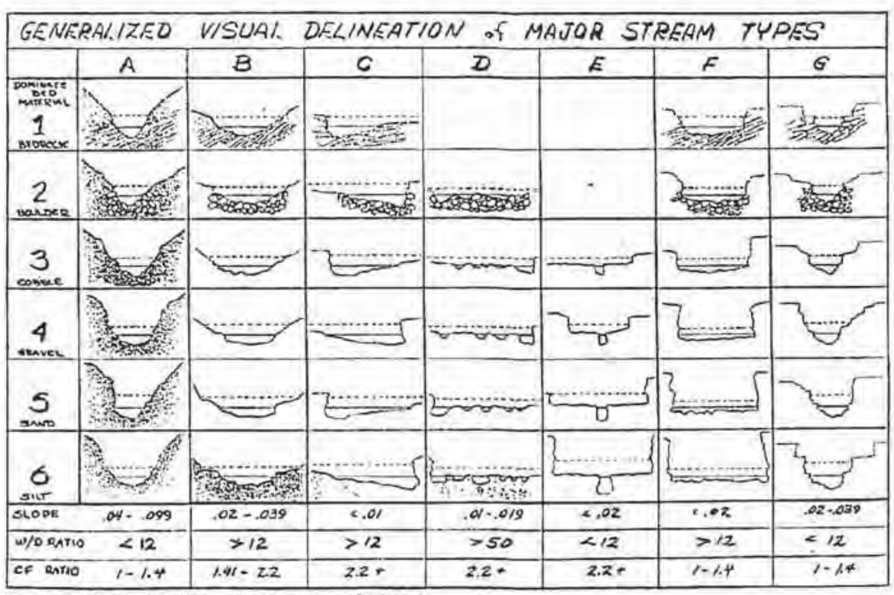
Source: GISC, UC Berkeley / Photos: Katherine Mortimer, Planning Consultant

Rosgen Channel Type Classification

Figure 5-9



Source: Catena Vol. 22, Rosgen (1994)



Source: Catena Vol. 22, Rosgen (1994)

Phase 1 Improvements

The steps to improving this reach include:

- Relocate the two Little League fields to Dowling Park (north)
- Culvert the section of Village Creek adjacent to Dowling Park
- Relocate the grounds storage building in Albany adjacent to the creek to the San Pablo Avenue frontage commercial development
- Relocate portion of Albany Children's Center play yard and a storage building
- Restore Codornices Creek between Sixth and Eighth Streets
- Move US Postal Service wall 12 feet to the south
- Construct a bicycle/pedestrian trail on the south side of the creek

Design Parameters

The channel valley is flat and the channel historically had a well developed sinuosity starting from the Fifth Street bridge up to the Ninth Street area. The sinuosity averaged about 1.3. These slopes and plan forms suggest a Rosgen C type channel. Therefore the channel design parameters used for the channel between 5th and 8th streets are (Figure 4.3: C type channel):

Channel forming or bankfull discharge - 80 cfs
Bankfull channel width - 16 ft
Bankfull channel depth - 1.5 ft
Width - depth ratio of - 10.6

Stream Channel Design

The Phase 1 project will be constrained by the Sixth Street culvert. Other existing land use constraints include the new university housing located between Sixth Street and theoretical Seventh Street. The plan requires setting back the 205 feet of chainlink fence and 325 foot long wall between Sixth to Seventh Street on the U.S. Post Office property 12 feet in order to realize the required floodplain space, channel length and trail.

Many difficult channel stability problems have been made much less critical by the rearrangement of the proposed site plan by the university on the north bank of the creek. The creek bank near the Albany Children's Center play area will be in a safer placement in reference to the flows discharging from the Eighth Street culvert. Ideally the U.S. Post Office Wall (325 lineal feet) should be moved south 12 feet to complete the project right-of-way needs for flood space, bank stability and trail. Approximately 22 perpendicular parking spaces would be affected by moving this wall. This loss of parking could be reduced to 13 to14 spaces by substituting 8 or 9 parallel spaces along the relocated wall. (Existing parking spaces are assumed to be

20 feet by 9 feet and the replacement spaces would be 8 feet by 22 or 24 feet). The reach will continue the 2:1 channel slopes up to the trail. In the event that the post office wall cannot be moved, the channel will require redesigning from the beginning of the wall near where 7th Street would meet the creek, up to 8th Street.

This report recommends leaving the Eighth Street culvert in to create a backwater in the deeper upstream channel during large flood flows. The desired 1.3 channel sinuosity can be attained in the Seventh to Eighth Street reach with the culvert in under this land use scenario (5-10 to 5-11). The lower Codornices Creek design team finds that it is desirable, for the management of flood flows through this reach and the entire project area, to replace undersized culverts under the Interstate 80 and the frontage road to the east of the freeway to correct for the backing up of floodwater. Corrections such as this in the lower watershed will enable the eventual removal of the 8th Street culvert.

Eighth to Ninth Streets Reach

Historic and Existing Conditions

This reach used to be contained in a large concrete culvert within a rail right of way until 1993, when the culvert was broken open and the creek daylighted. This reach is contained by a remnant of the old culvert on the south bank and planted rubble riprap on the north bank. The stream channel gradient is not matched to its historic sinuosity and valley slope, and therefore is not stable. Given the constraints caused by recent improvements, including construction of the north side trail and park, it is difficult to correct for the fact the current stream channel is too short. The conditions for this reach were further complicated by the location of a gas line at the current channel invert downstream of Ninth Street, but this line has since been deactivated. The widening of the bankfull width to 15 feet in 1996 has, however, helped contribute to a more stable channel (Figure 5-12)

Phase 1 Improvments

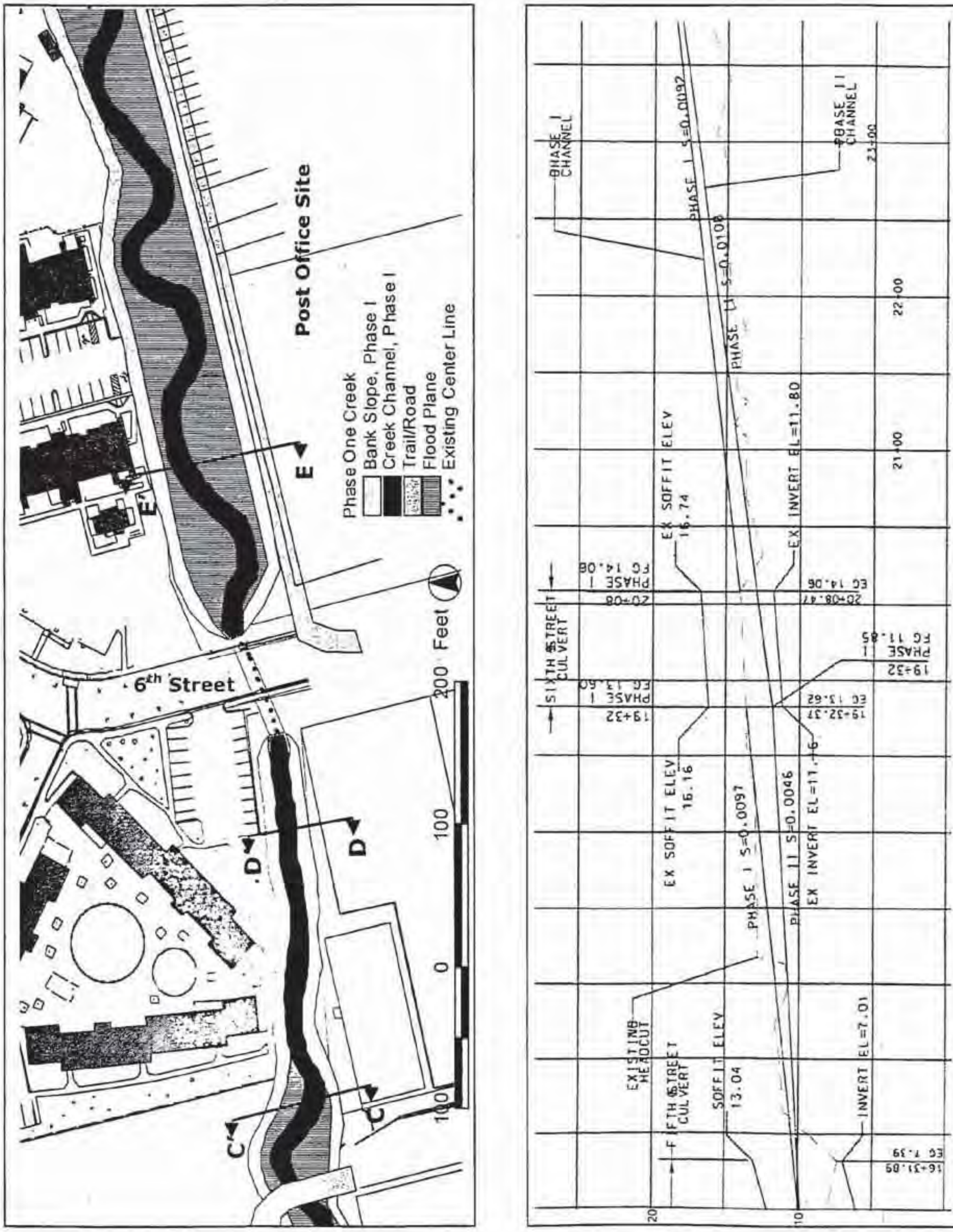
- Widen and improve existing pathway on north side of creek to accommodate both bicycles and pedestrians.
- No stream channel improvements required.
- Create landscape berm to reduce overbank flooding at 8th Street

Stream Channel Design

The existing channel conditions will prevail between Eighth and Ninth streets. This reach has an unusual history involving a great deal of citizen involvement to remove the creek from a culvert. The creek is still constrained for a section on the south bank against a four to five foot high wall composed of an old side of culvert, which the citizen groups did not have the resources to move. The university developed an

Channel Design: 5th to 7th Streets Plan and Profile: Phase 1

Figure 5-10

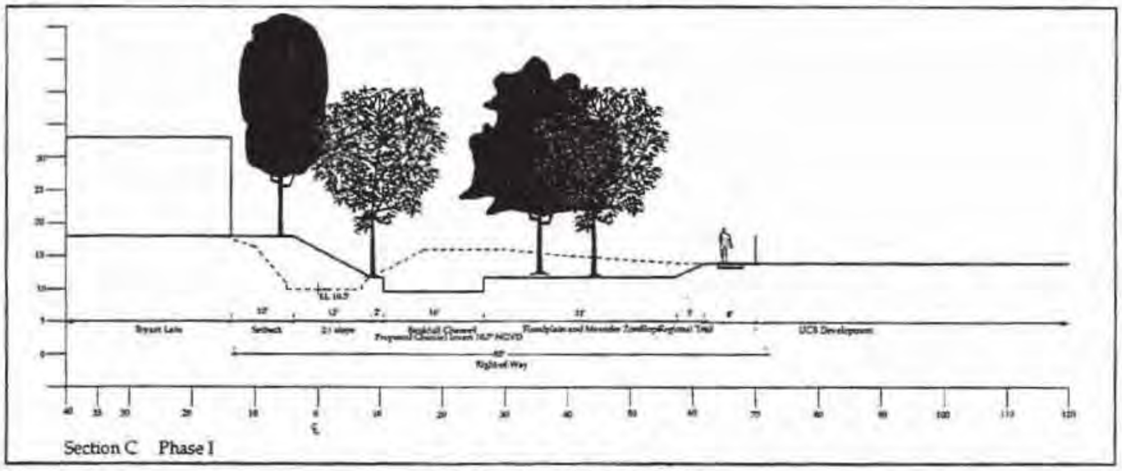


Source: GISC, UC Berkeley and WRI

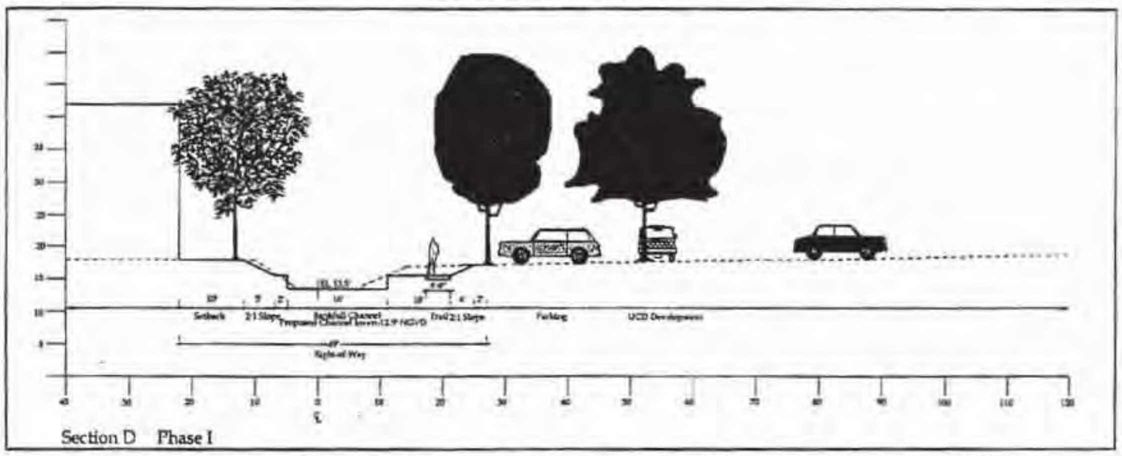
Channel Design 5th to 7th Streets Cross Sections: Phase I

Figure 5-11

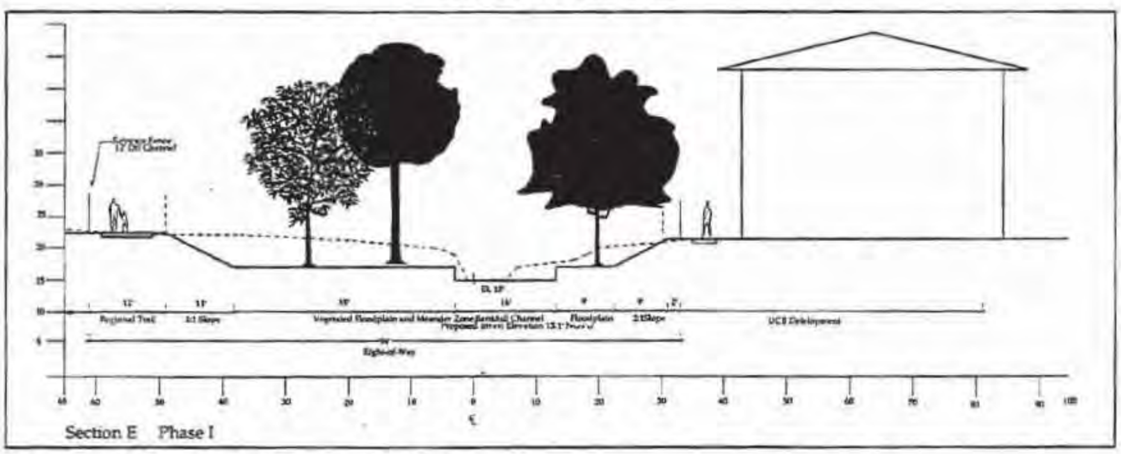
SECION C-C'



