

# INNOVATIONS IN STREAM RESTORATION AND FLOOD CONTROL DESIGN MEETING FLOOD CAPACITY AND ENVIRONMENTAL GOALS ON SAN LUIS OBISPO CREEK<sup>1</sup>

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*Abstract: Can a natural flowing creek be increased in drainage capacity to protect an adjacent community from flooding while still maintaining a natural habitat? San Luis Obispo constructed one such project on over a mile of Creek as a part of a housing development. The City found that some of the mitigation measures included in the project worked while others did not. In the years since, the project has been evaluated and improvements recommended. We will probably do another such project but in a different way as described in this paper.*

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San Luis Obispo is a City of 38,000 in a rural California coastal county located midway between Los Angeles and San Francisco. The area was first settled by Europeans in 1772 when the Mission San Luis Obispo de Tolosa was founded by Father Serra. The mission was located on the banks of a flowing creek, now called San Luis Obispo Creek. The creek drains an area of 84 square miles. The creek comes out of the Cuesta, dropping about 2000 feet in a distance of 3 miles. San Luis Obispo Creek is one of the southernmost steelhead fishery's in the state. (U.S. Army Corps of Engineers October 1986)

The large fish are seen in limited numbers in the creeks downtown segment during the winter. The community that grew up around the mission was built in a flood plain. Early history reports periodic flooding. In spite of this, around 1900 the city fathers decided that the creek was a real impediment to development of the downtown. To get rid of it, they built walls on the sides and allowed property owners to build their buildings over the creek. Along three downtown blocks most people don't know that the buildings and streets bridge the creek.

The post-war years were drought years. The community was growing and few remembered that the City could be flooded. At least this was true until 1969 when the rains came and the water rose. Most of the City was flooded. Everyone said, "This has got to be a 100 year storm - it won't happen again for another 100 years." In 1973 it happened again.

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## Concern for the Creeks

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Before the 1969 flood the citizens had begun to recognize what an important asset the creek could be. During the past 20 years two important projects have been built which show this recognition and also the community concern for flood prevention and the environment. The attached map shows the location of these two project.

A development project that first focused this interest was called Mission Plaza. This project was the result of a decade of planning and plenty of conflict. Construction was only begun after a referendum. The project involved the creek immediately in front of the mission. The street between the mission and the creek was closed, the area along both sides of the creek was cleaned up and landscaped. The area is not riparian in the sense that it provides for the needs of wildlife. It provides instead a comfortable escape for the species that frequents the immediate region. Humans. They flock here and enjoy the sound and site of moving water, the trees, birds and each other. Many activities are scheduled for this area. This project has done much to make the whole creek an appreciated asset.

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## Planning for Flood Protection

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After the flood of 1973 the politicians got busy. The city formed a Waterway Planning Board to review was done, and should be done with the creeks. The Board of Supervisors of the San Luis Obispo County Flood Control and Water Conservation District formed a Zone of Benefit to prepare studies on how to prevent future flooding and conduct maintenance to improve the flow of the creek. The authority for this action is in the "San Luis Obispo County Flood Control and Water Conservation Act" pursuant to Chapter 1294 of the Statutes of 1945 of the California State Legislature. (Nolte August 1977, pg. 1) The City and the Zone worked closely with the California Department of Fish and Game to develop a form of brush and tree maintenance that would improve the flood flows of the creek, minimize

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the amount of debris carried in the flood waters and maintain an appropriate habitat for the fish and other wildlife during low flows. The water only flows deep and swift during heavy rain and for a few hours after the rain stops. This only happens every couple years. The Corps of Engineers reports that San Luis Obispo Creek in the downtown carries 7,600 cubic feet of water a second during an Intermediate Regional Flood (Corps of Engineers November 1974, pg. 26) in the downtown. Normal flows are like that of a trickling brook. In fact this summer it is dry in many sections.

The City's Waterway Planning Board, besides reviewing existing obstructions to creek flow and new projects that may cause an obstruction, developed standards for creek bank protection along the creek. These design standards were prioritized in order from the most desirable, an earthen channel with lots of vegetation along the banks, to the least, a concrete channel. (City of San Luis Obispo June 1983) The City since has approved projects using all of these designs as they were appropriate. The Waterway Planning Board also worked closely with the County Zone of Benefit to assure the development of a flood control policy and program that could be supported by the city council.

The Zone of Benefit began a program of stream gauge measurement and hired a consultant who was directed to identify the extent of the problem and recommend how flood protection could be achieved.

About the same time the Army Corp of Engineers began their own study to find if there was some way that the Federal Government could assist in the solution. The two programs were closely coordinated and used a common data base. One of the first things we received from the Corps study was a Federal Insurance Rate Map and the City entered the federally subsidized flood insurance program.

