APPENDIX F – ALTERNATIVES 1-7 AND 10% DESIGN PLATES

TABLE OF CONTENTS

LIST OF TABLES

LIST OF PLATES

SECTION 1 -- Introduction

1.1 REVIEW OF SITING ALTERNATIVES

1.1.1 Introduction

The formulation of the "Federally Preferred Alternative" is accomplished by re-assessing the 7 alternatives previously investigated in the *Final Concept Design Report, February 2003*. The 7 alternatives are located at 3 sites: the existing diversion dam and fish trap location, the USGS gaging station, and at Mud Mountain Dam (MMD). These alternatives are evaluated in the context that fish passage is required around the existing diversion for upstream (Gaging Station and MMD) alternatives. This process includes describing the physical layout, operation, and cost of each of the seven alternatives followed by a comparison of the alternatives. The descriptions are followed by a comparison of the alternatives. This process concludes with a recommended Federally Preferred Plan. The Federally Preferred Plan is refined and compared to the Locally Preferred Plan in Section 4.

1.1.2 Alternative 1 – Existing Left Bank Trap-and-Haul with Ogee Weir and Radial Gate @ Diversion Dam Site

1.1.2.1 Physical Description

(a) Trap-and-Haul

i) The schedule modifications to the trap-and-haul facilities utilize much of the Corps' existing left bank trap-and-haul facilities, but also include several upgrades and modifications (see - Plates 3 and 9). Specifically, the existing ladder, holding pool, loading pool and fish hopper will remain largely intact with only relatively minor repairs and improvements. Major improvements and modifications include the following: a new supply intake with fish screens, screen cleaner and sediment control pump, a new auxiliary attraction water supply channel with upstream control gate and a new fish ladder entrance with entrance slot and entrance channel.

ii) The new trap-and-haul water supply intake is located at the existing PSE diversion channel intake. River flow enters the supply intake through a series of eight vertical fixed-plate fish screens aligned parallel to river flow and inline with the upstream left riverbank. The eight 6-ft high by 8-ft wide screen panels are designed to comply with current juvenile fish screen criteria while passing the maximum 130-cfs diversion flow. A concrete training wall flush with the screens' face extends upstream to block the remainder of the existing diversion intake. The tops of the screen panels are set below the normal pool level to remain submerged at all times. A brush-type system will automatically clean the upstream screen faces, and will be stowed out of the water when not in operation.

iii) The intake chamber behind the fish screens functions as a common forebay serving both the holding and loading pool flow demands as well as the new auxiliary water supply (AWS) channel. The existing control gates for the holding and loading pool water supply system will be retained. By default, the forebay also functions as a settling basin for suspended sediment, which pass through the screens and deposit on the forebay floor due to the relatively low flow velocities. To manage sediment deposition, within the forebay and throughout the fishway trap, a sediment control pump is located within the forebay. This pump will discharge water through manifolds placed, along the invert of the structure to create high velocity jets. The jets will resuspend sediment for flushing from the fish trap system.

iv) The new AWS channel delivers water from the supply intake forebay to the trap's new entrance channel. AWS flow is controlled by the AWS control gate located at the upstream end of the channel. Flow from the AWS channel is introduced to the entrance channel via an upwell chamber situated below the entrance channel. To prevent false attraction, the upwell chamber is separated from the entrance channel by diffusion grating set in the channel floor

v) The fish trap entrance is relocated farther out into the river channel. A downstream training wall built out from the existing bank will assist in guiding fish to the entrance. The entrance's proximity to the radial gate discharge will enhance attraction. The entrance itself will consist of a 3-foot wide slot with an adjustable crest for varying river flows and tailwater levels. The new entrance channel leads from the entrance slot to the existing fish ladder entrance. As discussed previously, supplementary attraction water is introduced into the entrance channel through diffuser grating in the channel floor.

(b) 16-ft Radial Gate

i) A 16-ft radial gate is located directly downstream from the supply intake fish screens (see Plate 3). The gate will be used to remobilize bedload and debris that have accumulated in front of the fish screen intake. A training wall extends upstream from the radial gate pier parallel to the fish screen panels. The purpose of the training wall is to concentrate flow and increase flow velocities between the wall and the intake screens when the gate is operated, enhancing mobilization of accumulated bedload and debris.

ii) The concrete apron downstream of the gate initially slopes downstream at 7.5% for 20-feet, then extends horizontally an additional 33-feet (see Plate 7). During gate operation, this configuration allows sufficient flow velocities to develop along the apron to create an effective upstream passage barrier. The downstream invert of the apron is set at the 4,000-cfs tailwater elevation. This prevents apron submergence throughout the river flow range during which the trap is operated.

(c) Ogee Weir

i) An ogee shaped concrete weir spans approximately 300-ft across the river channel between the radial gate pier and the right bank abutment, replacing the existing flashboard system. The ogee shape and weir height are designed such that sufficient flow velocities develop along the downstream apron to create an effective upstream passage barrier (see Plate 7). Additionally, during high flow conditions when the weir overtops, the ogee crest shape prevents free discharge directly onto the spillway apron allowing for the safe passage of juveniles downstream. As with the gate apron, the downstream invert of the weir's apron is set at the 4,000-cfs tailwater elevation preventing submergence during the river flow range when the trap is operated. Due to bedload movement, it is anticipated that over time the riverbed upstream of the weir will ultimately aggrade to a level approaching the weir's crest elevation.

(d) Right-Bank Dike

i) This alternative does not include facilities capable of maintaining existing river levels upstream of the diversion during high flow events. Consequently, a dike will be provided along the right-bank to prevent flooding during extreme flow events (see Plate 6). The dike is designed to maintain a 2.5-ft freeboard during the 12,000-cfs 100-year event. The 12-ft wide crest of the dike will function as a service road along the right bank. The riverside slope of the dike will be faced with riprap to prevent erosion during high flow events.

1.1.2.2 Facilities Operation

(a) The flow control operational schedule for Alternative 1 is summarized in a table on Plate 3. The combined facilities will be operated to maintain a pool level of HWEL 671.5 to 672.8 during normal operating conditions.

