Trout, Uninterrupted:

Assessment and Monitoring of the Mills Creek Dam Removal

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Abstract

Steelhead trout are a valuable species both in terms of their role in the ecosystem and their importance to humans. Like many salmonids, steelhead numbers have declined due to degradation of their highly specific habitat. Dams are an especial culprit, affecting the fish in both obvious and subtle ways. For these reasons, in September 2000 the California Department of Parks and Recreation removed a dam on Mills Creek in San Mateo County in an attempt to improve passage for steelhead. To evaluate the potential success of the project and make suggestions for future work, we conducted four site visits and reviewed relevant documents. During the site visits we constructed a plan view, longitudinal profile, and cross sections and made visual observations. Although some aspects of the dam removal could become problematic, the overall potential of the project to improve steelhead habitat seems favorable based on our investigations. Long term monitoring should be conducted to ensure the eventual success of the project, paying particular attention to bank stability, revegetation, gravel composition, and channel morphology.

Objective

Our goal was to evaluate the post-dam removal conditions at Mills Creek and to develop guidelines for long-term monitoring.

Introduction

Steelhead Trout

Valued for both ecological and human interests, steelhead trout are often the focus of modern river restoration projects. Like all salmonids, steelhead form an important component of the food web, and in California, steelhead are particularly valued as one of few remaining native species in waters that are otherwise dominated by exotic species. Therefore, restoring healthy steelhead populations is often seen as a necessary step in restoring the river ecosystem as a whole. Many conservationists also seek to restore steelhead for human uses.

The lifestyle of the steelhead encompasses several distinct phases. Salmonids begin life by hatching from eggs buried in a gravel bed. The young steelhead, or fry, burrow up through the gravel and enter the free flowing water of the stream. The fish will typically spend two to three years in the open water before migrating downstream to the ocean. The fish then leave the river environment and remain in the ocean exclusively until returning years later to spawn in the same reach. Each life stage requires different habitat conditions. These varying habitats are easily threatened, and successful restoration of steelhead populations requires that needs from all life stages be considered.

When mature salmonids migrate upstream to spawn, they require free passage uninterrupted by dams or other barriers. When the fish arrive at their destination reach, they need highly specific conditions in order to spawn. In particular, steelhead can only build a redd in certain gravel. If the rocks are too large, the female fish will not be able to dig a hole in which to lay her eggs. On the other extreme, densely packed, fine sediments can create pore spaces that are too small for hatchlings to burrow through, smothering eggs or trapping emerging fry. Intergravel flow must be sufficient to allow adequate dissolved oxygen to reach the eggs (Kondolf 1999). It is not uncommon for an otherwise ideal restoration project to be unacceptable by fish standards on the basis of bed composition (Kondolf 1999).

Once the steelhead fry successfully leave the redd and enter open water, their survival in the freshwater environment depends upon specific habitat requirements including adequate food. The young fry typically sit in eddies or behind small logs and wait for food, such as insects and other aquatic invertebrates, to float downstream. These organisms in turn rely upon a healthily functioning river and flood plain ecosystem. Indeed, the riparian zone surrounding the river has a direct influence on the health of the fry, since it typically forms the base of the food chain in upstream reaches.

Juvenile steelhead must have places to hide from predators such as birds and larger fish. Hiding places under bank outcroppings and large woody debris protect the young fish from their predators. Juvenile steelhead can also take advantage of their small size to dart into areas that are too shallow for larger predatory fish (NRC 1992). For this reason it is important for streams to have both pools and riffles.

Salmonids demonstrate a strong homing instinct back to their natal waters to spawn, making it more difficult for the fish to adjust to habitat degradation. Further, the loss of a species in one particular stream can prove detrimental to the species as a whole due to the corresponding loss of genetic diversity. Many steelhead runs are already lost or threatened.

The Impact of Dams on Fish Habitat/Populations

Dams are one of the greatest man-made threats to anadromous fish, potentially affecting all stages of the fish's development, and even preventing the fish from spawning at all by blocking upstream migration. Fish ladders built to provide fish with a route around the dam often fail due to design flaws; they expect fish to make higher jumps than are feasible, they contain water that is moving too rapidly to be navigable by fish, or they fail to attract fish to use them. Another frequently implemented option, catching fish downstream and moving them up past the dam by truck, can result in massive fish kills from trauma.

Dams can also impact salmonids by altering geomorphic processes within rivers. By changing the frequency and duration of floods, dams can affect the channel form and disrupt the natural dynamics of riparian vegetation establishment. This in turn reduces the quantity of food such as insects, seeds, and leaves that enter the stream and the amount of large wood that enters the stream.

Dams can also upset normal sediment transport processes, trapping sediment upstream of the dam and interfering with the development of spawning habitat. Downstream of dams, the sediment starved water can erode material from the river channel. Over bank flows, which provide an important path between the river and its floodplain, will be less frequent (M.E. Powers et al 1996). This disruption will further impact the natural recruitment of riparian plants.

The long-term geomorphic effects of dams, combined with the introduction of non-native species, can make for a very hostile environment for young steelhead trout. Predators, especially certain exotic species, learn quickly that the pool just beneath a dam is an ideal place to hunt (Moyle 1995). The situation does not improve downstream; dams can eventually destroy the natural sequence of riffles and pools, creating large expanses of deep water ideal for predators.

Some Cautions on Dam Removal

The growing understanding of the negative habitat impacts of dams has coincided with an increased awareness that many old dams currently serve no purpose. As a result, there is an increasing trend toward removing dams and restoring rivers as much as possible to their natural function. However, simply removing dams should not be seen as a panacea capable of solving all of a river's problems.

In theory, most rivers can "heal" themselves from damage if returned to their natural processes and allowed to function undisturbed. This does not imply, however, that this will happen within the timescale of interest. Geomorphic changes can take many years to occur naturally, and in the meantime species are still left without adequate habitat. For example, a bank may not grow new vegetation in time to prevent large scale erosion. In these situations, dam removal should be accompanied by other remediation efforts.

Dam removal places an additional stress on the ecosystem, given that it typically involves bringing heavy equipment and numerous people onto the site. Oil spills from vehicles, disruption of wildlife, and soil compaction from heavy machinery are all potential side effects. Project managers must take great care to ensure that the beneficial effects of dam removal are not diminished by accidents or poor planning.

Mills Creek

Mills Creek is a perennial stream located in San Mateo County, California (Figures 1 and 1A). The creek headwaters flow west along the ridgeline of the Santa Cruz Mountains and intersect with Arroyo Leon near the entrance to Burleigh H. Murray State Park. Arroyo Leon continues to the northwest, where it converges with Pilarcitos Creek, which then flows west under Highway 1 to its outlet into the Pacific Ocean at Half Moon Bay State Beach. The watershed area is approximately 2,450 acres and is shown on Figure 2. Pilarcitos Creek and its tributaries are known to contain steelhead and rainbow trout and are also listed by the State of California as habitat for the endangered red-legged frog.

Site History

In October 1992, two sediment basins at the Ox Mountain Landfill failed, resulting in destructive sediment input to Pilarcitos Creek. Browning Ferris Industries (BFI), operators of the landfill, reached a settlement with the State of California which required BFI to fund improvements within the Pilarcitos Creek watershed. Funding was administered by the Regional Water Quality Control Board and the California Department of Fish and Game. Using this funding, a Pilarcitos Creek Restoration Plan was prepared identifying specific restoration goals within the watershed, with the primary goal of removing barriers to fish migration. The pilot project of this plan was the removal of two fish migration barriers along Mills Creek – a concrete dam and a 9-foot vertical drop associated with an historic bridge downstream. A design-build team was created for this project, consisting of Clearwater Hydrology and Watershed Science. Since the project reach is located within Burleigh H. Murray State Park, the California Department of Parks and Recreation (DPR) is overseeing the project, with assistance from the Department of Fish and Game (DFG).

During 1996 and 1997, the initial project design was developed. The 5-foot high concrete dam was constructed in the 1950s to create a reservoir in order to provide water to two storage tanks located 440 feet downstream. Water from these tanks is used as drinking water supply for the one home located on the parkland and for fire protection within the park. Provisions needed to be made to assure that water could still be diverted to the tanks when the dam was removed and were incorporated into the 1997 design. The scope of work included the following elements:

- removal of the concrete dam,
- rehabilitation of the water supply system, including removal of the gravity fed delivery system from behind the dam, installation of a new infiltration gallery upstream of the dam site, and renovation of the water tanks to include new plastic liners to minimize water loss,
- stabilization of segments of the stream upstream and downstream from the dam, particularly three failing meander bends, with work extending 430 feet upstream and 440 feet downstream of the dam, and
- removal of invasive plant species encountered during construction.

During the 1997 design phase, field data were collected including 34 cross sections, taken both upstream and downstream of the dam, as well as plan and profile views of the project reach. In addition, the grain size distribution was evaluated both upstream and downstream of the dam using a sieve analysis.

From these evaluations, the design team determined that the ideal stable configuration of the project reach was represented by the first and eighteenth cross-sections, upstream and downstream of the dam respectively. The cross-sections chosen had the most desirable parameters such as width-to-depth ratio, longitudinal gradient, and confinement ratio. The Rosgen classification system was applied to these cross-sections, and the creek was determined to be between AB3 and B3.

Using these ideal configurations, Clearwater Hydrology developed the 1997 design and implementation plan for the stream improvements. Construction began September 2, 1997, and the water supply system improvements described above were completed, including the installation of an infiltration gallery upstream of the dam. However, early fall rains in 1997 precluded the dam removal from being completed, so temporary measures were taken to allow fish passage until construction resumed. All but one flashboard were removed from the dam. Sediment built up behind the dam had initially caused severe erosion and stream incision below the dam due to "clear water scour." Sediment trapped behind the dam built up to about 5 feet, reaching the top of the flashboards. Three-quarters of the sediment behind the dam was removed in 1997. In addition, six boulders were placed upstream of the dam to provide stream stability and minimize either aggredation or degradation of the channel which could result from the removal of the flashboards and the subsequent changes in sediment transport.

