MALIBU WETLAND FEASIBILITY STUDY

Prepared for:

Malibu Coastal Land Conservancy
Malibu, California

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LIST OF ATTACHMENTS

This report could be sited as: Malibu Wetland Feasibility Study, 33 pages, with attachments, Huffman and Carpenter, Inc. August, 2000.

EXECUTIVE SUMMARY

This analysis was conducted to assess the feasibility of wetland restoration within the Malibu Civic Center area, more specifically the Chili Cook-off site. The primary objective was to technically assess the potential of the Chili Cook-off area as a treatment wetland for water quality improvement.

The project area is located in the Malibu Creek Watershed, which is approximately 109 square miles in size. Malibu Creek is the main drainage feature within the watershed and its terminus is the Malibu Lagoon. The Creek and Lagoon are part of the coastal southern California ecosystem on the Pacific Ocean. The alluvial fan of the Malibu Creek is an impressive land feature, but it has been significantly altered by human development.

The Chili Cook-off area is seen as the heart of potential wetland restoration efforts because its location is a critical regional, hydrological/biological link along the southern California coastline. Not surprisingly, the area's natural beauty has led to development pressure in the Civic Center area. A growing awareness that real solutions are needed to address these valid economic concerns, as well as environmental concerns have led to studies like this. This awareness has resulted in grass roots' efforts and the formation of the Malibu Coastal Land Conservancy.

The Conservancy is dedicated to finding economic solutions and facilitating restoration solutions. Results of this study indicate that there are no technical constraints that would preclude wetland restoration in the Malibu Civic Center area. Land acquisition may be a more important concern than any scientific, policy or site feasibility criteria for achieving restoration at the Chili Cook-off site. *Prior to the public release of this document landowners should be contacted to convey the Conservancy's desire to facilitate the acquisition of their properties for restoration purposes.* Similar to a cathedral, this project's vision encompasses future generations. Several large parcels may be acquired over time to further the vision of restoration.

In order to restore wetlands within the Civic Center area, a bypass channel is proposed in this study. Along with the acquisition of the Chili Cook-off area, an easement or acquisition of the land for the bypass channel would need to occur. The bypass channel would gravity flow to the Chili Cook-off area. The basic design would include a natural channel approximately 16-feet to 20-feet wide, that would resemble or mimic Malibu Creek in appearance and divert flows in the range of three (3) to 23 cubic feet per second (cfs). Flows within the channel would have low velocities of approximately two (2) to three (3) feet per second and could accommodate a walking path, if desired. The channel would terminate at the Chili Cook-off area.

The Chili Cook-off site is approximately 15.8 acres in size, of which approximately 12.6 acres could be restored as wetlands for water quality treatment. Flows would be held (retained) for an average of 7 days to remove total nitrogen. This site, alone, could potentially treat one-half of the total nitrogen within Malibu Creek during the dry season. The wetland would increase ecological function and value and restore functioning of natural processes within the Malibu Civic Center area as well as improve the Malibu Creek/Lagoon system through the diversion, containment and release of Creek water.

The restored wetlands would be linked through either culverts as the outlet to Malibu Lagoon or eventually through a concrete box structure under the Pacific Coast Highway. The bypass channel would be designed so that it could accommodate diversions for other areas listed as potential restoration areas. The restored wetland area could function independently as a park with an interpretive trail and bird watching area. Ideally, the treatment wetland would also treat non-point source stormwater runoff from the Civic Center area. It is our recommendation that the project move to the design phase once the property has been acquired.

1.0 INTRODUCTION

Huffman and Carpenter, Inc. (H&C) was asked to assess the feasibility of restoring wetlands in the Malibu Civic Center area under a contract with the Malibu Coastal Land Conservancy (Attachment 1, Figure 1). The Scope of Work (SOW) for this project included two tasks: 1) prepare a water budget/balance in order to understand the hydroperiod necessary for wetland restoration and/or the construction of treatment wetlands; and, 2) using the information from Task 1 and existing information determine if wetland restoration is feasible using the California State Coastal Conservancy (CSCC) project science evaluation criteria (and to some extent the policy and feasibility criteria)[1].

The southern California wetland recovery program is a project of the CSCC. The CSCC evaluates potential projects based on acquisition, restoration and enhancement for coastal wetland and watersheds in Southern California. The recovery project targets projects and makes recommendations for "A" projects that might actually be allocated for on-the-ground work in the upcoming fiscal year. However, prior to submittal, a feasibility study would be conducted to determine if the area(s) in question would in fact meet the scientific, policy, and feasibility criteria (as determined by the CSCC). If it is determined that the area meets the scientific criteria (and to some extent the policy and feasibility criteria), then a design study would be conducted to determine actual acquisition and construction costs to include other specific engineering plans and specifications for construction. The specific area assessed in this report is a 15.8-acre parcel known locally as the Chili Cook-off site (Attachment 1, Figure 2). It is located within the Malibu Civic Center project area which is within the Malibu Creek Watershed. With respect to the Chili Cook-off site, if the scientific criteria can be met then it is recommended that a site availability and cost effectiveness study be undertaken.

Much work has been done in the Malibu area with regards to the Malibu Creek Watershed's ecosystem and the impacts to the watershed from human involvement. H&C reviewed several reports prepared within the last 12 years that were prepared for the City of Malibu or were related to water quality and wetland restoration in Southern California. Parts of all of these reports were incorporated into this study.

H&C was asked the following questions:

1. Will wetland restoration work?
2. Can wetlands be constructed to treat water from Malibu Creek to improve water quality?
3. Which sites will provide the most treatment potential?
4. How much water from Malibu Creek, or other sources, can be treated effectively?

Sections 2.0 and 3.0 give the reader general information about the historical and current status of the Malibu Creek Watershed. In Section 4.0, H&C evaluated the function(s) of the watershed including a water balance, a potential diversion channel design and water treatment through the construction of treatment wetlands. Section 5.0 evaluates the CSCC's project criteria. This section includes three

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[1] For a complete list of references utilized for this study please refer to Section 7, References.

criteria and specific factors to be considered 1) ecological, 2) policy, and 3) feasibility. Section 6.0 summarizes the feasibility study's conclusions and recommendations. Section 7.0 are the references and existing information on which this study relies.

2.0 HISTORIC CONDITIONS

The following two sections, 2.0 and 3.0 draw heavily on information gathered from the Malibu Civic Center Specific Plan, Background Information, Existing Conditions (1996) and the Lower Malibu Creek and Lagoon Resource Enhancement and Management (Ambrose & Orme 2000).

2.1 Wetland Habitat Types

Malibu Lagoon is a brackish water marsh. Historically, it occupied much of the low-lying area surrounding the Civic Center. The configuration was a crescent-shaped lagoon that extended up and down the coast. This extensive lagoonal area extended eastward around the point and westward to the hill at the base of Pepperdine University covering approximately 200 acres. The lagoon was surrounded by marsh vegetation. Malibu Creek flowed into the lagoon from the western boarder of the main lagoon area. By 1900 the Creek shifted its flow direction towards the eastern border of the lagoon. Aerial photography from 1938 show a reduced lagoon surrounded by houses and farmland. Pacific Coast Highway crossed through the lagoon at the northern end. The shape of the lagoon changed to a fan-shaped river mouth that provided direct discharge of creek waters to the ocean. Malibu Lagoon and the surrounding area gradually consisted of a landfill, native and non-native vegetation, two baseball fields, and a general fill site. Historically, the Lagoon was closed by a sand bar during the low summer creek flows and would be naturally breached during high winter flows.

Historic vegetation within the area included native grasslands, coastal scrub, oak woodlands, riparian communities, and coastal salt and brackish marshes.

2.2 Sources of Hydrology

Malibu Creek Watershed includes Malibu Creek and its tributaries. The watershed covers an area approximately 109 square miles in size. Malibu Canyon provides a significant amount of storm runoff to Malibu Creek and Malibu Lagoon. Historically, the Lagoon had little to no fresh water inputs during the summer and fall months due to the drop-off in flows within the Creek.

Various wells and spring water sources, which at one time provided limited public water supply for the Malibu Coastal Zone area, have gone dry or have been impacted by sea water intrusion.

3.0 EXISTING CONDITIONS

3.1 Wetland Habitat Types and Acreage

Wetland habitats within the project vicinity have changed significantly due to various human activities associated with agricultural and urban development. Existing wetlands within the Malibu Civic

Center area have been reduced to 1.53 acres (H&A, Inc. 1999). It was determined that two types of U.S. Army Corps of Engineers wetlands occur on these various land forms in the Malibu Civic Center area: 1) 0.87-acres of palustrine emergent temporarily flooded wetlands; and, 2) 0.03-acres of excavated, partly drained, palustrine emergent seasonal wetlands to temporarily flooded wetlands for a total of 0.90 acres. Also, portions of the eastern edge of the Malibu Civic Center project area have identifiable bed and bank land features. One occurs within the active floodplain of Malibu Creek with a total of 0.60 acres. Also, some drainage ditches have an identifiable bed and bank and total 0.03 acres. Both these areas would be considered Other Waters of the United States.

Wetland habitat areas subject to jurisdiction by the California Coastal Commission encompass a minimum of 3.90 acres in which the Section 404 is included.

***Waters of the United States*:**

Section 404 Clean Water Act	
Wetlands	**Acreage**
Palustrine Emergent, Temporarily Flooded	0.87
Excavated, Partly Drained, Palustrine Emergent Temporarily Flooded	0.03
subtotal	***0.90***
Other Waters	
Areas in Active Floodplain of Malibu Creek	0.60
Drainage Ditches	0.03
subtotal	***0.63***
Total Section 404 Clean Water Act	**1.53 Acres**
Wetland Habitat - Areas Subject to California Coastal Commission Jurisdiction	**3.90 Acres* (minimum)**
* the Section 404 acreage is included in this acreage.	

In 1983, the California State Department of Parks and Recreation began restoration of the Lagoon with excavation of three channels and construction of a series of bridges and trails. Today, Malibu Lagoon is a small (13 acres) shallow water embayment occurring at the terminus of the Malibu Creek Watershed. The total land area plus the aquatic lagoon is approximately 36 acres. Presently, Malibu Lagoon is closed most of the year by a sand and gravel bar, opening only when larger storm flows come down Malibu Creek or the lagoon overflows from smaller and/or continuous flows. The Lagoon is breached mechanically when natural breaching has not occurred for a prolonged period of time, generally when water levels reach 3.5 feet. The bar is replaced by the currents in the bay after only a few weeks.

3.2 Sources of Hydrology

Malibu Creek and precipitation are the major sources of hydrology within the watershed. Average annual rainfall is about 18 inches. Nearly all rainfall occurs between November and April.

The larger tributaries to Malibu Creek have become perennial through most or all of the year since irrigation and the use of reclaimed water have become widespread. Prior to this, most of these streams were intermittent to ephemeral with the exception of Las Virgenes Creek, lower Medea Creek, and Cold Creek, which were historically perennial to intermittent. Since the use of irrigation and releases of reclaimed water began, Malibu Creek, from Westlake Lake to Malibu Lagoon, has had flows at nearly all times, including drought periods. The flows have also increased in average volume. Additionally, water has been imported into the watershed since the late 1960's.

Groundwater can be found along the Malibu Coast in alluvium, beach deposits, and terrace deposits at shallow depths. Within the project area, groundwater occurs between five and 13 feet below ground surface (bgs). Today, the dominant source of groundwater recharge in Malibu is septic tank effluent (Malibu Civic Center Specific Plan - May 1996). Other sources of recharge include precipitation, stream flow and irrigation runoff.

3.3 Threatened and Endangered Species

Malibu Creek and Malibu Lagoon serve as breeding and nursery areas for various coastal fish and birds[2]. Within the lagoon area, over 150 species of birds have been identified. The Malibu Creek Watershed supports an abundant and diverse wildlife community, which reflects the diversity of the vegetative communities. More than 450 vertebrate species occur, including 50 mammals, 384 birds, and 36 reptiles and amphibians. The wildlife populations are unique in their proximity to one of the largest urban areas in the United States. Mammals include both the large and small, predator and prey. Birds include both residents and transients, predator and prey. Reptiles include 25 species, including two turtles, seven lizards, and sixteen snakes. Amphibians include eleven species: five salamanders and six frogs or toads. Fish include a remnant spawning population southern steelhead trout and reintroduced tidewater goby. Invertebrates are common throughout the watershed.

Of these species, nine birds, one fish, and one plant that are permanent or seasonal resident species in the Malibu Creek Watershed are federally listed as threatened or endangered. Nineteen additional state-listed species may occur within the watershed. Another 49 species are candidates for federal listing or have been proposed for listing.

Attachment 2, Table 1 is a listing of Federal and State threatened, endangered and candidate species that occur in the Malibu Creek Watershed.

[2] USDA-NRCS. 1995. Malibu Creek Watershed Natural Resources Plan.

4.0 FEASIBILITY STUDY

4.1 Project Objectives

The major objective of this study was to assess the feasibility of restoring wetlands to the Malibu Civic Center area. Many factors were considered including specific watershed problems that could be corrected through wetland restoration and enhancement. The restoration of both freshwater wetlands and treatment wetlands was examined. Listed below are some of the factors that were considered for this restoration study:

- Re-establish more natural ecosystem functions and processes
- Increase the amount of high quality wetland habitat
- Improve Creek and Lagoon water quality by removing nutrients
- Potentially polish secondary and tertiary wastewater effluent from treatment plants
- Treat urban runoff

The Chili Cook-off site (Attachment 1, Figure 2) has been selected for this project as the initial restoration site because it is the largest parcel under consideration and would provide the greatest treatment potential. In addition, the location is favorable and the parcel may be obtained for the purposes of a wetland. In order to assess and depict the feasibility of this parcel as a treatment wetland, a model to divert flow from Malibu Creek and build a natural channel with a specific flow capacity was developed.

4.2 Climate and Surface Water Hydrology of the Area

4.2.1 Water Balance

As previously stated, the project area is located in the Malibu Creek Watershed, which is approximately 109 square miles in size. The area receives approximately 18.1 inches of precipitation annually and approximately 55.2 inches (Williams 1992) of evaporation (Ambrose 2000). Most precipitation falls between the months of November and April (Attachment 3, Appendix 1, Figure 1)[3] and the growing season is essentially year round (Attachment 3, Appendix 1, Figure 2)[4]. The majority of natural wetlands found within the project area would have been seasonal in nature (since the construction of the Pacific Coast Highway). Although the project area has been isolated from its hydrologic source, a small bypass channel could deliver a fresh water supply on a more permanent basis. A preliminary design for a bypass channel was conducted as a part of this feasibility study. Because future wetland restoration may depend on a supplemental source of hydrology. Also, wetland objectives include a passive design for water quality treatment from Malibu Creek and adjacent non-point sources. The results are discussed below.

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[3] It is important to note on Figure 1 that average precipitation exceeds average evaporation only in the month of January - in other words the water balance is only positive on average in January.

[4] Utilizing the U.S. Army Corps of Engineers definition of the growing season would indicate that the growing season is defined by when the average minimum daily air temperature is greater than 28 degrees Fahrenheit (USACOE, Williams, 1992).

The Agoura and Monte Nido precipitation stations are representative of rainfall within the Malibu Creek Watershed (Attachment 2, Table 2). Hydraulic analysis was conducted as a water balance for the project area utilizing the data found below:

DATA SOURCES FOR HYDRAULIC ANALYSIS		
SOURCE	**DATE**	**TYPE OF DATA**
USGS	1931-1979	Annual Daily Values
UCLA (2000)	1931-1998	Total Annual Summation
UCLA (2000)	1950-1998	Instantaneous Peak Discharge
The USGS operated this station between 1931 and 1979, after which point the Los Angeles Flood Control District (LAFCD) continued to collect data at this site.		

H&C constructed a hydraulic data set to estimate annual daily maximum flows for use in a HECRAS model in order to conduct a preliminary design for a bypass channel. A Pearson type III analysis was applied to the data set (Malibu Creek at Calabasas - site no.11105500 - 1931 to 1979) for the purposes of this feasibility report. Hydraulic analysis results are summarized in Attachment 3, Appendix 2, Tables 2a and 2b for annual maximum daily flows and the total annual runoff frequencies for the return periods of 1931through 1998 period[5] (H&C and UCLA Report). For the purpose of this feasibility report, flows from the proposed bypass channel;

- Must be "captured" downstream,
- Pose no flood threats,
- Routed discharge should be reasonably small, and
- Be manageable at its terminus near the "Chili Cook-off" area.

Ideally, a bypass channel would be designed to convey a 2-year to 25-year flow event(s) for habitat considerations and specifications. However, a 2-year flow equates to 1,000 cfs and a 25-year flow is 6,600 cfs (Attachment 3, Appendix 2, Table 2b), and such flows are greater than the capacity of a small bypass channel. Because of the bypass channel's main objective to divert flow to the constructed wetland, a more thorough data review was conducted and it was determined that mean daily flows are approximately 23 cfs. It should also be noted that the Chili Cook-off site is in the 100-year FEMA floodplain, and at flood stage has an average flood depth of 1.0 ft.

4.2.2 Water Balance - Stream Flow Analysis Conclusions

Flow analysis indicates that low flows of approximately three (3) cfs are adequate to provide a fresh water source for the Chili Cook-off site[6]. Three (3) cfs or less occurs 61 percent of the time in

[5] The data from Tables 2a and 2b are presented here for future use in a potential design phase.

[6] Three cfs is the highest mean daily flow that can be diverted and treated at the Chili Cook-off site over a seven day period. A seven day period is necessary to effect treatment of nitrogen. The Chili Cook-off site is 15.8

Malibu Creek. However, the potential to buy more property in the Malibu Civic Center area would allow for more diversions and therefore more wetland areas.

In conclusion, data analysis indicate that mean daily flows in Malibu Creek are approximately 23 cfs. The probability of mean daily flows of 23 cfs or less occur 91 percent of the time in Malibu Creek. Therefore, a design channel should accommodate approximate 23 cfs, with some margin of freeboard.

4.2.3 Stream Flow, and Bypass Channel Analysis

The purpose of this section is to convey results of the preliminary design of a bypass channel that would be constructed to divert water from Malibu Creek to the constructed wetland site. While the scope of this project focuses on the Chili Cook-off site (15.8 acres), the potential to restore wetlands in a larger area is possible and approximately 60 acres of land surrounding the Malibu Civic Center project area have been identified for future projects (Attachment 1, Figure 3). The bypass channel is designed for 23 cfs because this represents the probability that the mean daily flow in Malibu Creek will be less than this 91% of the time.

The potential restoration sites are identified in the following table, or equivalent acreage can handle a diversion of 8.5 cfs (assuming a seven-day retention time). Based on statistical analysis, there is a 19 percent probability that the mean daily discharge in Malibu Creek will be 8.5 cfs or greater. To treat 23 cfs would require approximately 100 acres of land (assuming a seven-day retention time). The probability that the mean daily discharge in Malibu Creek will equal or exceed 23 cfs is nine (9) percent (Attachment 1, Figure 4).

LAND AREA NECESSARY TO TREAT VARIOUS FLOWS FOR A SEVEN DAY RETENTION TIME	
TREATMENT AREA	**FLOW (CFS)**
Chili Cook-off site (15.8 acres)	3 (Mean Daily flow 61 % of the time)
C1, C2, C3, A2 and A3 (60 acres)	8.5 (Mean Daily flow 81 % of the time)
up to 100 acres (because this is the majority of the Creek flow)	23 (Potential Maximum Mean Daily Flow 91% of the time)

Attachment 3 contains the HECRAS output and design steps for the proposed bypass channel.

The reported hydraulics/channel dimensions can be found in Attachment 3, Appendix 2, Table 6 and Attachment 3, Appendix 1, Figures 8 - 34. Hydraulic modeling results indicate that design flow velocities and depths are moderate enough to flush fine to medium sands, and should not cause any erosion and/or deposition within the proposed bypass channel. Flows will temporarily "pond" at the terminus (Chili Cook-off) area, but the final detention time will be controlled by the outlet culverts. The expected range of flows for the bypass channel are from 3 cfs to 23 cfs and are basically

acres (of which approximately 12.6-acres are available for the actual treatment wetlands).

contained with a 16 foot wide channel. Results of HECRAS modeling indicate that the bypass channel is stable for a natural channel composed of rocks, vegetation and root-wads and could include a walking path should the community desire one. The channel is approximately 16 to 20 feet wide with a depth of 2 - 3 feet.

The channel capacity or maximum amount of discharge for the designed channel is about 70 cfs (46 cfs, if desired). For upstream conditions flow widths for 23 cfs approach 16.0 feet. Flow velocities are moderate at 2 to 3 feet per second. Those flow velocities near critical[7] (Froude number near 1.0) and should be reduced by increasing roughness at or just downstream of various cross sections. An increase in roughness may lower velocities and increase depths, which would also reduce (albeit very little) sediment transport potential. Final analysis of sediment transport would need to consider dynamic equilibrium of the channel system and optimal flow range as linked to the channel's sediment transport potential.

<u>4.2.4 Stormwater Runoff Analysis</u>

Data analysis was conducted using the USGS gauge data from the Malibu Creek site. Attachment 1, Figure 4 shows peak annual exceedance curves for Malibu Creek at Calabasas 11105500. While the scope of this project focuses on the Chili Cook-off site (C2), there is potential to spread to a larger area. The land area in question, as reflected in Attachment 2, Table 1, represents approximately 60 acres of land in the Malibu Civic Center Area. Any bypass channel that is designed will be based on the total land area (60 acres) and a design flow of 8.45 cfs[8]. However, the design will also include a smaller channel inside this larger channel to accommodate the initial project site (Chili Cook-off).

4.3 Potential Wetland Mitigation Banking

Wetland mitigation banking is defined as:

> A system of compensatory mitigation in which the creation, enhancement, restoration, or in exceptional circumstances preservation of wetlands is recognized by a regulatory agency as

[7]A flow at or near the critical state is unstable. When flow is near the critical state, the water surface appears unstable and wavy. In the design of a channel, if the depth is found at or near the critical depth for a great length of the channel, the shape or slope of the channel should be altered, if practical, in order to secure greater stability (Chow, p. 64. 1988). This would be done for the bypass channel in the final design stage.

[8] The land area in question (as reflected in the Table on page 12) represents approximately 60 acres of land in the Malibu Civic Center Area. However, just evaluating areas C1, C2, C3, A2, and A3 would represent approximately 45 acres of land with approximately 36 acres available for treatment wetlands. This land area of 36 acres could treat approximately 35 million (M) gallons per week (considering a 7-day retention time) for total nitrogen. Treatment for total nitrogen is optimized at approximately 7 days retention time for low to moderate concentrations such as those found in Malibu Creek (0.4 mg/l to 16 mg/l) (Attachment 1, Figure 7 and Attachment 2, Table 2). The 35 M gallons per week equates to approximately a constant flow of 8.45 cfs. As you can see in Attachment 1, Figure 2 and Attachment 2, Table 1, the 36 acres of land denoted as C1, C2, C3, A2, and A3 would be able to treat the total flow for Malibu Creek 81 percent of the time. The larger flows would not be treated by the potential treatment wetlands as they constitute flood flows, and it is assumed that concentrations would be diluted during these time periods.

generating credits usable as advanced compensation for unavoidable wetland losses on other sites[9].

The goals of the Clean Water Act and the 404(b)(1) Guidelines are to maintain, restore, and enhance the physical, chemical, and biological integrity of the Nation's waters[10]. The Corps strives to avoid adverse impacts to waters of the United States, and to achieve a goal of no net loss of wetlands functions and values. To achieve this goal, replacement acreage may often be greater than the acreage lost. Replacement acreage will be determined based on functional values of the area being impacted, the temporal loss of habitats that will occur, as well as an adequate margin to reflect the expected degree of success associated with the mitigation plan. The purpose of compensatory mitigation is to develop long-term self-sustaining wetlands that area not dependent on human intervention after the establishment period. The Corps will determine the acreage ratio that will be required after receiving recommendations from the applicant and the appropriate resource agencies. The Corps will consider the functions and values of the wetlands that will be eliminated or degraded, the functions and values of the proposed mitigation site, and the likelihood of success of the proposed mitigation. Compensation for impacts to waters of the United States should be completed in advance by no later than concurrent with the impact, as near to the site of impacts as practicable, and protected from subsequent loss or degradation. In-lieu payments and purchase of property are usually not sufficient means of wetland compensation. Wetland mitigation may include habitat preservation, restoration, and/or creation. More information on wetland banking is located in Attachment 4.

4.4 Supplement Irrigation for Constructed Wetlands and Using Effluent Water from the Constructed Wetlands

Any natural wetland areas in the Malibu Civic Center area would be considered seasonal in nature and would only occur in low lying depressions due to the limited amount of rainfall. This conclusion is based on the water balance and the previous wetland delineations (Huffman & Associates, Inc. 1999). Therefore, a supplemental source of hydrology is necessary to support wetlands within the project area. The proposed bypass channel could divert water from Malibu Creek thereby creating a natural water source. Some of the effluent water from the treatment wetlands could be used to irrigate City planter areas, irrigate crops, and/or nursery stock.

4.5 Land Acquisition

The Chili Cook-off site is presently the most favorable location for the initial treatment wetland. The owner should be approached and a sales price determined. The other parcels could be added to the hydraulic system if and when they can be acquired.

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[9] Wetland Mitigation Banking: Resource Document IWR Report 94-WMB-2, McElfish et al, Environmental Law Institute, and Brumbaugh et al, Institute for Water Resources, January 1994.

[10] US Army Corps of Engineers. Habitat Mitigation and Monitoring Proposal Guidelines. Sacramento District. October 1996.

4.6 Easements

An easement would be necessary for the proposed bypass channel through parcel 20 (see Attachment 1, Figures 2 and 6). More information is necessary prior to negotiations or purchase.

4.7 Review of Existing Phase I/II Environmental Assessments

A review of the EPA's Toxic Release Inventory (TRI) data base was reviewed for this project. No documented toxic releases were found on the TRI for the Malibu Civic Center area. No documented superfund sites were listed either.

The only documented Phase I/II study was funded by the City of Malibu and contracted to URS Greiner Woodward Clyde to evaluate if septic systems could be a source of pathogens in the Malibu Lagoon and surf zone. The final Phase I report was completed in June 1999. Data collected during the study indicated that if there was at least 1.5 feet of separation between the bottom of a leach field and groundwater, the unsaturated soils would effectively remove pathogens from the effluent before it reached the water table. If the separation was not maintained, pathogens could enter the groundwater and potentially reach the creek, lagoon and surf zone. In some areas near commercial properties, it was found that the unsaturated zone pore space was filled with oils and fats. In these cases, the movement of water and wastewater becomes more complex and the above scenario would be in question.

The Phase II report expanded upon the findings of the Phase I report. An important element of this study was to associate the concentrations of indicator parameters with changes in water levels in Malibu Lagoon as a result of the lagoon being closed, breached or open to flow out to the surf zone. The study confirmed that hydrologic conditions within Malibu Lagoon and the surrounding area are controlled by the state of the lagoon. With the lagoon closed there are higher groundwater levels resulting in high indicator bacteria levels. Also, with the lagoon closed, the water quality in the surf zone was good.

4.8 Geomorphological Assessment

The Malibu Civic Center area is located in the southern Santa Monica Mountains within the Transverse Ranges. This physiographic province is characterized by many east-west trending fault systems; the major fault systems affecting the area are the Malibu Coast and Anacapa-Dume-Santa Monica fault systems. The bedrock includes predominantly tilted marine and non-marine sandstones, siltstones, and mudstones, as well as volcanic breccias that are overlain by quaternary marine and non-marine terrace deposits. The majority of the area is underlain by relatively young fluvial and estuarine sediments deposited by Malibu Creek. The Chili Cook-off site is approximately bisected by the Malibu Coastal Fault.

The Malibu Coast Fault is a high angle, north-dipping, reverse fault with a strong left-lateral strike-slip component that in general terms causes the Santa Monica Mountains to thrust upward and move westward relative to Santa Monica Bay. Various splays of this fault presumably pass beneath the Malibu Civic Center area. The behavior of these faults is a critical component of the structural dynamics of Malibu Lagoon.

Geomorphic features within the Malibu Civic Center area include beaches, coastal bluffs, a series of hillsides, ridges and canyons and landslides. Malibu Creek has maintained its course through the rising Santa Monica Mountains, incising a significant canyon, cutting its channel somewhere between 100 and 300 feet below present sea level near the coast. Neotectonic movements in the Malibu Coast fault zone and continuing relative sea-level rise of around 0.7 feet per century are ancillary issues for coastal management.

By 1900, the Malibu Creek fluvial system was restricted to a corridor that broadened into an estuarine lagoon near the coast (Orme 2000). The system varies from an open estuary under high fluvial discharge to a closed lagoon under minimal discharge and constructive, barrier-forming, wave action. The lagoon has been and is impacted by railroad and highway construction, erratic reclamation, and housing and commercial development. Impacts include widely fluctuating biological conditions, although stream floods and storm wave activity may temporarily recreate quasi-natural river-mouth dynamics during wet winters.

The creek and lagoon interact in a *dynamic equilibrium*, depending on creek flow and wave, tidal and sediment transport energy. At one extreme flows break down the barrier beach, but as flows diminish, wave action and tidal energy dissipation reestablish the barrier.

The degree to which Malibu estuarine lagoon fills and drains according to daily tidal cycles may be the most fundamental hydrologic parameter of the physical system. The tidal exchanges of water into and out of the system determines the following: pressure head on groundwater; backwater on surface water flows, etc.; water temperature and salinity; sediment concentration and distribution; and, general biological resources.

Geomorphic changes within Malibu Creek are primarily dictated by the duration of moderate to high flows and the size of peak flows, which produce flushing of channel sediments. Hydraulic analysis and field observation shows that the creek is trying to migrate westward. Riprap along the banks has kept it thus far from doing just that. Changes downstream (bridge abutment stabilizing and sea level rises) and upstream (other channel changes) could have profound effects upon the stability of the creek corridor that borders the project area. For example, with a sea level rise there is an increased probability of increased filling-in of the lagoon. With less flood storage downstream, the potential to flood outside of the channel's banks increases upstream.

Design and location of any diversion structure on the creek must take into account all of these factors. If a proper intake is not in-place, the structure could be hydraulically blown out without a thorough knowledge and understanding of the dynamics of Malibu Creek.

4.9 Review of Existing Water Quality Data to Assess Potential Treatment Levels from Constructed Wetlands

Release of Tapia effluent, watershed impacts, and frequent closure of the Lagoon entrance are major hydraulic factors affecting water quality of Malibu Lagoon. The result of these hydraulic factors produces high nutrient levels, high temperature ranges, high indicator organism density, and low salinity.

Potential sources of nutrients in the Malibu Creek Watershed include fertilizers, on-site wastewater systems (i.e., septic effluent or seepage), Tapia tertiary-treated wastewater, confined animal facilities (i.e., corrals), road surfaces from automobile deposits, and soils (Ambrose/Orme 2000). The nutrients entering Malibu Lagoon from surface and groundwater sources occur in both the wet and dry seasons.

Nitrogen is generally the primary limiting nutrient in estuarine systems and if the system is supplied with high levels of nitrogen, algal blooms occur. Surface water samples were collected during the dry and wet season in 1997 within Malibu Creek and at several locations within Malibu, Malibu Lagoon and the Ocean. Detailed information about this study is found in the Ambrose/Orme 2000 report in Chapter 5, *Eutrophication*, by I.H. Suffet and Shelby Sheehan. Water samples were analyzed for Total Nitrogen and Total Phosphorus. The results for sample location S1, within Malibu Creek, just downstream from Cold Creek and Tapia, are as follows:

	Dry Season Average Concentration	Wet Season Average Concentration
Nitrogen	1.06 mg/l	3.9 mg/l
Phosphorus	0.46 mg/l	0.60 mg/l

The study looked at all of the different potential sources for the nutrients and classified them in three categories: 1) Tapia; 2) Watershed runoff and seepage; and 3) Lagoon sources. What the study found was the most of the nutrients (greater than 70 percent) were coming from Malibu Creek Watershed and Tapia. To avoid blooms, the EPA and NOAA (1986) recommend the following for estuaries and coastal ecosystems:

- Nitrogen concentrations 0.1 - 1.0 mg/l
- Phosphorus concentrations 0.01-0.1 mg/l
- N to P concentration 10 to 1 ratio

Treatment wetlands could be constructed within the Malibu Civic Center area to divert Creek water to detain the water for a set period of time to treat for nutrients, and then released back to the Creek or Lagoon. By treating the water from the Creek or other sources using treatment wetlands, there would be an addition of new beneficial uses to the Creek and Lagoon through the improvement of water quality. It has been estimated that the total nitrogen loads from the Watershed to Malibu Lagoon are 4,939 pounds during the dry season (184 days) and 109,510 pounds during the wet season (181 days) (Suffet/Sheehan).

H&C looked at the Chili Cook-off site in detail for diversion channel design, as described in Section 4.2 (see Attachment 1, Figure 2). The total land on these parcels available for construction of a treatment wetland is approximately 12.6 acres. It has been suggested that nutrient removal can be achieved in treatment wetlands if loading does not exceed 225 pounds of nitrogen per surface wetland acre per year[11]. For this parcel, alone, over one-half of the watershed's total nitrogen could be treated during the dry season (Ambrose 2000). However, only 0.4 percent of the watershed's total nitrogen could be treated during the wet season (Ambrose 2000).

H&C also recommends properties C-1, C-3, A-2 and A-3 as other potential wetland restoration sites. All of the potential wetland sites are shown on Attachment 1, Figure 3. The total acreage of the five sites (including Chili Cook-Off) is approximately 45 acres, of which at least 36 acres would be available for actual treatment of water. The 36 acres could treat approximately 35 million gallons per week, if water was detained at seven day cycles.

Site	Acre	Land Loss	% of total	Total land	Acre	Average Depth of Water	Gallons of Water
C1	9.7	0.20	1.94	7.8	43,560.0	3	7,585,294.46
Chili Cook-Off C2	15.8	0.20	3.16	12.6	43,560.0	3	12,355,428.10
C3	7.9	0.20	1.58	6.3	43,560.0	3	6,177,714.05
A2	8.7	0.20	1.74	7.0	43,560.0	3	6,803,305.34
A3	2.7	0.20	0.54	2.2	43,560.0	3	2,111,370.62
TOTAL	**44.8**			**35.8**			**35,033,112.58**

The treatment time for Nitrogen is optimized at about seven days for low to moderate concentrations, like those found in Malibu Creek. Attachment 1, Figure 7 shows two examples of graphs depicting Nitrogen levels in milligrams per liter (mg/l) and detention time in days for Total Nitrogen concentrations. The 35 million gallons per week equates to a constant flow of 8.45 cfs. Attachment 1, Figure 4 is a graph of Malibu Creek flow data. The graphed data indicates that all of the treatment wetlands could effectively treat flow in the Creek 81 percent of the time.

Wetland treatment systems consistently reduce total nitrogen concentrations in many wastewaters (Kadlee & Knight 1995). The magnitude of these reductions depends on many factors including inflow concentrations, chemical form of the nitrogen, water temperature, pH, alkalinity, organic carbon, dissolved oxygen, water depth, and biota. Although these factors can be incorporated with some success into design of wetland treatment systems, precise nitrogen reaction rates and performance under different environmental variables are not known (Kadlee & Knight 1995).

5.0 DISCUSSION - PROJECT EVALUATION CRITERIA

The Malibu Creek Watershed project would be evaluated against the successful implementation of criteria for ecology, policy and feasibility. Specific criteria to be met are outlined in subsections 5.1 through 5.3.

[11] Schueler, T.R. *Controlling Urban Runoff: A Practice Manual for Planning and Designing Urban BMPS.* Department of Environmental Programs, Metropolitan Washington Council of Governments, Washington, D.C., 1987.

5.1 Ecological Criteria

5.1.1 Restoration Potential/ Functional Gain

The current creek system promotes bacterial contamination, eutrophication, degraded habitat and health risks[12]. Runoff from urban development, roads and septic systems, in addition to freshwater flow into Malibu Creek, has led to increased sediment, bacteria and nutrient levels. The shifts in water level, with increased year-around flows, have altered the seasonal succession of the lagoon system with artificial breaches in the sand bar. Artificial breaching of the sandbar leads to high levels of bacteria moving from the lagoon to the surf zone creating a health risk to the public[13]. The influx of freshwater also impacts the pH, temperature, salinity and water levels necessary to support species diversity. The Malibu Creek Watershed is home to eleven species (nine bird, two fish and one plant) that are federally designated as threatened or endangered. Malibu Creek and Lagoon provide spawning and juvenile rearing habitat for the southern steelhead and is home to the tidewater goby, which is found only along the coast of southern California. Changes in salinity and temperature as well as the introduction of non-native species threatens the survival of both the goby and the steelhead (USDA-NRCS 1995).

The proposed treatment wetland would help to abate issues of excess nutrients, bacteria, sediment and water levels thus increasing the ecological function of the area and sustaining sensitive habitat and safer recreational opportunities. The wetland would increase ecological function and value and restore functioning of natural processes within the Malibu Civic Center area as well as improve the Malibu Creek/Lagoon system through the diversion, containment and release of Creek water.

Approximately 2.8 cubic feet per second (cfs) of water from the Creek would be diverted to the Chili Cook-off site and held for 7 days to treat Total Nitrogen.

On the Chili Cook-off site alone, approximately 12.6 acres of wetlands could be constructed. Other potential sites of wetland construction could restore an additional 23.4 acres for a total of 36 acres.

5.1.2 Self-sustainability

The wetland will function as a detention area to remove pollutants before releasing the water back into the Creek. Unlike the retention area described in the Malibu Civic Center Specific Plan (Crawford 1996), the treatment wetland will detain water but allow for flow into and out of the wetland thus mitigating for excess siltation and decreasing detention capabilities. Malibu Creek is perennial throughout most of the year, including drought seasons, and should provide the required flow into the wetland to sustain ongoing functioning (USDA-NRCS 1995). The wetland will

[12] USDA-NRCS. 1995. Malibu Creek Watershed Natural Resources Plan; Philip. 1992. Malibu Wastewater Management Study; Crawford. 1996. Malibu Civic Center Specific Plan Background Information, Existing Conditions.

[13] USDA-NRCS. 1995. Malibu Creek Watershed Natural Resources Plan; Philip. 1992. Malibu Wastewater Management Study; Crawford. 1996. Malibu Civic Center Specific Plan Background Information, Existing Conditions.

promote and sustain restoration improvements through natural wetland functioning and provide functions as outlined in section 5.1.1.

Fire and intense storms may adversely affect the wetland site and cause degradation to the restored areas through flooding and increased erosion (USDA-NRCS 1995; Philip 1992). There have been 25 fire occurrences in the greater Malibu area between 1935 and 1993 but only one fire was adjacent to Malibu Creek (USDA-NRCS 1995). Future occurrences or impacts would be difficult to predict. Intense storm activity is also unpredictable. In the event of a major storm, it may be necessary to temporarily close the diversion structure that allows water to flow into the treatment wetland to avoid flooding outside of the diversion channel or within the wetland, itself.

Ground shaking, which could occur during an earthquake, may result in the in-filling of some of the diversion channel or within the wetland itself and could also result in some liquefaction or differential compaction of materials in some areas. In-fill material can be removed to keep the system running smoothly.

Initial construction of the treatment wetland should take into account objectives to determine amount and type of flow distribution mechanisms, incorporation of berms, dikes and/or levees and selection of plant species (Environmental 1989). Ongoing site management would include maintenance of the mechanisms that are utilized as well as occasional harvesting of wetland plants and removal of sediments from the wetland and the diversion channel (Environmental 1989).

5.1.3 Connection to Transitional/upland Areas

The Malibu Civic Center Project Area is located at the slope break between the upland Santa Monica Mountains and the Pacific Ocean. Historically, most of this land was part of the Malibu Lagoon/Estuarine system. It is still part of the Malibu Creek floodplain. Stormwater runoff and groundwater move over and through this area towards the south, or ocean. In many ways, this area is the last chance for the water to be treated through the use of natural wetlands or treatment wetlands.

5.1.4 Connection to Marine Environment

Again, this area is the transition between mountain and ocean. Surface water and groundwater flow over and through this area to end up in Malibu Creek, Malibu Lagoon and/or in the Pacific Ocean. The quality of this water is dependent upon stormwater pollution prevention planning and non point source identification and mitigation. The treatment wetland would help to relieve impacts caused by runoff and pollution into Malibu Creek and Malibu Lagoon, resulting in partial restoration and promotion of healthier systems and functions. It will benefit the marine and intertidal resources through the reduction of nutrients and pathogens.

5.1.5 Regional Linkage

In addition to the wetland project's waste water treatment capabilities and the resultant improvements to water quality within the Malibu Creek and Lagoon, regional benefits would also be gained through the construction of wetlands. The Overview of Wetland Opportunities Malibu Creek Watershed report provides a comprehensive list and matrix of the benefits associated with the creation of wetlands (Environmental 1989). The advantages include recreational opportunities, aesthetics/scenic enjoyment, atmospheric maintenance, educational opportunities, conservation and endangered species protection. The proposed wetlands would provide valuable habitat for great blue heron, American peregrine falcon, red-winged blackbird, and western aquatic garter snake as well as numerous plants and insect species (USDA-NRCS 1995).

The Malibu Lagoon is an extremely important link for all of the above. It has been compared to an island of habitat for use by migratory birds as similar habitat disappears along the southern Pacific coast. 151 different bird species use this area and the watershed has historically been an important southern steelhead spawning ground as well as home to the tidewater goby, which was reintroduced to the Lagoon.

5.2 Policy Criteria

5.2.1 Prevention of Future Degradation/Loss

The City of Malibu General Plan calls for the preservation of areas that promote scenic resources or values. Scenic resources are defined as those areas that should be preserved for "aesthetic, historical, topographical, cultural or biological reasons (Crawford 1996; pp. VIII-1)." In addition, the Malibu Coastal Zone is subject to the Coastal Act, which says that views should be protected and that new development must meet the guidelines for the preservation of visual resources. A treatment wetland could be classified as a preservation area under the planning provisions for the City of Malibu and the Coastal Act since it would protect the adjacent visual resources including the view of the Santa Monica Mountains. Further, the wetland itself may be classified as a scenic resource to be conserved for biological reasons.

