State of California
The Resources Agency
Department of Water Resources
Division of Planning and Local Assistance

North Fork Battle Creek Eagle Canyon Diversion

Preliminary Engineering Fish Passage Project

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Introduction

North Fork Battle Creek originates above the 7,000-foot elevation on the western slope of the Cascade Range and encompasses a watershed area of approximately 189 square miles. The creek is largely fed by rainfall and snowmelt from along Huckleberry Mountain and the Thousand' Lakes Wilderness of the Lassen National Forest. It is also supplemented by spring water which emerges from along its banks. The creek flows southwesterly from Huckleberry Mountain through North Battle Creek Reservoir and McCumber Reservoir. As the creek flows toward Manton, California, it drops abruptly through a steep canyon where it is joined by the South Fork Battle Creek, forming Battle Creek, it then flows to the Sacramento Valley. Battle Creek reaches the Sacramento Valley near the Coleman National Fish Hatchery. The creek then continues a short distance southwesterly to its confluence with the Sacramento River near the community of Cottonwood.

Battle Creek is a complex hydraulic system. During the early 1900s Battle Creek was developed into a highly efficient hydroelectric system. The system includes a series of small diversions, several canals, and low-volume/high-head power generators. Pacific Gas and Electric has owned and operated the Battle Creek Hydroelectric Unit since the 1930s.

Battle Creek has long been recognized as one of the three remaining Sacramento River tributaries in which spring-run chinook salmon, winter-run chinook salmon, and steelhead trout continue to exist. Declining Salmonid populations in the Sacramento River system have increased efforts to develop restoration activities that are compatible with the needs of the various stakeholders, while at the same time preserving and enhancing the salmon and steelhead populations. This proposed project is part of that restoration effort.

The proposed project involves modification of an existing diversion structure, which is owned and operated by PG&E. Modifications are intended to improve fish passage under a variety of flows and to screen the diversion to prevent fish losses.

The Eagle Canyon Dam and diversion structure have been in place since the early 1900s. The diversion structure provides up to 70 cubic feet per second of water to the Eagle Canyon Canal for power generation at lnskip and Coleman Power Houses. There is evidence that efforts to provide adult salmonids with passage at Eagle Canyon Dam predate the mid-1930s. Over the years, PG&E has maintained, modified, and replaced the fish ladder. Presently, there is an Alaska Steeppass fish ladder, which is nonoperational. PG&E has closed the fish ladder at the request of Department of Fish and Game to limit the stream available for spawning because of the low number of spring-run chinook salmon and steelhead adult spawners and because of disease concerns from the United States Fish and Wildlife Service at Coleman National Fish Hatchery.

Project Location

The Eagle Canyon Dam project area is on the border of Shasta and Tehama Counties on North Fork Battle Creek near Manton. (Figure 1). The diversion structure is about 3 miles west of Manton and is approximately 1 mile north of Manton Road. The project location can be identified on the Shingletown, U.S. Geological Survey, quad map, as Eagle Canyon Dam.

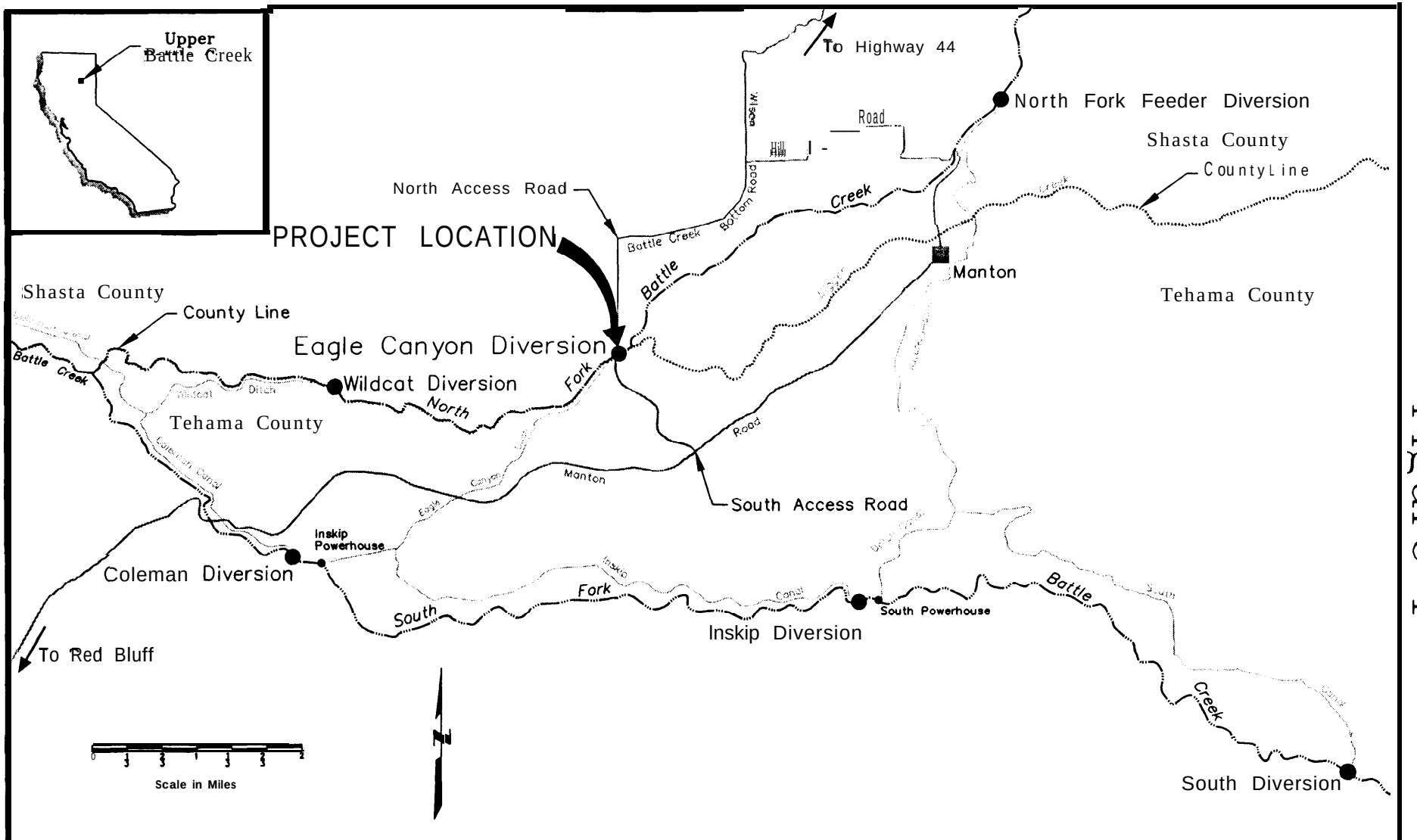
Project Description

The proposed project includes the addition of a new, higher flow capacity steppool with orifices or Denil 2 fish ladder located on the south side of Eagle Canyon Dam and the construction of an in-canal fish screen located adjacent to the proposed fish ladder (Figure 2). The existing fish ladder will be removed. A section of the south side of the dam will be removed that is approximately 7 feet deep and 10 feet wide. The existing canal will be enlarged, and a common wall will be built to serve as a canal wall and a side wall for the fish ladder. The preliminary layout requires that the existing canal be dewatered and widened. During construction, water will be temporarily diverted around the site. PG&E diverts a maximum of 70 cfs. Both ladder designs are considered feasible and conform to the minimum design requirements by DFG. A maximum design flow capacity for each ladder is set to approximately 50 cfs. The screen is designed to pass the maximum potential diverted water right, while meeting screening criteria set forth by the National Marine Fisheries Service and DFG for salmon and steelhead. The new modified canal is designed so that large debris can be diverted before it is introduced to the fish screen system. Salmonid juvenile bypass return systems are established so that National Marine Fisheries Service criteria are met, while maintaining ease of operation and low maintenance.

Special Project Notes

The preliminary cost estimate is subject to review by the Department of Water Resources, Division of Engineering staff and PG&E. The quantities and costs shown in Table 3 are preliminary and are not intended for bidding purposes as final designs may result in changes to some or all quantities and costs. Final designs will be subject to the approval of PG&E, DFG, and NMFS.

The available hydrology for North Fork Battle Creek is limited. Fortunately, the USGS stream gage station (No. 11376550) located on Battle Creek below Coleman Fish Hatchery, near Cottonwood, California, does provide an extended history of Battle Creek dating back to 1961. Therefore, it is possible to use the drainage basin areas to calculate a ratio that can be applied to the data for Battle Creek to estimate the hydrology of North Fork Battle Creek. USGS has calculated the drainage basin area for Battle Creek, above the stream gage, to be 357 square miles. The drainage area for North Fork Battle Creek, above Eagle Canyon Dam, is 186 square miles. Thus, the ratio of drainage areas is equal to 52 percent. Using this ratio, the



Location Map for
BATTLE CREEK-EAGLE CANYON DIVERSION
FISH PASSAGE PROJECT
near Manton, California

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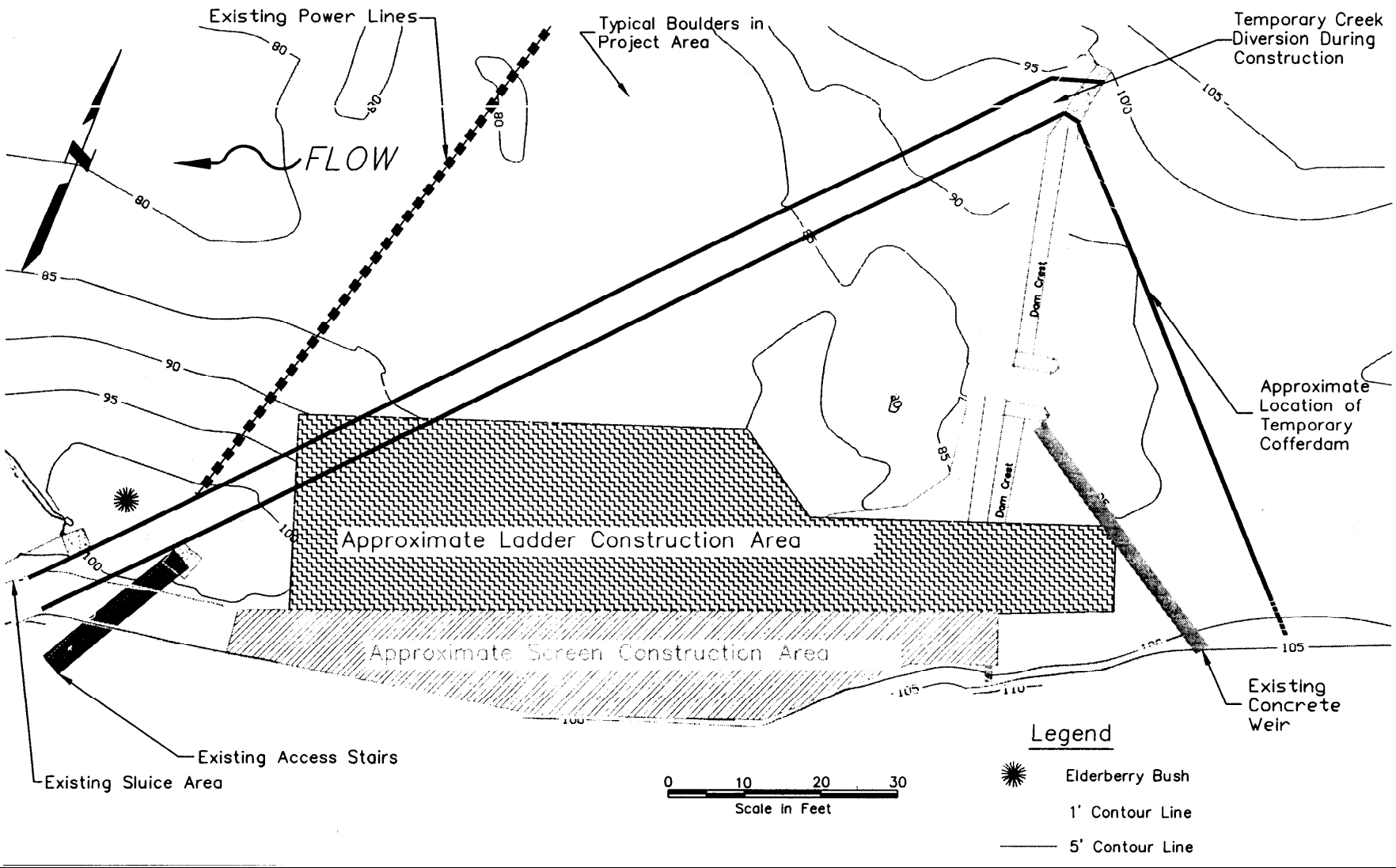
Northern District

Figure 1



SITE LAYOUT FOR BATTLE CREEK–EAGLE CANYON DIVERSION FISH PASSAGE PROJECT near Manton, California

State of California
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DEPARTMENT OF WATER RESOURCES
Northern District

Figure 2

daily average flows and percent exceedance can be calculated (Appendix D). This method of synthesized data should be dependable for the high-flow regime, which is used in determining the design flows for the fish ladders.

Project Alternatives

Ladder Alternatives

Five alternatives to the proposed fish ladder were given consideration based on numerous factors including fish passage, owner liability, operation and maintenance, available water rights, location and condition of existing facilities, stream characteristics, stream hydrology, biological criteria, and availability of funding. The recommended options will maximize fish passage while minimizing instream obstructions.

Through field visits and stakeholder meetings, the five alternatives were reduced to two, a Denil type 2 fish ladder and the steppool with orifices. The final two fish ladder types were taken through the preliminary design phase. The following lists the original five alternatives.

1. Do nothing.

2. A vertical slot fish ladder.

3. A new upstream low head dam with a pool and chute fish ladder.

4. A Denil type 2 fish ladder constructed on the left side of the existing dam.

5. A steppool with orifices fish ladder constructed on the left side of the existing dam.

Alternative 1 was abandoned because it did not meet any of the goals of restoration.

Alternative 2 was abandoned because of its tremendous length and construction complexity. To obtain approximately 50 cfs design flow, the length of the fish ladder would be more than 200 feet. This is unacceptable given the space constraints at the Eagle Canyon diversion site.

Alternative 3, a new low-head dam with a pool and chute-type fish ladder, located upstream of the existing dam, was found to be impractical. The natural gradient of the existing upstream channel and the overall slope of the proposed ladder structure is relatively equal. It is virtually impossible to provide a suitable entrance and exit for the pool and chute-type fish ladder. It was also found that the large, boulder material on the walls of the canyon appears to be supported by the boulder material in the bottom of the channel. Removing these boulders from their location would

destabilize the up-slope boulders. These unsupported boulders would cause major damage to any structure constructed in the channel below them. Finally, without the ability to create a minimal pool at the upstream side of the proposed dam, bedload cannot be sluiced. Thus, most of the bedload material will pass through either the fish ladder or the diversion inlet. This bedload would increase the operation and maintenance cost of the project and could cause blockage to fish.

Alternative 4 is one of the two fish ladder types carried through preliminary design. It is a Denil2 fish ladder which would be constructed on the left side of the existing dam. This fish ladder will have a 4-foot bottom width and will be 5 feet high. The maximum flow capacity for this alternative will be 54 cfs. Under low-flow conditions, fish passage will be possible until the flow reaches 5 cfs; at which time the water over the baffles is 6 inches deep. The flow capacity of the fish ladder will be at least 10 percent of the streamflow 94 percent of the year. The fish ladder consists of three run sections and two resting pools. General maintenance of the fish ladder will require frequent temporary shut downs of the fish ladder to allow an operator to check for and remove debris.

Alternative 5 is the other fish ladder type carried through preliminary design. It is a steppool fish ladder with orifices on each side the baffles. This fish ladder will be located on the south side of the existing dam. It will have IO-foot-wide suppressed baffles that have 15-inch-square suppressed orifices. The maximum flow capacity for this alternative will be 53 cfs. Under low-flow conditions, the orifices will be shut and fish passage will be possible over the weirs until the minimum flow of 12 cfs is reached. The flow capacity of the fish ladder will be at least 10 percent of the streamflow 94 percent of the year. This ladder will consist of a single run of pools with two turning pools. General maintenance of the steppool may require seasonal temporary shut downs of the ladder to allow sluicing and debris removal.

Screen Alternatives

The fish screen design alternatives considered were:

1. Off-site fish screen location, (Eagle Canyon Flume 5 Outfall and lnskip Powerhouse Header box).

2. On-stream fish screen.

3. Offstream fish screen.

Alternative 1, an off-site fish screen, was rejected. Field tours of potential sites for an off-site fish screen location were attended by DWR, DFG, NMFS, Metropolitan Water District, and PG&E. Only two sites were identified as having potential. The following lists reasons justifying the rejection of Alternative 1:

1. Eagle Canyon flume 5 outfall - Initial estimates suggest in excess of 14,000 linear feet of return piping to safely convey the fish back to the stream. The installation would be on a steep slope with difficult construction conditions. The cost of this return pipe could be more than one of the entire fish ladder and screen proposals.

2. Inskip powerhouse header box - There are two possible return routes for this location. The first return route is an 8,000-linear-foot intermittent drainage channel back to the North Fork of Battle Creek. Little to no vegetation exists along this route. A program to establish vegetation would take a substantial discharge, and some channelization to make this a biologically reasonable option. The second return route is 4,000 linear feet to the South Fork of Battle Creek. This route, like Flume 5, would require approximately 21,000 linear feet of return piping. The cost of the return pipe or value of the water makes these alternatives not viable.

3. The fishery agencies (DFG, USFWS, and NMFS) prefer an on-stream or offstream fish screen location near the diversion over a screen removed from the stream channel.

Alternative 2 was rejected. Although there are many new and innovative fish barriers throughout the United States, the selected on-stream screen design, with horizontal slotted openings are considered by DFG as the most effective (with acceptable mortality rates) for juvenile spring-run chinook salmon. Unfortunately, the site configuration at Eagle Canyon does not lend itself for an on-stream fish screen.

Alternative 3, an offstream fish screen placed in the widened existing canal configuration is the preferred design. There exists a feasible offstream fish screen design at the diversion location. DFG, DWR, and PG&E staff believe that a conventional, self-cleaning, chevron-style, fish screen concept will provide an acceptable and feasible design.

Sequence of Events

In April 1997, DWR, Northern District engineers met with staff from PG&E, DFG, USFWS, and other agencies for a Battle Creek Hydrologic Unit tour. Eagle Canyon was one stop. At the site, project objectives and alternatives were discussed. DWR began the preliminary engineering investigation process for the fish ladder and screen with site surveys, mapping, and analysis of hydrological and biological data. Northern District engineers referenced established screen and ladder design criteria to determine required dimensions and configuration. Northern District Environmental Specialists began the environmental site evaluation. During this time, DFG and PG&E provided essential information regarding the Eagle Canyon Dam site. Some information came as photographs, historic design plans, reports, flow data, and operational procedures.

In June 1997, Northern District engineers began a hydraulic analysis to determine the fish ladder types, dimensions, baffle sizes and configurations, orifice dimensions, and critical upstream and downstream ladder invert elevations. Paul Ward (DFG biologist) and George Heise (DFG hydraulic engineer) were consulted regularly. The Battle Creek Technical Working Group met frequently to discuss design details and options (Appendix B). Members of the Technical Working Group included staff from DWR, DFG, PG&E, USFWS, Kier Associates, and MWD. DFGs "Statewide Fish Screening Policy" and NMFS, "Fish Screening Criteria for Anadromous Salmonids" were used to determine the required screen size and dimensions. Preliminary engineering included preliminary drawings (Sheets l-l I), a descriptive report, and preliminary cost estimates (Table 3).

Screen and Ladder Technical Background

Water Rights

The current water rights and FERC license for Battle Creek Hydroelectric Project, Number 1121, dictates that PG&E maintain a minimum flow of 3 cfs below Eagle Canyon Dam and allow a maximum diversion of 70 cfs. Article 33 of the FERC license allows for temporary modification of the minimum flows for fish management purposes. Therefore, in cooperation with DFG, PG&E has entered into a short-term agreement to provide a target 30 cfs below Eagle Canyon Dam.

Screen Sizing and Configuration

The proposed preliminary fish screen design and required surface area of the screen was determined using the California DFG Statewide Fish Screening Policy design requirements for salmon and NMFS slot width criteria for steelhead. With a maximum allowable approach velocity of 0.40 ft/sec. for continually cleaned screens in canals and a maximum design flow of 70 cfs, the required wetted screen area is 175 sq. ft. (70 cfs/O.40 ft/sec.). Adding 20 percent (35 sq. ft.) to the required wetted area to compensate for reduction of screen area because of structural members, the required screen area becomes 210 sq. ft.

Water surface elevations in the canal at the location of the proposed fish screen are controlled by backwater from a canal tunnel immediately downstream. This backwater results in a direct correlation between depth of flow in the canal and average velocities. At 70 cfs, the water surface elevation at the screen location is about 98.0 feet, based on an assumed vertical datum. The width of the canal is limited at the location. There is also limited longitudinal space in the canal for placing a screen. Balancing the spatial limitations and the desired flow characteristics, the invert floor elevation of the canal in the screen area was set at 94.5 ft (3.5 foot depth). This translates to a screen length of 60 ft.

A fixed plate, chevron screen design was selected because of the space limitations at this location. Preliminary drawings, Sheets 6 and 9, show the plan and profile view of the fish screen layout. The fish screen will have a continuous cleaning apparatus with removable panels set at a slight incline. Space limitations would not allow the desired full 30 degree incline. However, an incline of 0.5 feet over the 3.5foot depth, with the aid of a counterweight, will be used to maintain positive contact between the brushes and the screen face. This incline resulted in a slight increase of the wetted screen area. To allow for minor canal fluctuations, 1 foot of screen height was provided for freeboard. Resulting average velocities in the canal at the screen are 1.4 ft/sec. Louvers will be constructed behind the screen to provide velocity control along the face of the screen. Sweeping velocities are expected to be approximately three times the approach velocities. The estimated time for juvenile fish to move to the bypass after entering the screen is 23 seconds.

The bypass return conduit is a smooth wall pipe 24 inches in diameter. It will flow with a minimum depth of 0.8 feet, an average velocity of 3.5 ft/sec., and exit into a pool in the adjacent fish ladder. The exit will be free flowing and set at an elevation such that adult fish using the ladder will not enter the return conduit. In the steppool fish ladder, the return exit will fall directly into the nappe of the flow over baffle number seven (Preliminary Drawings Sheet 7). In the Denil2 fish ladder, the return exit will be into a separate smaller box that will redirect flow over an ogee weir into the turn pool (Preliminary Drawing Sheet 4).

The proposed fish screen will have a reinforced concrete foundation. Structural frames will be spaced at approximately 5-foot intervals and attached to the foundation. The framing system will support a removable wedgewire or equivalent screen meeting DFG and NMFS fish screen criteria. Each half of the screen will be cleaned by a continuously sweeping brush, powered by an electric motor located at the downstream end of the structure at or near the bypass entrance.

A large straight wall will be constructed to form the side of the canal and the wall of the adjacent fish ladder. The foundation of the wall will be a simple spread footing. The wall will tie into the floor of the canal as well as the floors and walls of the pools in the fish ladder. Positioning of the wall and the ladder was driven by two objectives. First, widen the existing canal to allow sufficient space to construct and operate a fish screen in the canal. Second, minimize encroachment into the existing spillway area of the dam.

Screen Operation and Maintenance

Operation and maintenance will be performed by PG&E personnel. Operational requirements will include assurance that the screen cleaning equipment is functioning properly. Maintenance responsibilities include the periodic replacement of the brush components and the occasional cleaning of sediment from the screen bay. An additional operation requirement will be to maintain a stage sensor upstream of the fish

screen and downstream of the control gate, which will alert an operator if the water surface on either side of the fish screen reaches an unsafe operational depth.

Ladder Sizing and Configuration

Reliable, detailed streamflow data do not exist for this location on North Fork Battle Creek. DWR performed basic hydrologic analysis to estimate historic, average daily flows. This was done by multiplying the recorded average daily flows at the Battle Creek gage below Coleman National Fish Hatchery by the percentage of the drainage area collected at the Eagle Canyon diversion location. This correlation is reasonable for higher flows, which is the major concern for sizing the fish ladder. This correlation is believed to be incorrect for the lower flows. However, the minimum flow releases at the Eagle Canyon diversion will be some negotiated amounts, not a function of drainage area.

Two fish ladder types were carried forward in this preliminary investigation. A steppool with orifices fish ladder and a Denil 2 fish ladder were designed for a maximum flow capacity of approximately 50 cfs. DFG staff suggest that a minimum of 10 percent of the flow passing a diversion be conveyed through the fish ladder. When adding 70 cfs for the diverted amount, the 50 cfs then correlates to a total stream flow of 570 cfs. The hydrologic analysis indicates that this flow frequency has an exceedence of approximately 6 percent. Though flow duration was not taken into consideration, it is believed that the level of investigation is sufficient.

Steppool

The steppool fish ladder design features a lo-foot-wide suppressed weir and one 15-inch-square orifice suppressed at the bottom and one side (Preliminary drawings, Sheets 7-8). There is an enlarged orifice in each baffle, which is 15 inches wide and 36 inches tall to allow for sluicing. All orifices will have a stop gate mounted at the upstream face. The run of the fish ladder is designed to accommodate 53 cfs while maintaining plunging flow with full energy dissipation within the individual pools. A minimum flow of 12 cfs is needed in the fish ladder to provide adequate water depth over the baffles of 6 inches. Operation of the fish ladder at 12 cfs will require that all orifices are closed. The ladder contains one 180degree turn with one weir widened to 10.5 feet and containing a single enlarged orifice at the outside corner. The widening was necessary to maintain full energy dissipation while providing miters at the corners of the pool to reduce turbulence.

The pool size was determined using the energy dissipation requirements of 4 foot pounds per second per cubic foot of water in the pool, i.e., required pool volume of "V= 16xQxh."

Flow is controlled at the upstream exit of the fish ladder by a 3-foot-wide slide gate creating an orifice exit. The slide gate allows a wide range of flow control, to accommodate the range of flow conditions that may occur at the site.

The entrance at the downstream end of the fish ladder is controlled by two 3-foot wide slide gates, while only one will be in operation at a time. The angles of the gates are set so that for different stream characteristics distinct attraction flows can be obtained. The grade leading into the entrance of the fish ladder will be at 3:I slopes until original grade is met.

Denil 2

The Denil2 fish ladder design features 4-foot-wide and 5-foot-high steel baffles spaced at 2 feet-8 inches, set at a 45degree angle (Preliminary drawings, Sheets 4-5). The entire fish ladder consists of three runs all set at a 6:I slope and two resting pools. One resting pool also provides for a required 180-degree turn. The maximum design capacity of the fish ladder is 54 cfs. Flow below 5 cfs will not provide adequate water depth for fish passage. The lowermost run contains a modified fish ladder section, which maintains the invert at a 6:1 slope, but the top of steel remains level. This modification is necessary to allow varied tailwater elevations, without losing function of the fish ladder. Resting pool volumes were based upon guidance from DFG. While no established criterion dictated the solution, the consensus of Technical Working Group is that this configuration is sufficient to dissipate the effects of the jet entering the pools from the Denil2 chute.

The exit of the fish ladder controls flows by a single 3-foot-wide slide gate creating an orifice exit. The slide gate allows a wide range of flow control, to accommodate the range of flow conditions that may occur at the site.

The entrance of the fish ladder is controlled by two 3-foot-wide slide gates, while only one will be in operation at a time. The angles of the gates, with respect to the stream, are set so that for different stream characteristics distinct attraction flows can be obtained. The grade leading into the entrance of the fish ladder will be at 3:1 slopes until original grade is met.

Ladder Operation and Maintenance

Operational requirements will include cleaning debris from the fish ladder. During all seasons when the ladder is operational, maintenance by PG&E staff will be required. The steppool fish ladder will require occasional sluicing and cleaning after large flow events. The Denil 2 fish ladder will require frequent inspections and removal of debris, due to the characteristic of this type of fish ladder. The flow control gates for each ladder alternative at each ladder exit will need to be automated or adjusted frequently to compensate for the varied flows. The steppool is designed to have all orifices set at 15-by-15 inches during normal operations. Orifices will only be open if they will remain submerged when opened. While diverting, responsibilities for PG&E include providing desirable flows in the fish ladder, removing debris from the fish ladder and trashracks, and general maintenance to provide a passable fish ladder. Gate control automation will be addressed in final design.