The project was then left in this condition in fall 1997 and was not revisited until March 2000, when DPR began planning the project's completion. The contractor had intended to finish the work in summer 1998, but heavy rains in winter 1997-98 resulted in failure of the step-pools that had been constructed, and the money intended for the dam removal was instead spent on repair of the failed channel. In summer 2000, prior to implementing the design as previously planned, DFG was given the opportunity to reevaluate the need for certain components of the project, especially the stream restoration measures located far up and downstream of the dam site.

In a memorandum dated July 10, 2000, written by Kris Vyverberg, Engineering Geologist/ Geomorphologist for the DFG, a revised project scope was suggested. Based on the recommendations contained in this memo, the project was scaled back to only include a 140-foot reach, extending approximately 100 feet upstream and 40 feet downstream of the dam. Observations of the creek condition three years after the initial construction was performed revealed that the boulders were functioning as designed, the step-pool morphology created by the boulders was stable, and adult steelhead were migrating freely through the project reach. The three channel meanders identified in 1997 as requiring stabilization were reevaluated and deemed stable. Therefore this work was eliminated from the project scope.

Construction of this second project phase was performed between September 16 and early November, 2000. Approvals of the project were obtained through the United States Department of

Fish and Wildlife, the Army Corps of Engineers, the DFG, the Regional Water Quality Control Board, and the California Environmental Quality Act process. Mitigation measures required through the permitting process which relate to our evaluation of the project include the following:

- Restoration of the same step-pool and/or riffle-pool morphology that currently supports frog habitat.
- All existing vegetated areas denuded during project construction will be revegetated using native vegetation.
- Erosion control measures shall be utilized throughout all phases of operation where sediment runoff from exposed slopes threatens to enter waters of the State. At no time shall silt-laden runoff be allowed to enter the stream or directed to where it may enter the stream.

Fall 2000 Construction

Following the recommendations of the DFG, construction in fall 2000 consisted of the following:

- Dam abutments were removed with a wrecking ball.
- Cuttings from adjacent trees were strewn over the banks to control erosion and promote revegetation.
- Eight grade control structures of non-native material were placed.

Pursuant to required permit conditions, water was pumped around the entire construction site and discharged back into the creek downstream. Fish were removed from the project reach by electroshocking performed by Mountain West Engineering and Environmental Services. Two electroshocking passes of the entire project reach were performed, with one additional pass in a pool with extensively undercut banks. A total of 104 steelhead or rainbow trout (*Oncorhynchus mykiss*) were recovered, along with several larval Pacific giant salamanders. Trout ranged in size from 1.5 to 6 inches, and all trout appeared to be less than two years old. The trout population was more dense downstream, but a greater proportion of the young-of-the-year were found upstream.

Methods

We visited the Site on four separate occasions: September 20, September 27, October 9, and November 20, 2000. The first visit was an orientation to the project with Victoria Seidman from the DPR. This visit immediately followed the dam removal and rewatering of the project reach. Seidman described the work completed to date and pointed out prominent project features. On the second visit, we surveyed points to construct a plan view extending 86 feet upstream and 15 feet downstream from the dam location. We also sketched a plan view including the approximate locations of the survey points and prominent objects such as placed boulders and trees. On the third visit, we surveyed cross sections and the longitudinal profile in the project reach. The most recent trip was to extend the longitudinal profile upstream and downstream of the project reach and add two more cross-sections: one through the infiltration gallery and one further downstream of the dam than previously surveyed. On all site visits, visual observations were made.

We reviewed documents related to the project such as pre-design reports and calculations, memos, historic cross-sections, relevant project correspondence, and permit applications, supplied by the DPR. A list of these documents is provided in the references.

Surveying Procedure

For our field surveying, we used a surveyor's level with tripod and a 25' rod. We set up the instrument in a location providing good up- and downstream visibility and made a backshot (BS) to a large gouge on a tree near the stream at an arbitrarily chosen elevation. We took our relative elevation to give us an instrument height (HI). From this location we were able to shoot foreshots

(FS) to give us elevations of our cross-sections and longitudinal profile, all referenced back to the initial point.

We performed our field measurements using standard surveying procedure as outlined in *Field Assessment Techniques: Hydrology and Geomorphology* (Kondolf, 2000). To measure cross sections upstream (near the infiltration gallery) and far downstream, it was necessary to shoot several turning points.

Horizontal distances were measured using stadia intercepts on the level. We shot points for the longitudinal profile along the centerline of the stream with at least one point in each pool and riffle. Cross-sections were shot with a tape stretched across the stream to obtain horizontal measurements.

Results

Observations

We made the following observations during the field visits:

<u>September 20, 2000</u>

The initial site visit was conducted during the end of the construction phase. Construction equipment was still on the site, and site work had not yet been completed. Channel slopes were bare where construction equipment had disturbed them. There were no erosion control features in place, and no method of stabilization was in place for disturbed banks. Two alders were damaged from the construction, having noticeable gouges in their trunks (labeled A and B on the plan view sketch). Tree A appeared to be unstable with much of the root structure exposed as a result of having been disturbed by the excavator. Overall, the site was very muddy. The netting to prevent fish passage into the project reach was still in place. The area disturbed in 1997 was fully vegetated with native species. The location of the former dam was not obvious. The step-pool morphology looked appropriate for fish migration since the vertical drop never exceeded three feet.

September 27 and October 9, 2000

On the September 27 visit we noticed silt accumulating in the pools, a condition which worsened by the October 9 visit. Nearby trees had also been stripped of their limbs for use as bank stabilization and to provide seed bank for future revegetation in the area disturbed by construction equipment.

November 20,2000

Several days of heavy rains occurred between October 9 and November 11. The fine sediment appeared to have been flushed out of the pools leaving a more varied grain size distribution of mostly courser grained gravel. The disturbed banks had been revegetated with alder poles, and slopes were further stabilized with hay. Tree A had fallen and was resting on the left bank.

Constructed Figures

The following diagrams were constructed from survey data and are included in Appendix A:

- Plan View Sketch [Figure #3]
- Plan View [Figure 4]
- Longitudinal profile [Figure #5]
- Cross-section summary [Figure #6]
- Cross-sections 1-7 [Figures #7 – #13]

Photos are attached in Appendix B showing different features of the site over time.

Discussion

Evaluation of Project Design Approach

Three different approaches can be taken towards stream restoration projects: 1) non-intervention or undisturbed recovery, 2) partial intervention for assisted recovery, and 3) substantial intervention for managed recovery. Without human intervention, the Site would be unlikely to recover to the point of allowing fish passage within the time scale of interest. The grade necessary for the infiltration gallery may also not be able to be maintained using a purely natural recovery scheme. At the other extreme, there is no need for engineered or artificial grade control along the creek, given its location in the state park. Therefore, a compromise between natural recovery and total structural control was selected, referred to as "partial intervention with an actively managed component at the vertical changes in grade"[Vyverberg]. Restoration of the grade necessary for fish passage was considered "beyond the natural repair capacity," given the time-scale over which natural recovery would occur.

In the July 2000 memorandum referenced above, Ms. Vyverberg also describes this project as a "geomorphically-based assisted-recovery project," rather than a "symptom-based project," meaning that with assistance, the stream will be allowed to return to a self-regulating, equilibrium condition following the initial construction and possible placement of biotechnical structural elements. Based on our work at the site, we agree that this middle approach is the most appropriate for the design of this project. The scaled-back project seems to be adequate to address human concerns without trying to force the channel into an unnatural, "stabilized" form. The decision to eliminate structural controls in meander bends located several hundred feet from the dam location was especially appropriate given the lack of direct association with the dam removal and the availability of space in the park to allow the stream to pursue its natural course.

Discussion of Field Visits

Boulders placed for grade and slope stabilization appear accurately sized based on the sheer stress calculations performed by Watershed Science. Although sandstone was the preferred material for these boulders, non-native rocks were used instead. While the native rocks would be more aesthetically pleasing, the non-native rocks have higher densities, thus allowing smaller boulders to be used. Based on observations outside the project reach, the size of boulders used is compatible with existing site features.

As previously explained, salmonids require a specific gravel composition for spawning. In particular, the gravel needs to be free of fine sediment that can clog the bed. During the second and third site visits the gravel appeared to be full of silt that could prove detrimental to spawning. The silt had been mostly flushed out of the gravel by the fourth site visit, but we advise continued monitoring of the gravel composition to see if the siltation returns or appears further downstream. We were unable to make a baseline pebble count due to the silted condition of the gravel.

The revegetation and bank stabilization we observed at the site also merits discussion. Immediately following the destruction of the dam, the site was very muddy and erosion seemed highly probable. By the second site visit, clippings from nearby tress had been strewn on the banks as an attempt at stabilization and revegetation. This approach seemed inadequate to protect the banks from erosion; also the resulting possibility of long-term revegetation was questionable. Fortunately, by the fourth visit alder poles had been planted and the ground was covered in hay. The alder poles and hay seemed more likely to contribute to bank stabilization and revegetation as evidenced by the improved gravel conditions observed in the pools on this date as compared to prior site visits.

Appropriateness of design and plan

The design team evaluated the stream according to the Rosgen classification system and assigned Rosgen stream types to the project reach. The Rosgen system has fallen under intense criticism after the failure of several Rosgen classification based projects. The classification system oversimplifies the complexities of fluvial geomorphology. Fortunately, the contractor did not strictly adhere to the Rosgen classifications, and the project design was modified as work was implemented following an adaptive management approach.