5.2.2 Research Value

Research will be incorporated into the project through ongoing wetland and creek/lagoon monitoring at the site. How well the treatment wetlands work rests in how they are constructed, maintained and monitored.

Research in water quality improvements, habitat formation and species diversification could become an important and valuable adjunct to the overall project goals. Other avenues of research could be in the areas of economics, planning and development. How best to meld two juxtaposing principles and make them work together.

5.3 Feasibility Criteria

5.3.1 Site Availability

The Chili Cook-off site is privately owned and it is yet to be determined wether the owner will consider either selling the parcel or participating in a restoration project.

5.3.2 Total Cost and Unit Cost Effectiveness

The total cost of creating wetlands will be developed during the design and engineering stage of this project. Constructed wetlands vary widely in cost, generally ranging between $ 80,000 and $125,000[14] per acre, not including property costs.

The final design at the Chili Cook-off site could incorporate use of the entire 12.6 available acres as a treatment wetland, or a portion thereof. Obviously, the more area excavated and used for treatment of water, the greater the volume of water treated. A completed wetland restoration project within the Chili Cook-off area could range between $500,000 and $1,000,000, including environmental permitting and engineering fees. These numbers are very preliminary, but give general information for planning purposes.

Wetland monitoring would probably average $20,000 per year.

5.3.3 Available Funding

There are several funding options available for this project. Possible sources may come from the funds designated within California State Propositions 12 and 13. Proposition 12 is the Safe Neighborhood Parks, Clean Water, and Coastal Protection Bond Act of 2000. The bond monies under this Act are available to local governments and non-profits for recreational, cultural and natural areas and for state projects which include the acquisition and preservation of fish and wildlife habitat. Proposition 13 is the Safe Drinking Water, Clean Water, Watershed Protection, and Flood Protection Bond Act. This Act would provide grants and low interest loans to agencies involved in programs for urban stream cleanups, habitat preservation along streams and rivers, watershed protection and non-point source pollution control. Funding may also come from the following agencies/organizations:

Southern California Wetlands Recovery Project
Fish and Wildlife
Army Corps of Engineers
City of Malibu
Matching private funds
EPA
CRWQCB
County
State Parks
Dept. of Transportation
University of California - Natural Reserve System
Wildlife Conservation Fund

[14] CalTrans uses $125,000/acre for estimating purposes.

5.3.4 Restoration/Enhancement Plan

This report includes the Wetland Project's objectives and science-based criteria, which will be utilized for the development of the restoration plan. Prior to construction, this project will have a monitoring protocol and all necessary federal, state, county and local review will be covered and incorporated during the preparation of the plan.

Four topics are typically involved when considering ecosystem restoration: predictability; structure and function; limiting factors; and, landscape issues with respect to potential constraints. These four topics will be discussed below with respect to Team considerations for future habitat restoration.

5.3.4.1 Predictability

Every landscape is a mosaic of vegetation and habitat patches. Successful mitigation creates habitat that is functionally equivalent to the one lost (Zedler, 1996). The current standard for wetland mitigation site monitoring within the U.S. Army Corps of Engineers - Sacramento District is annual monitoring for the first 5 years, with additional monitoring (without human involvement) in years 7 through 10, before a project is considered "successful". Because nature is not completely predictable, there is necessarily some degree of uncertainty about any project's final outcome. Thus, a project could fail to actually meet success criteria despite sound design, construction, and monitoring efforts. Because of this element of uncertainty, up-front project analysis should include characterization of the full range of potential habitat outcomes. Potential outcomes viewed as undesirable should be analyzed carefully to (1) develop contingency plans at the onset of the project, and (2) assess the project in the context of the full set of potential project outcomes to determine if the project should be recommended for restoration in the first place.

5.3.4.2 Structure And Function

While the project goals focus on function, project performance is generally measured by monitoring structure. Ecosystem function focuses on processes that occur through time - geomorphic adjustments, primary productivity, nutrient cycling, organic matter accumulation, population persistence, predator-prey interactions, resistance to exotic invaders, and sustainability, sedimentation and nutrient retention. In contrast, a botanist would measure structure by measuring vegetation diversity and/or number of plants or aerial coverage over the area. The structure measures are typically used for assessing project performance because assessment of functional attributes is usually not cost effective. Since the structure measures typically used to monitor project performance provide a limited view of ecosystem function, specific measures and success criteria should be selected carefully.

The Corps typically requires that an area must persist in perpetuity to be a successful mitigation site. However, delineating a list of plants may not be sufficient. The ability of an ecosystem to persist in perpetuity may not be by delineating a list of plants, but rather by ensuring that soils and/or hydrology are in place or that pollinators are present, or that funding mechanisms are ensured. Should the success criteria allow for vegetation change (self-design) and should experimentation and simulation modeling components be included in the design phase? Can or should local university graduate research programs be funded to monitor the site and facilitate any necessary changes?

5.3.4.3 Limiting Factors (With Respect to Potential Constraints)

It will be important to identify the single limiting factor that will control the restoration of habitat at this site. Would the primary factor be soil texture/stability and soil chemistry, hydrologic regimes, flooding cycles, or something altogether different? Should the design specify soil amendments, transplantations, weed control, identification of vegetation species pollinators, or other agricultural techniques? These are the types of issues that could be explored by the conservancy team.

5.3.4.4 Landscape Issues And Potential Constraints

Success of this project may hinge on coordination with other regional restoration efforts (as identified above). Detailed review of these other Plans may be valuable. For example, Dr. Joy Zedler, an expert in restoring tidal wetlands has a new publication due out in September of this year that identifies important gaps in current restoration ecology and provides a broad-based compilation of case studies and principles to guide future management of tidal restoration sites. This and other current literature review will save many resources both from an hours and economic standpoint. Analysis provided in previous plans may clarify potential trade-offs between restoring ecosystem functions that were previously provided in the historic watershed and replacing the resources that are currently being lost. These plans should be reviewed to identify the relative abundance of existing and historic habitat types before setting any firm goals for this project. These plans may also identify restoration opportunities and estimate the likelihood of achieving restoration goals.

5.3.5 Technical and Biological Practicability

As has been proven with the many wetland restoration efforts along the California coastline, improvement to water quality through natural wetlands and treatment wetlands, this project is feasible and needed (Ambrose 2000). The location of the Chili Cook-off site makes it practicable as a treatment wetland because it is upstream of the Lagoon Restoration project. The habitat at the Lagoon would probably be more productive than the treatment wetland. Therefore, wildlife will tend to frequent the Lagoon area. This will benefit wildlife because the treatment wetland will accomplish its primary objective of water quality treatment. Notwithstanding this, the treatment wetland can be part of a community park system with an interpretive path and bird watching area. Where the project is located makes it practicable for many reasons: the location is perfect for water and wastewater quality improvement, habitat restoration, area beautification and responsible planning.

5.3.6 Future Management

The City of Malibu may be the owner and/or manager for the wetland. Long-term site management would need to come partially from the City of Malibu and/or the State of California. There may be State and private grants available for the improvement to water quality and habitat restoration. The Malibu Coastal Land Conservancy will explore these options.

6.0 CONCLUSIONS

Under a contract with the Malibu Coastal Land Conservancy, H&C have conducted a wetland restoration feasibility study in the Malibu Civic Center area, Malibu, California. The Malibu Civic Center area was evaluated due to the area's ability to affect wetland restoration that would create a continuous wetland/stream corridor that would essentially mimic natural conditions (pre-1920's). More specifically, H&C has evaluated a 15.8 acre parcel (known as the Chili Cook-off site) located within the Malibu Civic Center area, Malibu, California with respect to wetland restoration.

Within the context of the feasibility of wetland restoration and/or creation several objectives were identified: ability to link to a larger regional restoration effort; self-sustainability; connection to transitional/upland areas; connection to the marine environment and; the ability to effect water quality improvement as a primary goal (versus wildlife habitat). These objectives were considered mandatory with respect to restoring the chemical, physical and biological functions within the Malibu Creek Watershed. For the purpose of this feasibility study self-sustaining with respect to in-perpetuity means within the next 100 years (considering some aspect of global warming and an approximate one foot rise in ocean elevations).

Similar to a cathedral, which takes the vision of several generations, the vision of the Malibu Coastal Land Conservancy (over the next 100 years) is set in motion with this restoration project. The vision is the restoration of the Malibu Creek alluvial fan and adjacent wetlands (tidal, muted-tide, and seasonal and riparian wetlands). Therefore, based on the review of scientific studies to include our own data analysis, H&C concludes that it is technically feasible to restore wetlands within the Malibu Civic Center area. Land acquisition maybe a larger concern than the various technical or scientific issues associated with wetland restoration in this area. The various technical and scientific issues associated with restoration can be met. The timing of this project is critical as development pressure in this area may preclude restoration if immediate steps are not taken.

The following table outlines the CSCC's criteria for restoration projects.

Section 6, Conclusions. PROJECT EVALUATION CRITERIA FACTORS TO BE CONSIDERED

CRITERIA	SUCCESSFUL COMPLETION		RATIONALE
	YES	NO	
ECOLOGICAL			
Restoration Potential/ Functional Gain	✔		
How much potential is there to increase the ecological function and/or value of a site, including the amount and quality of habitat or potential habitats for sensitive and important wetland-dependent species?	✔		There would be a gain in wildlife function with the implementation of this project. The potential to increase the ecological function of the site is very high because presently the area does not serve an ecological function within the watershed. Section 3.3 documents the extent of species found within the area but not presently observed onsite.
To what extent will the project restore functioning of natural processes (e.g., hydrology)?	✔		By restoring the hydrologic source in a small by-pass channel the project will mimic a natural condition (pre-1900)
Will the project result in an increase in wetland acreage?	✔		Yes, there presently are no wetlands found within the Chili Cook-off site. The Chili Cook-off site is approximately 15.8 acres. An approximate 12.6 acres would be restored wetland with 3.2 acres of transition/buffer upland area.
Self-sustainability	✔		
Will potential restoration improvements be sustainable through natural wetland functioning?	✔		After an initial monitoring period, the area will be a self-sustaining natural wetland. A gravity fed by-pass channel will allow flow into the area. While some long-term maintenance will be required after flooding or with vegetation maintenance - these efforts will be minimal.
What is the likelihood of future degradation after restoration has occurred?			The area will require initial monitoring for an approximate 5-year period to ensure it meets the final success criteria. Upon project completion the site should persist in perpetuity without human intervention. Because this area is away from the ocean it should not be affected by global warming. Some maintenance will be required if the wetland's primary function is for water quality improvement. However, funds that would have been spent on capital improvements and upkeep/maintenance of a more traditional engineered storm water systems could be diverted to maintaining the wetland system. These costs are generally lower than other traditional methods associated with engineered facilities.

Section 6, Conclusions. PROJECT EVALUATION CRITERIA FACTORS TO BE CONSIDERED

CRITERIA	SUCCESSFUL COMPLETION		RATIONALE
	YES	NO	
Self-sustainability Continued			
What level of ongoing site management and/or maintenance will be required?			
Connection to Transitional/upland Areas	✔		
To what extent is the wetland site physically and ecologically connected to transitional/upland areas?	✔		The Chili Cook-off site is a part of a larger overall restoration plan to restore the Malibu Creek alluvial fan.
Connection to the Marine Environment			
To what extent is the site ecologically and hydrologically connected to the marine environment?	✔		The area can be connected to the lower Lagoon area, if desired, and as other properties 'come on line' the Chili Cook-off site could be a brackish-tidal wetlands.
To what extent will the project benefit marine and intertidal resources?	✔		Basically, as more habitat is created wildlife will benefit either directly due to improved water quality within the treatment wetland and the watershed and indirectly as the Chili Cook-off site will have habitat value. Malibu Creek and Malibu Lagoon serve as breeding and nursery areas for various coastal fish and birds.
Regional Linkage	✔		
What is the site's function and value from a regional perspective, including sensitive species habitat, use by migratory birds, fisheries support, and biodiversity?	✔		The area is already linked to the lower lagoon area. Rather this project is continuing the restoration process upwatershed, or upstream (to restore the Malibu Creek alluvial fan).
POLICY			
Could future loss or degradation of the wetland (from development or other activities in the watershed) be prevented through Wetlands Recovery Project involvement?	✔		This project is a critical link to the overall restoration of the Malibu Creek Watershed. The Malibu Civic Center area is presently undeveloped. This is essentially the last time a group can come together to effect change. If this key piece of property is developed it will be harder to accomplish the overall vision (of a restored functioning alluvial fan) that is in dynamic equilibrium with its surrounding ecosystem.

Section 6, Conclusions. PROJECT EVALUATION CRITERIA FACTORS TO BE CONSIDERED

CRITERIA	SUCCESSFUL COMPLETION		RATIONALE
	YES	NO	
Regional Linkage Continued			
How imminent is the threat?	✔		Development pressure is at a critical point. The Malibu Coastal Land Conservancy was formed as a grass roots effort to work with businesses to solve both environmental and economic problems. The Malibu Coastal Land Conservancy would define the highest and best use of the property as restoration.
Research value	✔		
Is wetlands research incorporated into the project?	✔		This project will become part of a larger restoration effort. It is anticipated that some Master's Thesis will be involved with on-going monitoring of the restored wetlands until they reach final success criteria.
What research questions will the project address:	✔		To be developed at a later date.
			FEASIBILITY
Site availability	✔		
Is the owner willing to sell the land or participate in a restoration project?	✔		It is anticipated that the Malibu Coastal Land Conservancy would facilitate the acquisition of this property to include fund raising.
Cost/cost effectiveness	✔		
What is the total cost, unit cost, and relative cost effectiveness?			To be developed in the engineering stage of this project. Typical constructed wetlands cost between $80,000 and $125,000 per acre, including environmental permitting and design, but not land acquisition. Development of Chili Cook-off site could range between $500,000 and $1,000,000.
Funding	✔		
What funding is available for the project?			See section 5.3.3
Restoration/Enhancement Plan	✔		

Section 6, Conclusions. PROJECT EVALUATION CRITERIA FACTORS TO BE CONSIDERED

CRITERIA	SUCCESSFUL COMPLETION		RATIONALE
	YES	NO	
Is there an existing restoration/enhancement plan that is consistent with the Wetlands Project's objectives and science-based criteria?	✔		To be determined in the design phase.
Does it include a monitoring plan?	✔		Yes, it will include a monitoring plan. Four topics are typically involved when considering ecosystem restoration: predictability; structure and function; limiting factors; and, landscape issues with respect to potential constraints. These four topics will be discussed with respect to final considerations for future habitat restoration.
Restoration/Enhancement Plan Continued			
Has the plan undergone environmental review?			
Technical Practicability	✔		
Are the planned restoration activities technically and biologically feasible and practicable?	✔		This project is technically, biologically feasible and practicable given a no-project alternative and the lost opportunity should the project not be implemented.
Future Management	✔		
Is an appropriate future owner and/or manager available for the site?	✔		The City of Malibu may be the owner and/or manager for the site. Long-term site management would need to come partially from the City of Malibu and/or the State of California.
Are sufficient funds available for long-term site management?	✔		There may be State and private grants available for the improvement to water quality and habitat restoration.

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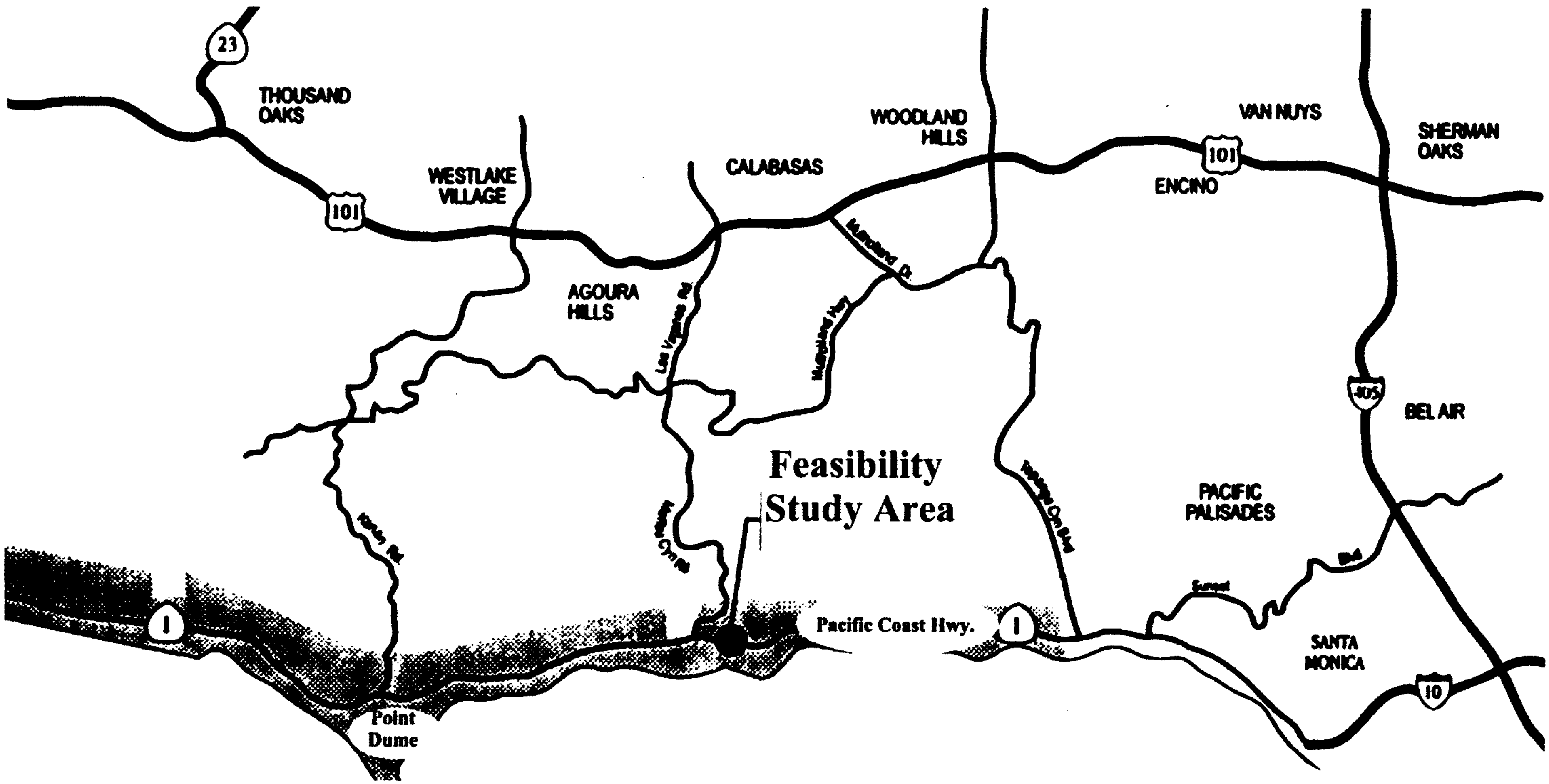
U.S. Department of Agriculture, Natural Resource Conservation Service, Topanga-Las Virgenes Resource Conservation District, University of California, Davis, California. *Natural Resources Plan. Malibu Creek Watershed, Los Angeles and Ventura Counties, California*, July 1995.

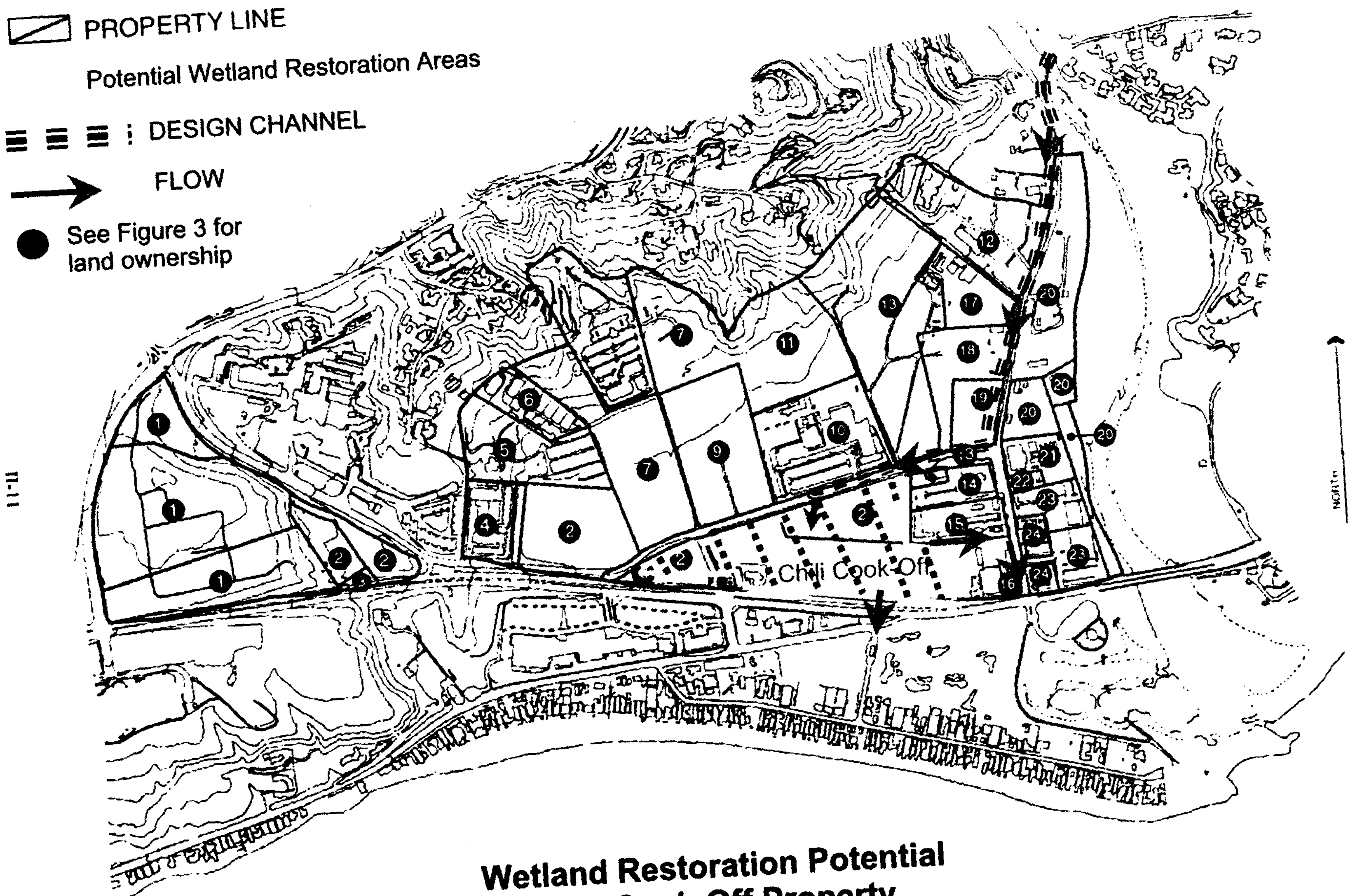
U.S. Geographical Survey, 2000. *Historical Flows and Surface Water Data.* Unpublished data.

ATTACHMENT 1 - FIGURES



Site Location Map
Malibu, California

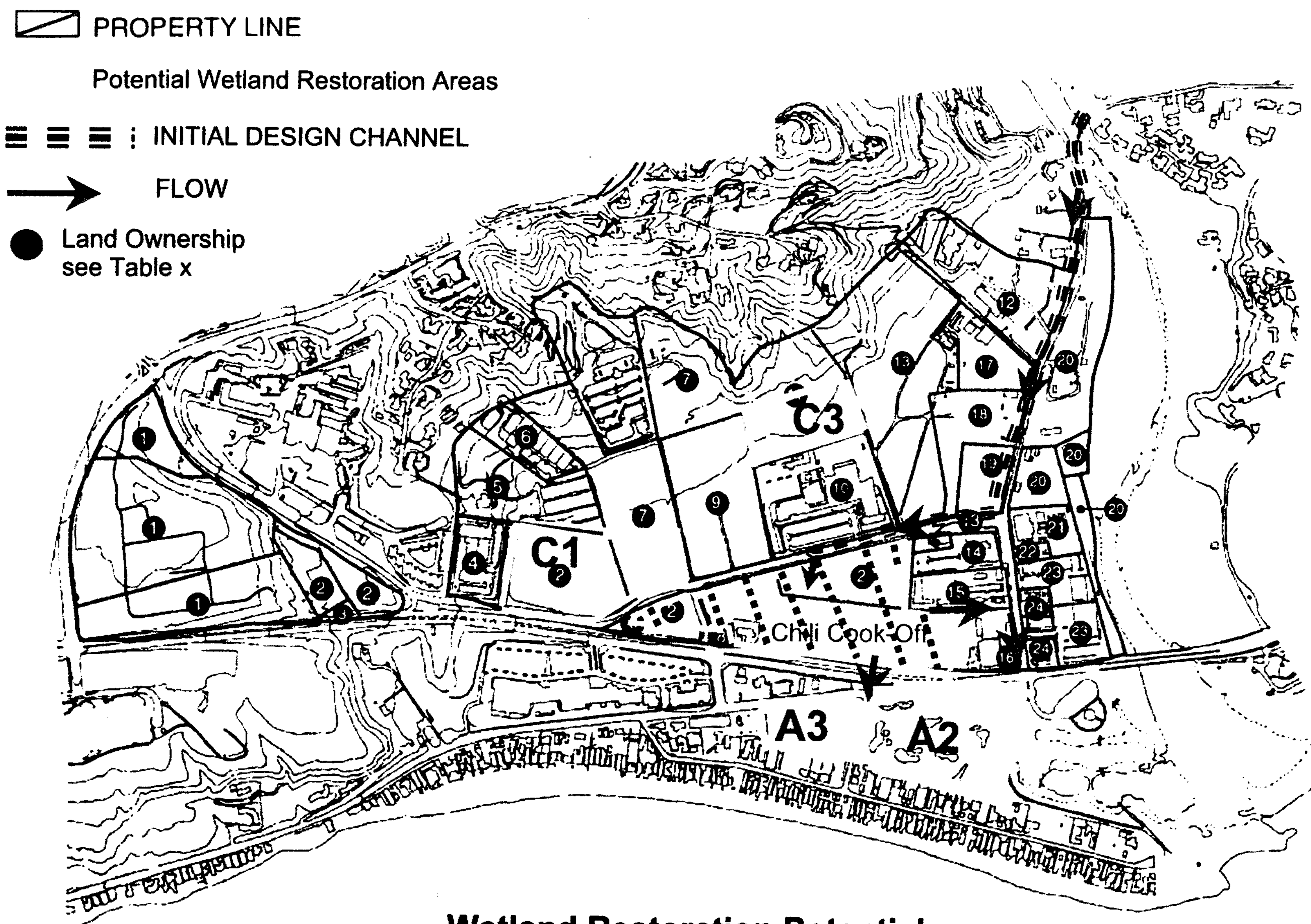
Figure 1



Wetland Restoration Potential
Chili Cook-Off Property

Malibu Civic Center, California

Figure 2



Wetland Restoration Potential
Civic Center Area
Malibu Civic Center, California

From: RRM Design Group

Figure 3

Figure 4. Percentage Exceedance (Flow is greater than) for Malibu Creek Gage DVS. 11105500

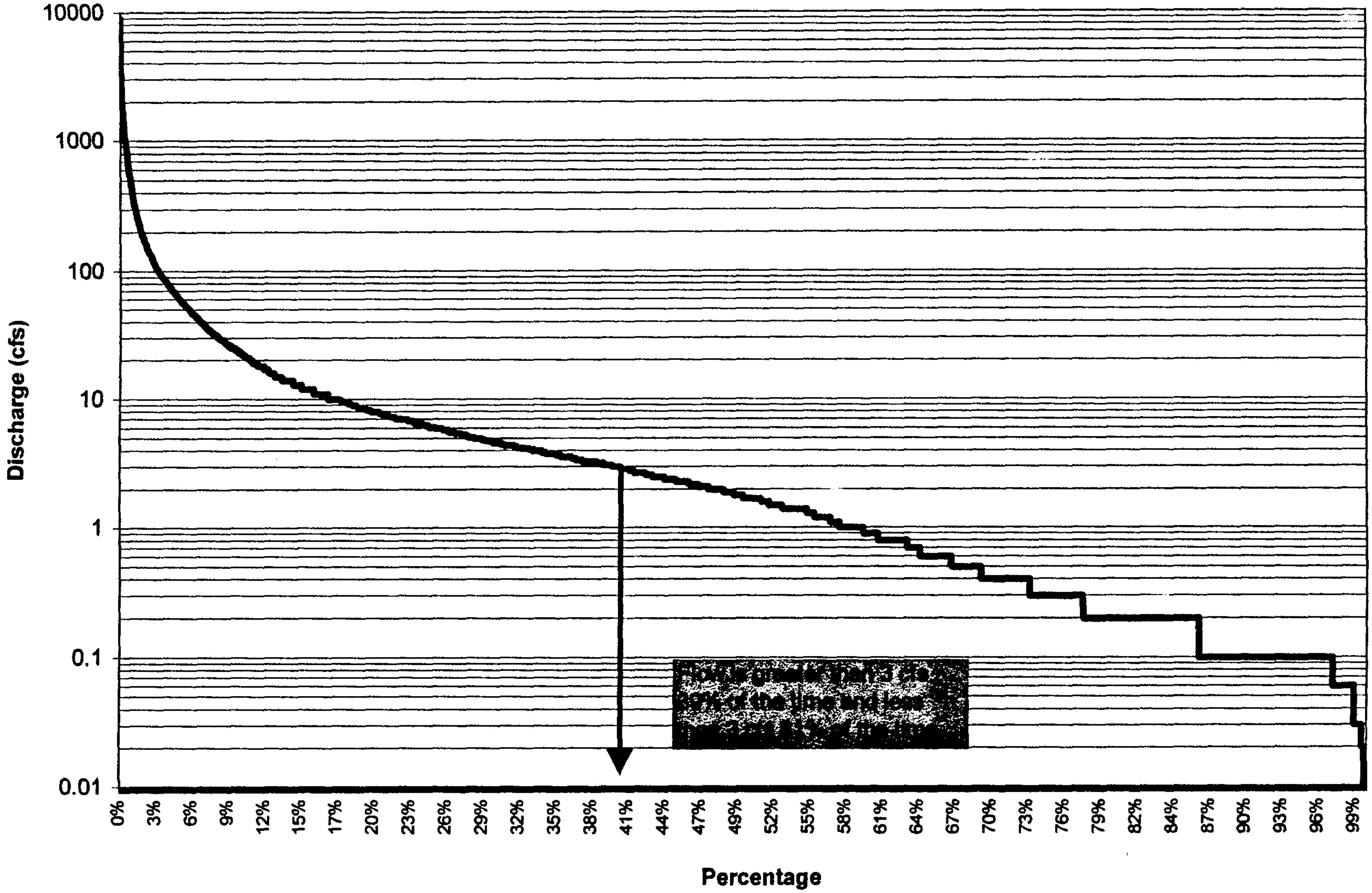
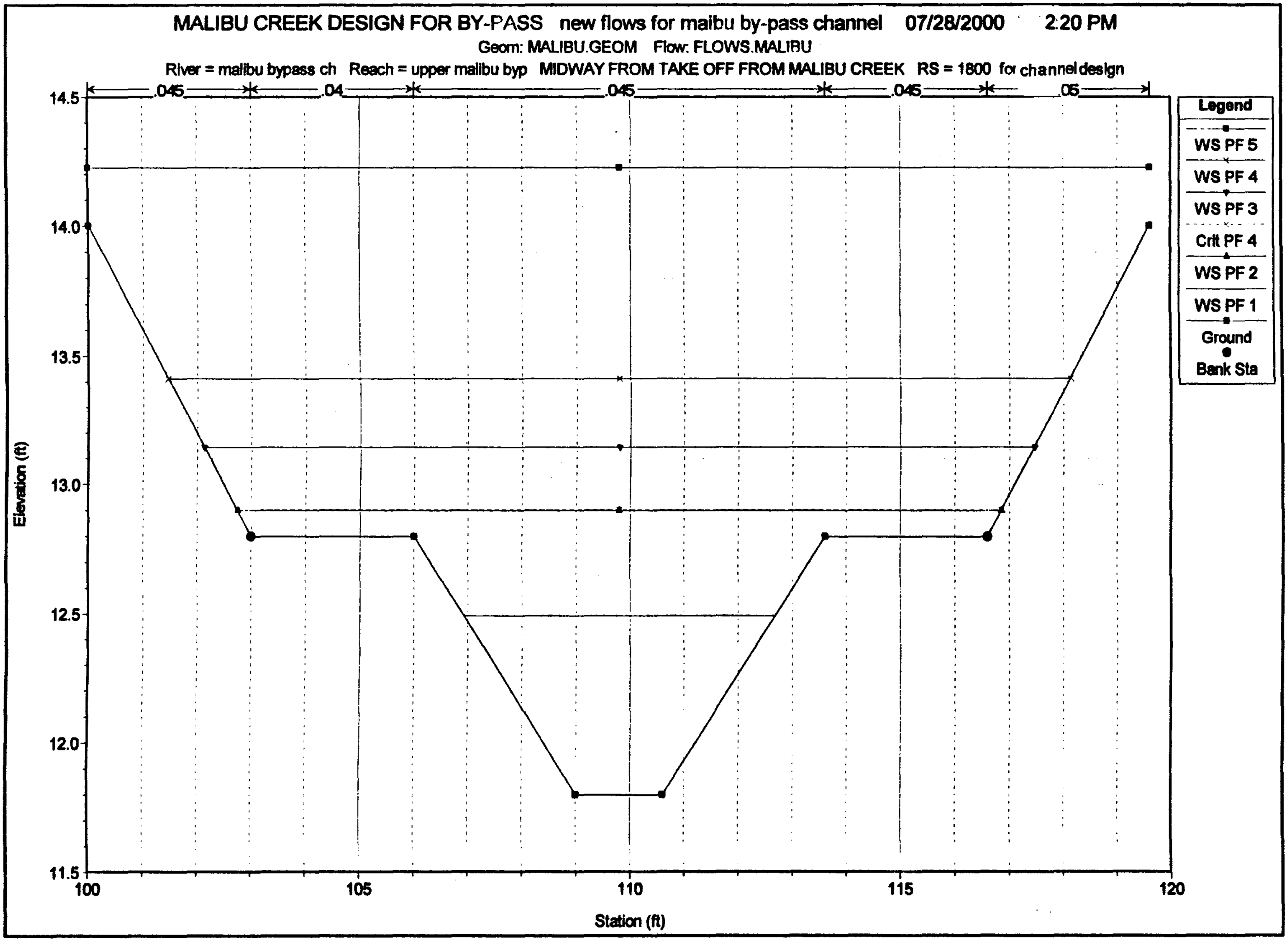
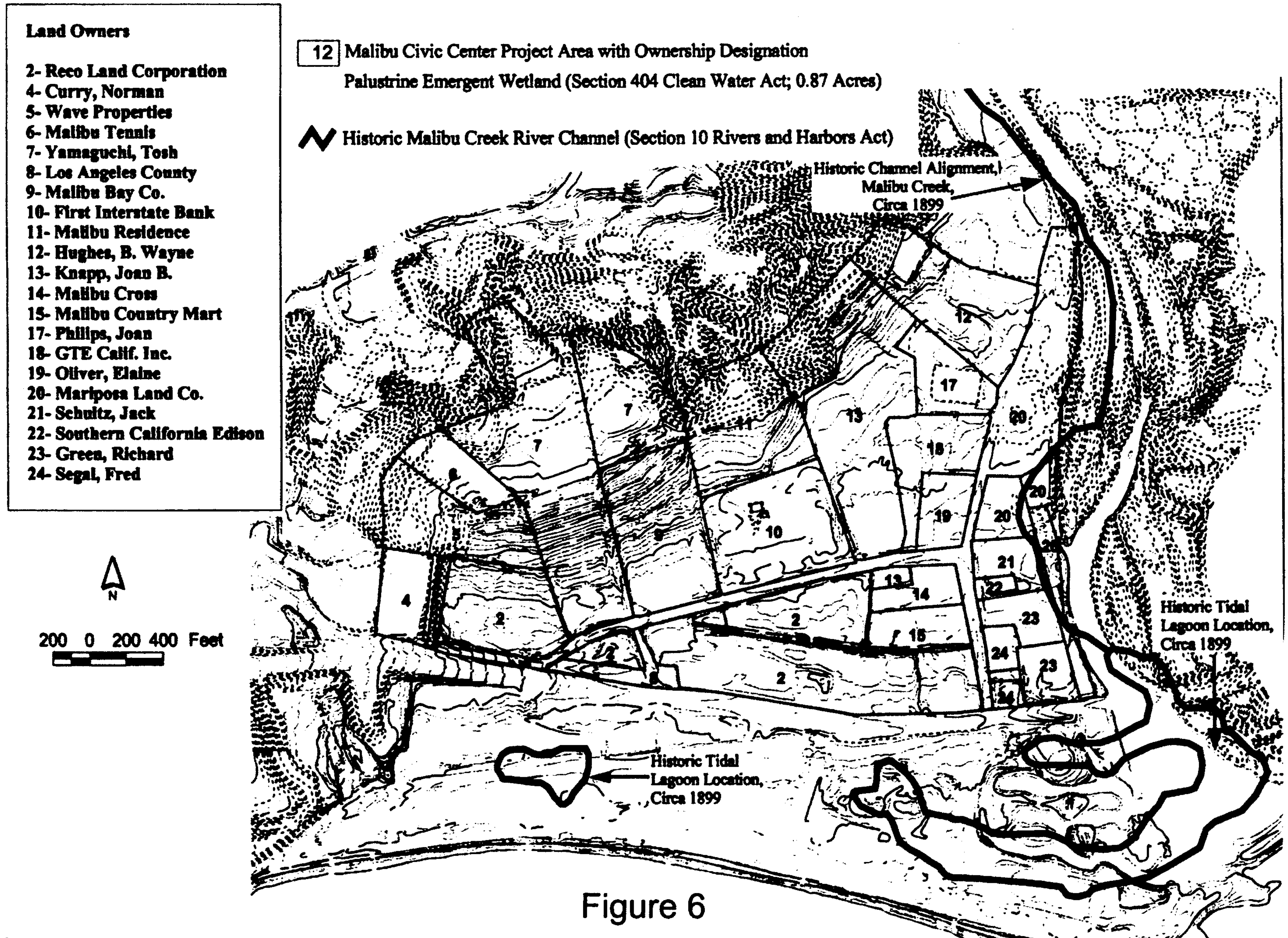


Figure 4



MALIBU CREEK DESIGN FOR BY-PASS new flows for malbu by-pass channel 07/28/2000 2:20 PM
Geom: MALIBU.GEOM Flow: FLOWS.MALIBU
River = malibu bypass ch Reach = upper malibu byp MIDWAY FROM TAKE OFF FROM MALIBU CREEK RS = 1800 for channel design
.045
.04
.045
.045
.05
Legend
WS PF 5
WS PF 4
WS PF 3
Crit PF 4
WS PF 2
WS PF 1
Ground
Bank Sta
Elevation (ft)
14.5
14.0
13.5
13.0
12.5
12.0
11.5
100
105
110
115
120
Station (ft)