Site Geology

While the preliminary layout and conceptual plans were being developed, site inspection was completed by DWRs Division of Engineering Project Geology Section. A memorandum report was completed and is shown in Appendix F. The geologic conditions at the site do not present any obstacles. However, construction at this site will be a challenge because of the large boulders, steep canyon walls, and space limitations. There is no need to perform geologic exploration at this site. The geologic materials at the site are visible and the condition of the basalt rock is of excellent quality. Blasting will be prohibited at this site. It is recommended that an engineering geologist be on-site during construction to inspect the rock at foundation grade.

Environmental

Environmental Documentation

Northern District Environmental Specialists performed an environmental site survey of the project area to document potential environmental issues. A separate draft Negative Declaration document will be prepared for California Environmental Quality Act compliance in the winter of 1998. They will also coordinate with DFG, U. S. Army Corps of Engineers, USFWS, NMFS, and Central Valley Regional Water Quality Control Board concerning project permitting. An archaeological records survey by California State University Chico staff (Appendix E) as well as an archaeological site walk report (Appendix E) has been completed. An information package was created that will accompany all permits (Appendix H). The package is retained at the Northern District. Permit applications will be submitted by the project coordinator. Finally, an Environmental Clearance Checklist (Appendix G) summarizes the status of permits. Table 1 lists the potentially required permits for the Eagle Canyon Fish Passage Project.

Table I. Environmental Permits Potentially Required for the Eagle Canyon Fish Passage Improvement Project

Federal
USACE 404 Permit-Nationwide Permits:
"Nationwide Permit 4-Fish and wildlife harvesting, enhancement, and attraction devices"
"Nationwide Permit 33-Temporary construction, access and dewatering"
Federal Endangered Species Act Compliance (see Appendix G):
"Federally listed species are present, will need federal nexus for Section 7 ESA"
NEPA Compliance (if federal funds or approvals are involved)
State
RWQCB 401 Water Quality Certification
RWQCB Stormwater Permit (if ground disturbance involves more than 5 acres)
DFG 1600 Agreement
CEQA Compliance (Categorical exemptions may apply)
State Endangered Species Act Compliance (see Appendix G)
Local
Shasta County Grading Ordinance

Design and Construction Summary

Construction Summary

At the Eagle Canyon Dam diversion site, construction equipment access is proposed from Manton Road to the south rim or from Battle Creek Bottom Road to the north rim. The existing dirt roads will need some improvements to allow for construction access. Temporary construction easements must be obtained from landowners. However, the Eagle Canyon diversion resides on property that PG&E owns. The canyon rims rise about 175 feet above the main creek channel. The use of a helicopter will aid in construction and will eliminate damage to the canyon walls and associated vegetation. There is room on the north rim for a construction staging area with minimal grading required. The north rim seems to have the most accessible flight path. Personnel access to the canyon floor is provided by a foot path that leads down the south canyon wall. This path will be improved slightly to provide a safer access for workers. The south rim does provide the most feasible access for heavy construction vehicles. The limits of the staging areas and access routes should be marked and managed to prevent vehicular access outside the designated zone. In addition to the rim staging areas, a small storage area will have to be constructed on the canyon floor

to store a small amount of equipment and fuels. The proposed access routes and staging areas were selected to minimize impacts to vegetation and wildlife.

A temporary cofferdam will be built around the construction areas. Additionally, if PG&E desires to continue diversions during construction a temporary rerouting of the stream will be constructed around the working area and back into the Eagle Canyon Diversion Ditch at the canal tunnel. If a gravel rather than sandbag or other type of cofferdam is constructed, then the cofferdam may be constructed using spawning gravel (consisting of rounded washed river gravels between 1/4 inches and 4 inches in diameter) which will be spread in the stream channel upon completion of the construction activities. The area downstream of the temporary cofferdam will be dewatered prior to and during construction activities. Fluids removed during the dewatering operation will be pumped into the diversion ditch. The existing power line will need to be rerouted to allow helicopter access. Gravels and concrete excavated from the construction zone will be temporarily stockpiled below the dam for reuse as backfill. Demolition and excavation will include the area to be occupied by the proposed ladder and screen, a pool at the base of the proposed ladder and the existing ladders. This includes the demolition of the existing radial gate control device anchor block which will be established at a new location.

All removed riparian vegetation will be salvaged and reestablished or replaced. No long-term change in diversion quantity will result from the project. The project is designed to avoid significant changes in stream channel hydrology and channel capacity. PG&E would prefer a construction window from approximately July 1 through November 1. This is when site conditions are most favorable.

Site Conditions and Assumptions

The preliminary layout and conceptual drawings presented as Sheets **1** through 11 will evolve during the final design process. The final design engineer should review the memorandum geology report (Appendix F) and complete a thorough site examination before proceeding with final designs. The dam has been repaired a few times over the past hundred years. Therefore, concrete sections as well as rock sections of the dam exist. Additional surveying may be necessary because of changes in site conditions since initial surveys were completed. A more extensive hydrologic study may be required for final design. The synthesized data need to be verified before the final design begins.

The preliminary cost estimate (Table 3) for design and construction was based on preliminary engineering drawings and current construction costs. Screen panel costs were based on using Johnson Wedge Wire. The final cost estimates may change depending upon specifications, alterations, and additions made by the final design engineer.

Final Design Criteria

The final designs must be approved by DFG and will be reviewed by NMFS.

Final fish screen designs must comply with DFG Statewide Fish Screening Policy design requirements and should consider NMFS criteria.

Table 2 presents the fish screen criteria that must be met.

Table 2. Department of Fish and Game and National Marine Fisheries Service Fish Screening Criteria

Salmon and Steelhead	
Approach Velocity	0.33 ft/sec (continually cleaned screens, on-stream)
Approach Velocity	0.40 ft/sec (continually cleaned screens, offstream)
Approach Velocity	0.0825 ft/sec (noncontinually cleaned screens)
Sweeping Velocity	V > 2 x Approach Velocity, (NMFS: V > approach velocity)
Slotted Openings	3/32 (0.094) in. max., (NMFS: 0.0689 in.-max.)
Round Openings	5132 in. max., (NMFS: 3/32 in. max.)
	3/32 in. max., for steelhead fry
Square Openings	5/32 in. max. (measured diagonally), (NMFS: 3/32 in. max)
	3/32 in. max., for steelhead fry
Net Open Area	> 27 percent

Codes and Standards

Final designs will be governed by the following criteria:

- Final designs will comply with the current Reclamation Board Standards
- Final structural designs will comply with the 1997, or latest, Uniform Building Code requirements
- Final concrete designs will comply with the 1995, or latest, American Concrete Institute Building Code Requirements for Reinforced Concrete Design
- Final electrical designs will comply with the 1996, or latest, National Electrical Code
- All current applicable CalOSHA safety standards must be met
- All environmental permit conditions will be met (Appendix G)

Final Design Instructions

The final design engineer will be selected by PG&E.

The elevations shown on Sheets 1 through 11 are assumed elevations. Descriptions and elevations of control points can be obtained from Northern District.

The following items shown on the Preliminary Engineering drawing Sheets 1 through **11** will not be changed without prior approval of DFG and DWR:

1. Elevations of the top of fish ladder slabs and walls.
2. Elevations of the top of fish screen slab.
3. Baffle dimensions and spacing.
4. Baffle weir dimensions and configuration.
5. Orifice dimensions and chamfer sizes.

- Concrete wall and slab thicknesses shown on drawings are minimums. Actual concrete thickness and reinforcement requirements will be determined by the final design engineer

- Cut-off wall/footing dimensions shown on drawings are approximate. Actual dimensions will be determined by the final design engineer

- Proposed temporary stream rerouting location is approximate. Actual dimensions and locations will be determined by the final design engineer and approved by PG&E

- Dewatering construction plans and details will be developed in final design

- Fish screen structural member dimensions are approximate. Actual dimensions will be determined by the final design engineer. The screen length shown may be adjusted depending on size, spacing and numbers of structural members, which will be determined by the final design engineer. However, DFG and NMFS criteria must be complied with if overall dimensions are changed

- All fish screen panels will be attached to the structural members such that they can be removed for maintenance. The removable panels will also allow juveniles back into the stream if the screen is overtopped and juveniles become trapped behind the screen

- The screen will be cleaned by a continually sweeping brush, powered by an electric motor and control unit, or acceptable alternative as determined by DFG and PG&E

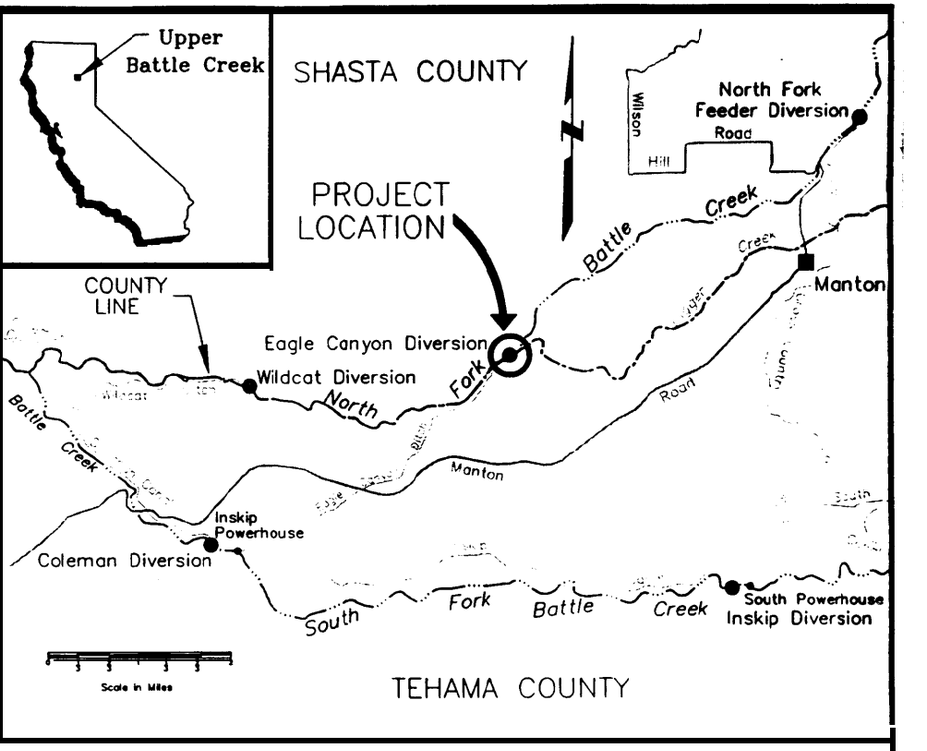
- Protection of the fish screens and structure during high flows should be considered during the final design process

- Details of the primary trashrack will be completed during the final design process
- Details of the secondary trashrack, in the canal, will be completed during the final design process
- Foundation details and tie-ins will be addressed in final design
- Working platforms, walkways, and foot ladders shown on drawings are approximate and details will be provided in final design
- Details of the support devices shown for the Denil 2 fish ladder will be provided in final design
- Automated trashrack rakes and gate operations will be addressed in the final design
- Water pumped from the work area will be discharged into the diversion ditch
- The configuration of the flow control baffles for the fish screen may change. The final design could have the baffles closer to the screen and parallel with the screen rather than vertical
- Questions regarding preliminary engineering drawings, environmental issues, or fish screen criteria may be directed to Paul Ward, DFG

Note: Upon completion of final designs, an application for an encroachment permit will need to be filed with the Reclamation Board.

PRELIMINARY ENGINEERING DRAWINGS FOR EAGLE CANYON DAM FISH PASSAGE PROJECT ON NORTH FORK BATTLE CREEK

TEHAMA COUNTY CALIFORNIA



INDEX OF SHEETS

Sheet 1 of 11 – Title Page and Location Map
Sheet 2 of 11 – Eagle Canyon General View
Sheet 3 of 11 – Site Plan
Sheet 4 of 11 – Denil 2 Ladder Plan and Profile
Sheet 5 of 11 – Denil 2 Ladder Sections
Sheet 6 of 11 – Denil 2 Screen Plan and Profile
Sheet 7 of 11 – Step Pool Ladder Plan and Profile
Sheet 8 of 11 – Step Pool Ladder Sections
Sheet 9 of 11 – Step Pool Screen Plan and Profile
Sheet 10 of 11 – Screen Sections and Return Details
Sheet 11 of 11 – Access Structures\Working Platforms

PRELIMINARY SUBJECT TO REVISION

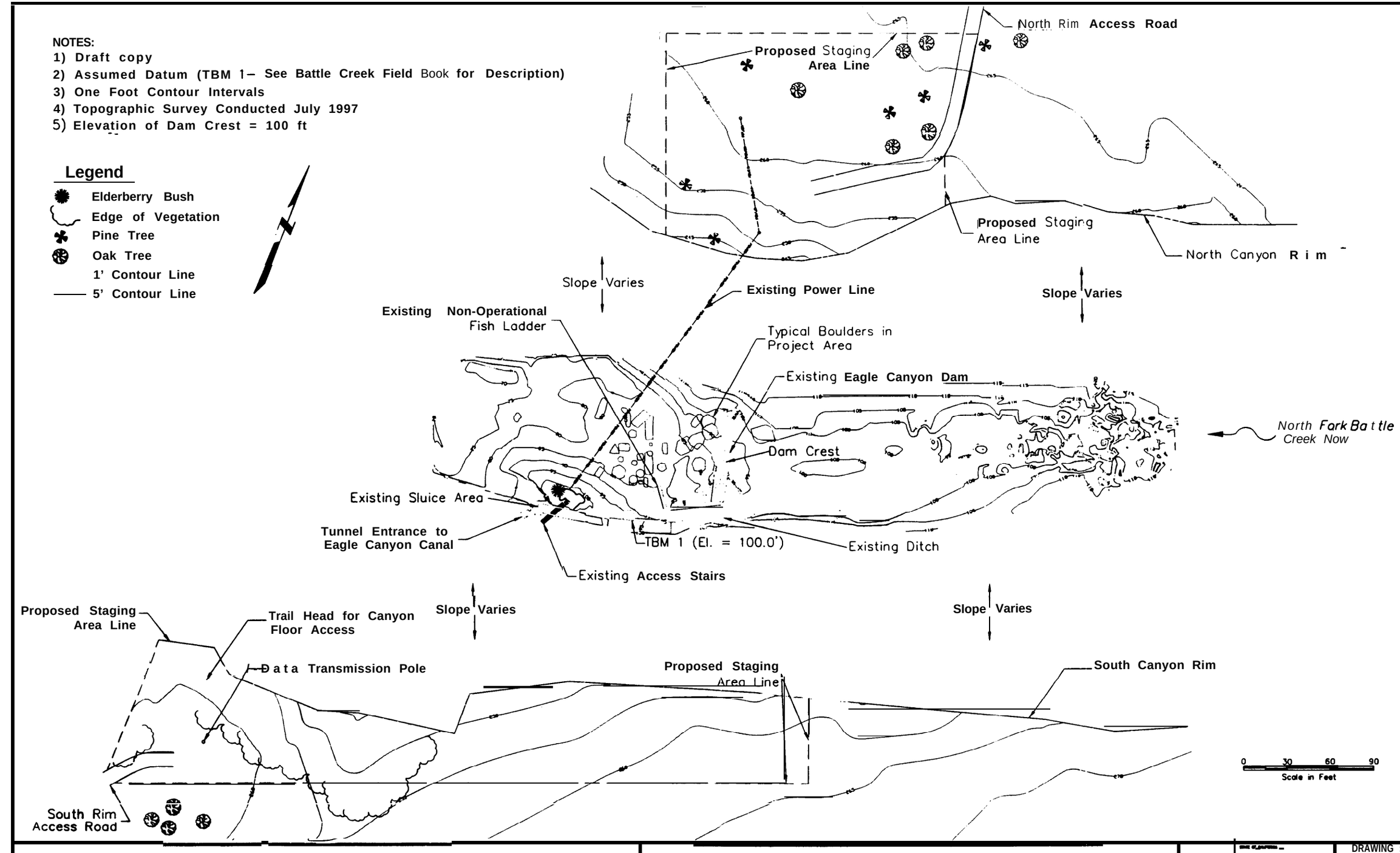
Note: Refer to Preliminary Engineering Technical Report for final design instructions.

EAGLE CANYON FISH PASSAGE PROJECT North Fork of Battle Creek near Manton, California	Title Page and Location Map	THE RESOURCES AGENCY DEPARTMENT OF WATER RESOURCES NORTHERN DISTRICT	DRAWING : ECDSHT197
		Revision Date: October 22, 1997	Sheet 1 of 11

NOTES:
1) Draft copy
2) Assumed Datum (TBM 1– See Battle Creek Field Book for Description)
3) One Foot Contour Intervals
4) Topographic Survey Conducted July 1997
5) Elevation of Dam Crest = 100 ft

Legend

- Elderberry Bush
- Edge of Vegetation
- Pine Tree
- Oak Tree
- 1' Contour Line
- 5' Contour Line



EAGLE CANYONFISH PASSAGE PROJECT

North Fork Battle Creek near Manton, California

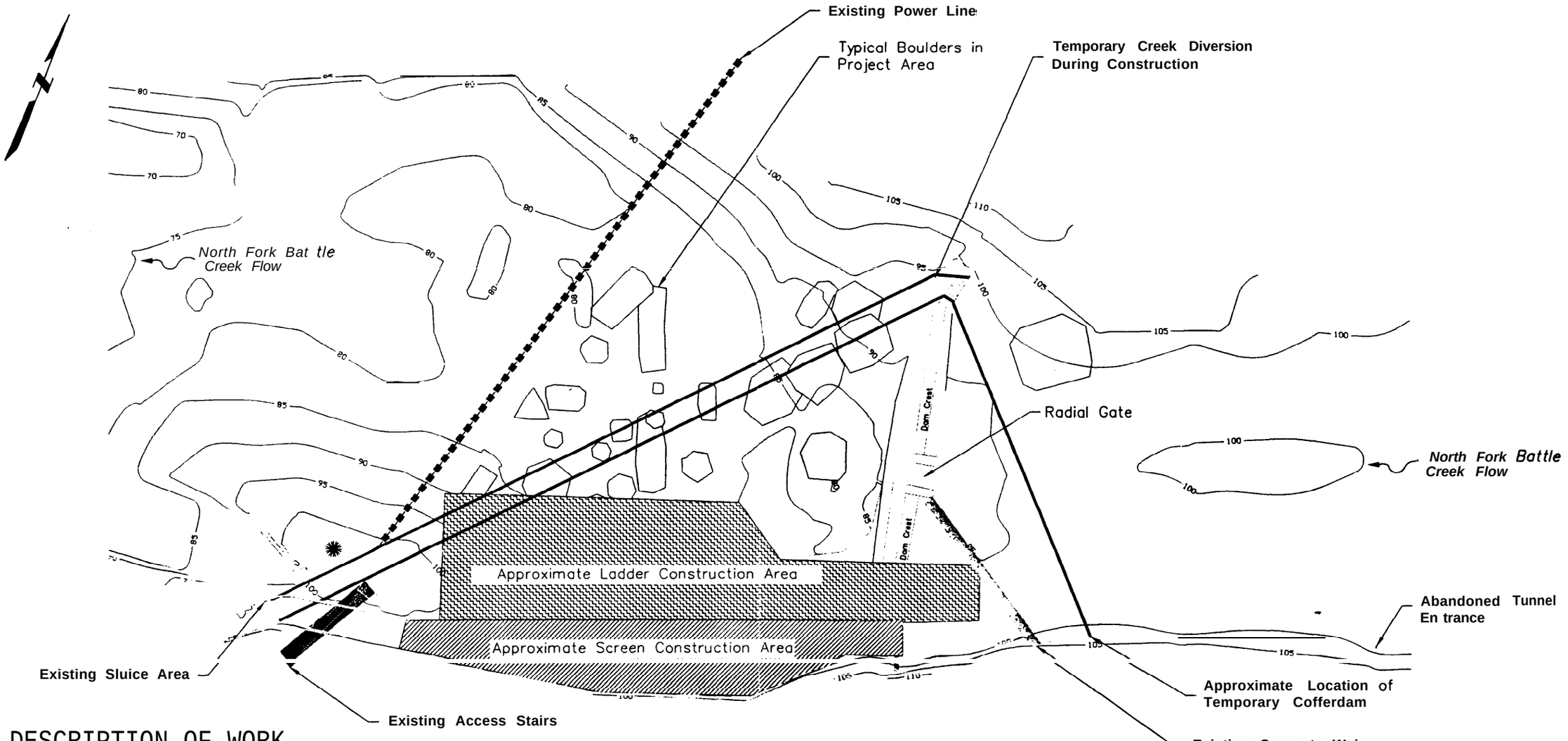
Eagle Canyon General View

DEPARTMENT OF WATER RESOURCES

Revision Date October 22, 1997

DRAWING : ECDSHT297

Sheet 2 of 1



DESCRIPTION OF WORK

1) Install dewatering system and dewater project area.
2) Remove section of dam where new fish ladder will be built.
3) Remove existing fish ladder.
4) Excavate for new fish ladder and screen.
5) Form and place concrete for new fish ladder and screen.
6) Install fish screen and ladder steel works
7) Perform site finish work, including revegetation, erosion control, and cleanup.

NOTES: Elevations are based on assumed datum
See Preliminary Engineering Technical Report, Final Design Instructions

0 10 20 30
Scale in Feet

Legend

- Elderberry Bush
- 1' Contour Line
- 5' Contour Line

EAGLE CANYON FISH PASSAGE PROJECT

North Fork Battle Creek near Manton. California

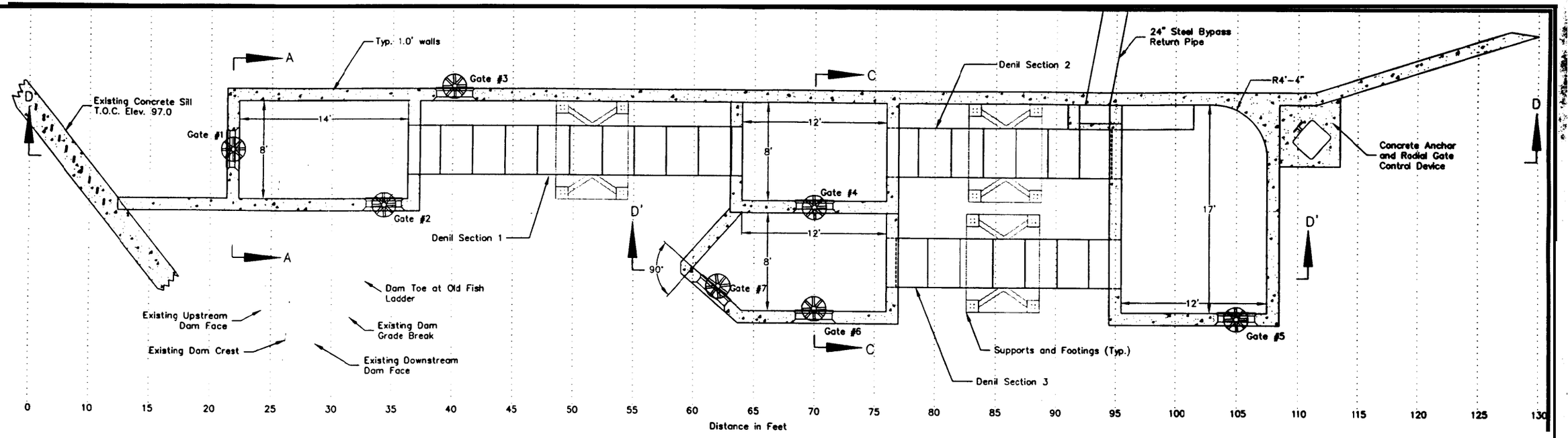
Site Plan

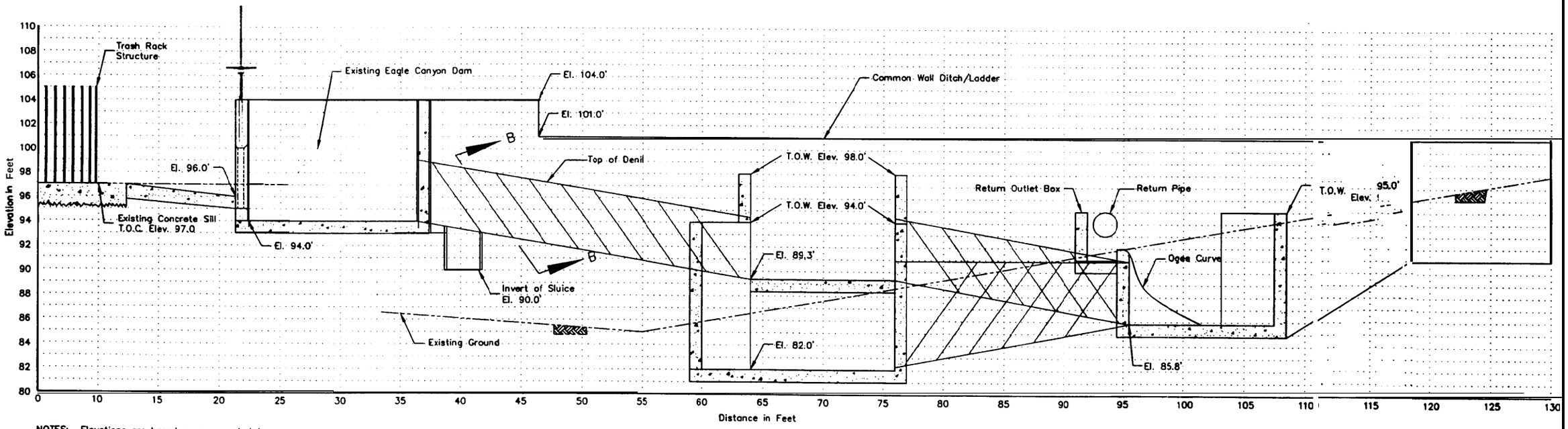
DEPARTMENT OF WATER RESOURCES
NORTHERN DISTRICT

Revision Date: October 15, 1997

DRAWING : ECDSHT397

Sheet 3 of 11





NOTES: Elevations are based on assumed datum
See Preliminary Engineering Technical Report, Final Design Instructions
All exposed external concrete corners shall be chamfered 3/4".