Long-Term Monitoring Plan

Given the uncertainties inherent in any restoration project, we recommend continued monitoring of the Mills Creek site to guarantee the project's long term success. In order to document the creek's evolution over time, monitored parameters should be consistent. The monitoring plan should focus on the suitability and use of the site as a habitat for steelhead. Specifically, monitoring needs to look for changes in the pool riffle sequence, channel grade, bank stability and gravel composition.

Not only is long term monitoring necessary to ensure the continued success of the project, but it also contributes to the field of river restoration itself. Currently the discipline suffers from a lack of good post-project analyses, since many projects do not include funding for this step.

The 1997 Mills Creek Restoration Design plan developed by Clearwater Hydrology proposes the following final success criteria of a restoration project:

- The particle size distribution of bed material should be within the tolerance of the plan
- The channel bed form and configuration should be stable (as from cross-sections, longitudinal survey, and plan view).
- The banks should be stable. This can be determined empirically.

- A minimum of 50% absolute cover should be attained within 5 years, with species abundance and diversity representative of adjacent non-disturbed areas.
- The site should have a maximum of 10% absolute cover of eucalyptus and/or poison hemlock.

To achieve the above ends, Clearwater suggested that monitoring consist of the following:

As-Built Channel Survey: Should be conducted immediately after restoration. Cross-sections should be permanently located and re-surveyed from design phase. An as-built longitudinal profile should also be surveyed with notations made at each cross-section. A pebble count should be performed, and a size distribution conducted. Photo documentation should be provided from set photo-points.

Annual Project Monitoring and Maintenance: The bulk of work should be conducted during early spring, right after rainy season. Periodic inspections should be made during and/or after significant floods. If any construction is necessary, it should be done in September or early October. Each year, the following should be performed: 1) channel cross-sections and longitudinal profile surveys; 2) bed sediment particle size distribution analysis (sieve or pebble counts); 3) photographic documentation; 4) observation of erosion, with reinforcement if required; 5) analyze bed form and bank stability; 6) assess performance of boulder weirs/cascades; 7) visually estimate percent native cover and percent non-native invasive species.

Overall, the monitoring plans established by Clearwater seem sound. The pebble count is vital to see that steelhead can spawn in the creek, and the measured gravel composition should be analyzed following the nine-step procedure established by Kondolf (Kondolf 2000). In addition to the above tasks, we recommend that future site visits involve actually checking visually for the presence of fish, since many projects which seem to meet all habitat requirements still fail to attract fish. Additionally, the site should be investigated thoroughly following the conclusion of the 2000-

2001 rainy season. Site managers should check that the banks remain stable and that revegetation has progressed. The site should be visually inspected for erosion, and after major storm events the locations of the boulders should be verified.

Conclusion

Based on field investigations conducted shortly after the dam removal, the implemented design of the project seems likely to meet the stated goals. The project reach will provide unobstructed fish passage uses. As with all river restoration projects, long term monitoring is essential to the continued success of the project.

References

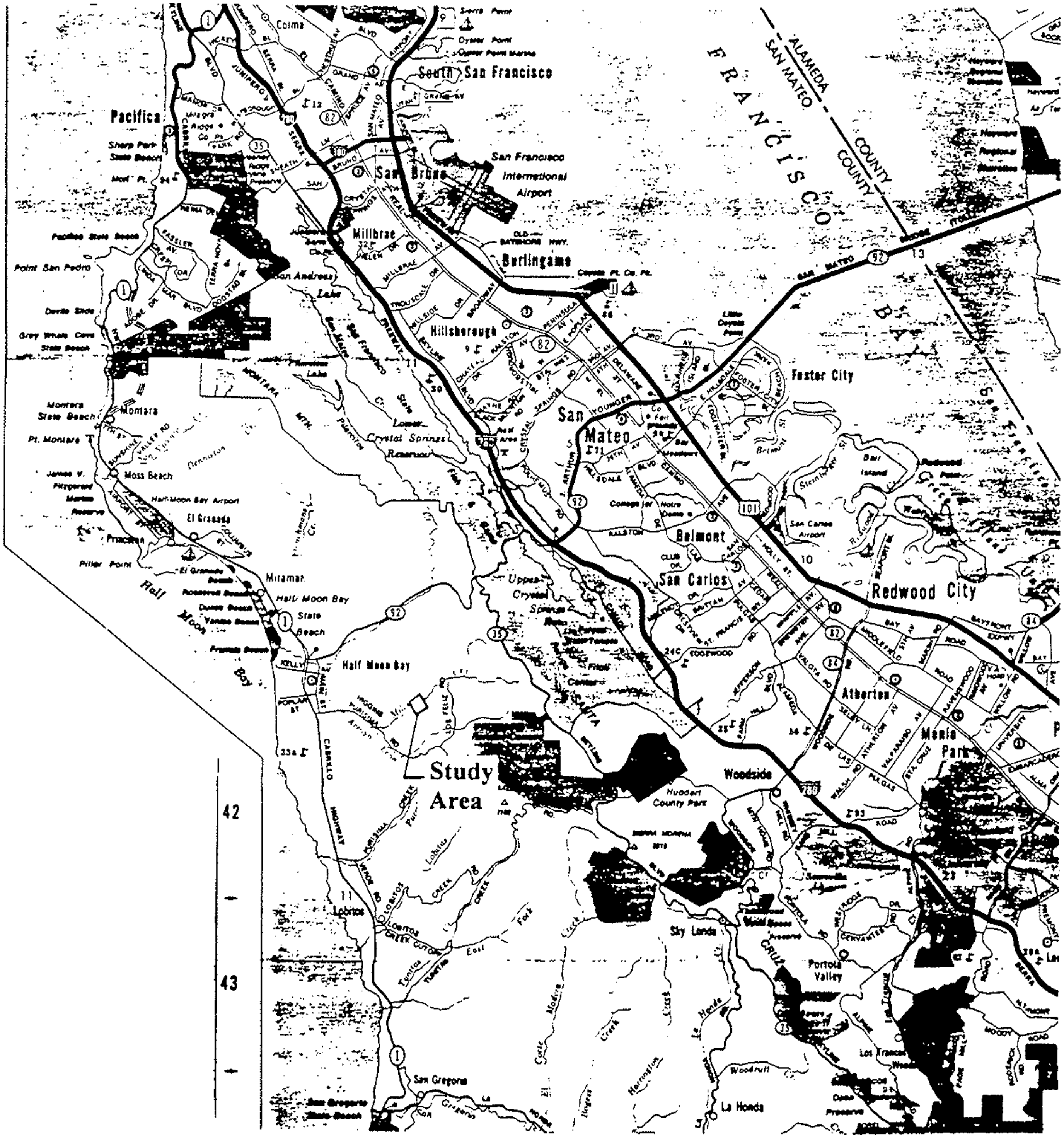
Kondolf, G. Matthias, Assessing Salmonid Spawning Gravel Quality. *American Fisheries Society,* 129:262-281, 2000.

Moyle, P.B., Conservation of Native Freshwater Fishes in the Mediterranean-Type Climate of California. *Biological Conservation* 72: 271-279, 1995.

Natural Research Council, Restoration of Aquatic Ecosystems: Science, Technology and Public Policy, National Academy Press, Washington D.C., 1992.

Powers, M.E. et al, Dams and Downstream Aquatic Biodiversity: Potential Food Web Consequences of Hydrologic and Geomorphic Change, *Environmental Management,* Vol. 20, No. 6, 887-895, 1996.