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## Solutions

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The county's study recommended a mixture of structural and non-structural projects:

1. New development projects were to be limited and built above the 100 year flood level. This level was first defined by the Corps of Engineers study. (Corps of Engineers November 1974)
2. A serious maintenance program was recommended.
3. A program identifying and removing so-called bottlenecks through projects that were compatible with a future 100 year channel.
4. The construction of a 100 year channel from the south city limit north to the downtown.
5. The construction of one of three solutions to solve the capacity limitations of the under-city culvert.

(Nolte August 1977)

These five recommendations represented a significant change in the way the City looked at development. The concept of a 100 year flood level was unknown by the community and there was almost no creek maintenance program. Bottlenecks existed in the creeks and no one was concerned. The total recommended program was estimated to cost over 12 million dollars. The final recommendations were never totally accepted by the City.

### Maintenance

Each year the City, along with the Zone of Benefit, conducts an annual maintenance program. The maintenance program cooperates fully with the California Department of Fish and Game and involves a combination of cutting, trimming, and spraying the various trees and shrubs along the creeks in order to maintain a tunnel through the vegetation which will allow high-water flows to occur while still maintaining a shaded stream during low flows.

### Improvements

Most of the bottlenecks to high-water flow were removed by the City. These are primarily manmade things like sewer and water pipes, retaining walls, undermined trees, and other so called improvements of the past that limit the flow in the creek. All new construction projects adjacent to the creeks are reviewed closely to assure that they are safe from flooding and will not prevent the city from solving the flooding problem in the future. Since the City joined the National Flood Insurance program and it has vigorously applied those standards. Private development has been required to improve the flood capacity of the creek as a condition of development. This is particularly true when we can show that the development will be the prime benefactor. Some projects build a bypass channel parallel to the creek, most just build back from the creek so that a future project can be built by the City in the future.

### Increasing Stream Capacity

One particular housing project built over 5000 feet of improvement in the main creek as a condition of development because their project was in a flood zone and could not have been built otherwise. This project followed the guidelines for creek channel widenings suggested in the County's Zone of Benefit study. The project design was worked out carefully with the involvement of many agencies and consultants. The project provoked a significant amount of discussion and still does. Environmental groups, California Department of Fish and Game, and U.S. Fish and Wildlife Service did not like the project.

Nevertheless the project was built with all the required permits in the fall of 1978 and spring of 1979.

In 1982 the City hired a consultant to review the project and to report on how the mitigation measures worked. In 1984 a class at California Polytechnic State University at San Luis Obispo (Cal Poly) also studied this issue and provided a report to the City. Included were recommendations on how the project could be improved.

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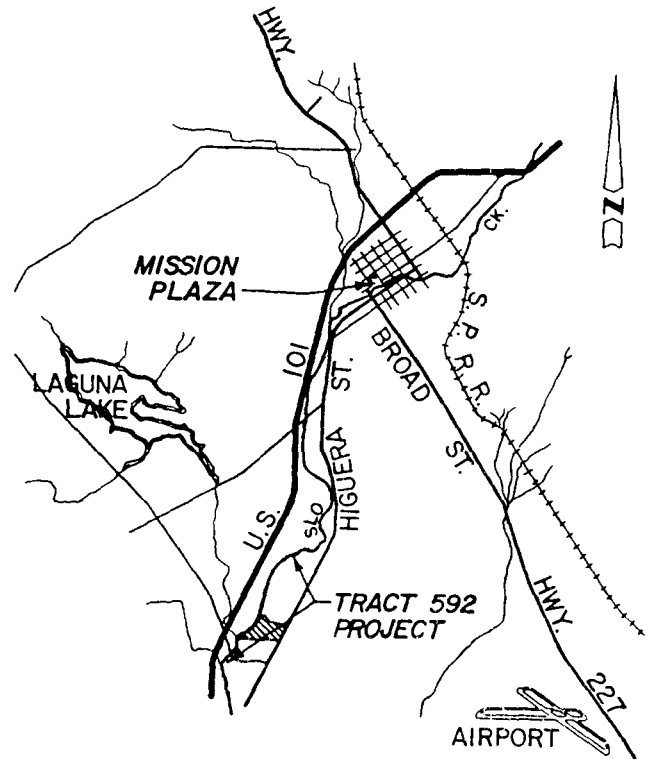
## The Project

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A housing project called "Tract 592" (fig. 1) was proposed adjacent to the creek. The flood plain information maps showed the site to be subject to sheet flow originating from the creek upstream of the project. The project, as a condition of approval, had to eliminate the potential overflow flooding. Design guidelines stipulated that the creek section should be able to carry a 100 year design storm and meet the Army Corp of Engineers design standards. The project was also to be designed so as to maintain existing and to restore lost habitat along the creek.