(b) Trap-and-Haul

i) The modifications to the trap-and-haul facilities will be designed for operation between river flows of 130 and 4,000-cfs. During river flows less than 130-cfs, the trap could be closed and all flow will pass over the ogee weir. During river flows exceeding 4,000-cfs, the trap ladder becomes increasingly flooded and conditions diverge from criteria. As flow exceeds 4,000-cfs the operator would use discretion on continuing operation, depending on river conditions and the occurrence of fish in the trap.

ii) When river flows allow, approximately 130-cfs will be diverted through the fish screens into the intake forebay. At 130-cfs, there is sufficient effective screen area to maintain screen approach velocities below the 0.4-fps velocity criteria. Louvers behind the screens will be adjusted to eliminate local velocity "hot-spots". The automated cleaning system will periodically brush the screen face to prevent debris accumulation and maintain velocity criteria. Sediment control pumping will re-circulate water within the fish trap.

iii) The sediment control pump situated in the supply intake forebay will be operated as needed to minimize accumulation of sediment deposits. This system will sequentially discharge water through orifices in manifolds located along the bottom of the pools and ladder of the trap. After fish have been loaded, the system will be run to minimize disturbance to fish.

iv) Similar to existing trap-and-haul operations, between 25 and 35-cfs will be delivered to the holding and hopper pools. At these flows, flow depth across the 8-foot ladder weirs will be approximately 1.2 to 1.4-ft, respectively. Up to 70-cfs will be delivered through the AWS channel to the trap entrance as supplementary attraction flow. Up to 25-cfs of this remaining flow will be delivered to the right bank hatchery ladder for attraction flow at the ladder entrance. The adjustable crest entrance slot will be operated to optimize the discharge jet for fish attraction during variable tailwater conditions.

v) In terms of trapping and hauling adult migratory fish, the facilities will be operated in a manner similar to the current operation. Adult fish will volitionally enter the trap and travel up the ladder until entering the holding pool. The brail in the holding pool will then be raised to funnel fish trapped in the holding pool into the loading pool. Once all the fish have been collected in the loading pool, the hopper will then be operated to transfer the captured fish into a tanker truck. The tanker trucks will likely use established haul-routes for transporting the adult fish to an unloading site upstream of MMD. The timing and frequency of this operational cycle will continue to be a function of the size and timing of fish runs.

(c) 16-ft Radial Gate

i) As mentioned previously, the primary purpose of the radial gate is to maintain the capacity of the supply intake by minimizing accumulation of bedload and debris in front of the supply intake fish screens. This is accomplished by operating the gate to develop sufficient velocities in front of the screen panels to mobilize bedload and debris to be discharged downstream. Additionally, operation of the gate will generate sweeping velocities in front of the fish screens to bypass juvenile fish downstream and minimize their exposure time to the intake screens.

ii) The gate will be operated to maintain the normal operating pool level, HWEL 671.5. At flows exceeding the gate's capacity to maintain the normal operating pool level, the gate will remain fully open. The operation of the radial gate is subject to the following constraints. The minimum gate opening to prevent vibration is 0.8-ft. The minimum flow through the gate required to develop barrier velocities on the gate apron is 220-cfs. This corresponds with a minimum gate opening of 1.6-ft at the normal operating pool level.

(d) Ogee Weir

Because the ogee weir is a fixed structure with no mechanical or moving parts, the weir will function passively and will not require any active operation. As discussed previously, it is expected that bedload movement will ultimately raise the riverbed behind the weir to nearly crest level.

1.1.2.3 Estimated Costs

(a) The capital cost for this alternative, in terms of 2003 dollars, are presented in Table 1, "Alternative 1 Capital Cost Summary". This table includes the construction cost, contingency, planning and design, and environment. The contingency is 30-percent of the construction cost. Planning and design are based on 15-percent of construction cost plus contingency. Environmental costs are 10-percent of construction cost plus contingency. The construction items included in each of the headings are summarized below. Details of the construction cost estimate are available in the "MCASES" cost estimating program report, which is submitted under a separate cover. Real estate costs were not estimated.

i) Mobilization and General Conditions

- a) Temporary Construction
- b) Erosion and Sediment Control
- c) Clearing and Grubbing
- d) Cofferdams
- e) De-watering
- f) Temporary Access

ii) Demolition

- a) Existing Dam
- b) Portion of PSE Intake

iii) Earthworks

- a) Dam Foundation
- b) Left Bank Access Road
- c) Care of River and Flow Handling
- d) General Backfill
- e) Major Right Bank Dike
- f) Rip Rap

iv) Structural Concrete

- a) Dam
- b) Fish Facilities
- c) Screened Water Intake Structure
- d) Upstream Aprons
- e) General Reinforcing Steel

v) Misc. Metals

- a) Armor Plate on the invert of the gate bays and aprons.
- b) Structural Steel, Grating, Handrail, etc.
- c) Stoplogs slots
- d) 16-foot Radial Gate

vi) Piping

- a) Pressure Relief Piping
- b) Right Bank Hatchery Attraction Water Supply

vii) Incidentals

- a) Landscaping
- b) Fencing

viii) Buildings

a) Equipment Building
b) Control Building

ix) Specialized Process Equipment

a) General Electrical Systems
b) Fish Screen
c) Fish Screen Baffles
d) Fish Screen Structural Steel
e) Fish Screen Cleaner
f) Sediment Control System
g) Fish Screen Electrical and Controls
h) Gate Hydraulic System

Table 1 - Alternative 1 - Capital Cost Summary

Cost Components	Total Cost
Mobilization / General Conditions	$ 378,252
Temporary Construction	$ 803,432
Demolition	$ 299,447
Earthworks	$ 616,298
Structural Concrete	$ 2,277,291
Misc. Metals	$ 465,315
Piping	$ 36,978
Incidentals	$ 64,035
Buildings	$ 217,420
Specialized Process Equipment	$ 1,587,724
CONSTRUCTION TOTAL	**$ 6,746,192**
CONTINGENCY (30% OF CONST.)	**$ 2,023,858**
PLANNING & DESIGN (15% OF CONST. + CONT.)	**$ 1,315,507**
ENVIRONMENTAL (10% OF CONST. + CONT.)	**$ 877,005**
TOTAL CAPITAL COST	**$ 10,962,562**