Appendix A: Figures



CLEARWATER HYDROLOGY

REGIONAL LOCATION MAP:
MILLS CREEK RESTORATION PROJECT

FIGURE

1

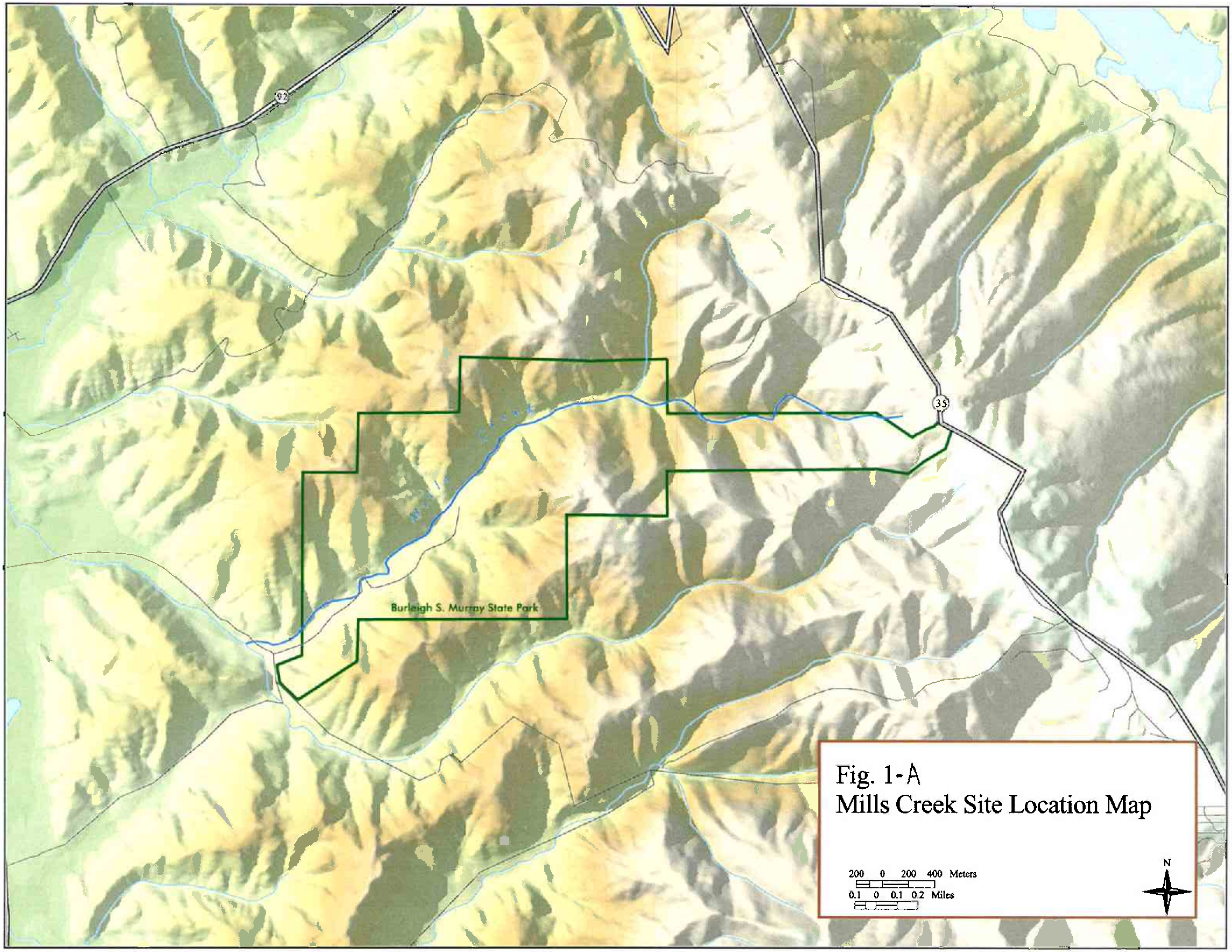


Fig. 1-A
Mills Creek Site Location Map
Burleigh S. Murray State Park
35
92
200 0 200 400 Meters
0.1 0 0.1 0.2 Miles
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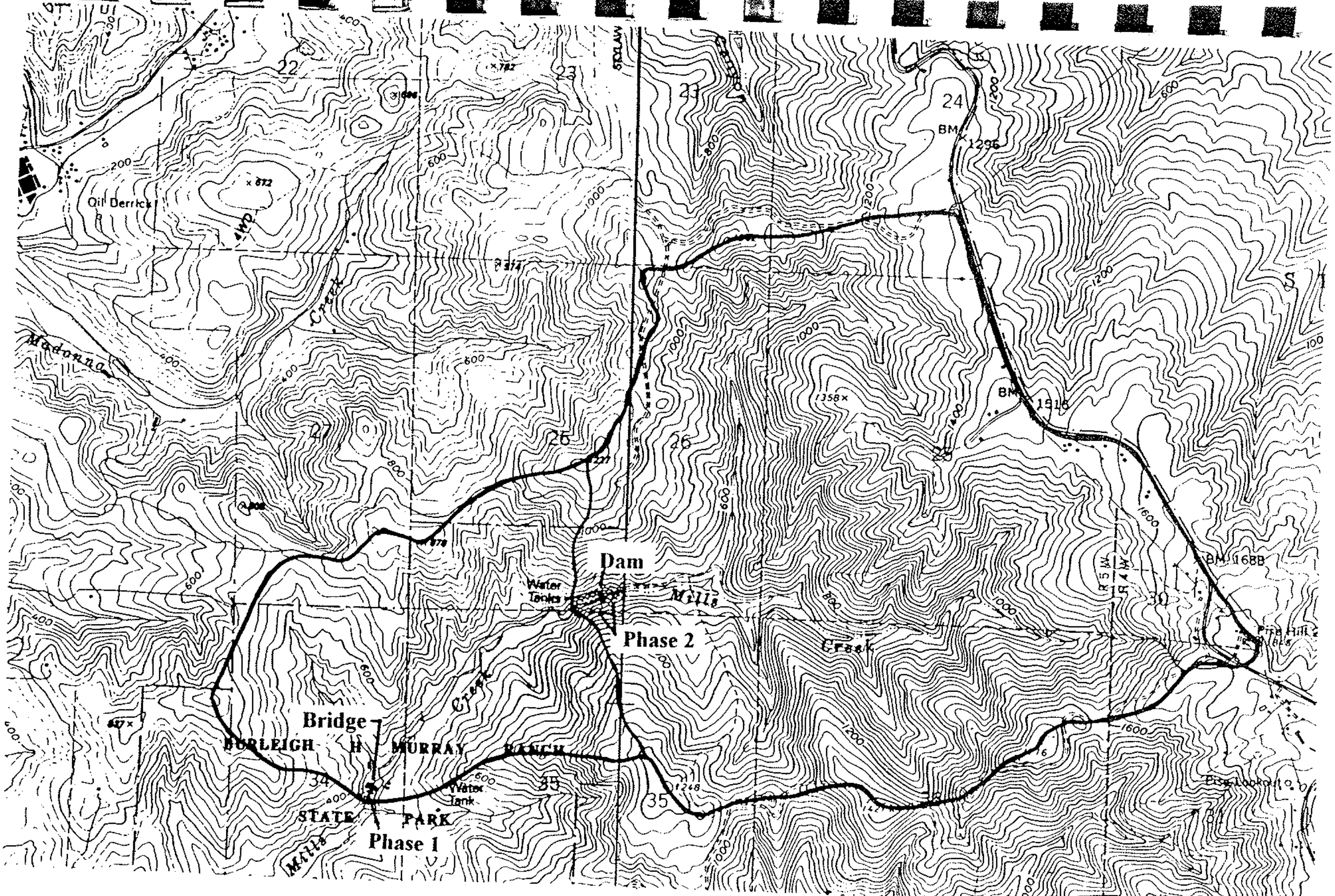
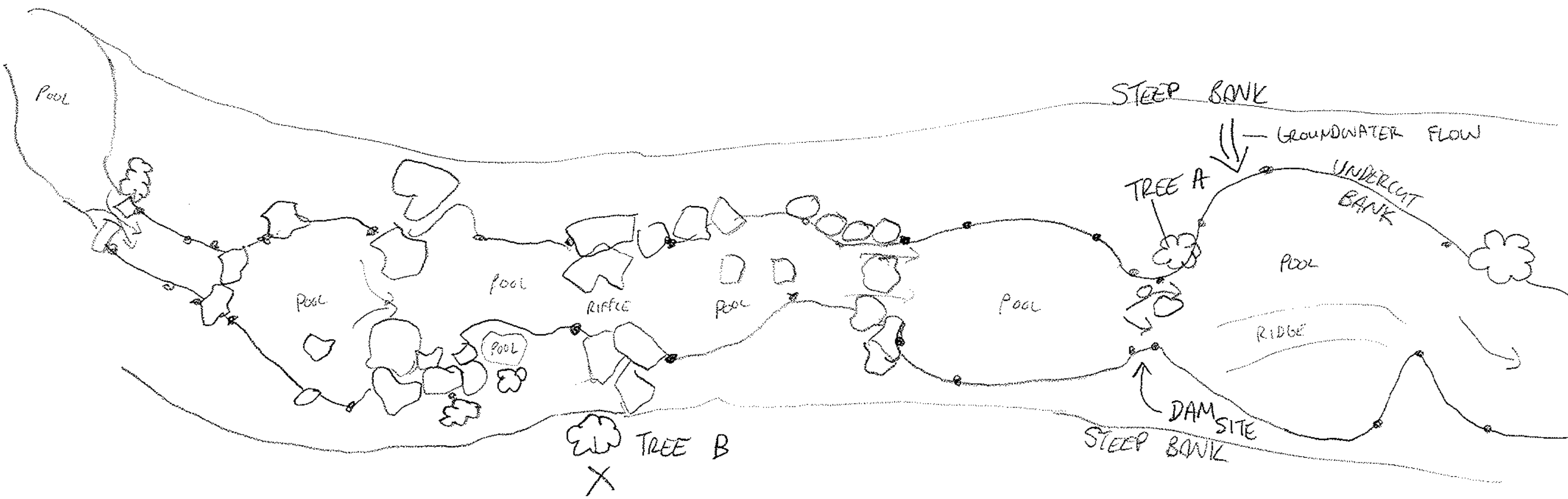


CLEARWATER HYDROLOGY	MILLS CREEK WATERSHED MAP	FIGURE
		2

FIGURE 3 : PLAN VIEW SKETCH



= vegetation (trees or bush)