Profile Section D-D/D'-D'

Scale: 1/8"=1'-0"

EAGLE CANYON FISH PASSAGE PROJECT
North Fork Battle Creek near Manton, California

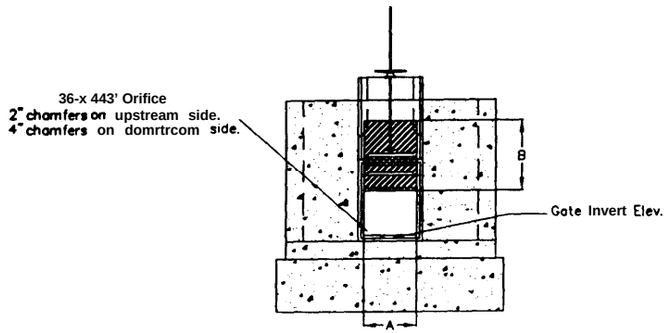
Denil 2 Ladder Plan and Profile

STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES
NORTHERN DISTRICT

Revision Date: October 21, 1997

DRAWING : ECDSHT497

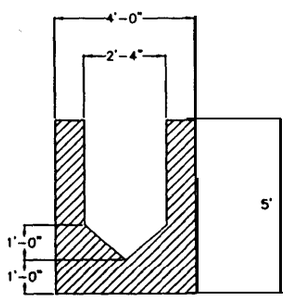
Sheet 4 of 11



TYPICAL GATE CONFIGURATION
SECTION A-A

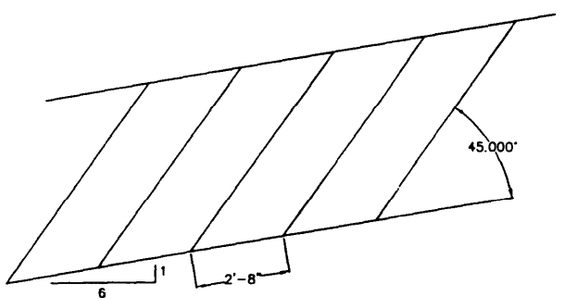
Scale: 1/8"=1'-0"

Gate No.	Invert Elev.	Gate Size (A"X B")	Mounting Method
1	96.0'	36 X 48	EMBEDDED
2	94.0'	36 X 48	EMBEDDED
3	90.0'	36 X 48	UP STREAM FACE
4	89.3'	36 X 48	EMBEDDED
5	85.8'	36 X 48	EMBEDDED
6	82.0'	36 X 48	EMBEDDED
7	82.0'	36 X 48	EMBEDDED



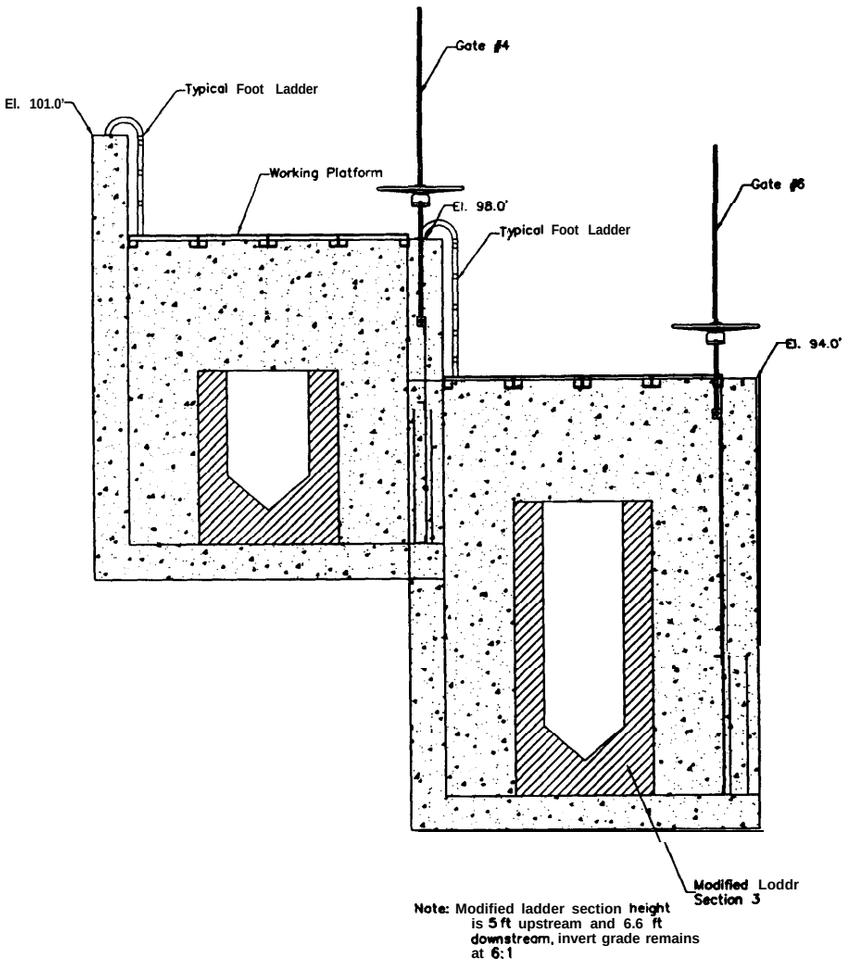
DENIL 2 END VIEW
SECTION B-B

Scale: 1/4"=1'-0"



DENIL 2 ELEVATION VIEW
TYPICAL GRADES

Scale: 1/4"=1'-0"



Note: Modified ladder section height is 5 ft upstream and 6.6 ft downstream, invert grade remains at 6:1

ENTRANCE & RESTING POOL
SECTION C-C

Scale: 1/4"=1'-0"

EAGLE CANYON FISH PASSAGE PROJECT

North Fork Battle Creek near Manton, California

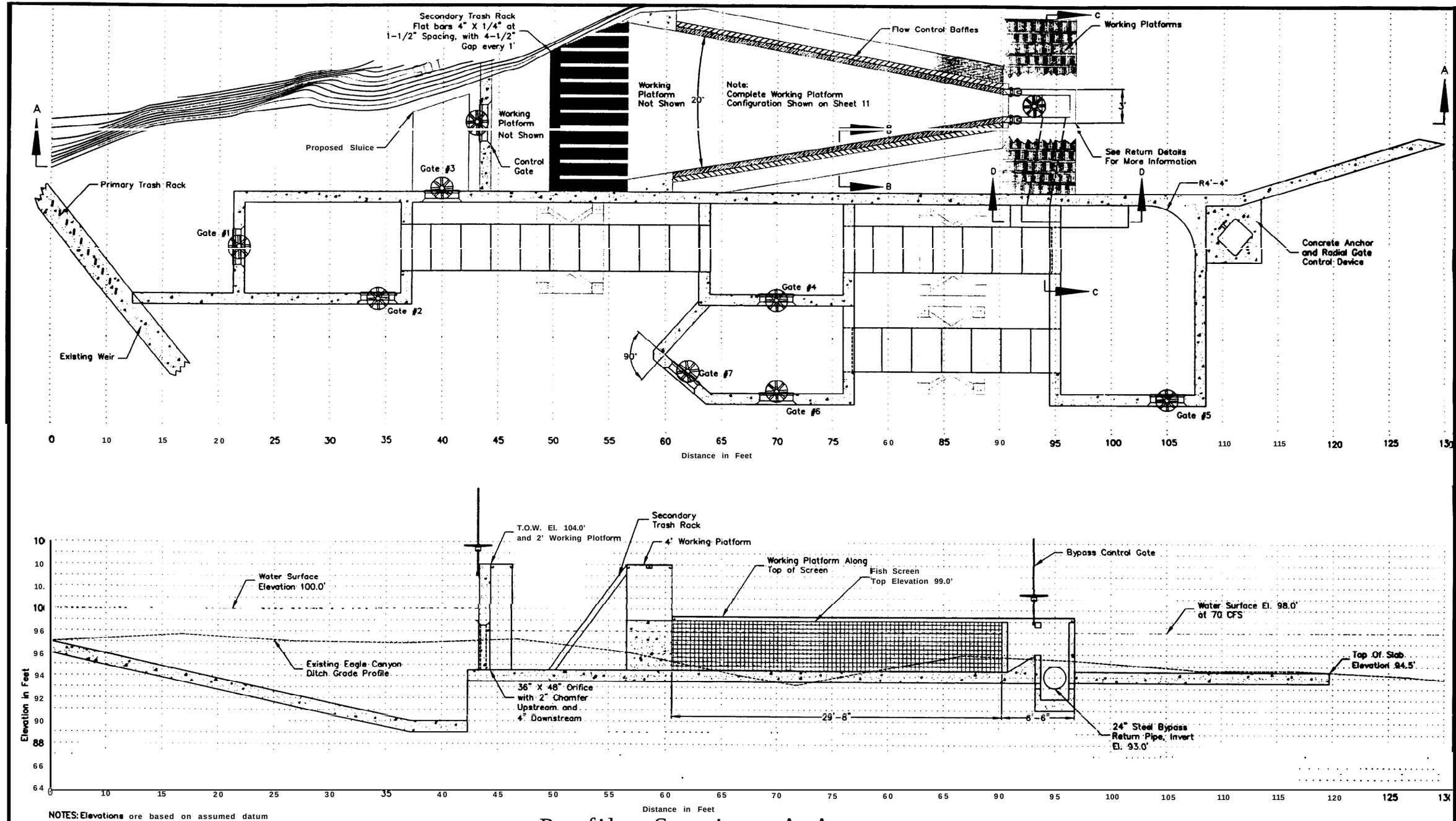
Denil 2 Ladder Sections

DEPARTMENT OF WATER RESOURCES

Revision Date: October 21, 1997

DRAWING : ECDSHT597

Sheet 5 of



NOTES: Elevations ore based on assumed datum
See Preliminary Engineaing Technical Report, Final Design Instructions
All exposed extemol concrete corners shall be chamfered 3/4"

Profile Section A-A

Scale: 1/8"=1'-0"

EAGLE CANYON FISH PASSAGE PROJECT

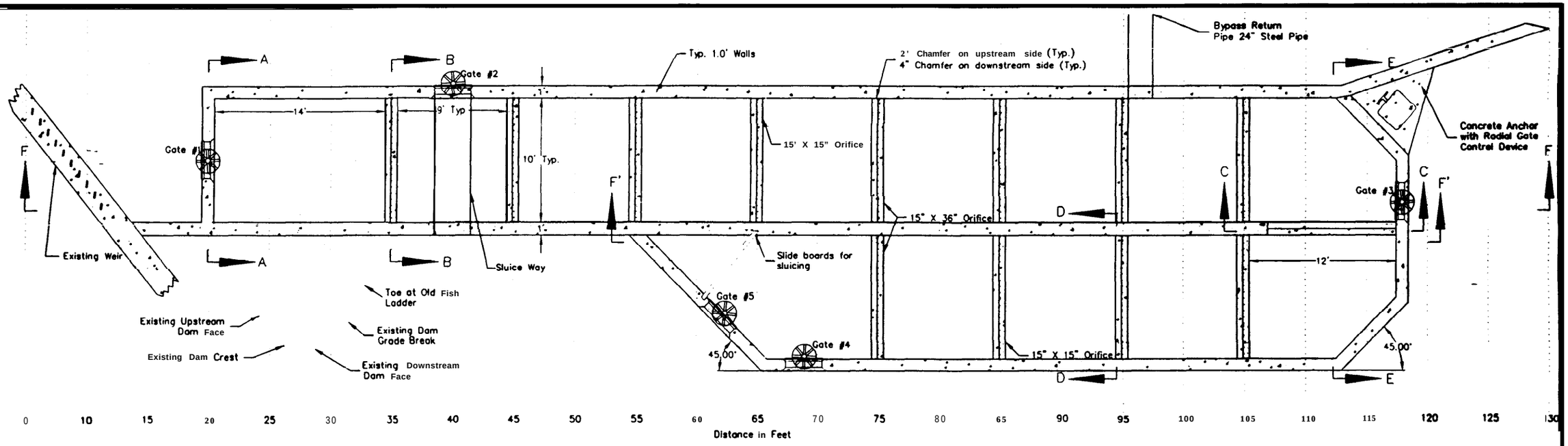
North Fork Battle Creek near Manton, California

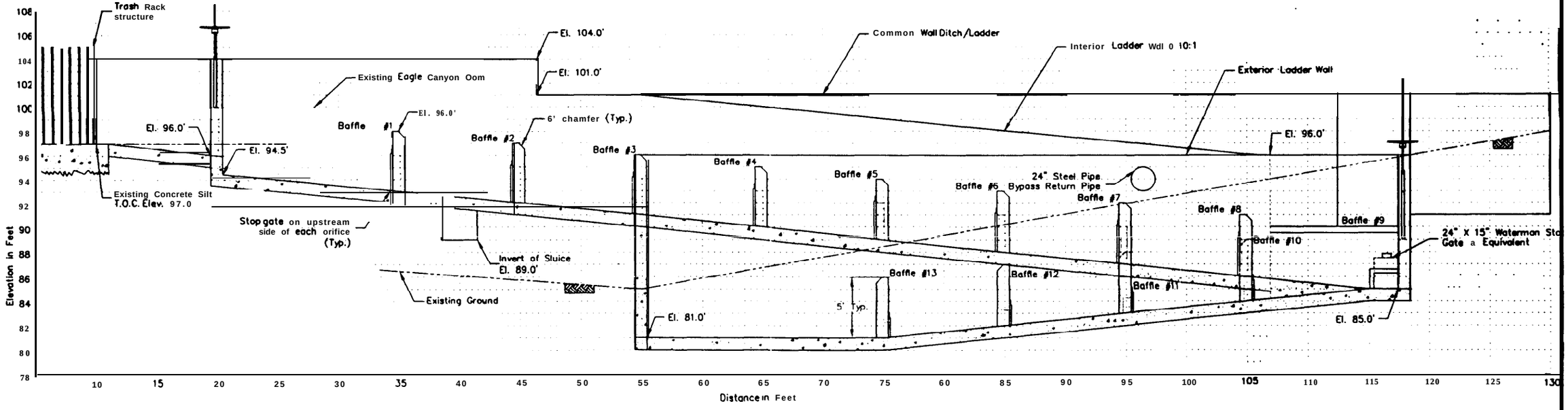
Denil 2 Screen Plan and Profile

DEPARTMENT OF WATER RESOURCES

Revision Date: October 21, 1997

DRAWING : ECDSHT697



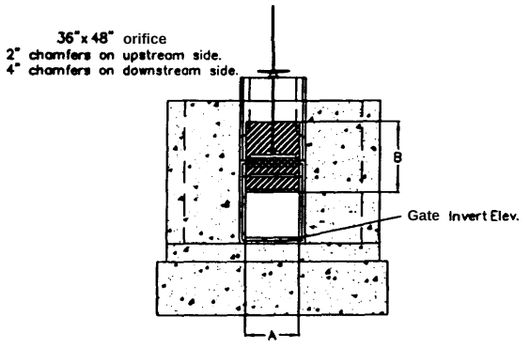


NOTES: Elevations ore bored on assumed datum
See Preliminary Engineering Technical Report. Finol Design Instructions
All exposed concrete corners shall be chamfered 3/4"

Profile Section F-F / F'-F'

Scale: 1 /8"=1'-0"

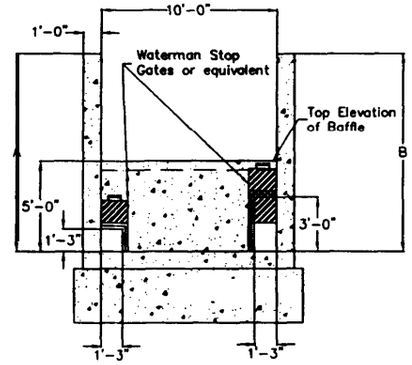
EAGLE CANYON FISH PASSAGE PROJECT North Fork Battle Creek near Manton. California	Step Pool Ladder Plan and Profile	STATE OF CALIFORNIA THE RESOURCES AGENCY DEPARTMENT OF WATER RESOURCES Revision Date: October 21, 1997
		DRAWING : ECDSHT797 Sheet 7 of 11



TYPICAL GATE CONFIGURATION
SECTION A-A

Scale: 1/8"=1'-0"

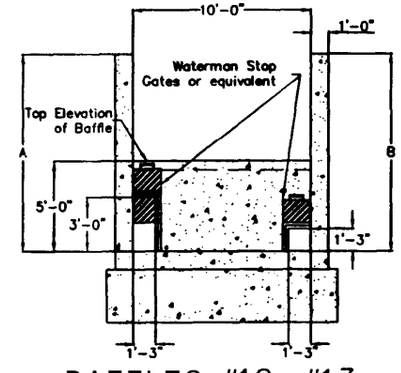
Gate No.	Invert Elev.	Gate Size(A"X B")	Mounting Method
1	96.0	36 X 48	EMBEDDED
2	89.0	36 X 48	UP STREAM FACE
3	85.0	36 X 48	EMBEDDED
4	81.0	36 X 48	EMBEDDED
5	81.0	36 X 48	EMBEDDED



BAFFLES #1-#8
SECTION B-B

Scale: 1/8"=1'-0"

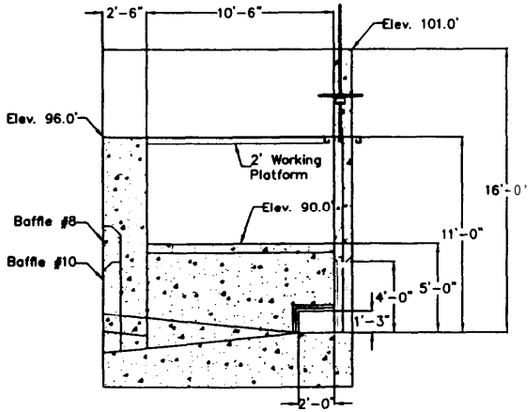
Baffle #	(A) Dim.	(B) Dim.	Top Elev.
1	11'	11'	98.0'
2	12'	12'	97.0'
3	10'	10'	96.0'
4	11'	10'	95.0'
5	12'	10'	94.0'
6	13'	10'	93.0'
7	14'	10'	92.0'
8	15'	10'	91.0'



BAFFLES #10-#13
SECTION D-D

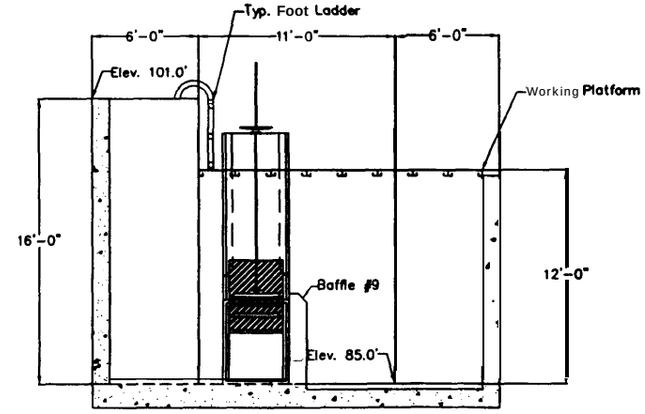
Scale: 1/8"=1'-0"

Baffle #	(A) Dim.	(B) Dim.	Top Elev.
10	12'	12'	89.0'
11	13'	14'	88.0'
12	14'	16'	87.0'
13	15'	18'	86.0'



BAFFLE #9
SECTION C-C

Scale: 1/8"=1'-0"



SECTION OF TURN POOL
SECTION E-E

Scale: 1/8"=1'-0"

EAGLE CANYON FISH PASSAGE PROJECT

North Fork Battle Creek near Manton, California

Step Pool Ladder Sections

STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES
NORTHERN DISTRICT

Revision Date: October 21, 1997

DRAWING : ECDSHT897

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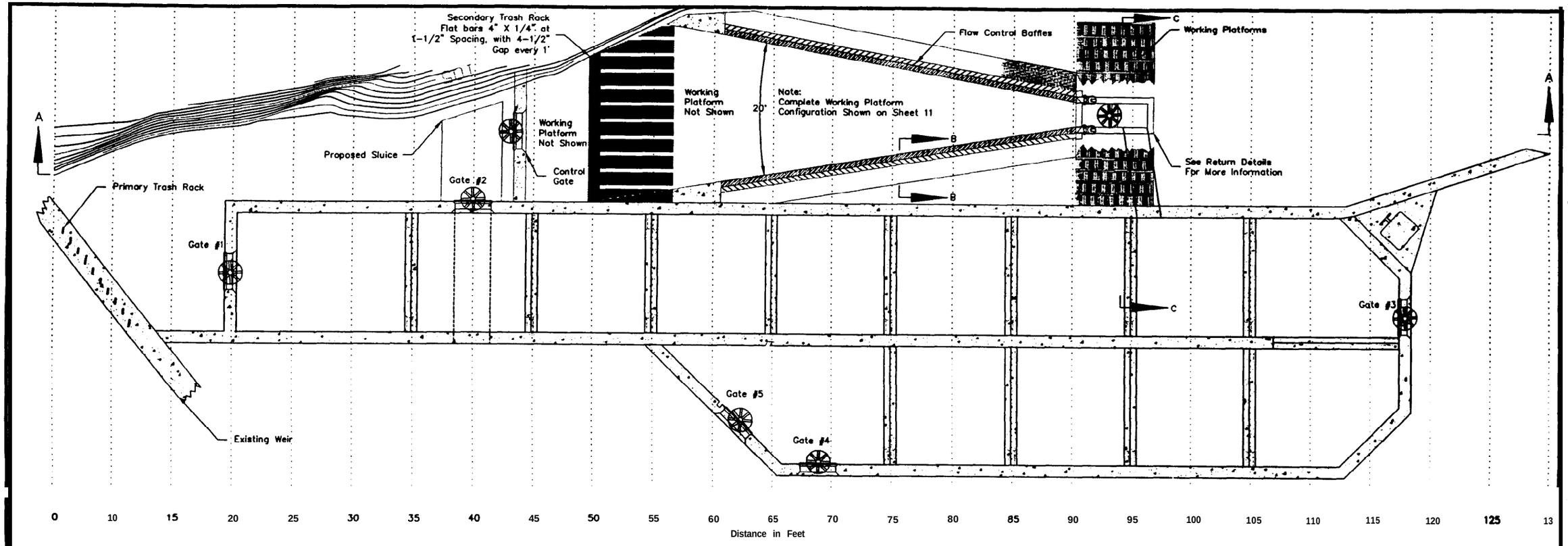

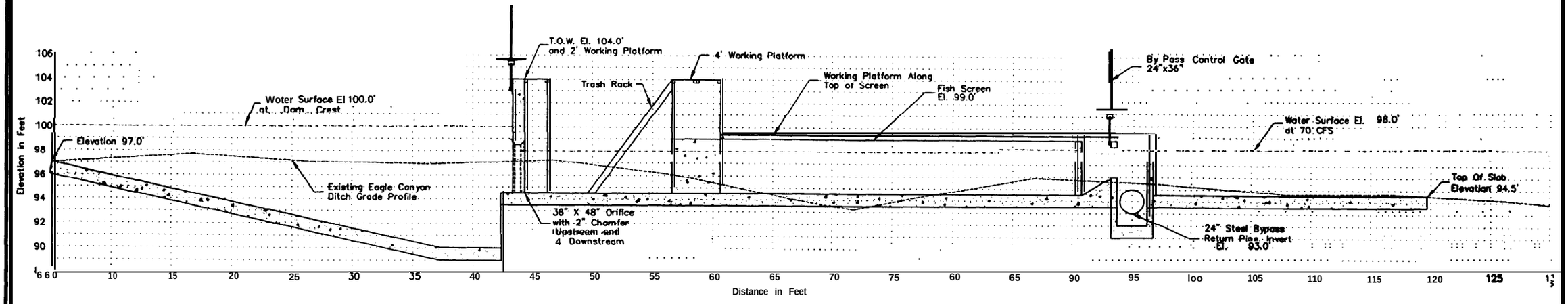

NOTES: Elevations are based on assumed datum
See Preliminary Engineering Technical Report, Finol Design Instructions
All exposed external concrete comers shall be chamfered 3/4"

Profile Section A-A

Scale: 1/8"=1'-0"

EAGLE CANYON FISH PASSAGE PROJECT

North Fork Battle Creek near Manton, California

Step Pool Screen Plan and Profile

STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES
NORTHERN DISTRICT

Revision Date: October 21, 1997

DRAWING : ECDSHT997

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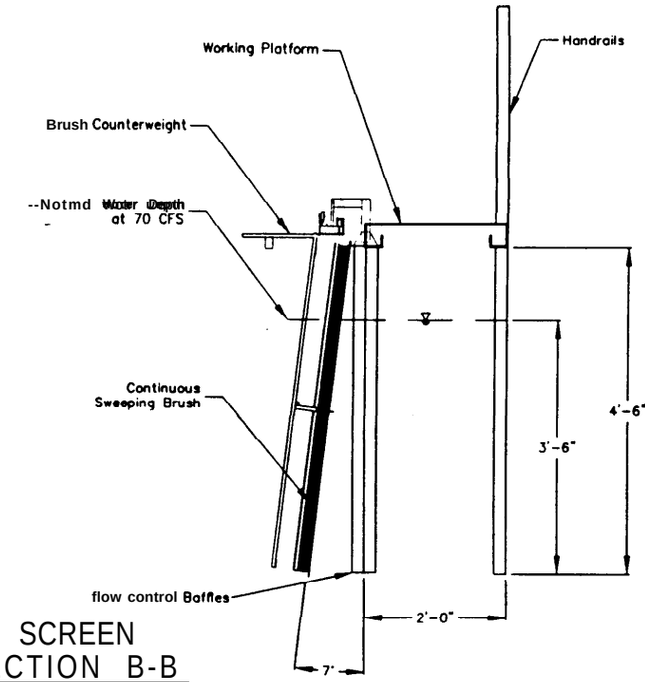
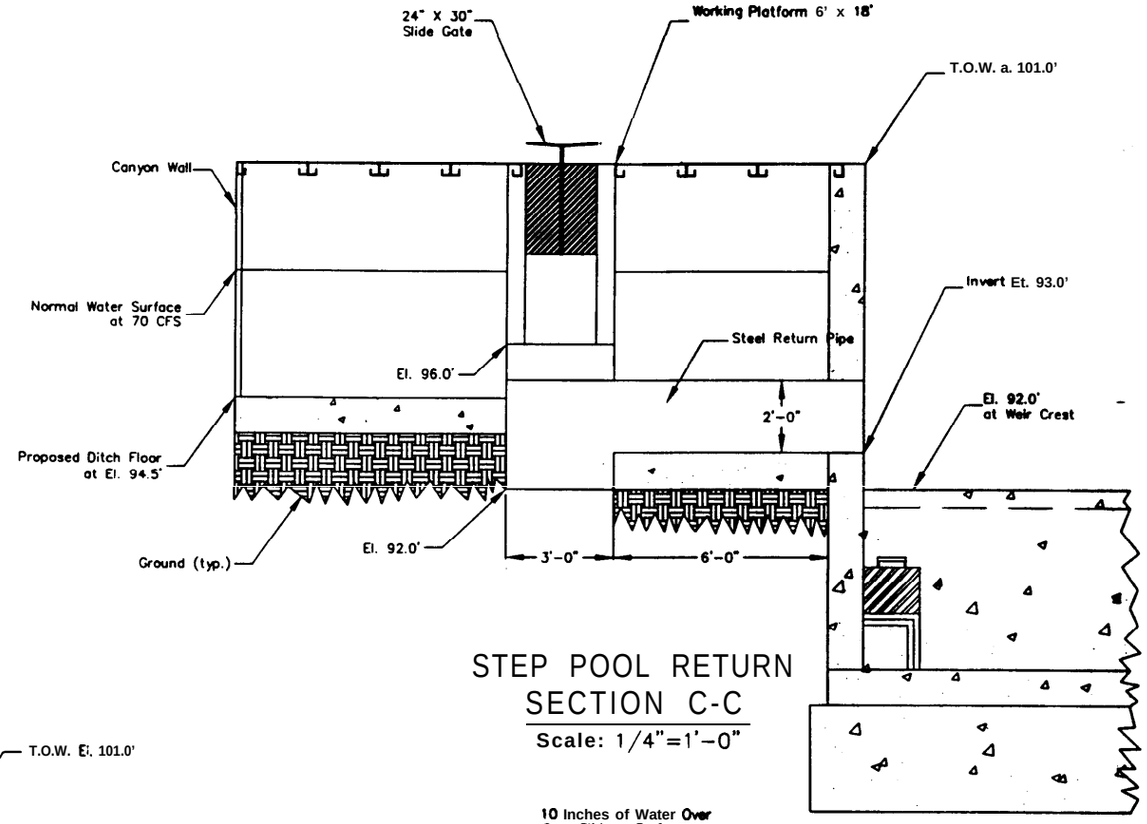
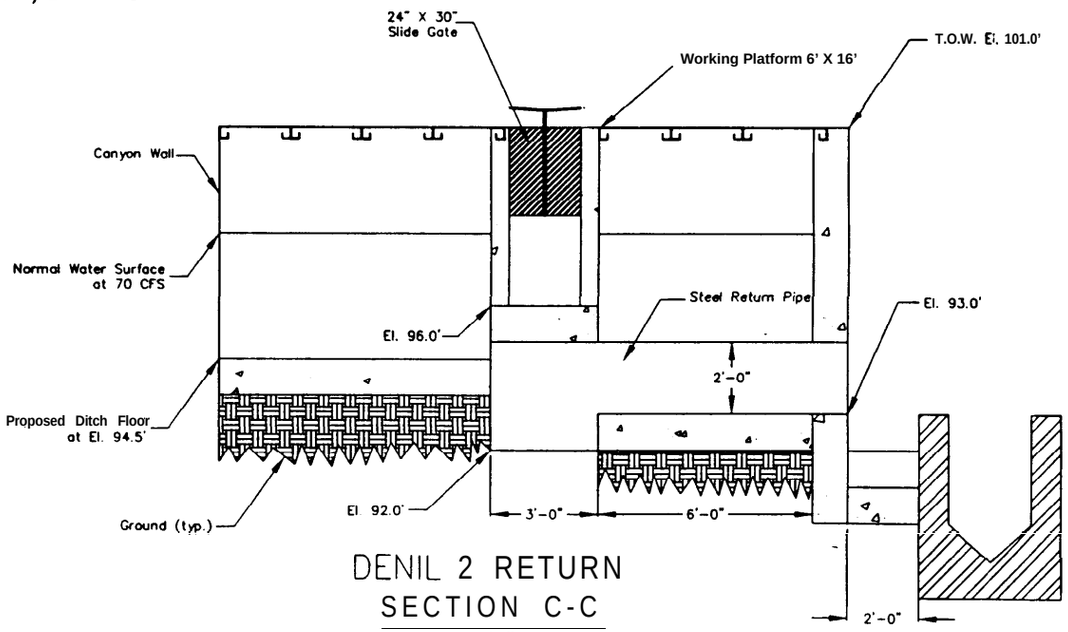