(b) Operation and maintenance costs are estimated over a 50-year project life and presented in Table 2, titled "Alternative 1 Operation and Maintenance Cost – 50 year Life Cycle. The costs cover weekly operation and inspections, annual maintenance, and two replacements of major mechanical items on a 16-year cycle. These costs are converted to present value dollars based on a discount rate of 5.875 percent. A labor rate of $60 per hour is assumed. Power costs are based on $0.06 per kW-Hour. Items included for each component of operation include:

i) Fish Trap Operation: Includes operating the trap and haul 3-days a week, including trucking. Inspection of the screen cleaner and operation of the sediment control system is assumed to occur on a weekly basis. Power costs are included for screen cleaning, sediment control, and general lighting and control. Significant upgrades to the existing fish trap facility are allowed on a 16-year interval, twice over the 50 year life.

ii) Fish Trap Maintenance: Labor, equipment, and material are included for annual inspections and repairs of the fish trap facility.

iii) Dam Maintenance: Maintenance for the dam includes weekly and annual inspection of the radial gate. Power cost for the gate is also included. Labor, equipment, and material are included for annual debris and bedload management. This activity assumes minor handling of large woody debris with portable cranes and minor dredging. Replacement of the radial gate is allowed on a 16-year interval, twice over the 50 year life.

Table 2 - Alternative 1 Operation and Maintenance Costs 50-year Life Cycle				
System Component	**Annual Labor, Equip. & Material $/yr**	**Annual Power Cost**	**16-Year Interval Replacement Costs**	**Total Present Value of O&M Cost**
		0.06 $/kWhr	2003 $	2003 $
Fish Trap Operation:				
Fish Trap and Haul	82,880		100,000	1,385,690
Sediment Control	6,240	350		105,717
Screen Cleaning	6,240	1,007		116,256
General Lights and Control		44		703
Fish Trap Maintenance				
Annual Inspection	6,300			101,059
Repairs	5,600			89,830
Dam Maintenance				
16' Radial Gate	8,300	153	74,420	177,429
Debris Management	10,200			163,619
Bedload Management	8,800			141,161
Totals	134,560	1,555	174,420	2,281,464

1.1.3 Alternative 2 – Existing Left Bank Trap-and-Haul with Rubber Weirs, Ogee Weir, Fixed-Crest Panels and Radial Gate @ Diversion Dam Site

1.1.3.1 Physical Description

(a) Trap and Haul

i) The schedule modifications to the trap-and-haul facilities utilize much of the Corps' existing left bank trap-and-haul facilities, but also include several upgrades and modifications (see Plates 4 and 9). Specifically, the existing ladder, holding pool, loading pool and fish hopper will remain largely intact with only relatively minor repairs and improvements. Major improvements and modifications include the following: a new supply intake with fish screens, screen cleaner and sediment control pump, a new auxiliary attraction water supply channel with upstream control gate, and a new fish ladder entrance with entrance slot and entrance channel.

ii) The new trap-and-haul water supply intake is located at the existing PSE diversion channel intake. River flow enters the supply intake through a series of eight vertical fixed-plate fish screens aligned parallel to river flow and inline with the upstream left riverbank. The eight 6-ft high by 8-ft wide screen panels are designed to comply with current juvenile fish screen criteria while passing the maximum 130-cfs diversion flow. A concrete training wall flush with the screens' face extends upstream to block the remainder of the existing diversion intake. The tops of the screen panels are set below the normal pool level to remain submerged at all times. A brush-type system will automatically clean the upstream screen faces, and will be stowed out of the water when not in operation.

iii) The intake chamber behind the fish screens functions as a common forebay serving both the holding and loading pool flow demands as well as the new auxiliary water supply (AWS) channel. The existing control gates for the holding and loading pool water supply system will be retained. By default, the forebay also functions as a settling basin for suspended sediment, which pass through the screens and deposit on the forebay floor due to the relatively low flow velocities. To manage sediment deposition, within the forebay and throughout the fishway trap, a sediment control pump is located within the forebay. This pump will discharge water through manifolds placed, along the invert of the structure to create high velocity jets. The jets will resuspend sediment for flushing from the fish trap system.

iv) The new AWS channel delivers water from the supply intake forebay to the trap's new entrance channel. AWS flow is controlled by the AWS control gate located at the upstream end of the channel. Flow from the AWS channel is introduced to the entrance channel via an upwell chamber situated below the entrance channel. To prevent false attraction, the upwell chamber is separated from the entrance channel by diffusion grating set in the channel floor

v) The fish trap entrance is relocated farther out into the river channel. A downstream training wall built out from the existing bank will assist in guiding fish to the entrance. The entrance's proximity to the radial gate discharge will enhance attraction. The entrance itself will consist of a 3-foot wide slot with an adjustable crest for varying river flows and tailwater levels. The new entrance channel leads from the entrance slot to the existing fish ladder entrance. As discussed previously, supplementary attraction water is introduced into the entrance channel through diffuser grating in the channel floor.

(b) 16-ft Radial Gate

i) A 16-ft radial gate is located directly downstream from the supply intake fish screens (see Plate 4). The gate will be used to remobilize bedload and debris that have accumulated in front of the fish screens. A training wall extends upstream from the radial gate pier parallel to the fish screen panels. The purpose of the training wall is to concentrate flow and increase flow velocities between the wall and the intake screens when the gate is operated, enhancing mobilization of accumulated bedload and debris.

ii) The concrete apron downstream of the gate initially slopes downstream at 7.5% for 20-feet, then extends horizontally an additional 33-feet (see Plate 7). During gate operation, this configuration allows sufficient flow velocities to develop along the apron to create an effective upstream passage barrier. The downstream invert of the apron is set at the 4,000-cfs tailwater elevation. This prevents apron submergence throughout the river flow range during which the trap is operated.

(c) Ogee Weir

i) An ogee shaped concrete weir spans approximately 73-ft between the radial gate pier and the left pier of the first rubber weir. The ogee shape and weir height are designed such that sufficient flow velocities develop along the downstream apron to create an effective upstream passage barrier (see Plate 7). Additionally, during high flow conditions when the weir overtops, the ogee crest shape prevents free discharge directly onto the spillway apron allowing for the safe passage of juveniles downstream. As with the gate apron, the downstream invert of the weir's apron is set at the 4,000-cfs tailwater elevation preventing submergence during the river flow range when the trap is operated.