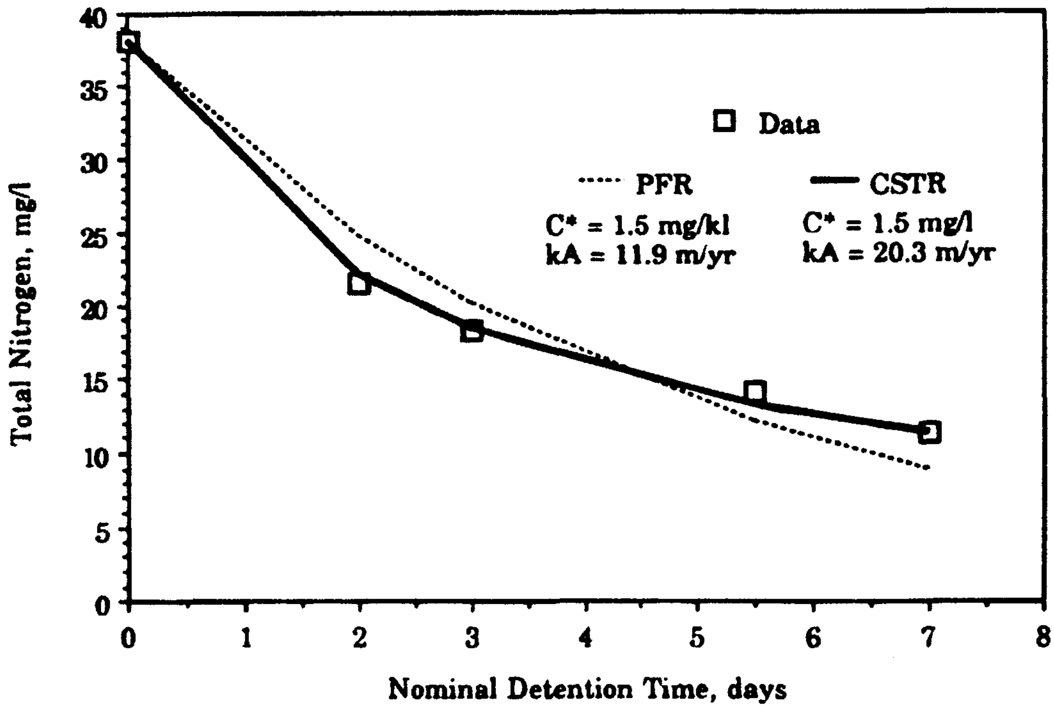
Figure 5



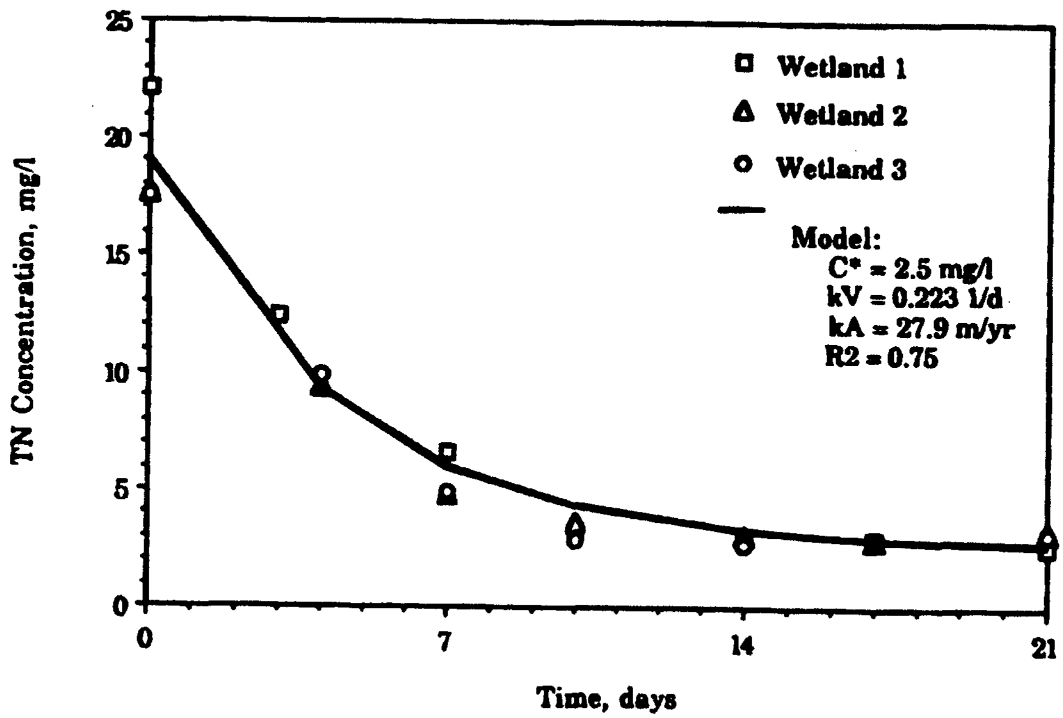
Source: 1994 Topographic Mapping from Civic Center Spcific Plan, 950050

Figure 6
Property Ownership Map

Total Nitrogen Removal vs Detention Time



(Lakshman 1981)



(Tanner, et al. 1995)

Figure 7

ATTACHMENT 2 - TABLES

NAME		FEDERAL STATUS	STATE STATUS
INVERTEBRATES			
Coelus globosus	globose dune beetle	C2	
Euphydryas editha quino	Wright's checkerspot butterfly	C2	
Lycaena arota nubila	clouded tailed copper butterfly	C2	
Panoquina errans	salt marsh skipper	C2	
Speveria callippe callippe	Callippe silverspot butterfly	C2	
Satyrium auretorum fumosum	Santa Monica Mtns. hairstreak	C2	
Brennania belkini	Belkins dune tabanid fly	C2	
Neduba longipennis	Santa Monica shieldback katydid	C2	
Proceratium californicum	valley oak ant	C2	
Trigonoscuta dorothea dorothea	Dorothy's El Segundo dune weevil	C2	
FISHES			
Eucyclogobius newberryi	tidewater goby	E	SC
Oncorhynchus mykiss	southern steelhead		SC
AMPHIBIANS			
Bufo microscapanus californicus	arroyo southwestern toad	C2	SC
Rana aurora draytoni	California red-legged frog	C1	SC
REPTILES			
Clemmys marmorata pallida	southwestern pond turtle	C1	SC
Phrynosoma coronatum blainvillei	San Diego horned lizard	C2	SC
Cnemidophorus tigris multiscutatus	coastal western whiptail	C2	
Diadophis punctatus modesto	San Bernardino ringneck snake	C2	
Lampropeltus zonata pulchra	San Diego mountain kingsnake	C2	
Lichanura trivirgata rosafusca	coastal rosy boa	C2	
Salvadora hexalepis virgultea	coast patch-nosed snake	C2	SC
Thamnophis hammondii	two-striped garter snake	C2	
BIRDS			
Ixobrychus exilis hesperis	western least bittern	C2	SC
Pelecanus occidentalis californicus	brown pelican	E	E
Histrionicus histrionicus	harlequin duck	C2	SC
Haliaeetus leucocephalus	bald eagle	E	E
Aquila chrysaetos	golden eagle	FP	SC
Buteo swainsoni	Swainson's hawk	C3	T
Falco peregrinus anatum	American peregrine falcon	E	E
Rallus longirostris levipes	light-footed clapper rail	E	E
Charadrius alexandrinus nivosus	western snowy plover	T	SC
Sterna antillarum browni	California least tern	E	E
Sterna elegans	elegant tern	C2	SC
Brachyramphus marmoratus	marbled murrelet	T	E
Empidonax trailii extimus	southwestern willow flycatcher	E	E
Coccyzus americanus occidentalis	western yellow-billed cuckoo		E
Eremophila alpestris actia	California horned lark	C2	SC
Riparia riparia	bank swallow		T
Campylorhynchus brunneicapillus couesi	coastal cactus wren	C2	SC
Polioptila californica	California gnatcatcher	E	SC
Lanius ludovicanus	loggerhead shrike	C2	SC
Vireo belli pusillus	least Bell's vireo	E	E
Agelaius tricolor	tri-colored blackbird	C2	SC
Aimophial ruficeps canescens	S. California rufous-crowned sparrow	C2	SC
Passerculus sandwichensis beldingi	Belding's savannah sparrow	C2	E
MAMMALS			
Euderma masulatum	spotted bat	C2	SC
Eumops perotis californicus	greater wetern mastiff bat	C2	SC
Marcrotus californicus	California leaf-nosed bat	C2	SC
Myotis lucifugus occultus	occult little brown bat	C2	SC
Plecotus townsendii townsendii	Pacific western big-eared bat	C2	SC
Sorex ornatus salicornicus	salt marsh ornate shrew	C2	SC
PLANTS			
Cordylanthus maritimus maritimus	salt marsh bird's beak	E	E
Astragalus pycnostachys lanosissimus	Ventura marsh milk vetch	C1	
Astragalus tener titi	coastal dunes rattleweed	C1	E
Berberis nevinii	Nevin's barberry	C1	
Chorizanthe parryi fernandina	San Fernando Valley chorizanthe	C1	

STATUS:

- E Endangered : Listed as Endangered
- T Threatened : Listed as Threatened
- C1 Candidate 1 : Sufficient biological data to support a proposal to list as threatened or endangered.
- C2 Candidate 2 : Existing information may warrant listing, but substantial biological support for listing is lacking.
- SC Special concern : California species that has either declined in numbers or its range reduced, population is monitored to see if more study is warranted.
- FP Federally Protected : Protected under federal law.

Table 1: Federal and State listed threatended, endangered, and candidate species that may occur in the Malibu Watershed. Data from the U.S. Fish&Wildlife Service, National Park Service, and Natural Diversity Database. 9/94

TABLE 2. MAXIMUM DAILY AND TOTAL ANNUAL PRECIPITATION RECURRENCE INTERVALS FOR AGOURA AND MONTE NIDO RAIN GAGE SITES

	Maximum Daily Precipitation		Total Annual Precipitation	
Recurrence Interval	Agoura Precip. (in)	Monte Nido Precip. (in)	Agoura Precip. (in)	Monte Nido Precip. (in)
2-year	3.5	4.3	15.7	19.7
5-year	4.7	5	25.6	30.7
10-year	5.5	5.8	29.5	40.2
25-year	6.9	6.9	41.3	52
50-year	8.1	7.7	47.6	60
100-year	9.4	8.7	54.3	68

Source: UCLA Study

ATTACHMENT 3 - HYDRAULIC MODELING

ATTACHMENT 3 HYDRAULIC ANALYSIS

The following attachment is meant to lead a hydrologist through the bypass channel design process. The scope was to design a by-pass channel from Malibu Creek at or near Arizona Crossing. The designed channel should be capable of diverting water from a gated structure (during non-flood periods).

Design assumptions include:

1. Determine a flow magnitude sufficient to spread out at downstream reach terminus and inundate some 12.6 acres. Flow to terminate near Chili Cook-off site. Flows to hypothetically spread out from a wider/shallower floodplain to a wetlands area. Earth can be excavated as necessary at most downstream sections. Runoff to be routed through treatment area and returned to lower lagoon area (or where water quality concerns warrant return path of treated flows).

2. Follow existing contours (with minimal disruption to existing land features) for most of design channel's course (path of some 4000 feet).

3. Design channel to be no wider than a street width or about 16.0 feet (or less).

4. By-pass channel to be designed to carry two flows in sub channels, i.e., maximum treatable discharge in the thalweg channel (up to 8.45 cfs) and the remainder in intermediate/upper channel. Channel dimensions to be designed to include pedestrian walkway if community desires one.

5. Flow velocities and water depths in by-pass channel cannot exceed or be at "critical velocity or depth" or at any unstable flow conditions that would create a potential flood hazard. Velocities at flow terminus to approach zero value.

6. Design channel for "natural roughness" (N=0.035-0.045), rather than a concrete lined channel (N=.015).

7. Treated return flows will require culvert capacity design to retain continuous water circulation within the bypass system.

Step 1: Determine Magnitude and Return Flows Within Malibu Creek to Be Used in Design of Channel Bypass. Select Design Geometry for Flow/channel Dimensions for Hydrology Associated with the Project

Hydraulic analysis was conducted as a water balance of the project area utilizing the data found below:

DATA SOURCES FOR HYDRAULIC ANALYSIS		
SOURCE	**DATE**	**TYPE OF DATA**
USGS	1931-1979	Annual Daily Values
UCLA (2000)	1931-1998	Total Annual Summation
UCLA (2000)	1950-1998	Instanteous Peak Discharge
The USGS operated this station between 1931 and 1979, since then the Los Angeles Flood Control District (LAFCD) has continued to collect data at the site. Data was analyzed using Pearson III (Appendix 2, Tables 3 and 4).		

H&C constructed a hydraulic data set to estimate annual daily maximum flows for use in a HECRAS model in order to conduct a preliminary design for a bypass channel. A Pearson type III analysis was applied to the data set (Malibu Creek at Calabasas - site no.11105500 - 1931 to 1979) for the purposes of this feasibility report. Hydraulic analysis results are summarized in Appendix 1, Figures 3 and 4, and Appendix 2, Tables 2a and 2b for annual maximum daily flows and the total annual runoff frequencies for the return periods during the 1931 to1998 period[15] (H&C and UCLA Report). For the purpose of this feasibility report, flows from the proposed bypass channel;

- Must be "captured" downstream,
- Pose no flood threats,
- Routed discharge should be reasonably small, and
- Be manageable at it's terminus near the "Chili Cook-off" area.

Ideally, a bypass channel would be designed to convey a 2-year to 25-year flow event(s) for habitat considerations/specifications. However, as noted above, a 2-year flow equates to 1,000 cfs, and a 25-year flow is 6,600 cfs (Attachment 3, Appendix 2, Table 2b) and such flows are greater than the capacity of a small bypass channel. Because this bypass channel's main objective is to divert flow to the constructed wetland, a more thorough data review was conducted and it was determined that mean daily flows are approximately 23 cfs. It should also be noted that the Chili Cook-off site is in the 100 year FEMA floodplain and at flood stage has an average flood depth of 1.0 ft.

Flow analysis indicates that low flows of approximately 3 cfs are adequate to provide a fresh water source for the Chili Cook-off site[16]. Three cfs or less occurs 61 percent of the time in Malibu Creek

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[15] The data from Tables 2a and 2b are presented here for future use in a potential design phase.

[16] Three cfs is the highest mean daily flow that can be diverted and treated at the Chili Cook-off site over a seven day period. A seven day period is necessary to effect treatment of nitrogen. The Chili Cook-off site is 15.8 acres (of which approximately 12.6-acres are available for the actual treatment wetlands).

(using a seven day retention time). However, the potential to buy more property in the Malibu Civic Center area would allow for greater diversions and therefore more treatment wetlands.

The mean daily flows in Malibu Creek are approximately 23 cfs. Mean daily flows of 23 cfs or less occur 91 percent of the time in Malibu Creek. Therefore, a design channel should accommodate approximate 23 cfs, with some margin of freeboard.

In conclusion, for the period of (non-USGS data), the 1979 through 1998 annual daily maximum flows were estimated by a regression derived from overlapping the concurrent instantaneous peak flow period. The Pearson and Normal Probability statistics of mean, standard deviation, and skew values did not statistically differ from the original analysis (when H&C changed 24200 to 9000 cfs) based on the USGS data of 1930-1979. The maximum daily mean flow for January 25,1969 peak flow of 33.800 cfs calculated from above regression was 8650 cfs, similar to the estimated daily mean value of 9000 cfs used above in initial analysis. What does this mean?

Step 2: Determine Bypass Channel Dimensions:

Look at the combinations of parameters needed for hydraulic modeling and make a selection for channel design based on above hydrology of 3.0, 8.5, and 23 cfs from Step 1. Appendix 1, Figures 5a and 5b and Appendix 2, Table 5a and 5b cover potential range of bypass design dimensions.

Step 2 Result: Variables needed for consideration in channel design:

Variables needed to estimate bypass channel size include: Z (side-slope), Y (depth of flow), B (bottom channel width), W (top channel width), N(Manning roughness value), Hydraulic Radius (R), Area, (A), and S (slope) for a multi-shaped trapezoidal channel.

Range of data looked at included Z's, 1.0 to 3.0, N values, 0.033 to 0.055, Widths from 0.3 to 60.0 feet, and Depths (Y) from 0.1 to 3.2 feet. The reduced range of variables needed for low flows (variable flows allowable for final design considerations) are listed in Appendix 2, Tables 5a and 5b and shown in Appendix 1, Figures 5a and 5b.

Step 3. From results of Step 2 find an average solution to handle expected bypass flows:

The task is to find a match of hydraulic parameters generated from Step 2 and the hydrology determined from Step 1. That is, the discharge solution for the "channel-defining" flows of 8.5 and 23 cfs and the corresponding channel geometry generated from Step 2 (Appendix 2, Tables 5a and 5b).

Step 3 Result: Selected channel dimensions:

Review of values from Tables 5a and 5b of Step2:

Suggested values or magnitudes of modeled parameters for 8.45 and 23 cfs, include: Z= 2.0, Y (depth) =1.2 to 1.4 ft depending on each subsections used, N can vary from 0.035 and 0.045, S (slope) = 0.0041 for upper channel, and slope equal to 0.0005 ft/ft at terminus reach. Low flows are expected to "nearly" pond at the terminus acreage, i.e. velocities are at a minimum, and the depth can approximate up to 3.0 feet inundation over the 12.6 acres.

Step 4: Use HEC-RAS Model to route flows down slope:

Build hydraulic model:

Input geometric design data from Step 3 into HEC-RAS hydraulic model. Shape cross sections to mimic Step 3 results. Selected cross section stationing distance along channel is at or near each foot change of bed elevation or where sub-reach x-section(s) needed to encounter rapid flow conditions in the model runs (instability of model) (Appendix 1, Figure 6). Top of bypass "ditch" to be at existing ground-contour elevations per dimensions described above.

Size of outlet culvert should allow outflow of discharges in excess of 3 cfs, and perhaps handle the mean daily flow of 23 cfs from the Chili Cook-off site and other areas.

Step 4 Result: HEC-RAS output to match initial scenario and design criteria addressed above:

Input prepared for HEC-RAS model to duplicate required design flow boundaries (Appendix 3, CD1). Output to Step 5.

Step 5: Check initial results for satisfaction of design scenario:

Flows are routed through hypothetical reach (cross sections)(Appendix 3, CD1). Profiles (Appendix 1, Figures 7a and 7b) and each cross section (Appendix 1, Figures 8 - 32) were checked for critical flow conditions and possible data entry errors. Modeled reach was checked to see if the low flow water-surface elevations generated from 8.45 cfs matched the top of ground elevation surface of lower thalweg designed channel.

Check for reasonableness of all flow boundaries and cross sections.

Step 5 Result: Check results and state pro's and con's of modeled reach:

- Check profile output for steepness of reach, where critical flows occur.
- Check for correct spacing of cross section with figure axis.
- Check for smooth profile at the lower flows of 3 to 23 cfs.
- Check for flatness of profile on downstream end of profile.
- Check for 2 to 3 feet of depth of pool at lower end.
- Consider the amount of earth removal needed to match this profile base. (Basin with a 7.5-foot to 8-foot bottom elevation).

Look at Appendix 2, Table 6 for small energy slope near the lower five cross sections. Also, at this lower sub reach of five sections review velocity, and Froude number as these should be low areas and the top channel widths are much greater than upstream section dimensions.

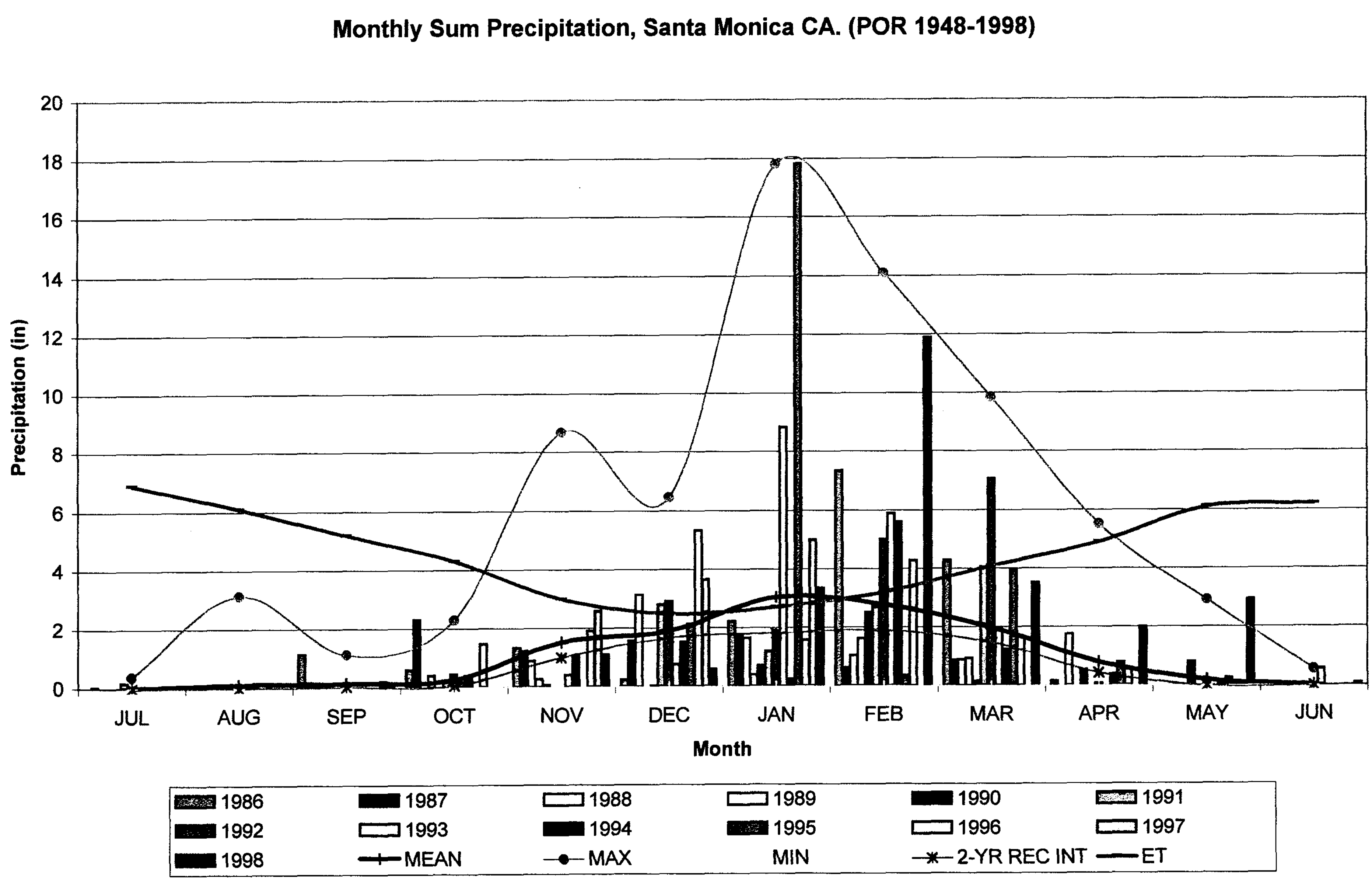
Step 6: Modeling conclusions and concerns:

The reported hydraulics/channel dimensions can be found in Appendix 1, Figures 8 - 32 and Appendix 2, Table 6. Reported findings yield that velocities/depths are moderate enough to flush fine to medium sands, and should not cause any erosion/deposition within design channel. Flows will temporarily "pond" at terminus area and the detention time will be controlled by the outlet culverts. Range of flows from 3 to 23 cfs are contained with the 16-foot wide channel. Hydraulics appear stable for N values selected (0.035 and 0.045). The potential stability problem areas are noted for cross sections 1270, 1700, and 3110 where the Froude number approaches 1.0 at the higher flow rate of 70 cfs. However, this should not be a feasibility design constraint and can be further evaluated in the engineering design phase where channel cross sections and slope can be further adjusted.

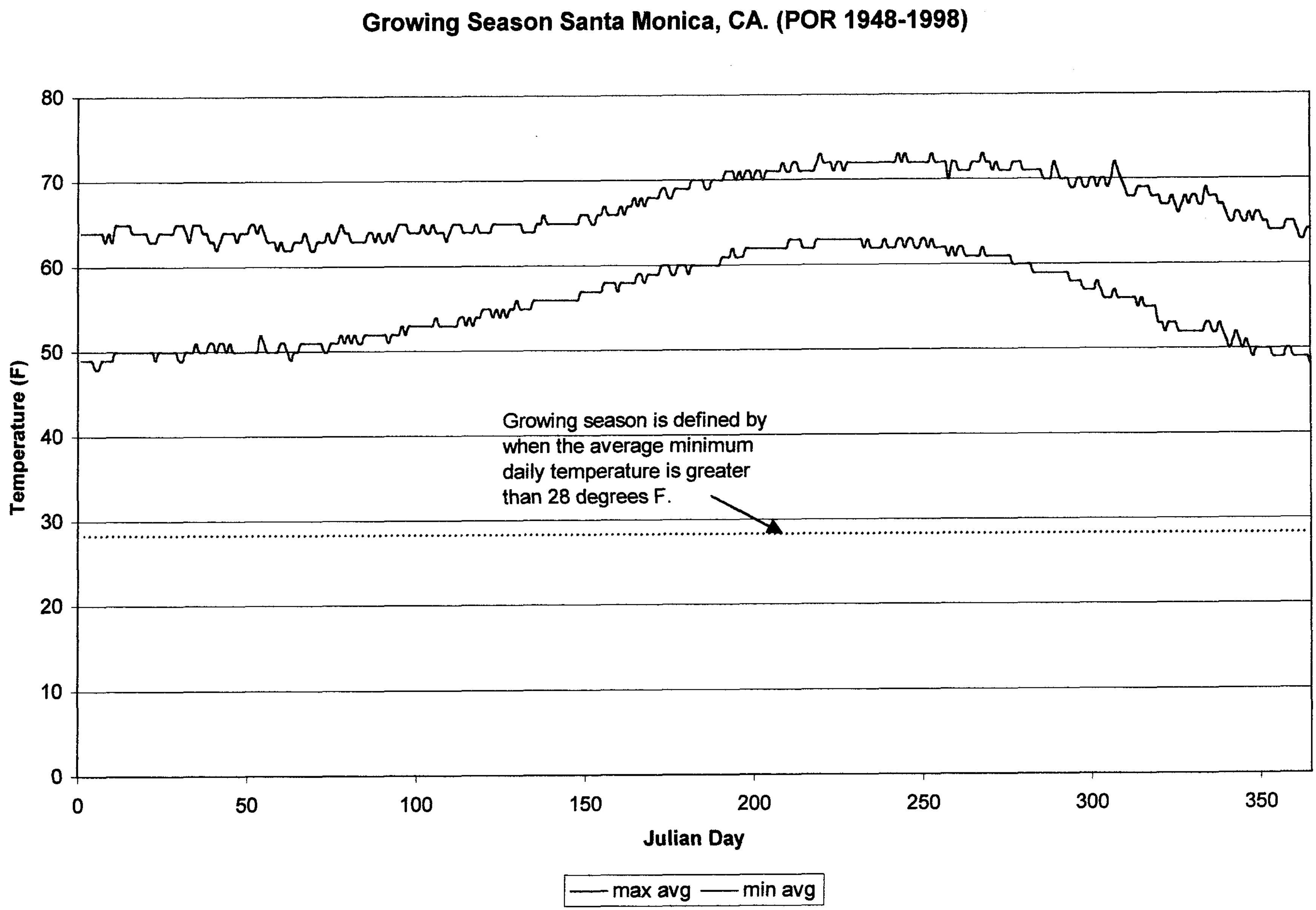
Step 6 Result: General Recommendations:

Recommend using the general hydraulics/hydrology used in this feasibility analysis (Appendix 1, Figures 33 and 34). Also channel capacity or maximum amount of discharge for the designed channel is about 70 cfs (46 cfs if desired). For upstream conditions flow widths for 23 cfs approach 16.0 feet. Flow velocities are moderate at 2 to 3 feet per second. Those flow velocities are near critical (Froude number near 1.0) and should be reduced by increasing roughness at or just downstream of various cross sections. An increase in roughness may lower velocities and increase depths, which would also reduce (albeit very) little sediment transport potential. Analysis of sediment transport would need to consider dynamic equilibrium of the channel's system and optimal flow range as linked to the channel's sediment transport potential.

ATTACHMENT 3 - HYDRAULIC MODELING
Appendix 1 - Figures



Attachment 3, Appendix 1, Figure 1



c:\mfh-home\malibu\st monica temp.xls max-min chart

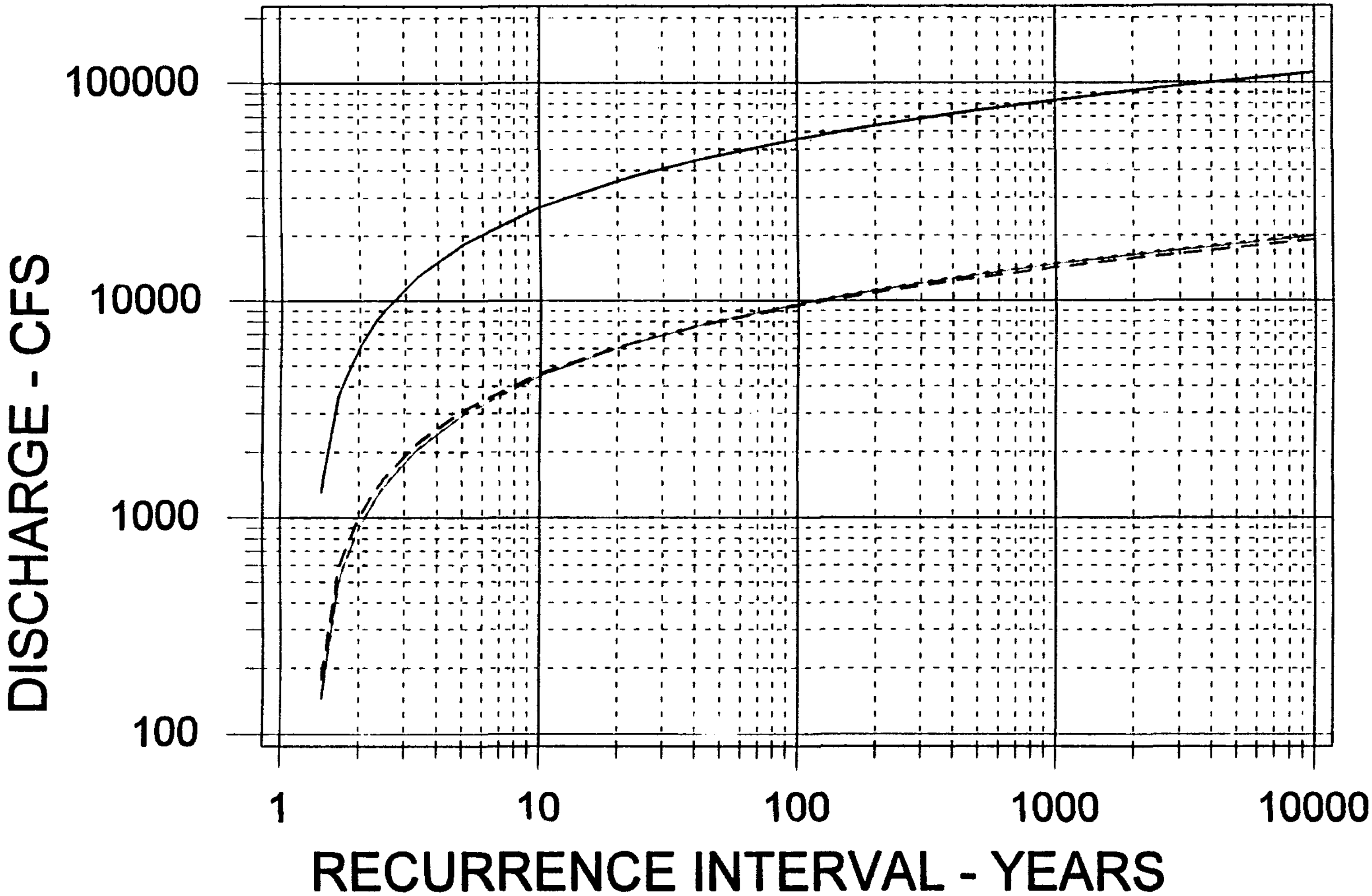
Attachment 3, Appendix 1, Figure 2

PEARSON FLOW FREQUENCY

Annual Total Discharge for 1931-1998

Annual Peak Daily Discharge for 1931-1979 (USGS Data)

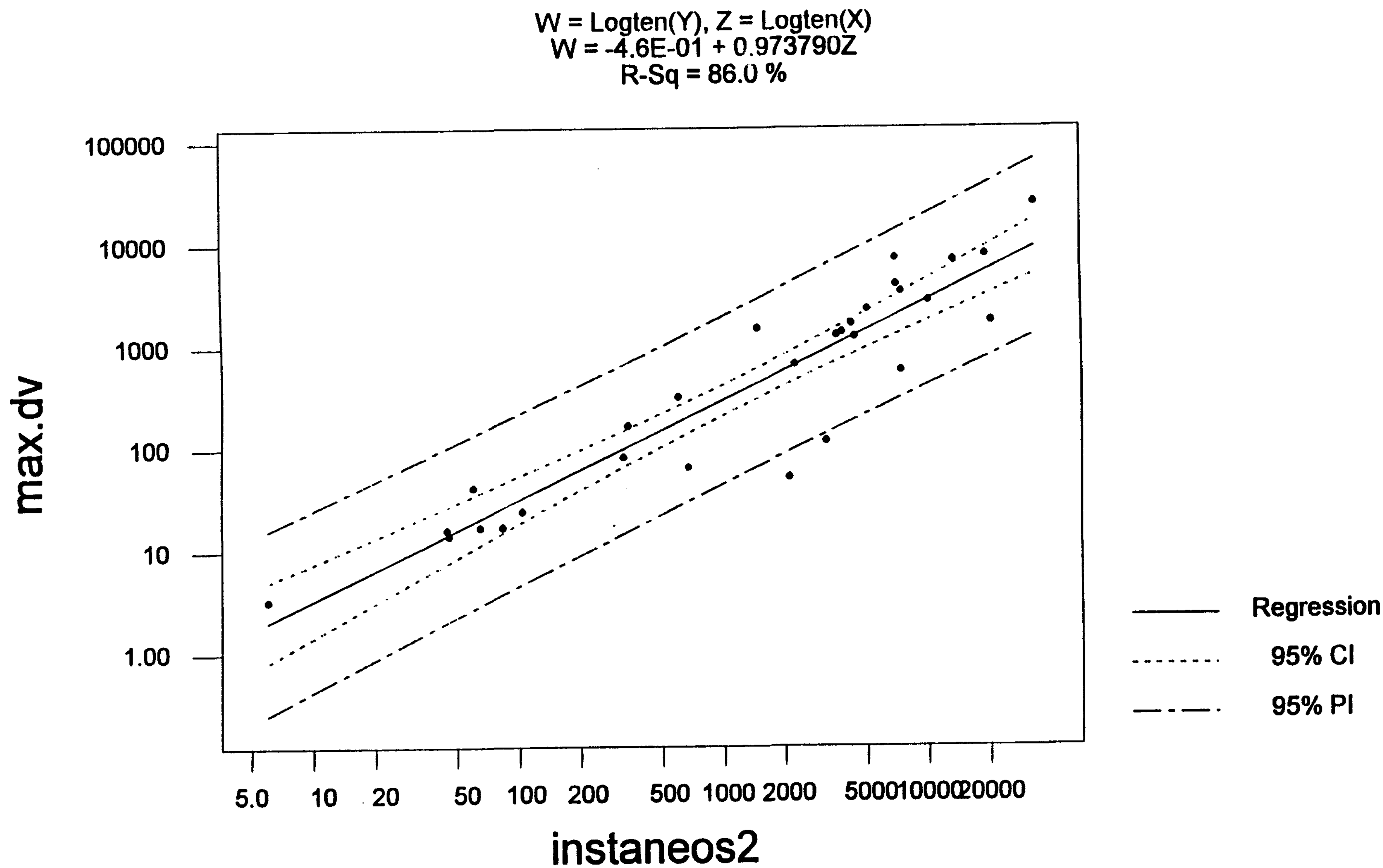
Estimated Annual Peak Daily Discharge 1931-1998



Attachment 3, Appendix 1, Figure 3

l:/projects/malibu/ar/technical/rhea's stuff/dv's.fig1ab

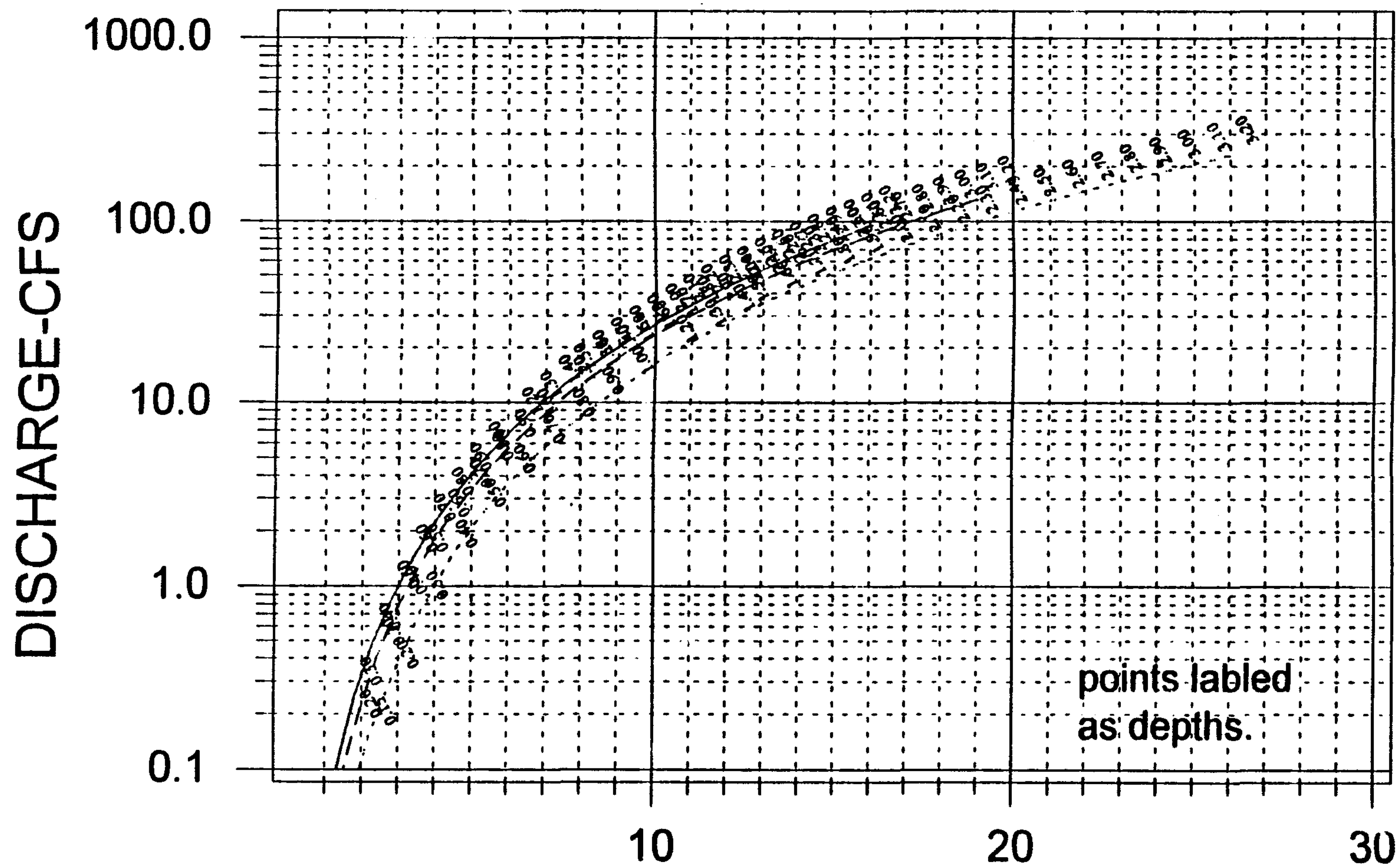
regression to determined non-usgs period of daily values



