EXECUTIVE SUMMARY

Pajaro River Watershed Flood Prevention Authority

Phase 2 Pajaro River Watershed Study

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RMC
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in association with
Schaaf & Wheeler
CONSULTING CIVIL ENGINEERS

Phase 2 Pajaro River Watershed Study

Executive Summary

The Pajaro River Watershed Flood Prevention Authority (Authority) has completed Phase 2 of the four phase Pajaro River Watershed Study. The Phase 2 report outlines, summarizes, and explains the progress achieved to date within the Pajaro River Watershed Study. Phase 1 consisted of modeling both the hydrologic and sediment regimes of the watershed. The results of Phase 1 provided a better understanding of the characteristics of the watershed and changes over time that affect flooding frequency and flooding potential in the downstream reaches of the Pajaro River. The purpose of Phase 2 of the study was to identify project alternatives that would provide flood protection for the Pajaro River from Chittenden to Monterey Bay from the 100-year flood flows identified in Phase 1.

Flooding on the Pajaro River

Corps of Engineers Alternatives
Lower Pajaro River Flood Protection Project

Alternative	Description	Level Of Protection*
1 - Floodwalls/Levee Raise in Place	Raise existing levee by an average of 4 feet to an average height of 11 feet.	30 yrs
2 - 100-foot Setback	Raise existing levee by an average of 5 feet to an average height of 12 feet. The levees will be set back 100 feet.	50 yrs
3 - 225/100-foot Setback	Raise existing levee by an average of 5 feet to an average height of 12 feet. The levees will be set back 100 to 225 feet in different reaches.	65 yrs
4 - Floodwall In-Lieu of Levee	Construct a floodwall with height of 12 feet located at the landside toe of the levee.	30 yrs
5 - Environmental Corridor	Raise existing levee by an average of 5 feet to an average height of 12 feet. The levees will be set back 100 feet. A high vegetation factor assumed for the channel reduces the level of protection compared with Alternative 2.	25 yrs

* Assumes a 90 percent confidence of non-exceedance (Source: Army Corps of Engineers, November 2002)

The Phase 2 Study projects were developed to coordinate with a concurrent Army Corps of Engineers (Corps) Lower Pajaro River flood protection project. The Phase 2 projects, when combined with the Corps Lower Pajaro River project, are designed to provide 100-year flood protection and maintain the existing watershed conditions (flood attenuation conditions). The Corps has identified several projects which provide different levels of flood protection, varying from a 25-year to a 100-year flood event protection. To coordinate with the Corps efforts, the alternatives identified in Phase 2 were coupled with the Corps projects to provide a minimum of 100-year flood protection. The current expectations

and direction of the Corps study process are that a 100-year flood protection project will be selected and constructed.

The combined Corps and the Authority 100-year flood protection projects are based on the assumption that the watershed conditions (or current level of flood attenuation provided in the upper watershed) are maintained. The Phase 1 model results highlighted the natural flood attenuation benefits of Soap Lake and the critical importance of maintaining those benefits as part of any Pajaro River flood protection solution. Based on the results of Phase 1 and 2 of the watershed study and the results of the Corps project evaluation, it is recommended that Phase 3 of the study focus on the preservation of the Soap Lake flood attenuation benefits. It is further recommended that Phase 3 identify opportunities for partnering with the Corps Lower Pajaro River project and other public and private resource agencies to develop and fund Soap Lake environmental enhancement and open space preservation opportunities.

Purpose/Legal Authority

The Pajaro River Watershed Flood Prevention Authority was established in July 2000 in order to "identify, evaluate, fund, and implement flood prevention and control strategies in the Pajaro River Watershed, on an intergovernmental basis."[1] Since the watershed covers areas of four counties and four water districts, the board is comprised of one representative from each of the following agencies:

- County of Monterey
- County of San Benito
- County of Santa Clara
- County of Santa Cruz
- Monterey County Water Resources Agency
- San Benito County Water District
- Santa Clara Valley Water District
- Zone 7 Flood Control Agency

The Authority acts as a governing body through which each member organization can participate and contribute to finding a method to provide flood protection in the watershed and promote general watershed interests. Although efforts by individual agencies have been made in the past to prevent flooding, the ultimate solution may require coordination of structural and non-

It is recommended that Phase 3 of the study, in partnership with the Corps and public and private resource agencies, focus on the preservation of Soap Lake flood attenuation benefits and Soap Lake environmental enhancement and open space preservation opportunities.