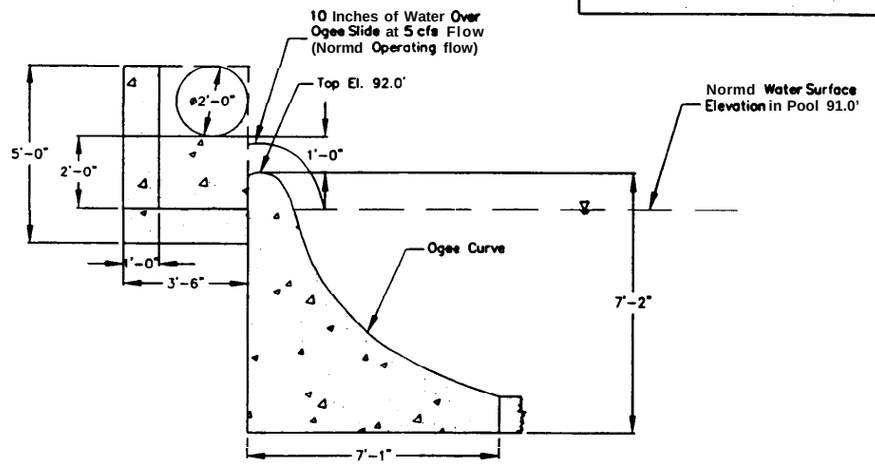
SCREEN
SECTION B-B
Scale: 1/2"=1'-0"



STEP POOL RETURN
SECTION C-C
Scale: 1/4"=1'-0"



DENIL 2 RETURN
SECTION C-C
Scale: 1/4"=1'-0"



DENIL 2 RETURN
SECTION D-D
Scale: 1/4"=1'-0"

EAGLE CANYON FISH PASSAGE PROJECT

North Fork Battle Creek near Manton, California

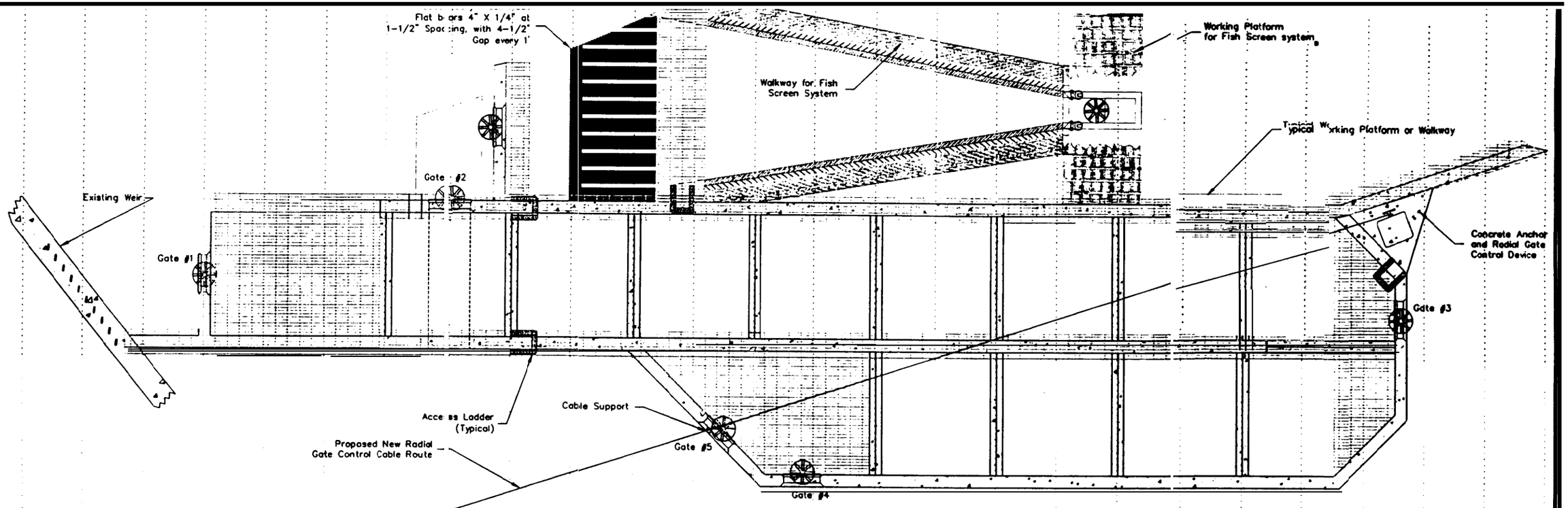
Screen Sections and Return Details

DEPARTMENT OF WATER RESOURCES

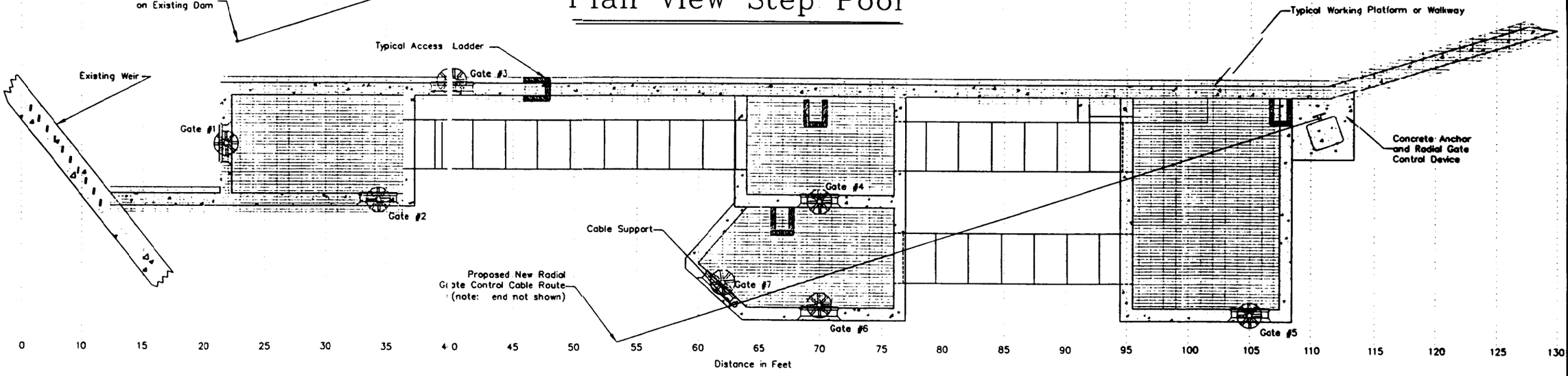
Revision Date: October 21, 1997

DRAWING : ECDSHT 1097

Sheet 10 of 11



Plan View Step Pool



Plan View Denil 2

Scale: 1/8"=1'-0"

EAGLE CANYON FISH PASSAGE PROJECT

North Fork Battle Creek near Manton, California

Access Structures\Working Platforms

DEPARTMENT OF WATER RESOURCES

DRAWING : ECDSHT1197

Revision Date: October 28, 1997

Sheet 11 of 11

TABLE 3: Eagle Canyon Preliminary Cost

EAGLE CANYON DIVERSION DAM FISH LADDER AND SCREEN
PRELIMINARY COST ESTIMATE FOR DESIGN & CONSTRUCTION
STEPPOOL FISH LADDER & SCREEN

ITEM #	ITEM DESCRIPTION	QUANTITY	UNIT		UNIT COST ($)		TOTAL COST ($)
	MISCELLANEOUS						
1	Mobilization/Demobilization*	1	LS	$	95,980.00	$	95,980.00
2	Access Road Improvement to stage area	1	LS	$	12,000.00	$	12,000.00
3	Construction Stage Areas	1	LS	$	16,800.00	$	16,800.00
4	Site Work, Access, & Mitigation*	1	LS	$	51,000.00	$	51,000.00
5	Dewatering*	1	LS	$	144,400.00	$	144,400.00
6	Remove Existing Fish Ladders*	1	LS	$	25,000.00	$	25000.00
						s	345,180.OO
	FISH LADDER						
7	Excavation-Rock*	320	CY	$	250.00	$	80,000.OO
8	Excavation-Entrance Pool*	5	CY	$	250.00	$	1,250.OO
9	Excavation - Existing Dam & Old Ladder*	25	CY	$	250.00	$	6,250.OO
10	Keying, Drilling & Doweling	1	LS	$	25,000.00	$	25,000.00
11	Concrete (Walls & Baffles)*	100	CY	$	1,250.OO	$	125,000.OO
12	Concrete Floor*	75	CY	$	1,250.OO	$	93,750.00
13	Gates & Brackets*	5	EA	$	4,500.00	$	22,500.OO
14	Working Platform*	775	SF	$	72.00	$	55,800.OO
15	Stop Gates*	25	EA	$	250.00	$	6,250.OO
						S	415,800.OO
	FISH SCREEN						
16	Excavation*	157	CY	$	250.00	$	39,250.00
17	Concrete (Walls)*	52	CY	$	1,250.OO	$	65,000.00
18	Concrete (Slab & Footings)*	50	CY	$	1,250.OO	$	62,500.OO
19	Screen (Johnson Wedge Wire)	267	SF	$	70.00	$	18,690.OO
20	Working Platform*	289	SF	$	72.00	$	20,808.OO
21	Frame*	1	LS	$	6,500.OO	$	6,500.OO
22	Electrical Control (installation & testing)*	1	LS	$	75,000.00	$	75,000.00
23	Sheaves, Pulleys, Bearings, Gate Etc.	1	LS	$	15,500.00	$	15,500.00
24	Debris Systems*	1	LS	$	118,000.OO	$	118,000.OO
25	Screen Installation (Labor)	1	LS	$	65,000.00	$	65.000.00
						$	486,248.OO
26	Construction Cost					$	1,247,228.00
27	Engineering **at 15%**					$	187,084.20
28	Environmental at 5%					$	62,361.40
29	Construction Inspection **at 10%**					$	124,722.80
30	**Contract Administration at 5%**					$	62,361.40
31	**Subtotal**					$	1,683,757.80
32	**Contingency at 30%**					$	374,168.40
33	**Total**					S	2,057,926.20

***Helicopter Work Included**

TABLE 3: Eagle Canyon Preliminary Cost (continued)

DENIL 2 FISH LADDER &SCREEN

ITEM #	ITEM DESCRIPTION	QUANTITY	UNIT		UNIT COST ($)		TOTAL COST ($)
	MISCELLANEOUS						
1	Mobilization/Demobilization*		LS	$	95,980.00	$	**95,980.00**
2	Access Road Improvement to stage area		LS	$	12,000.00	$	12,000.00
3	Construction Stage Areas		LS	$	16,800.00	$	16,800.00
4	Site Work, Access, & Mitigation*		LS	$	51,000.00	$	51,000.00
5	Dewatering*	1	LS	$	144,400.00	$	144,400.00
6	Remove Existing Fish Ladders*		LS	$	25,000.00	$	25,000.00
						$	345,180.00
	FISH LADDER						
7	Excavation-Rock*	320	CY	$	250.00	**$**	80,000.00
8	Excavation-Entrance Pool*	5	**CY**	$	250.00	**$**	1,250.00
9	Excavation - Existing Dam & Old Ladder*	25	CY	$	250.00	**$**	6,250.00
10	Keying, Drilling & Doweling	1	LS	$	19,00.00	**$**	19,000.00
11	Concrete Walls*	75	**CY**	**$**	1,250.00	**$**	93,750.00
12	Concrete Floor*	60	CY	$	1,250.00	**$**	75,000.00
13	Gates & Brackets*	7	EA	$	4,500.00	**$**	31,500.00
14	Working Platform*	790	SF	$	72.00	**$**	56,880.00
15	Steel Ladder Section*	67	LF	$	1,600.00	**$**	107.200.00
						$	470,830.00
	FISH SCREEN						
16	Excavation*	157	CY	$	**250.00**	$	39,250.00
17	Concrete (Walls)*	52	**CY**	**$**	1,250.00	$	65,000.00
18	Concrete (Slab & Footings)*	50	**CY**	**$**	**1,250.00**	$	62,500.00
19	Screen (Johnson **Wedge** Wire)	267	**SF**	**$**	**70.00**	$	18,690.00
20	Working Platform*	289	**SF**	**$**	**72.00**	$	20,808.00
21	Frame'		**LS**	**$**	**6,500.00**	$	6,500.00
22	Electrical Control (installation 8 testing)*		**LS**	**$**	**75,000.00**	$	75,000.00
23	Sheaves, Pulleys, Bearings, Gate Etc.		**LS**	**$**	15,500.00	$	15,500.00
24	Debris Systems*		LS	$	118,000.00	$	118,000.00
25	Screen Installation (Labor)	1	LS	$	65,000.00	$	65,000.00
						$	486,248.00
26	**Construction Cost**					$	1,302,258.00
27	**Engineering at 15%**					$	195,338.70
28	**Environmental at 5%**					$	26,045.16
29	**Construction Inspection at 10%**					$	130,225.80
30	**Contract Administration at 5%**					$	65.112.90
31	**Subtotal**					$	**1,718,980.56**
32	**Contingency at 30%**					**$**	**390,677.40**
33	**Total**					$	**2,109,657.96**

***Helicopter Work Included**

Appendix A

Battle Creek Technical Working Group Members
and Organizations Consulted

Battle Creek Technical Workina Group Members

Jim Buell, Metropolitan Water District

Tom Carrier, Foreman, Hydro Civil Construction, PG&E

Glyn Echols, Associate Engineer, DWR

Eugene Geary, Biologist, PG&E

George Heise, Hydraulic Engineer, DFG

Bill Kier, Kier Associates

Bill Mendenhall, Senior Engineer, DWR

Jean Oscamou, Supervising Engineer, Power Generation Services, PG&E

Patricia Parker, Fishery Biologist, USFWS

Harry Rectenwald, Environmental Specialist IV, DFG

Brian Stewart, Engineer, DWR

Paul Ward, Associate Fishery Biologist, DFG

Additional Technical Support

David Bogener, Environmental Specialist IV, DWR

Allen Boyd, Student Assistant, DWR

Frank Glick, Chief Project Geology Section, DWR

Jason Jurrens, Student Assistant, DWR

Joyce Lacey Rickert, Environmental Specialist IV, DWR

Bill McLaughlin, Assistant Engineer, DWR

Tim Nelson, Engineer, DWR

Robert Orlins, Archeologist, DWR

Jim West, Assistant Land Surveyor, DWR

Organizations Consulted

California Department of Fish and Game

California Department of Water Resources

National Marine Fisheries Service

Pacific Gas and Electric Company

U. S. Army Corps of Engineers

U. S. Fish and Wildlife Service

Appendix B

Correspondence and Meeting Notes

EAGLE CANYON
FISH LADDER AND SCREEN DESIGN
MEETING AGENDA
8-I 3-97

General Status

- Site Topographic Survey
- Environmental Work
  - Plants
  - Wildlife
  - Archeology
- Hydrology Research
- Site Visits DWR Project Geology and Division of Engineering
- Ladder Designs
- Screen Design

Ladder Design Discussion

- Preliminary Ladder Type Findings
  - Steppool w/ Orifices
  - Vertical Slot
  - Denil
  - Pool and Chute
- Ladder Type Preferences

Construction Constraints

- Biologically Preferred Window of Construction
- Operator (PG&E) Preferred Window of Construction
- Avoidance of the Mass Concrete Anchor
- Concrete Placement at the Site

Screen Design Discussion

- Alternative Sites – No further investigation at this point
- Conventional Self-Cleaning Screen Operation
- Initial Layout Concept
- Chevron or Single Plate Design w/ Bypass into the Ladder Entrance Flow
- DFG Screen Design Criteria
  - Approach Velocity
  - Screen Area
  - Sweeping Velocity

EAGLE CANYON
FISH LADDER AND SCREEN DESIGN
MEETING AGENDA
8-26-97

General Status
- Site Topographic Survey
- Environmental Work
  - Plants
  - Wildlife
  - Archeology
- Hydrology Research

Site Visits DWR Project Geology and Givisicn of Engineering

Construction Constraints

Biologically Preferred Window of Construction
Operator (PG&E) Preferred Window of Construction

Avoidance of the Mass Concrete Anchor

Concrete Placement at the Site

Ladder **Design Discussion**

Preliminary Ladder Type Findings
- Steppool w/ Orifices
- Vertical Slot
- Denil
- Upstream Pool and Chute

Options to be pursued

Screen Design Discussion

Alternative Sites – No further investigation at this point

Conventional Seif-Cleaning Screen Operation
Initiai Layout Concept
Chevron Design w/ Bypass into Ladder or Stream

Project Schedule

8-26-97	Battle Crk. Mtg.	DWR

Name	Organization	Phone #
Bill Mendenhall	DWR	529-7380
Brian Stewart	DWR	529-7340
Bill McLaughlin	DWR	529-7382
Jean Oscamou	PG&E	a-36-4405
Dave Bowers	"	335-5619
Harry Rectenwald	Dept. Fish & Game	225-2368
Paul Ward	CDFG	527-8987
Tricia Parker	USFWS	527-3043
George Heise	CDFG	(916) 653-2189
Glyn Echols	DWR	(916) 529-7324

22-141 50 SHEETS
22-142 100 SHEETS
22-144 200 SHEETS

Upstream P&C Ladder

Entrance Condition
Entrance conditions should be very good. Moderate to low flows will pass through or over the ladder. Attraction should be excellent.

Exit Condition
Exit conditions are assumed to be good. The last step in the ladder will exit directly into a pool in the channel.

Passaae Effectiveness
Passage effectiveness should be excellent.

Partial Operation
Partial operation characteristics should be very good. Performance will be better than the other ladder types.

Constructability
Constructability will be difficult. However, it should be no more difficult than the other work at the existing dam. Some boulder removal will have to occur. Cast-in-place concrete work will be extensive.

Operational Q Range
The discharge operational range is excellent. This ladder should be able to pass 25-250 cfs with 5-8 steps.

O & M Costs
The O&M costs could be more than the existing dam from large flood events. Pulling boards from the weirs to sluice sediment could be a major effort. Catwalks and handrails could be significantly damaged.

Flood Obstruction
Flood obstruction is not perceived to be a problem. This is an in-channel, low head structure with a relative roughness comparable to the existing channel. Major flood event should flow over the top of the structure, like the rest of the channel.

Auxiliary Water Needs
There would be no need for auxiliary water.

Denil 2 Ladder

Entrance Condition
Entrance conditions at this location are difficult. Some boulder and sediment movement may be necessary to enhance existing conditions. Sediment removal may be a regular maintenance item. The ladder entrance should have multiple elevation inlets.

Exit Condition
Exit conditions wiil be controlled by the water inlet control device. This will most likely be a rectangular orifice which wiil be elevated to maintain discharge control as streamflows increase.

Passage Effectiveness
Passage effectiveness could be limited in the future by the fish capacity of the Denil itself. The Denil is essentially a one fish ladder within the Denil portion. The intermitted resting pools have limited holding capacity. If the Battle Creek runs increase significantly this could become an issue.

Partial Operation
Partial operation due to smail debris is a real concern. Debris, which interferes with the sensitive flow characteristics in the bottom of the Denil, can effectively stop passage. The ladder exit, which as so functions as the flow control for the ladder, can control some of the debris, but it then, becomes a passage restriction.

Constructability
Constructability wiil be difficult. There will be less concrete work at the site, but still a significant amount. Steel ladder sections can be fabricated off-site, but resting poois and entrance structures will be cast-in-place concrete. Moderately less difficult than the other ladder types.

Operational Q Range
The discharge operational range is good. This ladder can pass 5-50 cfs with 1 resting pools.

0 & M Costs
The O&M costs for removing small debris from the ladder could be significant. Sediment removal from large floods could be a major effort.

Flood Obstruction
Flood obstruction should not be a problem, no more so than the existing structures.

Auxiliarv Water Needs
Auxiliary water will be needed for a portion of the time.

Vertical Slot Ladder

Entrance Condition
Entrance conditions at this location are difficult. Some bolder and sediment movement may be necessary to enhance existing conditions. Sediment removal may be a reguiar maintenance item. The ladder entrance should have multiple elevation inlets.

Exit Condition
Exit conditions will be controlled by the water the vertical slot itself. This should pose no problems.

Passage Effectiveness
Passage effectiveness is good. The resting pools should have adequate volume so as not to be a limiting factor. The vertical slot is self-adjusting, so during periods of rapid streamflow fluctuation, adjustments are not needed.

Partial Operation
Partial operation due to small debris is a concern, but not as great as with the Denil. Regular removal of debris should be adequate to maintain passage. Vertical slot ladders are more sensitive to debris than steppools.

Constructabiiitv
Constructability will be difficult. Cast-in-place concrete work will be extensive with a significant of formwork detail.

Operational Q Range
The discharge operational range is the least of the group. However, the vertical slot does not require adjustment operate effectively at low flows (<25cfs). This ladder can pass 10-30 cfs.

0 & M Costs
The O&M costs for removing small debris from the ladder should not be significant. Sediment removal from large floods could be a major effort.

Flood Obstruction
Flood obstruction is more of a concern than the other ladder types, except for the steppool.

Auxiliary Water Needs
Auxiliary water will be needed for a portion of the time.

Steppool Ladder

Entrance Condition

Entrance conditions at this location are difficult. Some bolder and sediment movement may be necessary to enhance existing conditions. Sediment removai may be a regular maintenance item. The ladder entrance should have multiple elevation inlets.

Exit Condition

Exit conditions will be controlled by the water inlet control device. This will most likely be a rectangular orifice which will be elevated to maintain discharge control as streamfiows increase. This should pose no problems except at flood conditions.

Passage Effectiveness

Passage effectiveness is good. The resting pools should have adequate volume so as not to be a limiting factor.

Partial Operation

Partial operation due to smail debris is not a major concern. Reguiar removal of debris should be adequate to maintain passage. Steppooi ladders are not as sensitive as other types.

Constructabiiitv

Constructability will be difficult. Cast-in-place concrete work will be extensive.

Operational Q Range

The discharge operational range is about the same as the Denil. However, the steppool requires adjustment of the orifices to operate effectively at low flows (<25cfs) This ladder can pass 5-50 cfs.

0 & M Costs

The O&M costs for removing small debris from the ladder should not be significant. Sediment removal from large floods could be a major effort. If frequent adjustments for low flows are needed often, this couid be significant.

Flood Obstruction

The exit works of this ladder will constrict higher flows. It will reduce the spill flow area of the right side of the dam by 25% and the overall area by 10%. A major flood event will over top the exit works.

Auxiiiarv Water Needs

Auxiliary water will be needed for a portion of the time.

22-141 50 SHEETS
22-142 100 SHEETS
22-144 200 SHEETS

7-16-97
v. 8-25-97
KGE

Eagle Canyon | Battle Creek | Ladder Comparison

Ladder Type	Flow Range (cfs)	Length (ft)	Width (ft)	depth (ft)
Steeppass	7 MAX	60	2	2.5
Denil 2	5.-54	75	4	4.5
Steppool w/ orifice (8' pool length)	4-53	1/120	2/12	5
Vertical Slot (12" V.S.)	8-32	1/160	2/10	5
(15" V.S.)	19-44	1/192	2/12	5

1/ Includes Baffle Thickness (6" - Steppool) (9" - Vertical Slot)

2/ Includes Wall Thickness 1'

Project Element	Ladder Alternatives			8/26/97
	Denil 2	Steppool	Vertical Slot	Upstream P&C
Entrance Condition	5	5	5	7
Exit Condition	5	5	8	8
Passage Effectiveness	6	7	7	9
Partial Operation	5	7	7	9
Constructability	7	5	3	4
Operational Q Range	7	7	3	10
O& M Costs	6	7	6	7
Flood Obstruction	8	5	5	9
Auxiliary Water Needs	8	8	4	10
Overall Rating	57	56	40	73

Memorandum

Date: August 26, 1997

To: Battle Creek Technical Working Group

From: Kayl G. Echols KGE

Subject: Alternative Fish Screen Locations for the Eagle Canyon Canai

From discussions with several of the group, since our last field tour, it is my opinion that none of the aitemative screen locations for the Eagle Canyon Canai are considered feasible. All are biologically inferior. One would require large quantities of water, and the other is just cost prohibitive. Unless, presented with a sound argument to the contrary, we attended to give these alternatives a brief qualitative discussion in our report and spend not further time investigating these. As a reminder these alternatives are the Eagle Canyon Flume 5 Outfall and the lnskip Power House Headerbox.

Please get back to me with a note if you feel differently. The FAX is 916-529-7322. My e-mail address is kayl@water.ca.gov.

State of California The Resources Agency

Memorandum

Date : August 29, 1997

To : William D. Mendenhall

From : Kayl G. Echols KGE
Department of Water Resources

Subject 8-26-97 Meeting Minutes of the Battle Creek Technical Working Group (TWG)

On August 26, 1997, the TWG met and DWR presented a status update of the preliminary design work for a fish ladder and fish screen at the Eagie Canyon Diversion on the North Fork of Battle Creek. Attached is the agenda for the meeting, which was followed with only minor deviations, and the attendance list. The goal of the meeting was to reach concurrence on some aspects of the project, reach consensus on what alternatives to pursue, and determine what level of detail DWR will take the project in this phase. The meeting began at approximately 0900 and ended at 1400. Discussions were participated in by ail in attendance and were helpful and positive. A summary of the group's conclusions and decisions are listed below. This is being circulated for the group's review and comment before finalizing. If comments are not received before 9-9-97, the original or modified minutes will stand.

- DWR will coordinate with property owners prior to surveys being conducted.
- At this time the current synthesized hydrology is reasonably adequate without further investigation.
- PG&E will provide hydrology data from their Wildcat diversion to DWR. DWR will attempt to correlate this wiil the synthesized hydrology as a reality check.
- PG&E prefers a construction window from approximately July 1 through November 1. This will reduce power generations impacts. → site conditions
- Since fish passage is currently blocked, from a biological point of view construction can take place during any time with the appropriate water quaiity safeguards.
- The construction of a fish screen in the canal at the diversion will incorporate the demolition of the existing mass concrete anchor for the radial sluice gate and the demolition of the existing canal control works. Consequently, reconfiguration and reconstruction of these elements will be part of the project.
- PG&E is to give some consideration to alternative ways to operate the sluice gate and to the location of new control works.
- DWR wiil schedule with PG&E a time to gather detailed cross-sectionai and profiie data of the canal at the diversion.
- DWR wiil investigate the hydraulics in the canal, through the proposed fish screen and new control works.
- PG&E suggested it may be necessary to do some physical modeling for a new control works.
- Based on preliminary investigation, it was agreed that no further design work would be done on a vertical slot type ladder at this site, for the following reasons:
    1. A 12 inch vertical slot ladder had an inferior flow capacity (32 cfs). This resulted in exceeding the minimum flow guidelines of 10 percent of the total

streamflow 23 percent of the time.

2. While a 15 inch vertical slot ladder had a flow capacity of 44 cfs, which resulted in an 11 percent exceedance, a shorter steppool ladder of the width provided a maximum flow of 53 cfs with 7 percent exceedance.
3. A steppooi ladder of the same width would be 72 feet shorter and require less detaiied formwork. This would result in a less costly structure.
4. A vertical slot type ladder does not perform as well as a steppool type when partially blocked with debris.

- DWR will continue preliminary design at the current level of detail through a construction cost estimate for a denil type ladder and a steppool type ladder.
- DWR will also continue with a third alternative, a new low head dam with pool and chute ladder, to the same level of detail as the other two ladders.
- Consequently, the level of detail of design as originally planned will be less, but the final report will address three ladder and screens combinations instead of one.
- DWR will have Project Geology staff visit the site for the proposed'upstream diversion.
- PG&E wiil provide highiine operation information from previous construction work at the site.
- The two alternative fish screening locations previously identified in group field tours will not be investigated any further at this time, for the following reasons:

1. Eagle Canyon Flume 5 Outfall – Initial estimates indicate an excess of 14,000 LF of return piping to safely convey the fish back to the stream. The installation would be on a steep slope with difficult construction conditions. The cost of this return pipe alone could be more than one of the entire fish ladder and screen proposals.
2. Inskip PH Headerbox – There are two possible return routes for this location. The first is 'an 8000 LF intermitted drainage channel back to the North Fork of Battle *Creek.* There is little to no vegetation along this route. The group felt that it would take a substantial discharge, a program to establish vegetation, and some channelization to make this a biologically reasonable option. The second is a 4000 LF route to the South Fork of Battle Creek. This route, like the Flume 5, would require approximately 21,000 LF of return piping. The cost of the return pipe or value of the water makes these alternatives not viable at this time, in light of the fact that there is an opportunity to screen at the head of the diversion.
3. The fisheries agencies (DFG, USFWS, and NMFS) all prefer an on-stream or near-stream fish screen location over a screen removed a significant distance from the stream channel.