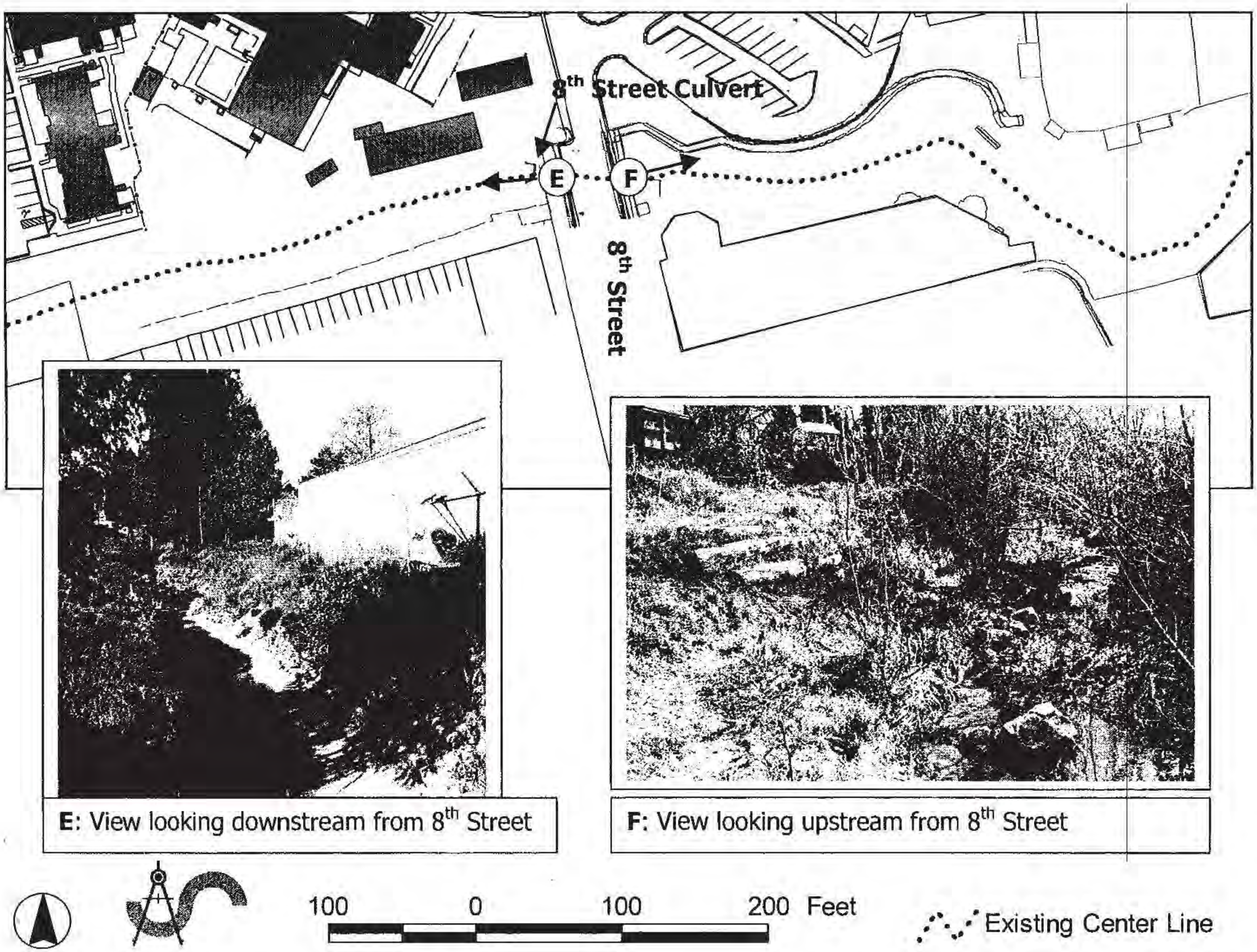
SECTION D-D'



SECTION E-E'



Source: Waterways Restoration Institute



E: View looking downstream from 8th Street

F: View looking upstream from 8th Street

Source: GISC, UC Berkeley / Photos: Katherine Mortimer, Planning Consultant attractive fenced trail and these considerable and well-intentioned efforts should not be undone at this time. Trail improvement should not impact the integrity of the existing conditions (Figures 5-13 and 5-14).

Ninth Street to San Pablo Avenue Reach

Opportunities and Constraints

The creek along this reach can be restored within an expanded right-of-way that will be available when the 1940s housing is demolished. The bike path connecting San Pablo Avenue to the creek can be accommodated in additional creek right-of-way or through the commercial development area. This will be determined as the commercial development is designed and approved. Locating the bike trail along the creek would provide an added creek erosion-flood buffer zone and provide for user safety by avoiding car traffic areas.

Historic and Existing Conditions

A meander bend at Ninth Street continues to expand to the south, indicating the need for more width to accommodate a slightly longer channel at this site. The cross-sectional area was restored in 1997 to a more stable shape. There is nice floodplain

development in this reach. The channel becomes constrained by concrete, debris and walls through the upstream reaches (Figure 5-15).

The reach from 10th Street to San Pablo Avenue was straightened and is trying to flatten its grade through headcutting and attacking its banks. The extent of headcutting is illustrated by the four-foot drop from the San Pablo Avenue culvert to the now incised creek bottom. Historically this upper channel and the Ninth to Tenth Street reach had a steeper sloped channel type with a lower sinuosity (about 1.2) than the channel downstream (about 1.3). The Ninth Street to San Pablo Avenue reaches fit the description of a Rosgen B type channel (Figure 5-9).

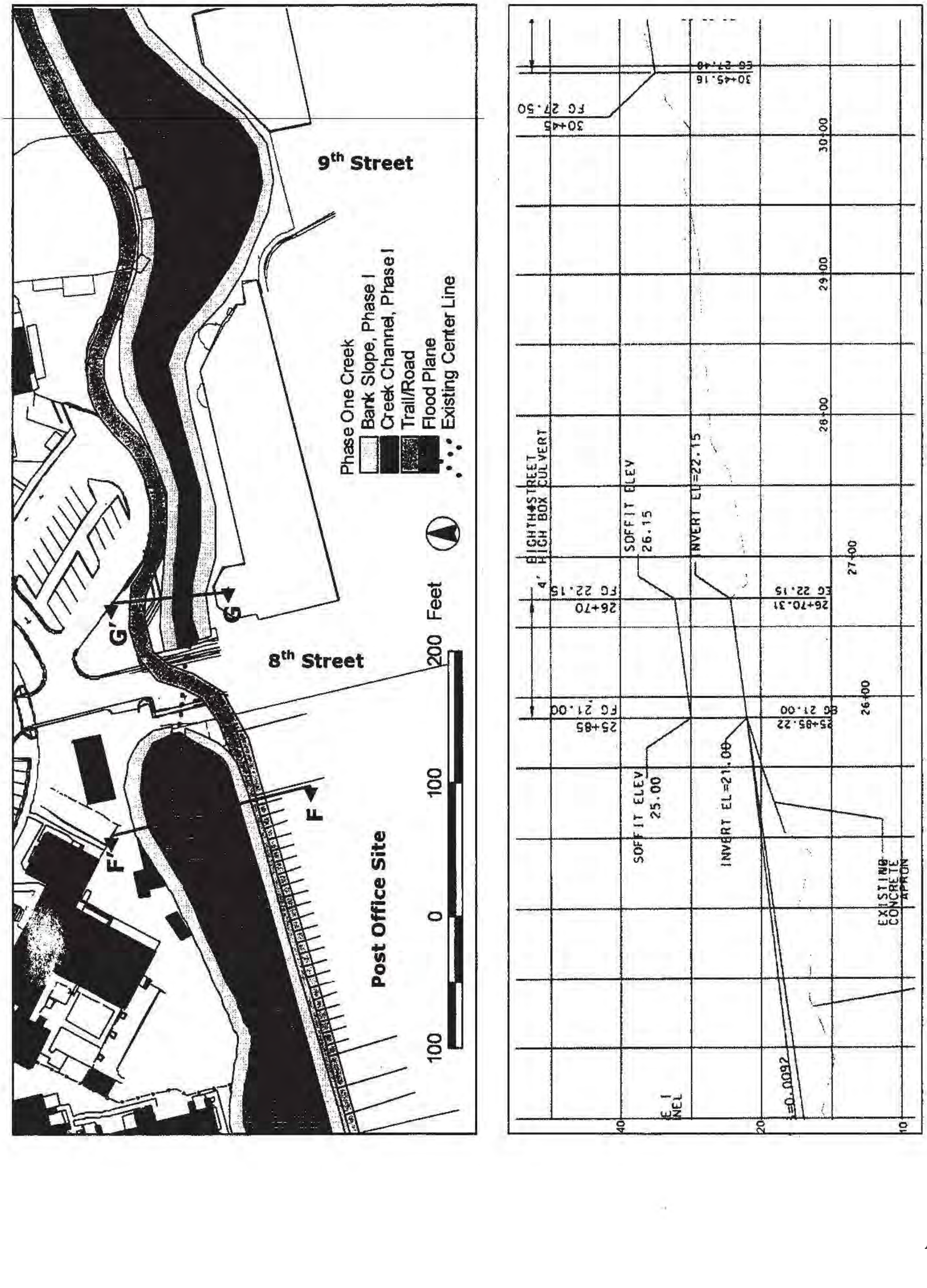
Phase 1 Improvements

Steps to improving this reach include:

- Relocate the Little League fields
- Remove existing student housing units along San Pablo Avenue as part of commercial development (lease)
- Restore Codornices Creek from San Pablo Avenue to Tenth Street
- Remove 10th Street culvert
- Provide access to the bike/pedestrian path from San Pablo Avenue either along the creek or via the new commercial development (depending on safest and most appropriate route from San Pablo Avenue)

Channel Design: 7th to 9th Streets
Plan and Profile: Phase 1

Figure 5-13



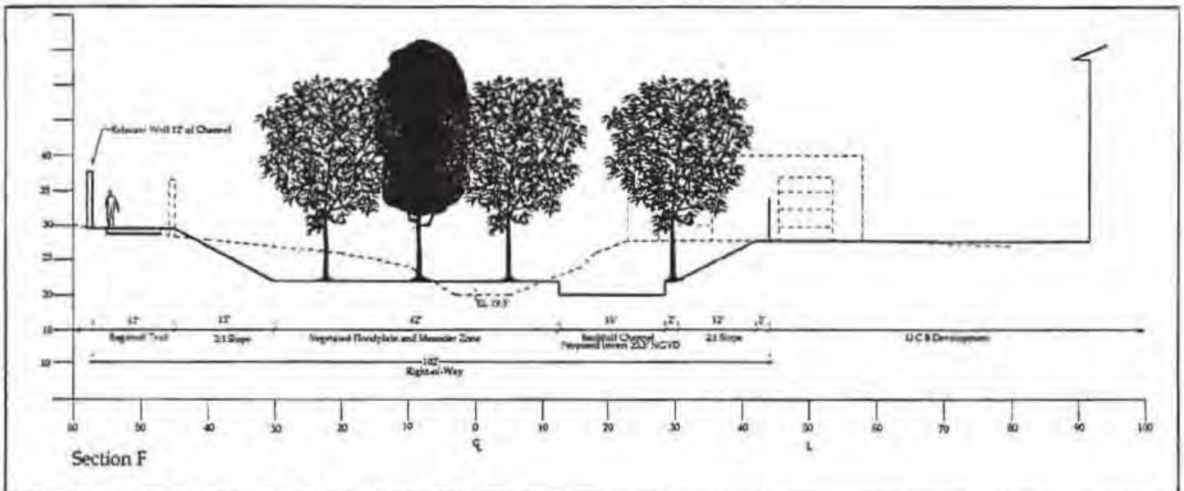
Source: GISC, UC Berkeley and WRI

AR 007462

Channel Design 7[th] to 9[th] Streets
Cross Sections: Phase 1

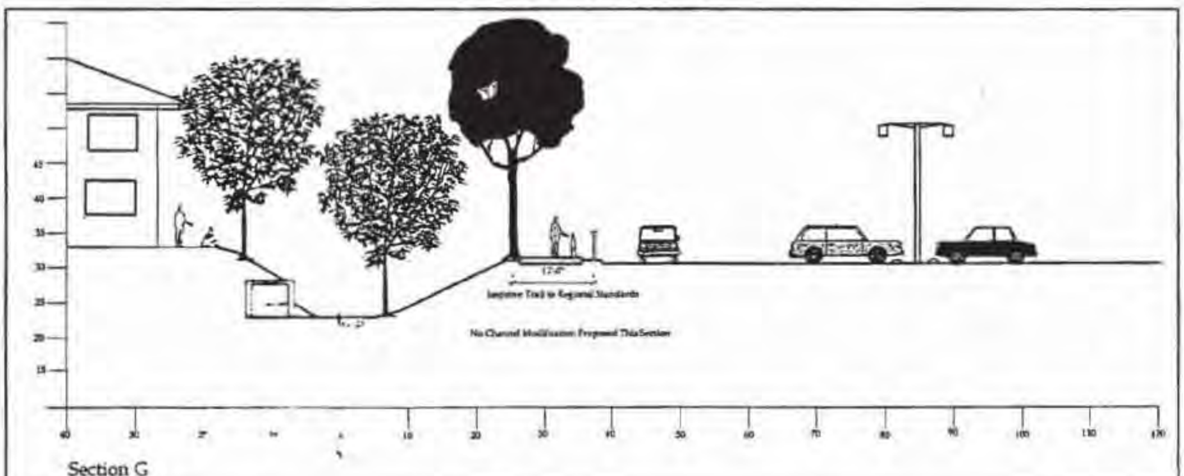
Figure 5-14

SECTION F-F'