= boulders

= survey points

X = location of survey level

Figure 4: Plan View

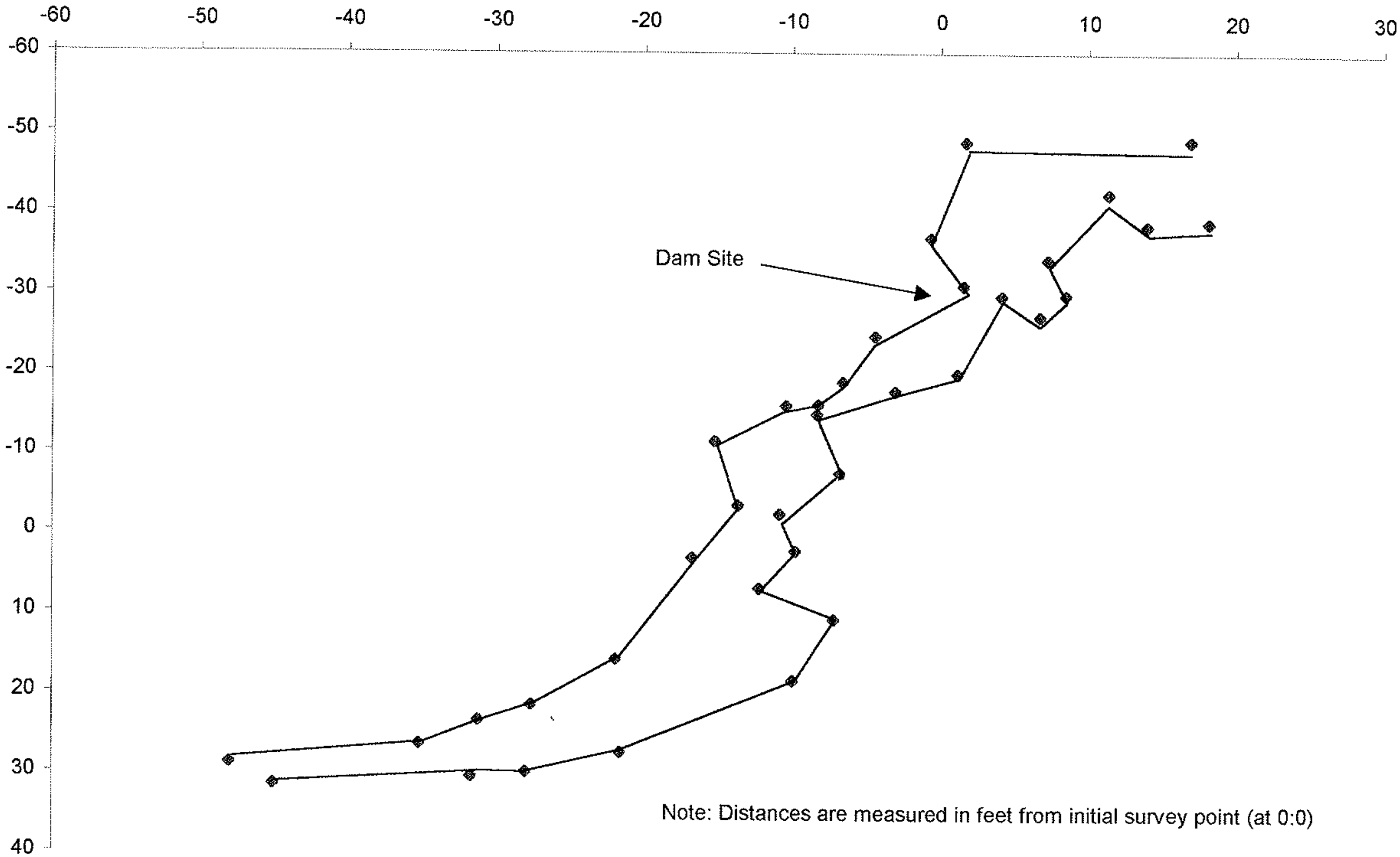
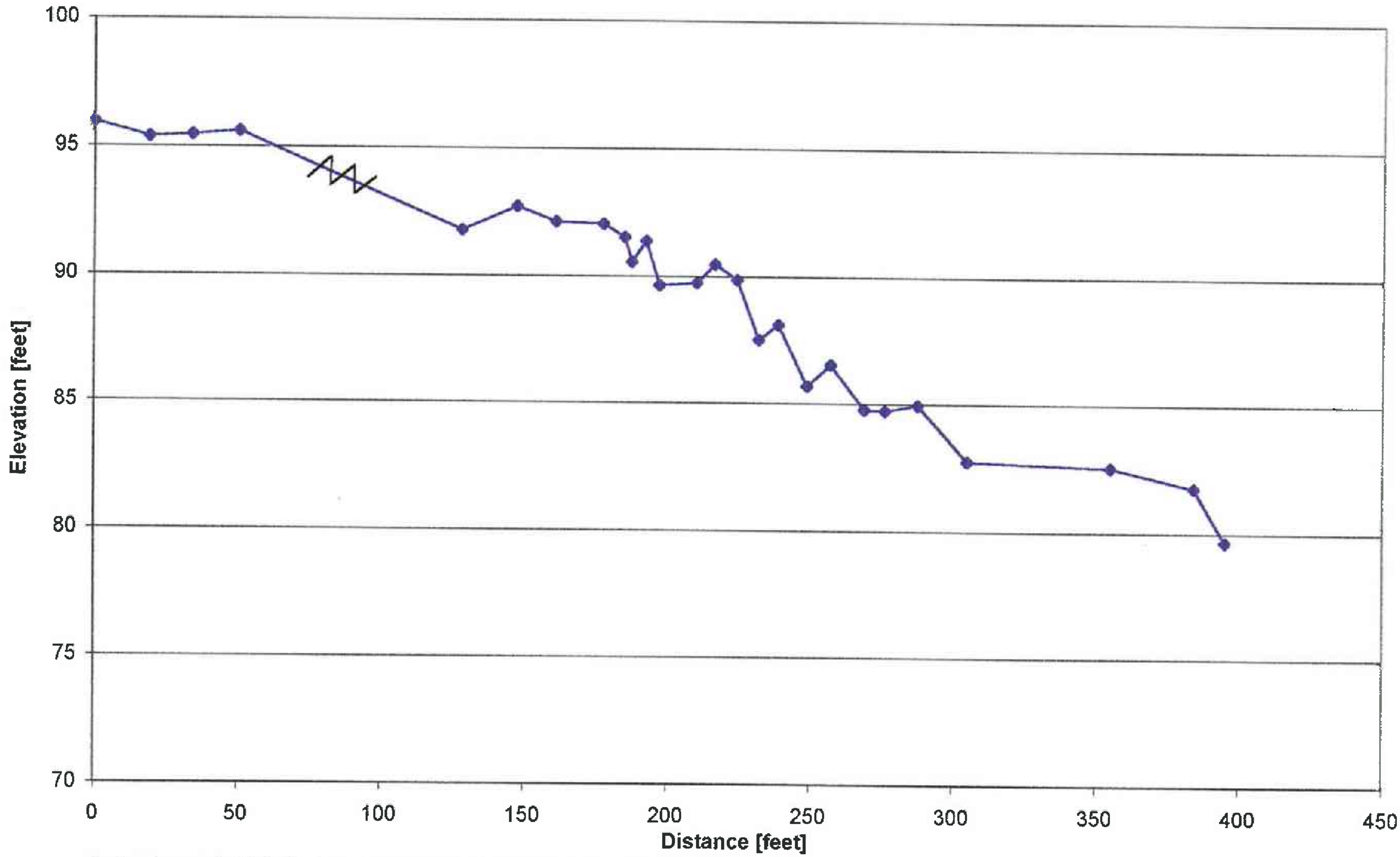
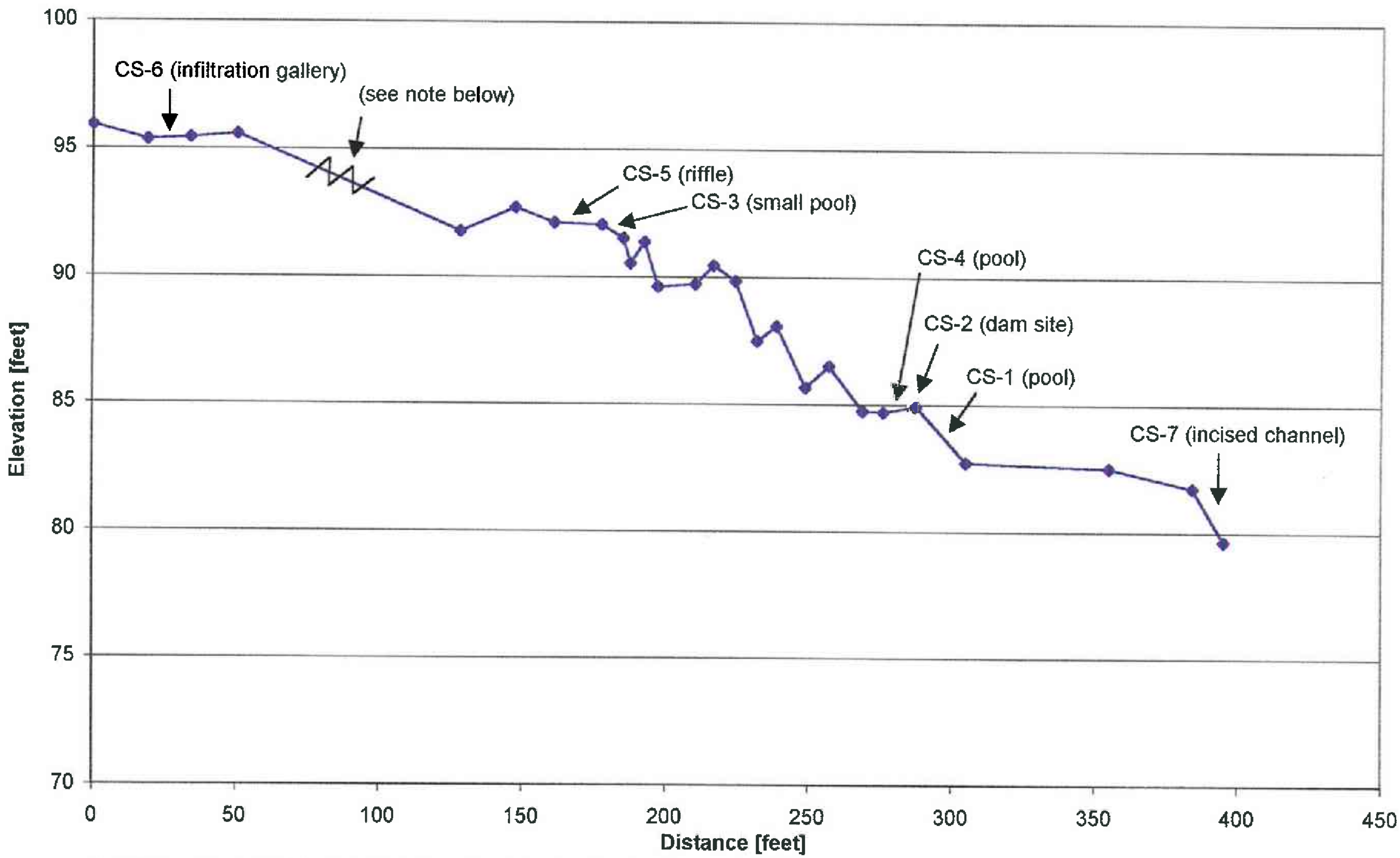


Figure 5: Longitudinal Profile



Note: Distance between infiltration gallery (upstream 4 points) and next profile point was estimated.