The Pajaro River flows through four counties

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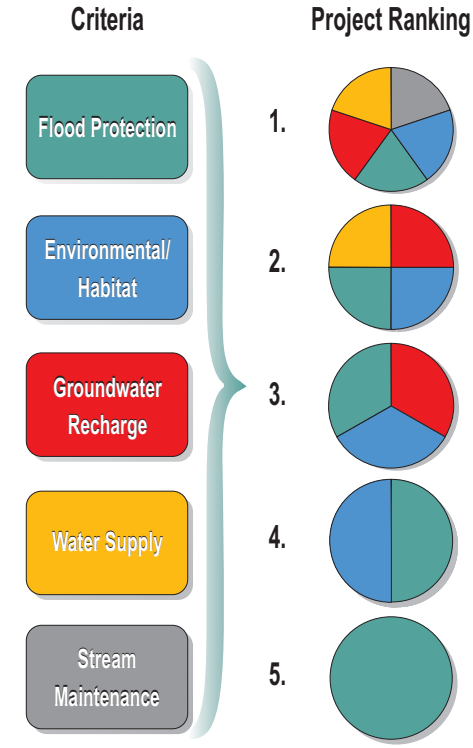

Projects with multiple benefits are the highest priority

structural projects throughout the four counties that make up the watershed. Therefore, it is critical that a governing body representing all eight agencies make the decisions necessary to ensure a flood protection solution is developed and general watershed interests are addressed and protected.

As described in the enabling legislation State Assembly Bill 807, the goal of the Authority is to implement flood protection strategies within the watershed. It is a further goal of the study to identify and prioritize strategies and projects that will provide multiple benefits, such as water supply, ground water recharge, or environmental restoration and protection benefits. Other potential benefits or watershed interests that have been identified and considered in the evaluation of project alternatives include:

- Municipal, agricultural, and industrial water supply
- Groundwater recharge
- Support of rare, threatened, or endangered species
- Migration and spawning of aquatic organisms
- Preservation of wildlife habitat[2]

Individual agencies have worked on solutions to the flooding, erosion, loss of wildlife habitat, and threat to listed species such as the steelhead trout, the California red-legged frog, the tidewater goby, and the western pond turtle. The Authority was created by state law to encourage cooperation between agencies and promote regional flood solutions.

Projects that provide multiple benefits maximize the opportunities for partnering and cost sharing. For example, the Soap Lake preservation project could satisfy mitigation requirements for the Corps Lower Pajaro River project, thereby creating an opportunity to partner with the Corps and potentially receive federal funds. The Soap Lake preservation project, if developed to protect the natural flood attenuation characteristics as well as provide open space or habitat protection, could create opportunities for partnering with public and private resource agencies like Santa Clara County Open Space Authority, the Nature Conservancy, California Department of Fish and Game, US Fish and Wildlife Services, and others. Any opportunity to partner with other agencies or organizations maximizes the opportunities for cost sharing.

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As currently outlined by the State, there are four phases of the Pajaro River Watershed Study:

Phase 1:
Stream Flow Modeling

Phase 2:
Identification and Evaluation of Alternatives

Phase 3:
Selection of Projects

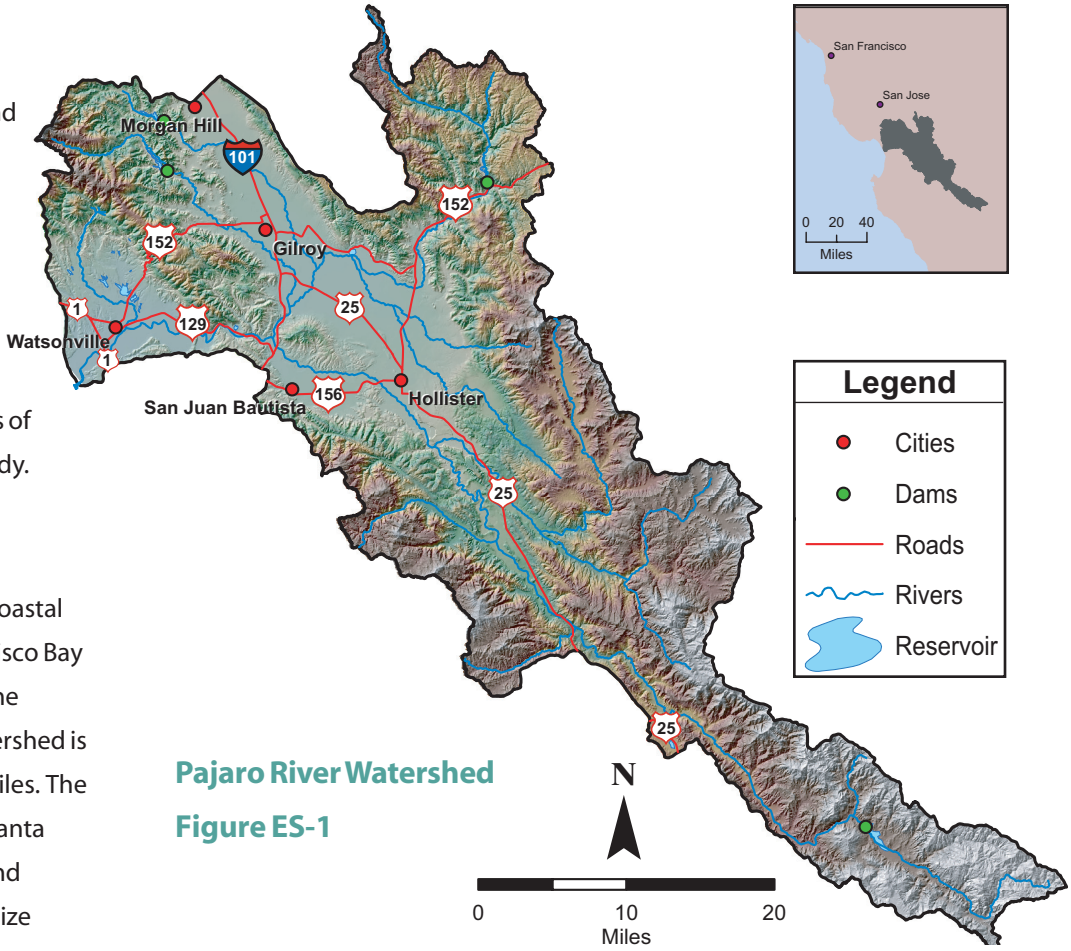
Phase 4:
Preliminary Design of Projects

The Authority's study began in late 2001. The Phase 1 Report was completed in July 2002 and the Phase 2 work began immediately thereafter. The Phase 1 Report summarized the results of the modeling effort and provided a foundation and stepping-stone for the remaining phases of the Pajaro River Watershed Study.

Setting

The Pajaro River is the largest coastal stream between the San Francisco Bay and the Salinas Watershed in the County of Monterey.[3] The watershed is approximately 1,300 square miles. The watershed covers portions of Santa Cruz, Santa Clara, San Benito, and Monterey Counties. The large size contributes to the number of diverse environments, physical features, and land uses within the watershed boundary. Tributaries to the Pajaro River, the largest of which is the San Benito River, originate throughout the watershed. Figure ES-1 is a relief map of the watershed which includes major highways, cities, dams, and rivers.

Soap Lake is an intermittent feature of the watershed but has been found to be an extremely important flood protection feature. Upper Soap Lake is also known as San Felipe Lake and is a permanent body of water. Lower Soap



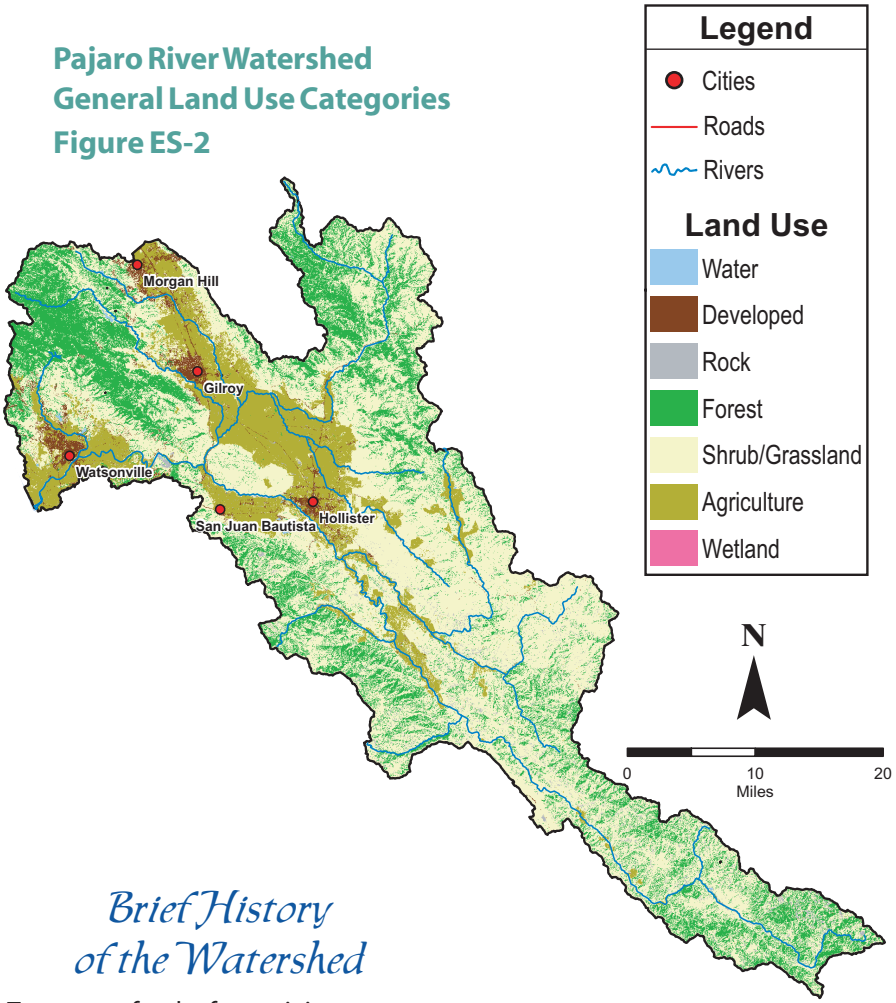
Pajaro River Watershed
Figure ES-1

Lake, referred to in this report as Soap Lake, will be formed in the floodplain between San Felipe Lake and the Highway 101 crossing. Soap Lake is created when flood events cause flooding of low-lying areas and flow backup on the Pajaro River upstream of the San Benito River. This reach of the Pajaro River acts as a natural control for increased flows from the upper Pajaro River watershed. The lake effects disappear as the floodwaters recede.