Attachment 3, Appendix 1, Figure 4

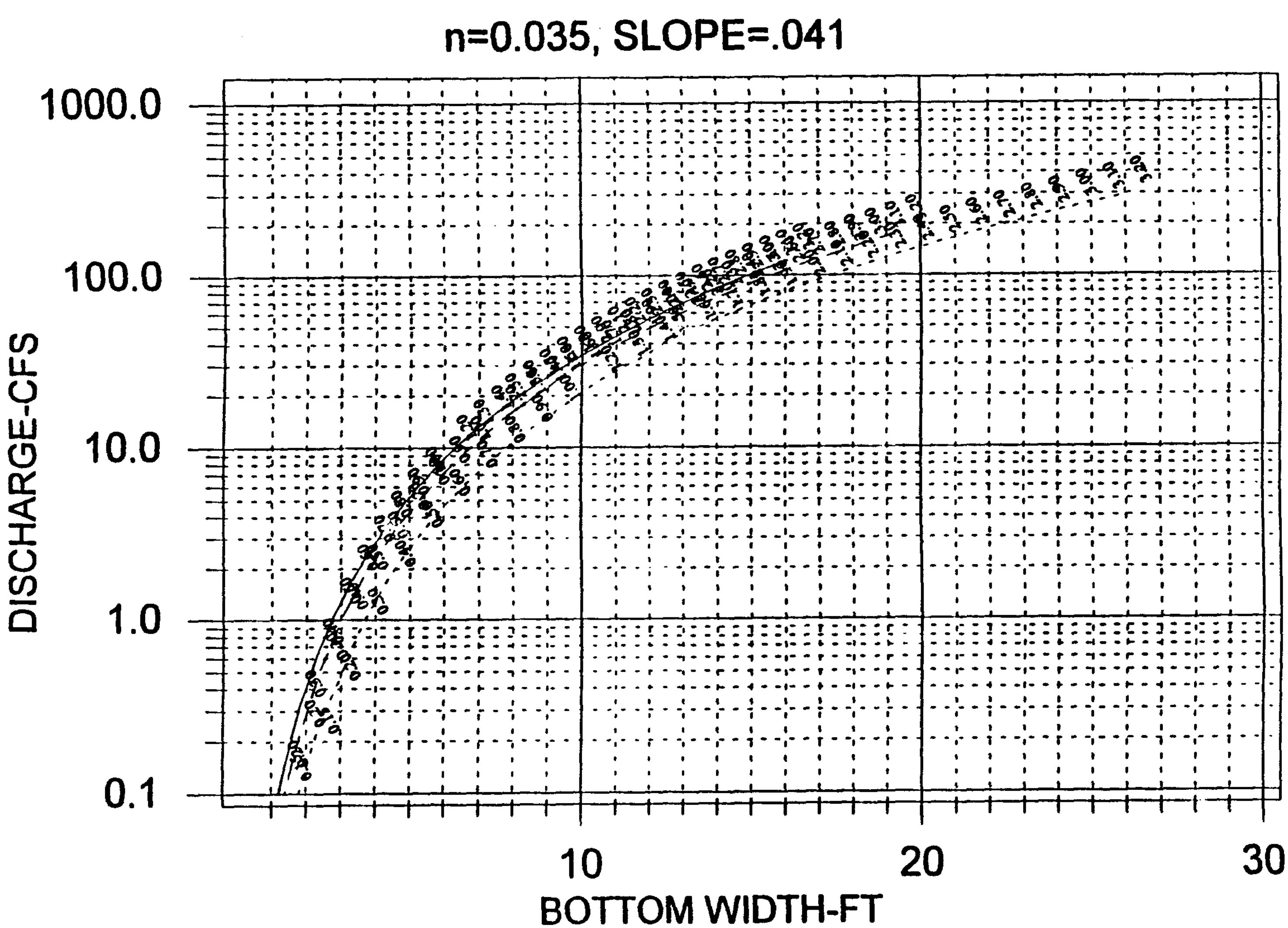
Geometries for Various Trapezoidal Channels

n=0.045, SLOPE=.041

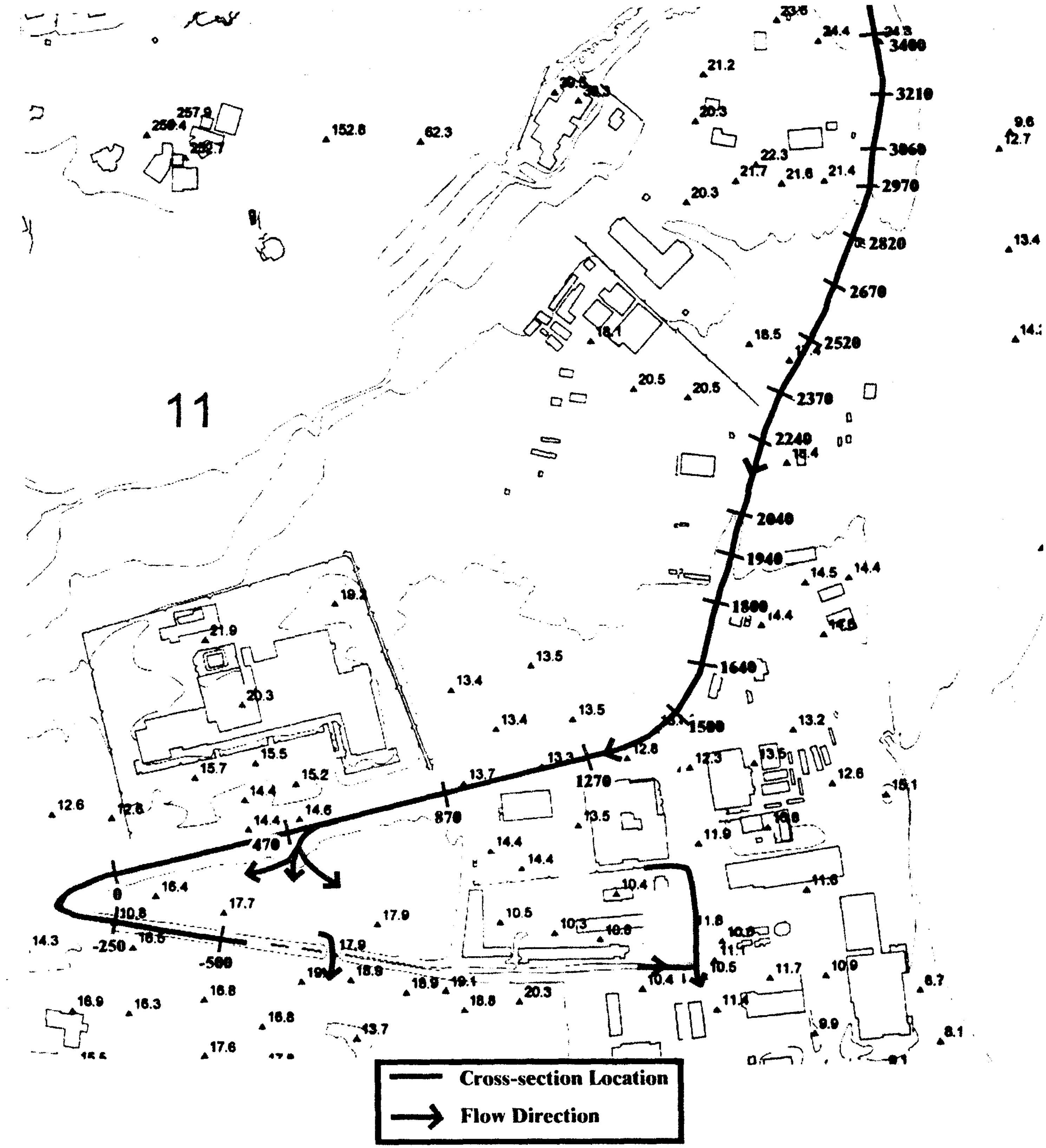


Attachment 3, Appendix 1, Figure 5a

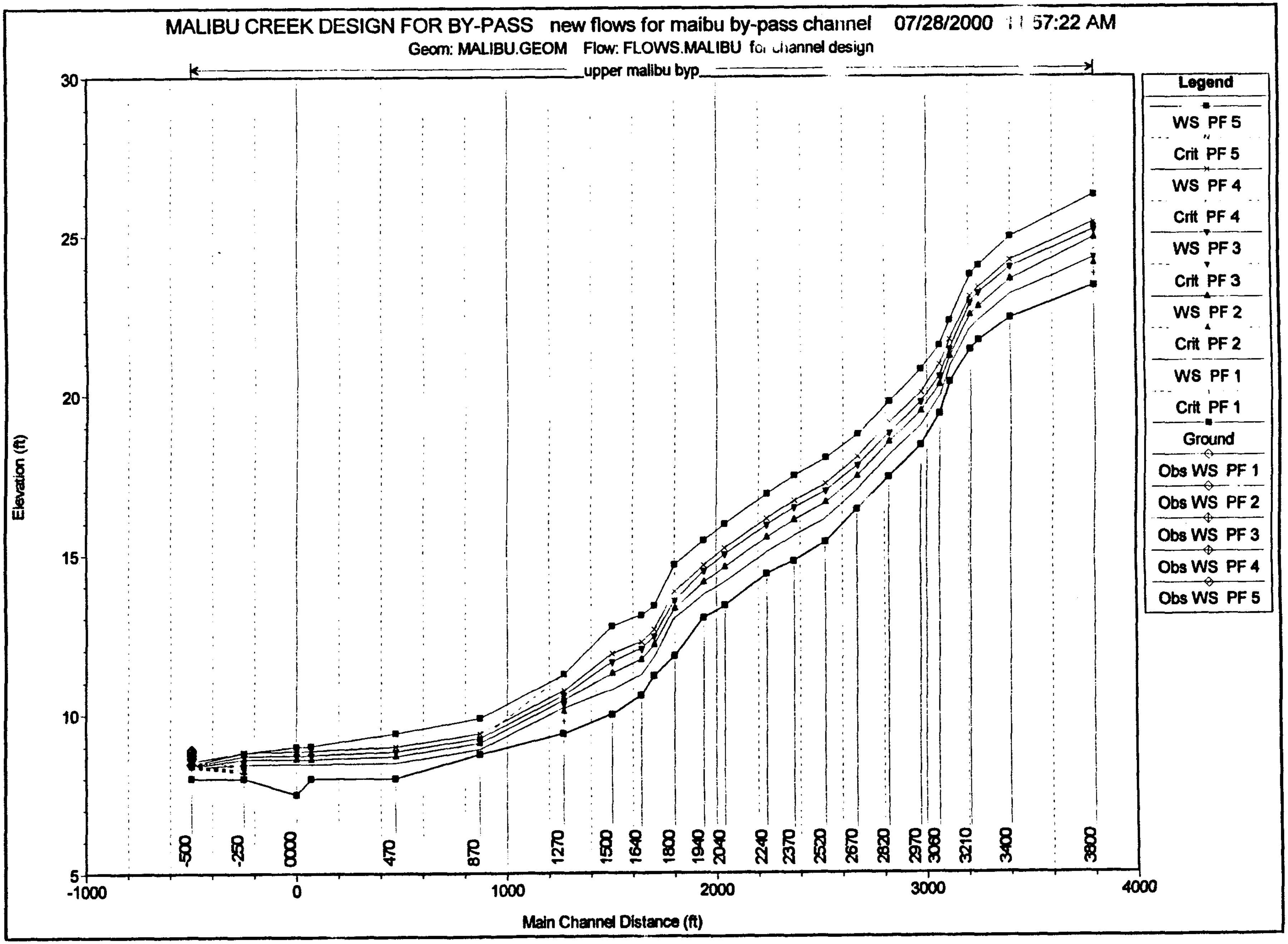
Geometries for Small Trapezoidal Channels



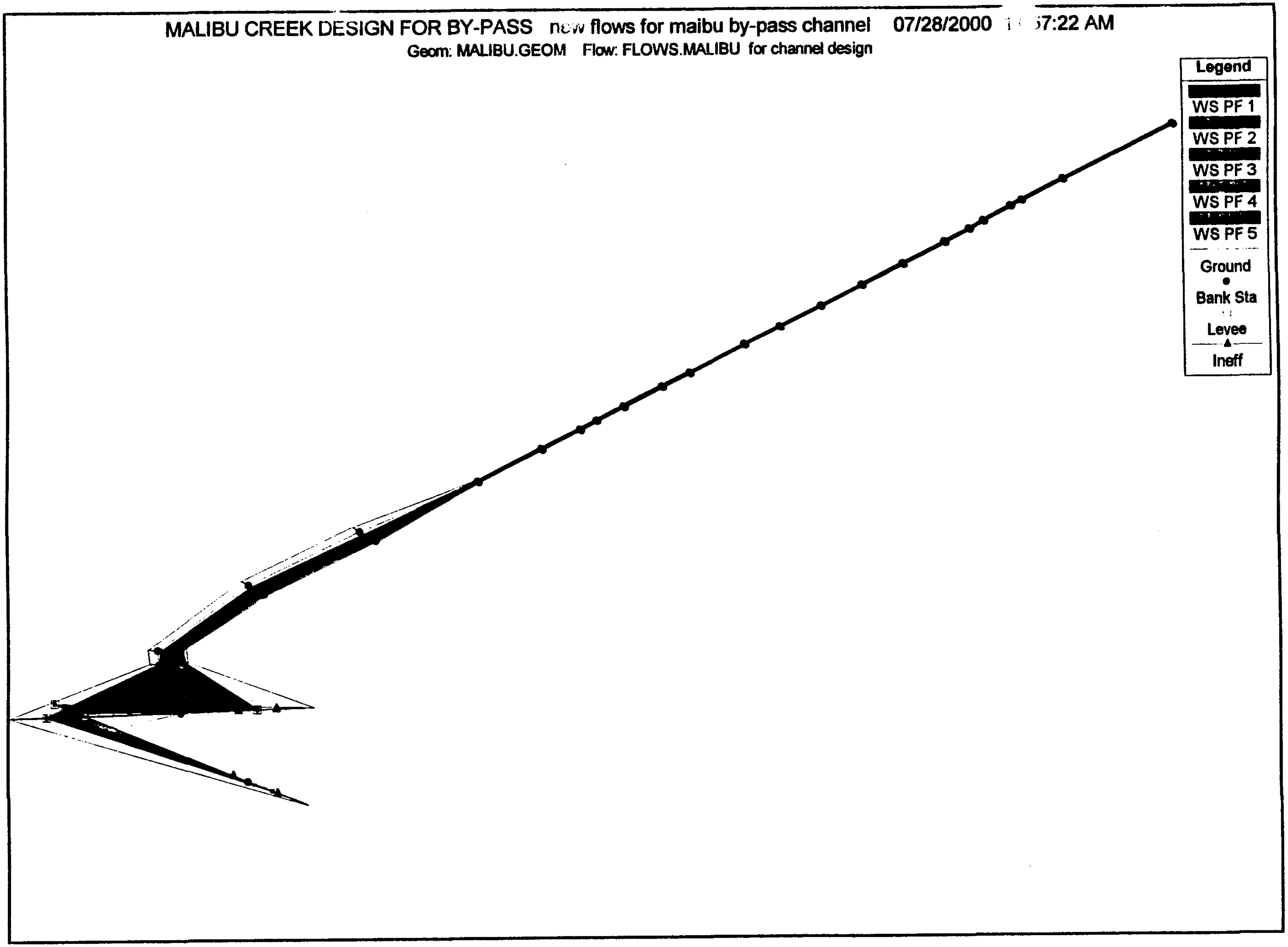
Attachment 3, Appendix 1, Figure 5b



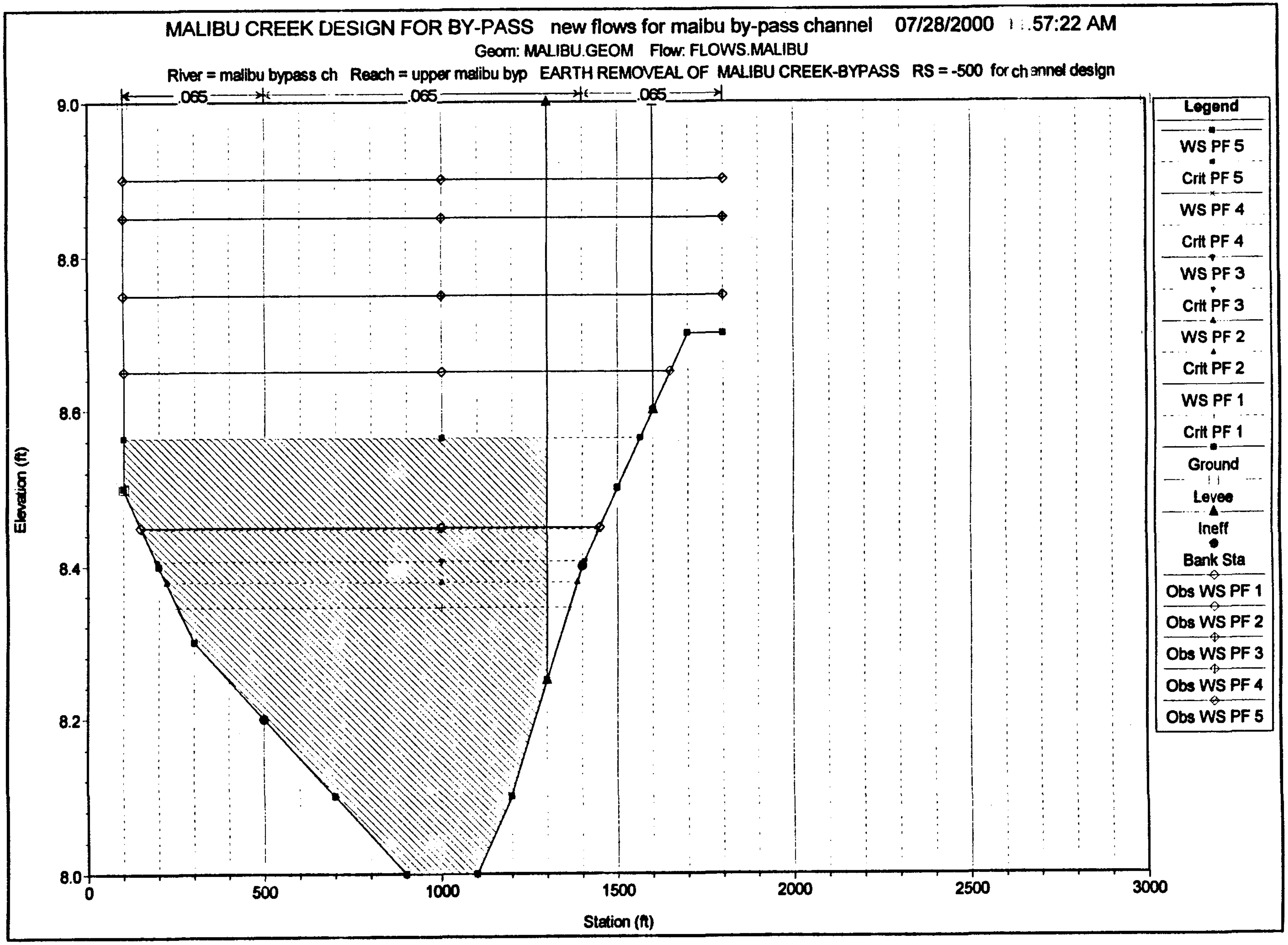
Attachment 3, Appendix 1, Figure 6
Location of Cross-sections Used in HEC-RAS Analysis



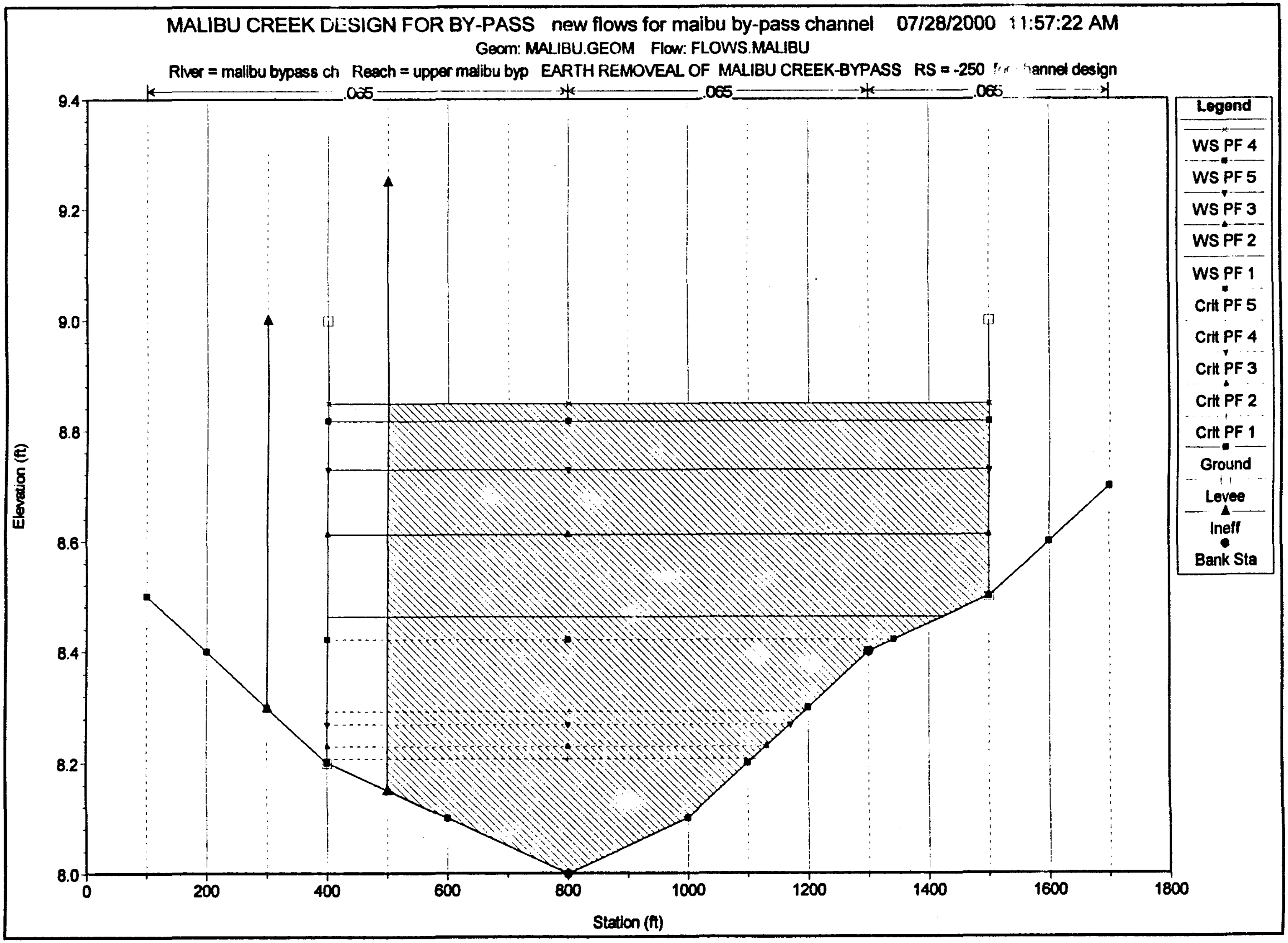
Attachment 3, Appendix 1, Figure 7



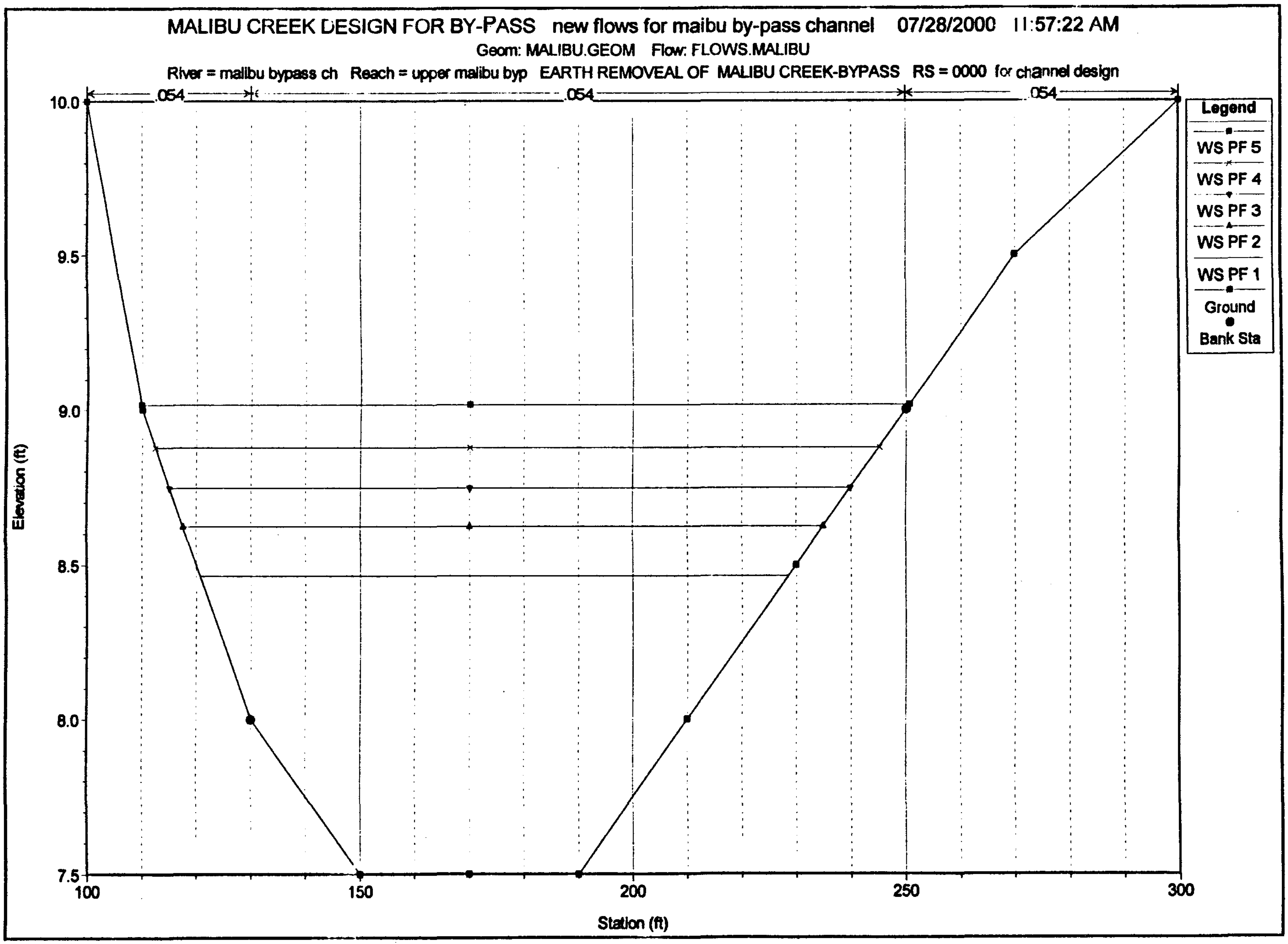
Attachment 3, Appendix 1, Figure 7b



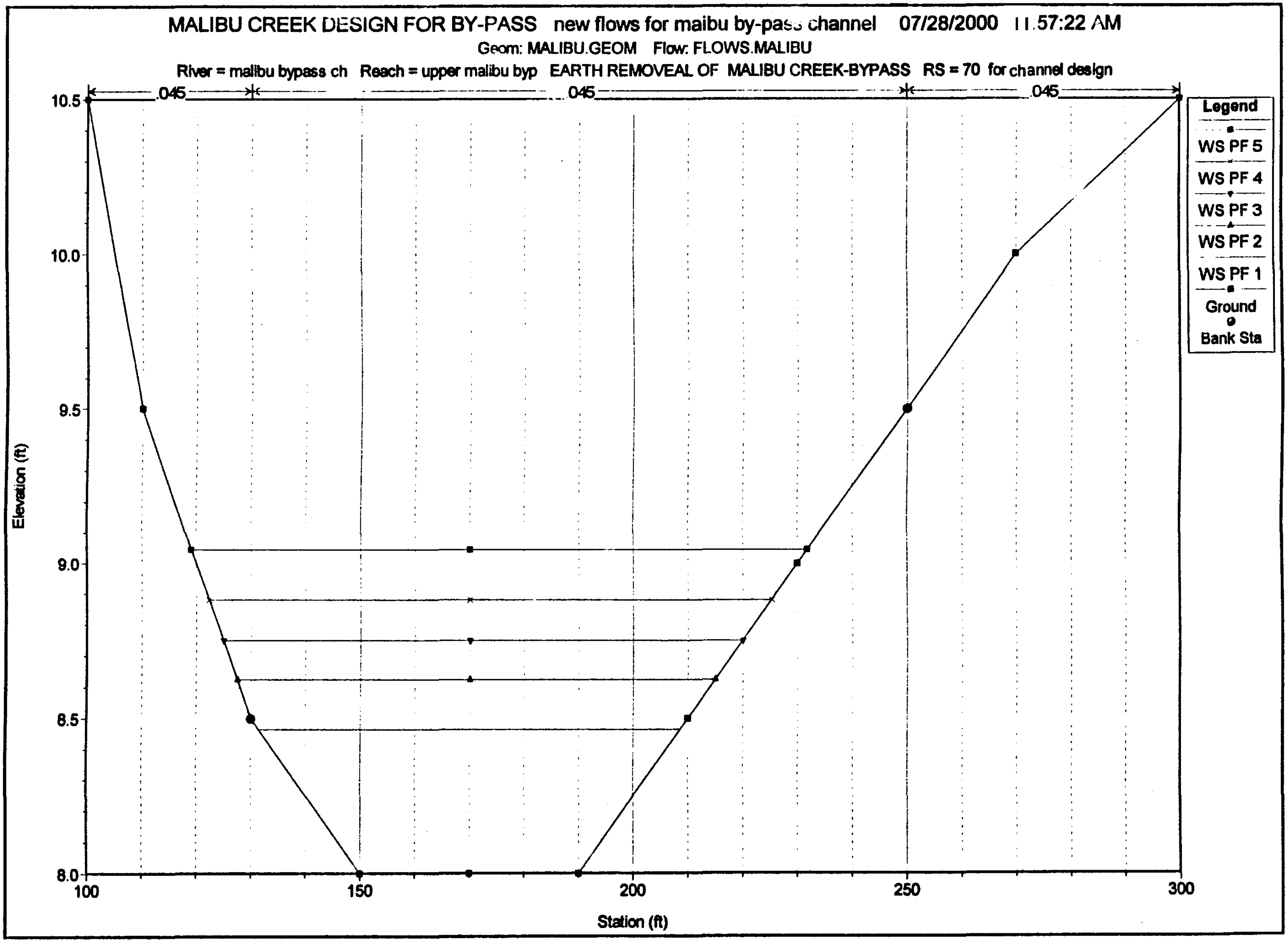
Attachment 3 Appendix 1 Figure



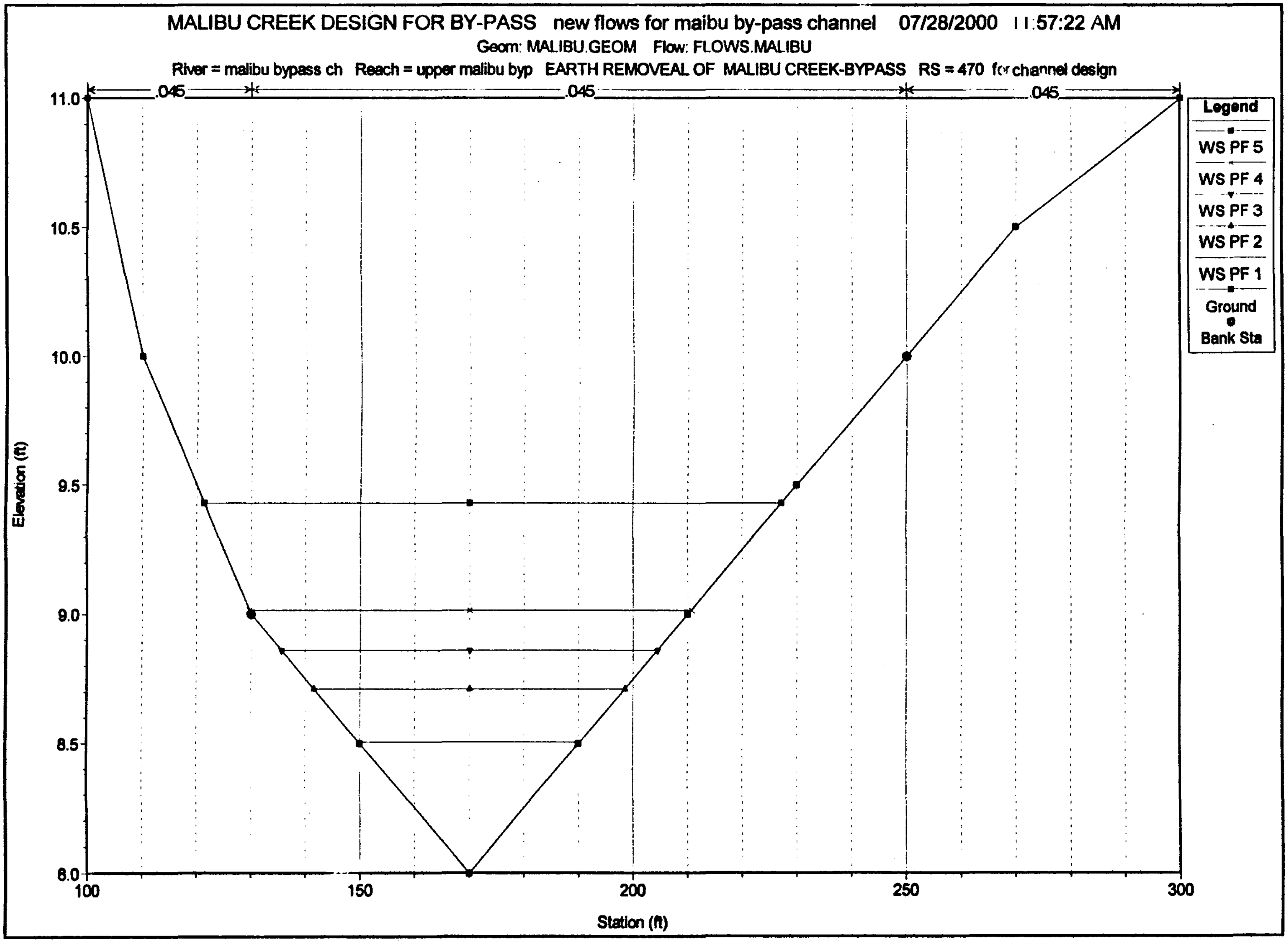
Attachment 3, Appendix 1, Figure



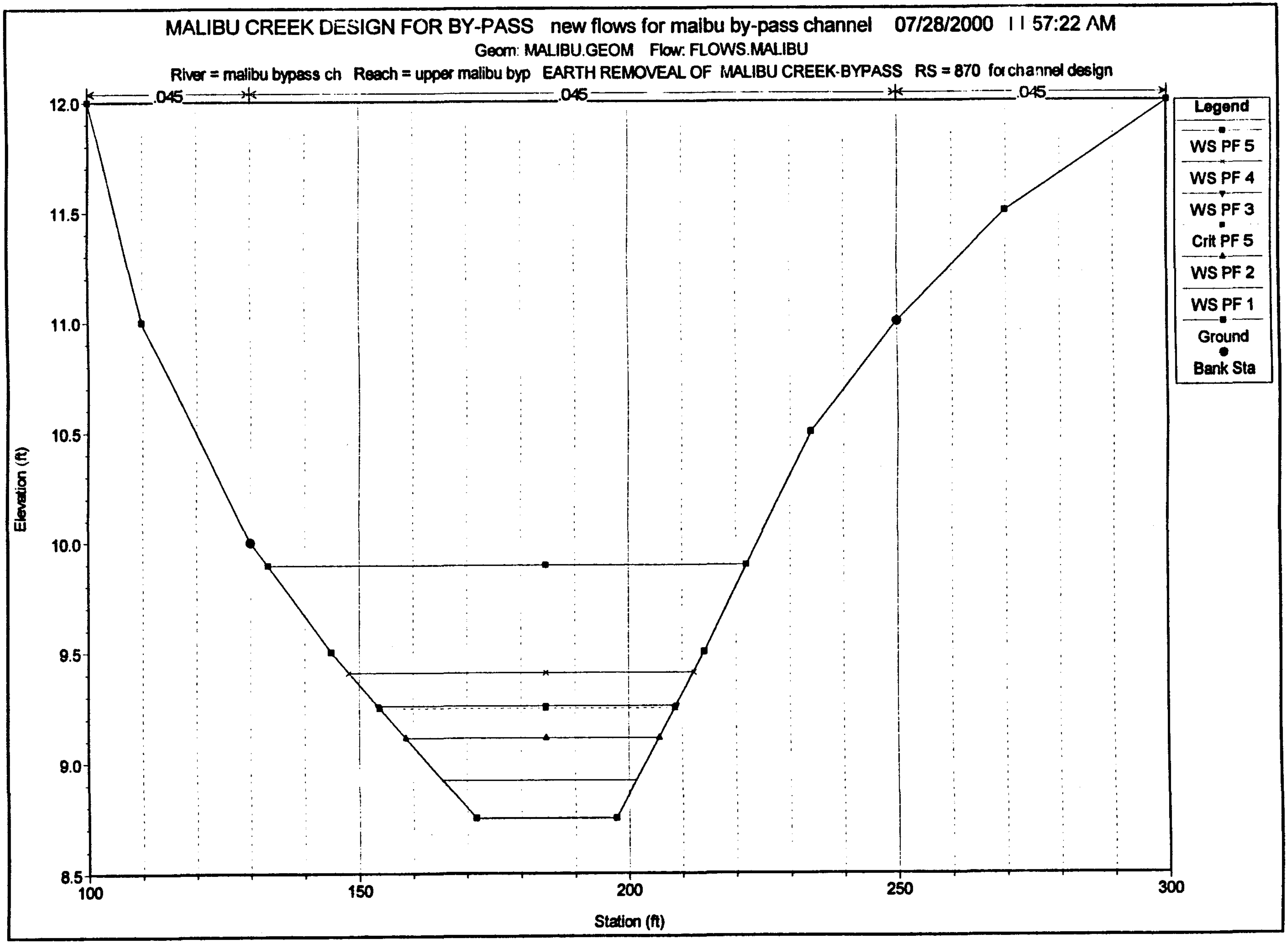
Attachment 3 Appendix 1 Figure 10



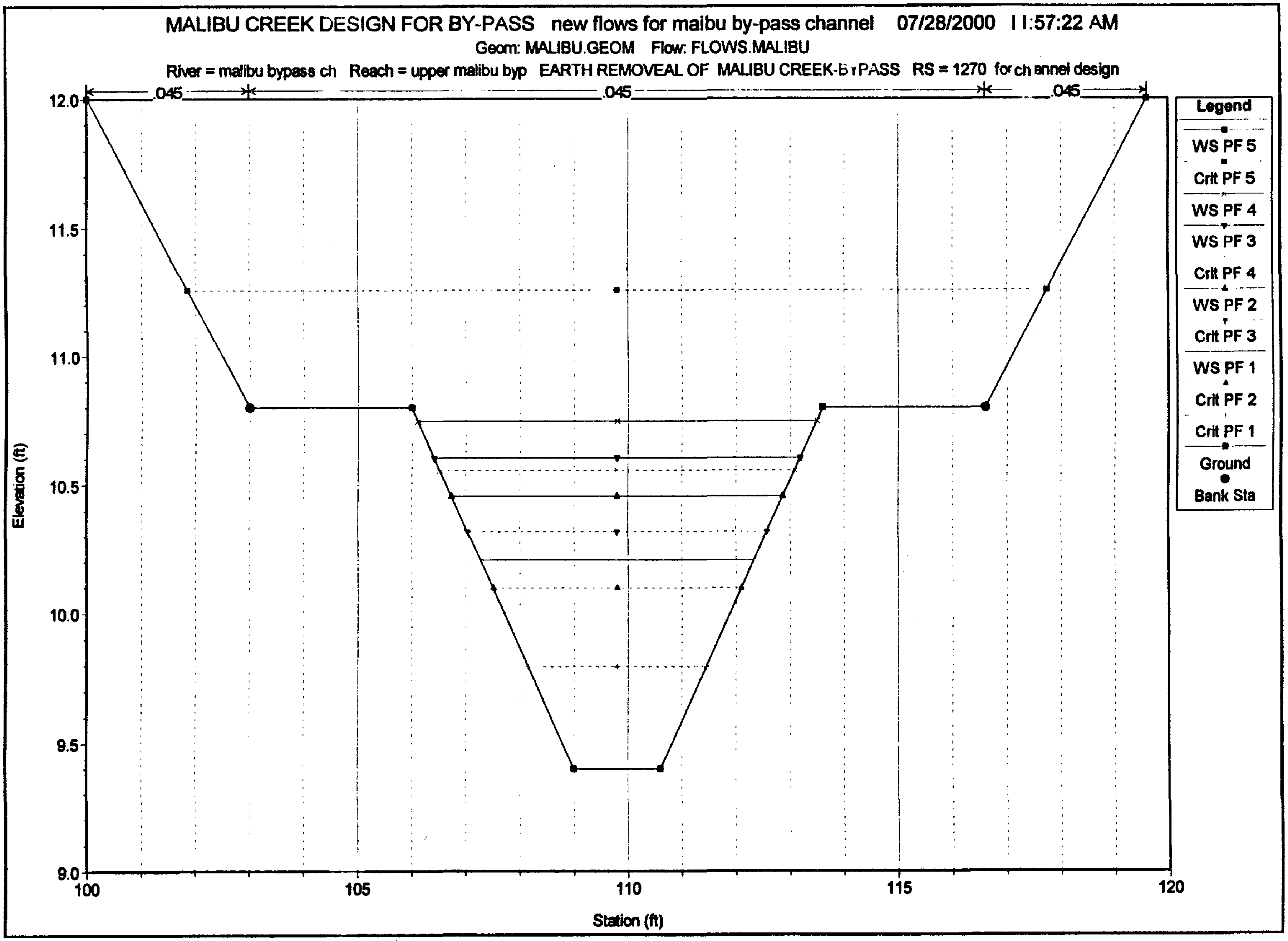
Attachment 3, Appendix 1, Figure 11



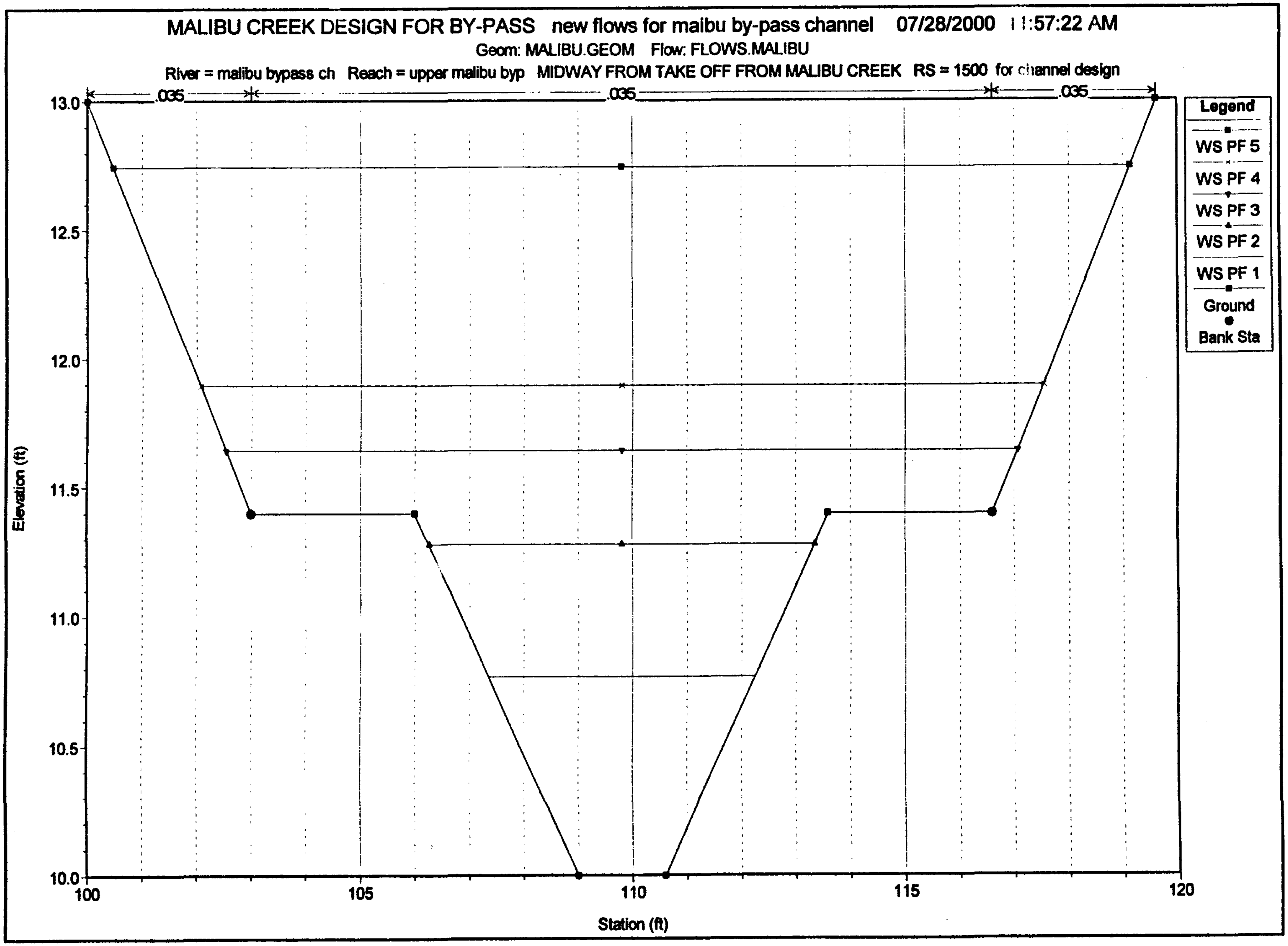
Attachment 3, Appendix 1, Figure 1?