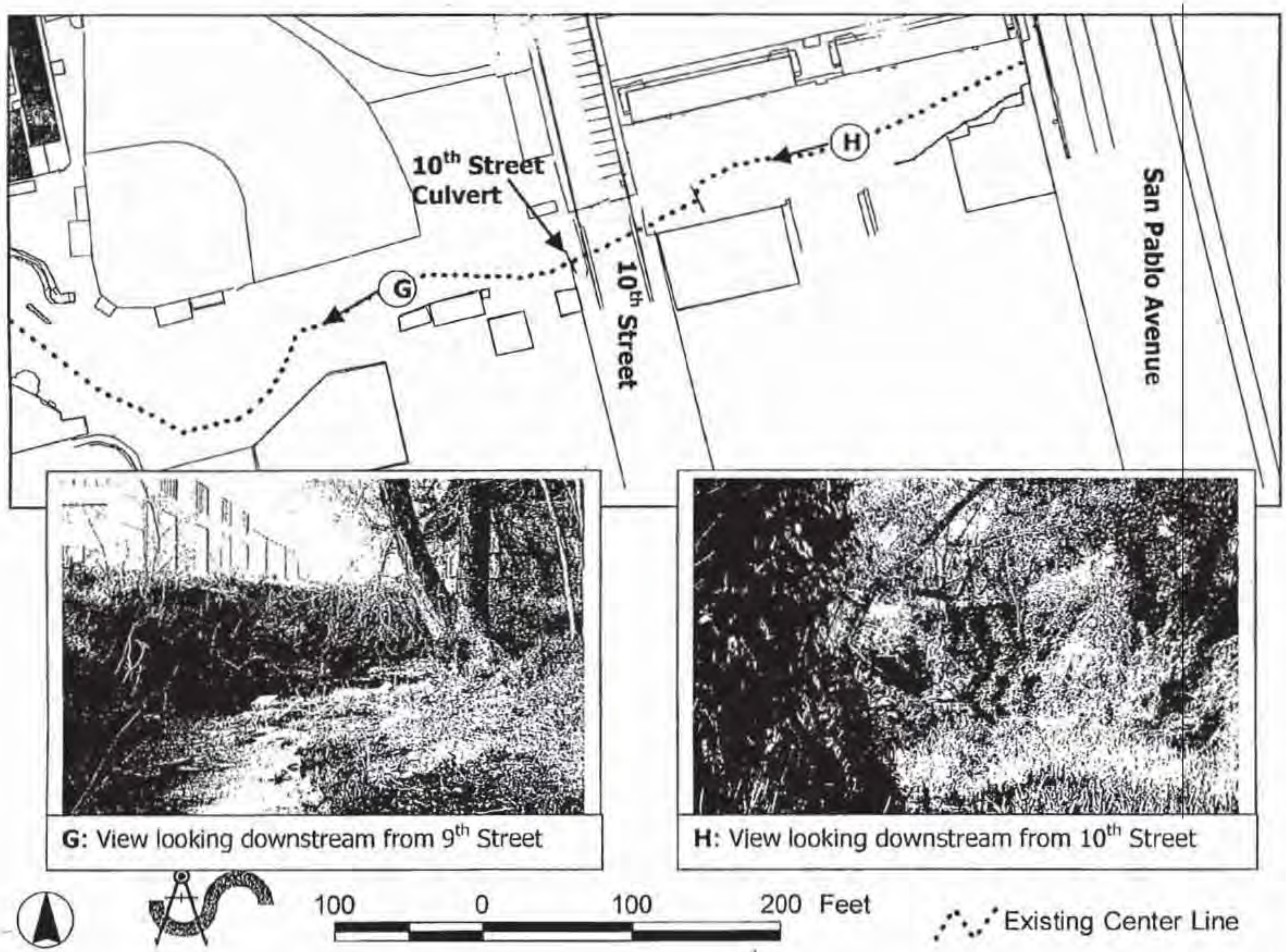
Source: Waterways Restoration Institute

SECTION G-G'



Source: Waterways Restoration Institute

Existing Conditions: 9th Street to San Pablo Avenue — Figure 5-15



G: View looking downstream from 9th Street

H: View looking downstream from 10th Street

Source: GISC, UC Berkeley

Design Parameters

Above Ninth Street where the valley slope gets closer to 2% and the historic sinuosity appears to average near 1.2, it is assumed the channel may have had a more confined floodplain more like a Rosgen B type channel. The channel boundary conditions are greatly influenced by the very cohesive, heavy clays. Based on past project experience at Ninth to Eighth Streets, it is assumed that the channel can achieve a significant level of stability if the channel lengths and sinuosity as well as the width and depth are correct. The design parameters therefore selected for the active channel between Ninth Street and San Pablo Avenue are as follows (Figure 5-9: B type channel):

Channel forming or bankfull discharge – 80 cfs
Bankfull channel width – 15 ft
Bankfull chanel depth - 1.5 ft
Width - depth ratio of – 10.6

Stream Channel Design

This reach can attain the restoration parameters identified in the first section of this chapter. The creek will be regraded with the more stable width of 15 feet with a 1.2 sinuosity. The side slopes from the floodplain trail can vary from 3:1 to 2:1, thereby making it a safe environment for a trail. Bank stabilization will be able to be attained with basic soil bioengineering planting systems such as willow and cottonwood stakes and posts and brush layering (Figures 5-16 and 5-17).

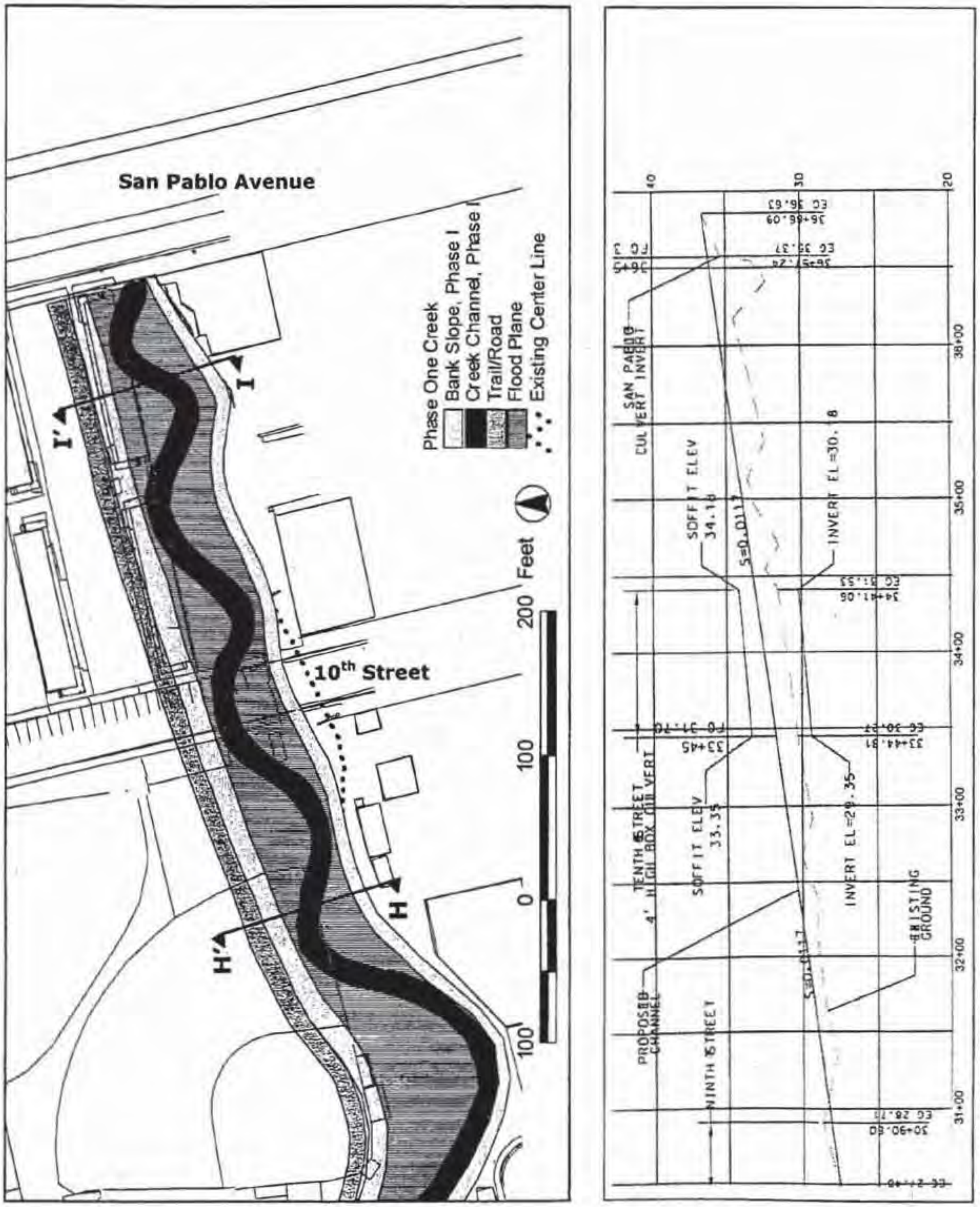
5.2 Phase Two Creek Improvements

Fifth to Sixth Streets Reach

Opportunities and Constraints

There should be an opportunity for significant improvements to this reach in the future when the university undertakes Step 2 of its housing redevelopment program. However, the modified right-of-way will result in the loss of 9 units to the current design for Step 2 of the University housing so the plan would have to be revised if this unit loss is to be avoided. To link the Phase 2 channel from the location of the 6th Street culvert to the Phase 1, 6th to 8th streets channel, 75 feet of restored channel will be added.

Channel Design: 9th Street to San Pablo Avenue   Figure 5-16
Plan and Profile: Phase 1

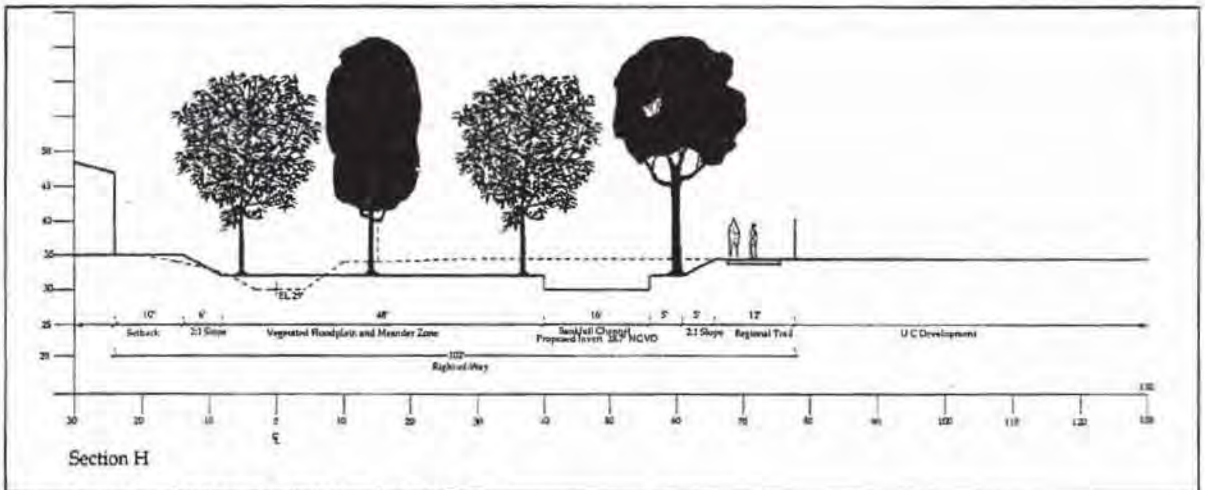


Source: GISC, UC Berkeley and WRI

Channel Design 9th Street to San Pablo Avenue Cross Sections: Phase 1

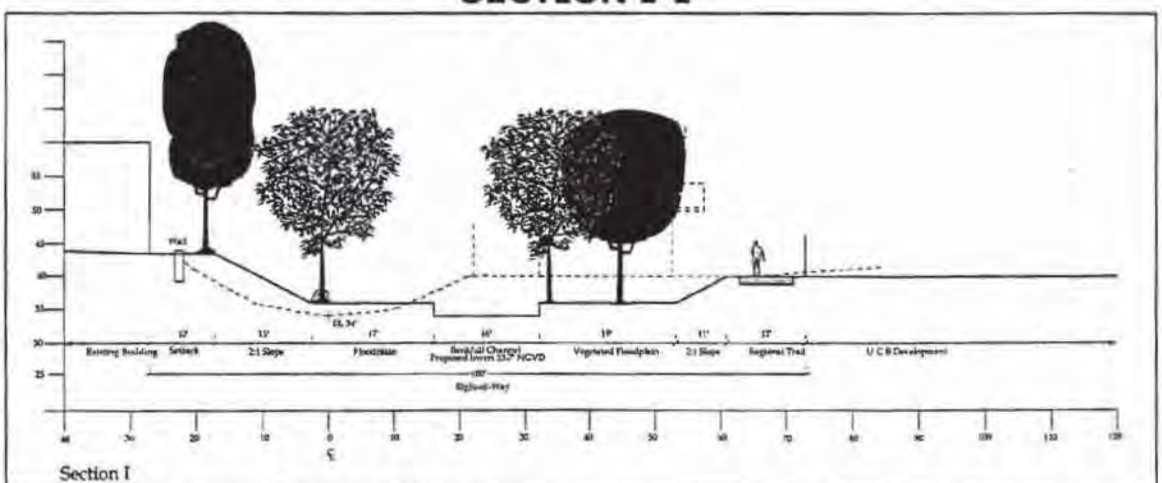
Figure 5-17

SECTION H-H'



Source: Waterways Restoration Institute

SECTION I-I'



Source: Waterways Restoration Institute

AR 007467

Phase 2 Improvements

Based on such a redesign, the steps to improve this reach would be:

- Remove 9 units of University Village housing and two parking spaces along Codornices Creek between Fifth and Sixth Streets
- Remove the Sixth Street culvert and replace with bicycle/pedestrian bridge
- Increase meanders in the larger right-of-way available for creek improvements.
- Construct a floodplain footpath
- Add 75 feet of channel at the 6th Street culvert area to link to the Phase 1, 6th to 8th streets channel.