### Unique Design Requirements

The design called for widening of the creek waterway by setting back one bank only. The new bank would be sloped at two feet horizontal to one foot vertical. The bottom of the widened area was to be three feet above the flow line of the creek. The creek bank on the side being widened was not to be disturbed below a point three feet above the flow line of the creek. Willows, shrubs and other vegetation would be left undisturbed along this low bank area. The other side of the creek was to be left totally undisturbed. At a point between the creek and the construction work a silt fence consisting of an engineering fabric supported on a wire fence was to be constructed along the entire length of the project. This fence was to prevent disturbed soil from the adjacent construction project from finding its way into the creek. New trees and shrubs were proposed along the top of the new bank and the disturbed area between the creek and the new bank was planted with a native grass mixture. Willow slips were to be planted along the interface between the creek natural bank and the widened bench area. There were some changes in the kind of trees and shrubs planted along the top of the new bank. One typical change was to plant native trees where non-native trees were called for on the plan.



**Figure 1**—Map of the city of San Luis Obispo showing location of Mission Plaza and Tract 594.

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## How Did the Project Work?

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In July 1982, MDW Associates of San Luis Obispo prepared a report for the City entitled "Tract 592 Creek Modifications: An Evaluation". The report was prepared "...to achieve a better understanding of the consequences of a proposed project to modify another, larger section of San Luis Obispo Creek." The report noted that the survival rate of trees and shrubs planted on the top of the new bank was not very good. Those that did survive were generally those that were native to the area. They were arroyo willow, red willow, fremont cottonwood, and sycamore. The shrubs that did best were elderberry, coffeeberry, holly-leaved cherry, mountain mahogany, and toyon. The biologists felt that none of the plantings on the new bank could replace the habitat lost since they were to far from the streams edge. The willows planted along the stream's edge, and

the seedlings of some of the riparian trees establishing themselves are expected to ultimately develop into a new riparian forest if left alone. The investigation of streamside wildlife revealed fewer individual birds and species of birds than in similar areas along the stream. The biologist felt that in a few years the tree sizes should increase to a point where the overstory canopy would possess the necessary habitat stratification to support a greater number and diversity of birds. Aquatic wildlife was sampled and revealed higher numbers of organisms in relation to stream flow than in unmodified sites on the stream. The report stated, "These data suggest that extensive modification of the creek bank and removal of the riparian vegetation will not result in long-term damage to the creek if the revegetation of the stream bank (close to the threadline of the stream) is implemented." The report also confirmed that no significant siltation had taken place as a result of the project. This meant that the design maintenance of the silt fence was successful.

The MDW report of July, 1982 and the Cal Poly University report of 1984 lead me to recommend the following guidelines for future channel widening projects.

The same antisiltation measures incorporated in Tract 592 should be used. These measures should include a silt barrier constructed immediately downstream of the construction site, approved by Department of Fish and Game, prior to any grading. The silt barrier should be removed with all accumulated sediment at the end of the project, and the streambed restored to 'as near an original condition as possible.' A filter fence should be constructed of fine-mesh material adjacent to the stream along the entire length of the project, following grubbing and clearing operations but prior to grading. The fence should be removed after project completion and after the vegetation becomes established.

Disturbed areas should be hydroseeded immediately after completion of the grading. Graded areas should not be left smooth. The contractor should be required to run a bulldozer up and down all slopes with the blade up, leaving horizontal grooves to slow the sheet flow of water. In some soil situations straw should be laid down and tracked into the slopes by the tractors. Drainage from the areas outside of the channel should be controlled to prevent erosion of the newly created slope banks.

The part of the Tract 592 revegetation program which was most successful in terms of re-establishing the stream ecosystem was the planting of the 2500 willow slips along the threadline of the stream. This practice should be continued in future projects. The landscape plan should concentrate the plantings to the immediate area of the low flow stream. Figure 2, *Recommended Landscaping Concept*, illustrates this idea. Key points of the design are:

Only *one bank* should be modified along any portion

of stream.

Riparian trees and shrubs should be left undisturbed within 6-10' on the low flow stream wherever possible. If it is impossible to save the existing trees and shrubs adjacent to the low flow area, new trees and shrubs should be planted. Willows do the best here but for reasons of debris management alternative trees may be considered. It would be best if the new trees were planted on berms about four feet high within this strip. If the berms are constructed as 'islands' they will help establish the young trees by protecting them from most flood conditions. Where trees are retained or planted, it is appropriate to prune branches from their trunks as needed to assure that they will not obstruct flood flows (six to eight feet above the grade of the creek's flowline). This measure implies that trees to be planted must be large enough to be able to withstand such pruning.