- DFG believes for this particular screen installation, that a conventional self-cleaning screen mechanism is the appropriate standard.
- The group agreed that for the options for a ladder at the existing dam, the proposed Chevron screen concept is acceptable.
- PG&E will provide to DWR information on property ownership.
- DWR will contact the Tehama and Shasta RCDs regarding property ownership.
- PG&E and DWR will coordinate a time to visit the proposed upstream dam site area.
- The next meeting will be at DWR on 9-30-97 at 0900.

cc: Jean Oscamou, PG&E
Harry Rectenwaid, DFG
Paul Ward, DFG
Tricia Parker, USFWS

State of California **The Resources Agency**

Memorandum

Date : September 12, 1997

To : William D. Mendenhall
Chief, Engineering Services Section
Department of Water Resources

From : Kayl G. Echols
Department of Water Resources

Subject: Eagle Canyon – Upstream Pool & Chute Ladder Alternative

During the Battle Creek Technical Working Group (TWG) Meeting on August 26, we agreed to investigate a third alternative, a new low head dam with a pool and chute ladder. We were to develop this alternative to the same level of detail as the other two alternatives. This new dam was to be constructed upstream where a much lower height dam could replace the existing dam. A new, fish friendly, pool and chute ladder could be constructed in the channel as part of the new diversion. Because, the initial concept had merit we agreed to pursue the alternative. However, as we have gathered field information and attempted to choose the new dam location, we have encountered serious project shortcomings, which I believe make it nonproductive to continue to investigate this alternative any further.

On September 8, Jean Oscamou and Tom Carrier from PG&E, Brian Stewart, and myself visited the area of the proposed damsite. Jean and Tom focussed on constructability and project operations issues. Brian and I focussed on dam alignment, ladder operations, spill routing, diversion method, and bedload passage. All of us discussed our ideas and concerns openly. My general feeling is that technically we can construct the new dam. However, in my mind there is a high degree of uncertainty if it will function adequately. Furthermore, I believe there exists a potential for decreasing the stability of the rock walls of the canyon during construction.

Jean has summarized PG&E's concerns as a result of our site visit. Attached are his comments. I generally agree with his observations and concerns. I have the following additional comment to his statement.

> Operational Issues: Item 3. To avoid the uncertainty of extent of potential down cutting of the channel after the existing dam is removed, I have proposed a location upstream far enough (above the head of the pool of the existing dam) that channel slope and invert should remain stable.

In addition to Jean's attached comments, I have the following concerns or have encountered the following obstacles:

1. The natural gradient of the existing upstream channel and the overall slope of the proposed ladder structure are relatively the same. This makes it virtually impossible, to enter and exit the ladder into a pool, without creating a passage problem upstream or downstream of the structure. The initial assessment, based on ladder type, gave this alternative a high ranking for entrance and exit conditions. However, based on the specific site conditions, this was not a valid assessment. would now rank this alternative the lowest among the alternatives in the entrance and exit categories and lowest overall.
2. The large, boulder material on the wails of the canyon at this location appear to be supported by the boulder material in the bottom of the channel. Removing these boulders from their present locations, to construct a dam and ladder, may destabiiize the up-slope boulders. This may cause major damage to any structure built in the channel in this area.
3. Without the ability to create a minimal pool at the upstream side of the proposed dam, bedload can not be sluiced. Thus, most of the bedload material will pass through either the ladder or the diversion inlet. This is an extremely undesirable condition. Even moderate storm events could plug both structures.

Based on these concerns and PG&E's comments, I recommend that we discontinue the investigation into the upstream dam/ladder alternative and focus our resources on the other two ladder alternatives. The degree of uncertainty and the potential marginal results make this alternative less desirable than the others and not comparable in terms of confidence.

cc: Jean Oscamou, PG&E
Harry Rectenwaid, DFG
Paul Ward, DFG
Tricia Parker, USFWS

Return-Path: CJR03%Campl%NAH@bangate.pge.com>
From: JR03%Campl%NAH8bangate. pge.com
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Date: Tue, 9 Sep 97 18:42:18 PDT
To: <kayl@water.ca.gov>
cc: <TLCG%AngelsCamp%SAH@bangate.pge.com>, CACRl%201Msn%HGO@bangate.pge.com>,
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Reply-To: <JR03%Campl%NAH@bangate.pge.com>
Errors-To: CJR03%Campl%NAH@bangate.pge.com>
Subject: Issues with E. Can. Alternate Dam Site
X-Incognito-Sn: 237
X-Incognito-Version: 4.10.130

Glyn,

The negative aspects of the alternate dam site at Eagle Canyon as Tom Carrier and I saw them during our field trip with you Monday are as follows:

CONSTRUCTION ISSUES:

1. The site conditions are terrible with large boulders and an unknown substrate.

2. Achievement of effective water control during construction is doubtful due to large rocks, underwater passages, etc. Coffer damming and bypassing around the work area is not practicable due to the nature of the stream bed and confined work area.

3. The site is more constricted than the present dam for aerial work, such as concrete placement.

4. An extremely serious safety issue is present regarding the stability of the rocks on the north side of the canyon as is. The extensive blasting necessary to deal with the rocks that are currently visible in the stream will further destabilize the north side of the canyon. This safety hazard simply will not be tolerated by PGCE. We have had the sad misfortune of an employee fatality a short distance downstream due to a rock fall on the north side of the canyon in the 1980's and will not subject our employees, contractors, the public, or anyone else to such a hazard as would be involved with work at the proposed site.

5. Heavy equipment would be required at the site for excavation and construction of the proposed dam. The extent of work and size of material would not be practical for accomplishment with small equipment that could be air-lifted into place. The most probable way to insert heavy equipment would be via an access road constructed from the south rim. This would involve great expense, cause heavy environmental impact, would be unlikely to receive landowner approval, and would be an invitation to increased human access of the stream. Further, a great effort would be necessary to provide rock slide protection and for the safety of personnel and facilities below.

6. Providing an engineered safe work area in the proposed location, if even possible, would be of enormous expense.

OPERATIONAL ISSUES:

1. The control works to assure proper diversion of water to the canal from within the ladder section is unclear and would be subject to damage during typical high flows at this site.

2. The exposed pipe down the left side of the channel to the current canal intake area would be at high risk of failure during floods. (We have had such experience in the past with the Wildcat pipe at the next diversion downstream.)

3. Once the existing dam is breached for passage, the stream channel area

between the proposed site and the existing dam will be destabilized and can be expected to resemble the exposed natural channel in the area. The effects are unknown and the impact on the downstream discharge area of the new structure cannot be predicted. This is likely to result in a string of retrofits to assure fish passage before the stream bed reaches a final, stable condition.

4. Destabilization of the rock formations on the canyon walls as a result of construction is likely to result in continuing intrusion of large boulders, and possibly a barrier to upstream fish migration.

5. The run of pipe from the proposed dam to the existing canal intake will be susceptible to plugging with gravel and debris. An open conduit at this location is not a feasible alternative.

These are the high points that Tom and I recalled. You guys may recall some others. Please let me know if you need any additional information, but I don't think it is worth expending any further effort and money developing even conceptual level plans for a new dam at this site. If there are any non-believers remaining, we will be happy to take them in for a first-hand observation.

Jean

EAGLE CANYON
FISH LADDER AND SCREEN DESIGN
MEETING AGENDA
g-30-97

Review Previous Meeting Minutes

Ladder Design Discussion

Upstream Pool and Chute - Shelved

Steppool w/ Orifices – Hydraulic Design Complete, Feature Details 70%

Denil - Hydraulic Design Complete, Feature Detaiis 70%

Screen **Design Discussion**

Vertical, Fixed Plate Chevron Design - Hydraulic Analysis Complete, Feature Details 80%

General Status

Environmental Work
- Plants
- Wildlife
- Archeoiogy

Hydrology Research – Considered Complete for Preliminary Design

Construction Cost Estimates – To begin October 1

Report – Draft to be complete by Approximately October 31

09-30-97	BATTLE CREEK MTG.	ATTENDANCE LIST

NAME	ORGANIZATION	PHONE #
BRIAN STEWART	DWR	527-7340
Gene Geary	PG+E	(510) 866-5821
Phil Warner	DFG	(916) 225-2307
Tricia Parker	USFWS	916-527-3043
Jim Buell	consult. MWD	(503) 203-1248
Harry Rectenwald	DFG	(916) 225-2368
Glyn Echols	DWR	(916) 529-7324
Jean Oscamou	PG&E	916 896-4405
BILL KIER	Kier Associates	415/331.4505

22-141 50 SHEETS
22-142 100 SHEETS
22-144 200 SHEETS
AMPAD

State of California The Resources Agency

Memorandum

Date : October I, 1997

TO : William D. Mendenhall

From : Brian A. Stewart
Department of Water Resources

Subject: 9-30-97 Meeting Minutes of the Battle Creek Technical Working Group (TWG)

On September 30, 1997, the TWG met and DWR presented a status update of the preliminary design work for a fish ladder and fish screen at the Eagle Canyon Diversion on the North Fork of Battle Creek. Attached is the agenda for the meeting, which was followed with only minor deviations, and the attendance list. The goal of the meeting was to reach concurrence on some details of the project. The meeting began at approximately 0915 and ended at 1530. Discussions were participated in by ail in attendance and were helpful and positive. This is being circulated for the group's review and comment before finalizing. If comments are not received before 1 O-10-97, the original or modified minutes wiil stand.

- The 08-26-97 meeting minutes were reviewed and no objections were raised.
- The Memorandum dated August 29,1997 was reviewed and modified oniy at bullet four, page one, from "PG&E prefers a construction window from approximately July 1 through November 1. This will reduce power generations impacts." To read, PG&E prefer a construction window from approximately July 1 through November 1. This is when the site conditions are favorable.
- Steppooi w/ Orifices ladder details were addressed and DWR agreed to investigate suggested additions and revisions to the ladder design.
- Denil2 ladder details were addressed and DWR agreed to investigate suggested additions and revisions to the ladder design.
- Headwork trash rack details were discussed and PG&E agreed to research material and size needed at the Eagle Canyon Site.
- Screen Design will continue without any additions, except the idea of a secondary trash rack, which would be placed between the head of screen and main control gate.
- Return Bypass details were discussed and suggested additions and revisions will be investigated by DWR.
- DWR will consult with DFG Engineer, George Heise, with the TWG's suggested additions and revisions.
- Final Project Geology Memorandum Report will be completed the week of October 6.
- Environmental work to continue as previously stated.

The next meeting will be at DWR on 1 O-20-97 at 0915.

cc: Gyln Echols, DWR
George Heise, DFG
Jim Bueil, MWD
Jean Oscamou, PG&E
Harry Rectenwald, DFG
Bill Kier, Kier Associates
Paul Ward, DFG
Tricia Parker, USFWS

EAGLE CANYON
FISH LADDER AND SCREEN DESIGN
10-20-97

Review Previous Meeting Minutes

Ladder Design Discussions
Denil 2
Step Pool w/ Orifices

Screen **Design Discussions**

Return Discussions
Denil 2
Step Pool w/ Orifices

Draft Report to be completed by approximately November 15

Department of Water Resources
Meeting Attendance List

October 20, 1997

Eagle Canyon, on North Fork Battle Creek

Name:	Organization:	Contact Number:
BRIAN STEWART	DWR	529-7340
PAUL WARD	DFG	527-8987
George Heise	DFG	(916) 653-2189
Henry Roetemeyer	DFG	(916) 225-2368
Jean Oscamou	PG&E	(916) 896-4405
Tricia Parker	USFWS	527-3043
Kayl Glyn Echols	DWR	916-529-7324
Jim Buell	Consultant MWD	(503) 203-1248
Bill Mendenhall	DWR	529-3258

State of California The Resources Agency

Memorandum

Date : October 21, 1997

To : William D. Mendenhall
Department of Water Resources

From : Brian A. Stewart
Department of Water Resources

Subject: 10-20-97 Meeting Minutes of the Battle Creek Technical Working Group (TWG)

On October 20, 1997, the TWG met and DWR presented a status update of the preliminary design work for a fish ladder and fish screen at the Eagle Canyon Diversion on the North Fork of Battle Creek. Attached is the agenda for the meeting, which was followed with only minor deviations, and the attendance list. The goai of the meeting was to reach concurrence on some detaiis of the project. The meeting began at approximately 1045 and ended at 1400. Discussions were participated in by all in attendance and were helpful and positive. This is being circulated for the group's review and comment before finalizing. If comments are not received before 10-30-97, the original or modified minutes wiil stand.

- The 09-30-97 meeting minutes were reviewed and no objections were raised.
- The TWG looked at DWR preliminary drawings (sheets 4-10) for the Eagle Canyon Dam Fish Ladder and Screen. Details were addressed and comments made by all members of the group. DWR agreed to make minor changes to drawings and details.
- The bypass return system for both ladder configurations was discussed and a solution was reached for each design. DWR agreed to research these ideas and complete changes to the drawings as needed.
- DWR agreed that the Draft Report wiil be completed around November 15, 1997.
- PG&E was provided several copies of the preliminary drawings.
- DWR requested that PG&E provide some aid during the cost estimation. PG&E was willing to meet DWR request.

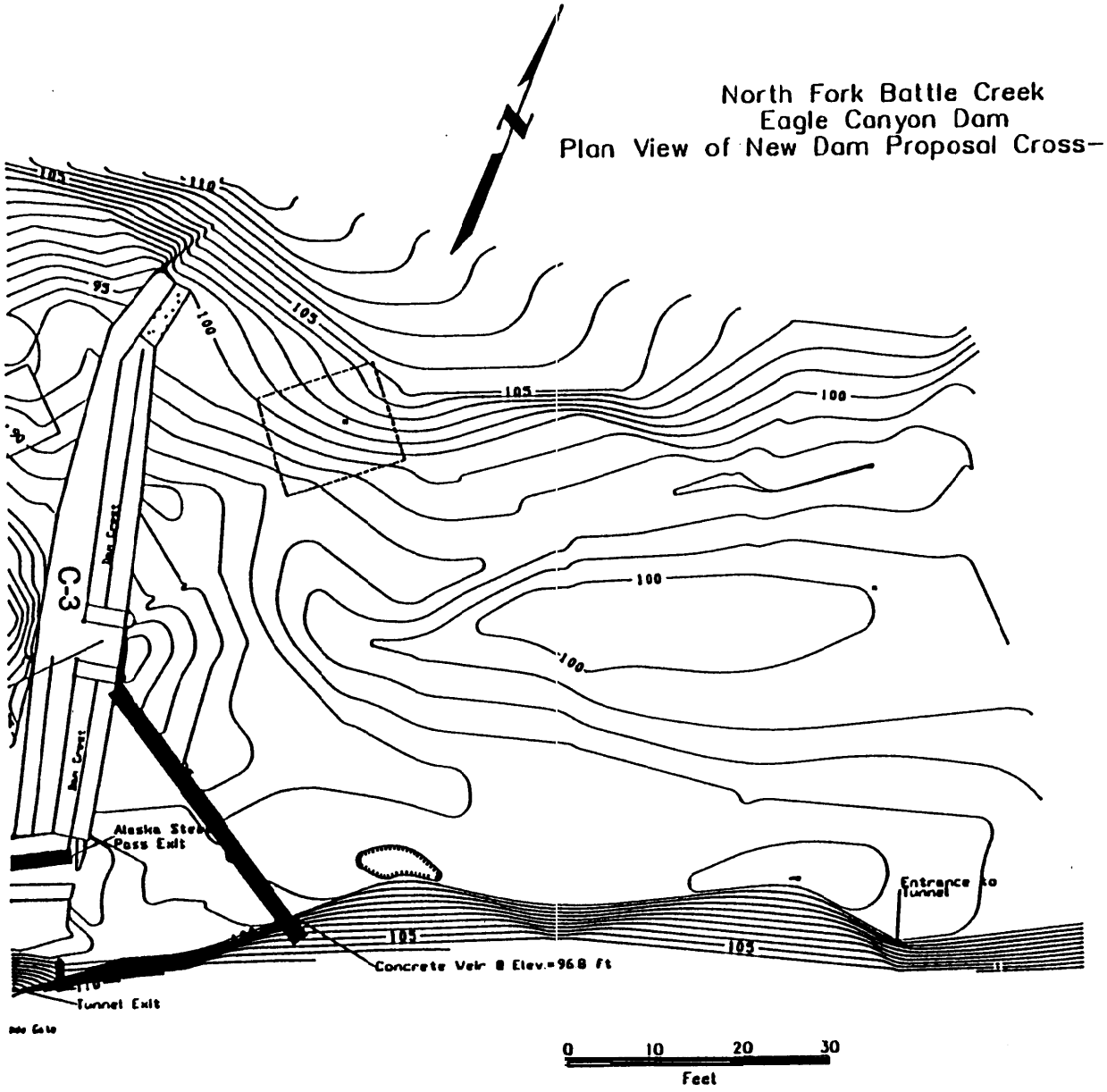
cc: Glyn Echols, DWR
George Heise, DFG
Jim Buell, MWD
Jean Oscamou, PG&E
Harry Rectenwaid, DFG
Paul Ward, DFG
Parker, USFWS

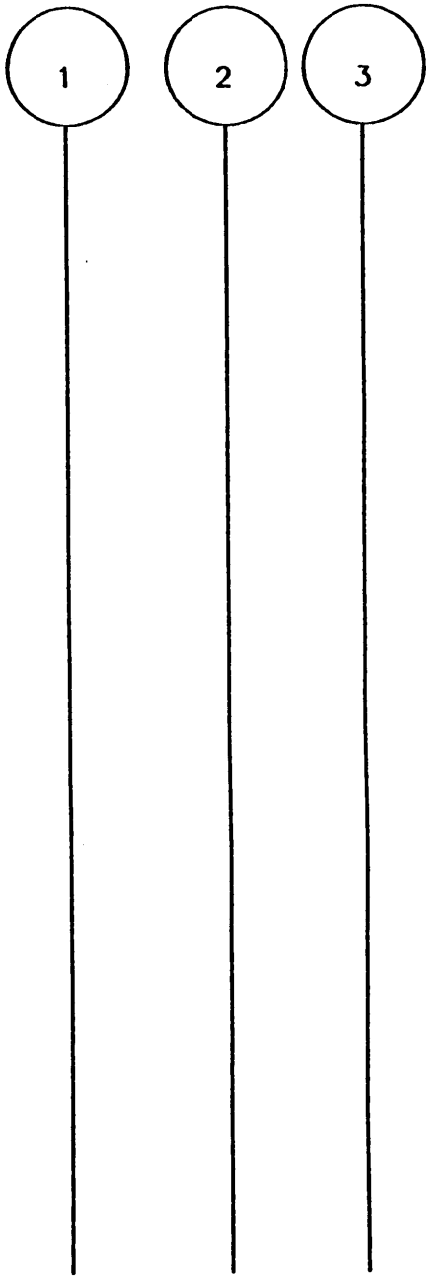
Appendix C

Project Alternative Drawing

New Dam with Pool and Chute Ladder

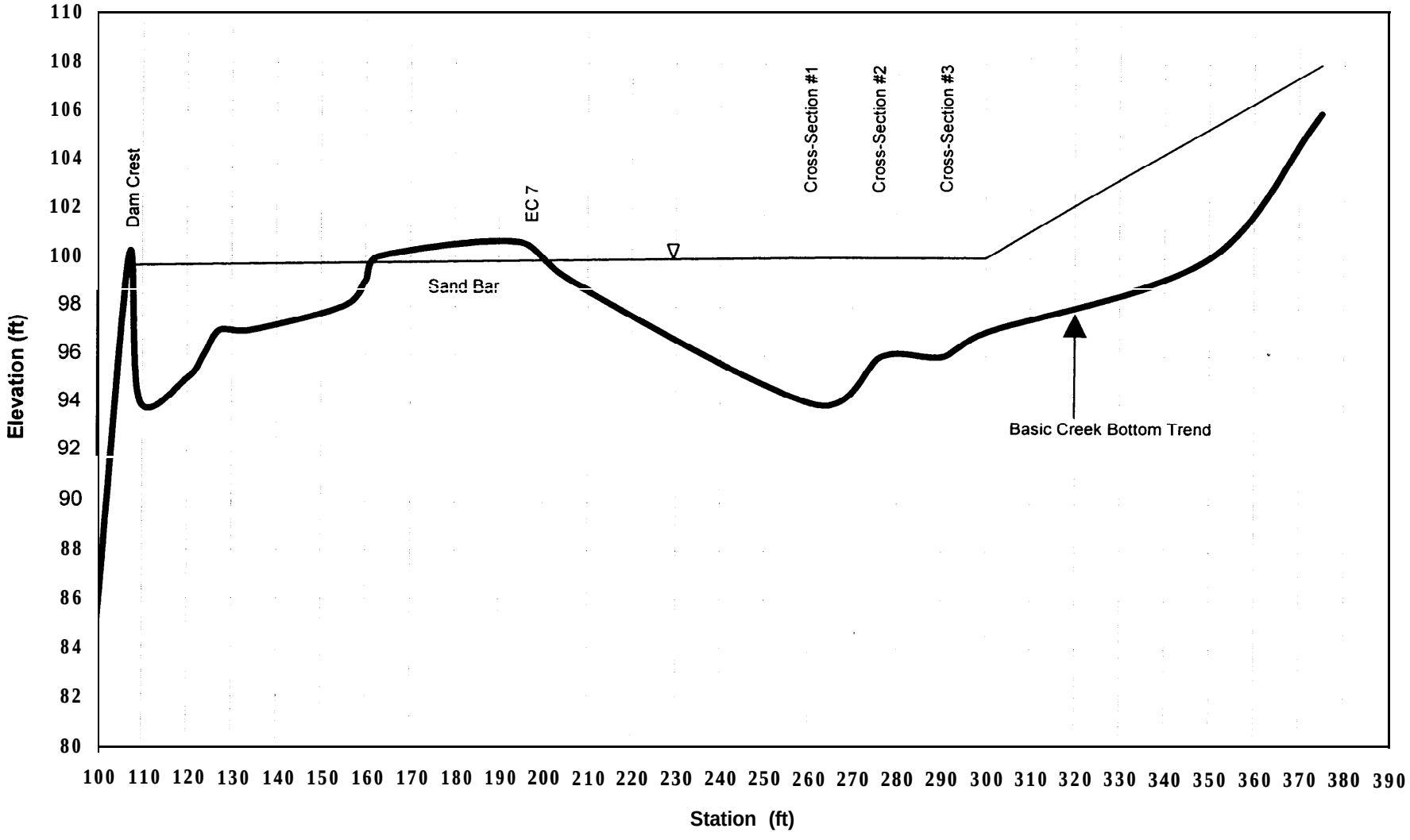
North Fork Battle Creek
Eagle Canyon Dam
Plan View of New Dam Proposal Cross-Sections