Design Parameters

Design parameters for this reach are the same as those used for the 6th to 8th streets reach. They are:

Channel forming or bankfull discharge – 80 cfs
Bankfull channel width – 16 ft
Bankfull channel depth – 1.5 ft
Width - depth ratio of – 10.6

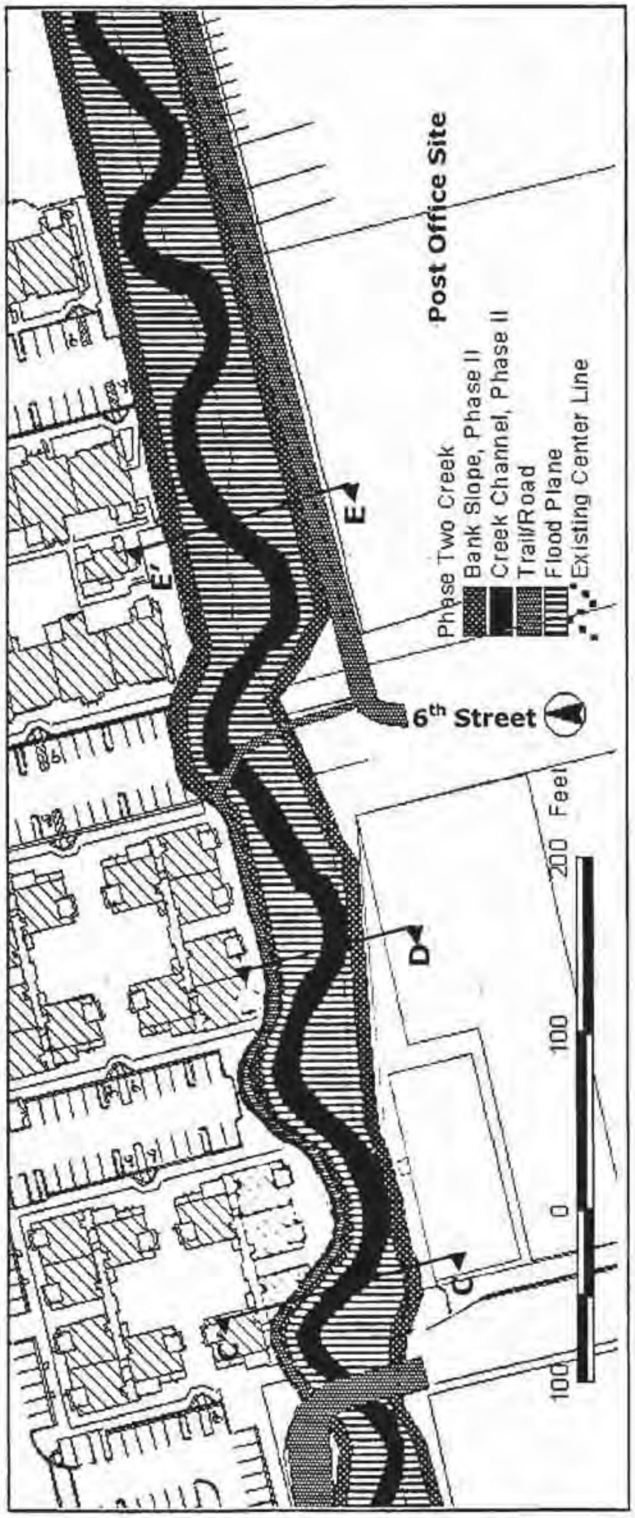
Stream Channel Design

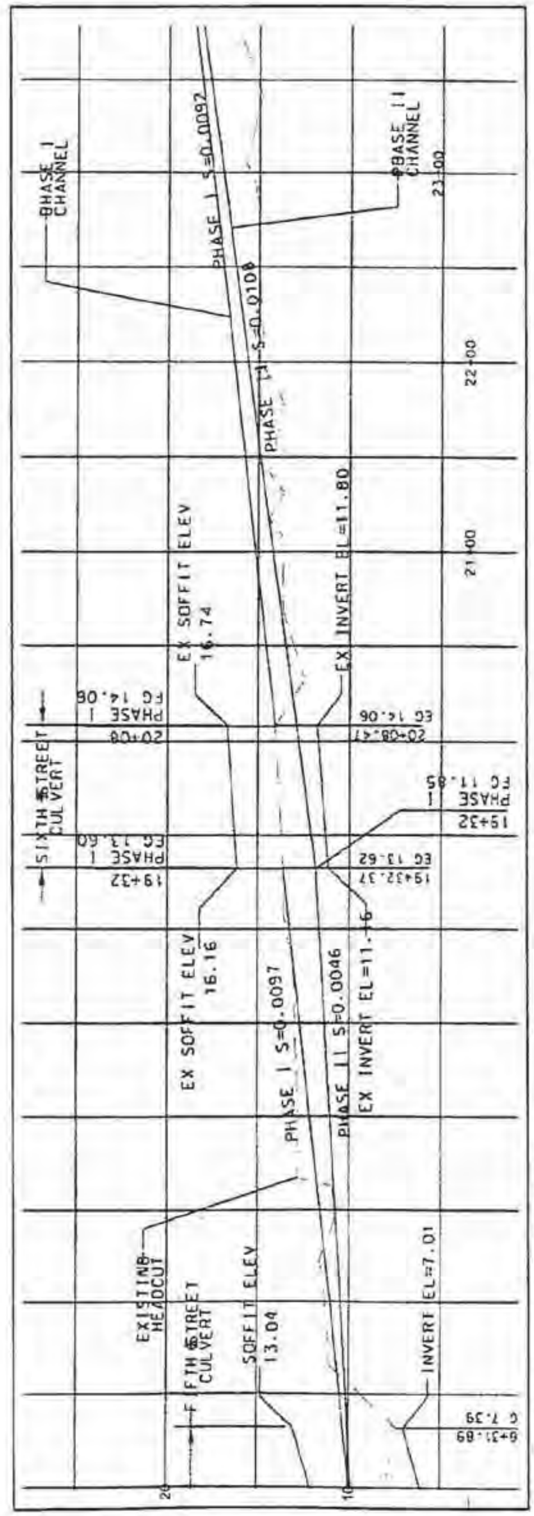
The channel reach extending to below Fifth Street is vulnerable to bank over-topping and erosion because of the increase of flood flows which are released to the downstream reaches by the new development creek project. The Phase 2 improvements will increase the channel stability both up- and downstream from this reach. Computer modeling of the Creek with Phase 2 improvements in place, with the Eighth Street culvert remaining, and with the use of soil bioengineering vegetated methods of stream bank stabilization, shows that high velocities can be restricted to under 6 ft. per second in this reach. The creek right-of-way between Fifth and Sixth Streets afforded by the Phase 2 plan can also contain the 1 in 100 year flood discharges of 600 cfs if a 1-2 foot landscaping berm located on the terrace (ground elevation) is integrated into the landscaping plan between the housing and the creek. The sinuosity of the Phase 1 interim channel can be increased in Phase 2 to the desirable 1.3 design parameters and the correct channel width of 16 feet can be attained. Side slopes on the north bank can be varied from 2:1 to 3:1, making the creek corridor safer for the housing area on the north bank. A six-foot wide pedestrian trial is being provided along the floodplain to link 6th Street and the regional trail with the athletic fields below 5th Street. A pedestrian can continue from 5th Street along the planned 5th Street access road and access another pedestrian trail continuing down the north side of the creek.

A few project features need to be integrated into this plan to avoid flood damages from the 1 in 100 year flood (600 cfs scenario). If the Eighth Street culvert is left in under the current conditions, flood flows will continue to overtop the Eighth Street culvert. The recommended design is to regrade the trail and landscaped area immediately adjacent to the upstream entrance of the Eighth Street culvert to allow for a greater backwater condition upstream of Eighth Street. (Figures 5-18 and 5-19).

Channel Design: 5th to 7th Streets
Plan and Profile: Phase 2

Figure 5-18



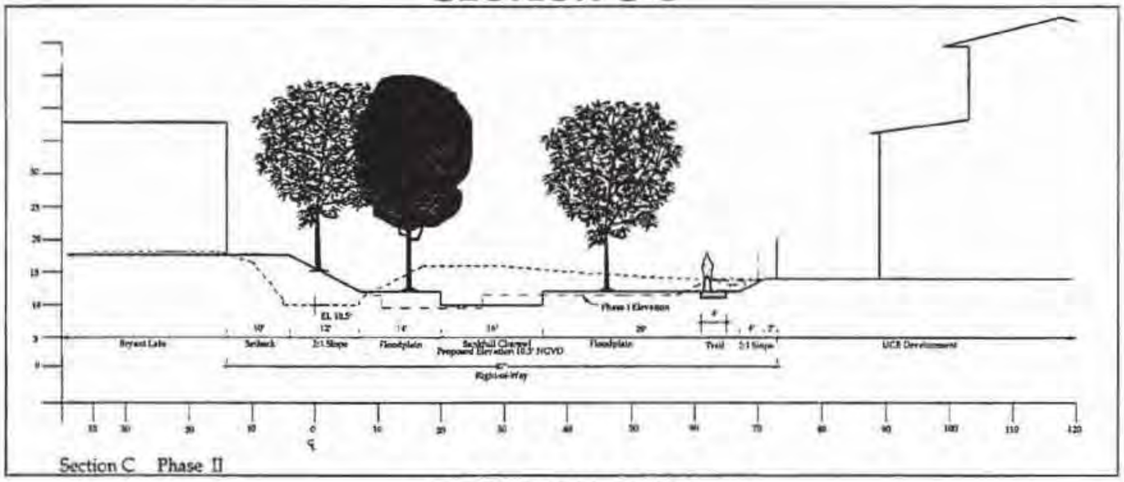


Source: GISC, UC Berkeley and WRI

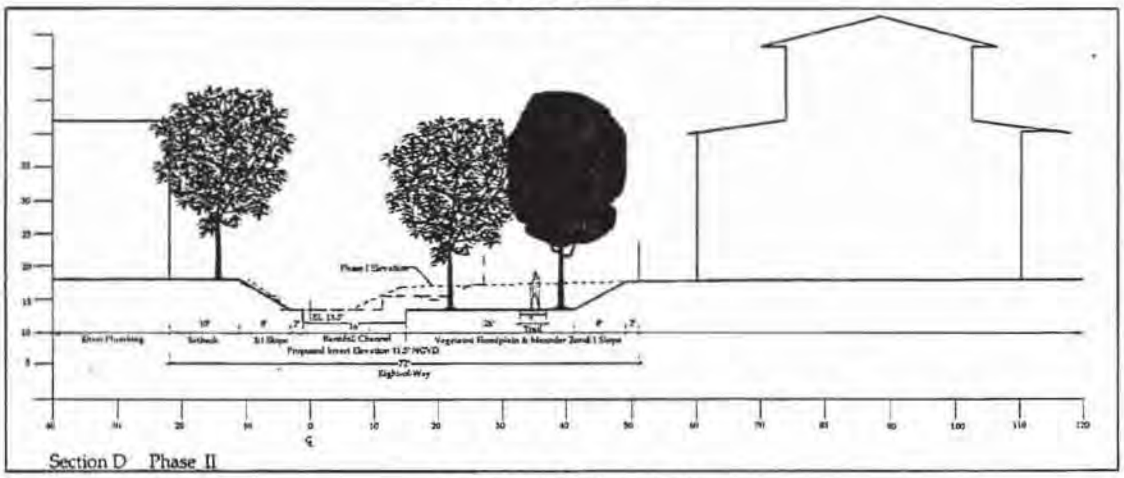
Channel Design 5th to 7th Streets
Cross Sections: Phase 2

Figure 5-19

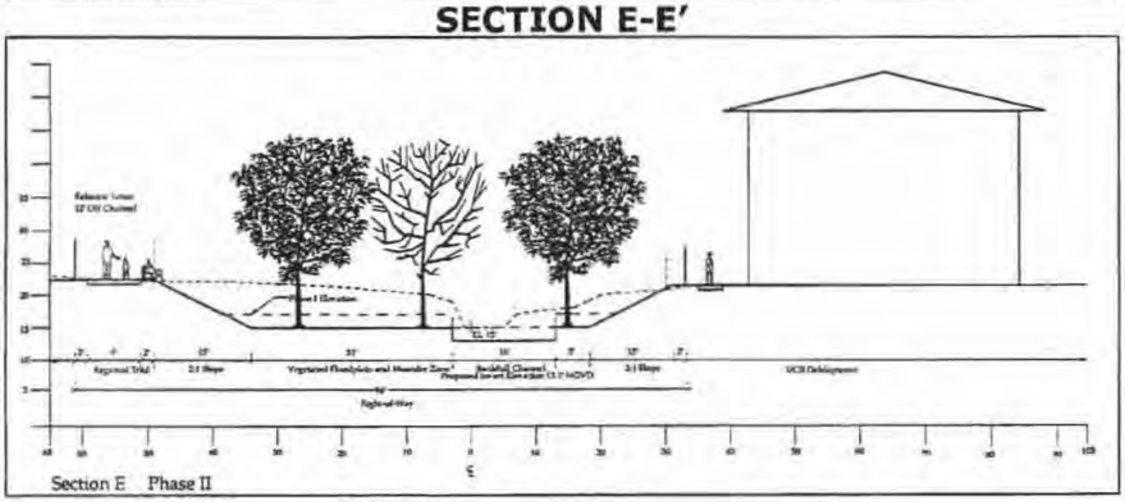
SECTION C-C'



SECTION D-D'



SECTION E-E'



Source: Waterways Restoration Institute

6.0 RIPARIAN CORRIDOR DESIGN

Lower Codornices Creek is located in an ecotone (ecological transitional zone) between several major vegetation communities. To the north is the North Oak Woodland, to the south is the Southern Oak Woodland, to the west is the (historic) Coastal Marsh and to the east are Oak Savannah, Chaparral and Redwood communities. The Lower Codornices Creek riparian corridor was comprised of plant species from all of these plant communities and was dependent on microclimates caused by variation in elevation, aspect, and canopy tree shade conditions. Dominant plant species included *Salix sp., Alnus rogosa, Quercus agrifolia,* and *Acer macrophylium.*

The project reach is located within the cohesive, alluvial soils of the lower watershed. The topography is flat with broad floodplains. Channel inverts depths rarely exceed five feet below the channel top of bank and well-defined terraces are not evident. The area below Fifth Street was historically a salt marsh that has been separated from tidal interaction due to the construction of the Southern Pacific Railroad and I-80 freeway.