(d) Rubber Weirs

i) Two identically sized inflatable rubber weirs are located between the ogee crest weir and the fixed-crest panels. When fully inflated, each rubber weir crest spans 73-ft and has a crest elevation of 672.5 (see Plate 8). The flat spillway apron directly below the rubber weirs is set at EL 663.8 resulting in a crest-to-apron height of 8.7-ft. The final downstream 15-ft of the apron slopes down to EL 662.3 corresponding with the 4,000-cfs tailwater level. As with the ogee weir and radial gate, the apron remains unsubmerged during the river flow range when the trap is operated. The height of the rubber weirs in conjunction with the absence of a plunge pool below their crest creates an effective upstream passage barrier. A 12-ft wide service bridge from the left bank spans the radial gate, ogee crest and first rubber weir to provide service access to both rubber weirs.

(e) Fixed-Crest Panels

i) The fixed-crest panel section of the barrier is located between the right pier of the second rubber weir and the right riverbank abutment. This section is composed of three removable fixed-crest concrete panels. The section of removable panels is provided for bypassing river flows during construction of the remaining barrier components. Once construction is complete, these panels would be installed more or less as permanent fixtures.

ii) Each panel measures 19-ft long by 9-ft high with crests set at EL 672.8 (see Plate 8). The spillway apron below the panels is similar to that for the rubber weirs. The flat invert directly below the panels is set at EL 663.8 with the final 15-ft sloping down to EL 662.3. Again, the apron remains unsubmerged during the river flow range when the trap is operated. As with the rubber weirs, the height of the fixed-crest panels in conjunction with the absence of a plunge pool below their crest creates an effective upstream passage barrier even when the weirs are being overtopped.

1.1.3.2 Facilities Operation

(a) The flow control operational schedule for Alternative 2 is summarized in a table on Plate 4. The combined facilities will be operated to maintain a pool level of HWEL 671.5 during normal operating conditions.

(b) Trap and Haul

i) The modifications to the trap-and-haul facilities will be designed for operation between river flows of 130 and 4,000-cfs. During river flows less than 130-cfs, the trap could be closed and all flow will pass over the ogee weir. During river flows exceeding 4,000-cfs, the trap ladder becomes increasingly flooded and conditions diverge from criteria. As flow exceeds 4,000-cfs the operator would use discretion on continuing operation, depending on river conditions and the occurrence of fish in the trap.

ii) When river flows allow, approximately 130-cfs will be diverted through the fish screens into the intake forebay. At 130-cfs, there is sufficient effective screen area to maintain screen approach velocities below the 0.4-fps velocity criteria. Louvers behind the screens will be adjusted to eliminate local velocity "hot-spots". The automated cleaning system will periodically brush the screen face to prevent debris accumulation and maintain velocity criteria.

iii) The sediment control pump situated in the supply intake forebay will be operated as needed to minimize accumulation of sediment deposits within the fishway. This system will sequentially discharge water through orifices in manifolds located along the bottom of the pools and ladder of the trap. After fish have been loaded, the system will be run to minimize disturbance to fish.

iv) Similar to existing trap-and-haul operations, between 25 and 35-cfs will be delivered to the holding and hopper pools. At these flows, flow depth across the 8-foot ladder weirs will be approximately 1.2 to 1.4-ft, respectively. Up to 70-cfs will be delivered through the AWS channel to the trap entrance as supplementary attraction flow. Up to 25-cfs of this remaining flow will be delivered to the right bank hatchery ladder for attraction flow at the ladder entrance. The adjustable crest entrance slot will be operated to optimize the discharge jet for fish attraction during variable tailwater conditions.

v) In terms of trapping and hauling adult migratory fish, the facilities will be operated in a manner similar to the current operation. Adult fish will volitionally enter the trap and travel up the ladder until entering the holding pool. The brail in the holding pool will then be raised to funnel fish trapped in the holding pool into the loading pool. Once all the fish have been collected in the loading pool, the hopper will then be operated to transfer the captured fish into a tanker truck. The tanker trucks will likely use established haul-routes for transporting the adult fish to an unloading site upstream of MMD. The timing and frequency of this operational cycle to be a function of the size and timing of fish runs.

(c) 16-ft Radial Gate

i) As mentioned previously, the primary purpose of the radial gate is to maintain the capacity of the supply intake by minimizing accumulation of bedload and debris in front of the supply intake fish screens. This is accomplished by operating the gate to develop sufficient velocities in front of the screen panels to mobilize bedload and debris to be discharged downstream. Additionally, operation of the gate will generate sweeping velocities in front of the fish screens to bypass juvenile fish downstream and minimize their exposure time to the intake screens.

ii) The gate will be operated to maintain the normal operating pool level, HWEL 671.5. At flows exceeding the gate's capacity to maintain the normal operating pool level, the gate will remain fully open. The operation of the radial gate is subject to the following constraints. The minimum gate opening to prevent vibration is 0.8-ft. The minimum flow through the gate required to develop barrier velocities on the gate apron is 220-cfs. This corresponds with a minimum gate opening of 1.6-ft at the normal operating pool level.

(d) Ogee Weir

i) Because the ogee weir is a fixed structure with no mechanical or moving parts, the weir will function passively and not require any active operation. As discussed previously, it is expected that bedload will raise the riverbed behind the weir.

(e) Rubber Weirs

i) The two inflatable rubber weirs will be operated in conjunction with the radial gate to maintain the normal pool level HWEL 671.5 during normal operations including trap operation. At high flow the dams have the capability to be incrementally inflated or deflated to achieve the desired pool level. During extreme flow events, both rubber weirs will be fully deflated to pass the high flows as well as bedload and debris. A more detailed description regarding the operation of the rubber weirs is provided in the flow control operational schedule in Plate 4.

(f) Fixed-Crest Panels

i) As described previously, the three removable fixed-crest panels are provided primarily for construction purposes. However, they could potentially be removed to bypass river flow around the barrier during major maintenance, repairs and/or upgrades of the other barrier components. Additionally, they could potentially be removed to remobilize bedload accumulations upstream. Otherwise, as with the ogee weir, the fixed-crest panels are effectively a fixed structure and will generally function passively and not require any active operation.