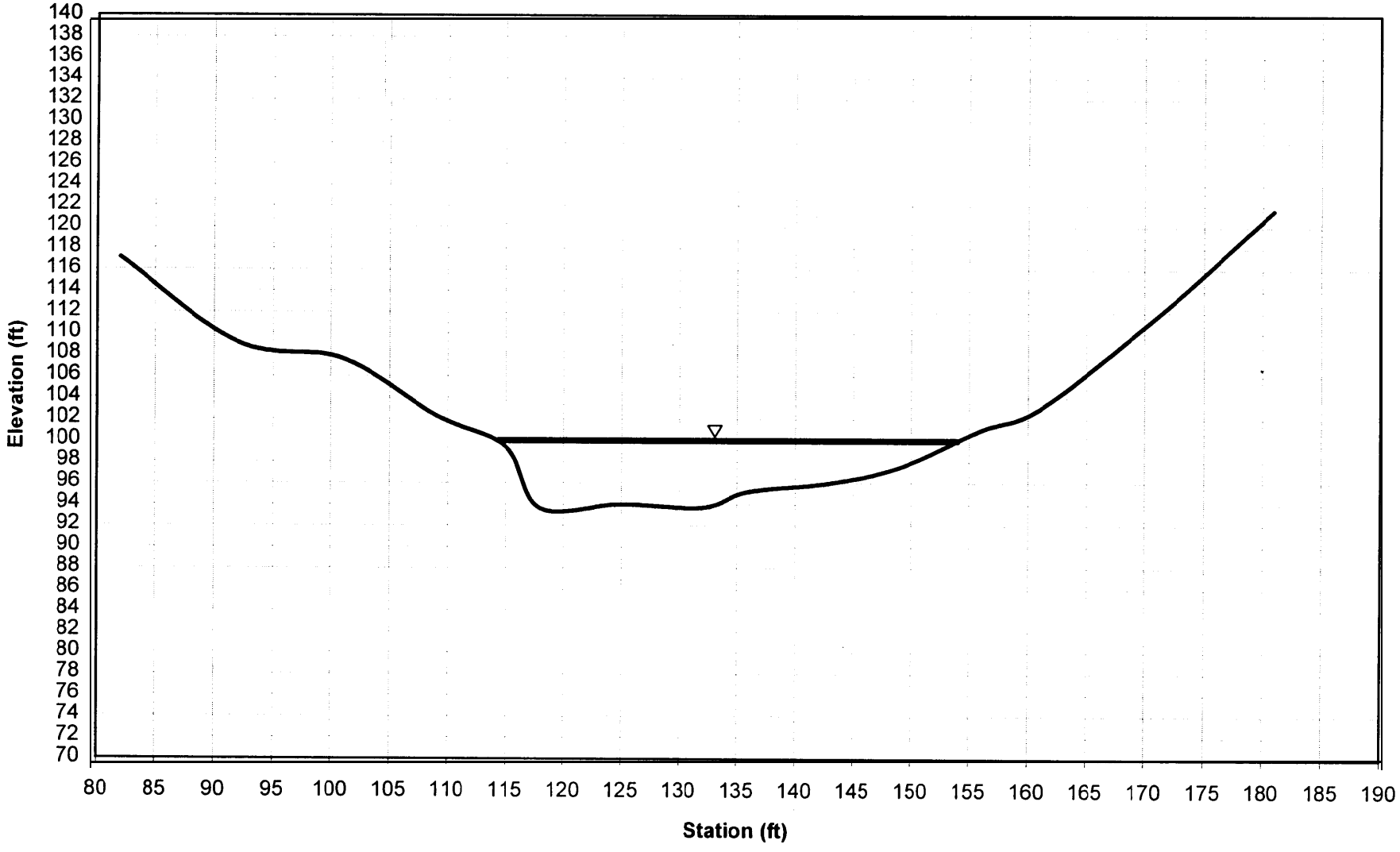


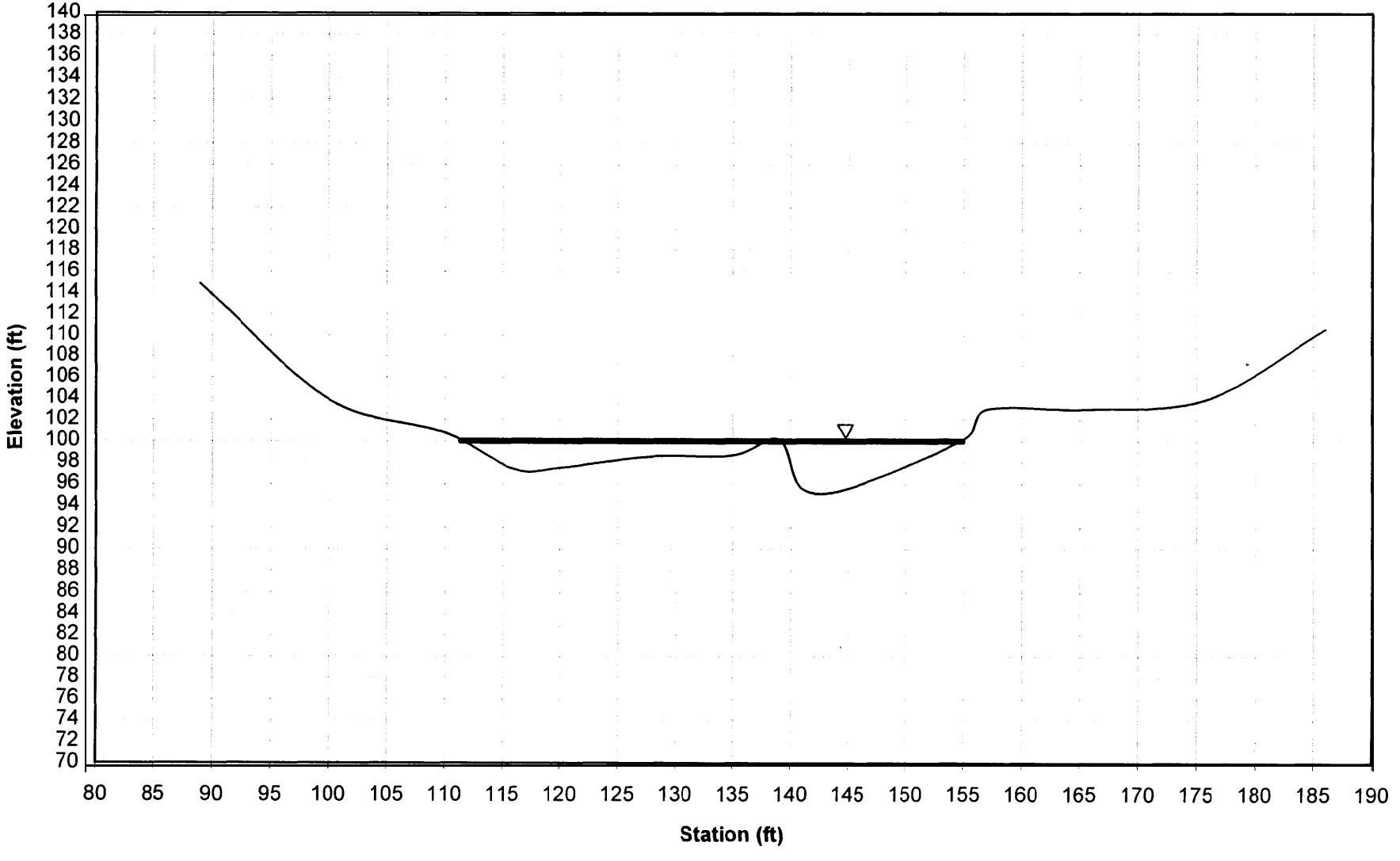


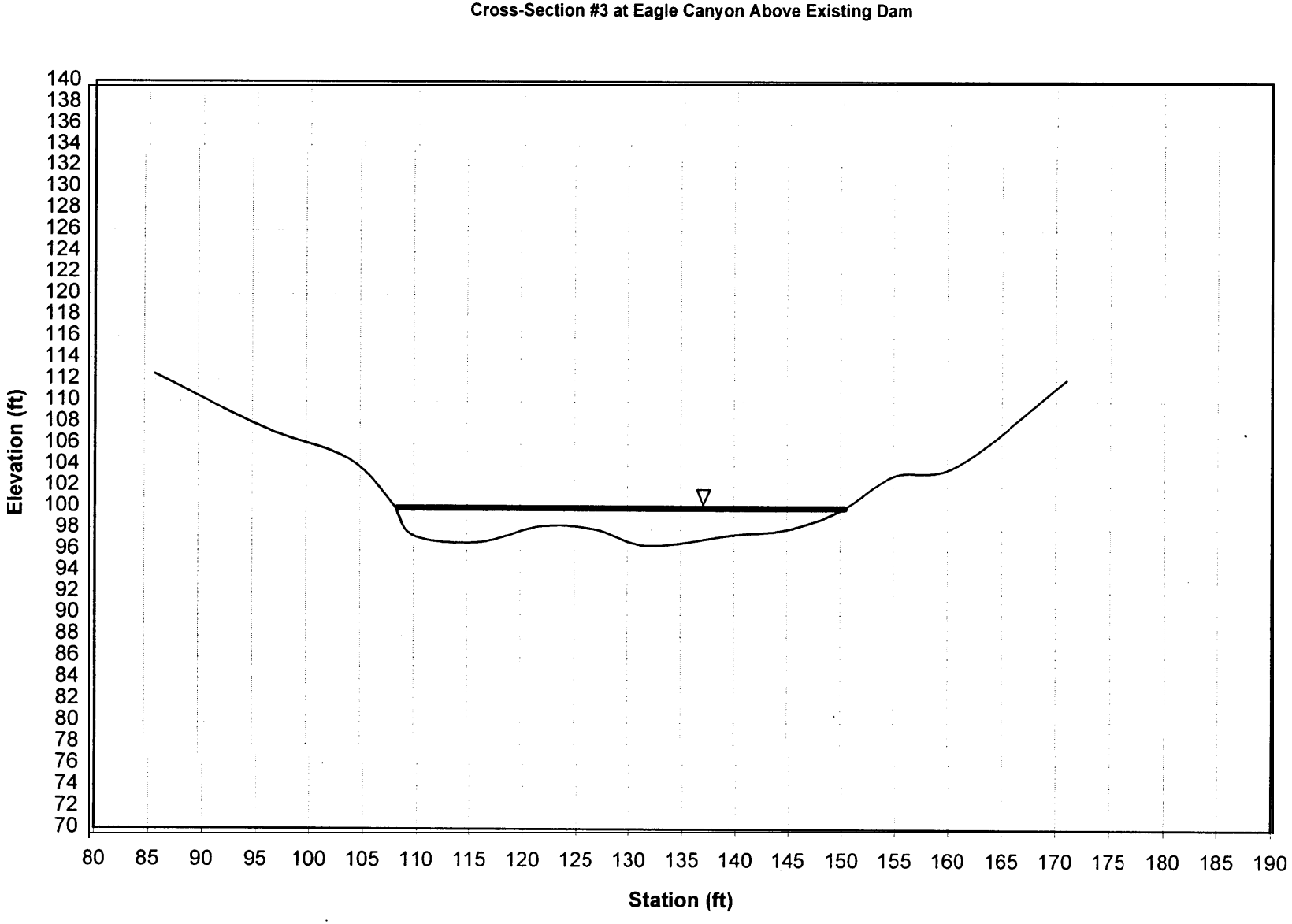
Profile of Battle Creek above Eagle Canyon Dam

Stationing begins at toe of existing dam with 1+00 being the starting value



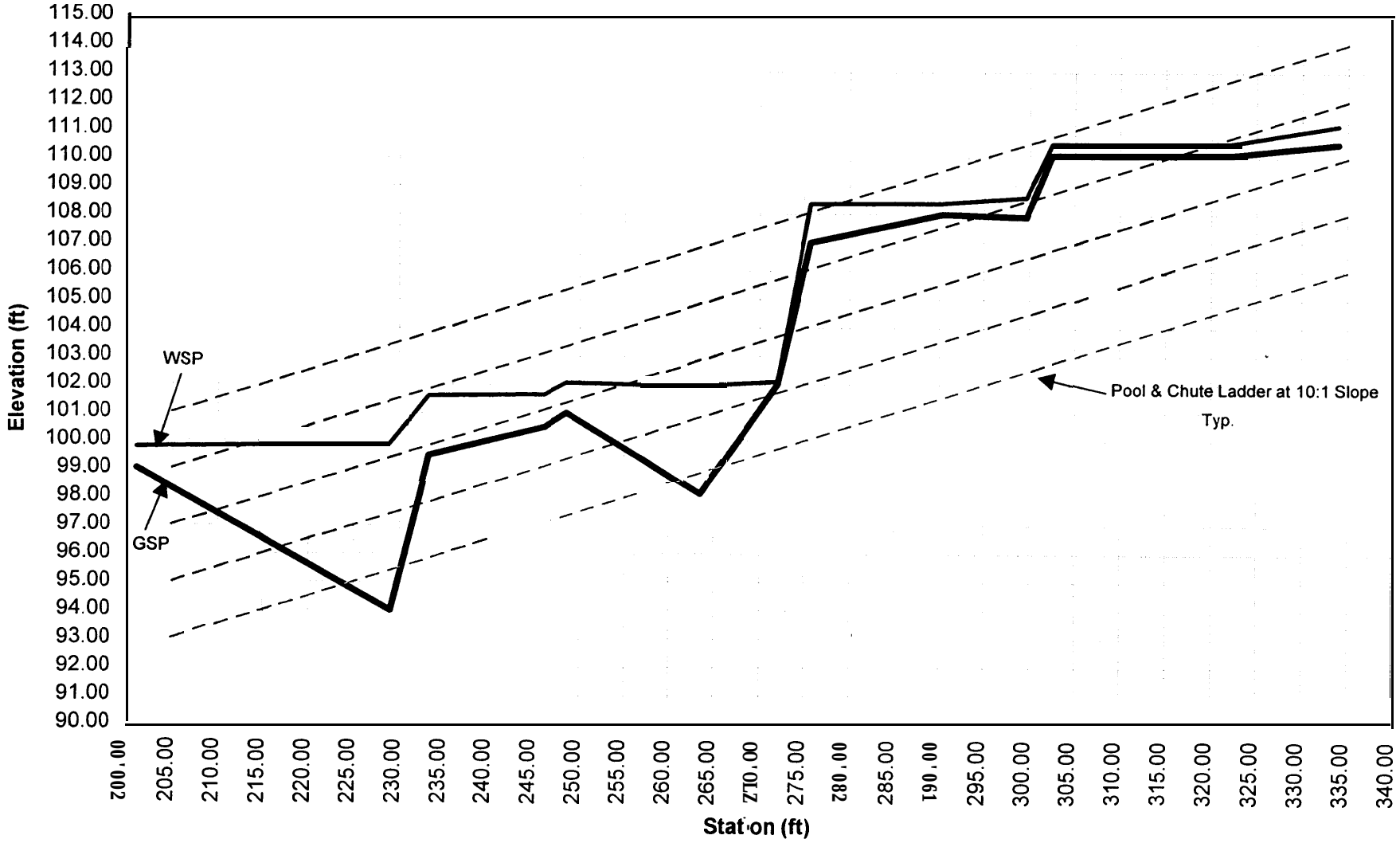

Cross Section #1 at Eagle Canyon Above Existing Dam
Elevation (ft)
140
138
136
134
132
130
128
126
124
122
120
118
116
114
112
110
108
106
104
102
100
98
96
94
92
90
88
86
84
82
80
78
76
74
72
70
80 85 90 95 100 105 110 115 120 125 130 135 140 145 150 155 160 165 170 175 180 185 190
Station (ft)


Cross-Section #2 at Eagle Canyon Above Existing Dam
Elevation (ft)
140
138
136
134
132
130
128
126
124
122
120
118
116
114
112
110
108
106
104
102
100
98
96
94
92
90
88
86
84
82
80
78
76
74
72
70
80
85
90
95
100
105
110
115
120
125
130
135
140
145
150
155
160
165
170
175
180
185
190
Station (ft)


Cross-Section #3 at Eagle Canyon Above Existing Dam
Elevation (ft)
140
138
136
134
132
130
128
126
124
122
120
118
116
114
112
110
108
106
104
102
100
98
96
94
92
90
88
86
84
82
80
78
76
74
72
70
80
85
90
95
100
105
110
115
120
125
130
135
140
145
150
155
160
165
170
175
180
185
190
Station (ft)

Eagle Canyon WSP and GSP Above Existing Dam

Station 0+00 is at Up-Stream Face of Dam



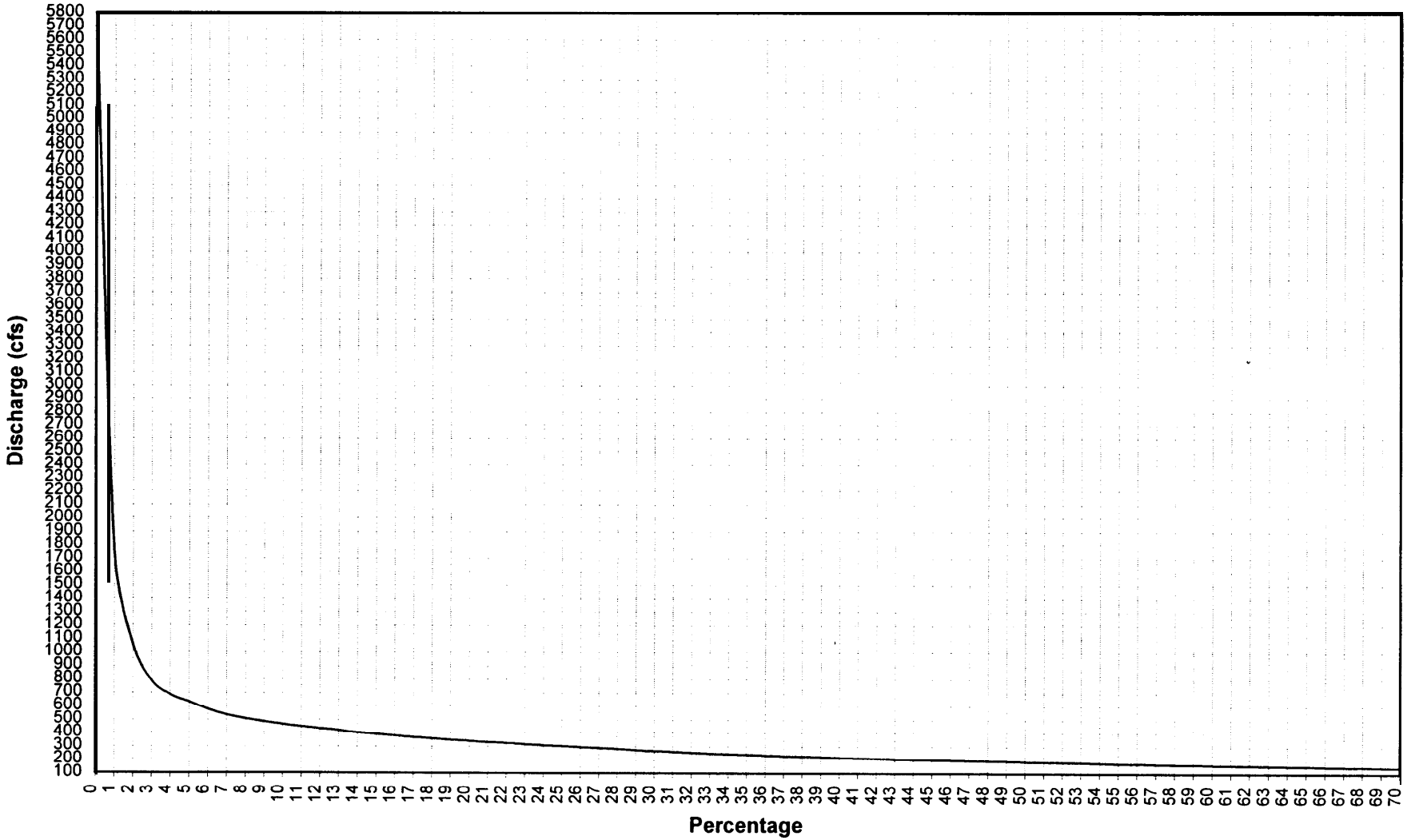
WSP and GSP Surveyed 09-02-97

Appendix D

Exceedence Curve for North Fork Battle Creek

Eagle Canyon Percent Exceedance

Based on Drainage Basin Area Ratio of 1861357 sq. mi. = 52% of total flow at gage #11376550
Daily Average Flows---Oct. 1961 to Dec. 1995

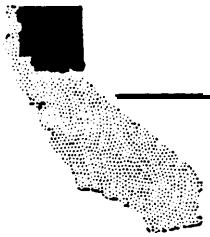


Appendix E

Project Site Archeology

The Northeast Center of the California Historical Resources Information System

BUTTE SIERRA
GLENN SISKIYOU
LASSEN SUTTER
MODOC TEHAMA
PLUMAS TRINITY
SHASTA



Department of Anthropology
California State University, Chico
Chico, CA 95929-0400

(916) 898-6256

September **26,** 1997

Bob Orlins
Department of Water Resources
Environmental Service Office
3251 S Street
Sacramento, CA 95816-7017

RE: EAGLE CANYON DIVERSION: FISH LADDER AND SCREEN;
I.C. File # H97-14
T30N, Rl W, Section **25;**
USGS Shingletown **7.5'** and Manton 15' quads
estimated 20 acres (on the Shasta/Tehama County line)

Dear Mr. Orlins,

In response to your fax request received September 25, 1997, a record search for the above mentioned project was conducted by examining the official maps and records for archaeological sites in Shasta and Tehama Counties.

RESULTS:

PREHISTORIC RESOURCES:. Our records indicate that there are no recorded sites of this type known to be located within the project boundaries. However, one site of this type has been recorded along the creek to the east, between the dam and the section line (CA-SHA-1346), which has been described as a lithic scatter.

, HISTORIC RESOURCES: Our records indicate that there are no recorded sites of this type known to be located within project boundaries. However, the USGS Manton 15' quad map (1956) shows an Eagle Canyon Ditch flowing from the dam. This may be an unrecorded historic feature. Additionallly, the historic Nobles Trail passed north of the project area by Shingletown.

PREVIOUS ARCHAEOLOGICAL INVESTIGATIONS: According to our records, no portion of the project area within the circle has been previously surveyed for cultural resources by a professional archaeologist. The closest recorded survey was done east of the project location (I. C. Report # SH-L-67). In 1982, Neal Neuenschwander conducted an archaeological reconnaissance of the proposed Digger-Battle Hydroelectric Project in Shasta County. Two

aboriginal siates were recorded during the course of the survey, one of which is CA-SHA-l 146 mentioned above.

LITERATURE SEARCH: Reviewed were the official records and maps for archaeological sites and surveys in Shasta and Tehama Counties. Also reviewed were the **National Register of Historic Places -** Listed properties and Determined Eligible Properties (1988, Computer Listings 1966 through 7-96 by National Park Service), the **California Inventory of Historic Resources** (1976), **California Points of Historical Interest (1992), California Historical Landmarks** (1990), and **The Directory of Properties in the Historic Property Data File for Shasta and Tehama Counties** (1996).

RECOMMENDATIONS: Based upon the above information and the local topography, the project is located in an area considered to be highly sensitive for cultural resources. You may wish to contact the appropriate local Native American group regarding information on unrecorded ethnographic sites which may be located within project boundaries for which we have no records. You may also want to consult historic Government Land Office maps for unrecorded historic sites which may be located within project boundaries for which we have no records. If the project is located within or adjacent to Forest Service or Bureau of Land Management lands, we recommend that you contact the appropriate agency for information on sites which may extend into project boundaries for which we have no records.

The charge for this record search is $90.00. An invoice for billing purposes will be mailed to Joyce Lacey, Department of Water Resources, Northern District Office, 2440 **Main Street,** Red Bluff, California, 96080 as you requested. Thank you for your concern in preserving California's cultural heritage.

Sincerely,

Makoto Kowta

Makoto Kowta, Coordinator
Northeast Information Center

A CULTURAL RESOURCES SURVEY FOR THE NORTH FORK BATTLE CREEK EAGLE CANYON DIVERSION FISH PASSAGE PROJECT SHASTA AND TEHAMA COUNTIES, CALIFORNIA

PREPARED BY
ROBERT I. ORLINS
ASSOCIATE STATE ARCHAEOLOGIST
DEPARTMENT OF WATER RESOURCES
ENVIRONMENTAL SERVICES OFFICE

FOR
DEPARTMENT OF WATER RESOURCES
NORTHERN DISTRICT

JANUARY 9, 1998

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PROJECT DESCRIPTION

ENVIRONMENTAL SETTING

CULTURAL SETTING

SURVEY METHODS

SURVEY FINDINGS

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EAGLE CANYON DIVERSION DAM PRIMARY RECORD

INTRODUCTION

The Department of Water Resources is proposing to modify Eagle Canyon Dam as part of an effort to restore the Salmonid populations on Battle Creek. Battle Creek is recognized as one of the few remaining tributaries of the Sacramento River with spring and winter-run chinook salmon and steelhead trout populations. Declining populations have led to an increase in restoration efforts that are compatible with the needs of the various water users and also preserve and enhance the Salmonid populations. The proposed project would contribute to this effort through the modification of an existing diversion structure to improve fish passage under a variety of conditions and to screen the diversion to prevent fish losses.

An archaeological survey has been completed for the project, since it has the potential to adversely effect prehistoric and historic cultural resources that may be present. The results of the survey, consisting of a record search and a field reconnaissance, are documented herein.

PROJECT DESCRIPTION

The initial development of the Battle Creek hydroelectric system occured during the early 1900s and the Eagle Canyon Dam dates to that period. The diversion structure provides up to 70 cfs of water to the Eagle Canyon Canal for power generation at Inskip Power House. Structures to provide adult salmonids with passage at the dam predate the mid- 1930s and PG&E has maintained and replaced the fish ladder over the years. The existing fish ladder is non-operational at the request of the U.S. Fish and Wildlife Service (Department of Water Resources 1997: 1).

The proposed project includes the addition of either a new higher flow capacity steppool with orifices or a Denil2 type fish ladder which would be built on the left (south) bank of the dam. The existing fish ladder would be removed and an in-canal fish screen would be installed adjacent to the proposed fish ladder. This work would necessitate the the removal of an approximately 7 foot deep by 10 foot wide section of the south side of the dam. The existing canal at the dam would be enlarged and a common wall would be built that would serve as a canal wall and an interior wall for the fish ladder. The project area would have to be dewatered during construction; streamflow would have to be temporarily diverted around the site or PG&E would would have to abandon diversions until project completion (Department of Water Resources 1997: l-2).

ENVIRONMENTAL SETTING

North Fork Battle Creek originates above the 7,000 foot elevation on the western slope of the Cascade Range. The creek flows southwesterly from Huckleberry Mountain through North Battle Creek and McCumber reservoirs toward the community of Manton, where it drops abruptly through a steep canyon. It is joined there by South Fork Battle Creek, becoming Battle Creek, continuing southwesterly to the Sacramento Valley where it joins with the Sacramento River near the town of Cottonwood.

The Eagle Canyon Dam straddles the Shasta-Tehama County line which runs through the middle of the streambed of North Fork Battle Creek. It is located about 30 miles east-southeast of Redding and three miles west of Manton, approximately one mile north of Manton Road. The dam is about 500 feet downstream of the confluence of Digger Creek with North Fork Battle Creek.

The dam was built in a gorge where the canyon walls are nearly vertical, rising about 175 feet above the main creek channel. The local geology is dominated by volcanics, consisting predominantly of basalt rock types. Soils are the reddish iron-rich volcanic soils typical in foothill settings. The ground surface is littered with volcanic boulders and cobbles (Department of Water Resources 1997: Appendix F).

The south rim of the canyon in the vicinity of the South Rim Staging Area supports a Foothill Woodland vegetation community, dominated by foothill pine and blue oak with California bay and woody shrubs such as buckbrush and manzanita. Common understory plants include non-native grasses, star thistle, blackberry, poison oak, mugwort, wild rose, grapevine, and yerba santa.

The North Rim Staging Area is in a Mesic North Slope Woodland Community, an open woodland dominated by blue oak and foothill pine with a groundcover of non-native grasses.

The canyon itself supports a dense riparian community with a shady oak-bay overstory that also includes ruderal fig trees. Many springs issue through the steep canyon walls creating a multitude of rills and shallow pools which have plants such as duckweed and watercress. The wet canyon walls support ferns and a wide variety of bryophytes including selaginellas, liverworts, and mosses.

CULTURAL SETTING

When the first Europeans arrived in the region it was the homeland of the Yana, the indigenous people who spoke a language that belonged to a branch of the Hokan language family. They inhabited the upper Sacramento River valleys and foothills east of the river, having been pushed away from the river by their enemies and neighbors to the west, the Wintun people. Separation of the Yana into the Northern, Central, Southern, and Yahi divisions was based primarily on linguistic differences; other differences between the groups were, in the overall scheme of things, relatively minor. The territory of the Central Yana who inhabited the area of the proposed project, extended on the north from the divide between Bear Creek and Battle Creek to the divide between Antelope Creek and Mill Creek on the south. The eastern limit of their territory was along the western slope of Lassen Peak.

Elevation in their territory ranged from 300 to over 10,000 feet, providing a variety of floral and fauna1 resources. Acorns were the most important staple food and large amounts of several kinds of roots, tubers, and bulbs were also used. Deer was the most important big game, supplemented by rabbits, quail, and other small mammals. Fishing was an important secondary food-procuring activity. Salmon entered most of the streams within the territory; they were taken with spears and harpoons. Trout and suckers were captured with bone gorges, seine nets, traps of woven willow branches, and with plant poisons.

During years with good acorn harvests the supply would last until the next harvest but after a poor crop the Yana were often on the verge of starvation. Normally, they had a relative abundance of food in the fall when salmon, acorns, buckeye, deer, and other food sources were available. During the hot summer months after the greens had shriveled and the seed plants were spent, there was little food available below 2,500 feet. The search for food and avoidance of the heat in the foothills was probably the primary stimulus for the seasonal migration to higher elevation where deer, berries, and seed plants could be found.

The political and settlement organization of the Yana was based based on a system of tribelets, each having a major village where the principal chief and assembly house was located, and several smaller affiliated villages. Each tribelet held a particular territory that generally provided an adequate resource base for its population.

The Arguello exploratory expedition of 1821 was probably the first contact between the Yana and Europeans. Subsequent contacts up to the mid- 1840s would have been with trappers sent out by the Hudson's Bay Company. In 1844, the Mexican government granted land to several individuals in the upper Sacramento Valley and foothills. By 1848, the California-Oregon trail and the Lassen trail passed through Yana territory. Even though the southern Cascade foothills was one of the regions in California least affected by early American mining and settlement at this time, the use of the foothills as grazing land and the establishment of hunting cabins led to increasing hostilities and ultimately massacres of the native population by the ever-growing number of Euroamericans. In approximately 20 years, the Yana were reduced from 1,900

individuals to probably less than 100 people by the turn of the century. In 1973, 20 persons were able to identify themselves as Yana (Johnson 1978:361-369).

By the turn of the century, growth of the urban centers and the accelerating development of the mining and associated industries in Tehama and Shasta counties, placed a strain on the area's fuel resources. Massive amounts of timber were consumed to fire the boilers of steam-powered mining machinery and to operate smelters. The pressure placed on the local wood fuel supply to support the urban growth and the mining enterprises was probably the primary incentive to develop hydroelectric power in those counties (Reynolds and Scott n.d.:22). The Battle Creek Project was a component of that effort. The system included a series of small diversions, several canals, and low volume/high head power generators. Eagle Canyon Dam, reportedly built in 19 10, is one such diversion dam. The Battle Creek Hydroelectric Unit has been owned and operated by PG&E since the 1930s (Department of Water Resources 1997).

SURVEY METHODS

RECORD SEARCH

Base maps, site records, report files, and federal and state listings of significant cultural resources were reviewed at the Northeast Information Center at California State University, Chico. The closest survey on record was done east of the proposed project location. A prehistoric lithic scatter was found approximately a quarter mile east of Eagle Canyon Dam. This is the nearest known site. No historic sites have been recorded in the vicinity of the project.

FIELD RECONNAISSANCE

The field survey was carried out by the writer on November 6, 1997, accompanied by Brian Stewart and John Elko, Department of Water Resources, Northern District. The proposed project area consisted of the Eagle Canyon Dam itself in the bottom of the canyon, a South Rim Staging Area and access road, and a North Rim Staging Area and access road.

From the end of the access road at the South Rim Staging Area, the dam is reached by walking one quarter-mile down a steep and narrow path to the bottom of Eagle Canyon. The dam is a masonry structure approximately 15 feet high by 65 feet long, spanning the narrow gorge (see Appendix A). It is built of local basalt rocks, 6 inches to 2 feet in diameter. The cement mortar has been replaced in several areas (Department of Water Resources 1997: Appendix F). The fish ladder and some of the appurtenances on the left side of the dam were added sometime after original construction (personal communication, Brian Stewart).

The South Rim Staging Area covered an area about 75 feet north-south by 480 feet east-west.

The North Rim Staging Area measured approximately 135 feet north-south by 2 10 feet east-west. Each of the access roads were single lane dirt ranch roads approximately one mile long.

Other than the dam and appurtenances, the project area within the canyon consisted of the nearly vertical canyon walls and the channel of North Fork Battle Creek, a jumble of bedrock exposures, boulders, and cobbles. Accessible rock surfaces were examined both for rock art and grinding/
milling features such as slicks and bedrock mortars; there was no potential for other types of prehistoric sites or features in the canyon bottom.