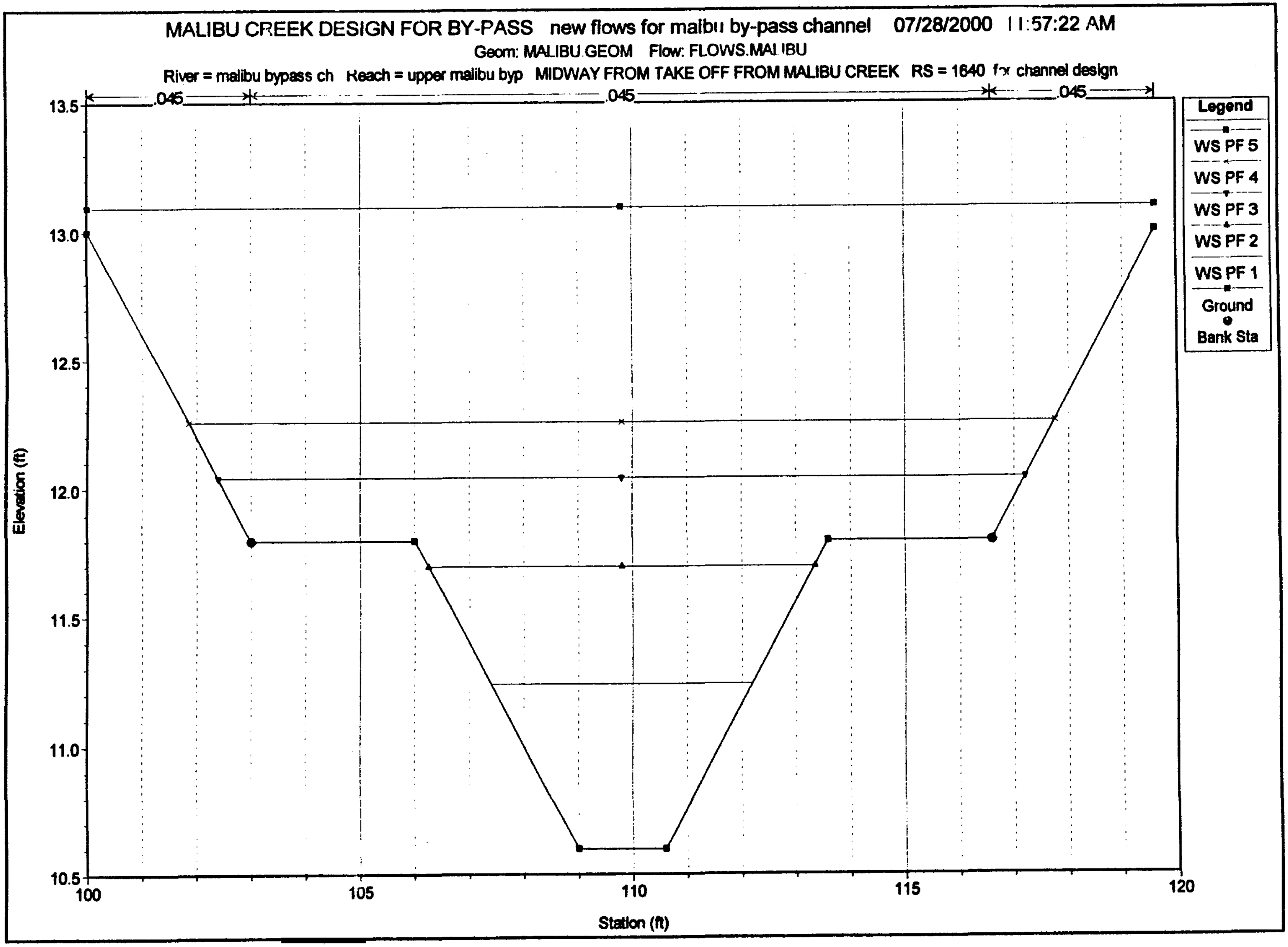
Attachment 3, Appendix 1, Figure 1



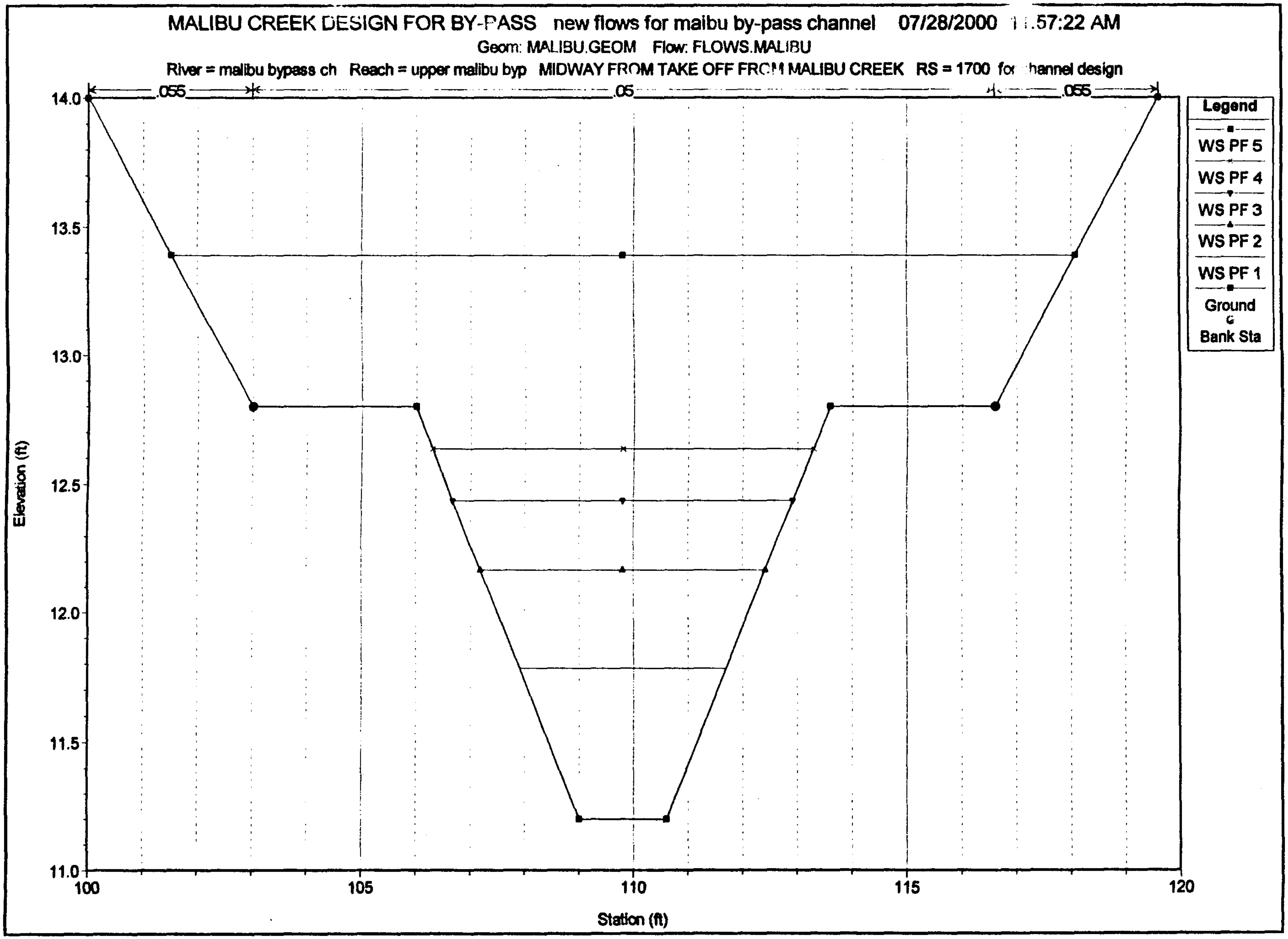
Attachment 3, Appendix 1, Figure 14



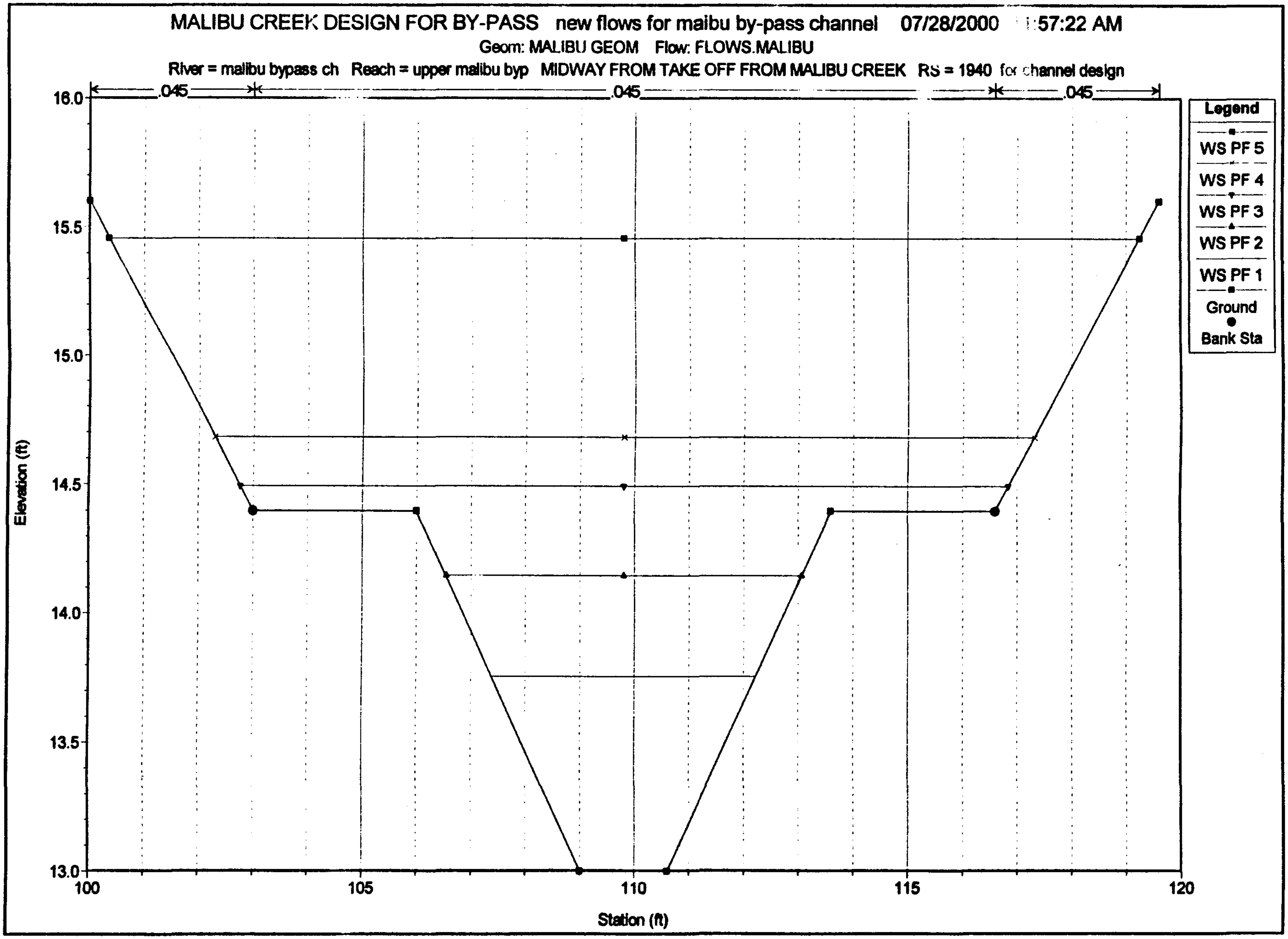
Attachment 3, Appendix 1, Figure 15



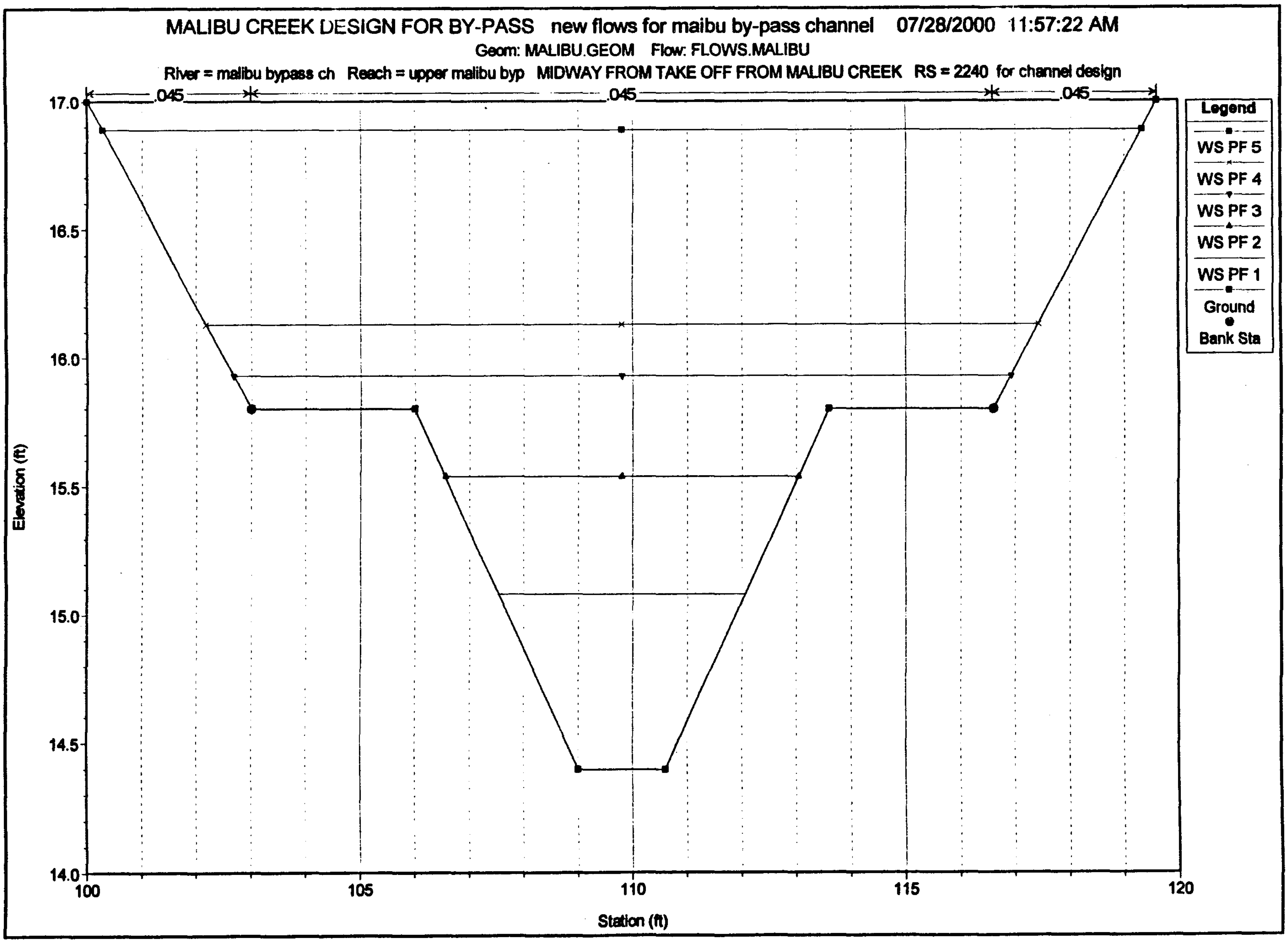
Attachment 3, Appendix 1, Figure 16



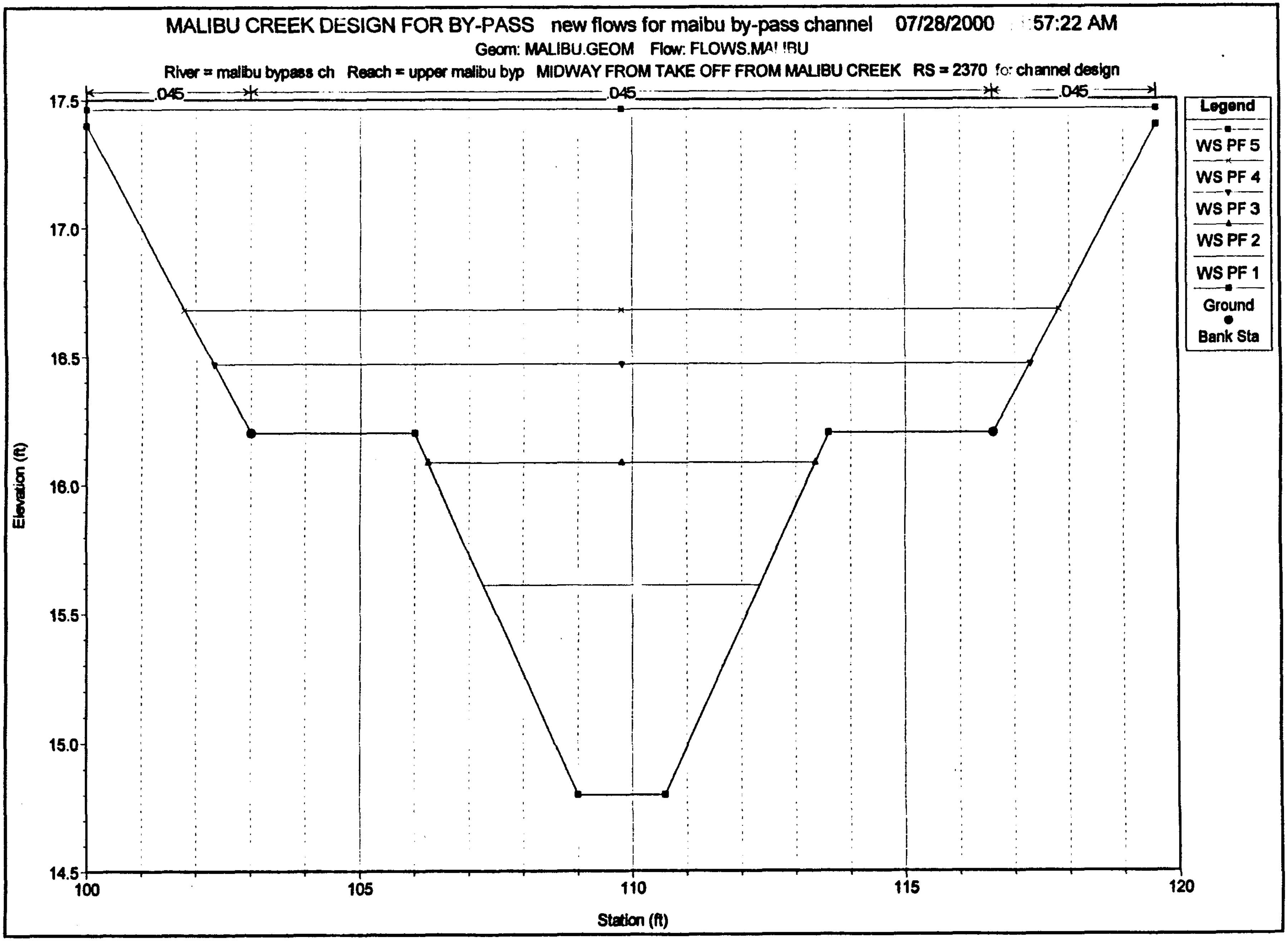
Attachment 3. Appendix 1 Figure 17



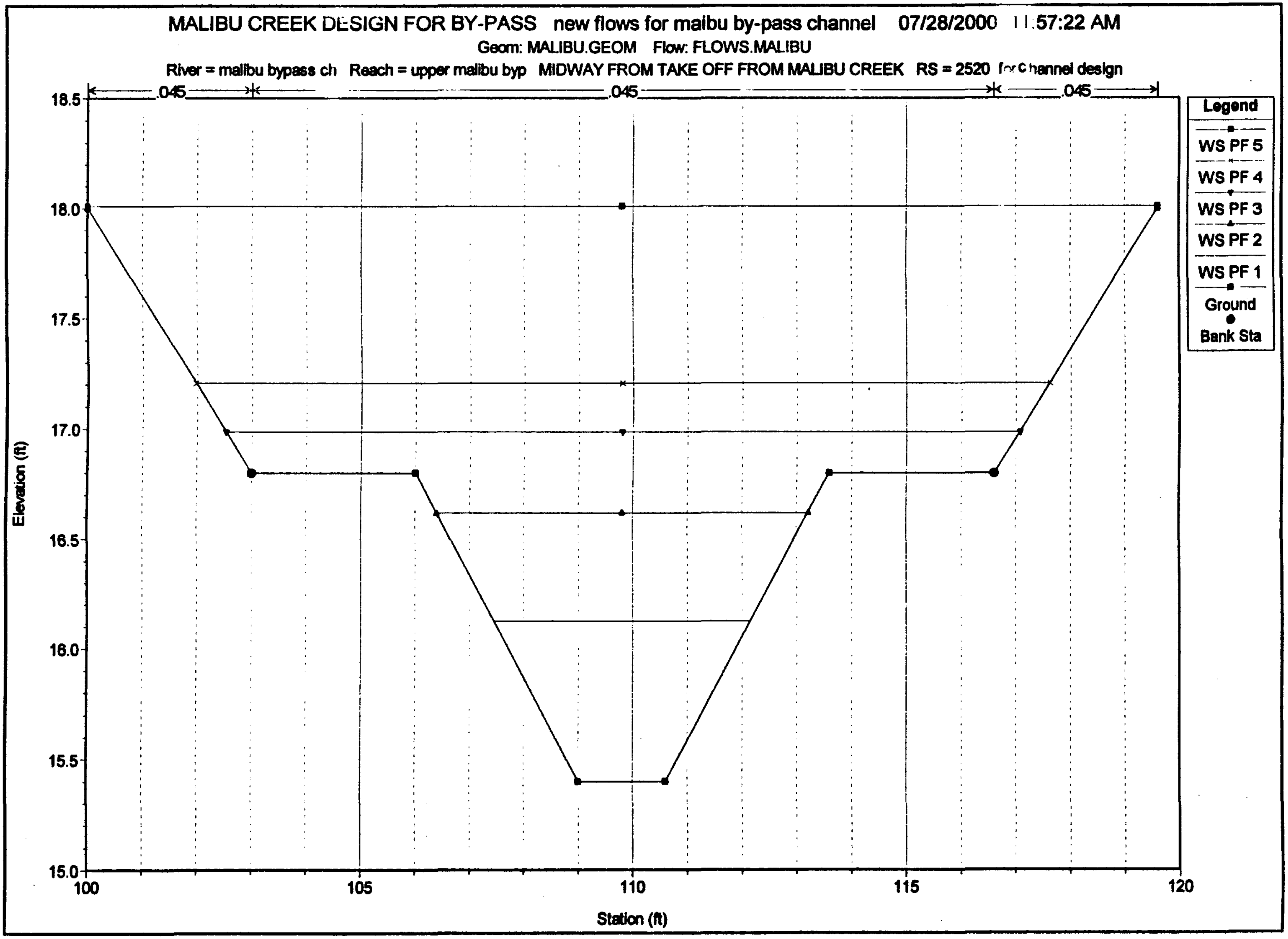
Attachment 3 Appendix 1 Figure 18



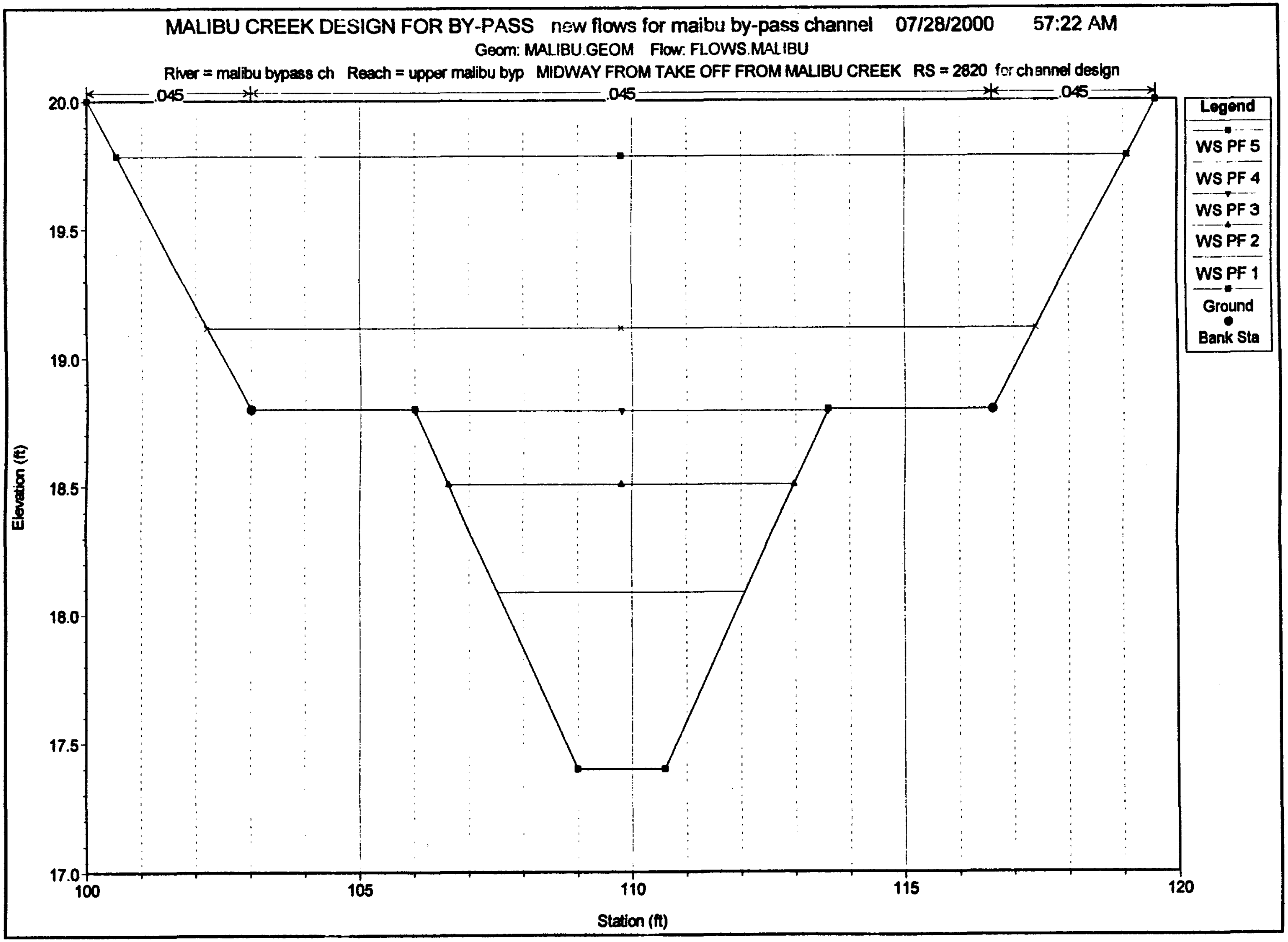
Attachment 3, Appendix 1, Figure 2(



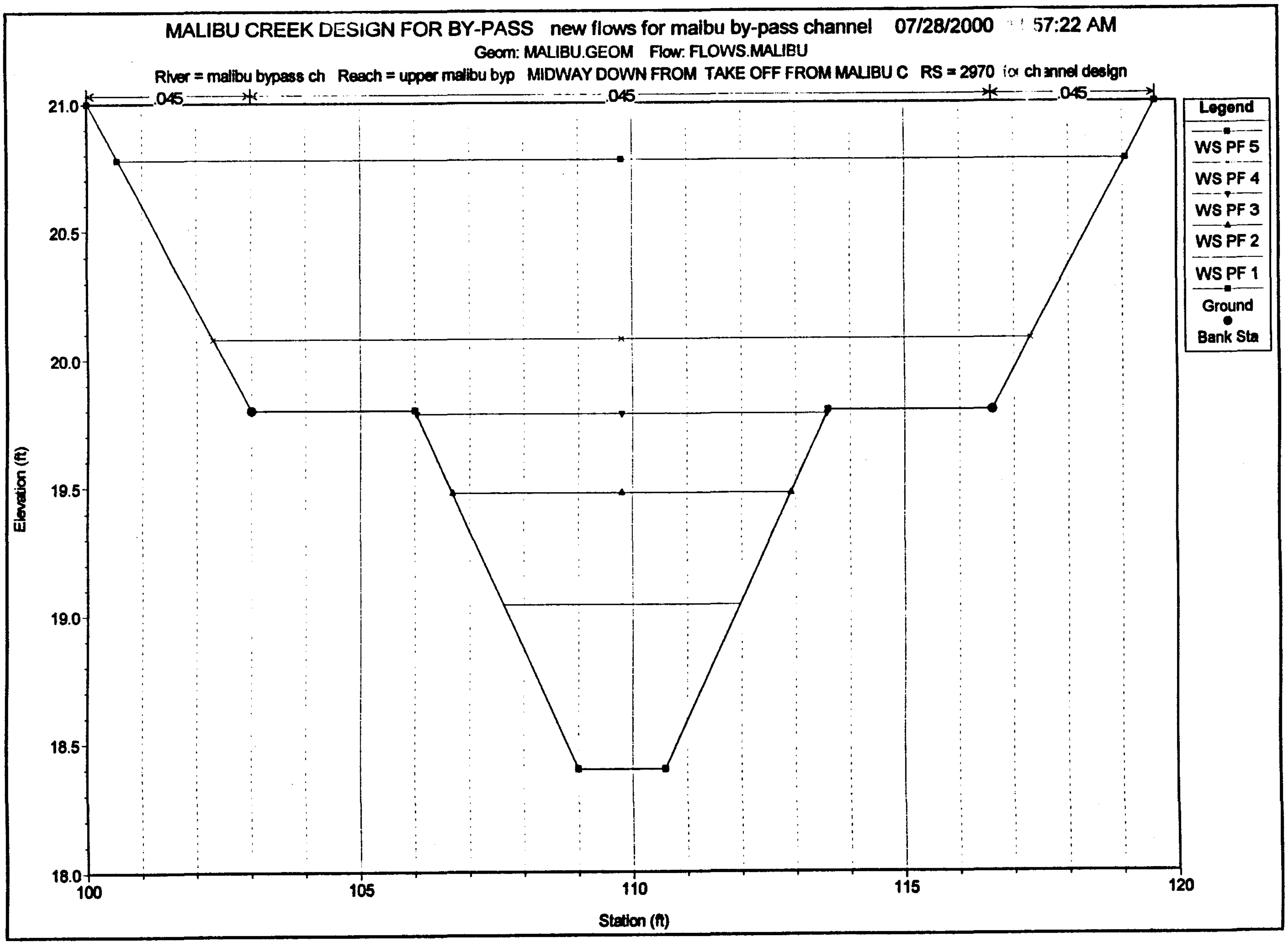
Attachment 3, Appendix 1, Figure 21



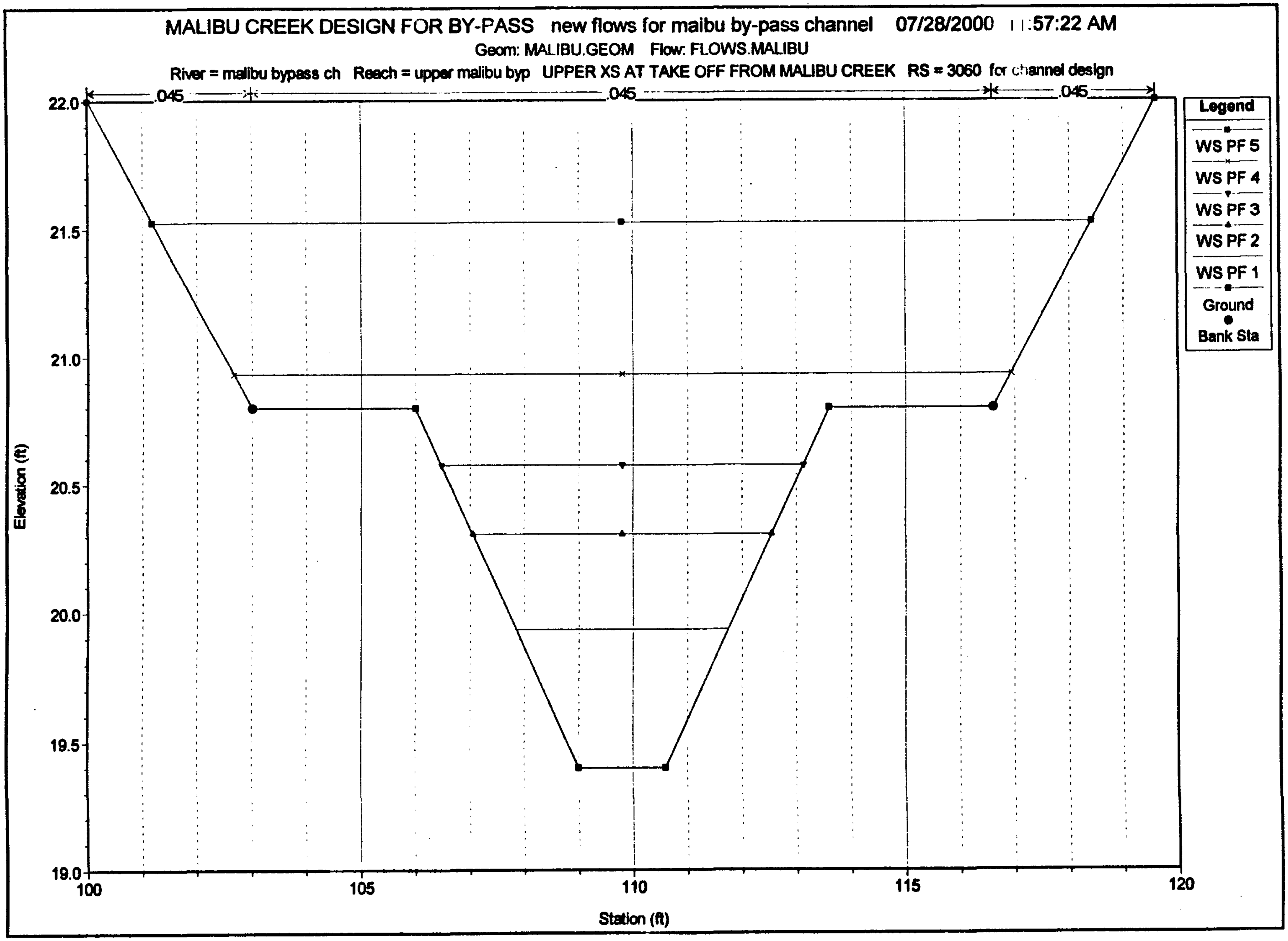
Attachment 3, Appendix 1, Figure 22



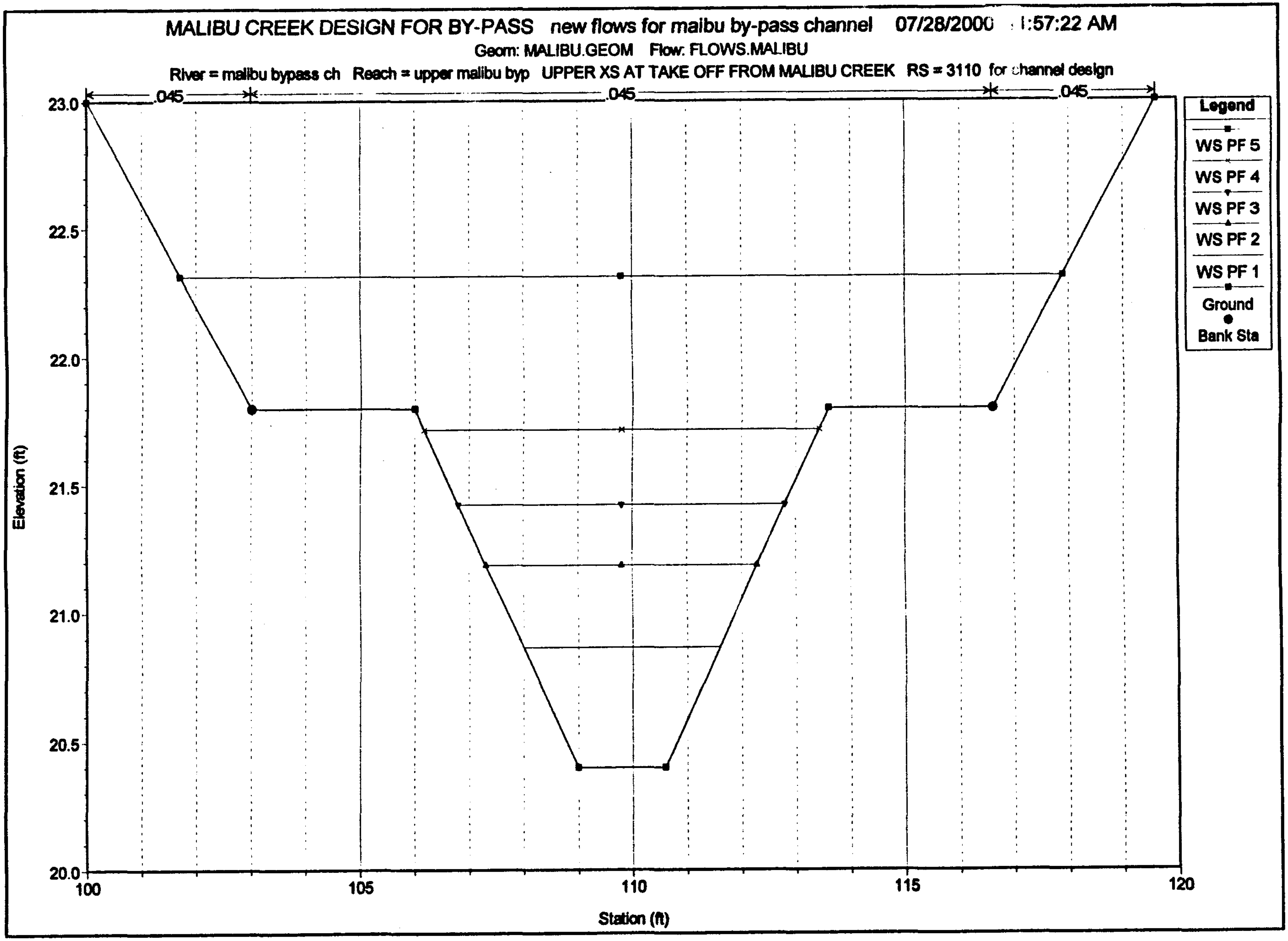
Attachment 3, Appendix 1, Figure 24



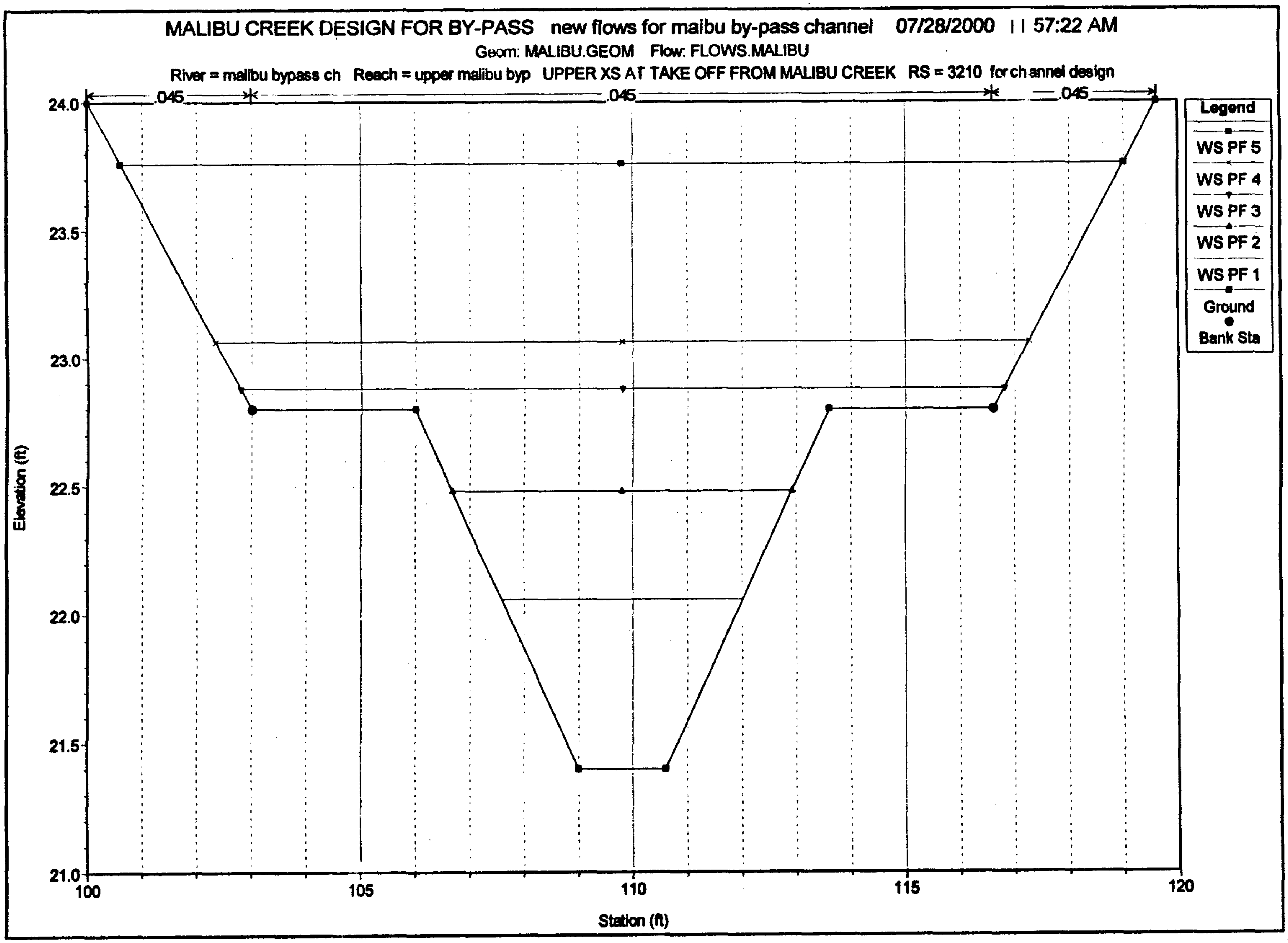
Attachment 3, Appendix 1, Figure 25



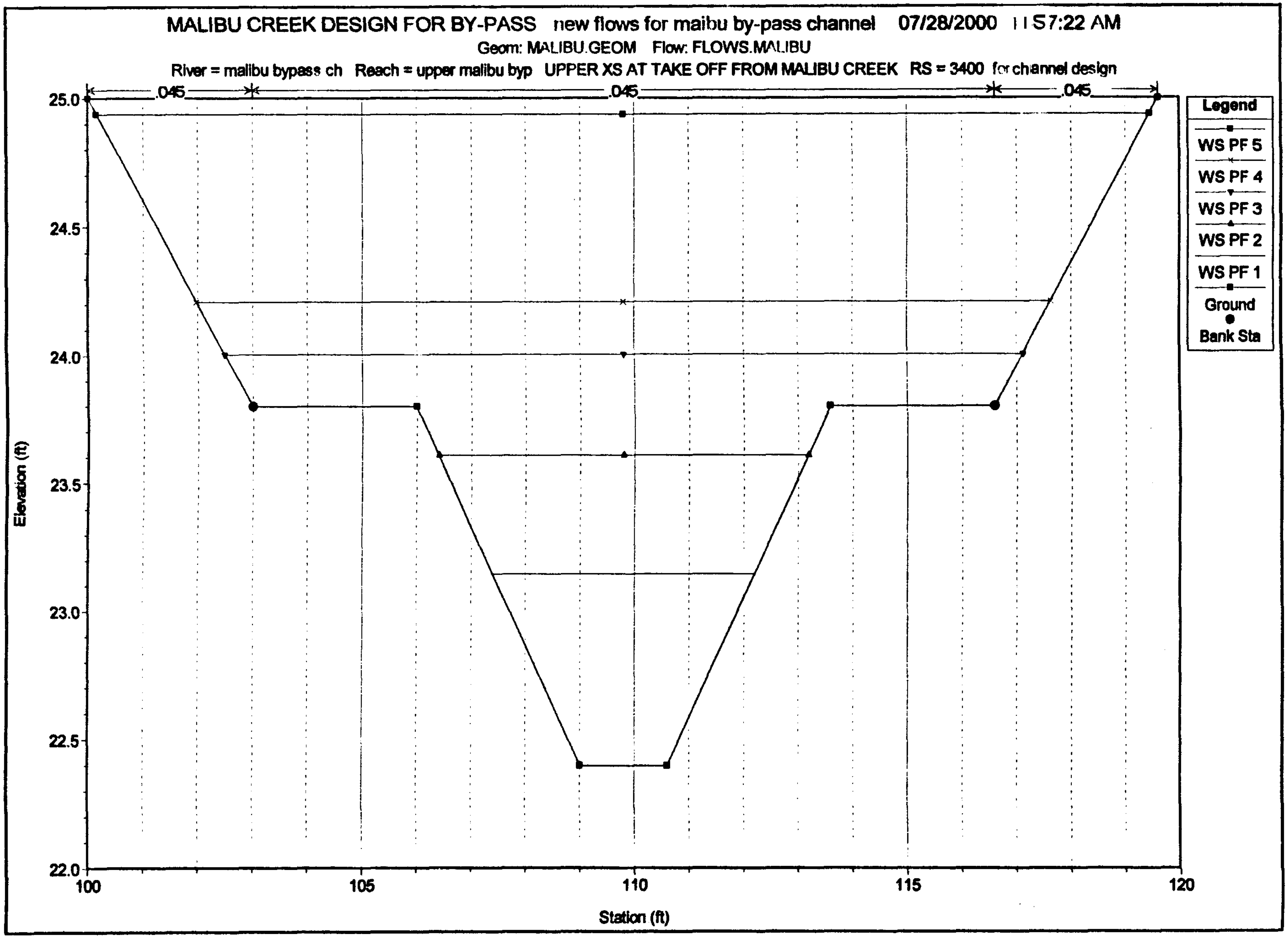
Attachment 3, Appendix 1, Figure 26



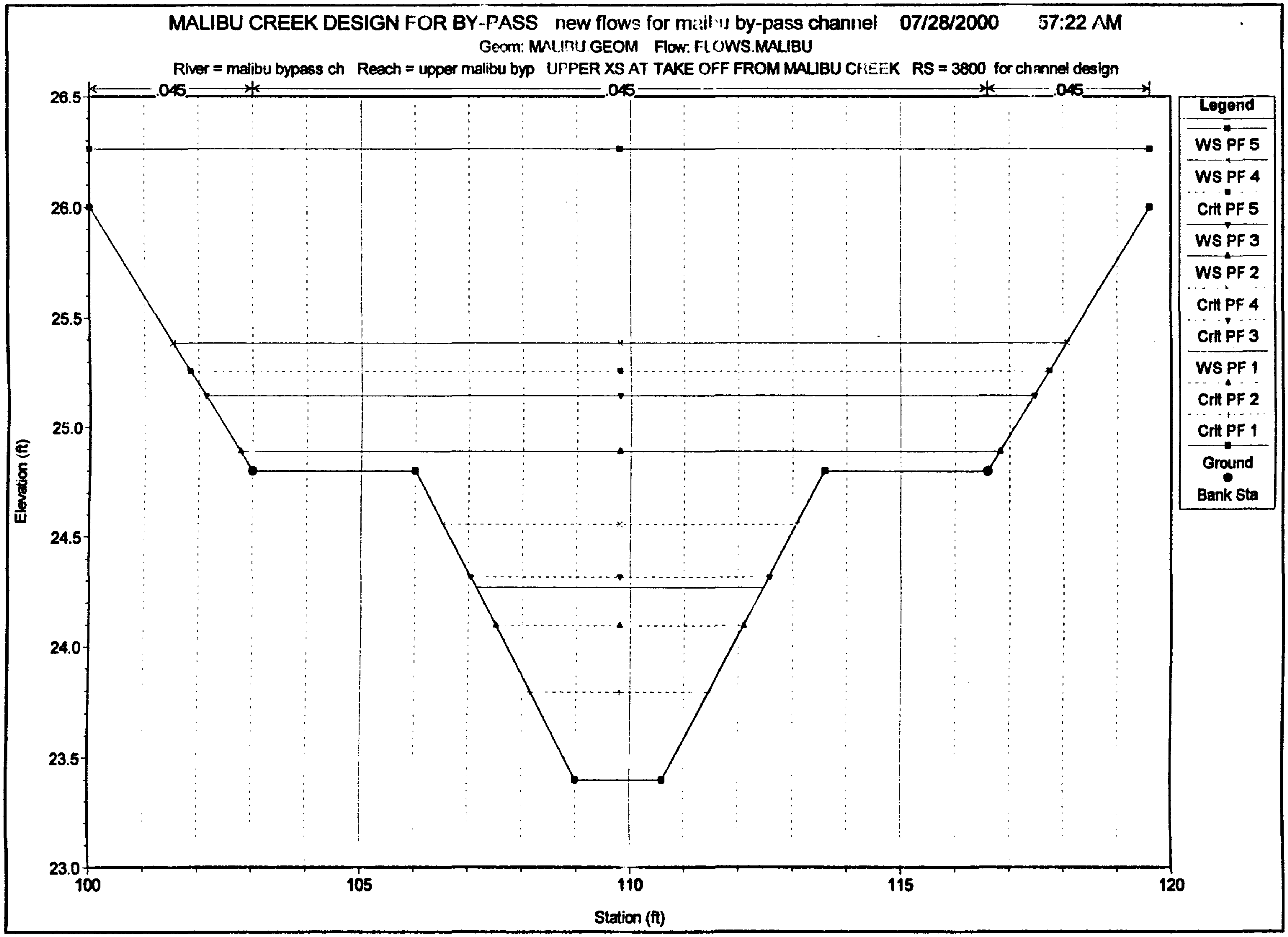
Attachment 3, Appendix 1, Figure 27



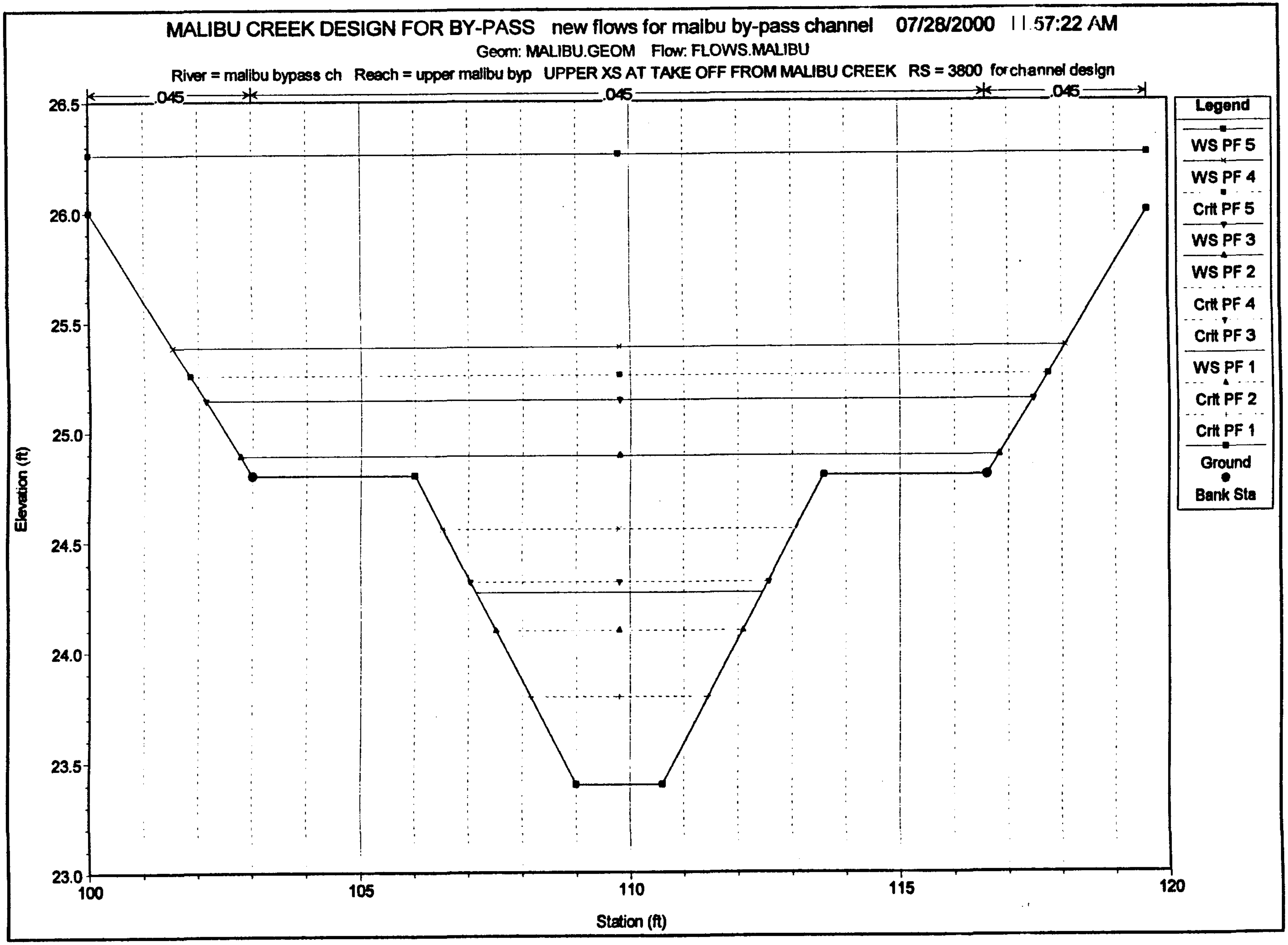
Attachment 3, Appendix 1, Figure 28



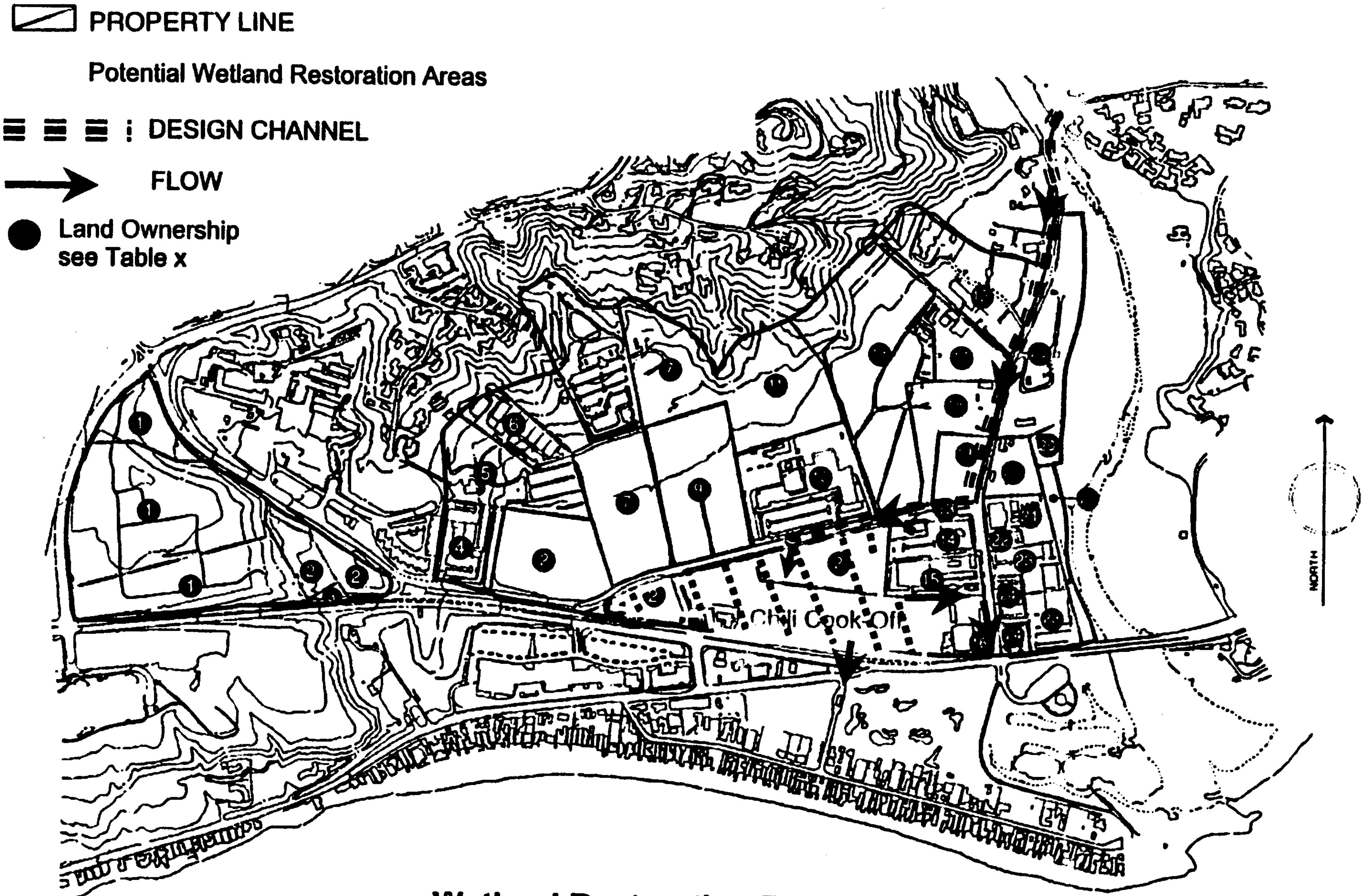
Attachment 3, Appendix 1, Figure 30



Attachment 3, Appendix 1, Figure 31



Attachment 3, Appendix 1, Figure 32

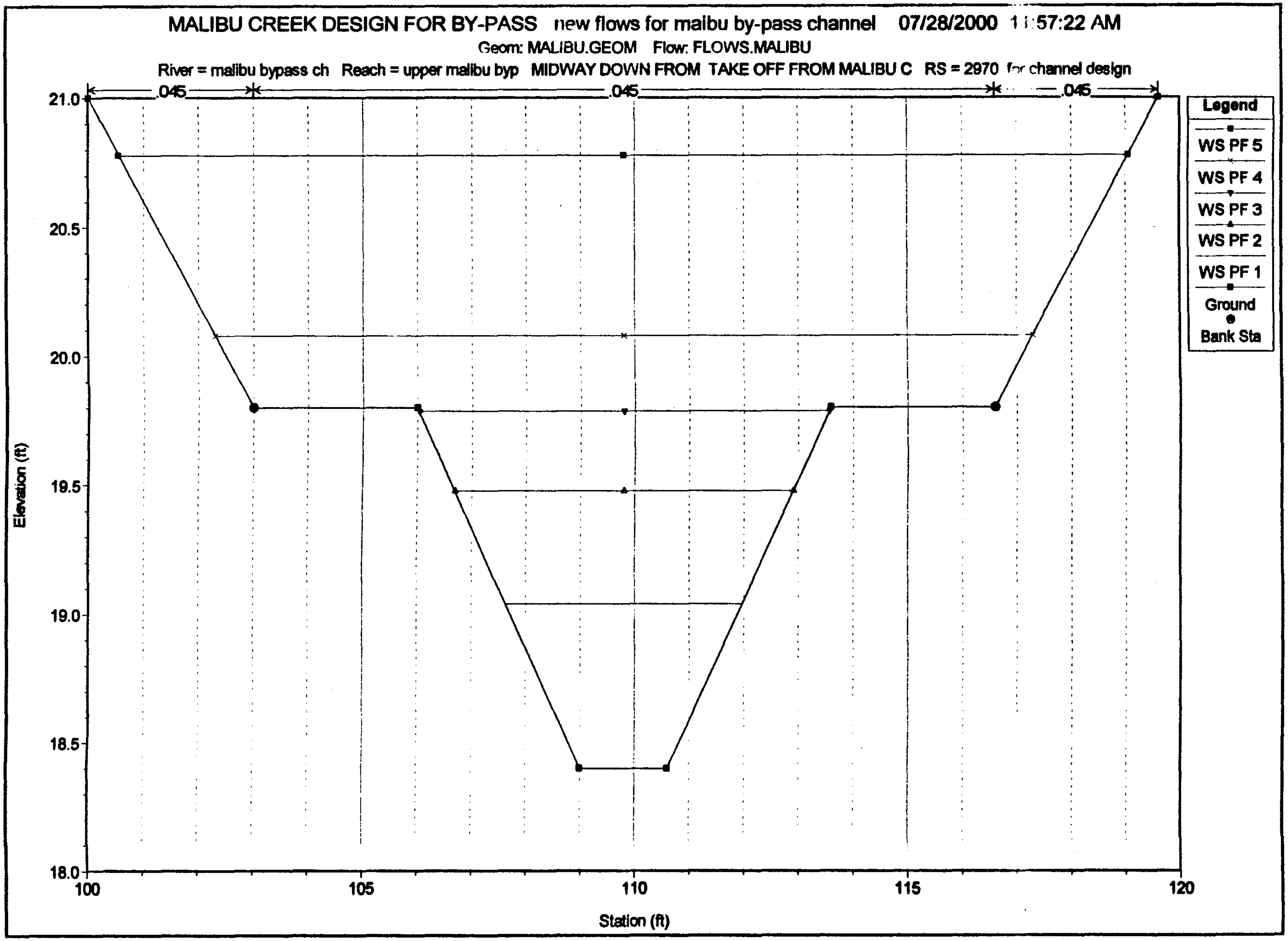


Wetland Restoration Potential
Chili Cook-Off Property

Malibu Civic Center, California

From: RRM Design Group

Attachment 3, Appendix 1, Figure 33



Attachment 3, Appendix 1, Figure 34

ATTACHMENT 3 - HYDRAULIC MODELING

Appendix 2 - Tables

TABLE 2A. SUMMARY OF MAXIMUM DAILY DISCHARGE AND TOTAL ANNUAL DISCHARGE RECURRENCE INTERVALS FOR MALIBU CREEK, CA

	Maximum Daily Discharge (cfs)	Total Annual Discharge (ac-ft)	
Recurrence Interval	Malibu Creek H&C Pearson Analysis	Malibu Creek UCLA Study	Malibu Creek H&C Pearson Analysis
2-year	1000	8110	12100
5-year	3100	32800	36300
10-year	4620	56300	53900
25-year	6580	90,800	76600
50-year	8050	126000	93600
100-year	9520	158000	111000

I don't get it?

Attachment 3, Appendix 2, Table 2a

TABLE 2B. PEARSON ANALYSIS FOR TOTAL ANNUAL DISCHARGE RECURRENCE INTERVALS FOR MALIBU CREEK, CA

Recurrence Interval (years)	K value	total annual discharge (ac-ft)
1.4	-0.645	2598
1.7	-0.470	7167
1.8	-0.420	8473
2.0	-0.280	12128
2.3	-0.120	16305
2.5	-0.050	18133
3.3	0.242	25757
5	0.645	36279
10	1.320	53902
20	1.980	71134
25	2.190	76617
40	2.630	88105
50	2.840	93588
100	3.490	110559
200	4.130	127269
500	4.950	148678
1000	5.600	165649
2000	6.240	182359
10000	7.760	222044
mean = 19,493 ac-ft; std dev = 26,109; skew =1.83		

Attachment 3, Appendix 2, Table 2b

TABLE 3. DISCHARGE DATA USED IN PEARSON ANALYSIS

Year	total annual discharge (ac-ft)	instantaneous peak discharge (cfs)	maximum daily discharge (cfs)	estimated[1] maximum daily discharge (cfs)
1931	15190	---	259	259
1932	9177	---	1770	1770
1933	12209	---	1100	1100
1934	6212	---	3160	3160
1935	2361	---	511	511
1936	24954	---	347	347
1937	33911	---	1680	1680
1938	4651	---	5090	5090
1939	6252	---	139	139
1940	74780	---	567	567
1941	1820	---	2200	2200
1942	47485	---	11	11
1943	30645	---	5370	5370
1944	4322	---	3400	3400
1945	3790	---	210	210
1946	3940	---	267	267
1947	180	---	138	138
1948	90	---	3.1	3
1949	478	---	1	1
1950	56.3	674	64	194
1951	58211	3	3.2	1
1952	2934	13600	6720	3578
1953	4991	322	81	95
1954	758	2250	655	625
1955	6465	45	16	14
1956	444	3600	1260	986
1957	31675	46	14	14
1958	1512	4260	1630	1160
1959	504	3180	114	874
1960	99	84	17	26
1961	26154	8	41	3
1962	702	7060	3920	1894
1963	384	104	24	32
1964	1554	65	17	20
1965	37529	521	7060	151
1966	25735	20600	1710	5352
1967	13434	10200	2710	2707
1968	119916	3830	1350	1047
1969	7163	33800	24200	8652
1970	17300	1150	1480	1480
1971	4240	7390	566	566
1972	25401	2120	51	51
1973	15911	7480	3340	3340
1974	---	5100	2240	2240
1975	---	---	519	519
1976	3907	339	163	163
1977	4984	597	315	315
1978	80995	19400	7620	7620
1979	33416	4420	1220	1220
1980	---	42170	---	10723
1981	9833.5	910	---	260
1982	10033	676	---	195
1983	88160	24200	---	6257
1984	17414	1840	---	514
1985	12003	880	---	251
1986	27884	5880	---	1586
1987	6237	653	---	188
1988	17339	1680	---	471
1989	8877	441	---	129
1990	6076	---	---	---
1991	14892	3150	---	866
1992	67339	23300	---	6031
1993	51685	---	---	---
1994	11094	2450	---	679
1995	68712	15700	---	4112
1996	9397	1220	---	345
1997	31182	1800	---	503
1998	81714	19108	---	4976

[1] Estimated from regression analysis per 1950-1979 data

Attachment 3, Appendix 2, Table 3

TABLE 4. PEARSON TYPE III ANALYSIS FOR PEAK DAILY DISCHARGE RECURRENCE INTERVALS FOR MALIBU CREEK, CA

	Without Jan. 25, 1969 maximum discharge (24,200 cfs)[1]		Using 1931-1998 data estimated from regression analysis[2]	
Recurrence Interval (years)	K value	peak daily discharge (cfs)	K value	peak daily discharge (cfs)
1.05	-1.025		-0.949	
1.11	-0.950		-0.895	
1.25	-0.800		-0.777	
1.43	-0.645	178	-0.643	146
1.67	-0.470	574	-0.489	492
1.75	-0.420	687	-0.439	606
2.00	-0.280	1003	-0.307	902
2.33	-0.120	1365	-0.155	1243
2.50	-0.050	1523	-0.084	1404
3.33	0.242	2183	0.204	2050
5	0.645	3093	0.609	2961
10	1.320	4618	1.303	4520
20	1.980	6110	1.996	6077
25	2.190	6584	2.219	6579
40	2.630	7579	2.689	7636
50	2.840	8053	2.912	8137
100	3.490	9522	3.605	9695
200	4.130	10968	4.298	11252
500	4.950	12821	5.215	13312
1000	5.600	14290	5.908	14871

[1] mean cfs = 1,636; std dev = 2,260; skew = 1.77

[2] mean cfs = 1,592; std dev = 2,248; skew = 2.05

Attachment 3, Appendix 2, Table 4

TABLE 5a. STEP 2 HYDRAULIC PARAMETERS FOR BYPASS CHANNEL DESIGN: N=0.035; SLOPE=0.0041

side-slope 2:1	depth (ft)	bottom width 1 (ft)	bottom width 2 (ft)	bottom width 3 (ft)	top width 1 (ft)	top width 2 (ft)	top width 3 (ft)	area 1 (ft^2)	area 2 (ft^2)	area 3 (ft^2)	hydraulic radius 1 (ft)	hydraulic radius 2 (ft)	hydraulic radius 3 (ft)	velocity 1 (ft/s)	velocity 2 (ft/s)	velocity 3 (ft/s)	discharge 1 (cfs)	discharge 2 (cfs)	discharge 3 (cfs)
2	0.10	0.30	0.60	1.20	0.7	1.0	1.6	0.05	0.08	0.14	0.07	0.08	0.08	0.45	0.49	0.52	0.02	0.04	0.07
2	0.15	0.40	0.80	1.60	1.0	1.4	2.2	0.11	0.17	0.29	0.10	0.11	0.13	0.58	0.63	0.68	0.06	0.10	0.19
2	0.20	0.50	1.00	2.00	1.3	1.8	2.8	0.18	0.28	0.48	0.13	0.15	0.17	0.69	0.76	0.82	0.13	0.21	0.39
2	0.30	0.60	1.20	2.40	1.8	2.4	3.6	0.36	0.54	0.90	0.19	0.21	0.24	0.88	0.97	1.05	0.32	0.52	0.95
2	0.40	0.70	1.40	2.80	2.3	3.0	4.4	0.60	0.88	1.44	0.24	0.28	0.31	1.05	1.15	1.25	0.63	1.01	1.81
2	0.50	0.80	1.60	3.20	2.8	3.6	5.2	0.90	1.30	2.10	0.30	0.34	0.39	1.21	1.32	1.44	1.09	1.72	3.03
2	0.60	0.90	1.80	3.60	3.3	4.2	6.0	1.26	1.80	2.88	0.35	0.40	0.46	1.35	1.48	1.61	1.71	2.66	4.65
2	0.70	1.00	2.00	4.00	3.8	4.8	6.8	1.68	2.38	3.78	0.41	0.46	0.53	1.49	1.63	1.78	2.51	3.87	6.73
2	0.80	1.10	2.20	4.40	4.3	5.4	7.6	2.16	3.04	4.80	0.46	0.53	0.60	1.62	1.77	1.94	3.51	5.38	9.29
2	0.90	1.20	2.40	4.80	4.8	6.0	8.4	2.70	3.78	5.94	0.52	0.59	0.67	1.75	1.91	2.09	4.72	7.21	12.39
2	1.00	1.30	2.60	5.20	5.3	6.6	9.2	3.30	4.60	7.20	0.57	0.65	0.74	1.87	2.04	2.23	6.18	9.38	16.07
2	1.20	1.40	2.80	5.60	6.2	7.6	10.4	4.56	6.24	9.60	0.67	0.76	0.88	2.09	2.27	2.49	9.52	14.17	23.87
2	1.30	1.50	3.00	6.00	6.7	8.2	11.2	5.33	7.28	11.18	0.73	0.83	0.95	2.20	2.39	2.62	11.73	17.41	29.28
2	1.40	1.60	3.20	6.40	7.2	8.8	12.0	6.16	8.40	12.88	0.78	0.89	1.02	2.31	2.51	2.75	14.23	21.08	35.40
2	1.50	1.60	3.20	6.40	7.6	9.2	12.4	6.90	9.30	14.10	0.83	0.94	1.08	2.40	2.60	2.85	16.56	24.22	40.22
2	1.60	1.70	3.40	6.80	8.1	9.8	13.2	7.84	10.56	16.00	0.89	1.00	1.15	2.51	2.72	2.98	19.64	28.70	47.62
2	1.70	1.80	3.60	7.20	8.6	10.4	14.0	8.84	11.90	18.02	0.94	1.06	1.22	2.61	2.83	3.10	23.05	33.66	55.82
2	1.80	1.90	3.80	7.60	9.1	11.0	14.8	9.90	13.32	20.16	0.99	1.12	1.29	2.71	2.94	3.22	26.81	39.13	64.85