Development within the watershed, both urban and rural, is clustered around the major cities. The major urban centers are Watsonville, Gilroy, Morgan Hill, Hollister, and San Juan Bautista. Agriculture and grazing are the dominant land uses in these areas but represent a small portion of the total watershed land use. Other industries outside of the urban setting include mining and timber harvesting. The majority of the land cover is grassland, shrubland, and forest. The spatial distribution of the land uses is shown on Figure ES-2.

Pajaro River in the Soap Lake floodplain

Pajaro River Watershed
General Land Use Categories
Figure ES-2



Brief History of the Watershed

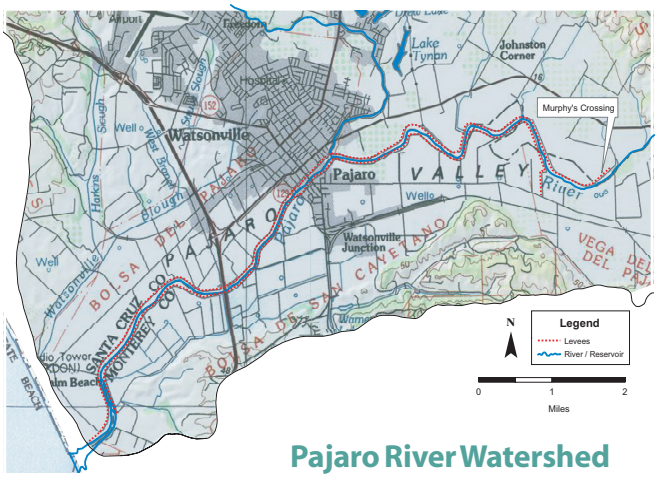
To prepare for the future, it is necessary to understand current and past watershed conditions. The present is important because it is the reference point for future courses of action. The past is relevant because the ability to see how the watershed has changed over the years makes it possible to understand how different factors, taken individually or as a whole, affect flooding potential. The late 1940s are especially significant because of major flood protection work done at that time. The work radically changed the

shape and function of the river and flood plain. It is important to see how the watershed has changed since that time.

Flood protection management entered the current era when the Corps initiated a flooding study in 1936. However, it was not until 1949 that a complete levee was constructed from Murphy's Crossing to the river mouth, a distance of about 10.5 miles, Figure ES-3 to improve flood protection for the lower Pajaro River flood plain.[4] In some locations, existing levees, which had straightened the river course somewhat, were raised to provide additional protection. New levees filled in gaps and extended the coverage area. Based on recent studies by the Corps, the existing flood protection project has an 8-year level of protection at 90 percent confidence of non-exceedance.[5]

Four large flood discharges have caused major flooding and damage. The first two high water periods, in 1955 and 1958, stimulated interest in further flood protection works, but since no consensus could be reached regarding the type of project, the idea was abandoned.The droughts throughout the 1970s and early 1980s lowered public awareness of floods. Recently, major floods occurred in 1995 and 1998. The flooding in 1995 caused Governor Pete Wilson to suspend Department of Fish and Game regulations and the California Environmental Quality Act (CEQA) to provide emergency flood protection.[6] This most often took the form of vegetation and sandbar removal.

The magnitude of flood protection is not the only aspect of the watershed that has changed since the early 1940s. There has been a shift in the type and extent of agricultural production within the watershed. Agriculture has been a huge part of the area's economy since the late 1800s, the magnitude of export due largely to the available transportation to ship the product, the development



Pajaro River Watershed
Lower Pajaro River - Figure ES-3

Based on recent studies by the Corps, the existing flood protection project has an 8-year level of protection at 90 percent confidence of non-exceedance.

Pajaro River and adjacent fields

Strawberry fields in Pajaro Valley

of refrigeration, and the availability of deep wells. Up to World War II, orchard crop production, especially of apples, apricots, and prunes, was increasing. Vegetables high in nutrition also experienced elevated demand. As the years passed, the local demand for staple crops lessened and the orchards passed their prime growing years. Sometime during the 1950s, a gradual transition was made to smaller crops, such as strawberries, which had a higher yield per acre in both tonnage and profit. Not all of the orchards were replaced, however, and those that remain are a significant part of the watershed's land use. Martinelli's Cider has maintained its fields in the Watsonville area. Many other agricultural products are still grown in great quantities for both domestic use and foreign export.[7,8,9]

Population growth[10] in the urban areas of the watershed is shown on Figure ES-4. Most of the growth and urbanization has taken place around the five largest cities within the watershed: Watsonville, Gilroy, Morgan Hill, Hollister and San Juan Bautista. All five cities have grown recently as the area has become more popular due to the housing availability, regional agriculture and industry, and proximity to other major economic and industrial locales.