Vegetation should be planted within the channel area behind the riparian corridor to establish erosion control, or if desired, to provide for public recreation fields or other aesthetic purposes. The need for this area to carry flood flows and the distance from the low flow channel means that plantings in this area will achieve little if any biological mitigation. Additionally, if this area is to be improved for public recreation, it may be necessary to discourage public access to the stream. Too much public access may be as detrimental to the riparian habitat as the original widening project. To this end, species such as poison oak and blackberries should be included in the stream plantings to protect the integrity of the stream corridor from excessive intrusion of humans.

Project plans should specify that the landscape contractor is responsible for at least one year's maintenance of all trees and shrubs planted for the creek modification. The project should be closely inspected to assure that all trees and shrubs receive adequate watering and that plants which die or are uprooted are replaced.

The plants used should include entirely native plants and should concentrate on those species found to be most successful in the Tract 592 landscaping (willow, elderberry, cottonwood, coffeeberry, holly-leaved cherry, toyon, sycamore, live oak, white alder, etc.). Where significant trees are to be removed (i.e. over 8" in trunk diameter), replacement trees should be planted in a ratio of five to one. The Department of Fish and Game should be included in the planning, design and implementation of any project involving streambed alteration. A streambed alteration agreement must be executed with that agency prior to construction.

The City has not conducted any streambed alteration projects on any scale in the last few years. Projects proposed have usually resulted in significant public and political controversy. While the Tract 592 project did have problems and did not perform in every respect as

we may have liked, it did provide us with an excellent example of what happens when the stream banks are altered. Hopefully, the community's desire for flood protection will be addressed in the near future. By using the experience of the past the concerns of all can be met.

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## References

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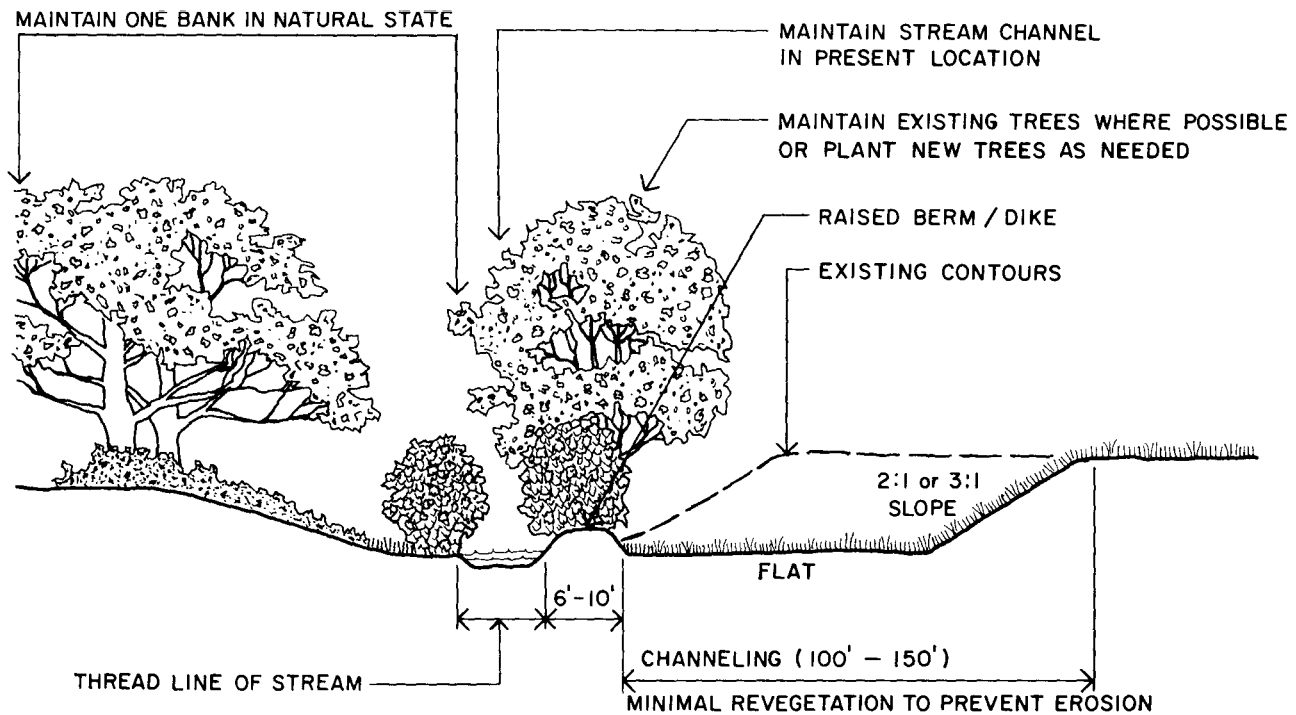
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**Figure 2**—Recommended landscaping concept.