1.1.3.3 Estimated Costs

(a) The capital cost for this alternative, in terms of 2003 dollars, are presented in Table 3, "Alternative 2 Capital Cost Summary". This table includes the construction cost, contingency, planning and design, and environment. The contingency is 30-percent of the construction cost. Planning and design are based on 15-percent of construction cost plus contingency. Environmental costs are 10-percent of construction cost plus contingency. The construction items included in each of the headings are summarized below. Details of the construction cost estimate are available in the "MCASES" cost estimating program report, which is submitted under a separate cover. Real estate costs were not estimated.

i) Mobilization and General Conditions

ii) Temporary Construction

a) Erosion and Sediment Control
b) Clearing and Grubbing
c) Cofferdams
d) De-watering
e) Temporary Access

iii) Demolition

a) Existing Dam
b) Portion of PSE Intake

iv) Earthworks

a) Dam Foundation
b) Left Bank Access Road
c) Care of River and Flow Handling
d) General Backfill
e) Limited Right Bank Dike
f) Rip Rap

v) Structural Concrete

a) Dam
b) Fish Facilities
c) Screened Water Intake Structure
d) Upstream Aprons
e) General Reinforcing Steel
f) Fixed Crest Panels

vi) Misc. Metals

a) Armor Plate
b) Structural Steel, Grating, Handrail, etc.
c) Stoplogs slots
d) 16-foot Radial Gate

vii) Piping

a) Pressure Relief Piping
b) Right Bank Hatchery Attraction Water Supply

viii) Incidentals

a) Landscaping
b) Fencing

ix) Buildings

a) Equipment Building
b) Control Building

x) Specialized Process Equipment

a) General Electrical Systems
b) Inflatable Rubber Weirs
c) Fish Screen
d) Fish Screen Baffles
e) Fish Screen Structural Steel
f) Fish Screen Cleaner
g) Sediment Control System
h) Fish Screen Electrical and Controls
i) Hydraulic System

Table 3 - Alternative 2 - Capital Cost Summary

Cost Components	Total Cost
Mobilization / General Conditions	$ 381,230
Temporary Construction	$ 803,432
Demolition	$ 299,447
Earthworks	$ 362,476
Structural Concrete	$ 1,948,742
Misc. Metals	$ 747,911
Piping	$ 36,978
Incidentals	$ 64,035
Buildings	$ 217,420
Specialized Process Equipment	$ 2,274,312
CONSTRUCTION TOTAL	**$ 7,135,983**
CONTINGENCY (30% OF CONST.)	**$ 2,140,795**
PLANNING & DESIGN (15% OF CONST. + CONT.)	**$ 1,391,517**
ENVIRONMENTAL (10% OF CONST. + CONT.)	**$ 927,678**
TOTAL CAPITAL COST	**$ 11,595,972**

(b) Operation and maintenance costs are estimated over a 50-year project life and presented in Table 4, titled "Alternative 2 Operation and Maintenance Cost – 50 year Life Cycle. The costs cover weekly operation and inspections, annual maintenance, and two replacements of major mechanical items on a 16-year cycle. These costs are converted to present value dollars based on a discount rate of 5.875 percent. A labor rate of $60 per hour is assumed. Power costs are based on $0.06 per kW-Hour. Items included for each component of operation include:

i) Fish Trap Operation: Includes operating the trap and haul 3-days a week, including trucking. Inspection of the screen cleaner and operation of the sediment control system is assumed to occur on a weekly basis. Power costs are included for screen cleaning, sediment control, and general lighting and control. Significant upgrades to the existing fish trap facility are allowed on a 16-year interval, twice over the 50 year life.

ii) Fish Trap Maintenance: Labor, equipment, and material are included for annual inspections and repairs of the fish trap facility.

iii) Dam Maintenance: Maintenance for the dam includes weekly and annual inspection of the radial gate and rubber dams. Power cost for the gate and rubber dams are also included. Labor, equipment, and material are included for annual debris and bedload management. This activity assumes minor handling of large woody debris with portable cranes and minor dredging. Replacement of the radial gate and rubber dams is allowed on a 16-year interval, twice over the 50 year life

Table 4 - Alternative 2 Operation and Maintenance Costs 50-year Life Cycle				
System Component	Annual Labor, Equip. & Material $/yr	Annual Power Cost	16-Year Interval Replacement Costs	Total Present Value of O&M
		0.06 $/kWhr	2003 $	2003 $
Fish Trap Operation:				5.875%
Fish Trap and Haul	82,880		100,000	1,385,690
Sediment Control	6,240	350		105,717
Screen Cleaning	6,240	1,007		116,256
General Lights and Control		44		703
Fish Trap Maintenance				
Annual Inspection	6,300			101,059
Repairs	5,600			89,830
Dam Maintenance				
16' Radial Gate	8,300	153	74,420	177,429
Rubber Dam	8,300	66	743,926	552,332
Debris Management	10,200			163,619
Bedload Management	26,400			423,484
Totals	160,460	1,621	918,346	3,116,118

1.1.4 Alternative 3 – New Right Bank Trap-and-Haul with Rubber Weirs, Ogee Weir, Fixed-Crest Panels and Radial Gate@ Diversion Dam Site

1.1.4.1 Physical Description

(a) Trap-and-Haul

i) The proposed right bank trap-and-haul facilities replaces the Corps' existing left bank trap-and-haul facilities (see Plates 5 and 9). Much of the new right bank facility will be essentially be a mirrored image of the existing ladder, holding pool, loading pool and fish hopper. The right bank trap will also include the following: a new supply intake with fish screens, screen cleaner and sediment control pump, a new auxiliary attraction water supply channel with upstream control gate, and a new fish ladder entrance with entrance slot and entrance channel.

ii) The new trap-and-haul water supply intake is located on the right bank upstream of the radial gate. River flow enters the supply intake through a series of eight vertical fixed-plate fish screens aligned parallel to river flow and inline with the upstream right riverbank. The eight 6-ft high by 8-ft wide screen panels are designed to comply with current juvenile fish screen criteria while passing the maximum 130-cfs diversion flow. The tops of the screen panels are set below the normal pool level to remain submerged at all times. A brush-type system will automatically clean the upstream screen faces, and will be stowed out of the water when not in operation.