Phase 1 Flooding Studies

One of the conclusions of the Phase 1 study was the impact of land use on flooding. Neither the increased urbanization nor the agricultural changes had a significant effect on

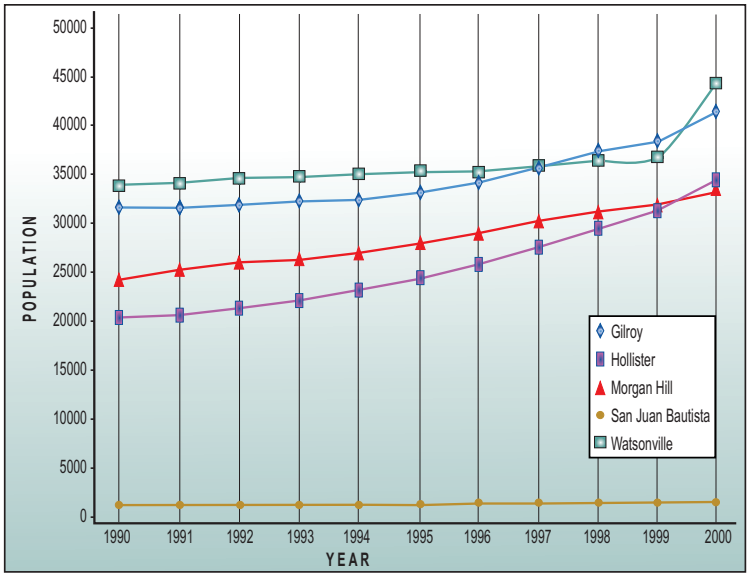


Figure ES-4 Census data and estimated population

runoff for 50-year to 200-year return period flood flows. However, for smaller, 2-year to 25-year return period floods, these conditions caused greater percentage increases in flood flow rates.

The type of agriculture will impact runoff locally, but on a watershed scale the modeled watershed agricultural changes caused an increase of less than two percent in the peak flow rate at Chittenden during storms with return periods of 10 years and larger. Urbanization causes slightly greater increases in peak flow, with Chittenden peak flow rates increased by 2.4 percent or less for storm with return periods greater than 50 years. The small change in peak flows for these large storms is due to the saturated ground surface that occurs in these events. These large storms will saturate the ground quickly, effectively creating an impermeable surface for any additional rain. The amount of runoff created by a saturated non-urban surface is nearly the same as an urban surface.

For smaller storms, such as 2- to 25-year storms, land use and urbanization cause larger increases in peak flow. Peak flows at Chittenden are approximately 3 percent higher than the existing condition peak flows for the 10 year and 25 year return periods.

The peak flows at Chittenden with the Ultimate Buildout condition are approximately 6 percent higher than the existing condition peak flows for the same return periods. The discharges from these storms can cause additional flooding if not managed properly.

Model results indicated that regional flooding potential was worse in 1947. This is due primarily to the lack of upstream storage that is currently provided by the Hernandez, Uvas, and Chesbro dams, which have been constructed since 1947. The addition of these dams reduced the peak flows at Chittenden from 10 to 20 percent over the range of storm return periods studied.

Phase 1 Modeling Results
Peak Flood Discharge at Chittenden

Existing Conditions	
2-Year	3,100 cfs
100-Year	44,600 cfs
Historic Conditions (1947)	
2-Year	3,700 cfs
100-Year	50,200 cfs
General Plan Build-Out (2015 to 2020)	
2-Year	3,600 cfs
100-Year	45,200 cfs
Ultimate Build-Out (2050)	
2-Year	4,300 cfs
100-Year	45,700 cfs
Changes in Agriculture	
2-Year	3,300 cfs
100-Year	45,000 cfs

Neither the increased urbanization nor the agricultural changes had a significant effect on runoff for 50-year to 200-year return period flood flows. However, for smaller, 2-year to 25-year return period floods, these conditions caused greater percentage increases in flood flow rates.

Phase 2 Project Development

Interagency cooperation facilitated the development of fourteen conceptual flood protection project alternatives.

Interagency cooperation facilitated the development of fourteen conceptual flood protection project alternatives. Though many alternatives were developed, there are several that have been identified as the most favorable for pairing with the Corps projects. Their status is based on multi-objective benefits, a minimization of adverse effects, and a relatively low cost. While all of the favored alternatives have these traits in common, the types of projects included in the alternatives are quite diverse. One alternative, the Soap Lake Preservation Project, was considered imperative to maintain the projected downstream discharge levels. Preserving or perhaps enhancing the intermittent detention basin characteristics of Soap Lake will play a major role in maintaining discharge levels in the lower reaches of the Pajaro River. Increases in the 100-year flow from the Soap Lake Area could increase peak flows downstream and the planned Corps projects may be inadequate to convey the discharge.