2	1.90	2.00	4.00	8.00	9.6	11.6	15.6	11.02	14.82	22.42	1.05	1.19	1.36	2.81	3.04	3.33	30.93	45.12	74.75
2	2.00	2.10	4.20	8.40	10.1	12.2	16.4	12.20	16.40	24.80	1.10	1.25	1.43	2.90	3.15	3.45	35.42	51.65	85.53
2	2.10	2.20	4.40	8.80	10.6	12.8	17.2	13.44	18.06	27.30	1.16	1.31	1.50	3.00	3.25	3.56	40.30	58.74	97.24
2	2.20	2.30	4.60	9.20	11.1	13.4	18.0	14.74	19.80	29.92	1.21	1.37	1.57	3.09	3.35	3.67	45.59	66.41	109.9
2	2.30	2.40	4.80	9.60	11.6	14.0	18.8	16.10	21.62	32.66	1.27	1.43	1.64	3.19	3.45	3.78	51.28	74.68	123.5
2	2.40	2.50	5.00	10.00	12.1	14.6	19.6	17.52	23.52	35.52	1.32	1.49	1.71	3.28	3.55	3.89	57.40	83.56	138.2
2	2.50	2.60	5.20	10.40	12.6	15.2	20.4	19.00	25.50	38.50	1.38	1.56	1.78	3.37	3.65	4.00	63.96	93.08	153.9
2	2.60	2.70	5.40	10.80	13.1	15.8	21.2	20.54	27.56	41.60	1.43	1.62	1.85	3.45	3.75	4.10	70.96	103.2	170.7
2	2.70	2.80	5.60	11.20	13.6	16.4	22.0	22.14	29.70	44.82	1.49	1.68	1.93	3.54	3.84	4.21	78.43	114.1	188.5
2	2.80	2.90	5.80	11.60	14.1	17.0	22.8	23.80	31.92	48.16	1.54	1.74	2.00	3.63	3.93	4.31	86.37	125.6	207.5
2	2.90	3.00	6.00	12.00	14.6	17.6	23.6	25.52	34.22	51.62	1.60	1.80	2.07	3.71	4.03	4.41	94.79	137.8	227.7
2	3.00	3.10	6.20	12.40	15.1	18.2	24.4	27.30	36.60	55.20	1.65	1.87	2.14	3.80	4.12	4.51	103.7	150.7	249.0
2	3.10	3.20	6.40	12.80	15.6	18.8	25.2	29.14	39.06	58.90	1.71	1.93	2.21	3.88	4.21	4.61	113.1	164.4	271.5
2	3.20	3.30	6.60	13.20	16.1	19.4	26.0	31.04	41.60	62.72	1.76	1.99	2.28	3.97	4.30	4.71	123.1	178.8	295.3

TABLE 5b. STEP 2 HYDRAULIC PARAMETERS FOR BYPASS CHANNEL DESIGN (TRAPEZOIDAL CHANNEL): N=0.045; SLOPE=0.0041

side-slope 2:1	depth (ft)	bottom width 1 (ft)	bottom width 2 (ft)	bottom width 3 (ft)	top width 1 (ft)	top width 2 (ft)	top width 3 (ft)	area 1 (ft^2)	area 2 (ft^2)	area 3 (ft^2)	hydraulic radius 1 (ft)	hydraulic radius 2 (ft)	hydraulic radius 3 (ft)	velocity 1 (ft/s)	velocity 2 (ft/s)	velocity 3 (ft/s)	discharge 1 (cfs)	discharge 2 (cfs)	discharge 3 (cfs)
2	0.10	0.30	0.60	1.20	0.7	1.0	1.6	0.05	0.08	0.14	0.07	0.08	0.08	0.35	0.38	0.41	0.02	0.03	0.06
2	0.15	0.40	0.80	1.60	1.0	1.4	2.2	0.11	0.17	0.29	0.10	0.11	0.13	0.45	0.49	0.53	0.05	0.08	0.15
2	0.20	0.50	1.00	2.00	1.3	1.8	2.8	0.18	0.28	0.48	0.13	0.15	0.17	0.54	0.59	0.64	0.10	0.17	0.31
2	0.30	0.60	1.20	2.40	1.8	2.4	3.6	0.36	0.54	0.90	0.19	0.21	0.24	0.69	0.75	0.82	0.25	0.41	0.74
2	0.40	0.70	1.40	2.80	2.3	3.0	4.4	0.60	0.88	1.44	0.24	0.28	0.31	0.82	0.90	0.98	0.49	0.79	1.41
2	0.50	0.80	1.60	3.20	2.8	3.6	5.2	0.90	1.30	2.10	0.30	0.34	0.39	0.94	1.03	1.12	0.85	1.34	2.35
2	0.60	0.90	1.80	3.60	3.3	4.2	6.0	1.26	1.80	2.88	0.35	0.40	0.46	1.05	1.15	1.26	1.33	2.07	3.62
2	0.70	1.00	2.00	4.00	3.8	4.8	6.8	1.68	2.38	3.78	0.41	0.46	0.53	1.16	1.27	1.38	1.95	3.01	5.23
2	0.80	1.10	2.20	4.40	4.3	5.4	7.6	2.16	3.04	4.80	0.46	0.53	0.60	1.26	1.38	1.51	2.73	4.19	7.23
2	0.90	1.20	2.40	4.80	4.8	6.0	8.4	2.70	3.78	5.94	0.52	0.59	0.67	1.36	1.48	1.62	3.67	5.61	9.64
2	1.00	1.30	2.60	5.20	5.3	6.6	9.2	3.30	4.60	7.20	0.57	0.65	0.74	1.46	1.59	1.74	4.80	7.30	12.50
2	1.20	1.40	2.80	5.60	6.2	7.6	10.4	4.56	6.24	9.60	0.67	0.76	0.88	1.62	1.77	1.93	7.41	11.02	18.57
2	1.30	1.50	3.00	6.00	6.7	8.2	11.2	5.33	7.28	11.18	0.73	0.83	0.95	1.71	1.86	2.04	9.12	13.55	22.78
2	1.40	1.60	3.20	6.40	7.2	8.8	12.0	6.16	8.40	12.88	0.78	0.89	1.02	1.80	1.95	2.14	11.07	16.40	27.54
2	1.50	1.60	3.20	6.40	7.6	9.2	12.4	6.90	9.30	14.10	0.83	0.94	1.08	1.87	2.03	2.22	12.89	18.85	31.29
2	1.60	1.70	3.40	6.80	8.1	9.8	13.2	7.84	10.56	16.00	0.89	1.00	1.15	1.95	2.11	2.32	15.28	22.33	37.05
2	1.70	1.80	3.60	7.20	8.6	10.4	14.0	8.84	11.90	18.02	0.94	1.06	1.22	2.03	2.20	2.41	17.93	26.19	43.43
2	1.80	1.90	3.80	7.60	9.1	11.0	14.8	9.90	13.32	20.16	0.99	1.12	1.29	2.11	2.29	2.50	20.86	30.44	50.46
2	1.90	2.00	4.00	8.00	9.6	11.6	15.6	11.02	14.82	22.42	1.05	1.19	1.36	2.18	2.37	2.59	24.06	35.10	58.16
2	2.00	2.10	4.20	8.40	10.1	12.2	16.4	12.20	16.40	24.80	1.10	1.25	1.43	2.26	2.45	2.68	27.56	40.18	66.55
2	2.10	2.20	4.40	8.80	10.6	12.8	17.2	13.44	18.06	27.30	1.16	1.31	1.50	2.33	2.53	2.77	31.36	45.70	75.66
2	2.20	2.30	4.60	9.20	11.1	13.4	18.0	14.74	19.80	29.92	1.21	1.37	1.57	2.41	2.61	2.86	35.47	51.67	85.5
2	2.30	2.40	4.80	9.60	11.6	14.0	18.8	16.10	21.62	32.66	1.27	1.43	1.64	2.48	2.69	2.94	39.90	58.10	96.1
2	2.40	2.50	5.00	10.00	12.1	14.6	19.6	17.52	23.52	35.52	1.32	1.49	1.71	2.55	2.76	3.03	44.66	65.02	107.5
2	2.50	2.60	5.20	10.40	12.6	15.2	20.4	19.00	25.50	38.50	1.38	1.56	1.78	2.62	2.84	3.11	49.76	72.42	119.7
2	2.60	2.70	5.40	10.80	13.1	15.8	21.2	20.54	27.56	41.60	1.43	1.62	1.85	2.69	2.91	3.19	55.21	80.3	132.8
2	2.70	2.80	5.60	11.20	13.6	16.4	22.0	22.14	29.70	44.82	1.49	1.68	1.93	2.76	2.99	3.27	61.02	88.8	146.7
2	2.80	2.90	5.80	11.60	14.1	17.0	22.8	23.80	31.92	48.16	1.54	1.74	2.00	2.82	3.06	3.35	67.20	97.7	161.5
2	2.90	3.00	6.00	12.00	14.6	17.6	23.6	25.52	34.22	51.62	1.60	1.80	2.07	2.89	3.13	3.43	73.75	107.2	177.1
2	3.00	3.10	6.20	12.40	15.1	18.2	24.4	27.30	36.60	55.20	1.65	1.87	2.14	2.96	3.20	3.51	80.7	117.3	193.7
2	3.10	3.20	6.40	12.80	15.6	18.8	25.2	29.14	39.06	58.90	1.71	1.93	2.21	3.02	3.27	3.59	88.0	127.9	211.3
2	3.20	3.30	6.60	13.20	16.1	19.4	26.0	31.04	41.60	62.72	1.76	1.99	2.28	3.09	3.34	3.66	95.8	139.1	229.7

Table 6. HEC-RAS Out

HEC-RAS Plan: new flows fo River: malibu bypass ch Reach: upper malibu byp

Reach	River Sta	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude # Chl
upper malibu byp	-500	3.00	8.00	8.35	8.35	8.36	0.106819	0.98	3.05	1109.38	0.79
upper malibu byp	-500	8.50	8.00	8.38	8.38	8.42	0.177501	1.54	5.50	1164.13	1.07
upper malibu byp	-500	14.50	8.00	8.41	8.41	8.46	0.170814	1.78	8.18	1213.14	1.10
upper malibu byp	-500	23.00	8.00	8.45	8.45	8.50	0.103141	1.81	13.44	1295.78	0.91
upper malibu byp	-500	70.00	8.00	8.56	8.56	8.63	0.067310	2.29	37.50	1464.57	0.82
upper malibu byp	-250	3.00	8.00	8.46	8.21	8.46	0.000110		28.76	1025.29	0.00
upper malibu byp	-250	8.50	8.00	8.61	8.23	8.61	0.000217		43.86	1100.00	0.00
upper malibu byp	-250	14.50	8.00	8.73	8.27	8.73	0.000289		55.46	1100.00	0.00
upper malibu byp	-250	23.00	8.00	8.85	8.29	8.85	0.000378		67.50	1100.00	0.00
upper malibu byp	-250	70.00	8.00	8.82	8.42	8.84	0.004130		64.25	1100.00	0.00
upper malibu byp	0000	3.00	7.50	8.47		8.47	0.000003	0.04	73.72	107.92	0.01
upper malibu byp	0000	8.50	7.50	8.62		8.62	0.000015	0.09	91.55	117.42	0.02
upper malibu byp	0000	14.50	7.50	8.75		8.75	0.000029	0.14	106.52	124.83	0.03
upper malibu byp	0000	23.00	7.50	8.88		8.88	0.000048	0.19	123.32	132.66	0.03
upper malibu byp	0000	70.00	7.50	9.02		9.02	0.000298	0.51	142.39	140.85	0.09
upper malibu byp	70	3.00	8.00	8.47		8.47	0.000044	0.11	27.31	77.26	0.03
upper malibu byp	70	8.50	8.00	8.63		8.63	0.000110	0.21	40.51	87.53	0.05
upper malibu byp	70	14.50	8.00	8.75		8.75	0.000154	0.28	51.91	95.02	0.07
upper malibu byp	70	23.00	8.00	8.88		8.88	0.000202	0.36	65.01	102.96	0.08
upper malibu byp	70	70.00	8.00	9.05		9.06	0.000948	0.86	82.63	112.76	0.17
upper malibu byp	470	3.00	8.00	8.51		8.51	0.000488	0.29	10.28	40.55	0.10
upper malibu byp	470	8.50	8.00	8.71		8.71	0.000640	0.42	20.27	56.95	0.12
upper malibu byp	470	14.50	8.00	8.86		8.87	0.000673	0.49	29.68	68.91	0.13
upper malibu byp	470	23.00	8.00	9.02		9.02	0.000691	0.56	41.36	81.02	0.14
upper malibu byp	470	70.00	8.00	9.43		9.44	0.000969	0.89	79.92	105.79	0.17
upper malibu byp	870	3.00	8.75	8.92		8.93	0.003672	0.56	5.34	35.95	0.26
upper malibu byp	870	8.50	8.75	9.12		9.12	0.001977	0.63	13.40	47.14	0.21
upper malibu byp	870	14.50	8.75	9.26		9.27	0.001665	0.70	20.73	55.40	0.20
upper malibu byp	870	23.00	8.75	9.41		9.42	0.001535	0.77	29.70	64.06	0.20
upper malibu byp	870	70.00	8.75	9.89	9.25	9.91	0.001466	1.05	66.89	88.79	0.21