Figure 6: Cross Section Summary



Note: Distance between infiltration gallery (upstream 4 points) and next profile point was estimated.

Figure 7: Cross Section 1

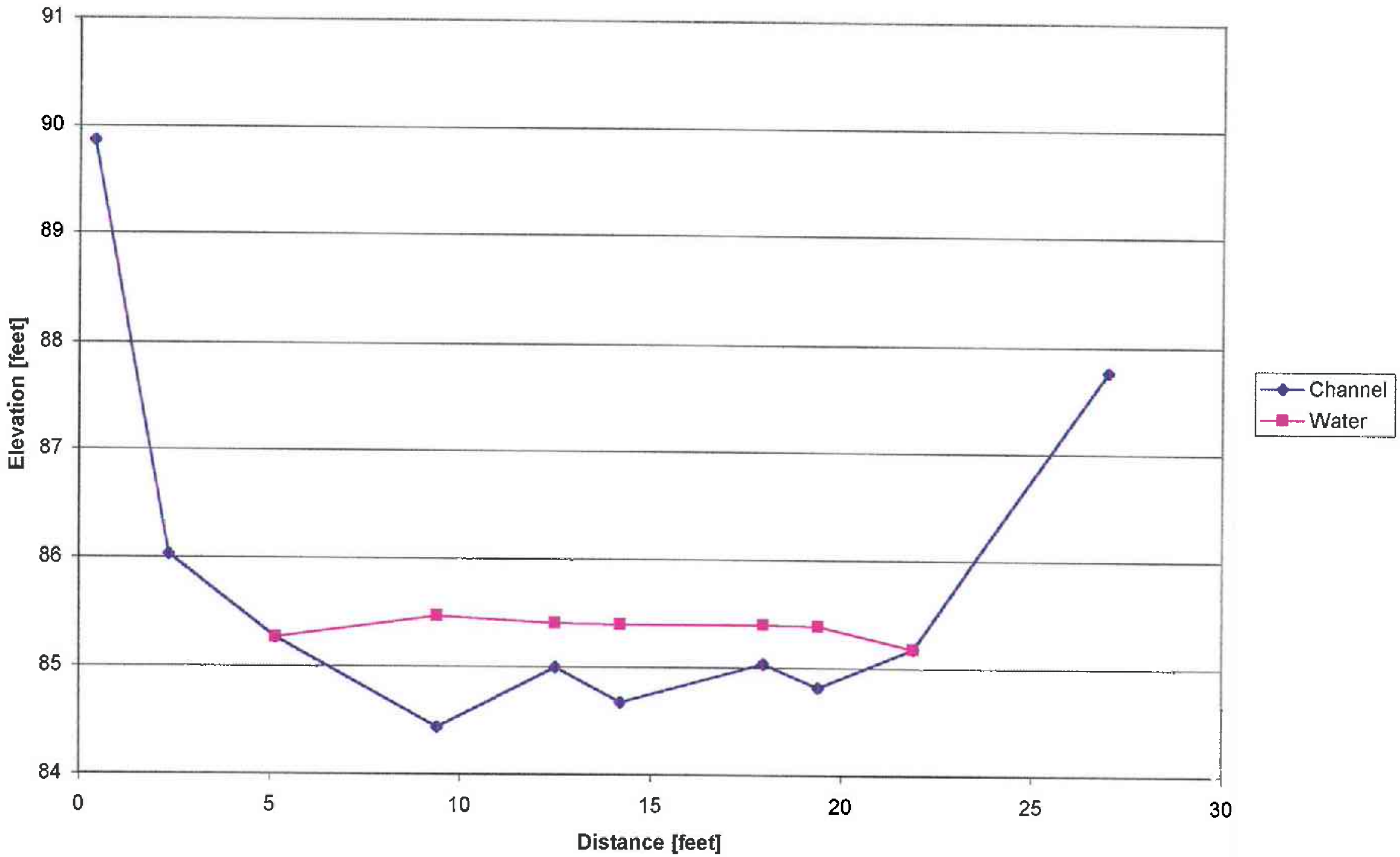


Figure 8: Cross Section 2

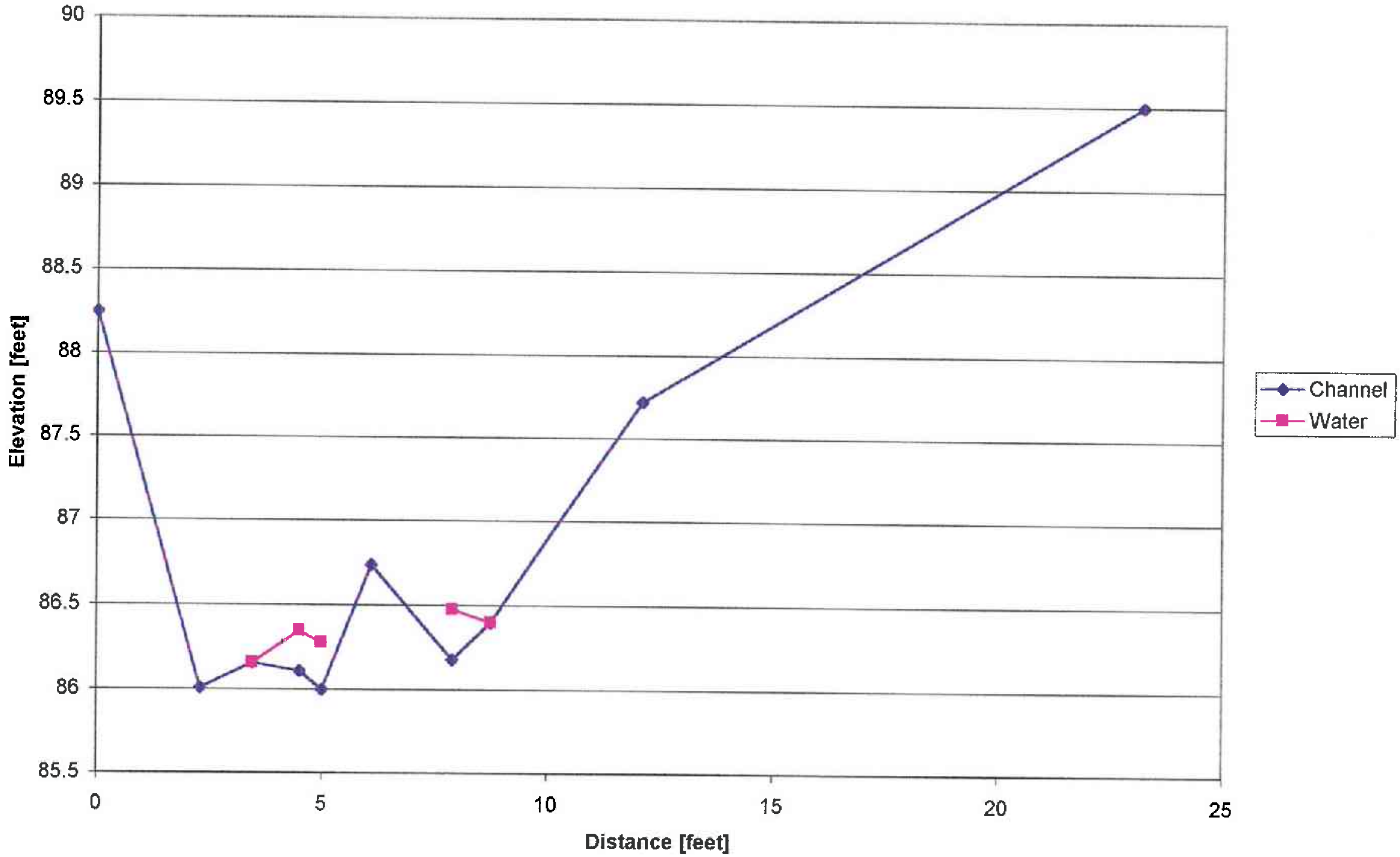


Figure 9: Cross Section 3

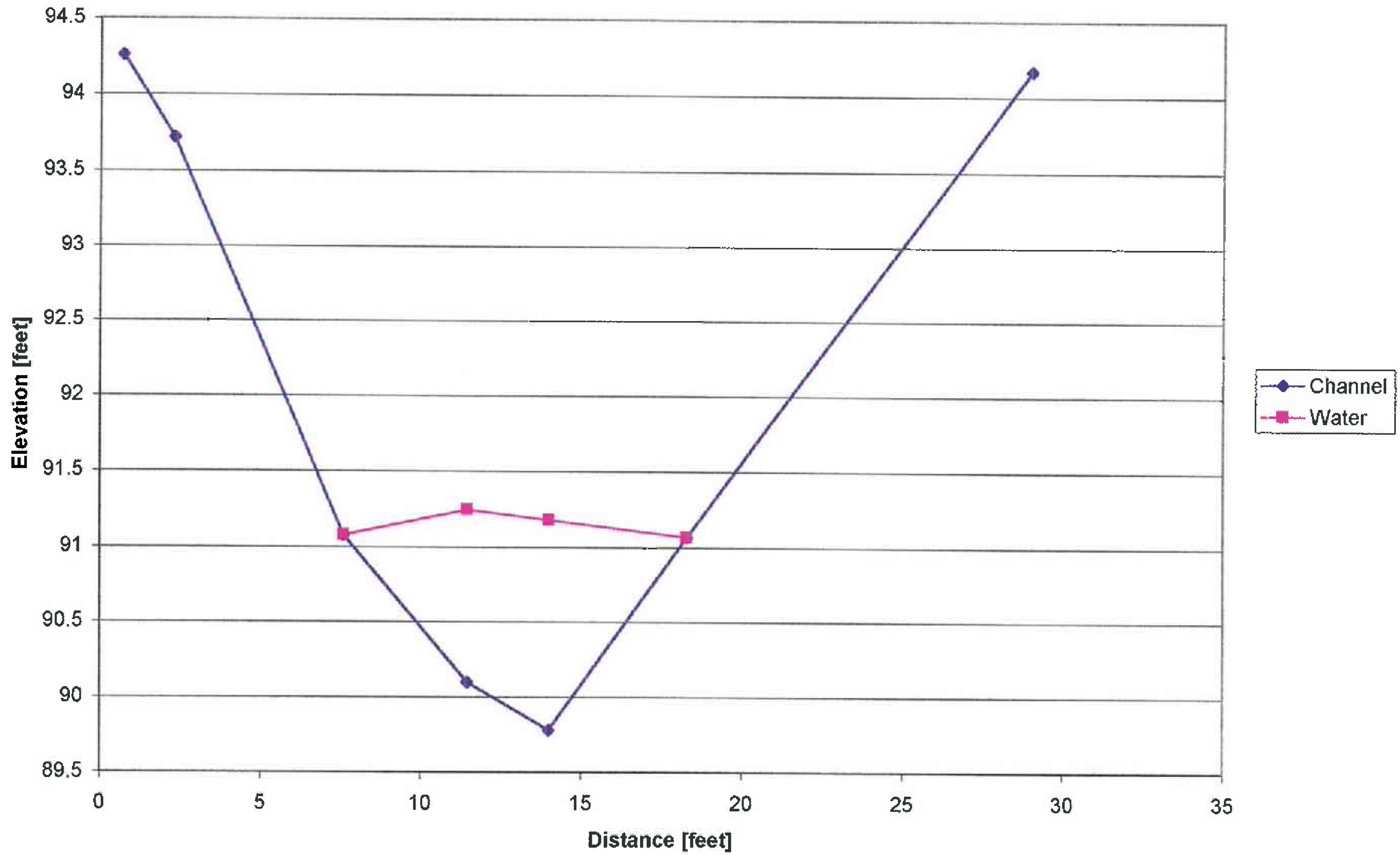


Figure 10: Cross Section 4

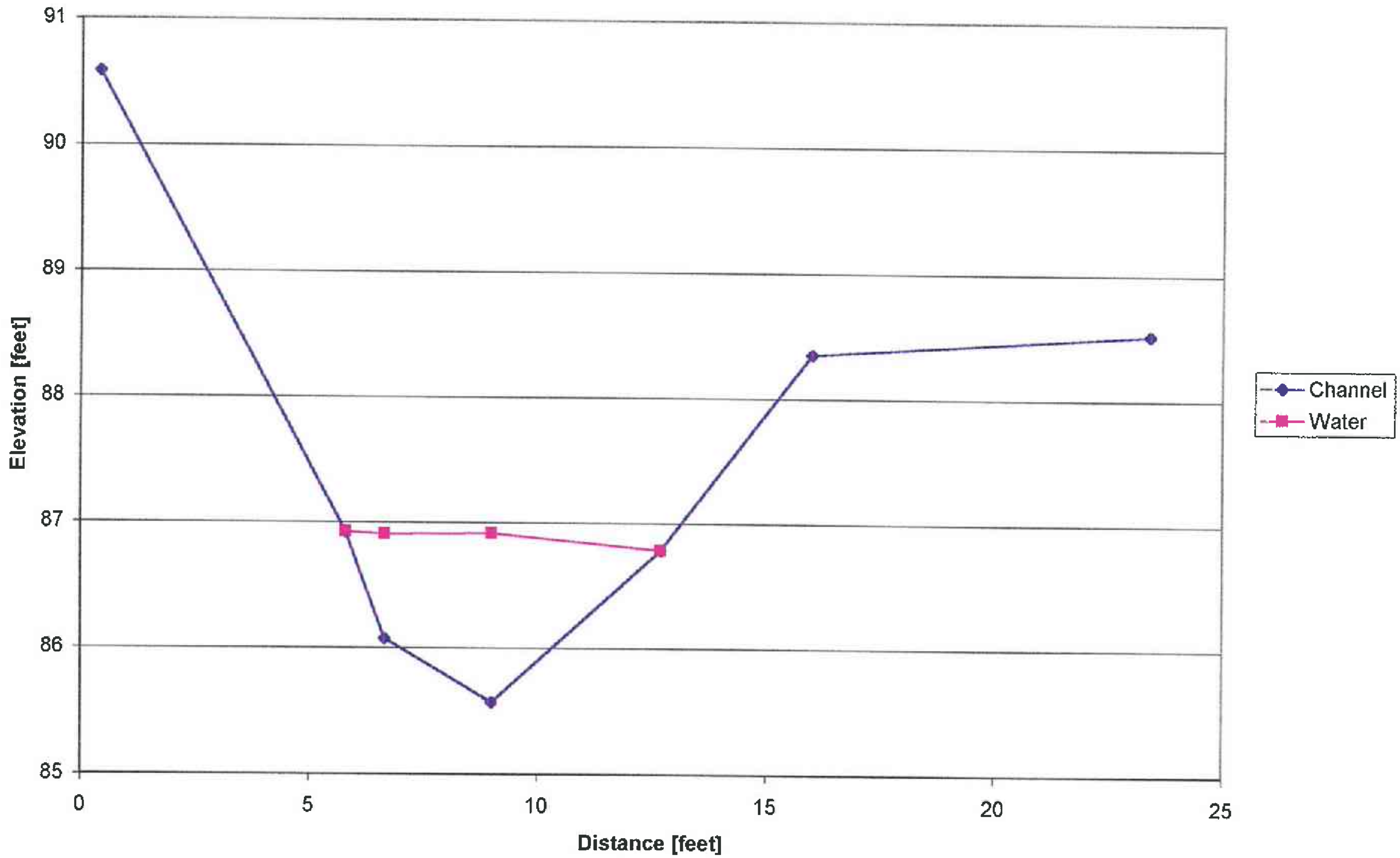


Figure 11: Cross Section 5

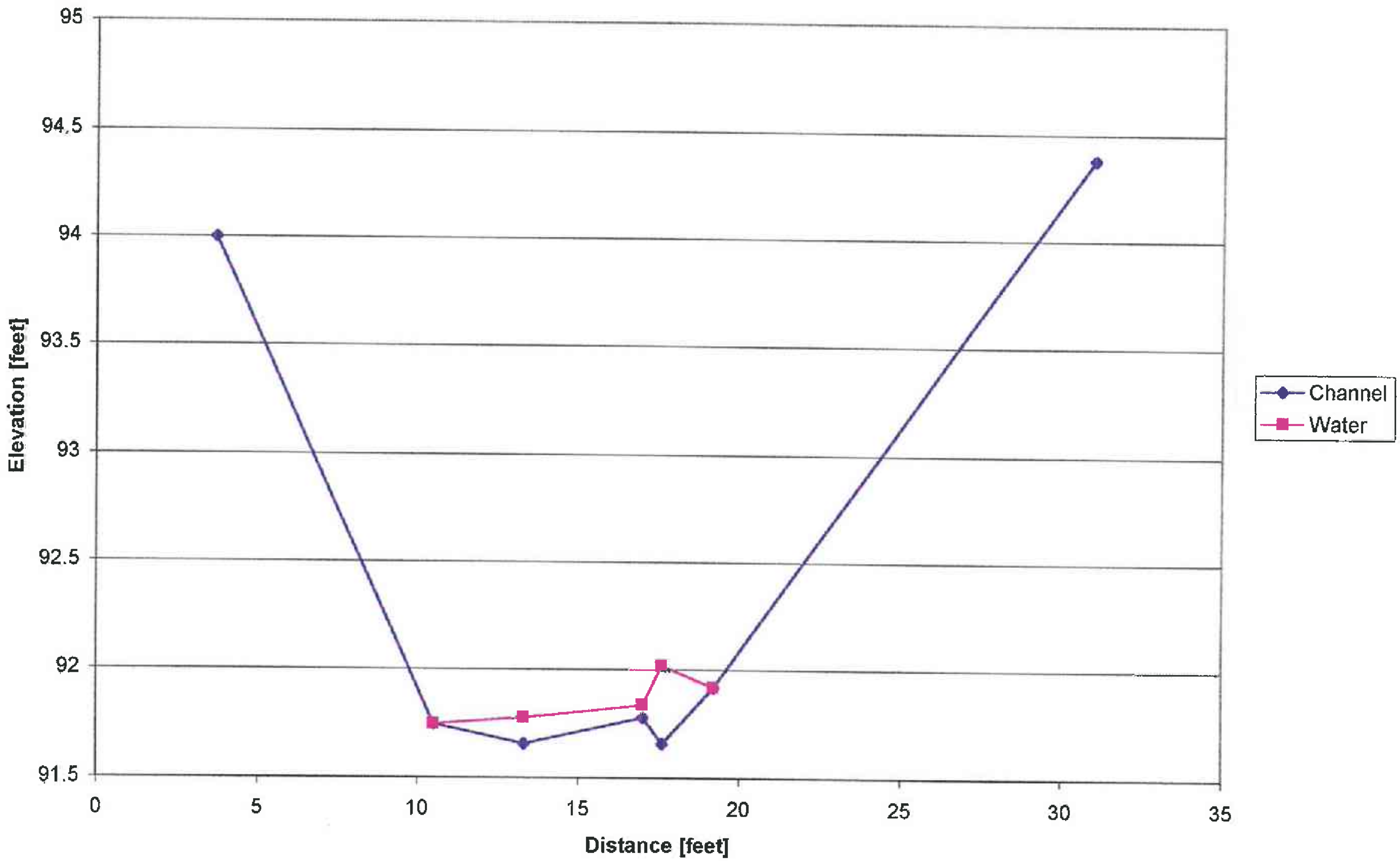


Figure 12: Cross Section 6