Flood warnings in the watershed

Flood Protection Project Alternatives

- **Corps Lower Pajaro River Flood Protection Project Alternatives**
  1. Corps Alternative 1 – Floodwalls and Levee Height Increase
  2. Corps Alternative 3 – Floodwalls and Levee Height Increase with 100 feet and 225 feet Setbacks

- **Upper Watershed Alternatives**
  3. Land/Flood Easement at Soap Lake
  4. Detention Basin in San Benito Watershed
  5. Raise Existing Dams
  6. Detention Basin at College Lake
  7. New Pacheco Dam
  8. New Soap Lake Dam
  9. New Tres Pinos Dam
  10. New San Benito Dam
  11. New Chittenden Dam

- **Lower Watershed Alternatives**
  12. Open Channel Bypass
  13. Flood Channel
  14. Underground Bypass
  15. Flood Tunnel
  16. Floodwalls

Soap Lake Preservation Project

Upstream of the San Benito River confluence to the Pajaro River, the low-lying, flood prone land known as Soap Lake provides a measure of flood protection to reaches on the lower Pajaro River. Approximately 7,900 acres of the relatively flat land straddling the San Benito and Santa Clara County boundary in the Soap Lake area will flood during a 100-year storm event. Without the flooding of this area, the downstream discharge with current land use conditions could increase from 43,700 cfs to approximately 60,000 cfs, or 137 percent of the current 100-year flow at Chittenden. The current land use and land cover of the area is predominantly agricultural and open space. One of the recommendations of this phase of the Pajaro River Watershed Study is to further study the Soap Lake floodplain characteristics in order to verify the flood attenuation properties. This information would be used to develop a Soap Lake Preservation Plan necessary to prevent increases in downstream flow.

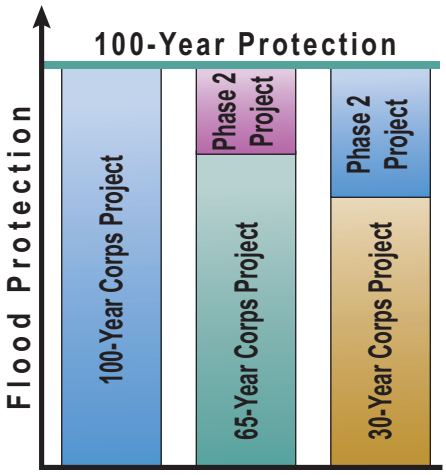
Agriculture in Soap Lake area

One of the recommendations of this phase of the Pajaro River Watershed Study is to further study the Soap Lake floodplain characteristics in order to verify the flood attenuation properties.

Flood Protection Project Comparisons

The fourteen project alternatives were combined with the Corps projects into packages that provided 100-year flood protection. The sizes of some projects were reduced to provide flood protection that did not exceed the 100-year event when paired with the Corps projects. The packages of Corps projects and Phase 2 project alternatives were evaluated based on several different criteria. These included:

- **Benefits Other Than Flood Protection** – These benefits included surface water quality, groundwater recharge, regulatory compliance, and open space and agricultural preservation.
- **Impact to Existing Infrastructure Facilities** – Residential and commercial land use areas, highways, railroads, and facilities such as treatment plants played a role in determining the impact that the project would have on the surrounding area.
- **Implementation Issues** – Compliance with the Endangered Species Act and other laws, physical constraints of the alternative, and the expected reaction of the public to the project were all identified as possible implementation issues.
- **Project Costs** – A conceptual level planning cost estimate was completed for each alternative to allow comparison of relative expense. More detailed estimates will be needed to obtain a better understanding of the total construction cost as the alternatives are further defined.



Phase 2 projects build on the Corps Lower Pajaro River Project to provide 100-year flood protection

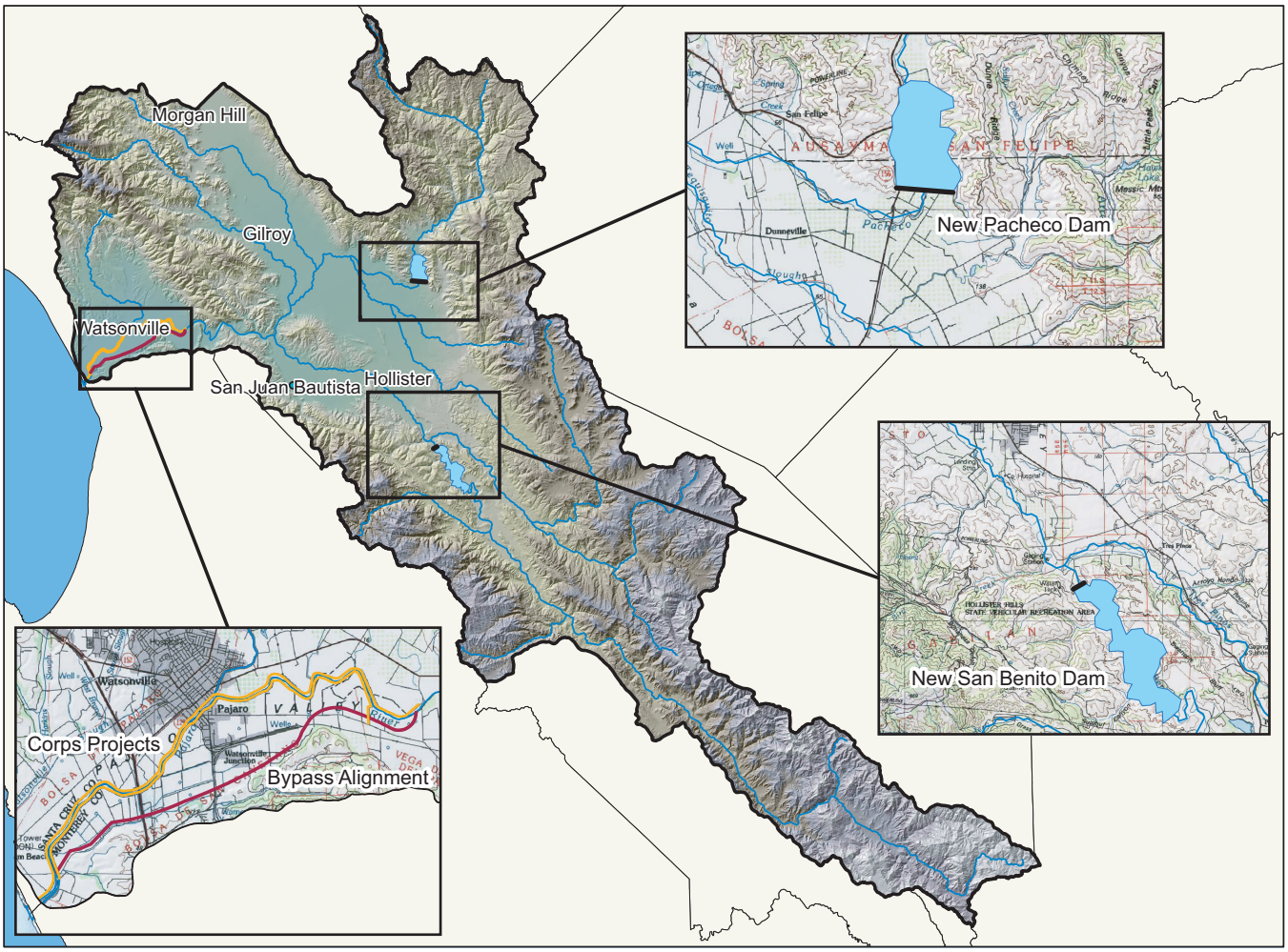
After the project packages were formed, some were eliminated based on one or more of the four criteria that made the packages less viable. The four criteria were:

- **Cost** - Package cost is greater that $500 million
- **Limited Flood Protection Area** - 100-year flood protection is not available upstream of Corralitos Creek
- **Project Feasibility** - Extensive relocation of infrastructure, facilities, and residences is required
- **Public Safety** - Reservoirs are located nearby and upstream of population centers

The remaining nine packages were presented to the interagency Staff Working Group. After review of the packages, the Staff Working Group identified the following packages, the locations of which are shown in Figure ES-5 on the following page, as the favored alternative packages:

- Corps 100-year Project
- Corps 65-year Project and New Small San Benito Dam
- Corps 65-year Project and Open Earthen Bypass Channel
- Corps 30-year Project and New San Benito Dam
- Corps 30-year Project, New Pacheco Dam, and New Small San Benito Dam

A Corps 100-year project is possible if the previously calculated 100-year flood flow is reduced to a level comparable to the capacity of a Corps Lower Pajaro River project. Each of these packages utilizes a downstream Corps project and assumes the Soap Lake flood attenuation conditions are maintained. The upstream dams will reduce the peak discharge, alter the timing of the peak, and provide benefits such as water supply, potential water quality improvements, and recreation opportunities. The open earthen bypass channel would remove the peak discharge from the main channel and transport it to the mouth of the river during flood events.



Pajaro River Watershed
Favored Package Element Locations

Figure ES-5

Goal of Pajaro River Watershed Study Phase 2:

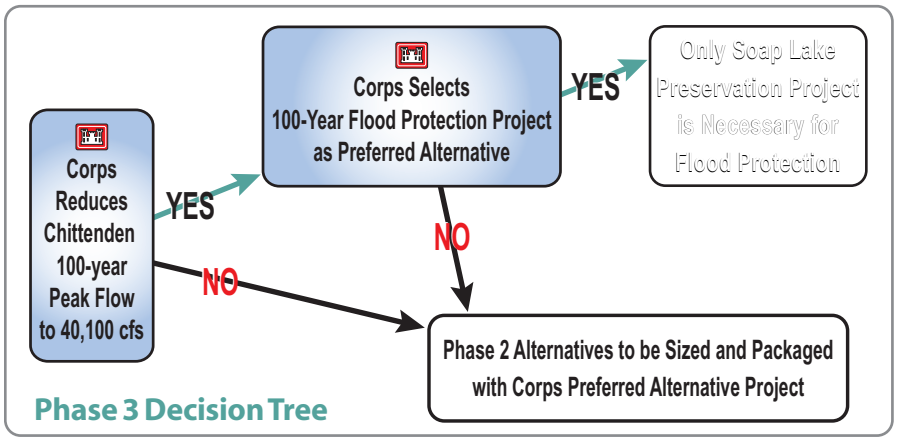
Identify & select projects that implement flood protection strategies within the watershed and enhance opportunities for water supply, environmental restoration, groundwater recharge & intergovernmental participation.

Conclusions and Next Steps

The goal of the second phase of the Pajaro River Watershed Study was to identify and select projects that will implement flood protection strategies within the watershed as well as enhance opportunities for water supply, environmental restoration, groundwater recharge, and intergovernmental participation. The goal has been met, projects have been selected and key issues for the next phase have been identified.