HEC-RAS Plan: new flows fo River: malibu bypass ch Reach: upper malibu byp (Continued)

Reach	River Sta	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
		(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
upper malibu byp	1270	3.00	9.40	10.21	9.80	10.23	0.002896	1.11	2.69	5.06	0.27
upper malibu byp	1270	8.50	9.40	10.46	10.10	10.53	0.007483	2.08	4.09	6.14	0.45
upper malibu byp	1270	14.50	9.40	10.61	10.32	10.73	0.012373	2.87	5.05	6.77	0.59
upper malibu byp	1270	23.00	9.40	10.75	10.56	10.97	0.019051	3.79	6.06	7.38	0.74
upper malibu byp	1270	70.00	9.40	11.26	11.26	11.71	0.031422	5.43	13.22	15.90	0.99
upper malibu byp	1500	3.00	10.00	10.77		10.79	0.002129	1.20	2.51	4.90	0.30
upper malibu byp	1500	8.50	10.00	11.28		11.32	0.001982	1.53	5.56	7.09	0.30
upper malibu byp	1500	14.50	10.00	11.65		11.68	0.001993	1.48	9.90	14.52	0.31
upper malibu byp	1500	23.00	10.00	11.90		11.94	0.001813	1.72	13.66	15.46	0.31
upper malibu byp	1500	70.00	10.00	12.75		12.85	0.001862	2.65	28.15	18.65	0.35
upper malibu byp	1640	3.00	10.60	11.24		11.27	0.006499	1.46	2.05	4.81	0.39
upper malibu byp	1640	8.50	10.60	11.70		11.75	0.005307	1.78	4.78	7.10	0.38
upper malibu byp	1640	14.50	10.60	12.04		12.08	0.004570	1.64	8.97	14.81	0.36
upper malibu byp	1640	23.00	10.60	12.26		12.32	0.004294	1.92	12.29	15.89	0.36
upper malibu byp	1640	70.00	10.60	13.09		13.21	0.003610	2.76	27.30	19.60	0.37
upper malibu byp	1700	3.00	11.20	11.78		11.84	0.014635	1.90	1.57	3.79	0.52
upper malibu byp	1700	8.50	11.20	12.17		12.27	0.015488	2.57	3.31	5.23	0.57
upper malibu byp	1700	14.50	11.20	12.44		12.58	0.015917	2.98	4.87	6.25	0.60
upper malibu byp	1700	23.00	11.20	12.64		12.85	0.021093	3.72	6.18	6.99	0.70
upper malibu byp	1700	70.00	11.20	13.39		13.69	0.020527	4.45	16.27	16.56	0.74
upper malibu byp	1800	3.00	11.80	13.01		13.01	0.009110	0.40	7.52	14.63	0.09
upper malibu byp	1800	8.50	11.80	13.31		13.32	0.007653	0.68	12.18	16.14	0.13
upper malibu byp	1800	14.50	11.80	13.55		13.57	0.006614	0.86	16.30	17.37	0.15
upper malibu byp	1800	23.00	11.80	13.84		13.86	0.005741	1.04	21.46	18.80	0.16
upper malibu byp	1800	70.00	11.80	14.70		14.75	0.006330	1.72	38.25	19.60	0.20
upper malibu byp	1940	3.00	13.00	13.76		13.78	0.003778	1.23	2.44	4.85	0.31
upper malibu byp	1940	8.50	13.00	14.15		14.20	0.005275	1.82	4.66	6.52	0.38
upper malibu byp	1940	14.50	13.00	14.49		14.55	0.007276	1.88	7.75	14.07	0.44
upper malibu byp	1940	23.00	13.00	14.68		14.76	0.006961	2.22	10.49	15.02	0.45
upper malibu byp	1940	70.00	13.00	15.46		15.61	0.005485	3.15	23.64	18.89	0.45

HEC-RAS Plan: new flows fo River: malibu bypass ch Reach: upper malibu byp (Continued)

Reach	River Sta	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude # Chl
upper malibu byp	2040	3.00	13.40	14.15		14.17	0.003926	1.25	2.41	4.82	0.31
upper malibu byp	2040	8.50	13.40	14.62		14.66	0.004069	1.66	5.13	6.82	0.34
upper malibu byp	2040	14.50	13.40	15.02		15.06	0.003691	1.53	9.58	14.71	0.32
upper malibu byp	2040	23.00	13.40	15.22		15.27	0.003928	1.87	12.61	15.71	0.35
upper malibu byp	2040	70.00	13.40	15.97		16.09	0.004281	2.92	25.72	19.44	0.40
upper malibu byp	2240	3.00	14.40	15.08		15.12	0.005736	1.43	2.09	4.53	0.37
upper malibu byp	2240	8.50	14.40	15.54		15.59	0.005432	1.84	4.61	6.49	0.39
upper malibu byp	2240	14.50	14.40	15.93		15.98	0.005908	1.76	8.27	14.26	0.40
upper malibu byp	2240	23.00	14.40	16.13		16.20	0.005640	2.08	11.22	15.26	0.41
upper malibu byp	2240	70.00	14.40	16.89		17.03	0.005107	3.08	24.22	19.05	0.43
upper malibu byp	2370	3.00	14.80	15.61		15.63	0.002847	1.11	2.71	5.08	0.27
upper malibu byp	2370	8.50	14.80	16.09		16.12	0.003216	1.52	5.60	7.11	0.30
upper malibu byp	2370	14.50	14.80	16.47		16.50	0.002888	1.42	10.35	14.97	0.29
upper malibu byp	2370	23.00	14.80	16.69		16.73	0.003089	1.73	13.63	16.03	0.31
upper malibu byp	2370	70.00	14.80	17.47		17.57	0.003457	2.73	27.64	19.60	0.36
upper malibu byp	2520	3.00	15.40	16.13		16.15	0.004438	1.30	2.30	4.72	0.33
upper malibu byp	2520	8.50	15.40	16.62		16.66	0.004046	1.65	5.14	6.83	0.34
upper malibu byp	2520	14.50	15.40	16.99		17.03	0.004336	1.60	9.10	14.55	0.35
upper malibu byp	2520	23.00	15.40	17.21		17.26	0.004104	1.89	12.43	15.65	0.35
upper malibu byp	2520	70.00	15.40	18.01		18.13	0.003899	2.83	26.56	19.60	0.38
upper malibu byp	2670	3.00	16.40	17.02		17.06	0.008673	1.67	1.80	4.24	0.45
upper malibu byp	2670	8.50	16.40	17.44		17.51	0.008182	2.15	3.96	6.04	0.47
upper malibu byp	2670	14.50	16.40	17.77		17.86	0.007008	2.32	6.24	7.49	0.45
upper malibu byp	2670	23.00	16.40	18.04		18.13	0.008441	2.35	9.87	14.81	0.49
upper malibu byp	2670	70.00	16.40	18.75		18.92	0.007224	3.44	21.53	18.33	0.51
upper malibu byp	2820	3.00	17.40	18.09		18.12	0.005570	1.42	2.12	4.55	0.37
upper malibu byp	2820	8.50	17.40	18.51		18.57	0.006123	1.93	4.41	6.35	0.41
upper malibu byp	2820	14.50	17.40	18.80		18.88	0.006525	2.26	6.41	7.58	0.43
upper malibu byp	2820	23.00	17.40	19.12		19.19	0.005944	2.12	11.04	15.20	0.42
upper malibu byp	2820	70.00	17.40	19.79		19.95	0.006522	3.33	22.29	18.53	0.49

HEC-RAS Plan: new flows fo River: malibu bypass ch Reach: upper malibu byp (Continued)

Reach	River Sta	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude # Chl
upper malibu byp	2970	3.00	18.40	19.04		19.08	0.007418	1.57	1.91	4.35	0.42
upper malibu byp	2970	8.50	18.40	19.48		19.54	0.006912	2.02	4.22	6.22	0.43
upper malibu byp	2970	14.50	18.40	19.79		19.87	0.006710	2.29	6.34	7.54	0.44
upper malibu byp	2970	23.00	18.40	20.08		20.16	0.007083	2.23	10.44	15.00	0.45
upper malibu byp	2970	70.00	18.40	20.78		20.95	0.006621	3.35	22.17	18.50	0.49
upper malibu byp	3060	3.00	19.40	19.94		20.00	0.014973	2.03	1.48	3.90	0.58
upper malibu byp	3060	8.50	19.40	20.31		20.42	0.014193	2.63	3.23	5.50	0.61
upper malibu byp	3060	14.50	19.40	20.58		20.72	0.013716	2.98	4.86	6.65	0.61
upper malibu byp	3060	23.00	19.40	20.93		21.05	0.014636	2.78	8.31	14.27	0.63
upper malibu byp	3060	70.00	19.40	21.53		21.79	0.013036	4.14	17.66	17.24	0.66
upper malibu byp	3110	3.00	20.40	20.87		20.96	0.025418	2.46	1.22	3.61	0.75
upper malibu byp	3110	8.50	20.40	21.19		21.36	0.025689	3.28	2.60	4.98	0.80
upper malibu byp	3110	14.50	20.40	21.43		21.64	0.024959	3.73	3.89	5.99	0.81
upper malibu byp	3110	23.00	20.40	21.72		21.96	0.021041	3.94	5.84	7.26	0.77
upper malibu byp	3110	70.00	20.40	22.32		22.71	0.025513	5.09	14.15	16.19	0.90
upper malibu byp	3210	3.00	21.40	22.06		22.10	0.006611	1.51	1.99	4.43	0.40
upper malibu byp	3210	8.50	21.40	22.48		22.54	0.006791	2.00	4.24	6.24	0.43
upper malibu byp	3210	14.50	21.40	22.88		22.94	0.007868	1.92	7.57	14.01	0.45
upper malibu byp	3210	23.00	21.40	23.07		23.15	0.007507	2.27	10.24	14.93	0.47
upper malibu byp	3210	70.00	21.40	23.76		23.93	0.006931	3.40	21.84	18.41	0.50
upper malibu byp	3250	3.00	21.70	22.34		22.38	0.007375	1.57	1.91	4.35	0.42
upper malibu byp	3250	8.50	21.70	22.76		22.83	0.007360	2.06	4.12	6.15	0.44
upper malibu byp	3250	14.50	21.70	23.19		23.24	0.007527	1.89	7.67	14.04	0.45
upper malibu byp	3250	23.00	21.70	23.37		23.45	0.007497	2.27	10.25	14.93	0.47
upper malibu byp	3250	70.00	21.70	24.04		24.22	0.007294	3.45	21.46	18.31	0.51
upper malibu byp	3400	3.00	22.40	23.15		23.17	0.003965	1.25	2.40	4.81	0.31
upper malibu byp	3400	8.50	22.40	23.61		23.65	0.004208	1.68	5.07	6.78	0.34
upper malibu byp	3400	14.50	22.40	24.01		24.04	0.003967	1.56	9.36	14.63	0.33
upper malibu byp	3400	23.00	22.40	24.21		24.27	0.004066	1.88	12.47	15.66	0.35
upper malibu byp	3400	70.00	22.40	24.94		25.07	0.004552	2.97	25.19	19.30	0.41

HEC-RAS Plan: new flows fo River: malibu bypass ch Reach: upper malibu byp (Continued)

Reach	River Sta	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
		(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
upper malibu byp	3800	3.00	23.40	24.27	23.80	24.29	0.002086	0.99	3.04	5.35	0.23
upper malibu byp	3800	8.50	23.40	24.89	24.10	24.91	0.002545	1.11	7.71	14.06	0.26
upper malibu byp	3800	14.50	23.40	25.15	24.32	25.17	0.002109	1.29	11.44	15.33	0.25
upper malibu byp	3800	23.00	23.40	25.39	24.56	25.43	0.002165	1.55	15.32	16.54	0.27
upper malibu byp	3800	70.00	23.40	26.26	25.26	26.35	0.002324	2.40	31.52	19.60	0.30

ATTACHMENT 4 - WETLAND BANKING INFORMATION

Wetland Mitigation Banking: Status and Prospects II

97-849 ENR

CONTENTS FOR THIS SECTION

Mitigation Banking Today

The Clinton Administration endorsed mitigation banking in its wide-ranging Wetland Plan, issued on August 24, 1993. As part of this effort, the Corps and EPA issued a regulatory guidance letter endorsing mitigation banking as a part of the § 404 program. The Administration promulgated detailed guidance, issuing draft regulations in the *Federal Register* on March 6, 1995 and final regulations on [illegible] 28, 1995 (effective on December 28, 1995). The guidance is signed by the five principal agencies involved in federal wetland programs-in addition to the Corps and EPA, the other agencies are the FWS, NMFS, and NRCS. These agencies are all members of a Interagency Wetlands Work Group. The regulations detail the process by which banks could be set up, used, and monitored to comply with requirements of the § 404 and swampbuster programs, emphasizing the roles that the federal agencies will play. This guidance includes a list of related statutes, regulations, and policies. The final guidance discusses several policy issues, including:

- planning considerations, including goal setting, site selection, technical feasibility, role of preservation, inclusion of upland areas, and banking in a watershed context;

the 1970s, legal decisions in several cases led the Corps to revise this program and to incorporate broad jurisdictional definitions for both regulated waters and adjacent wetlands.

In reviewing permit applications, the Corps evaluates a broad range of factors, including cumulative impacts of the proposal and its intended use on the public interest. This process is intended to consider various competing and conflicting views and values. The decision whether to authorize a permit, and the conditions under which the proposed activity will be allowed, are determined by a general balancing process that reflects concern for both protection and utilization of important resources. As part of this process, the Corps considers the extent to which mitigation shall be required when damage to wetlands cannot be avoided or minimized. Further, the Corps approves and monitors mitigation projects, including any banking activity.

Environmental Protection Agency. EPA has significant responsibilities under the § 404 program. First, the substantive water protection criteria that permit applicants must meet are established in guidelines developed by EPA in conjunction with the Corps. Second, EPA has the authority to veto the Corps' permit decisions under § 404(c), if it determines that the discharge of fill material would have an unacceptable adverse effect on municipal water supplies, shellfish beds and fishery areas, wildlife, or recreational uses. EPA's veto authority has been highly controversial: although rarely used (about a dozen times in 20 years), some believe that it has served as a deterrent many other times. Authority to enforce § 404 is shared by EPA and the Corps.

Fish and Wildlife Service. The FWS, in the Department of the Interior, cooperates with the Corps and the EPA in permit reviews for the § 404 program. Under the Fish and Wildlife Coordination Act (ch. 55, 48 Stat. 401), the Corps is required to consult the FWS before issuing permits. The FWS provides recommendations on how wetland losses can be avoided, minimized, or mitigated. However, unlike the EPA, the FWS has no authority to override a Corps decision. The FWS published a formal mitigation policy more than a decade ago which ranks habitat by its scarcity value, and establishes mitigation planning goals. 14

National Marine Fisheries Service. The NMFS, a part of the National Oceanic and Atmospheric Administration in the Department of Commerce, is actively involved in providing guidance on mitigating wetlands losses in coastal areas. This agency contributed to the development of the *Federal Register* guidelines. Its role is similar to that of the FWS.

Natural Resources Conservation Service. NRCS, in the Department of Agriculture, administers the swampbuster program, enacted in the 1985 Food Security Act (P.L. 99-198). Swampbuster specifies that farmers who drain wetlands to plant crops could lose access to numerous federal farm program benefits until they restore those wetlands. Swampbuster is not a regulatory or permit program, as each farmer decides whether he will risk losing these benefits by altering a wetland. NRCS assists farmers in identifying and delineating wetlands, and determines if they are violating swampbuster. (NRCS is also responsible, based on a MOA with the Corps, for delineating wetlands in agricultural areas for the § 404 program. Also, § 404 includes a provision that explicitly excludes "normal farming activities" from permit requirements, while swampbuster excludes certain kinds of wetlands, such as those created as a byproduct of leaking pipes around irrigation apparatus.)

Swampbuster allows mitigation in some instances, and the federal guidance states that mitigation banks may be used to satisfy' requirements of swampbuster.15 To date, no banks have been set up specifically to support the swampbuster program. Amendments in the 1996 farm law (P.L. 104-127) authorized a pilot mitigation banking effort, increasing the likelihood that banks will emerge in agricultural areas in the future. This pilot program is being administered through a large agricultural land retirement program, the Conservation Reserve Program (CRP).16

State Involvement

The concept of mitigation banking was applied at few sites and in relative obscurity for about two decades, until interest suddenly blossomed in the 1990s. Some states operate programs, but most are currently translating the concept from an abstract idea into a functioning program. Some states prohibit banks under current laws. Other states limit mitigation banking to use by state departments of transportation or highways for impacts to wetlands caused by highway construction. A few states have been more aggressive in developing mitigation banks, and some were pursuing banking initiatives before the federal guidance was issued. including California, Illinois, Wyoming, and Minnesota. Two innovative states, New Jersey and South Carolina, have created wetland councils to oversee the development of banks and have numerous projects underway. Many other states which are attempting to develop banks are working to resolve the same kinds of questions about the guidelines and operation for mitigation banks that the federal government had to resolve for its guidelines.

Federal Mitigation Banking Guidance

Federal mitigation banking guidance requires programs to be consistent with agency policies before bank development and maintenance plans are approved. Under the 1995 guidelines, banking may be acceptable if specific criteria, summarized below, are followed. This guidance is intended to be administered with flexibility to accommodate variations in banking. This flexibility may become more important if planning on a watershed basis continues to be emphasized. The watershed approach places wetlands in a larger geographic context, and should contribute to more effective decisions about the location and use of banking sites.

At each federally-approved bank site, activities of all agencies are coordinated through an interagency mitigation bank review team. The team oversees planning and operations. The Corps representative chairs all teams, except the NRCS representative chairs banks that are limited to wetland losses on agricultural lands in conjunction with the swampbuster program. The primary purpose of these teams is to facilitate the timely development of an acceptable banking instrument, but they are involved in other ways as well.

Project Considerations. The central goal of any bank is to manage a self-sustaining, functioning wetland ecosystem. The criteria encourage restoration projects to replace the wetland values that would be lost over creation projects. Experience has shown that restoration sites are much more likely to succeed than sites where wetlands are created. The credits at a bank should be at least equal in acreage. functions. and values to similar wetlands that will be degraded through anticipated projects. Each bank [illegible] specified number of credits that it can provide for compensatory mitigation. Each proposed activity which must compensate for adverse impacts to wetlands can be authorized to use a mitigation bank as a condition of a permit, as long as credits are not resold or used to compensate for multiple activities. However; the same credit can be used for an activity which requires approval by more than one agency.

Geographical Considerations. The guidelines stress that the designation of the banking service area should be based upon the "consideration of hydrologic, edaphic and biotic criteria," with a strong preference for replacing the losses at the impact site with similar wetland functions, similar positioning in the broader landscape, and similar species populations. For example, purchasing credits at a freshwater wetland bank may not be appropriate compensation for the degradation of a brackish or saline wetland.

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Debiting from mitigation banks which have different functions than affected wetlands may be limited to banks that are developed to accomplish a specific resource objective. All permit reviews are handled on a case-by-case basis.

The selection of a bank site should be based on how it will functions in the context of the watershed, and not on what land happens to be available, as often has been the case with mitigation. Banking may have its greatest potential for success when it is part of a watershed-based wetland plan. However, such planning is especially difficult for banks that serve linear projects passing through multiple landscapes or watersheds. such as new highway or pipeline corridor locations. The guidelines emphasize that banking should be used only after the three-step process of avoidance, minimization, and on-site mitigation has been followed, which is likely to fit with watershed planning goals.

Crediting and Debiting Procedure. Credits and debits designate the units of trade. Credits represent the composite of wetland functions at a bank site, while debits represent either the loss of wetlands and their functions at a project site, or the wetlands values that are withdrawn from a bank when a transaction is approved. The number of wetland credits available from the mitigation bank should be determined using an appropriate functional assessment methodology acceptable to all parties with official responsibilities, including members of the mitigation bank review team. A single method should be used to quantity the value of both credits and debits. Credit and debit documentation is to be submitted to the chair of the mitigation bank review team each time a transaction is approved. The guidance allows the use of an acreage measure if a functional assessment methodology is impractical.

Compensation Ratios. Some banks do not always issue credits at a ratio of 1:1; that is, each acre of wetland lost is not treated as identical to an acre gained at the bank site. The ratio may be different because:

- the value of the wetland debits varies;
- the value of the credit depends on the pre-bank wetland functions;
- the bank recognizes different levels of risk of success in various banking situations;
- the transaction involves different types of wetlands; or
- some functions are valued more highly than others.

The replacing of a naturally-occurring wetland with one that is restored or created may also lead to a variable ratio. The ratio may change over time, as well; it may decrease as the wetlands at the bank site become established and the risk of failure declines.

A bank in Eugene, Oregon, for example, uses variable compensation ratios. It gives restored wetlands a full credit, but only 0.66 for created wetlands and only 0.44 for enhanced wetlands. 17 There[illegible] restored mitigation bank site of 3 acres, for example, a credit would be 3.0, but if the bank site was an enhanced wetland, the credit would only be worth 1.32. Using the same example and viewed from the applicant's perspective, 3 acres of degraded wetlands would require purchasing credits worth 3 acres of restored wetlands, but 7.5 acres of enhanced wetlands. In this example, the "quality" of the 3 acres to be affected or lost is not considered. It is not clear from published sources whether variable credits are widely used, but they appear to be more widely used now than in earlier years, and may reflect an increasing sophistication and creativity in banking.

Bank Sponsor Responsibilities. The bank sponsor is responsible for assuring the success of all operations at the bank site. The bank sponsor carefully manages the accounting procedures, financial considerations, and long-term maintenance of wetland functions and values for the banking entity. The bank sponsor should submit all appropriate documentation to the team. Prior to any debiting from a bank, the sponsor must satisfy three requirements:

- the banking instrument and final mitigation plans must be approved;
- the bank site must be secured; and
- appropriate financial assurances must be confirmed.

In addition, initial physical and biological improvements to the bank site should be completed within the first growing season following the first debiting by the bank. Federal and state agencies will oversee the maintenance of the bank site. One source of information about the condition of the site is the monitoring reports prepared by the bank sponsor. The bank sponsor can be held responsible to finance additional resource improvements if the team determines that the bank is not achieving the objectives outlined in the authorization documents.

Banking instruments, the agreements between the bank operator and regulatory agencies, have taken many forms, ranging from memoranda of agreement to permits to corporate charters. Topics commonly addressed in banking instruments include the permitting and approval process, bank management and operation, credit production and evaluation, client relationships, and, if appropriate, long-term bank ownership. These agreements vary in several ways, including the amount of detail, the duration of the agreement, the methods prescribed to resolve disputes, and enforcement mechanisms. If the model banking instrument that the Interagency Wetlands Work Group is developing is widely adopted, it will gradually bring greater uniformity to future agreements.

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10 Testimony submitted by Charles Ruma, on behalf of the National Association of Home Builders, to the Senate Committee on Environment and Public Works, March 14, 1996.

11 U.S. Army Corps of Engineers. *Commercial Wetland Mitigation Credit Ventures; 1995 National Survey* IWR Report 96-WMB-9. August 1996, Alexandria, VA. P.54.

12 Testimony submitted by Robert Sokolove, President of U.S. Wetland Services Inc., to the Senate Committee on Environment and Public Works, March 14, 1996.

13 Personal communication with Robert Brumbaugh, Corps Institute for Water Resources, September 1997. Counts of bank numbers require careful review to determine whether each site is considered as a bank or whether all units operated by one entity are combined and considered as a single bank. For example, in this count, he considered a Minnesota Department of Transportation activity as a single bank even though it involves more than 60 sites. Others might count each site as a bank.

14 U.S. Dept. Of the Interior, Fish and Wildlife Service. "U.S. Fish and Wildlife Service Mitigation Policy: Notice of Final Policy." *Federal Register* 456(15):7644-7663.

15 Currently, mitigation banking is allowed only in the conversion of frequently cropped wetlands, with restoration allowed on prior converted wetlands. For more information on Swampbuster, see CRS Report 96-35 ENR, Agricultural Wetlands: Current Programs and Legislative Proposals.

16 For background information on the CRP, see CRS Report 97-673, Conservation Reserve Program: Status and Current Issues.

17 Testimony submitted by Steve Gordon on behalf of the Council of Lane County Governments to the Senate Committee on Environment and Public Works, March 14,1996.

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NCSE

Wetland Mitigation Banking: Status and Prospects III

97-849 ENR

CONTENTS FOR THIS SECTION

Support for Mitigation Banking

Many advocates of banking view it as a promising alternative to current mitigation programs, which some characterize as ineffective. They argue that banking can make important contributions to achieving the overall national policy goal of "no net loss." The benefits ascribed to banking below are generally supported by the experiences recounted at congressional hearings.

Consolidation of Small Wetland Losses

Mitigation banks encourage the restoration and creation of larger wetland areas than on-site mitigation. Banks generally have higher success rates and lower cost ratio per mitigated acre. 18 Wetlands within banks may also be more enduring because the sponsor has the opportunity and a strong commitment to implementing a long-term program for preservation and maintenance of wetland values. Additionally, combining many wetland acres in a single site may allow the mitigation effort to focus on a habitat with especially desirable characteristics.

By contrast, individual on-site mitigation projects are typically smaller and fragmented. Often such sites are less hospitable to the creation or restoration of wetlands, and may have a lower probability for establishing a sustainable habitat. Numerous scattered sites have proven inefficient and difficult for public agencies (with limited staff) to monitor, and for applicants (who have little commitment to protecting long-term wetland values beyond what is required by regulatory agencies) to maintain. 19 In addition, a large majority of permit applicants do not have professional staff knowledgeable about wetlands ecology and are often interested in minimizing the financial and other resources that must be devoted to their mitigation effort.

Proponents contend that having the banker select a site for mitigation banks is an additional advantage. A banker has a strong incentive to choose a location at which a project could flourish. Often, conventional mitigation ends up being placed on lands which the applicant owns or can easily purchase at the time that the permit process is being completed. These sites may be far less than ideal for establishing and maintaining wetland functions and values. The process of locating and establishing a bank helps insure that it will be located at a hydrologically and ecologically favorable place.

Planning and Implementation

Mitigation banks may have a better design for long-term maintenance and operation than on-site mitigation projects. Bank sponsors make a substantial financial commitment to the success of each project, and are much more likely to retain experts, including biologists, engineers, and ecologists, to design and monitor the site.20 Scattered mitigation projects are more likely to fail, especially if applicants have little wetland experience, because they seek to minimize additional costs. Supporters of mitigation banking claim that the extra scientific and technical effort that goes into establishing a bank will continue with a stronger commitment to successful implementation, including proper siting, design and construction, and long-term maintenance of the site.

The timing with which credits are made available has been subject to some debate. Entrepreneurial bankers want the flexibility to sell at least some credits as they develop the site to raise implementation funds. Skeptics of mitigation banking want some credits to be withheld from the market until the performance of the wetland can be certified. Also, if credits are sold only after the bank is operating and the wetland functions are in place, then the purchase of credits will bypass temporary losses associated with on-site mitigation. These temporary losses can be significant if they occur during the breeding or nesting season, or if a flood occurs, for example.

The federal guidance supports sale of some credits before the bank is fully functional at sites where it can determine that there is a high likelihood of success. Some sites, such as a bank in Eugene Oregon, sold "uncertified" credits a a lower prices. In this case, they sold them only during the first 6 years of the project and the quantity that could be sold was limited.21 For commercial banks, the longer the time before credit sales are allowed, the greater the economic exposure for the bank sponsor.

Monitoring and Evaluation

Monitoring wetland values at mitigation sites is more practically accomplished at a larger mitigation bank. The process is more efficient because a single entity would operate a bank. For a federally-approved bank, the banking agreement defines responsibilities for maintaining wetland values. Follow-up evaluation activities by mitigation banking review team members would identify adjustments that are necessary to protect the site values that are identified in a bank management plan. If a sponsor fails to comply with its

A portion of all banks have involved creation. However, creating wetlands remains generally regarded as an experimental technique among knowledgeable scientists. Critics contend that created wetlands may not be as successful as natural wetlands. To date, created wetland areas have not replaced the equivalent attributes of natural wetlands. Wetland protection advocates caution that a created wetland must be evaluated over a long time period before a conclusion can be drawn on whether equivalent functions and values have been replaced and the site is self-sufficient. Credit purchases should be authorized only after this objective is achieved, and contingency plans, including some form of a performance bond in case the bank fails, should be included.

Dissimilar Replacement of Wetland Habitat

Opponents claim that replacement of similar functions and values of altered wetlands will be difficult to accomplish through a bank. Ideally, mitigation should occur in the same watershed as the affected site, and should have similar ecological characteristics, sometimes referred to as in-kind mitigation. Since mitigation banks are not at the same site as the project, they may not fully replicate the mix of functions and values that the affected wetlands provided. That mix may be impossible to recreate due to ecological differences, the location of the bank in the watershed, or surrounding land uses. For example, it may be impossible to recreate significant flood storage at a wetland with the same value at a bank site, even in the same watershed. Differences are often more subtle than this example, yet have a substantial effect on the value of the resource. Critics contend that differences should be accounted for in the credit system, and any uncertainty about how to value the credits and debits should err in favor of protecting wetland resources.

Opponents also believe that the diversity of species supported by the wetland to be altered should be fully replaced. They argue that even when replacement is attempted, identical habitat may not be readily established at another site, resulting in declines or the potential loss of some species, and in less diversity in the ecosystem.

The availability of banks could promote more purchases of mitigation credits at sites with different replacement values. In terms of vegetation, for example, shrub, marsh, or tidal wetlands have been the most common replacement projects. These wetlands require less planning, management, and expense than other types of wetlands, such as bottomland hardwood forests, and generally are more likely to be successful. Some types, such as those with peat soils or ones that rely on ground water or rainfall, are more difficult to create or restore. As a result, banks with "easier sites could be established more widely and quickly. While applicants and bank sponsors would seek to use these easier sites whenever possible, they might provide inadequate or inappropriate credit for degraded wetlands from a different biological community. Expanding mitigation banking opportunities could stimulate this kind of inappropriate mitigation, and lead to a debate over whether the bank is a success with either less than an[illegible] benefits or a different mix of benefits.

While the federal guidance addresses this issue by stating that in-kind compensation of wetland impacts should generally be required and the requests for out-of-kind mitigation will be handled on a case-by-case basis, critics wonder whether federal agencies can be counted on to vigorously monitor these requirements. Requests for out-of-kind mitigation are supposed to be approved only when it is a part of an area-wide management plan designed to address a specific resource objective.

Nature of Crediting and Debiting Techniques

Critics contend that a consensus should be reached on the value of wetland credits purchased for mitigation before banks can be utilized. Such an agreement is necessary so that when debits are measured, team members and others can determine the amount of credit necessary for appropriate compensation. Disagreements over the value of a credit can be contentious, in part because alternative methods for calculating these values are available. Probably the most widely-used method is some version of the Habitat Evaluation Procedure (HEP), first developed by FWS 20 years ago. HEP comes in several forms, and has several competitors as well. Some of these methods are relatively simple to use, while more complicated ones better assess the values and functions; no single method appears to be simple yet sophisticated. A new method for assessing functions being developed and field tested by the federal agencies, the hydrogeomorphic approach, is not yet fully in place. Another cause of disagreements is whether and how to differentiate the value of credits for wetlands that are created, restored, or preserved at the bank site.

Bank Operations

Critics worry that banking proponents are not sufficiently concerned about both the start up of banks and the long-term liability to ensure that wetland values will be maintained. As a part of the start up, there will be pressure to sell credits before they have matured at the site, a practice characterized as "speculating in wetland credit futures."22 If the bank fails after selling credits, wetland values at both the old and new sites are lost. Also, financial pressures on bank sponsors from the private sector could cause them to seek public lands and agency expertise, generating additional taxpayer costs.

Long-term responsibility may be at risk if enforcement mechanisms and operating controls are inadequate and a bank fails. Many banking agreements appear to offer little detail on enforcement and responsibility should a bank fail. There is little evidence about the frequency with which this kind of information is included in agreements, or even what should be required, at a minimum. Requiring a bond and a clear assignment of liability would certainly be important to ensure the protection of public values.

Congressional Considerations

Mitigation banking is drawing increasing attention from Congress. Some Members may view banking as an additional means to slow the decline of wetlands and attain the "no net loss" goal. Others may view banking as an approach that would relieve some pressure on Congress to act to further protect private property rights by providing a market-based option that also could increase flexibility for federal agencies administering wetland programs. Implementation of the pilot program mitigation banking provisions in the 1996 Federal Agricultural Improvement and Reform Act (1996 farm bill) through the Conservation Reserve Program could create substantial new opportunities on agricultural lands. The steadily increasing number of operating banks demonstrates an expanded interest and an ability to overcome impediments.

Economic activity and growth will continue to threaten the existence of some wetlands, keeping the issue of wetland protection before Congress. On-site mitigation projects have a poor track record, supporting the claims of those who believe that these efforts are not effective. The potential for banking to be more successful, especially under some conditions, appears viable. However, mitigation banking will be inhibited unless conservation interests support it, banking entities prove that they can make the program work for a long time period, and mitigation requirements are achieved. For Congress, the policy debate will continue to center on how national policy should endorse or support mitigation banking as a practical mitigation alternative for wetland protection programs. However, the 105th Congress has yet to act on legislation that would affect mitigation banking activities.

In the 104th Congress, the House did address many of these issues as it considered HR. 961, Clean Water Act reauthorization legislation. Provisions in this bill, which passed the House in May 1995, would have modified the § 404 program in many ways. Among other things, it would have required the Corps to issue regulations governing mitigation activities in wetlands and regulations for the establishment, use, and oversight of mitigation banks. The Senate did not act on this bill, or on other legislation which included similar mitigation and mitigation banking provisions.

The Senate Environment and Public Works Committee, however, did explore current mitigation banking efforts at a March 14, 1996 hearing. Witnesses suggested that there is considerable entrepreneurial interest and activity. They identified examples of current experiences, successes and impediments, and suggested further changes that they believe would help mitigation banking flourish. One tension in banking was between the flexibility that proponents sought for success and the tight administration that critics thought should be placed on these activities to ensure that wetland resources are protected. A policy topic not addressed at the hearing that seem certain to receive future congressional attention, is whether the federal government should provide financial or other incentives. Should any incentives be provided for all federally-endorsed banks, for selected "model" banking efforts, or for no banks? Also, are non-financial incentives, such as streamlining the permit process or providing scientific or technical assistance, either appropriate or necessary, and if so, under what circumstances? Should a revolving fund be established to support overall banking efforts?

Federal agencies have moved slowly in adopting mitigation banking policies. After President Clinton announced his wetland policies in August 1993, including support for mitigation banking, more than 2 years elapsed before the final guidance was issued. With five agencies having to agree on the many specific issues surrounding implementation, perhaps this is not surprising. But even after the release of final guidance for banking, concerns over banking policy remain, and are likely to continue.

Implementing the mitigation banking guidelines could help ensure that degraded wetlands are fully replaced. Yet, many unanswered questions remain. Development interests are generally strong supporters of the concept of banking. They view banking as another alternative for the mitigation process. Many environmentalists are skeptical of mitigation banks. They claim that banking policy endorses wetland destruction, with little assurance that functional values will be protected over the long term. Some of them will only support mitigation banking if use is limited to a last option and monitored closely. They want mitigation banks to have precise, scientifically sound rules that provide for guaranteed banking success. Though the federal guidance seems to respond to many of these arguments, mitigation banks must provide some long term success stories before concerns can be alleviated. Congress may continue to encourage banking generally, as it did in the 1996 farm bill, but it is also likely to address these issues as part of legislation that authorizes any specific mitigation banking programs or policies.

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NCSE

Welcome to the US Army Corps of Engineers
Sacramento District
Regulatory Program

HABITAT MITIGATION AND MONITORING PROPOSAL GUIDELINES

October 25, 1996

INTRODUCTION

I. PURPOSE OF GUIDELINES

These guidelines serve to assist applicants in the preparation of compensatory mitigation and monitoring plans associated with projects requiring Department of the Army (Corps) permits.

The United States Environmental Protection Agency and the United States Department of the Army have formulated policy and procedures to be used in determining the mitigation necessary to demonstrate compliance with the Clean Water Act Section 404(b)(1) Guidelines. This information is set forth in the "Memorandum of Agreement Between the Environmental Protection Agency and the Department of the Army Concerning the Determination of Mitigation under the Clean Water Act Section 404(b)(1) Guidelines" (MOA), dated November 15, 1989. The 404(b)(1) Guidelines allow permit issuance for only the least environmentally damaging practicable alternat[illegible]f the overall project purpose. The 404(b)(1) Guidelines state that no discha[illegible]dged of fill material shall be permitted if there is a practicable alternative to the proposed discharge which would have less adverse impact on the aquatic ecosystem so long as the alternative does not have other significant adverse environmental consequences. Practicability is defined in terms of cost, logistics, and existing technology. The burden to demonstrate compliance with the 404(b)(1) Guidelines rest with the permit applicant. For nonwater dependent discharges into special aquatic sites (e.g. wetlands), there is a presumption that less environmentally damaging practicable alternatives exist. If the applicant has complied with the 404(b)(1) Guidelines through first evaluating alternatives to avoid impacts, and then taken appropriate and practicable steps to minimize adverse impacts to the maximum extent practicable, then reasonable and practicable compensatory mitigation is required for the unavoidable impacts that remain.

Mitigation banks provide compensatory mitigation for adverse impacts to wetlands and other aquatic resources. Creation and use of a mitigation bank can be used to offset the impacts from third party development or, for those with a higher than average need for mitigation, the impacts associated with single party development.

Mitigation banks have the potential to create large contiguous areas of habitat that are more ecologically viable than numerous smaller, and often isolated, areas of similar habitat. The establishment of a mitigation bank creates the potential for streamlining approval of certain classes of regulated activities and should also provide increased likelihood that the created habitats will remain viable and protected over time.

A potential bank operator must submit a prospectus to the Corps of Engineers. According to the federal guidelines, the prospectus must contain the following elements, as appropriate:

a. Bank goals and objectives;
b. Ownership of bank lands;
c. Bank size and classes of wetlands and/or other aquatic resources proposed for inclusion in the bank;
d. Description of baseline conditions;
e. Geographic service area;
f. Wetland classes or other aquatic resource impacts suitable for compensation;
g. Methods for determining credits and debits;
h. Accounting procedures;
i. Performance standards for determining credit availability and bank success;
j. Reporting protocols and monitoring plan;
k. Contingency and remedial actions and responsibilities;
l. Financial assurances;
m. Compensation ratios;
n. Provisions for long term management and maintenance.

The Corps will transmit the prospectus to the other involved federal agencies, typically EPA and the US Fish and Wildlife Service. If the project involves a waterway that supports anadromous fisheries, the National Marine Fisheries Service will be involved. At the state level, the California Department of Fish and Game is involved in the development of a banking agreement. The lead local agency, typically the county, will also be invited to participate.

Coordination between the agencies and the bank developer will ideally result in the creation of a "Mitigation Banking Instrument". This document sets out how the bank will be established, operated, utilized, and eventually closed out. If the construction of the bank site involves a discharge into waters of the United States, the banking instrument will become part of the Department of the Army □404 permit issued for the work. Currently, this is the most expeditious route to establishment of a bank. In the absence of a permit, a Memorandum of Agreement (MOA) must be established amongst the federal agencies governing evaluation of the bank operation and stipulating when the bank may be used. Once the MOA is established, the bank developer signs as a concurring party, agreeing to abide by the terms of the document to the extent that it affects his management of the bank.

If a §404 permit is involved, §401 water quality certification will need to be obtained from the appropriate Regional Water Quality Control Board.

Copies of the federal guidelines may be requested by contacting the Corps Regulatory Branch. Or download this pdf version

- **PRESERVATION**

The acquisition and preservation of existing wetlands can be an appropriate approach to wetland mitigation. In some circumstances, this form of mitigation may be appropriate in combination with construction of wetlands or, in rare cases, as the sole method of mitigation. Attempts should be made to aggregate these preserves in large areas that would generally be located outside of areas planned for urban development.

III. PLACE OF MITIGATION PLAN IN PERMIT PROCEDURE

A. Individual Permit

If an applicant is applying for an individual permit and proposes mitigation, it is preferable that a preliminary mitigation and monitoring plan be submitted along with application materials. A detailed preliminary mitigation plan should generally not be completed until a final jurisdictional map has been accepted by the Corps and the area of fill to be mitigated has been identified. The final mitigation plan will usually be submitted following the public comment period and Corps review of the preliminary plan.

B. Nationwide/General Permit Program

If an applicant is requesting verification of a project's qualification for a Department of the Army general permit, and proposes mitigation, a detailed mitigation and monitoring plan should generally be submitted with the request for verification.

C. Final Submission

The final submission of all mitigation and monitoring plans should be in a SINGLE document. It should contain up-to-date versions of all materials, even if other versions were submitted earlier in the application process. Include the preparer's identity if other than the applicant, and the date of the final submission. Include full size delineation maps of the same scale of the impact and mitigation sites.