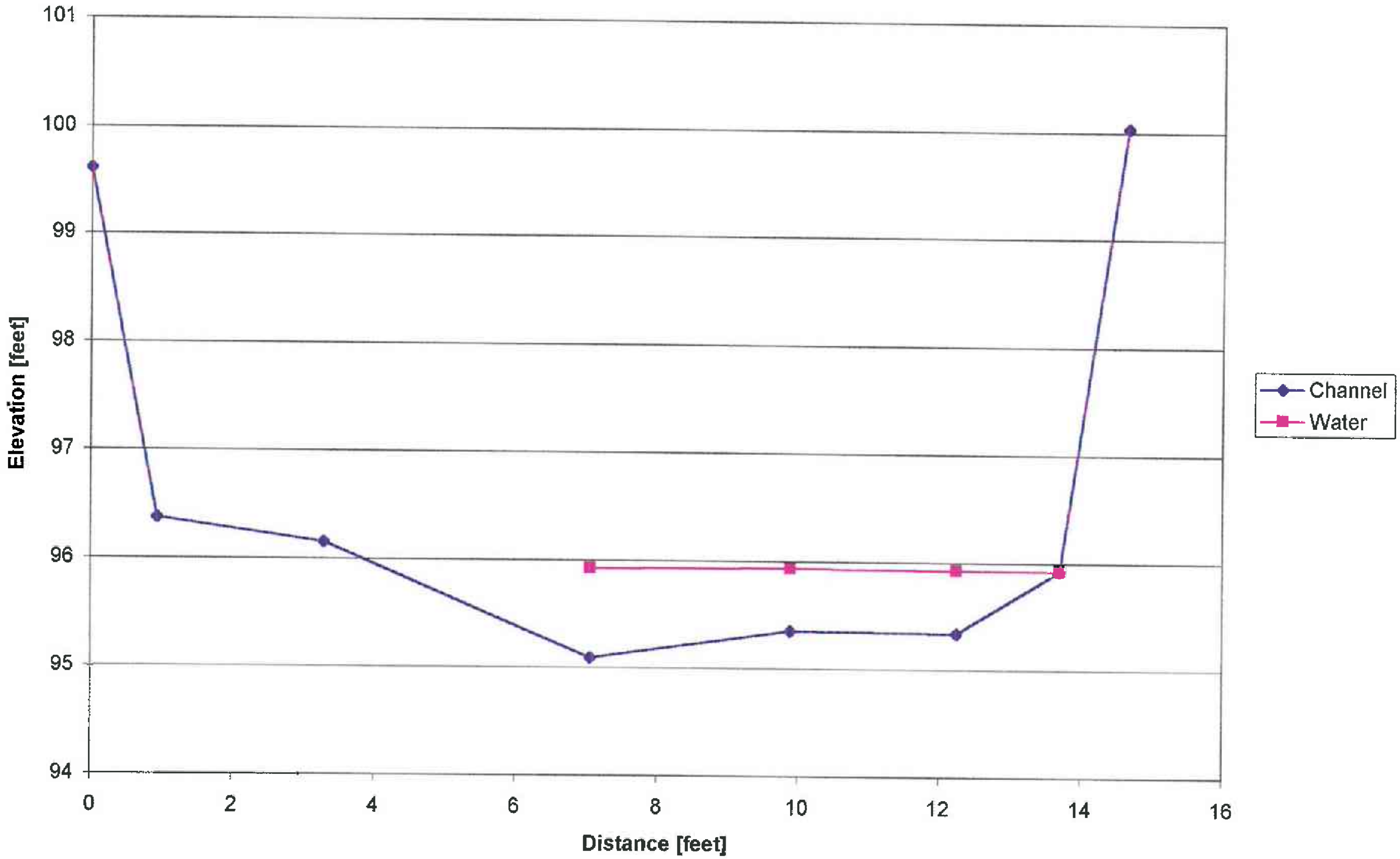
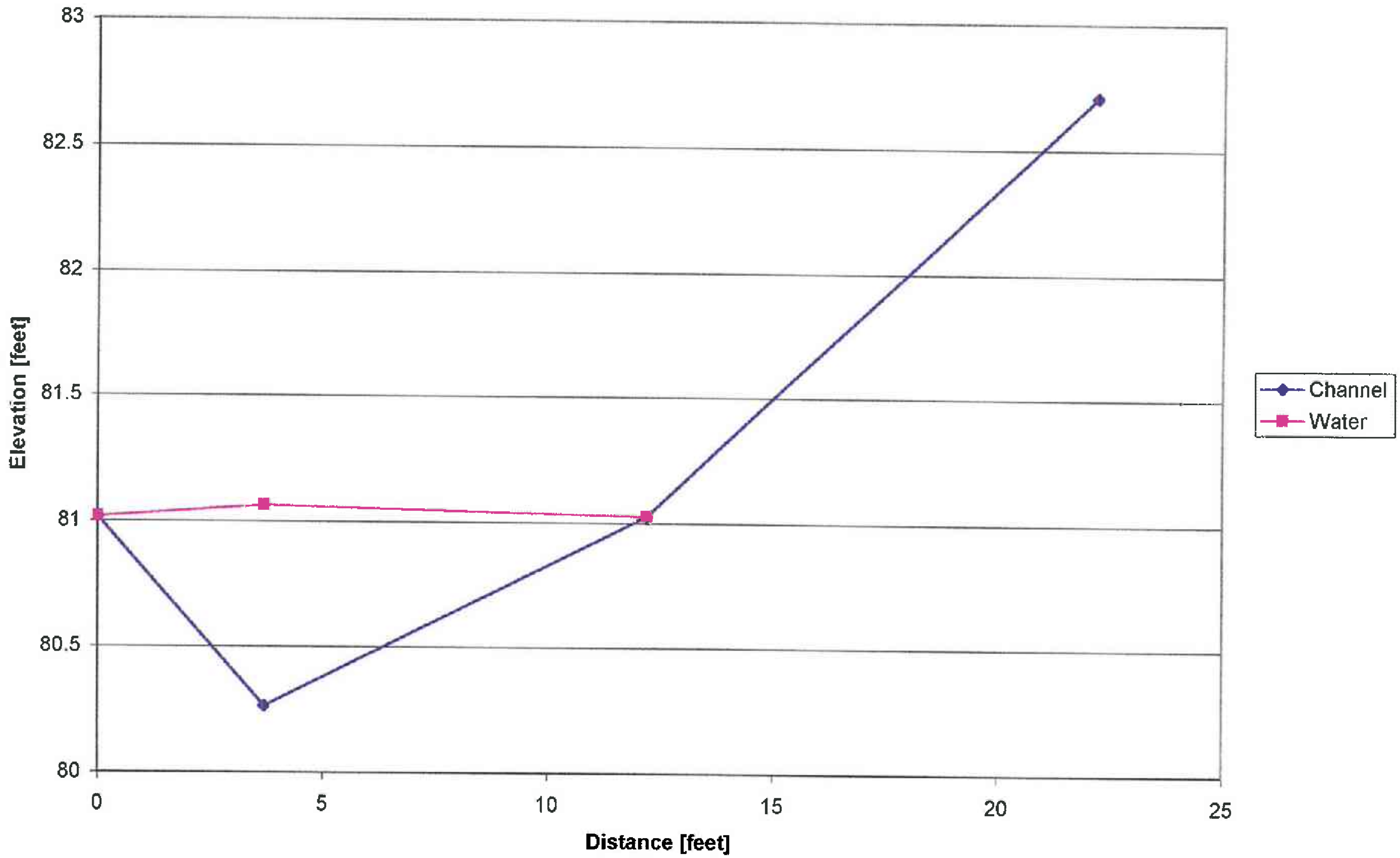


Figure 13: Cross Section 7



Appendix B: Photographs

Photo 1: The dam as it appeared on March 17, 2000. After the 1997 construction was halted, all but one flashboard were removed from the dam.

Photo 2: Post-removal view of the dam reach.

Photo 3: Taken on September 22, 2000, this photo shows the disturbed condition of the site immediately following the dam removal.

Photo 4: Efforts towards bank stabilization and revegetation had improved by the November 20, 2000 site visit. Cuttings from local vegetation had been strewn on the banks and willow poles had been planted.

Photo 5: This post-dam removal shot shows an alder tree on the left bank that was scared during construction.

Photo 6: By the November 20, 2000 site visit, the tree had fallen over, most likely due to changes in the bank that occurred following the dam removal.

Photo 7: During the 2000 construction phase, the river was diverted through pipes. Excavation was used to establish a pool-riffle sequence.