iii) The intake chamber behind the fish screens functions as a common forebay serving both the holding and loading pool flow demands as well as the new auxiliary water supply (AWS) channel. The existing control gates for the holding and loading pool water supply system will be retained. By default, the forebay also functions as a settling basin for suspended sediment, which pass through the screens and deposit on the forebay floor due to the relatively low flow velocities. To manage sediment deposition, within the forebay and throughout the fishway trap, a sediment control pump is located within the forebay. This pump will discharge water through manifolds placed, along the invert of the structure to create high velocity jets. The jets will resuspend sediment for flushing from the fish trap system.

iv) The intake chamber behind the fish screens functions as a common forebay serving both the holding and loading pool flow demands as well as the new auxiliary water supply (AWS) channel. By default, the forebay also functions as a settling basin for suspended sediment, which pass through the screens and deposit on the forebay floor due to the relatively low flow velocities. To manage sediment deposition, a sediment control pump is located within the forebay.

v) The design of the fish ladder, holding pool with brail, loading pool with hopper and the associated water supply system remains essentially unchanged from the existing system. The only significant change is the elimination of the sand-settling basin as it is redundant with the function of the supply intake forebay. Instead, water is delivered directly from the forebay to the loading and holding pools via underground piping. Similar to the existing system, loading and holding pool flow demand is controlled by two gates located in the forebay at the upstream end of the delivery piping.

vi) The new AWS channel delivers water from the supply intake forebay to the trap's new entrance channel. AWS flow is controlled by the AWS control gate located at the upstream end of the channel. Flow from the AWS channel is introduced to the entrance channel via an upwell chamber situated below the entrance channel. To prevent false attraction, the upwell chamber is separated from the entrance channel by diffusion grating set in the channel floor

vii) The fish trap entrance is relocated farther out into the river channel. A downstream training wall built out from the existing bank will assist in guiding fish to the entrance. The entrance's proximity to the radial gate discharge will enhance attraction. The entrance itself will consist of a 3-foot wide slot with an adjustable crest for varying river flows and tailwater levels. The new entrance channel leads from the entrance slot to the existing fish ladder entrance. As discussed previously, supplementary attraction water is introduced into the entrance channel through diffuser grating in the channel floor.

(b) 16-ft Radial Gate

i) A 16-ft radial gate is located directly downstream from the supply intake fish screens (see Plate 5). The gate will be used to remobilize bedload and debris that have accumulated in front of the fish screens. A training wall extends upstream from the radial gate pier parallel to the fish screen panels. The purpose of the training wall is to concentrate flow and increase flow velocities between the wall and the intake screens when the gate is operated, enhancing mobilization of accumulated bedload and debris.

ii) The concrete apron downstream of the gate initially slopes downstream at 7.5% for 20-feet, then extends horizontally an additional 33-feet (see Plate 7). During gate operation, this configuration allows sufficient flow velocities to develop along the apron to create an effective upstream passage barrier. The downstream invert of the apron is set at the 4,000-cfs tailwater elevation. This prevents apron submergence throughout the river flow range during which the trap is operated.

(c) Ogee Weir

i) An ogee shaped concrete weir spans approximately 73-ft between the radial gate pier and the right pier of the first rubber weir. The ogee shape and weir height are designed such that sufficient flow velocities develop along the downstream apron to create an effective upstream passage barrier (see Plate 7). Additionally, during high flow conditions when the weir overtops, the ogee crest shape prevents free discharge directly onto the spillway apron allowing for the safe passage of juveniles downstream. As with the gate apron, the downstream invert of the weir's apron is set at the 4,000-cfs tailwater elevation preventing submergence during the river flow range when the trap is operated.

(d) Rubber Weirs

i) Two identically sized inflatable rubber weirs are located between the ogee crest weir and the fixed-crest panels. When fully inflated, each rubber weir crest spans 73-ft and has a crest elevation of 672.5 (see Plate 8). The flat spillway apron directly below the rubber weirs is set at EL 663.8 resulting in a crest-to-apron height of 8.7-ft. The final downstream 15-ft of the apron slopes down to EL 662.3 corresponding with the 4,000-cfs tailwater level. As with the ogee weir and radial gate, the apron remains unsubmerged during the river flow range when the trap is operated. The height of the rubber weirs in conjunction with the absence of a plunge pool below their crest creates an effective upstream passage barrier. A 12-ft wide service bridge from the right bank spans the radial gate, ogee crest and first rubber weir to provide service access to both rubber weirs.

(e) Fixed-Crest Panels

i) The fixed-crest panel section of the barrier is located between the left pier of the second rubber weir and the left riverbank abutment. The left riverbank abutment extends upstream to block the entrance to the PSE diversion channel. This fixed-crest panel section is composed of three removable concrete panels. The removable panels are provided for bypassing river flows during construction of the remaining barrier components. Once construction is complete, these panels would be installed more or less as permanent fixtures.

ii) Each panel measures 19-ft long by 9-ft high with crests set at EL 672.8 (see Plate 8). The spillway apron below the panels is similar to that for the rubber weirs. The flat invert directly below the panels is set at EL 663.8 with the final 15-ft sloping down to EL 662.3. Again, the apron remains unsubmerged during the river flow range when the trap is operated. As with the rubber weirs, the height of the fixed-crest panels in conjunction with the absence of a plunge pool below their crest creates an effective upstream passage barrier even when being over topped.

1.1.4.2 Facilities Operation

(a) The flow control operational schedule for Alternative 3 is summarized in a table on Plate 5. The combined facilities will be operated to maintain a pool level of HWEL 671.5 during normal operating conditions.