Currently there are few existing native species along the channel, with the exception of two reaches where restoration efforts have previously taken place. On the north bank between the SPRR and 5th Street there are two small clusters of willow. There are no existing native species on the south bank. The channel reach between 5th Street and 6th Street was the subject of restoration efforts in 1998. The native vegetation planted in this reach is immature and portions have been removed due to maintenance activities by the university and streamside residents. Between 6th and 8th streets are two willow trees on the south bank and one on the north bank. Management activities in recent years have removed much of the herbaceous vegetation in this reach. The reach between 8th and 9th streets has been the subject of a sustained volunteer restoration effort since 1995. A large variety of native tree and under-story species are now established in this reach although they are still mature or the trees are now forming a canopy along this reach and pruning is done by Urban Creeks Council supervised volunteers. At Ninth Street a large willow tree is located on the north bank and provides significant shade to the channel. Between 9th and 10th streets the channel is well shaded with non-native elms. Little under-story vegetation exists in this reach. Immediately above 10th Street there is a large mature willow on the south bank. The remainder of the reach contains only one additional willow and one box elder, both of which are on the south bank. Throughout the entire project reach there are numerous non-native species including acacia, elm, German and English ivy, and Himalayan blackberry.

Recommended Vegetation Restoration Objectives

- Remove invasive plant species.

- Retain elm tree stand and manage for succession to native species.
- Establish native riparian canopy shade trees along north and south banks.
- Maximize diversity of native species.
- Manage for diversity of plant species age.
- Grade banks and floodplain to promote variations in slope and aspect for species diversity.
- Maximize use of soil bioengineering systems for bank stabilization and re-vegetation of floodplain and banks.
- Incorporate local University Village, Albany and Berkeley residents in volunteer in-fill planting projects.

Recommended Species

The recommended plant list identifies 50 native species appropriate for the Codornices Creek riparian corridor. This list has been divided into trees, shrubs, and groundcovers. Modification to the list may be required because many of these species are not typically available at most plant nurseries. Since the under-story planting should be conducted over a period of several years, contract growing is a viable option. There are a number of options for contract growing in the Bay Area, including the California Conservation Corps and the local chapter of the California Native Plant Society. (Table 6-1)

Installation

A detailed planting plan should not be developed until final grading plans have been completed in order to ensure proper placement of species with appropriate topographic and aspect conditions. Plantings should also be conducted with a phased approach so that the canopy trees have time to mature and develop the microclimates necessary for some of the shrubs and groundcovers.

Phase I (Years 1 and 2)

Immediately after construction, 100% Coir© erosion control fabrics made of erosion resistant coconut fiber should be installed along the active channel to minimize soil loss. In mid-late fall soil bioengineering systems including willow and cottonwood post, brush layering, and staking of dogwood and ninebark should be incorporated into the Coir fabric along the active channel banks. Container planting of the canopy tree species and sun tolerant shrubs should also be conducted at this time.

TABLE 6-1 RESTORATION PLANT SPECIES

Scientific Name	Common Name	Zone	Propogation	Aspect	Note
Trees					
Acer macrophyllum	Big Leaf Maple	B, C	Container	All	6
Aesculus californica	California Buckeye	B, C	Container	All	6
Alnus rubra	Red Alder	A	Container	NA	1,6
Alnus rhombifolia	White Alder	A	Container	NA	1,6
Populus fremontii	Fremont Cottonwood	A	Cutting	NA	2,6
Quercus agrifolia	Coast Live Oak	B,C	Container	All	6
Salix laevigata	Red Willow	A	Cutting	NA	3,6
Salix lasiolepis	Arroyo Willow	A	Cutting	NA	3,6
Salix lasiandra	Yellow Willow	A	Cutting	NA	3,6
Shrubs					
Artemesia californica	California Sage	C	Container	S	7
Baccharis pilularis	Coyote Bush	C	Container	S,E	7
Baccharis viminea	Mule Fat	B,C	Container	S,E	7
Cornus stolonifera	Dogwood	A,B	Cutting	All	3,4,6
Diplacus aurantiacus	Sticky Monkey Flower	B,C	Container	All	7
Hetermoneles arbutifolia	Toyon	C	Container	All	5,6
Holodiscus discolor	Oceanspray	B	Container	All	7
Lupinus arboeus	Bush Lupine	B	Container	All	7
Physocarpus capitatus	Ninebark	A,B	Cutting	All	3,6
Prunus demissa	Western Choke Cherry	C	Container	All	7
Prunus illicifolia	Holly-Leaved Cherry	C	Container	All	7
Rhamnus californica	Dwarf Coffeeberry	B,C	Container	All	7
Rhamnus crocea	Red Berry	B,C	Container	All	7
Ribes glutinosum	Flowering Currant	B	Container	E	7
Ribes sanguineum	Red Flowering Currant	B	Container	E	7
Ribes viburnifolium	Evergreen Currant	B	Container	E	7
Rosa californica	California Wild Rose	B	Container	All	4,7
Rubus ursinus	California Blackberry	B	Container	All	4,7
Salvia mellifera	Black Sage	C	Container	All	
Salvia sonomensis	Sonoma Sage	C	Container	All	5,7
Salvia spathacia	Hummingbird Sage	C	Container	All	5,7
Symphoricarpos mollis	Creeping Snowberry	A,B	Cutting	E	5,7
Symphoricarpos rivularis	Common Snowberry	A,B	Cutting	All	4,7
Zauschneria californica	California Fuchsia	C	Container	All	4,7
					5,7
Vines					
Vitis californica	Wild Grape	B	Container	All	
					4,7
Groundcovers					
Aster chilensis	Western Aster	B,C	Seed	All	
Clarkia amoena	Farewell-to-spring	B,C	Seed	All	5,6
Eschscholzia californica	California Poppy	B,C	Seed	All	5,6
Iris douglasiana	Wild Iris	B,C	Container	All	5,6
Lotus scoparius	Deerweed	B,C	Seed	All	7
Mimulus cardinalis	Scarlet Monkeyflower	B,C	Container	All	5,7
Nemophilia sp.	Baby Blue Eyes	A,B,C	Seed	All	5,7
Orphocarpus purpurascens	Owis Clover	A,B,C	Seed	All	5,6
Phacelia campanularia	California Blue Bell	B,C	Seed	All	6
Plagiobothrys sp.	Popcorn Flower	B,C	Seed	All	6
Satureja douglasii	Yerba Buena	B,C	Seed	All	6
Stipa pulchra	Purple Needlegrass	A,B,C	Seed	All	6
Linum sp.	Flax	B,C	Seed	All	6
Polystichum munitum	Western Sword Fern	A,B	Container	S,W	6
Dryopteris arguta	Wood Fern	A,B	Container	S,W	4,7
					4,7

Notes

1. Red Alder is preferred but may not be available. White Alder may be substituted
2. May require dryer climate dryer climate than exists along Lower Codornices Creek but can be tested in small quantities
3. Primary species for soil-bio-engineering systems
4. Requires part to full shade
5. Requires full sun
6. Phase I planting
7. Phase II planting

At the completion of the Phase I plantings, groundcover seeding can be done through manual or hydroseeding techniques. During the first two years after initial planting, management practices should include the replacement of any losses, the manual removal of invasive species and the addition of shade requiring understory species.

Phase 2 (Years 3-5)

In the fall of the third year after construction, species diversity should be increased through the installation of the remainder of species contained in the plant list. Plant species propagated under contract should be available at this time. The removal of invasive species and the replacement of any canopy tree losses should continue through Phase 2.

Plant Collection

There are several locations where cuttings of willow, dogwood, and ninebark could be collected on a sustained yield basis. Negotiations with park management agencies will be needed to obtain the plant materials.

Irrigation Systems

Temporary irrigation systems can be used to increase survival of the plantings. Irrigation will be most beneficial to plantings conducted near the top of the bank. If irrigation is used, watering regimes should be infrequent, with long duration to promote deep root growth and for survival after the removal of the system. Temporary irrigation should be designed to last for three to five years before it is removed.

7.0 VEGETATION MANAGEMENT AND CHANNEL MONITORING

After the initial construction of a project reach, a second phase of the construction is to observe how the channel is performing and make appropriate physical adjustments to channel banks, soil bioengineering systems, erosion control measures and rock wiers. This is performed over a two year period. A second phase planting is also installed two years after the first construction planting is put in. This is second phase planting takes into consideration the fact that some plants have to be planted after there is some initial plant growth and shading in order to survive. At this time, it also makes sense to repair irrigation lines and replace damaged tree stakes or container plants. These activities are considered part of the project construction and appear in the project construction costs table as second phase revegetation and stream flow and geomorphic monitoring. The costs described in this section should not be confused with future and on-going creek maintenance costs. These needs and costs are addressed in the next section of this report.

Management and Monitoring Activities

- Channel stability and flood flow capacity
- Adjustment of rock wiers
- Adjustment of erosion control systems
- Correction of overbank drainage erosion
- Installation of stream gages and measuring of flood flows
- Cross-section and profile surveys

Second Phase Revegetation, Monitoring

- Plant shade requiring container plants
- Replace dead and damaged plants
- Replace damaged or lost tree stakes and irrigation system components

Channel Stability and Flood Control Capacity

Typically, after a design such as proposed here is constructed, the creek will fine-tune its meander, create a channel thalweg—a deeper, low-flow summer flow channel and sort its sediment and bed material into pools, riffles and point bars. This is usually accomplished within the first to second winter following construction.

During these first two winters, therefore, creek projects are carefully monitored during and after each significant winter storm to assure that the channel slopes and grades and shapes are attaining an equilibrium condition. Typically, a few adjustments are made to rocks which serve as grade controls, erosion control plantings on banks, and to overbank drainage coming from storm drains, parking lots or streets.

The second condition monitored is to record the actual flood channel capacity of the creek system. This important step has been left out of many conventional flood control projects of the past. At some future date communities can be surprised by how much less (or how much more) flood flow capacity the modified channels have. Cordonices Creek will continue to be affected by a diversity of variables including culvert performance, street runoff, channel meandering and plant growth in regards to the flood discharges the creek will convey. A crest gauge will be installed at the location of the old Fifth Street culvert and between the post office and the Albany Children's Center to monitor flood velocities and stages of storm flows. A rating curve will then be created which will indicate how deep different flood discharges will be on the newly created landscape. Two normal (or above normal rainfall) winters should provide enough time to establish a working rating curve. The rating curve can of course be improved over time.

Monitoring of the physical adjustments the channel is making is done by surveying monumented channel profiles and cross-sections. An as-built survey is done immediately after construction and is a construction budget item. The degree to which the channel is making minor-or major adjustments is then assessed from these as-built surveys.

The National Marine Fisheries Service and U.S. Fish and Wildlife Service may require some habitat and or passage improvement analysis for steelhead. If so, these improvements would be prescribed in the permit requirements.

Second Phase Revegetation Monitoring and Management

Second phase planting, vegetation monitoring and management achieves three basic objectives. The first is to determine whether there is an acceptable level of survival of planted species, which should be an 80-85% survival rate given a highly dense planting design. The second objective is to assure that some of the second tier or later succession-species which grow up under the shade of the pioneer species are planted. The third objective is to assure that irrigation systems are operating.

Some popular riparian species such as ferns, irises and flowering herbaceous plants will not survive unless they are planted in a second planting after a shading canopy has developed. This project is best scheduled in the second year after the initial planting project. At the time this final planting is completed, irrigation systems are overhauled and missing or broken tree stakes are replaced. The irrigation systems are checked twice a year for the first three years to assure their operating condition.

Stream Maintenance

Maintenance of lower Codornices Creek up to now has occurred largely at the initiative of the University Village maintenance department with some assistance from non-profit citizen organizations. The lower Codornies Creek design team recommends that this future responsibility be more equitably shared among the University, citizen groups and the two cities using a Joint Maintenance Agreement.

This creek improvement project should greatly reduce the historic need for excavating and grubbing out clogged channels and culverts. The only maintenance that should need to occur is the supervised pruning of lower branches of willow and cottonwood cuttings. In-channel cattail, rushes, reeds and watercress growth should be removed during the first 3-4 years while the stream side vegetation is maturing into a shaded corridor. Monitoring the mouth of the 8th Street channel should also occur to ensure its free flow during storm events.

Maintenance costs and activities should be shared by streamside residents, the cities, and the university. Maintenance is currently occurring between 9th and 10th streets by Eco-City Builders and Body Time. Other reaches of Codornices Creek could be adopted by Friends of Five Creeks, for example. Maintenance can involve conservation corps crews as necessary. Every year, the Urban Creeks Council has brought youth program volunteers from Richmond and Berkeley to help weed along the creek corridor, but many weed species on the bank side slope are also shaded out over time. Future cost estimates are going to depend on these creative institutional arrangements.

Maintenance Activities

- In channel removal of rushes and reeds
- Bank slope weeding
- Pruning of tree species

8.0 PERMITTING

Permitting Requirements for Proposed Channel Modifications

The following agencies will have permitting authority over any creek improments project:

1. Regional Water Quality Control Board (RWQCB) Water quality certification or waiver (Clean Water Act §401)
2. U.S. Army Corps of Engineers (COE) Clean Water Act §404 Rivers and Harbors Act§10 permit
3. California Department of Fish and Game (CDGG) Streambed Alteration Agreement (Fish and Game Code §1601)

Special status species surveys required by the University Village and Albany/Northwest Berkeley Properties EIR (i.e. red-legged frogs) and indicated by site conditions (i.e. steelhead and western pond turtles) have not been performed to date. Depending on the results of these surveys, and at the discretion of the California Department of Fish and Game (CDFG), U.S. Fish and Wildlife Service (USFWS) and/or the National Marine Fisheries Service (NMFS), incidental take permits may also be required for some activities.

Potential Permitting Issues

As a condition of its approval for the stream channel modifications, the RWQCB has requested that the redeveopment of the Harrison Street playing fields and University Village housing include the implementation of stormwater/urban runoff treatment and control measures to minimize impacts to water quality prior to discharge into the creek (RWQCB 2000). A pre-design consultation with federal and state regulatory agencies also produced a recommendation that the whole project area from San Pablo Avenue to the railroad tracks and bypass and Village Creek channel be designed and planned as a whole because the permitting agencies did not want piecemeal permit applications for different reaches.