The ground surface on the access roads and staging areas had excellent visibility. The staging areas were examined using overlapping transects spaced no greater than three meters apart. Survey coverage was complete and intensive.

SURVEY FINDINGS

The result of the record search was negative for the proposed project. The nearest known site, a lithic scatter, was approximately one quarter mile upstream. Other than the dam itself, no other cultural resources were identified during the survey within the project boundaries. The left side of the dam has been extensively modified since original construction. With the exception of minor mortar replacement, the remainder of the structure appears to have reasonably good integrity.

The Eagle Canyon Dam is a contributing element of the Battle Creek Hydroelectric System which has been determined to be a typical turn-of-the-century California hydroelectric system (Reynolds and Scott n.d.). The dam on its own, does not have completely intact historic integrity but does have some degree of importance as a component within the context of the entire hydroelectric system. For the purposes of the proposed project, the dam is documented by the Primary Record in Appendix A, and no further work is warranted at this time.

REFERENCES CITED

Department of Water Resources
1997 Preliminary Engineering Technical Report: North Fork Battle Creek Eagle Canyon Diversion Fish Passage Project. Northern District, Red Bluff.

Johnson, Jerald Jay
1978 Yana. In: Handbook of North American Indians, Vol. 8, California, Robert F. Heizer, ed., pp.3 6 1-3 69. Washington: Smithsonian Institution.

Reynolds, Terry S. And Charles Scott
n.d. The Battle Creek Hydroelectric System and the North California Power Company 1900-19 19. Historic American Engineering Record, CA-2.

ATTACHMENT A

PRIMARY RECORD
EAGLE CANYON DIVERSION DAM

State of California — The Resources Agency
DEPARTMENT OF PARKS AND RECREATION
PRIMARY RECORD

Primary #
HRI #
Trinomial
NRHP Status Code
Other Listings
Review Code Reviewer Date

Page 1 of 6 *Resource Name or #: (Assigned by recorder) Eagle Canyon Dam

P1. Other Identifier:

● P2. Location: ☐ Not for Publication ☐ Unrestricted *a. County Shasta and Tehama

and (P2b and P2c or P2d. Attach a Location Map as necessary.)

● b. USGS 7.5' Quad Shingle town Date 1985 T30N; R 1W; NW ¼ of SE ¼ of Sec 25;

c. Address N. Fork Battle Cr. 2.5mi. SW of Manton City n.a. Zip n.a.

d. UTM: (Give more than one for large and/or linear resources) Zone 10; 591800 mE/4475200 mN

e. Other Locational Data: (e.g., parcel #, directions to resource, elevation, etc., as appropriate) Eagle Canyon Dam straddles the Shasta-Tehama Countyline through the middle of the streambed of N. Fork Battle Cr. It is located about 500 feet downstream of the confluence of Digger Cr. with N. Fork

*P3a Description: (Describe resource and its major elements. Include design, materials, condition, alterations, size, setting, and boundanes)

Eagle Canyon Dam was built during the early 1900s as a component of the Battle Creek Hydroelectric System. Growth of the urban centers in Shasta and Tehama counties and the boom times of mining and smelting enterprises placed enough pressure on the local wood fuel supply to provide incentives to develop hydro-electric power.

The dam is a masonry structure built of local basalt rock from 6 inches to 2 feet in diameter. It is 15 feet high and 65 feet long. The cement mortar has been replaced in several areas. The right side and central sections of the dam appear to have good historic structural integrity. However, the fish ladder, now not operational, and the appurtenances on the left side of the dam were added during later periods.

The Battle Creek Hydroelectric System has been assessed to represent a typical California turn-of-the-century hydroelectric system (HAER CA-2).

*P3b. Resource Attributes: (List attributes and codes) HP 21 Dam

● ?4. Resources Present: ☐Building ☐ Structure ☐ lObject ☐Site ☐District ☐Element of District ☐Other (Isolates, etc.)

P5b. Description of Photo: (View, date, accession #) Eagle Canyon Dam. View upstream to NE. 11/6/97

● P6. Date Constructed/Age and Sources: ☒Historic ☐ Prehistoric ☐ Both
Early 1900s; later modifications

●7*P7. Owner and Address:
Pacific Gas & Electric Co.
3600 Meadow View Rd.
Redding, CA 96002

*P8 Recorded by: (Name, affiliation, and address) R. I. Orlins
Dept. of Water Resources
Envir. Services Office
Sacramento, CA

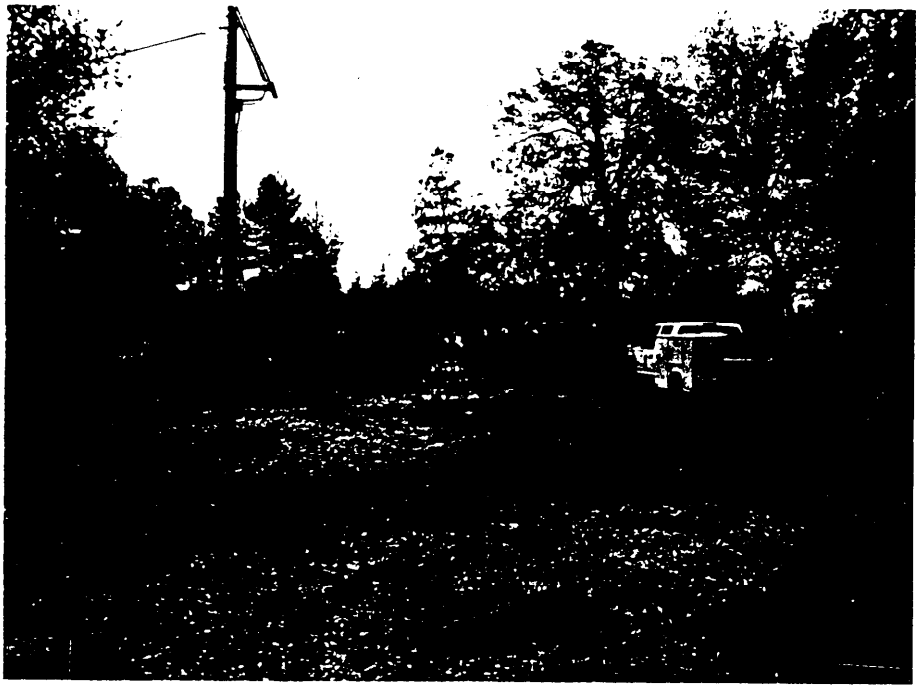
*P9. Date Recorded: 11 /6/97

● P10. Survey Type: (Describe) Reconnaissance Survey for DWR fish passage project.

*P11. Report Citation: (Cite survey report and other sources, or enter "none.") A Cultural Resource s Survey for the North Fork Battle Creek Eagle Canyon Dam Fish Passage Project, Shasta & Tehama Counties

*Attachments: NONE @Location Map ☒Sketch Map ☒Continuation Sheet ☐Building, Structure, and Object Record'
☐ Archaeological Record ☐District Record ☐Linear Feature Record ☐ M$ng Station Record ☐Rock Art Record
☐Artifact Record ☐ Photograph Record ☐ Other (List)

P2e. Battle Cr. and approx. **3** miles west of the community of Manton.
To access the South Rim Staging Area, take State Highway 36 from Red Bluff east 14 miles to Manton Rd. Take Manton Rd. north toward Manton. Three miles east of Wildcat Rd. there is a private ranch road on the north side of Manton Rd. Take this access road approx. **1** mile north to the rim of-the canyon. The trailhead down to the dam is near the power pole at the rim of the canyon at the end of the access road.
To reach the North Rim Staging Area, from Manton Rd. turn north onto Wildcat Rd. Go 2 miles and turn east onto Battle Cr. Bottom Rd. Proceed approx. 3 miles and turn south onto a private ranch road. Take this access road approx. 1 mile to the rim of the canyon.
The south rim access road runs through land owned by Mr. Leland Davis, Red Bluff
The north rim access road runs through land owned by Mr. Frank Matas, Los Gatos.
Elevation of the dam is 1412.1, feet at its crest. The staging areas are at the 1600 ft. elevation.



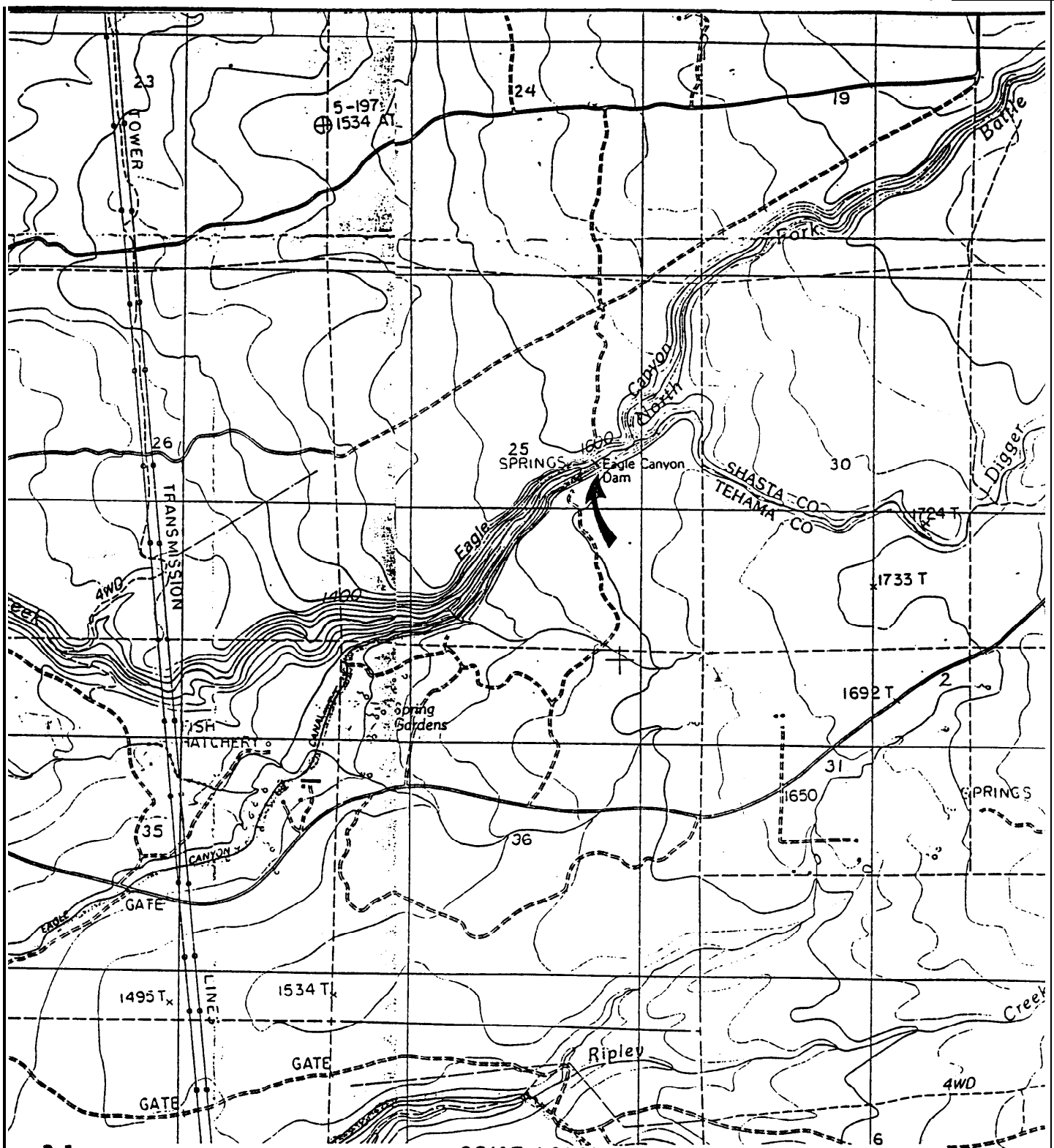
a. View south of South Rim Staging Ares.

b. View southwest of North Rim Staging Area.

State of California — The Resources Agency — Primary #
DEPARTMENT OF PARKS AND RECREATION — HRI#
LOCATION MAP — Trinomial

Page 4 of 6 — *Resource Name or # (Assigned by recorder) Eagle Dam

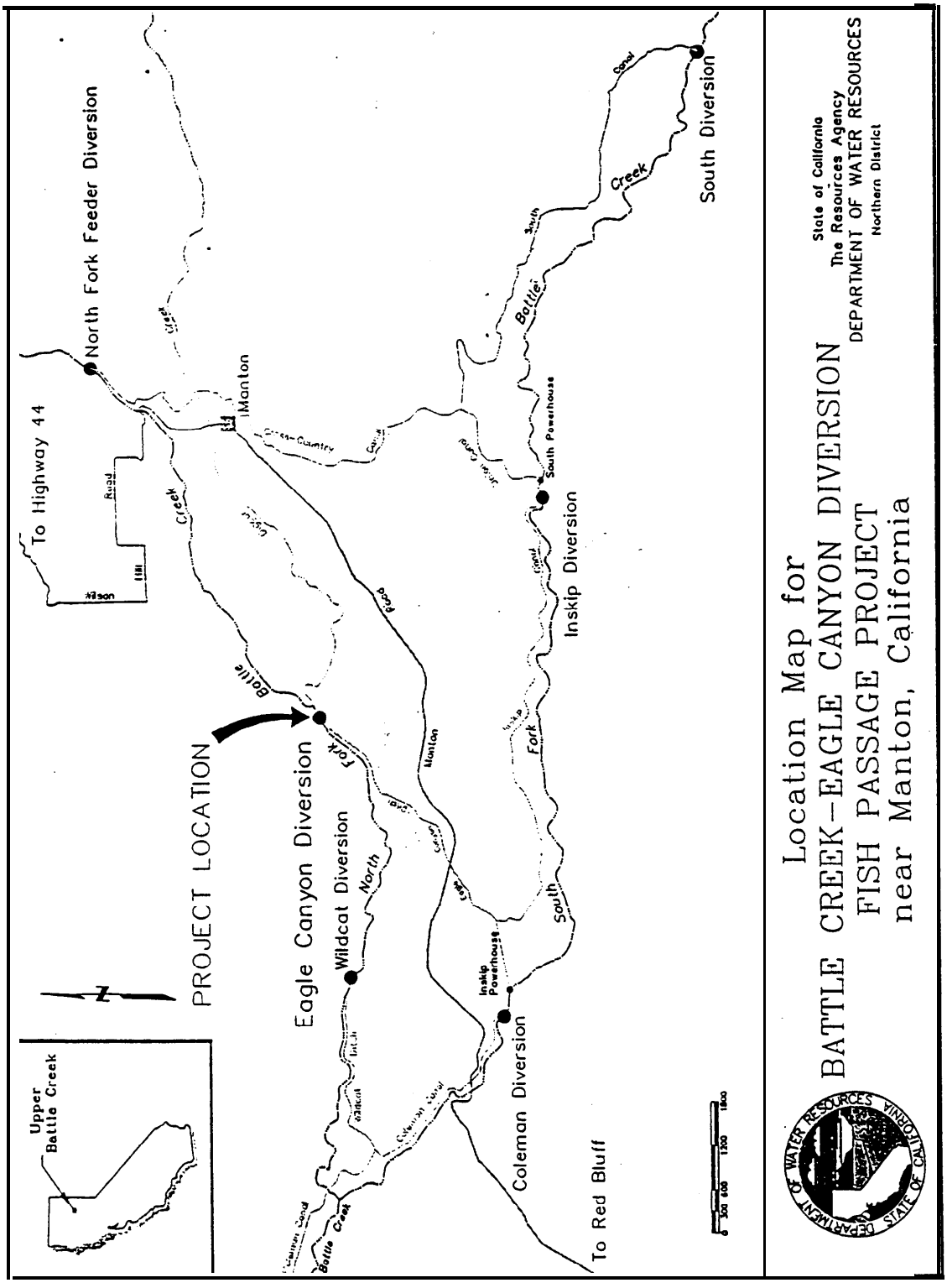
*Map Name: Shingletown 7.5' — *Scale: 1:24000 — *Date of Map: 1985



State of California — The Resources Agency — Primary #
DEPARTMENT OF PARKS AND RECREATION — HRI#
LOCATION MAP — Trinomial

Page 5 of 6 *Resource Name or # (Assigned by recorder) Eagle Canyon Dam

*Map Name: n. a. *Scale: n.a. 'Date of Map: 1997



State of California — The Resources Agency
DEPARTMENT OF PARKS AND RECREATION
SKETCH MAP

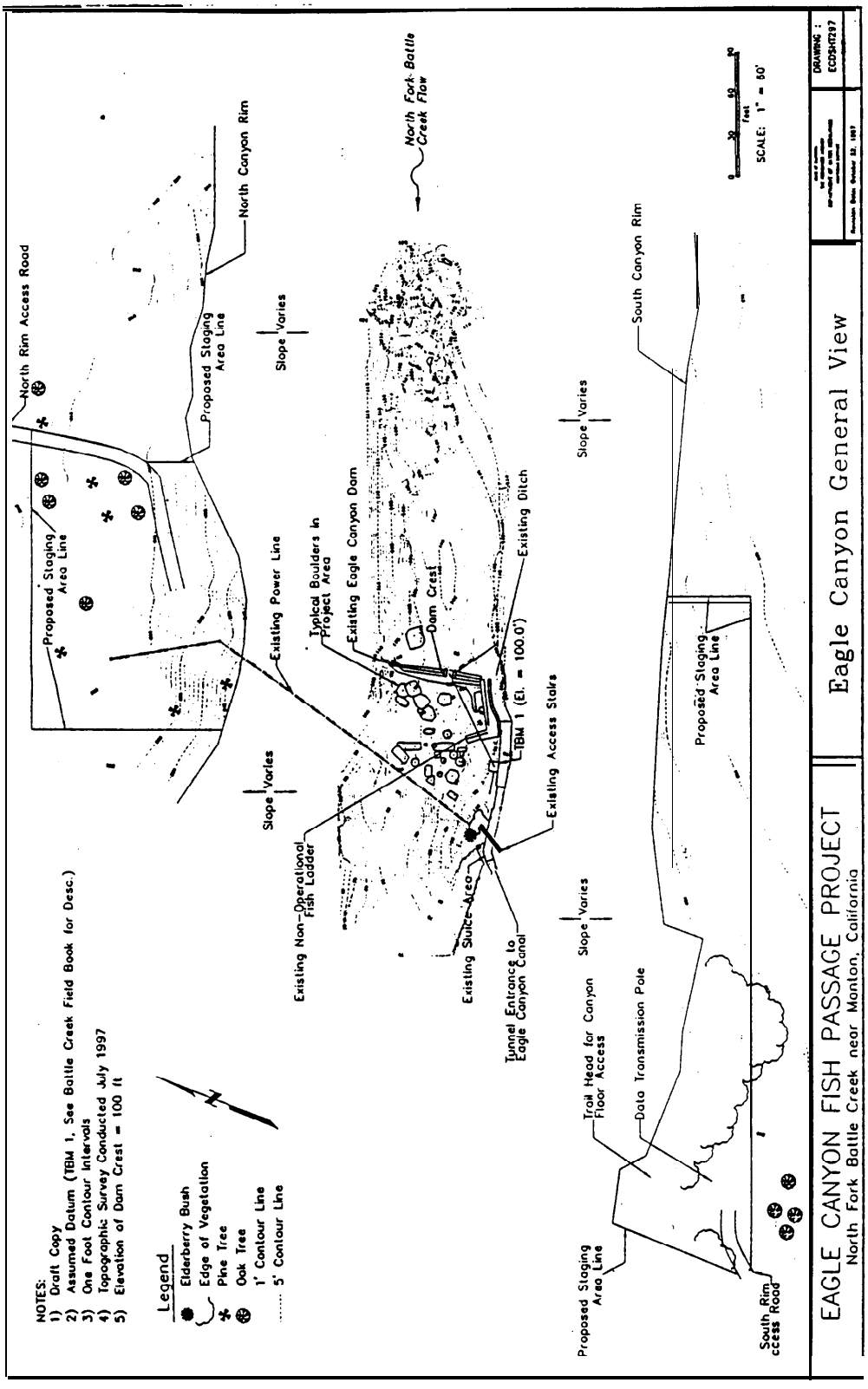
Primary #
HRI#
Trinomial

Page 6 of 6

*Resource Name or # (Assigned by recorder) Eagle Canyon Dam

*Drawn BY: DWR

*Date: 1/9/98



NOTE: Include bar scale and north arrow.

Appendix F

Project Geology Report

State of California

The Resources Agency

Memorandum

Date : November 17, 1997

To : Bill Mendenhall, Chief
Engineering Studies Section, Northern District

From : Frank L. Glick, Chief
Project Geology Section, Division of Engineering
Department of Water Resources

Subject: Eagle Canyon Dam, Proposed Fish Passage Project; Results of Geologic Inspection

Introduction

On July 2, 1997, I accompanied Glyn Echols and Kevin Dossey from the Northern District to inspect the geologic conditions at the location of a proposed fish passage project at Eagle Canyon Dam on North Fork Battle Creek. The dam is owned by PG&E and operated to divert water flows into Eagle Canyon Canal for power generation. It is located approximately 30 miles east-south-east from Redding, California, at the location shown on the attached map (Figure 1). This memorandum report was written to stand alone, but it is my understanding that it will be included as an appendix to the Preliminary Engineering Technical Report being prepared by the Northern District.

Site Description

Eagle Canyon Dam is in a narrow gorge about 200 feet deep and 300 feet wide (see Figure 2 - Topography Map). The dam is a masonry structure approximately 15 feet high and about 65 feet long. It has an existing non-operational fish ladder on the left end (southeast side) of the dam (see Photographs 1 and 2). A new fish ladder and screen structure is being planned at the same location. Access to the dam is only available by walking about one-quarter mile down a very steep and narrow path. The dam's crest at Elevation 1412.4 feet is about four feet wide and trends approximately N30°W across the southwest-flowing North Fork Battle Creek. It was reportedly built in about 1910 and utilized the local basalt rocks. The physical condition of the dam appears to be good considering its age and method of construction. The cement mortar has been replaced in several areas and overall looks good. The basalt rocks used in the dam are very hard and fresh; they show very few signs of deterioration (see Photographs 3 and 4). Average size is 6 inches to 2 feet. Moss is growing on many of the rocks exposed on the downstream dam face but that has not effected the strength of the rocks. Some water leaks through and under the dam but it does not appear to be critical.

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SURNAME			
DWR 155 (Rev 2/85	11/17/97		

The pond behind the dam is mostly filled in with silt, sand, gravel, cobbles, boulders, and miscellaneous debris so the depth of water averages only three to five feet (see Photograph 5). At the time of the inspection, water was flowing through the radial sluice gate structure in the center of the dam and also into the diversion canal. This dam is not under the jurisdiction of the Division of Safety of Dams.

There are numerous tunnels associated with the facilities at and near Eagle Canyon Dam. They all appear to be stable and functioning. A construction diversion tunnel still exists at the site but is not in use. The inlet to the this tunnel is about 125 feet upstream of the dam crest on the left side of the creek. The outlet is connected to the diversion canal currently in use. We were not able to inspect the construction diversion tunnel, but we assumed it was in good shape based on the high quality of the rock. This tunnel may be very useful during future construction of the proposed fish ladder to move the creek water around the work area.

Proposed Fish I adder and Screen

A new fish ladder and screen structure is proposed for the left side of the dam. It would be constructed adjacent to the Eagle Canyon Canal. From an engineering geology point of view, this appears to be the best location at the site for the proposed structure.

Geologic Conditions

Eagle Canyon Dam was built in a gorge where the canyon walls are nearly vertical along this reach of North Fork Battle Creek. The Westwood Sheet of the Geologic Map of California (scale 1:250,000) shows volcanic basalt rock in the project area. Office research by the Northern District geologists also indicated basalt should be found at the site. The presence of that rock type was confirmed on my inspection.

For the most part, the walls of the canyon appeared to be stable. Groundwater flows from numerous open vertical fractures and horizontal contacts between basalt flows in the rock (see Photograph 6) but this does not affect the overall stability. The presence of large, angular basalt blocks in the stream channel indicate that there are times when significant rockfalls occur. Regardless, it should be safe to work in the canyon during the relatively short duration of the proposed construction period.

The stream channel contains silt, sand, gravel, cobbles, and boulders up to 20 feet in size. It is difficult to distinguish some of the partially buried, large blocks of basalt from the inplace bedrock outcrops.

Foundation for the dam appears to be a combination of inplace basalt bedrock and large, independent basalt blocks in the stream channel. The quality of the rock is excellent. The left abutment of the dam and the existing canal is in bedrock while the right abutment is in talus material (see Photograph 7) with individual blocks up to 15 feet in size. There is the potential for erosion of the right abutment material.

It appears there was a problem with the right abutment material and approximately 8 feet of the dam was repaired there. Also, extra concrete has been added to fill in the spaces between individual blocks in the right abutment and downstream area. The foundation was not stripped to bedrock probably because the independent blocks were too large to move. There are a few drill holes exposed in the rocks at the site indicating some blasting was performed during construction.

Geologic Exploration

Geologic exploration is not needed to design and construct a fish ladder at the proposed site. The materials at the site are clearly visible. The cost of mobilizing drilling or other exploration equipment at the site would not be worth the additional information gained. We already know that the hard and fresh basalt bedrock will be more than adequate to support the proposed fish ladder. The only remaining question is: What part of the proposed fish ladder will be founded on bedrock and what part will be on independent blocks of basalt? That question can be fully answered only during actual construction.

Construction and Excavation

If DWR takes this project through to construction, then I recommend that a DWR engineering geologist be on-site during construction of the fish ladder structure to inspect and/or approve the rock at foundation grade. The same recommendation is made for a private engineering geologist if DWR does not construct the project.

Any loose rocks smaller than three to four feet in size should be removed from the foundation. The final disposition of rocks larger than that size range in the foundation should be evaluated on a case by case basis. Overexcavated areas should be backfilled with concrete. Also, all exposed openings between rocks and any bedrock fractures should be filled with concrete. Blasting should not be permitted during construction because of the potential damage to the adjacent dam and canal. Blasting could also open-up rock fractures that are presently closed. Lastly, if at all possible, any rock that is too hard and/or too large to be removed should be left inplace.

Excavation andsubsequent placement of concrete should be performed in dry conditions. Dewatering will be required at this site. Small sump pumps should be able to handle all inflows of water, providing the creek flows are successfully diverted around the construction area.

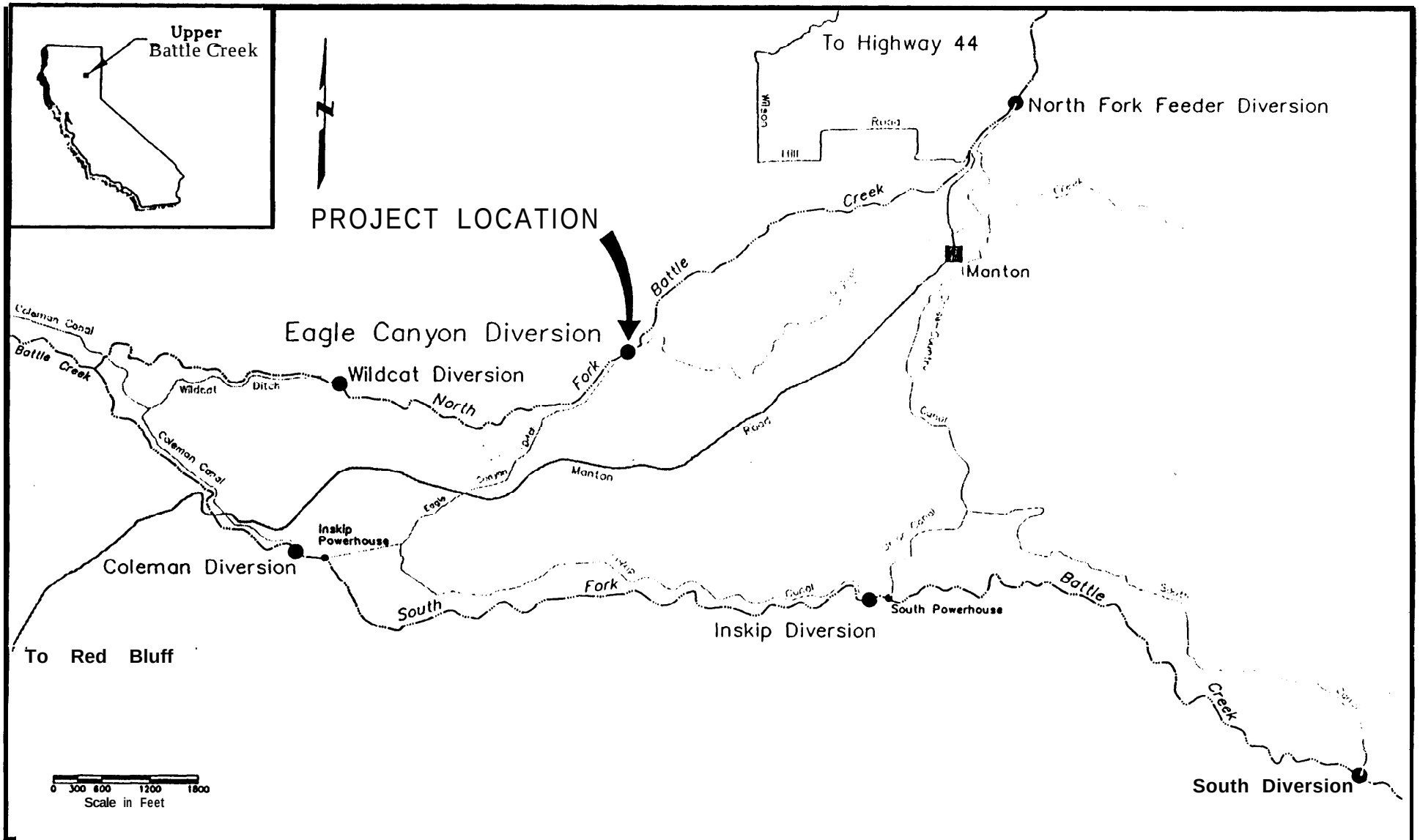
One possible method of diverting the creek is by constructing a temporary cofferdam upstream of the existing dam and creating a diversion channel through the right abutment. Special care should be taken during construction to prevent erosion of those materials.