IV. COMPLIANCE ASSURANCES

An applicant may be required to provide a letter of credit, performance bond, collateral, or special funding (i.e., Community facilities tax district) to ensure attainment of the final mitigation success criteria as stated in the permit conditions. The monetary value of the functional guarantee will be determined by the Corps, based on an estimate of the total cost of the proposed mitigation project provided by the applicant. This estimate shall include, as a minimum, the costs associated with site acquisition and preparation, vegetation establishment, operational costs, and the generation of performance reports.

V. PERSONS TO CONTACT WITH QUESTIONS

For answers to questions regarding the interpretation of these guidelines or acceptable mitigation for a specific project, contact a project manager within the Regulatory Branch of the Sacramento District.

HABITAT MITIGATION AND MONITORING PROPOSAL GUIDELINES

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HABITAT MITIGATION AND MONITORING PROPOSAL GUIDELINES

ANNOTATED OUTLINE

SUMMARY

Provide a one-page summary of report contents.

I. PROJECT DESCRIPTION (Site of Impacts)

A. Responsible Parties

Provide name(s), title(s), address(es), and phone number(s) for the following (including contact person(s) if applicant is a company or an agency):

1. Applicant(s)
2. Preparer(s) of proposed mitigation plan.
3. Party(ies) having financial responsibility for the attainment of the success criteria required by the proposed mitigation plan.
4. Present owner of the proposed mitigation site.
5. Expected long-term owner of mitigation site.
6. Party(ies) responsible for long-term maintenance of mitigation site.

B. Location of Project

1. Describe location.
2. Provide:
   a. road map of site location with road names, highways, and other features clearly indicated
   b. USGS quad map with project site outlined (clear photocopy is acceptable)(include name of quad map and Section, Township, and Range)
   c. Parcel Number(s) of project site

C. Brief Description of Overall Project

In one or two paragraph, describe the overall project (not just the area to be filled). Include type of development and project size, and a brief schedule/date line of project construction. Include anticipated start date, construction time period, phasing, and life of project.

D. Jurisdictional Areas to be filled, as defined in the "Corps of Engineers Wetlands Delineation Manual" (Waterways Experiment Station Technical Report Y-87-1, January, 1987) and in 33 CFR 328.3(a).

Provide topographic base map with verified Corps jurisdictional area(s) and area(s) of proposed fill outlined (see Appendix A for map format information).

E. Type(s), Functions and Values of the Jurisdictional Areas on the project site To Be Directly and Indirectly Impacted

1. Type (e.g. seasonal wetland, vernal pool, freshwater marsh, riparian, open water, etc)

2. Functions, Values, and Baseline Information

The Corps has not yet adopted formal procedures to assess functions and values of waters of the United States. Therefore, to assist in an evaluation of the project, a qualified environmental sciences professional familiar with aquatic systems shall provide a summary of the functions and values of waters of the United States, assessing a measure of its value. In addition, multi-disciplinary expertise (e.g., hydrology, geology) may be required to evaluate the functions and values of an area on a site-specific and, as necessary, a regional basis. Examples of features to be addressed are:

- Water Quality
  - groundwater recharge/discharge
  - nutrient removal/transformation
  - flood flow alteration
  - sediment stabilization
  - turbidity
  - surface and subsurface water sources
- Habitat
  - rare/endangered species (Federal and state)
  - known or probable wildlife use
  - plant communities
  - complete species list
  - known or probable fish, shellfish, and aquatic invertebrate use
- Recreational use/public access
  - non-consumptive (e.g. birding, walking)
  - consumptive (e.g. fishing, hunting)
- Streams and Channels
  - slope
  - hydrology
  - channel morphology
- Soils
  - Soil Unit(s) from SCS Soil Survey Map
  - Field indicators of hydric soils indicating unmapped hydric soil inclusions

II. GOAL OF MITIGATION (i.e. the long-term goals, which may not be reached until some years after the applicant's mitigation responsibilities have been completed)

A. Type(s) (e.g. seasonal wetland, vernal pool, freshwater marsh, riparian, open water, etc) of Habitat to be Created or Enhanced

If out-of-kind,present rationale. Include a Table listing the size of impact, proposed mitigation ratio, acreage for each habitat type to be impacted,and proposed buffer areas.

B. Characteristics, Functions and Values of Habitat to be Created/Enhanced

Refer to Section I.E.2. above.

C. Evaluation of Temporal Losses

How many years is it likely to take for long-term goal habitat to develop?

D. Estimated Cost

What will cost of habitat mitigation be? Estimate the cost of design, land acquisition, implementation, maintenance and monitoring of the mitigation area until completion of the permittee's mitigation responsibilities.

III. PROPOSED MITIGATION SITE

A. Mitigation Site

1. Describe location, including rationale for choice. Indicate distance from project site, if offsite. Indicate if in/out of the same watershed as project.
2. Provide the following maps:
    a. full-size copy of USGS quad map with mitigation location outlined. Indicate name of quad sheet and Section, Township, and Range.
    b. site location on a road map
    c. base topographic map (same size and scale as project site delineation map) with proposed mitigation area(s) outlined and acreage indicated (see Appendix A for figure format information)
    d. verified wetland delineation map of the mitigation site, if applicable.
    e. SCS soil map with mitigation site outlined.

B. Ownership Status

1. Indicate who presently owns the mitigation site. If different from permit applicant(s), what is availability of the property? Does the property carry any encumbrances on the title? If on public land, what arrangements, if any, have been discussed with managing agency?
2. Indicate expected ownership of the mitigation area following completion of the mitigation project. Who will be responsible for long-term management and protection of the area? If entity other than applicant will assume management responsibilities following completion of mitigation project, is there a signed, written agreement with the entity to manage the area in conformance with goals of the mitigation? Include copies of any agreements. Include copies of all applicable deed restrictions.
3. Indicate what entity, if any, controls water flow to and/or from the site. Who maintains water control structures? What arrangements have been made to guarantee appropriate water flow in the mitigation area during and after the establishment of the mitigation project?
4. Indicate who the point of contact is for permission to gain access to the site, or include a statement giving the Corps permanent access to the site.
5. Deed restrictions will be required that maintain on-site and off-site mitigation

and preservation areas as wetland preserve and wildlife habitat in perpetuity. Copies of the proposed language will have to be submitted to the Corps of Engineers for approval prior to recordation. Copies of the recorded documents must be provided to the Corps no later than 30 days subsequent to recordation. Recordation must occur at least 15 days prior to the start of project construction.

C. Existing Functions, Values, Baseline Information of Mitigation Area

The Corps has not yet adopted formal procedures to assess functions and values of waters of the United States. Therefore, to assist in an evaluation of the project, a qualified professional familiar with aquatic systems should provide a summary of the functions and values of waters of the United States, assessing a measure of its value. In addition, multi- disciplinary expertise (e.g., hydrology, geology) may be required to evaluate the functions and values of an area on a site- specific and, as necessary, a regional basis. Examples of features to be addressed are:

- Water Quality
  - groundwater recharge/discharge
  - nutrient removal/transformation
  - flood flow alteration
  - sediment stabilization
  - turbidity
  - surface and subsurface water sources

- Habitat
  - rare/endangered species (Federal and state)
  - known or probable wildlife use
  - plant communities
  - complete species list
  - known or probable fish, shellfish, and aquatic invertebrate use

- Recreational use/public access
  - non-consumptive (e.g. birding, walking)
  - consumptive (e.g. fishing, hunting)

- Streams and Channels
  - slope
  - hydrology
  - channel morphology

- Soils
  - Soil Unit(s) from SCS Soil Survey Map
  - Field indicators of hydric soils indicating unmapped hydric soil inclusions

D. Present and Proposed Used of Mitigation Area

Briefly describe all known present and proposed uses of mitigation area. Discuss non-native landscape plantings, pipelines, power lines, roads, distance and location of nearest structures, if any, etc. on property containing mitigation site. Discuss use of mitigation area after project is complete.

E. Jurisdictional Delineation (if applicable)

If jurisdictional areas are already present on the mitigation site, describe. Provide base topographic map (see appendix A) of site with jurisdictional areas (and proposed fill) indicated.

F. Present and Proposed Uses of All Adjacent Areas

Briefly describe all known present and proposed uses of all property sharing a common border with the property containing the mitigation site.

G. Zoning

Give all present and proposed uses consistent with the local general plan and zoning, if applicable, for mitigation site and adjoining properties, including city, county, special constraints, etc.

IV. IMPLEMENTATION PLAN

A. Rationale for Expecting Implementation Success

Refer to previous relevant experience of applicant and/or consultant and to other similar and successful mitigation projects. Include hydrology and soils information. Describe appropriateness of site, methodologies, and materials to be used. Describe how this plan may affect wetlands already present on the site.

B. Responsible Parties

Give Name(s), title(s), address(es), and phone number(s) of person(s) responsible for implementing the mitigation projects.

C. Schedule

Provide a schedule in the form of a legible flow chart or chronology showing intended timing of site preparation and plantings.

D. Site Preparation

1. Describe plans for grading, hydrologic changes, water control structures, soil amendments, erosion control, bank stabilization, equipment and procedures to be used, site access control, etc, as applicable. Include a description of exotic vegetation control techniques, planting hole excavation methods (e.g., auguring, hand digging) and the size of the planting-hole (e.g., twice size of container). Describe disposal of excavated soil from mitigation site.
2. Provide base topographic maps showing planned site preparation (see Appendix A for figure format information).
3. Provide representative cross-sections of mitigation site with elevations and

scale indicated.
4. Give name, title address, and phone number of person supervising or providing biological monitoring during grading activities.

E. Planting Plan

1. Briefly describe planting plan and methods.
2. Provide a table of species to be planted, including numbers, spacing, types of propagules, pot size, etc.
3. Indicate source of seed, plant plugs, cuttings, etc, (plant material should be selected from within a limited distance of the project site to preserve regional genetic diversity).
4. Show planting and species locations on a base topographic map (see Appendix A for figure format information).
5. If transplanting is to be done, describe storage method and duration.
6. Describe any expected volunteer native revegetation that is included in mitigation planning.

F. Irrigation Plan

Irrigation should be temporary and used solely for the purpose of establishing the mitigation site. The applicant shall provide the Corps with evidence and assurances that an adequate hydrological regime is present for the habitat to survive without irrigation in perpetuity, once the plants are established

1. Describe irrigation method(s) and estimated frequency, duration, and amount during dry months.
2. Indicate water source(s) for mitigation area.

G. As-Built Conditions

The plan should specify that the applicant will:

1. Submit a report to the Corps within 60 days of completion of site preparation and planting, describing as-built status of the mitigation project. Submit separate reports for grading, planting work and erosion control measures if not completed within six weeks of each other.
2. Provide topographic maps showing as-built contours of mitigation areas. Indicate location of planting and any other installations or structures. Changes from the original plans must be indicated in indelible red ink. Significant changes must be coordinated with and approved by the Corps prior to implementation.

V. MAINTENANCE DURING MONITORING PERIOD

A. Maintenance activities

Describe planned maintenance activities, including irrigation system inspection, plant replacement, non-native plant control, water structure inspection, fertilization, erosion control, herbivore protection, trash removal, and/or any other such activities. Include protective measures such as signs, easements, landuse management, and access control.

B. Responsible Parties

Identify persons or entities responsible for financing and carrying out maintenance activities, including names, titles, addresses, and phone numbers.

C. Schedule

Provide a table showing schedule of maintenance inspections.

VI. MONITORING PLAN

A. Final Success Criteria

These are criteria that are proposed by the applicant for Corps approval and are used to determine completion of permittee's responsibilities. Fulfillment of these criteria for all the factors listed below should indicate whether the mitigation is progressing well toward establishing the habitat type, functions and values which constitute the long-term goals of this mitigation, The applicant is strongly encouraged to link the goals and objectives of the monitoring effort with the project goals. The applicant should use statistically valid techniques that are as simple and quantitative as possible. For mitigation plantings, final success criteria will not be considered to have been met until a minimum of three years after all human support (e.g., irrigation, replanting, rodent control, fertilization) has ceased. The criteria should be stated in such a manner that the Corps can return to the site for a compliance check and verify attributes (e.g. measure percent cover) of the target functions and values. Control sites should be established for each type of wetland to be created. Modifications of the implementation plan will be considered by the Corps as long as the final result is successfully achieved. Examples of factors to be evaluated are:

1. Target Functions and Values
    - percent (%) vegetation cover by strata and/or density
    - target native plant species diversity and composition (if monitoring indicates a high level of non-native species diversity, corrective action will be required)
    - approximate plant height and diameter at breast height (dbh) (shrubs and trees)
    - evidence of natural reproduction (seed viability, etc.)
    - percent survivorship and other quantitative measures of success
    - frequency of target species among created wetlands
    - Cover or Dominance of target species within created wetlands.

2. Target Hydrological Regime
    - source(s) of water
    - discharge points
    - areas affected by seasonal flooding
    - direction(s) of flow

- size (and map) of watershed
- duration, periodicity, and depth of ponding/flooding
- water quality (i.e. salinity, pH, dissolved oxygen, temperature, etc)
- sediment transport

3. Site Integrity
   - Erosion into or within protected, restored, or created wetlands
   - Human disturbance (trash dumping, off-road vehicles, etc.)

B. Target Jurisdictional Acreage to be Created/Enhanced

The applicant must demonstrate that the required jurisdictional area of wetlands or waters of the United States have been created. The Corps will verify that the created acreage conforms with permit requirements as a part of final success criteria.

C. Performance Criteria

Provide yearly target criteria to be met, as appropriate, based on reasonable progress toward final success criteria (Refer to Section III). Target criteria shall emphasize the establishment of native plant species. If monitoring indicates a high level of non-native species, corrective measures may be required.

D. Monitoring methods

Monitoring is a requirement of most Corps permit mitigation plans. Monitoring assesses the attainment of yearly and final success criteria and identifies the need to implement contingency measures in the event of failure.

1. Describe monitoring methods. If using sampling methods, include sample sizes, statistical justification for sampling regime, and data analyses to be performed. Also, include assessment of natural population growth by target species.
2. Provide samples of all proposed data sheets.
3. Photos shall be taken during each monitoring period. They shall be taken from the same vantage point and in the same direction every year, and shall reflect material discussed in the monitoring reports. When percent cover estimates are made of herbaceous vegetation, photographs should be taken of sampling quadrats or transects.
4. Maintain as much continuity within the methodology of monitoring as possible to ensure comparable assessments.

E. Annual Reports

1. If required, annual reports shall be submitted which present monitoring results. They shall assess both attainment of yearly performance criteria and progress toward final success criteria. Specify the number in the series (year 1, year 2, etc.) of the report being submitted to the Corps. The first monitoring report will be due one year after completion of mitigation construction, however, annual progress reports will be required from the date of permit

A. Initiating Procedures

If an annual performance criterion is not met for all or any portion of the mitigation project in any year, or if the final success criteria are not met, the permittee shall prepare an analysis of the cause(s) of failure and, if determined necessary by the Corps, propose remedial action for approval. If the mitigation site has not met the performance criterion, the responsible party's maintenance and monitoring obligations continue until the Corps gives final project confirmation.

B. Alternative Locations for Contingency Mitigation

Indicate specific alternative mitigation locations that may be used if mitigation cannot be successfully achieved at the intended mitigation site. Include current ownership information if offsite.

C. Funding Mechanism

Indicate what funds will be available to pay for planning, implementation, and monitoring of any contingency procedures that may be required to achieve mitigation goals.

APPENDIX A - FORMAT INFORMATION

A. Text Format for Mitigation/Monitoring Proposals, As-Built Reports, and Annual Reports

1. The Corps file number and the date of the report shall be included in title page heading.

2. Include a distribution page listing names, titles, companies/agencies and addresses of all persons/agencies receiving a copy of the report.

B. Figure Format Notes

1. All maps and plans submitted shall be legible and include title, date of preparation, and date of submission.

2. A legend shall be provided if symbols, patterns, or screens are used on the map or plan.

3. If colors are used to indicate areas on the original map, color copies shall be included in all copies of the report submitted to the Corps.

4. Indicate North and provide a scale and datum (if appropriate, e.g., tidal influence).

5. Scale and orientation shall be the same for all maps, except for detail sections.

6. Base topographic maps (i.e., for jurisdictional areas, locations and size of mitigation areas, mitigation site preparation plans, planting plans, irrigation plans, and as-built reports) shall be full-size (1 inch = 100 feet or less, 1 inch = 400 feet for very large projects).

7. USGS quad maps shall be full-size and full scale (may be photocopies, if legible).

NOTE: Reduced copies of maps shall be bound with all documents to facilitate review by advisory agencies. For Corps review, at least two sets of full-sized copies shall accompany mitigation and monitoring proposal, and one set shall accompany each annual report.

C. Schedule

When submitting the mitigation and monitoring plan, the applicant shall indicate the month and date on which the yearly report will be delivered. If plan involves planting, this date should be between growing seasons for the primary plants so that timely decisions can be made about any modifications to the plan.

APPENDIX B

SPECIFIC HABITAT MITIGATION AND MONITORING GUIDELINES FOR VERNAL POOLS

I. INTRODUCTION

This appendix is a supplement to the information provided in the Habitat Mitigation and Monitoring Proposal Guidelines for projects that affect vernal pools and vernal pool complexes. These general guidelines represent a minimum standard for vernal pool mitigation projects. Other requirements may be added, as appropriate, to particular mitigation projects on a case by case basis. The Corps of Engineers may m[illegible] by case determinations, where circumstances warrant, that vary from the recommendations contained in these Guidelines and appendices. It is our intent to make revisions as necessary based on comments and field experience.

II. DEFINING CHARACTERISTICS OF VERNAL POOLS

For the purposes of these Guidelines, vernal pools are characterized as follows:

Vernal pools are ephemeral wetlands that form in shallow depressions underlain by a substrate near the surface that restricts the percolation of water. They are characterized by a barrier to overland flow that causes water to collect and pond. These depressions fill with rainwater and runoff from adjacent areas during the winter and may remain inundated until spring or early summer, sometimes drying more than once during the wet season.

Vernal pools typically undergo four distinct phases: (1) the wetting phase occurs in the fall and early winter with the first rains; (2) the aquatic phase when the peak rainfall and inundation occurs; (3) the drying phase, when many plants flower and produce seed and many animals disperse; and finally (4) the drought phase when the soil dries and cracks, and the plants succumbs to extreme dry conditions and turn brown[1].

[1] Zedner, P.H. 1987. The Ecology of Southern California Vernal Pools: a Community Profile. (Biological Report 85[7.11]) US Fish and Wildlife Service, Washington, DC.

Under undisturbed conditions and average rainfall patterns, vernal pools are characterized by an annual plant community dominated by native wetland species. A list of native plant species that are either restricted to vernal pools or, when found in the Central Valley, occur more often in vernal pools than other habitat types, is provided in Table 1.

In a normal year, during the aquatic and the drying phase, vernal pools will generally support a dominance of hydrophytic plant species, including a minimum of 30% relative cover of native vernal pool species from the attached vernal pool species list (Table 1) and at least 30% of total pool species from that list.

Other terms used in these Guidelines that require definition are:

affected pool:	a vernal pool on the project site that is filled, excavated, or adversely modified.
baseline:	The physical and biological conditions of the project site (or, in some cases, the mitigation site) prior to any effects from the project. Establishing baseline usually involves monitoring hydrology, vegetation, soils, and surveying for listed threatened and endangered species.
created pool:	a pool constructed for the purposes of satisfying mitigation requirements.
natural/reference pool:	A natural vernal pool usually on or in the general vicinity of the mitigation site that is, for all practical purposes, unaffected by activities associated with the project. A reference pool should generally represent the hydrology, soils (series), slope, topography, biology, and micro-climate at the impact site.
period of inundation:	the length of time that ponding occurs.
special status species:	species that are Federal candidates, proposed for listing, or listed under the Endangered Species Act of 1973, as amended and State listed species.
vernal pool complex:	the assemblage of vernal pools and swales within a localized watershed, including the uplands encompassed within that area.

within that area.

vernal pool density: the total acreage of vernal pools on the project site divided by the acreage of the watershed of the vernal pool complex.

III. GOALS AND OBJECTIVES OF VERNAL POOL MITIGATION AND MONITORING

A. Overall Goal

To provide guidance for the applicant to: select the mitigation site, construct compensatory vernal pools, and establish a monitoring program that will determine whether or not vernal pools have been adequately constructed.

B. Objectives

1. To assist applicant in selecting optimal sites for compensatory mitigation and to provide information on vernal pool design criteria and construction techniques.

2. To assess the hydrologic performance and floristic development of the created pools and identify those that need to be modified.

3. To collect and assess data that allow for the determination of overall mitigation success and allow comparisons with other similar mitigation projects.

4. To collect and assess data for purposes of early detection of problems that might arise and for establishing remediation plans in the event of project failure. Examples of these problems are failed hydrology, lack of vegetation growth, erosion, litter, trespassing by both humans and livestock, and off-road vehicle use.

IV. DATA AND INFORMATION ATTRIBUTES

The mitigation monitoring required for projects involving effects to waters of the United States under Section 404 of the Clean Water Act needs to collect data and information with specific, useful attributes for the resource and regulatory agencies. The data and information should have the following attributes:

1. **Verifiable:** By reviewing monitoring reports and inspecting mitigation sites, the Corps (and other agencies that review 404 permits) should be able to verify that the reported methods of data collection were actually used in the field, and the data collected represent reported field conditions. The agencies should be able to evaluate data to clearly determine if the compensation is successful.

2. **Interpretable and Practical:** Data collected for mitigation monitoring should be easily interpreted and presented in a practical format. Refer to the Habitat Mitigation and Monitoring Guidelines for formatting.

3. **Linkage:** Consistent with a goal of the program, the data and information collected for mitigation monitoring should allow for linkage to specific management or maintenance actions. The Corps and review agencies (see Table 2) should be able to identify remediation actions to be taken as a result of the outcome of monitoring information.

V. TYPES OF MITIGATION

Compensatory mitigation ratios will be determined on a case-by-case basis depending on conditions of both the affected and compensation site. Ratios should exceed 1:1 because of the need to mitigate for temporal losses and because projects may not attain 100% success. Compensatory mitigation can include restoration of previously destroyed or degraded vernal pool complexes provided that the impervious subsurface layers are still intact. The following describe the various approaches to vernal pool mitigation. The approaches to mitigation for affected vernal pool listed below would be subject to the sequencing requirements of the Corps and EPA mitigation guidelines. They would be considered in the order listed, with the potential for avoidance considered first; however, the type of mitigation that is determined to be practicable will be based on that providing the most benefit to vernal pools as an aquatic resource.

1. Avoidance/Minimization

In areas where avoided pools would be disturbed by the secondary effects of project development or where the overall preserve size would be less than 10 acres, mitigation should occur through offsite construction of pools or offsite acquisition and preservation. Mitigation/preserve areas that would be affected by the subsequent secondary effects will not be considered appropriate mitigation. Avoided areas of less than 10 acres will be considered too small to remain viable when surrounded by project development. Therefore, for these small areas, the other types of mitigation described below would be more suitable.

2. Compensation

Compensation includes the construction of new vernal pools or the restoration of pools in an area that previously supported pools, but has been degraded to the point that pools no longer exist, but the water restricting substrate remains intact. Construction can occur onsite where pools exist, but only where the construction of new pools would not negatively affect the watershed of existing pools and the overall preserve size would be greater than 10 acres. Construction could also occur offsite in conjunction with a preserved area or through a mitigation bank. Another approach to pool construction would be to aggregate mitigation sites that are created as a result of the mitigation requirements of two or more projects in order to create larger preserve/compensation areas.

3. Acquisition and Preservation

The acquisition and preservation of existing pool complexes can be an appropriate approach to vernal pool mitigation. In some circumstances, this form of mitigation may be the best way to mitigate for affected vernal pools particularly where soils that are a suitable substrate for vernal pools are limited. Again, attempts should be made to aggregate these preserves in large areas that would generally be located outside of areas planned for urban development.

4. Special Status Species

Specific mitigation for affected vernal pool complexes that support special status plants or animals will be determined on a case-by-case basis through the Endangered Species Act, section 7 consultation process or in consultation with the California Department of Fish and Game. Mitigation requirements will depend on the species, the extent and nature of the effects, cumulative effects to the species and their habitat, and other factors. Contact the Field Office of the US Fish and Wildlife Service in Sacramento for information regarding Federally listed species. Contact the California Department of Fish and Game for information concerning State listed species. (See Table 2).

VI. BASELINE MONITORING, SITE SELECTION, DESIGN, AND CONSTRUCTION

This section provides general guidance on baseline monitoring, site selection, design and construction of vernal pools. It is recognized that there will be specific cases where there may be deviations from these guidelines.

A. Baseline (or Pre-project) Monitoring

1. A baseline survey of the vernal pools and vernal pool complexes on the project site and the mitigation site should be completed prior to project effects and the baseline conditions monitored for as much time as practicable. The survey should collect information on soils, vegetation, hydrology, and the presence or absence of any special status species.

2. The survey should describe the types of vernal pools in terms of soil types, slopes, general drainage pattern and directions, and other aspects of the watershed.

B. Mitigation Site Selection

1. The soil type of the site selected for vernal pools creation should be a type known to support vernal pools. These soils typically have subsurface water-restricting layers such as claypan, duripan, volcanic mud[illegible] clay. Consult with the Natural Resource Conservation Service (formerly the Soil Conservation Service) or soil surveys to help in this determination.

2. Slopes within the portions of the site to be used for vernal pool construction should be less than 5%.

3. In selecting the mitigation site, give priority to areas that formerly supported vernal pool complexes or areas that have few vernal pools and the appropriate soil type and hydrology.

4. The subsurface conditions of potential mitigation sites need to be evaluated to determine: the uniformity of the water-restricting layer across the project

site; the depth from the soil surface to the uppermost water-restricting layer; and the type (duripan, claypan, etc.), thickness and quality of the water-restricting layer.

C. Design Considerations

1. A map of soil conditions across the site of the mitigation project should be prepared, based on the soil data collected.

2. Vernal pools should be designed to avoid impairing the functions of important upland habitats and existing vernal pools. The final vernal pool density in the mitigation area should be limited to that which can be supported by the existing hardpan and claypan and can fit within the existing mound and depression topography (pools must fit the existing landscape). See Figure 1.

3. Plans designed to avoid vernal pool complexes should consider and discuss adjacent landscapes and land uses. Direct urban runoff away from vernal pool preserves. Do not place compensation pools within avoidance areas unless it is shown that existing wetlands and the watershed will not be affected.

4. Identify the locations of the created pools and where they are in relationship to existing pools and other waters of the United States on site.

5. Clearly identify areas of cut and/or fill within the project site and adjacent to preserve or mitigation areas.

6. Provide a buffer for the watershed around all vernal pool preserves and mitigation sites. Buffers should consist of native vegetation or annual grassland. Appropriate buffer width will be the amount necessary to protect the watershed and the aquatic resources from the effects of surrounding uses.

7. In general, it is intended that created vernal pools will have physiographic features (i.e., side slopes, depth of inundation, and aerial extent of inundation) within the range of natural pools and should be interconnected by a system of drainage swales when mitigating for a natural vernal pool complex exhibiting such features. To the extent possible, created vernal pools should be constructed on the same soil series that is found on the affected site. The use of installed clay layers (such as Bentonite) and creation in soil series that do not naturally support vernal pool habitats generally is unacceptable.

8. Fencing and low earth berms may be required in certain cases to protect the avoided areas from vehicular traffic or unwanted disturbance. Berms should not alter preserve area hydrology and construction activities must minimize adverse effects to the preserve area.

D. Construction Techniques

1. Remove soils from donor pools only after soils are thoroughly dry and all native vernal pool plant species have dispersed seed. The soil should be scraped from these pools up to a depth of 4 inches. This material can be stockpiled for a short period, or directly applied to newly constructed basins. Stockpiling vernal pool seed and soil over the winter for the following summer is not recommended.

2. Pools should be excavated to the desired depth, plus 2-4 inches, depending on the available volume of seed/soil inoculum. Rough-grading of the wetland basins includes cutting bottom contours and adjusting side slopes to specifications listed in the construction plans.

3. Topsoil removed from the pool area should be stockpiled for later use.

4. Vernal pool seed/soil material collected from the affected site should be spread over the pool bottom and leveled. There is no need to compact this seed/soil material, beyond the normal compaction of the equipment used to spread the seed/soil.

5. Revegetation of the pool sideslopes should be hastened by spreading the topsoil removed from the pool location along the upland portion of the pool's sideslopes.

6. Other disturbed surfaces outside of the constructed vernal pools should be hydroseeded and/or broadcast seeded with a native/naturalized seed mixture.

7. Remove excess material resulting from the construction of vernal pools from the mitigation or preserve site.

8. Figure 2 and Figure 3 show typical cross sections of constructed vernal pools.

VII. MITIGATION MONITORING METHODS AND PERFORMANCE CRITERIA

At a minimum, each project proponent will be required to monitor elements within the following broad categories: hydrology, vegetation, and signs of human disturbance. In some instances, other elements will require monitoring such as special st[illegible] d animal species (if found on site). The intensity and extent of monitoring will depend on site-specific conditions and surrounding land uses. This is summarized below:

A. Duration of Monitoring for Individual Projects

Vernal pool projects will require at least 5 years of monitoring, beginning when the construction of the mitigation wetlands is completed. Continual success of the mitigation vernal pools, without human intervention, must be demonstrated for 3 consecutive years. For example, if some corrective action is required in the 4th year in an attempt to attain performance standards, then that portion of the project requiring remediation will be monitored at least until the 7th year.

B. Hydrology Monitoring for Vernal Pools

Hydrology monitoring is the primary focus of the first year of the monitoring program and may not be necessary in subsequent years except in those cases where the initial year's hydrology monitoring or where subsequent vegetation monitoring indicates a potential problem.

1. Elements of Hydrology Monitoring

a. Inundation

b. Duration of inundation

c. Area of inundation

2. Methods for Hydrology Monitoring

a. Install staff gages at the deepest point of pools to be monitored.

b. When staff gages are measured, record observations whenever surface water is present even if it is too shallow to read on the gage.

c. During the first growing season monitoring should be conducted every other week in which monitored pools have or are likely to have surface water ponding.

d. Document measurements and conditions in pools with photographs when practical and appropriate. Photographs should represent peak ponding conditions and should be taken no less than five days after rainfall.

   i. For some large projects, aerial photographs taken annually in the spring to document the extent and duration of ponding in vernal pools may be required.
   ii. Where photographs are provided, indicate the date, location, and time since last rain event for the photograph. Indicate the locations on a site map where photographs were taken.

3. Performance Standards for Hydrology

a. Pools must be inundated for a duration that is within the range of ponding for natural vernal pools.

b. Pools must hold water in a manner consistent with natural pools.

C. Vegetation Monitoring for Vernal Pools

For the first year of the monitoring period, only qualitative vegetative monitoring is required. Detailed vegetative monitoring is required for years

two to five of the monitoring period.

1. Elements of Vegetation Monitoring

a. Total absolute vegetation cover

b. Relative vegetation cover by native vernal pool species[1] per pool (total for all vernal pool species in pool combined, not each species individually)

c. Plant species composition per pool[2]

d. Species with at least 20% relative cover per pool

e. Federal candidate and listed species. See the following section.

f. Photography

[1] See Table 1, Central Valley Vernal Pool Species List (CVVPSL).
[2] Include indicator staus of all plant species.

2. Performance Criteria for Vegetation Monitoring

a. The total vegetative cover for each created vernal pool must be no less than 30% relative cover and 30% total species from Table 1, the CVVPSL, and within the range found in natural vernal pools.

b. Each vernal pool must be dominated by hydrophytic vegetation according to the method provided in the Corps of Engineers' 1987 wetland delineation manual. Use of the Prevalence Index from the Food Securities Act (FSA) Manual may be acceptable on a case by case basis.

3. Methods for Vegetation Monitoring

a. For each pool, estimate the percentage of total vegetative cover that is made up of species from the Central Valley Vernal Pool Spe... (Table 1). Include the method of selecting the size, number, and placement of sampling units. The sampling method and intensity must be suitable for the patchy distribution of some vernal pool plant species. Plot the value for total relative cover by native vernal pool plants for each pool (same manner as total vegetative cover).

b. Identify all of the vascular plant species that are present in each pool. Make certain a dated species list or checklist for each pool remains available (for example, checklists can be in the form of a table with species names labeling the rows and pool identification codes labeling the columns). Survey each pool entirely, though certain areas may be subsampled more intensively based on professional judgement. This information should be included as an appendix to the monitoring report.

c. Plot the number of native vernal pool species for each pool in a manner similar to that described for total vegetative cover.

d. For each pool, note which species (vernal pool and non-vernal pool) have a relative cover of 20% or greater. These data should remain available for each pool (can be recorded with list for Item "3b" above). Indicate which species are the ten most prevalent and provide relative cover of each of these species.

e. Record subjective observations on vigor and reproduction of native vernal pool species. Note areas with invasions by species that may indicate a hydrological problem exists (upland plants, perennial marsh plants, etc.). These field observations should be available in an appendix in the monitoring report.

f. If 50 vernal pools or less are created, take a photograph of every created pool. Color photocopies should be included as an appendix in at least one copy of the monitoring report per agency, labeled to identify the pool and dominant species present.

g. If over 50 pools are created, photodocument whichever is higher: either 10% each of the created pools or 50 created pools.

D. Site Quality Monitoring

1. Elements of Site Quality Monitoring

a. Each time the site is visited, monitor the area for signs of excessive or uncontrolled human disturbance or other unexpected conditions to develop. Problems include: erosion, pools affected by nearby channels, signs of feral dogs and cats, off-road vehicle use, presence of trash and litter, human foot traffic, trespassing livestock, run-off water entering the property, etc.

b. The applicant should indicate on data sheets that a site has been checked, and presence or absence of this type of human disturbance. Record the details and suggested remedial action.

2. Performance Criteria for Site Quality Monitoring

There are no specific criteria for this element. However, the permittee should notify the Corps of any excessive signs of disturbance. The Corps project manager will decide, in consultation with the review agencies if necessary, on any appropriate remedial action.

3. Annual Schedule of Site Quality Monitoring

Each time the site is visited for any monitoring or restoration work, the entire site should be evaluated for signs of human disturbance and noted on the data sheets.

VIII. ANNUAL ASSESSMENT AND OVERALL PROJECT PERFORMANCE CRITERIA

At the end of each year, prepare a report containing the results of the monitoring and an assessment of the data. Also, provide summaries of the total number and percentages of created pools that attained performance criteria. Use photographic and other evidence to support the final assessment.

A. Annual Performance Criteria

1. Pools may be considered candidates for remedial action if they do not attain all of the criteria in a given year.

2. As stated in the Overall Guidelines, the duration of monitoring and assessment of results may by adjusted for unusual circumstances (such as drought).

B. Overall Project Success

1. For projects not attaining performance criteria, the permit holder will mitigate for these losses, or continue to monitor for an additional period of time as determined by the Corps of Engineers.

2. Any sustained negative trend in the mitigation project may require additional monitoring or remediation.

IX. REPORTING

1. Monitoring reports shall be submitted by the end of August for each year that monitoring is required for the duration of the project, including a final report at the end of any extended monitoring demonstrating continued success of the mitigation program without human intervention.

2. Reports shall be submitted to agencies the Corps of Engineers, US Environmental Protection Agency, US Fish and Wildlife Service, and the California Department of Fish and Game. Addresses for these agencies are list in Table 2.

TABLE 1 Vernal pool species list (natives), which are either vernal pool obligates or, at least when found in the Central Valley, are more frequently in vernal pools than in other habitats. Indicator status is from the U.S. Fish and Wildlife Service's National List of Plant Species That Occur in Wetlands: California (Region 0), May 1988.

PLANT NAME	INDICATOR STATUS	PLANT NAME	INDICATOR STATUS
Agrostis hendersonii	FACW	Alopecurus saccatus (A. howellii)	OBL
Bergia texana	OBL	Blennosperma nanum var. nanum	OBL

Callitriche heterophylla	OBL	Callitriche marginata	OBL
Castilleja campestris ssp. campestris	OBL	Castilleja campestris ssp. succulenta	OBL
Centunculus minimus	NI FAC-*	Chamaesyce hooveri	NI
Crassula aquatica	OBL	Crassula saginoides	NI
Cuscuta howelliana	NI	Damasonium californicum (Macherocarpus californicus)	OBL
Deschampsia danthonioides	FACW	Downingia bella	OBL
Downingia bicornuta var. bicornuta	OBL	Downingia bicornuta var. picta	OBL
Downingia concolor var. concolor	OBL	Downingia cuspidata	OBL
Downingia insignis	OBL	Downingia ornatissima var. eximia	OBL
Downingia ornatissima var. ornatissima	OBL	Downingia pulchella	OBL
Downingia pusilla (Downingia humilis)	OBL	Eleocharis acicularis	OBL
Eleocharis macrostachya	OBL	Epilobium cleistogamum (Boisduvalia cleistogamum)	OBL
Eryngium aristulatum var. aristulatum	OBL	Eryngium aristulatum var. hooveri	OBL
Eryngium castrense (E. vaseyi var. castrense)	FACW	Eryngium constancei	OBL
Eryngium pinnatisectum	OBL	Eryngium spinosepalum	NI
Eryngium vaseyi	FACW	Gratiola ebracteata	OBL
Gratiola heterosepela	OBL	Hesperevax caulescens (Evax caulescens)	NI
Isoetes howellii	OBL	Isoetes nuttallii	NI
Isoetes orcuttii	OBL	Juncus uncialis	OBL
Juncus leiospermus var. ahartii	N	Juncus leiospermus var. leiospermus	NI
Lasthenia chrysantha	FACU	Lasthenia conjugens	NI
Lasthenia ferrisiae	NI	Lasthenia fremontii	OBL
Lasthenia glaberrima	OBL	Lasthenia glabrata ssp. glabrata	FACW
Layia fremontii	NI	Legenere limosa	OBL
Lepidium latipes var. latipes	NI	Lilaea scilloides	OBL
Limnanthes alba	OBL	Limnanthes douglasii var. nivea	OBL
Limnanthes douglasii var. rosea	OBL	Limnanthes floccosa ssp. californica	OBL
Limnanthes floccosa ssp. floccosa	OBL	Marsellia oligospora	FAC

Marsellia vestita	NI	Mimulus tricolor	OBL
Montia fontana (M. verna)	OBL	Myosurus apetalus	NI
Myosurus minimus	OBL	Myosurus sessilis	NI
Navarretia heteranda	OBL	Navarretia intertexta ssp. intertexta	OBL
Navarretia leucocephala ssp. bakeri	OBL	Navarretia leucocephala ssp. leucocephala	OBL
Navarretia leucocephala ssp. pauciflora	OBL	Navarretia myersii	NI
Navarretia nigelliformus ssp. nigelliformis	OBL	Navarretia nigelliformus ssp. radians	NI
Navarretia prostrata	OBL	Navarretia tagetina	NI
Neostapfia colusana	OBL	Orcuttia inaequalis	NI
Orcuttia pilosa	NI	Orcuttia tenuis	OBL
Orcuttia viscida	NI	Pilularia americana	OBL
Plagiobothrys acanthocarpus	OBL	Plagiobothrys austinae	NI
Plagiobothrys bracteatus	OBL	Plagiobothrys humistratus	OBL
Plagiobothrys hystriculus (presumed extinct)	FACW	Plagiobothrys leptocladus	OBL
Plagiobothrys stipitatus var. micranthus	OBL	Plagiobothrys stipitatus var. stipatatus	OBL
Plagiobothrys trachycarpus	FACW	Plagiobothrys undulatus	FACW+
Plantago bigelovii	OBL	Plantago elongata	FACW
Pogogyne douglasii	NI	Pogogyne zizyphoroides	OBL
Psilocarphus brevissimus var. brevissimus	OBL	Psilocarphus brevissimus var. multiflorus	OBL
Psilocarphus oregonus	OBL	Psilocarphus tenellus var. globiferus (P. tenellus var. tenuis)	FAC
Ranunculus bonariensis var. trisepalus (R. alveolatus)	OBL	Sagina decumbens ssp. occidentalis	FAC
Sibara virginica	NI	Sidalcea calycosa ssp. calycosa	OBL
Sidalcea hirsuta	OBL	Triteleia hyacinthina (Brodiaea hyacinthia)	FACW
Tuctoria greenei	OBL	Tuctoria mucronata	NI

* - National Indicator Status

Table 2. List of state and federal agencies involved in Section 404 permits.

Federal Agencies

US Army Corps of Engineers
Regulatory Branch
1325 J Street, Room 1444
Sacramento, CA 95814-2922
(916) 557-5250
http://www.spk.usace.army.mil/cespk-co/regulatory

US Environmental Protection Agency
Wetlands Permits and Enforcement Section
75 Hawthorne Street (W-3-3)
San Francisco, CA 94105
(415) 744-1962
http://www.epa.gov/region9

US Fish and Wildlife Service
Ecological Services, Wetlands Branch
2800 Cottage Way
Sacramento, CA 95825
(916) 979-2116
http://www.r1.fws.gov

State Agencies

State Water Resources Control Board, Division of Water Quality
901 P Street
Sacramento, CA 95814
http://www.swrcb.ca.gov

Regional Water Quality Control Board - Central Valley Region
3443 Routier Road
Sacramento, CA 95827-3089
http://www.swrcb.ca.gov/~rwqcb5

California Department of Fish and Game, State Headquarters
1416 9th Street
Sacramento, CA 95814
http://www.dfg.ca.gov/dfghome.html

California Department of Fish and Game, Region 1
601 Locust Street
Redding, CA 96001
http://www.dfg.ca.gov/org/reg1.html

California Department of Fish and Game, Region 2
1701 Nimbus Road, Suite A
Rancho Cordova, CA 95670
http://www.dfg.ca.gov/org/reg2.html