(b) Trap-and-Haul

i) The modifications to the trap-and-haul facilities will be designed for operation between river flows of 130 and 4,000-cfs. During river flows less than 130-cfs, the trap could be closed and all flow will pass over the ogee weir. During river flows exceeding 4,000-cfs, the trap ladder becomes increasingly flooded and conditions diverge from criteria. As flow exceeds 4,000-cfs the operator would use discretion on continuing operation, depending on river conditions and the occurrence of fish in the trap.

ii) When river flows allow, approximately 130-cfs will be diverted through the fish screens into the intake forebay. At 130-cfs, there is sufficient effective screen area to maintain screen approach velocities below the 0.4-fps velocity criteria. Louvers behind the screens will be adjusted to eliminate local velocity "hot-spots". The automated cleaning system will periodically brush the screen face to prevent debris accumulation and maintain velocity criteria.

iii) The sediment control pump situated in the supply intake forebay will be operated as needed to minimize accumulation of sediment deposits. This system will sequentially discharge water through orifices in manifolds located along the bottom of the pools and ladder of the trap. After fish have been loaded, the system will be run to minimize disturbance to fish.

iv) Similar to existing trap-and-haul operations, between 25 and 35-cfs will be delivered to the holding and hopper pools. At these flows, flow depth across the 8-foot ladder weirs will be approximately 1.2 to 1.4-ft, respectively. Up to 70-cfs will be delivered through the AWS channel to the trap entrance as supplementary attraction flow. Up to 25-cfs of this remaining flow will be delivered to the right bank hatchery ladder for attraction flow at the ladder entrance. The adjustable crest entrance slot will be operated to optimize the discharge jet for fish attraction during variable tailwater conditions.

v) In terms of trapping and hauling adult migratory fish, the facilities will be operated in a manner similar to the current operation. Adult fish will volitionally enter the trap and travel up the ladder until entering the holding pool. The brail in the holding pool will then be raised to funnel fish trapped in the holding pool into the loading pool. Once all the fish have been collected in the loading pool, the hopper will then be operated to transfer the captured fish into a tanker truck. Due to the new, right bank location of the trap-and-haul facilities, it will be necessary to modify the haul-routes for transporting the adult fish to an unloading site upstream of MMD. The timing and frequency of this operational cycle will be a function of the size and timing of fish runs.

(c) 16-ft Radial Gate

i) As mentioned previously, the primary purpose of the radial gate is to maintain the capacity of the supply intake by minimizing accumulation of bedload and debris in front of the supply intake fish screens. This is accomplished by operating the gate to develop sufficient velocities in front of the screen panels to mobilize bedload and debris to be discharged downstream. Additionally, operation of the gate will generate sweeping velocities in front of the fish screens to bypass juvenile fish downstream and minimize their exposure time to the intake screens.

ii) The gate will be operated to maintain the normal operating pool level, HWEL 671.5. At flows exceeding the gate's capacity to maintain the normal operating pool level, the gate will remain fully open. The operation of the radial gate is subject to the following constraints. The minimum gate opening to prevent vibration is 0.8-ft. The minimum flow through the gate required to develop barrier velocities on the gate apron is 220-cfs. This corresponds with a minimum gate opening of 1.6-ft at the normal operating pool level.

(d) Ogee Weir

i) Because the ogee weir is a fixed structure with no mechanical or moving parts, the weir will function passively and not require any active operation. As discussed previously, it is expected that bedload movement will raise the riverbed behind the weir.

(e) Rubber Weirs

i) The two inflatable rubber weirs will be operated to maintain the normal pool level HWEL 671.5 during normal operations including trap operation. The dams have the capability to be incrementally inflated or deflated to achieve the desired pool level. During extreme flow events, both rubber weirs will be fully deflated to pass the high flows as well as bedload and debris. A more detailed description regarding the operation of the rubber weirs is provided in the flow control operational schedule on Plate 5.

(f) Fixed-Crest Panels

i) As described previously, the three removable fixed-crest panels are provided primarily for construction purposes. However, they could potentially be removed to bypass river flow around the barrier during major maintenance, repairs and/or upgrades of the other barrier components. Additionally, they could potentially be removed to remobilize bedload accumulations upstream. Otherwise, as with the ogee weir, the fixed-crest panels are effectively a fixed structure and will generally function passively and not require any active operation.

1.1.4.3 Estimated Costs

(a) The capital cost for this alternative, in terms of 2003 dollars, are presented in Table 5, "Alternative 3 Capital Cost Summary". This table includes the construction cost, contingency, planning and design, and environment. The contingency is 30-percent of the construction cost. Planning and design are based on 15-percent of construction cost plus contingency. Environmental costs are 10-percent of construction cost plus contingency. The construction items included in each of the headings are summarized below. Details of the construction cost estimate are available in the "MCASES" cost estimating program report, which is submitted under a separate cover. Real estate costs were not estimated.

i) Mobilization and General Conditions

ii) Temporary Construction

a) Erosion and Sediment Control
b) Clearing and Grubbing
c) Cofferdams
d) De-watering
e) Temporary Access

iii) Demolition

a) Existing Dam
b) Portion of PSE Intake
c) Existing left bank fish trap

iv) Earthworks

a) Dam Foundation
b) Left Bank Access Road
c) Care of River and Flow Handling
d) General Backfill
e) Limited Right Bank Dike
f) Rip Rap
g) New Fish Trap Excavation
h) New Fish Trap Backfill

v) Structural Concrete

a) Dam
b) Fish Facilities
c) Screened Water Intake Structure
d) Upstream Aprons
e) General Reinforcing Steel
f) Fixed Crest Panels
g) New Fish Trap

vi) Misc. Metals

a) Armor Plate on the invert of the gate bays and aprons
b) Structural Steel, Grating, Handrail, etc.
c) Stoplogs slots
d) 16-foot Radial Gate

vii) Piping

a) Pressure Relief Piping

viii) Incidentals

a) Landscaping
b) Fencing

ix) Buildings

a) Equipment Building
b) Control Building

x) Specialized Process Equipment

a) General Electrical Systems
b) Inflatable Rubber Weirs
c) Fish Screen
d) Fish Screen Baffles
e) Fish Screen Structural Steel
f) Fish Screen Cleaner
g) Sediment Control System
h) Fish Screen Electrical and Controls
i) Gate Hydraulic System
j) Fish Trap Mechanical
k) Fish Trap Misc. Metals

Table 5 - Alternative 3 - Capital Cost Summary

Cost Components	Total Cost
Mobilization / General Conditions	$ 381,230
Temporary Construction	$ 780,913
Demolition	$ 333,226
Earthworks	$ 381,538
Structural Concrete	$ 2,247,731
Misc. Metals	$ 752,527
Piping	$ 15,199
Incidentals	$ 64,035
Buildings	$ 217,420
Specialized Process Equipment	$ 2,399,388
CONSTRUCTION TOTAL	**$ 7,573,207**
CONTINGENCY (30% OF CONST.)	**$ 2,271,962**
PLANNING & DESIGN (15% OF CONST. + CONT.)	**$ 1,476,775**
ENVIRONMENTAL (10% OF CONST. + CONT.)	**$ 984,517**
TOTAL CAPITAL COST	**$ 12,306,461**