There is very little room in the canyon near the dam for a contractor to store equipment and supplies. It is likely the contractor will want to set up a staging area on one or both of the canyon rims. During my site visit on July 2, 1997, I did not inspect the rims for stability. However, I suggest that equipment, supplies, and personnel should stay at least 20 feet away from the rims because adding weight too close to the edge of the canyon could cause blocks of rock to break away. If there is enough space, a set back distance of 50 feet would be preferable.

Thank you for the opportunity to assist you. Please feel free to call me at (916) 653-9624 if you have any questions or need additional information.

Attachments

FIGURES



Location Map for
BATTLE CREEK-EAGLE CANYON DIVERSION
FISH PASSAGE PROJECT
near Manton, California

State of California
The **Resources Agency**
DEPARTMENT OF WATER RESOURCES
Northern District

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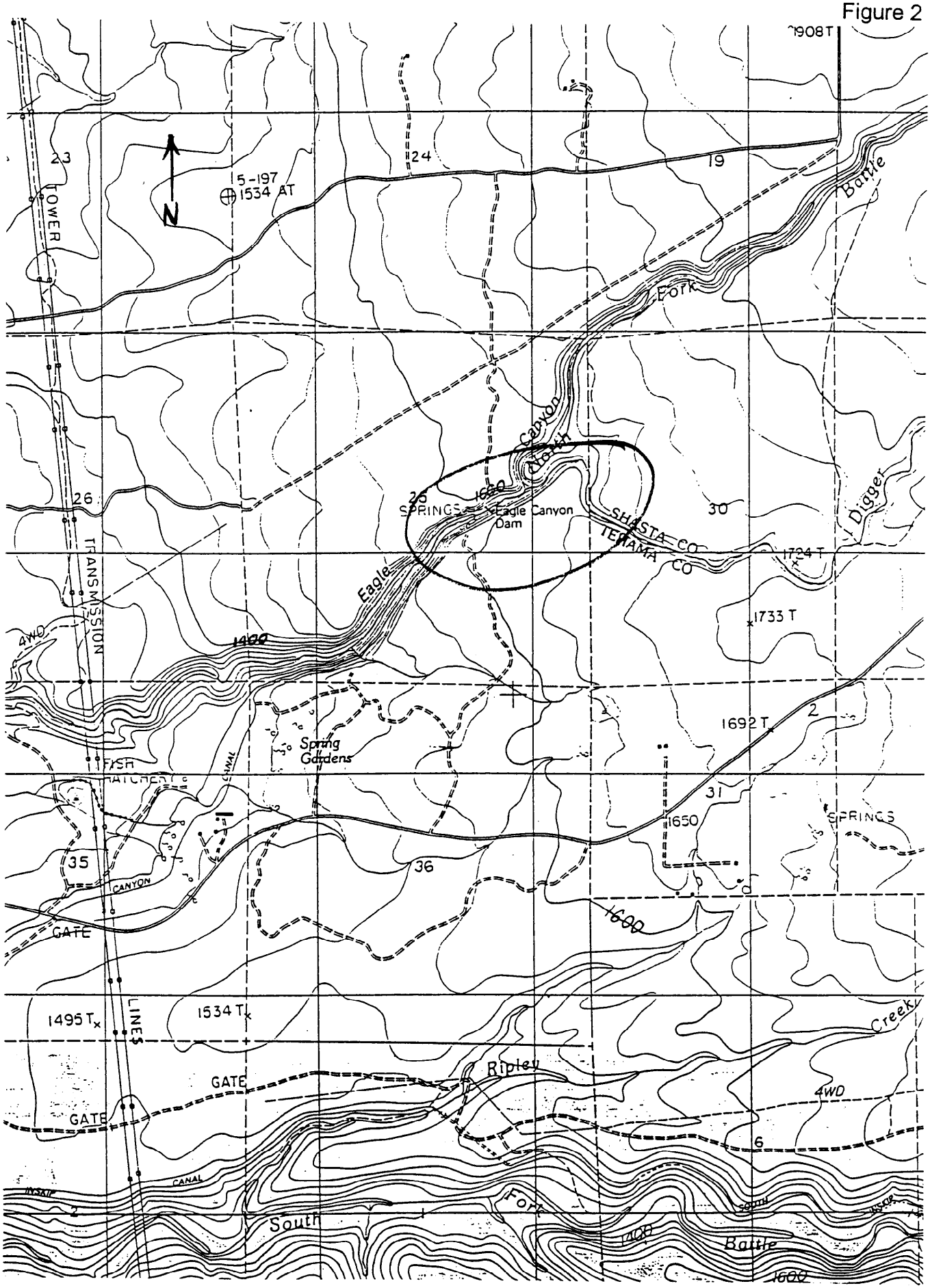
Figure 1

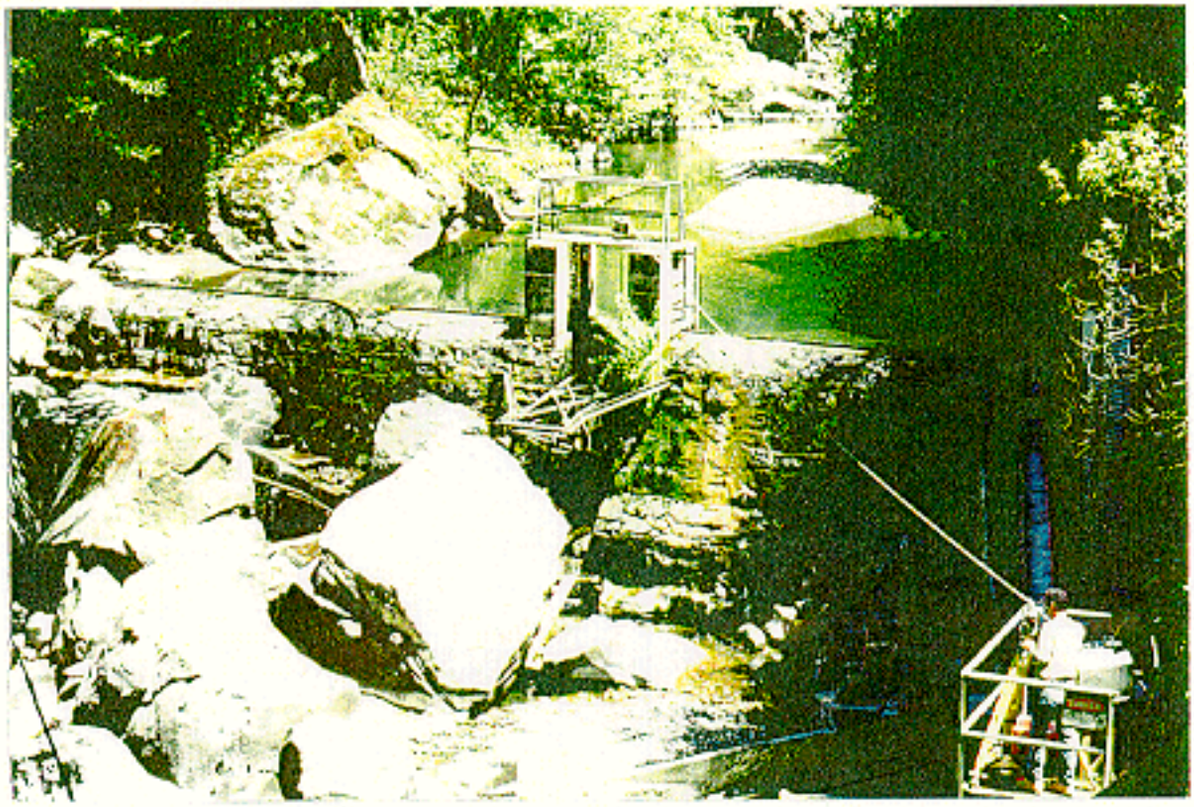
Figure 2



EAGLE CANYON DAM
TOPOGRAPHIC MAP
Scale 1" = 2,000'

PHOTOGRAPHS

Photograph 1: View looking northeast at the downstream face of Eagle Canyon Dam. Radial sluice gate structure is in center of dam. Old fish ladder is on left side of dam (right side of photograph).



Photograph 2: Another view looking northeast at the downstream face of Eagle Canyon Dam. Note large basalt rocks in the stream channel; some are incorporated into the foundation of the dam.

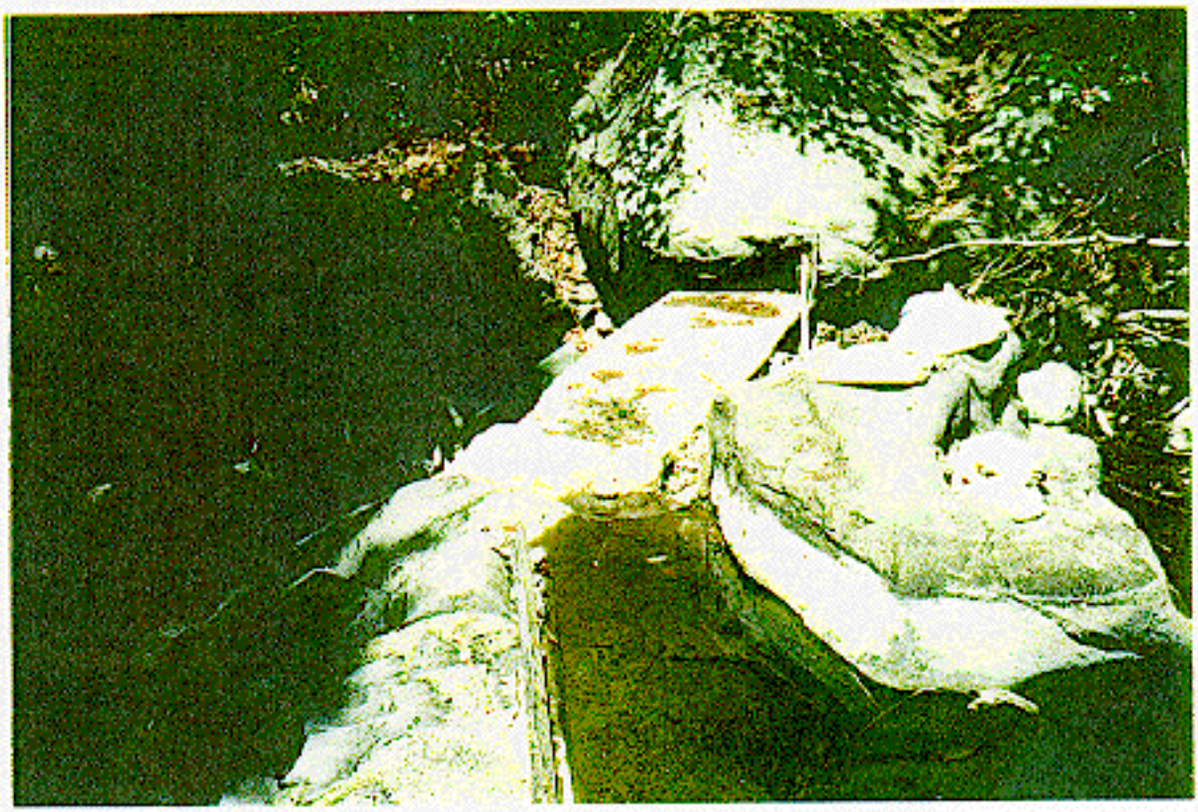
Photograph 3. Close-up view of the toe of the dam. Note water seeping through the dam and moss growing on the rocks. The existing fish ladder is just out of the right side of the photograph.

Photograph 4. Extreme close-up view of dam foundation. The rock in the dam labeled "A" is also shown in Photograph 3. Area "B" is concrete placed between two rocks. Inplace bedrock is not exposed here.

Photograph 5: View of pond and stream channel upstream of the dam. Photo was taken while standing on the center of the dam.

Photograph 6: Close up view of groundwater flowing from an open horizontal contact between basalt flows exposed in the canyon wall.

Photograph 7: Right abutment of Eagle Canyon Dam is based in talus material. A repair of the dam at the abutment suggests some erosion problems in the past.



Appendix G

Environmental Notes

ENVIRONMENTAL CHECKLIST FORM

PROJECT LOCATION: Battle Creek at Eagle Canyon Dam-Shasta and Tehema Counties
City *County*

PROJECT ADDRESS: _____

_____

DESCRIPTION OF PROJECT: Improve fish passage in the vicinity of Eagle Canyon Dam

_____

_____

_____

ENVIRONMENTAL IMPACTS:

	Yes	Maybe	No
1. Earth. Will the proposal result in:			
a. Unstable earth conditions or in changes in geologic substructures?			X
b. Disruptions, displacements, compaction, or overcovering of the soil?		X	
c. Change in topography or ground surface relief features?		X	
d. The destruction, covering, or modification of any unique geologic or physical features?			X
e. Any increase in wind or water erosion of soils, either on or off the site?		X	
f. Changes in deposition or erosion of beach sands, or changes in siltation, deposition or erosion which may modify the channel of a river or stream or the bed of the ocean or any bay, inlet, or lake?		X	
g. Exposure of people or property to geologic hazards such as earthquakes, landslides, mudslides, ground failure, or similar hazards?			X
2. Air. Will the proposal result in:			
a. Substantial air emissions or deterioration of ambient air quality?			X
b. The creation of objectionable odors?			X
c. Alteration of air movement, moisture, or temperature, or any change in climate, either locally or regionally?			X

	Yes	Maybe	No
3. Water Will the proposal result in:			
a. Changes in currents, or the course of direction of water movements, in either marine or fresh waters?			X
b. Changes in absorption rates, drainage patterns, or the rate and amount of surface runoff?		X	
c. Alterations to the course or flow of flood waters?			X
d. Change in the amount of surface water in any water body?		X	
e. Discharge into surface waters, or in any alteration of surface water quality, including but not limited to temperature, dissolved oxygen, or turbidity?		X	
f. Alteration of the direction or rate of flow of ground waters?			X
g. Change in the quantity of ground waters, either through direct additions or withdrawals, or through interception of an aquifer by cuts or excavations?			X
h. Substantial reduction in the amount of water otherwise available for public water supplies?			X
i. Exposure of people or property to water-related hazards such as flooding or tidal waves?			X
4. Plant Life. Will the proposal result in:			
a. Change in the diversity of species, or number of any species of plants (including trees, shrubs, grass, crops, and aquatic plants)?		X	
b. Reduction of the numbers of any unique, rare, or endangered species of plants2		X	
c. Introduction of new species of plants into an area, or in a barrier to the normal replenishment of existing species?			X
d. Reduction in acreage of any agricultural crop?		X	
5. Animal Life. Will the proposal result in:			
a. Change in the diversity of species, or numbers of any species of animals (birds, land animals including reptiles, fish, and shellfish, benthic organisms, or insects)?		X	
b. Reduction of the numbers of any unique, rare, or endangered species of animals?		X	
c. Introduction of new species of animals into an area, or result in a barrier to the migration or movement of animals?			X
d. Deterioration to existing fish or wildlife habitat?		X	

	Yes	Maybe	No
6. Noise. Will the proposal result in:			
a. Increases in existing noise levels?	X		
b. Exposure of people to severe noise levels?			X
7. Light and Glare. Will the proposal produce new light or glare?			X
8. Land Use. Will the proposal result in a substantial alteration of the present or planned land use of an area?			X
9. Natural Resources. Will the proposal result in:			
a. Increase in the rate of use of any natural resources?			X
b. Substantial depletion of any non- renewable natural resource?			X
10. Risk of Upset. Will the proposal involve:			
a. A risk of an explosion or the release of hazardous substances (including, but not limited to, oil, pesticides, chemicals, or radiation) in the event of an accident or upset conditions?		X	
b. Possible interference with an emergency response plan or an emergency evacuation plan?			X
11. Population. Will the proposal alter the location, distribution, density, or growth rate of the human population of an area?			X
12. Housing. Will the proposal affect existing housing, or create a demand for additional housing?			X
13. Transportation / Circulation. Will the proposal result in:			
a. Generation of substantial additional vehicular movement?			X
b. Effects on existing parking facilities, or demand for new parking?			X
c. Substantial impact upon existing transportation s ys terns?			X
d. Alterations to present patterns of circulation or movement of people and / or goods?			X
e Alterations to waterborne, rail, or air traffic?			X
f. Increase in traffic hazards to motor vehicles, bic yclis ts, or pedestrians?			X

	Yes	Maybe	;No
14. Public Services. Will the proposal have an effect upon, or result in a need for new or altered governmental services in any of the following areas:			
a. Fire protection?	____	____	X
b. Police protection?	____	____	X
c. Schools?	____	____	X
d. Parks or other recreational facilities?	____	____	X
e. Maintenance of public facilities, including roads?	____	____	X
f. Other governmental services?	____	____	X
15. Energy. Will the proposal result in:			
a. Use of substantial amounts of fuel or energy?	____	____	X
b. Substantial increase in demand upon existing sources of energy, or require the development of new sources of energy?	____	____	X
16. Utilities. Will the proposal result in a need for new systems, or substantial alterations to the following utilities:			
a. Power or natural gas?	____	____	X
b. Communications systems?	____	____	X
c. Water?	____	v	____
d. Sewer or septic tanks?	____	____	X
e. Storm water drainage?	____	X	____
f. Solid waste and disposal?	____	____	
17. Human Health. Will the proposal result in:			
a. Creation of any health hazard or potential health hazard (excluding mental health)?	____	____	
b. Exposure of people to potential health hazards?	____	____	
18. Aesthetics. Will the proposal result in the obstruction of any scenic vista or view open to the public, or will the proposal result in the creation of an aesthetically offensive site open to public view?	____	____	
19. Recreation. Will the proposal result in an impact upon the quality or quantity of existing recreational opportunities?	____	____	X
20. Cultural Resources.			
a. Will the proposal result in the alteration of or the destruction of a prehistoric or historic archaeological site?	____	X	____
b. Will the proposal result in adverse physical or aesthetic effects to a prehistoric or historic building, structure, or object?	____	X	____

	Yes	Maybe	No
c. Does the proposal have the potential to cause a physical change which would affect unique ethnic cultural values?	____	X	____
d. Will the proposal restrict existing religious or sacred uses within the potential impact area?	____	____	X
21. Mandatory Findings of Significance.			
a. Does the project have the potential to degrade the quality of the environment, substantially reduce the habitat of a fish or wildlife species, cause a fish or wildlife population to drop below self-sustaining levels, threaten to eliminate a plant or animal community, reduce the number or restrict the range of a rare or endangered plant or animal, or eliminate important examples of the major periods of California history or prehistory?	____	X	____
b. Does the project have the potential to achieve short-term, to the disadvantage of long-term, environmental goals? (A short-term impact on the environment is one which occurs in a relatively brief, definitive period of time, while long-term impacts will endure well into the future.)	____	____	X
c. Does the project have impacts which are individually limited, but cumulatively considerable? (A project may impact on two or more separate resources where the impact on each resource is relatively small, but where the effect of the total of those impacts on the environment is significant.)	____	____	X
d. Does the project have environmental effects which will cause substantial adverse effects on human beings, either directly or indirectly?	____	____	X

Table 1. Environmental Permits Potentially Required for the Proposed Battle Creek Fish Passage Improvement Project

Federal

- USACE 404 Permit-Nationwide Permits
  - Nationwide Permit 4-Fish and wildlife harvesting, enhancement, and attraction devices
  - Nationwide Permit 33-Temporary construction, access and dewatering
- Federal Endangered Species Act Compliance (see table 2)
  - Federally listed species are present, will need federal nexus for Section 7 ESA
- Nepa Compliance (if federal funds or approvals are involved)

State

- RWQCB 401 Water Quality Certification
- RWQCB Stormwater Permit (if ground disturbance involves more than 5 acres)
- DFG 1600 Agreement
- CEQA Compliance (Categorical exemptions may apply)
- State Endangered Species Act Compliance (see table 2)

Local

- Shasta County grading ordinance

Table 2. State and federally "listed" species that may occur in the Battle Creek Fish Passage Improvement project area and their current status (continued)

Common Name	Scientific Name	Status/Listing
silky cryptantha	*Cryptantha crinita*	F CAT 2, CNPS lb
Red Bluff dwarf rush	*Juncus leiospermus leispermus*	F3c, CNPS lb
legenere	*Legenere limosa*	F CAT 2, CNPS lb
Ahart's paronychia	*Paronychia ahartii*	F CAT 2, CNPS lb
red flowered lotus	*Lotus rubriflorus*	F CAT 2, CNPS lb
Shasta ciarkia	*Clarkia borealis ardi*	F CAT 2, CNPS lb
Bogg's Lake hedge-hyssop	*Gratida heterosepala*	CE, CNPS lb
Sanford's arrowhead	*Sagittaria sanfordii*	F CAT 2. CNPS lb
four-angled spikerush	*Eleocharis quadrangulata*	CNPS 2
slender orcutt grass	*Orcuttia tenuis*	CE, FC *2,* CNPS lb
Butte County fritillaria	*Fritillaria eastrvoodiae*	F CAT 2. CNPS lb

FE federal endangered
FT-federal threatened
CE California endangered
CT California threatened
CSSC- California species of special concern
C CAND-California candidate
F CAT 1 Proposed federal
F CAT 2 Proposed federal
CNPS 1 b- California Native Plant Society List (Rare or endangered in California and elsewhere)
CNPS 2- California Native Plant Society List (Rare or endangered in California but more common elsewhere)

Table 3. Potential environmental issues related to aspects of the three alternatives under the Battle Creek Fish Passage Improvement Project

Fish Ladder Construction

Short Term
- increased turbidity, suspended solids
- hazardous material spills (diesel, oil, gas)
- mechanical damage to dam (project engineer says not likely)
- take of aquatic and riparian species and habitat
- disturbance/displacement of upland wildlife
- 'take of valley elderberry longhorn beetle
- increased dust and noise

Long term
- improved fish passage
- increased maintenance
- mechanical damage to dam (project engineer says not likely)
- increased safety hazard and liability?
- impacts to dam historical value

Fish **Screen**

Short Term
- decreased short term water delivery to users?
- hazardous material spills (diesel, oil, gas)
- turbidity
- take of aquatic and riparian species and habitat
- take of valley elderberry longhorn beetle
- increased dust and noise

Long term
- increased maintenance-permanent habitat loss
- decreased fish loss and mortality
- increased safety hazard and liability

Staging Areas and Access **Road Improvement**

Short Term
- loss of upland habitat and effects on wildlife
- archeological concerns
- soil loss, erosion
- increased turbidity, suspended solids
- increased dust and noise
- hazardous material spills (diesel, oil, gas)
- take of fairy shrimp and other vernal pool species

Long term
- loss of upland habitat and effects on wildlife
- impact to historical resources

December 29, 1997

Brian Stewart

Dave Bogener

Battle Creek Elderberry Mitigation

Your E-mail message dated December, 11 1997 requested information on costs associated with mitigation of the clump of elderberry bushes present at the Eagle Canyon project area. I am unable to provide cost information until the stakeholders decide which avoidance and mitigation measures they would like to propose. The costs will vary significantly depending on which approach is used. I have outlined the potential mitigation and avoidance measures which are practical at this location in this memo.

The valley elderberry longhorn beetle (Desmocerus caiifornicus dimorphus) was listed as a threatened species by U. S. Fish and Wildlife Service during August 1980 (Federal Register 45: 52803-52807). This listing provided the valley elderberry longhorn beetle with protection under the federal Endangered Species Act. The valley elderbeny longhorn beetle completes its entire life cycle within or upon mature (greater than 1 inch in diameter at ground level) elderberry (Sambucus sp.) bushes. Elderberry bushes occur in the remaining stands of valley riparian forests and woodlands as well as associated upland habitats.

A single elderberry bush (with multiple stems) is located within the proposed project area on Battle Creek at Eagle Canyon Dam. The project engineer initially believed that this bush can be preserved in place during project construction. However, if any disturbance within 20 feet of the dripline of this clump of elderberries is contemplated, it is prudent (and legally mandated) that an elderberry avoidance and mitigation plan be developed (by project sponsors) and approved (by US Fish and Wildlife Service) prior to project construction.

US Fish and Wildlife Service guidelines recommend a buffer area be established within 20 feet of the dripline of elderberry bushes containing at least one stem greater than one inch in diameter at ground level. No ground or vegetative disturbance is allowed within this buffer strip. Retention of the recommended buffer strip at the Eagle Canyon site could impact both the fish ladder and the limited equipment area on the small existing pad. However, several options or approaches can considered which would allow construction to proceed while meeting the US Fish and Wildlife guidelines including:

- *transplanting on site followed by extended survival monitoring*
- *extensive pruning and protection in place followed by extended survival monitoring*
- *off-site mitigation.*

Transplanting on-site is relatively impractical in the steep canyon. However, transplanting into a constructed planter of adequate size on-site might be possible. Transplanting to the adjacent uplands (blue oak-foothill pine habitat) offers little chance for long-term plant sutvival. Pruning and protection in place would be the most economical and would offer the greatest opportunity for long-term survival if the root mass is not damaged. Off-site mitigation would involve a long-term financial and or maintenance obligation by the stakehoiders. Four stems greater than one inch are present. No emergence holes are present on any of the live stems. Mitigation requirements would involve

- *acquiring a suitable mitigation site (usually within one mile of the project)*
- *planting and maintaining eight elderberries (2 to 7 when no emergence holes are present) and eight associated native shrub or tree species*
- *stocking rate not to exceed 7,800 square feet per 5 elderberry plantings*
- *use of native ground cover in mitigation area*
- *construction and operation of a watering system*
- *Protection of elderberries and associated plantings in <u>perpetuity</u>*
- *At least 70 years of survival monitoring*
- *Following monitoring deed transfer to resource agency or private organization (such as the Nature Conservancy)*
- *Development of a maintenance plan which includes weed control measures (no pesticide, herbicide and fertilizer use) litter control, fencing and signing, monitoring and funding*

If the stakeholders propose to transplant on-site or prune and protect in place, a mitigation plan will have to be developed and approved. This plan must be implemented if plant dies. Obviously, insuring the plants survival on-site is more economical than off-site mitigation. Both US Fish and Wildlife Service and the California Department of Fish and Game own lands near the mouth of Battle Creek which would be suitable mitigation areas. Use of these lands for elderberry mitigation would reduce the mitigation costs by eliminating the costs associated with land purchase. Further, both water and maintenance personnel are present at the fish hatchery.

Under a ESA Section 7 formal consultation, US Fish and Wildlife Service has up to 180 days to issue a biological opinion on a proposed mitigation and avoidence plan. This timeline requires the stakeholders to make a decision on avoidence measures and potential mitigation areas in the very near future.