Recent surveys indicate that "healthy populations" of steelhead occur in the creek as far upstream as the BART overpass[1]. Historically, both steelhead and salmon spawned in the creek (Mortimer, 1999). San Francisco Bay (including any river reaches or estuarine areas accessible to steelhead) was recently designated critical habitat for the Central California Coast steelhead (Federal Register 2000), which

[1] Tom Dudley, U.C. Berkeley Environmental Studies Lecturer, personal communication 2000

indicates that Section 7 (Endangered Species Act) consultation with the USFWS and/or NMFS will be initiated by the COE whether or not steelhead are actually observed within the project area. Given these considerations, surveys for steelhead in the appropriate season may be a requirement of the COE permit. Also, compliance with the NMFS guidelines for development adjacent to steelhead habitat such as those cited in the proposed Endangered Species Act 4(d) rule (Federal Register 1999) may be required by the COE. NMFS guidance for development cited in proposed 4(d) include provisions such as:

- Adequate (preferably 200 foot) vegetated riparian setbacks, including prevention of mechanical entry of disturbance within the inner 50 feet setback.
- Avoidance of stormwater discharge impacts to the water quality or quantity, including the sedimentation of contaminant discharge.
- Design of landscaping to minimize lawn areas, conserve water and limit the use of herbicides, pesticides and fertilizers within the development.

A certified NEPA document or proof of exemption from the NEPA process is required to obtain an individual COE permit. Activities conducted under COE Nationwide Permits are considered approved pursuant to NEPA. However, given the nature of the project, the possible presence of listed species and the amount of jurisdictional acreage involved, permitting the proposed activities under a Nationwide Permit is unlikely. NEPA review has not been performed to date and would have to be completed before issuance of the COE permit.

9.0 PROJECT COSTS

Estimated costs for creek restoration from the railroad tracks to San Pablo Avenue including both a Phase 1 and Phase 2 construction is about $1.38 million in 2001 dollars. This cost estimate is based on the costs of previous restoration projects constructed by WRI on Codornices Creek and other similar East Bay sites and therefore do not include a profit margin, but represent actual installation costs. Design documents and bidding, as well as some other "soft" costs, are not included. Because it is assumed that a design-build project implementation can save these costs. This total cost estimate includes the costs for management and monitoring described in the previous section.

The costs include a phased planting approach in which shade requiring plants are installed two years after the construction year and damaged irrigation components and dead or damaged plants are replaced.

Preliminary Cost Estimate

This section presents the preliminary cost estimates for final design and implementation of the restoration plan. This cost estimate has been made using detailed unit cost values from similar East Bay projects completed by WRI. The estimates presented herein therefore represent a high degree of reliability for purposes of developing grant applications and government budgets. Actual costs will likely vary due to inflation, fuel costs, and unforeseen field conditions. This cost estimate assumes that the Waterways Restoration Institute (WRI) performs the work as a design-build project and oversees field construction of the project.

The following additional assumptions are contained within this cost estimate:

- No hazardous waste or environmental issues are included in the project budget
- A limited volume of debris encountered during excavation activities has been assumed. Significant additional debris has not been included.
- The cost estimate has been prepared assuming each reach and phase of the project will be implemented separately. Some cost savings may be realized by implementation of multiple project reaches at the same time.
- Several cost items (such as bridges, trails) have been marked as "Assumed cost. Final cost by others". These costs budget items have not been fully verified in this preliminary design budget.

TABLE 9-1
Preliminary Design-Build Construction and Project
Implementation Cost Estimate
Lower Codornices Creek
April 20, 2001

description	quantity	units	unit cost ($)	total cost ($)
Direct Capital Costs				
Reach 1 - RR Tracks to 5th street - 600' linear feet - 900' meander distance				
clearing and demolition				
clearing and grubbing	1	ls	$10,500	$10,500
concrete demolition	205	cy	$30	$6,150
culvert removal/disposal at 5th St	1	ls	$35,000	$35,000
concrete disposal	300	cy	$30	$9,000
earthwork				
dewatering system	1	ls	$2,000	$2,000
rough grading				
---cut	3155	cy	$3	$9,465
---fill	669	cy	$5	$3,345
near site clean fill disposal	2013	cy	$3	$6,038
debris disposal	473	cy	$30	$14,198
fine grading and erosion control	1	ls	$20,000	$20,000
construction				
soil bioengineering	1	ls	$20,500	$20,500
container plants	1	ls	$13,600	$13,600
meander toe rock	1	ls	$4,000	$4,000
install irrigation system	1	ls	$7,000	$7,000
construct flood control berm	300	cy	$5	$1,500
temporary chainlink fence	1200	lf	$5	$6,000
permenant wood fence	600	lf	$15	$9,000
foot trail construction	4800	sf	$3.8	$18,240
new ped/light vehicle bridge at 5th St	1	ls	$40,000	$40,000
general				
final design and planning	1	ls	$15,000	$15,000
security during excavation	1	ls	$1,000	$1,000
project survey	1	ls	$2,500	$2,500
project management	1	ls	$3,000	$30
misc construction costs	1	ls	$600	$6
overhead	8	% of total	$254,072	$20,326
contingency	10	% of total	$263,897	$26,390
	Reach 1 Construction Cost			**$300,787**
monitoring and management				
install flood gauge	1	ls	$6,000	$6,000
permanent cross-sections	2	ea	$300	$600
geomorphic monitoring	1	day	$800	$800
biological monitoring	1	ls	$1,500	$1,500
streamflow monitoring	1	ls	$1,500	$1,500
biological protection	1	ls	$2,500	$2,500
report preparation	1	ls	$1,500	$1,500

TABLE 9-1
Preliminary Design-Build Construction and Project
Implementation Cost Estimate
Lower Codornices Creek
April 20, 2001

2nd phase revegetation	1	ls	$9,200	$9,200
		Reach 1 Total Cost		**$324,387**
Reach 2 - 5th to 6th street (phase I) - 165' linear feet - 200 'meander distance				
clearing and demolition				
clearing and grubbing	200	lf	$6	$1,200
by-pass removel	1	ls	$8,000	$8,000
by-pass plugging	1	ls	$2,000	$2,000
concrete disposal	1	ls	$2,000	$2,000
earthwork				
cofferdam Installation	1	ls	$2,000	$2,000
rough grading				
---cut	1070	cy	$3	$3,210
---fill	422	cy	$5	$2,110
near site clean fill disposal	488	cy	$3	$1,463
debris disposal	161	cy	$30	$4,815
fine grading and erosion control	1	ls	$3,500	$3,500
construction				
soil bioengineering	1	ls	$5,000	$5,000
container plants	1	ls	$3,000	$3,000
install irrigation system	1	ls	$3,500	$3,500
construct flood control berm	400	cy	$5	$2,000
spur trail construction	1600	sf	$2.0	$3,200
general				
final design and planning	1	ls	$3,000	$3,000
security during excavation	1	ls	$400	$400
project management	1	ls	$1,600	$16
misc construction costs	1	ls	$150	$2
overhead	8	% of total	$50,415	$4,033
contingency	10	% of total	$50,415	$5,042
	Reach 2 Construction Cost			**$59,490**
monitoring and management				
install flood gauge	---	---	---	---
permanent cross-sections	---	---	---	---
geomorphic monitoring	---	---	---	---
biological monitoring	---	---	---	---
biological protection	---	---	---	---
streamflow monitoring	---	---	---	---
report preparation	---	---	---	---
2nd phase revegetation	1	ls	$2,200	$2,200
		Reach 2	**total cost:**	**$61,690**
Reach 2 - 5th to 6th street (phase II) - 350' linear feet - 420' meander distance				
clearing and demolition				
clearing and grubbing	1	ls	$5,500	$5,500
culvert removal at 6th St	1	ls	$20,000	$20,000

TABLE 9-1
Preliminary Design-Build Construction and Project
Implementation Cost Estimate
Lower Codornices Creek
April 20, 2001

earthwork				
cofferdam installation	1	ls	$11,000	$11,000
rough grading				
---cut	1433	cy	$3	$4,299
---fill	225	cy	$5	$1,125
near site clean fill disposal	993	cy	$3	$2,979
debris disposal	215	cy	$30	$6,449
fine grading and erosion control	1	ls	$9,000	$9,000
construction				
soil bioengineering	1	ls	$10,000	$10,000
container plants	1	ls	$5,800	$5,800
install irrigation system	1	ls	$5,100	$5,100
permanent wood fence	350	lf	$15	$5,250
spur trail construction	2800	sf	$2.0	$5,600
general				
final design and planning	1	ls	$8,000	$8,000
security during excavation	1	ls	$1,000	$1,000
project survey	1	ls	$2,500	$2,500
project management	1	ls	$2,000	$20
misc construction costs	1	ls	$300	$3
overhead	8	% of total	$103,625	$8,290
contingency	10	% of total	$103,625	$10,362
	Reach 2 (ph II) Construction Cost			**$122,277**
monitoring and management				
permanent cross-sections	2	ea	$300	$600
geomorphic monitoring	1	day	$800	$800
biological protection	1	ls	$2,500	$2,500
report preparation	---	---	---	---
2nd phase revegetation	1	ls	$1,990	$1,990
	Reach 2 (ph II)		**total cost:**	**$128,167**
Reach 3 - 6th to 8th - ph I - 653 linear feet - 755' meander distance				
clearing and demolition				
clearing and grubbing	1	ls	$8,500	$8,500
concrete demolition (8th st apron)	1	ls	$10,000	$10,000
concrete demolition (maintenance facility)	75	cy	$30	$2,250
remove/dispose UCB metal maintenance facility	1	ls	$15,000	$15,000
concrete disposal	85	cy	$30	$2,550
earthwork				
cofferdam installation	1	ls	$11,000	$11,000
rough grading				
---cut	2768	cy	$3	$8,304
---fill	324	cy	$5	$1,620
near site clean fill disposal	2029	cy	$3	$6,086
debris disposal	415	cy	$30	$12,456
fine grading and erosion control	1	ls	$17,000	$17,000

TABLE 9-1
Preliminary Design-Build Construction and Project
Implementation Cost Estimate
Lower Codornices Creek
April 20, 2001

construction				
relocate post office wall	1	ls	$150,000	$150,000
relocate fence near day care center	230	lf	$10	$2,300
temporary fence	1306	lf	$5	$6,530
soil bioengineering	1	ls	$18,000	$18,000
container plants	1	ls	$10,500	$10,500
meander toe rock	1	ls	$3,000	$3,000
install irrigation system	1	ls	$7,000	$7,000
regional trail construction	5224	sf	$3.8	$19,851
general				
final design and planning	1	ls	$7,000	$7,000
security during excavation	1	ls	$1,000	$1,000
project survey	1	ls	$1,500	$2,500
project management	1	ls	$4,000	$40
misc construction costs	1	ls	$250	$3
overhead	8	% of total	$322,490	$25,799
contingency	10	% of total	$322,490	$32,249
	Reach 3 (ph I) Construction Cost			**$380,538**
monitoring and management				
install flood gauge	1	ls	$6,000	$6,000
permanent cross-sections	2	ea	$300	$600
geomorphic monitoring	1	day	$800	$800
biological monitoring	1	ls	$1,500	$1,500
biological protection	1	ls	$2,500	$2,500
streamflow monitoring	1	ls	$1,500	$1,500
report preparation	1	ls	$1,500	$1,500
2nd phase revegetation	1	ls	$8,700	$8,700
	Reach 3 (ph I) Total Cost		**total cost:**	**$403,638**
Reach 3 - 6th to 8th - ph II = 75 linear feet				
clearing and demolition				
clearing and grubbing	1	ls	$1,800	$1,800
earthwork				
cofferdam installation	1	ls	$2,000	$2,000
rough grading				
---cut	1400	cy	$3	$4,200
---fill	0	cy	$5	$0
near site clean fill disposal	1190	cy	$3	$3,570
debris disposal	210	cy	$30	$6,300
fine grading and erosion control	1	ls	$1,800	$1,800
construction				
soil bioengineering	1	ls	$2,500	$2,500
container plants	1	ls	$1,400	$1,400
install irrigation system	1	ls	$1,800	$1,800
permanent fence	728	lf	$15	$10,920
regional trail construction	600	sf	$3.8	$2,280

TABLE 9-1
Preliminary Design-Build Construction and Project
Implementation Cost Estimate
Lower Codornices Creek
April 20, 2001

new ped/light vehicle bridge at 6th	1	ls	$20,000	$20,000
general				
final design and planning	1	ls	$2,000	$2,000
security during excavation	1	ls	$200	$200
project survey	1	ls	$500	$500
project management	1	ls	$1,000	$1,000
misc construction costs	1	ls	$100	$100
overhead	8	% of total	$58,570	$4,686
contingency	10	% of total	$58,570	$5,857
	Reach 3 (ph II) Construction Cost			**$72,913**
monitoring and management				
2nd phase revegetation	1	ls	$1,250	$1,250
	Reach 3 (ph II) Total Cost			**$74,163**
Reach 4 - 8th to 9th street				
construction				
trail improvements	800	lf	$3.8	$3,040
container plants	1	ea	$1,000	$1,000
flood berm construction	300	cy	$7	$2,100
		Reach 4	**subtotal:**	**$6,140**
Reach 5 - 9th to 10th street - 300 linear feet - 410 meander distance				
clearing and demolition				
clearing and grubbing	1	ls	$4,500	$4,500
tree removal	1	ls	$30,000	$30,000
culvert removal/disposal at 10th st	1	ls	$25,000	$25,000
concrete disposal	10	cy	$30	$300
earthwork				
cofferdam installation	1	ls	$11,000	$11,000
rough grading				
—cut	2400	cy	$3	$7,200
---fill	395	cy	$5	$1,975
near site clean fill disposal	1645	cy	$3	$4,935
debris disposal	360	cy	$30	$10,800
fine grading and erosion control	1	ls	$1,800	$1,800
construction				
soil bioengineering	1	ls	$9,800	$9,800
container plants	1	ls	$5,800	$5,800
install irrigation system	1	ls	$5,200	$5,200
regional trail construction	3280	sf	$3.8	$12,464
temporary fence	410	lf	$5	$2,050
permanent fence	410	lf	$15	$6,150
new ped/light vehicle bridge at 10th	1	ls	$20,000	$20,000
general				
final design and planning	1	ls	$8,000	$8,000