It is expected that the Corps will select and construct a downstream flood protection project that provides protection in a 100-year flood event. However, the Corps has not made a final selection of the project. If the Corps selects a project that does not protect the surrounding communities and land from flooding in the 100-year event, the packages developed in Phase 2 of the Pajaro River Watershed Study would be considered. In development of flood protection alternatives, the Soap Lake Preservation Project was identified as a necessary component of any of the Corps projects. The next phase of the study will verify the floodplain attenuation characteristics of the Soap Lake area and identify preservation plans necessary to maintain the existing flood attenuation properties. Phase 3 of the Pajaro River Watershed Study will focus on understanding the functionality of Soap Lake and the flood peak attenuation benefits it provides locally and downstream of Chittenden Pass.

Certain issues and items of concern need to be resolved or addressed in Phase 3 of the study. These include stakeholder consensus, coordination with other studies, and environmental matters. At this point in the study, a strong foundation has been laid for most of these matters. For the others, being aware of the concerns and



Phase 3 Decision Tree

complying with any laws or regulations is the best preparation. Below is a brief description of some of these issues, why they are important, and any work that should be done in the next phase of the study to resolve or address the issues.

Stakeholder Consensus

One of the keystones of a successful program is being sure that people agree on its value and believe that the best possible projects have been developed. Consensus within two groups is important for this study. One is consensus within the Authority and the second is consensus within the public.

Agency representatives meet at least once a month to discuss progress on the study and answer any questions that arise. With all eight agencies discussing issues of concern and working together, it is possible to arrive at a solution that is both technically feasible and politically friendly. The representatives of the eight agencies have all agreed with the recommendations of the Phase 2 Study.

The other aspect of consensus is the public opinion. Through outreach efforts, it is possible to both educate the public and obtain their input for the study. It is important to learn what matters to the stakeholders since they are the ones who will be directly impacted by any projects or conclusions that come out of the study. During Phase 2, the opportunities to inform and educate the public on the progress of the study were through presentations at the Authority Board meetings and the progress reports at the Corps Lower Pajaro River project stakeholder meetings. In Phase 3 of the study, public outreach efforts will be increased to ensure stakeholder issues are identified and addressed in the Soap Lake Preservation Project.

Coordination With Other Studies

Coordination with past, current, and future projects affecting the Pajaro River watershed is crucial to the success of the study. Past projects have identified areas of concern for the local residents and collected a great deal of data for the watershed. Future studies should be able to dovetail with ongoing efforts for this study. Current relevant projects and studies include:

- Corps Lower Pajaro River Flood Protection Project
- San Luis Reservoir Low Point Improvement Project

The Phase 3 stakeholder process will be coordinated with the Corps to deliver a consistent message

A project like the Soap Lake Preservation Project could go beyond simply complying with the Endangered Species Act by providing environmental enhancement opportunities which would then maximize funding opportunities.

- Various Sediment Projects with the Regional Water Quality Control Board
- Pajaro Valley Water Management Agency Water Supply Project
- Llagas Creek Flood Protection Project

It is critical that Phase 3 efforts are closely coordinated with the Corps Lower Pajaro River project and that progress on both projects is communicated in a unified, consistent message.

Environmental Issues

Impacts to the environment are very important considerations when planning any project or developing an area. Threatened and endangered species such as the steelhead trout, the California red-legged frog, the tidewater goby, and the western pond turtle must be protected and their habitats preserved. The Pajaro River Watershed Study will, at a minimum, be in compliance with the Endangered Species Act (ESA). However, a project like the Soap Lake Preservation Project could go beyond simply complying with the ESA by providing environmental enhancement opportunities which would then maximize funding opportunities.

In addition to the ESA and biological environmental impacts, the Clean Water Act must be adhered to as well. For example, the Pajaro River was listed on the 303 (d) list as a high priority site for nutrients and Llagas Creek is listed for both nutrients at a high priority and sedimentation at a medium priority. San Benito River was listed on the 1998 list as a medium priority for sedimentation and Hernandez Reservoir was a medium priority for mercury.[11,12] Again, the Soap Lake Preservation Project, with careful planning and consideration, could provide the necessary flood protection benefits as well as the needed water quality improvements.

The scope for Phase 3 of the study has been developed to ensure the Soap Lake Preservation Project is developed in a manner that maintains the flood attenuation benefits, protects and enhances the environment, and maximizes funding opportunities.

Open space in Soap Lake

References

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[2] "Draft Water Quality Management Plan for the Pajaro River Watershed." Prepared for Association of Monterey Bay Area of Governments. March 1999.

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[10] 1990-1999 Population Estimates from internet url: http://www.census.gov/ population/estimates/metro-city/placebyst/SC99T7_CA.txt, and Census data from internet url: http://factfinder.census.gov/servlet/BasicFactsServlet.

[11] Central Coast Regional Water Quality Control Board. "2002 Revision of the Clean Water Act Section 303(d) List of Water Quality Limits: Section 303(d) List Proposals."

[12] Central Coast Regional Water Quality Control Board. "1998 303(d) List and TMDL Priority Schedule."