TABLE 9-1
Preliminary Design-Build Construction and Project
Implementation Cost Estimate
Lower Codornices Creek
April 20, 2001

security during excavation	1	ls	$1,000	$1,000
project survey	1	ls	$1,500	$2,500
project management	1	ls	$2,000	$2,000
misc construction costs	1	ls	$250	$250
overhead	8	% of total	$172,724	$13,818
contingency	10	% of total	$172,724	$17,272
	Reach 5 Construction Cost			**$203,814**
monitoring and management				
permanent cross-sections	1	ea	$400	$400
geomorphic monitoring	1	day	$400	$400
biological monitoring	1	ls	$1,500	$1,500
biological protection	1	ls	$2,500	$2,500
report preparation	1	ls	$1,200	$1,200
2nd phase revegetation	1	ls	$3,840	$3,840
		Reach 5 Total Cost		**$213,654**
Reach 6 - 10th to San Pablo Ave - 310 linear feet - 410 meander distance				
clearing and demolition				
clearing and grubbing	1	ls	$4,500	$4,500
tree removal	1	ls	$10,000	$10,000
earthwork				
cofferdam installation	1	ls	$11,000	$11,000
rough grading				
---cut	2885	cy	$3	$8,655
---fill	1336	cy	$5	$6,680
near site clean fill disposal	1116	cy	$3	$3,349
debris disposal	433	cy	$30	$12,983
fine grading and erosion control	1	ls	$9,000	$9,000
construction				
soil bioengineering	1	ls	$9,800	$9,800
container plants	1	ls	$5,800	$5,800
install irrigation system	1	ls	$5,400	$5,400
boulders for step pools	1	ls	$1,500	$1,500
temporary fence	410	lf	$5	$2,050
permanent fence	410	lf	$15	$6,150
regional trail construction	2480	sf	$3.8	$9,424
general				
final design and planning	1	ls	$8,000	$8,000
security during excavation	1	ls	$1,000	$1,000
project survey	1	ls	$1,500	$2,500
project management	1	ls	$2,000	$20
misc construction costs	1	ls	$500	$5
overhead	8	% of total	$117,815	$9,425
contingency	10	% of total	$117,815	$11,782
	Reach 5 Construction Cost			$139,022
monitoring and management				

TABLE 9-1
Preliminary Design-Build Construction and Project
Implementation Cost Estimate
Lower Codornices Creek
April 20, 2001

permanent cross-sections	1	ea	$400	$400
geomorphic monitoring	1	day	$400	$400
biological monitoring	1	ls	$1,500	$1,500
biological protection	1	ls	$2,500	$2,500
report preparation	1	ls	$1,500	$1,500
2nd phase revegetation	1	ls	$3,840	$1,500
	Reach 6 Construction Cost			$146,822
	ESTIMATED TOTAL COST:			**$1,358,661**
Notes: Specific costs will be determined by further discussion with permitting agencies				

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Appendix B
Stable Channel Design Process

Appendix B: Stable Channel Design Process

Stable channel design requires that a project results in a desirable active channel width and depth, slope, meander and floodplain area. As a result of monitoring for equilibrium channel shapes and meanders, local relationships have been derived for the East Bay urban creeks between drainage area and active, or bankfull, channel widths and depths. The design process also uses relationships between the lengths of the channel meanders and the widths of the creeks based on different stream types. The stable channel design, therefore applies these localized relationships to design a channel that should not result in substantial maintenance or management needs. These regional relationships are supplemented with historic information from aerial photos and survey maps that help determine the type of stream channels that have flowed down the reaches of Codornices Creek this report addresses. WRI has has also done previous projects on Codornices Creek within the project area (at Fifth - Sixth Streets and between Eighth- Ninth Streets) to gain experience in applying these localized averages. The next section describes how the design parameters for stable channels for each project reach were derived and quantified.

The project described in this report is based on applying the principles of the stable channel restoration design. Land use constraints rarely allow for optimum conditions for creating stable channels but reasonable site plans can achieve a considerable stability. This plan represents this reasonable balance. The current creek conditions are typified by channel lengths which are too short and therefore the meandering is inadequate. These situations result in the stream trying to compensate by attacking the banks and by head cutting. Head cutting is currently occurring on Codornices Creek at numerous locations because it has been straightened in the past. Headcutting is one way that the creek tries to reflatten its slope. This is typified by erosion of the bottom of the creek bed, which continues to travel up the stream channel in a series of waterfalls or "nick points" (Figure 5-4).

Channels that do not achieve the correct, stable dimensions require project designs which lock the channel into place using concrete, rock banks and grade control structures. These features incur higher maintenance and management costs because they have to be repaired or replaced over time due to the constant stress exerted on them by a stream attempting to establish a stable equilibrium. The unstable reaches have a tendency to affect the stable design reaches up and downstream from them. This Phased Creek Restoration Plan project attempts to minimize these problems.

Stream Channel Forming Discharges

In order to design a stable, or equilibrium channel, it is necessary to estimate the channel forming or bankfull discharge. This discharge is one of the smaller, more frequent flows that typically fall between the one and a half and the two year recurrence interval, or in other words, the flow that can be expected to occur on the average of two times every three years. The active, meandering channel that is formed by these discharges must be correctly sized to avoid excessive erosion or deposition. Two methods are typically engaged to estimate these channel-forming flows when gauge data is not available for a stream. One estimate is derived from regional data compiled from U.S. Geological Survey stream gauge stations in which the 1.5-year recurrence interval discharges are plotted against watershed drainage areas. A graph was developed that shows cross-sectional channel areas and channel widths for various sized drainage areas for local East Bay streams using only information from East Bay gauges and restoration projects that have been observed. This graph has refined one started by Luna Leopold and published in Water and Environmental Planning in 1978 (Leopold 1978). A relatively recently published graph of bankfull discharges as a function of drainage area published by Leopold in 1994 (Leopold 1994) for the San Francisco Bay was used. WRI cross-checked this with regional relations provided by the U.S.G.S. obtained with drainage area and rainfall data by multiple regression equations for estimating the 2, 5, 10, 25 and 50 year recurrence interval discharges (Rantz 1971). These values can be adjusted for degree of urbanization. Based upon WRI's experience, these two methods of estimating lower level discharges provide more reasonable values than the HEC-I model commonly used to estimate flood flows within a basin. (Figure B-1: Flood Frequency Curve; Figure B-2: Adjusted Regional Curve: Bankfull Cross-sectional Area as a Function of Drainage Area; Figure B-3: Adjusted Regional Curve: Bankfull Width as a Function of Drainage Area).

Restoration Parameters

The Active Channel Shape

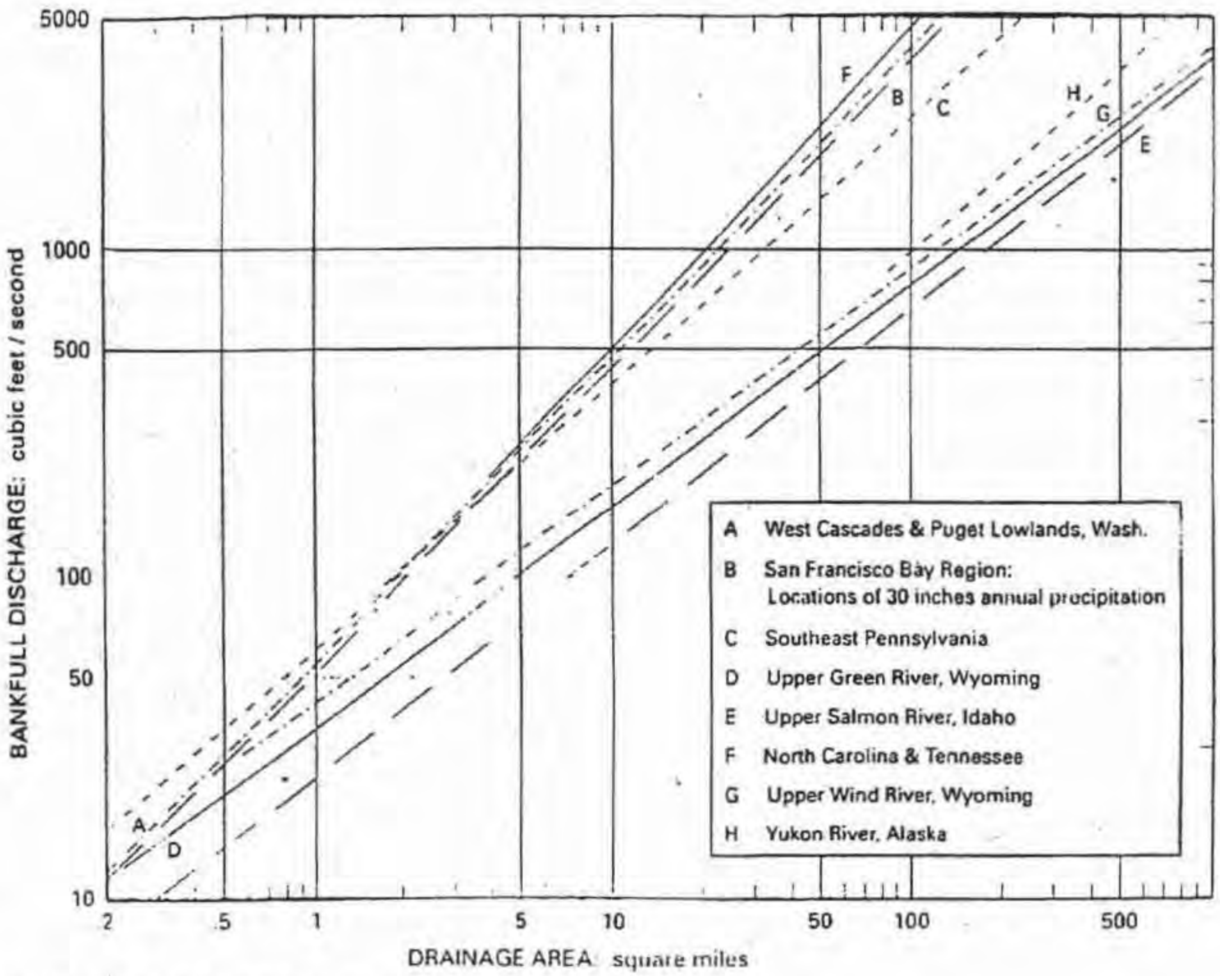
The Codornices Creek project area drains a watershed area of 1.2 square miles. Using this figure and the assumption that the average rainfall is 25 inches a year, both the Rantz equation and the East Bay adjusted regional channel hydraulic geometry were used to estimate the active or channel forming flow.

The flood frequency curve derived from Rantz's San Francisco Bay regression equations provided a value of about 80 cubic feet per second (cfs) discharge for the 1.5 recurrence interval flow. Leopold's San Francisco Bay Regional data that plots bankfull discharge as a function of drainage area also provides a value of 80 cfs. The agreement of these values gives some confidence that the findings in this report are close to the correct values.

The East Bay regional curve indicates that the average cross-sectional area of an active channel for this watershed drainage area is about 25 square feet and the width is about 15 feet. Based upon experience with previous projects in this area of the watershed, it was found that channel widths adjust at about 16 feet. The depths appear to be about 1.5 to 1.6 feet. These regional values apply well to Rosgen B and

Flood Frequency Curve

Figure B-1

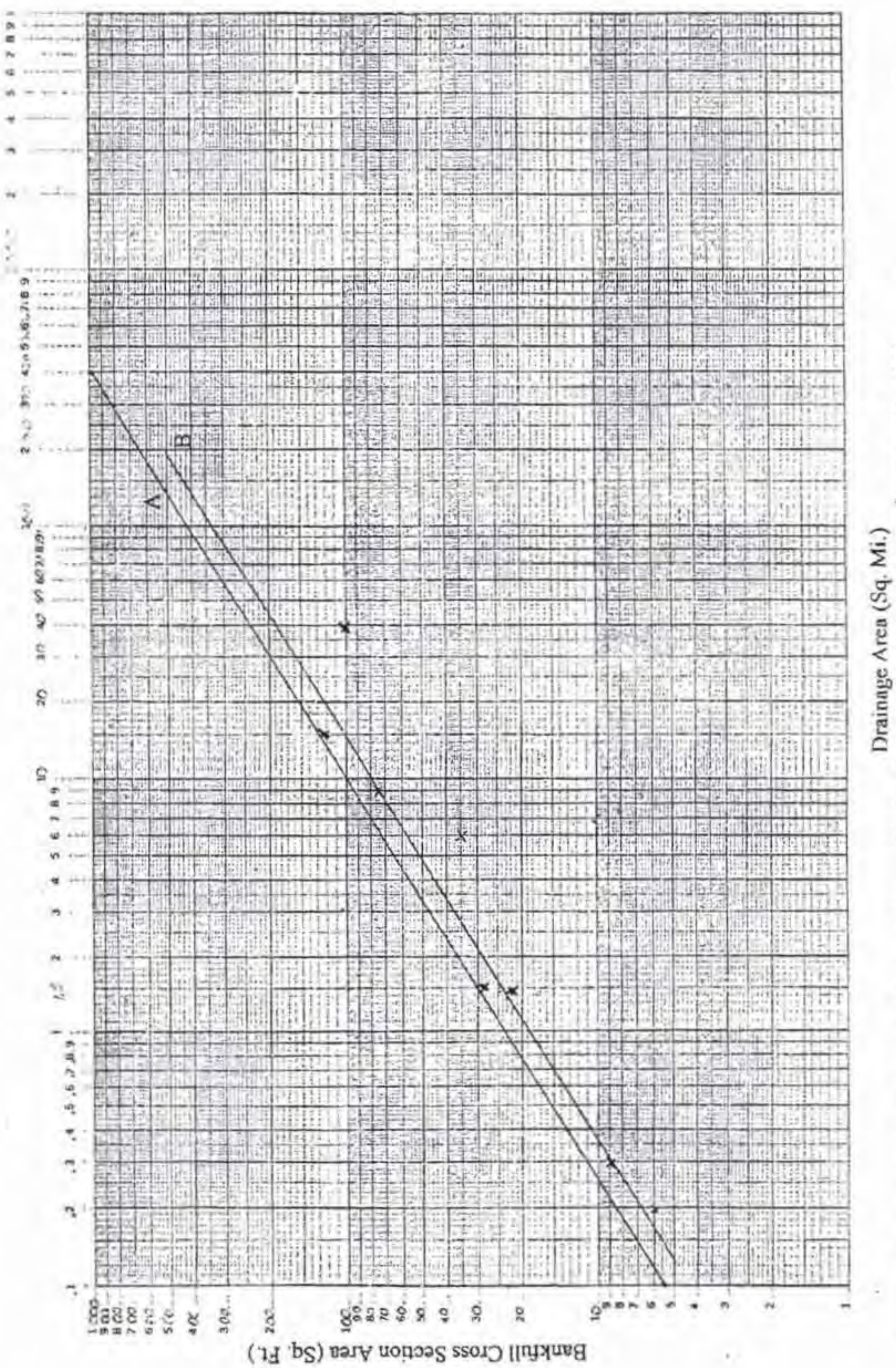


Source: *View of the River*, Leopold (1994)

Bankfull Discharge as a function of drainage area for several regions in the United States.

Adjusted Regional Curve: Bankfull X-Section as a Function of Drainage Area

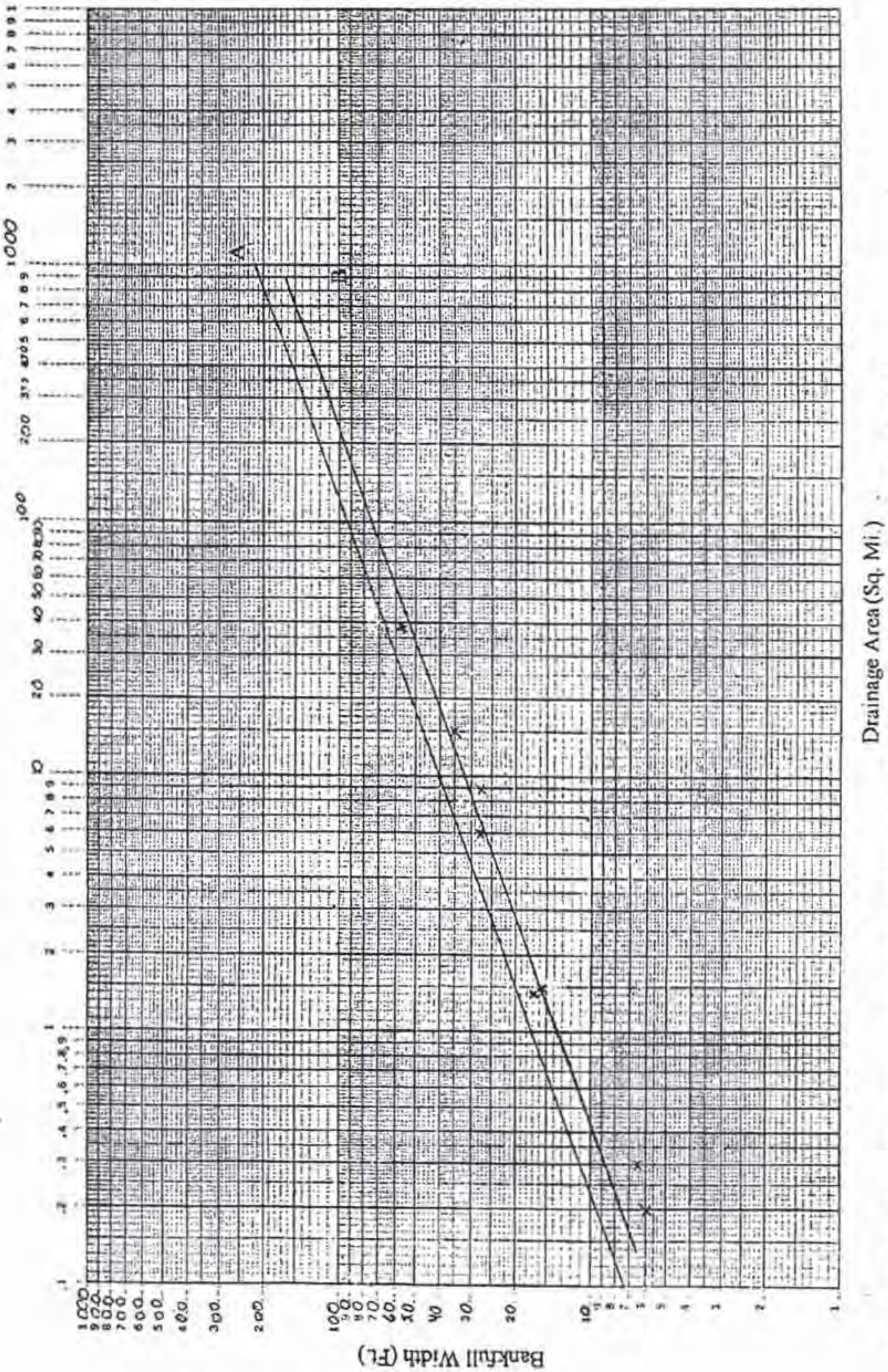
Figure B-2



Source: San Francisco Bay Region, Dunne and Leopold, 1978 and Waterways Restoration Institute, 1999

Adjusted Regional Curve: Bankfull Width as a Function of Drainage Area

Figure B-3



Source: San Francisco Bay Region, Dunne and Leopold, 1978 and Waterways Restoration Institute, 1999

C type channels, which are very common in the East Bay. Table B-1 shows the design parameters for a stable channel design.

Channel Meanders, Slopes and Stream Banks Meanders
Historic conditions provide the best possible information to guide the return of a more natural sinuosity to a creek as badly modified as Codornices and were used to the extent possible. It was fortunate to have such information in maps and photos. In the absence of historic information, indications are sought by looking at the landscape for old meanders, continuous topographic low points, and groupings of wetland vegetation. Sometimes modern-day aerial photos help to identify these low points. On lower Codornices, however, the landscape has been so transformed and impacted by human use that this was not an option in this case.

National averages provide guidance for the relationships between bankfull channel widths and the lengths of the channel meanders. In the absence of historic or on-the-ground indications, this report applies these averages developed by fluvial geomorphologists. In the case of the restoration project that was designed between Fifth and Sixth Streets in 1997, good historic information was not available at that time. Since then, additional historic information has been located for that reach. Using the equations in Figure 4-2 entitled Geometry of Meanders, a design meander was developed that measured a restoration sinuosity of 1.3 for this reach. At a later date a sketch of this channel was obtained that had been drawn by a City of Berkeley engineer when the Fifth Street culvert was put in (Figure 5-3). It confirmed that the designs based on these relationships matched the 1.3 historic sinuosity.

Based upon experience in the East Bay, the following relationships are good for estimating restoration channel lengths:

- Rosgen B channel type: bankfull width x 11 = channel length
- Rosgen C channel type: bankfull channel x 10 = channel length
- Rosgen E channel type: bankfull channel x 8-9= channel length

When the channel meanders along Codornices Creek are designed, the first step is to set the objective of deriving the right channel sinuosity. The historical data on nearby Village and Codornices Creeks provides that information. The next design objective is to make sure that the meander shapes are not squeezed or drawn out too much so that they do not exhibit shapes not found in nature. For example, one would not usually find a channel doubling over itself like an accordion on a moderately to steeply sloping valley. While recognizing there is a great deal of variability in natures stream channel meanders, efforts are made not to force a channel into shapes that would not tend to be matched to the type of landscape the channel flows through. Therefore, information on average channel lengths were

TABLE B-1
Channel Design Worksheet
Codronices Creek
April 14, 2001

Phase I - 5th, 8th street culverts stay in — Bankfull Q= 80 cfs

description	local valley slope	Thalwag Elev stream station sta1	elev 1	sta 2	exist thal elev	existing stream length	input sinuosity	calculated channel slope (1)	new stream length	input or calc elev 2	sta 2 cut/fill depth	actual channel slope (2)	bankfull width (ft)	bankfull depth (ft)	side slopes (x:y)	area (ft2)	hyd radius	mannings "n"	calc velocity	calc flow (cfs)	% bankfull flow	calc shear vel (ft/s)	calc shear stress
RR tracks to 4th st	0.0060	999	6.25	1302	7.2	303	1.7	0.00353	515	8.07	0.87	0.00353	12	3	2	18.00	0.71	0.04	1.76	31.65	39.56	0.2837	0.080
4th to 5th	0.0060	1302	8.07	1583	8.38	281	1.36	0.00441	382	9.75	1.37	0.00441	12	3	2	18.00	0.71	0.04	1.97	35.38	44.23	0.31719	0.101
5th to 6th	0.0060	1583	9.75	1932	13.6	349	1.14	0.00526	398	13.60	-0.02	0.00966	16	2	2	24.00	0.96	0.04	2.63	63.21	79.01	0.4038	0.163
6th to 8th	0.0170	2008	14.06	2585	21	577	1.3	0.01308	750	21.00	0.00	0.00925	16	2	2	24.00	0.96	0.045	3.69	88.57	110.71	0.6365	0.405
8th to 9th (3)	0.0140	2670	22.15	3045	27.5	375	1.3	0.01077	488	27.50	0.02	0.01097	16	2	2	24.00	0.96	0.045	3.35	80.37	100.46	0.57762	0.334
9th to 10th	0.0140	3045	27.50	3345	30.3	300	1.2	0.01167	360	31.70	1.42	0.01167	16	2	2	24.00	0.96	0.045	3.49	83.65	104.57	0.6012	0.361
10th to San Pablo	0.0190	3345	31.70	3686	36.6	341	1.2	0.01583	409	36.50	-0.13	0.01174	16	2	2	24.00	0.96	0.045	4.06	97.45	121.82	0.70038	0.491

Phase II-8th street culvert stays — Bankfull Q= 80 cfs

description	local valley slope	Thalwag Elev stream station sta1	elev 1	sta 2	exist thal elev	existing stream length	input sinuosity	calculated channel slope (1)	new stream length	input or calc elev 2	sta 2 cut/fill depth	actual channel slope (2)	bankfull width (ft)	bankfull depth (ft)	side slopes (x:y)	area (ft2)	hyd radius	mannings "n"	calc velocity	calc flow (cfs)	% bankfull flow	calc shear vel (ft/s)	calc shear stress
RR tracks to 4th st	0.0060	999	6.25	1302	7.2	303	1.7	0.00353	515	8.07	0.87	0.00353	12	3	2	18.00	0.71	0.04	1.76	31.65	39.56	0.2837	0.080
4th to 5th	0.0060	1302	8.07	1583	8.38	281	1.36	0.00441	382	9.75	1.37	0.00441	12	3	2	18.00	0.71	0.04	1.97	35.38	44.23	0.31719	0.101
5th to 6th	0.0060	1583	9.75	1932	13.6	349	1.3	0.00462	454	11.85	-1.77	0.00462	16	2	2	24.00	0.96	0.04	2.47	59.19	73.99	0.37814	0.143
6th to 8th	0.0170	1932	11.85	2585	21	653	1.3	0.01308	848	21.00	0.00	0.01078	16	2	2	24.00	0.96	0.045	3.69	88.57	110.71	0.6365	0.405
8th to 9th (3)	0.0140	2670	22.15	3045	27.5	375	1.3	0.01077	488	27.50	0.02	0.01097	16	2	2	24.00	0.96	0.045	3.35	80.37	100.46	0.57762	0.334
9th to 10th	0.0140	3045	27.50	3345	30.3	300	1.2	0.01167	360	31.70	1.42	0.01167	16	2	2	24.00	0.96	0.045	3.49	83.65	104.57	0.6012	0.361
10th to San Pablo	0.0190	3345	31.70	3686	36.6	341	1.2	0.01583	409	36.50	-0.13	0.01174	16	2	2	24.00	0.96	0.045	4.06	97.45	121.82	0.70038	0.491

Notes:

(1) Calculated channel slope assumes an equilibrium slope between valley slope and sinuosity

(2) Actual channel slope has been adjusted to meet existing culvert elevations

(3) Calculations shown for analysis purposes only. No work proposed between 8th and 9th street.

used to guide the drawing of the meanders. While is it not possible to transform the creek back to historical conditions as land use changes have made this impossible, the objective of this plan is to restore the sinuosity of the creek as much as possible within existing, available rights-of-way.

The next step is to draw the design meanders to fit the proper channel length within the distances in each project reach. The proper sinuosity is critical to meeting the objective of having a stable channel, so this is a very sensitive design parameter. The next concern is to achieve a meander length and shape that is within a reasonable range of the averages calculated from the equations.

The restoration design sinuosity for Fifth Street to the railroad tracks is 1.6. The design sinuosity for Fifth to Eighth Streets is 1.3. Upstream of Ninth Street the design sinuosity is 1.2. The restoration design conforms to what is believed will stabilize the now caving banks of Codornices creek.

Slopes

As the discussion of existing conditions indicates, the straightened creek has an oversteepend channel and has been headcutting to flatten out its slope. In many reaches the slope of the creek is flatter now than it was historically. To achieve an estimate of the historical channel bottom slope, the slope of the Codornices Creek valley was estimated over its different reaches from San Pablo Avenue to the railroad tracks using level and stadia surveys. Given the relationship of valley slope, channel slope and sinuosity under natural conditions, it was deduced that the channel slope should be steepened from Sixth to Eighth Streets and Ninth Street to San Pablo Avenue. At San Pablo Avenue, this plan recommends the culvert and channel invert be reconnected, which should greatly facilitate steelhead migration.

Stream Banks

The 1.5 foot active channel banks are vertical or near vertical as they occur in nature. In the C-type channels between Fifth and Ninth Streets where there is floodplain space, there is room for point bar (where deposition collects along the side of the flood channel) development on the outside meander bends. The project then slopes the terrace banks up to the top of the ground where the trail may be located using 2:1 side slopes. This is often considered too steep for designs in urban environments but given the constrained right of way, a 2:1 design assumption was applied to most of the slide slopes, and 3:1 slopes were used for only a few sections. The terrace banks will be revegetated with native riparian plants which once established should provide a high level of stability.

Appendix C
Flood Peaks for Codornices Creek

As directed, WRI adopted estimated discharges calculated by previous project consultants to the University and used these flows as the basis of the hydraulic analysis:

Table C-1: Comparison of Estimated Peak Flow Discharges (cfs):

Flows (cfs)	FEMA 1978	PWA 1993	PWA 1997	SHJ 1998
Q10	660	580	---	---
Q50	960	---	---	---
Q100	1100	920	1085	928
Q500	1420	---	---	---

Q - Discharge
cfs - cubic feet per second
FEMA - Federal Emergency Management Agency
PWA - Philip Williams Associates
SHJ - Sandis Humber Jones