(b) Operation and maintenance costs are estimated over a 50-year project life and presented in Table 6, titled "Alternative 3 Operation and Maintenance Cost – 50 year Life Cycle. The costs cover weekly operation and inspections, annual maintenance, and two replacements of major mechanical items on a 16-year cycle. These costs are converted to present value dollars based on a discount rate of 5.875 percent. A labor rate of $60 per hour is assumed. Power costs are based on $0.06 per kW-Hour. Items included for each component of operation include:

i) Fish Trap Operation: Includes operating the trap and haul 3-days a week, including trucking. Inspection of the screen cleaner and operation of the sediment control system is assumed to occur on a weekly basis. Power costs are included for screen cleaning, sediment control, and general lighting and control.

ii) Fish Trap Maintenance: Labor, equipment, and material are included for annual inspections and repairs of the fish trap facility.

iii) Dam Maintenance: Maintenance for the dam includes weekly and annual inspection of the radial gate and rubber dams. Power cost for the gate and rubber dams are also included. Labor, equipment, and material are included for annual debris and bedload management. This activity assumes minor handling of large woody debris with portable cranes and minor dredging. Bedload management could be a significant problem with this alternative and may require re-training the river rather than the annual maintenance assumed.

Replacement of the radial gate and rubber dams is allowed on a 16-year interval, twice over the 50 year life

Table 6 - Alternative 3 Operation and Maintenance Costs 50-year Life Cycle				
System Component	**Annual Labor, Equip. & Material $/yr**	**Annual Power Cost**	**16-Year Interval Replacement Costs**	**Total Present Value of O&M**
		0.06 $/kWhr	2003 $	2003 $
Fish Trap Operation:				5.875%
Fish Trap and Haul	82,880			1,329,483
Sediment Control	6,240	350		105,717
Screen Cleaning	6,240	1,007		116,256
General Lights and Control		44		703
Fish Trap Maintenance				
Annual Inspection	6,300			101,059
Repairs	5,600			89,830
Dam Maintenance				
16' Radial Gate	8,300	153	74,420	177,429
Rubber Dam	8,300	66	743,926	552,332
Debris Management	10,200			163,619
Bedload Management	26,400			423,484
Totals	160,460	1,621	818,346	3,059,911

1.1.5 Alternative 4 – Trap-and-Haul with Rubber Weirs, Ogee Weir and Radial Gate @ USGS Gauging Station Site

1.1.5.1 Physical Description

(a) Trap-and-Haul

i) The proposed right bank trap-and-haul design retains much of the Corps' existing trap design, but also includes several upgrades and modifications (see Plates 10 and 15). Specifically, the design of the ladder, holding pool, loading pool and fish hopper remains largely the same, with the only significant change being two additional ladder weirs to account for the greater range in design tailwater levels. Major additions and modifications include the following: a modified supply intake with fish screens, new auxiliary water supply (AWS) and trap water supply channels, and a reconfigured trap entrance.

ii) The new trap-and-haul water supply intake is located on the right bank upstream of the radial gate. River flow enters the supply intake through a series of eight vertical fixed-plate fish screens aligned parallel to river flow and inline with the upstream right riverbank. The eight 6-ft high by 8-ft wide screen panels are designed to comply with current juvenile fish screen criteria while passing the maximum 130-cfs diversion flow. The tops of the screen panels are set below the normal pool level to remain submerged at all times. A brush-type system will automatically clean the upstream screen faces, and will be stowed out of the water when not in operation.

iii) The intake chamber behind the fish screens functions as a common forebay serving both the holding and loading pool flow demands as well as the new auxiliary water supply (AWS) channel. The existing control gates for the holding and loading pool water supply system will be retained. By default, the forebay also functions as a settling basin for suspended sediment, which pass through the screens and deposit on the forebay floor due to the relatively low flow velocities. To manage sediment deposition, within the forebay and throughout the fishway trap, a sediment control pump is located within the forebay. This pump will discharge water through manifolds placed, along the invert of the structure to create high velocity jets. The jets will resuspend sediment for flushing from the fish trap system.

iv) The new AWS channel delivers water from the supply intake forebay to the trap's new entrance pool. AWS flow is controlled by the AWS control gate located at the upstream end of the channel. A gate at the downstream end of the channel facilitates periodic flushing of the channel for bedload management. Flow from the AWS channel is introduced to the entrance pool via an upwell chamber situated under the entrance channel. To prevent false attraction, the upwell chamber is separated from the entrance pool by diffusion grating set in the channel floor.

v) The trap water supply channel that services trap and ladder flow demands branches from the AWS channel at its downstream end and runs parallel to the ladder terminating at the holding and loading pools. A gate at the upstream end of the channel controls flow.

vi) The fish trap entrance is located just downstream from the radial gate. The entrance's proximity to the radial gate discharge will enhance attraction. The entrance itself consists of a 3-foot wide slot with an adjustable crest for varying river flows and tailwater levels. As discussed previously, supplementary attraction water is introduced into the entrance pool through diffuser grating in the channel floor.

vii) An access road is provided between the hillside and the trap's intake supply system allowing O&M access to these facilities as well as to the service bridge.

(b) 16-ft Radial Gate

i) A 16-ft radial gate is located directly downstream from the supply intake fish screens (see Plate 10). The gate will be used to remobilize bedload and debris that have accumulated in front of the fish screens. A training wall extends upstream from the radial gate pier parallel to the fish screen panels. The purpose of the training wall is to concentrate flow and increase flow velocities between the wall and the intake screens when the gate is operated, enhancing mobilization of accumulated bedload and debris.

ii) The concrete apron downstream of the gate initially slopes downstream at 7.5% for 20-feet, then extends horizontally an additional 33-feet (see Plate 14). During gate operation, this configuration allows sufficient flow velocities to develop along the apron to create an effective upstream passage barrier. The downstream invert of the apron is set at the 4,000-cfs tailwater elevation. This prevents apron submergence throughout the river flow range during which the trap is operated.

(c) Ogee Weir

i) An ogee shaped concrete weir spans 20-ft between the radial gate pier and the right pier of the first rubber weir (see Plate 10). The ogee shape and weir height are designed such that sufficient flow velocities develop along the downstream apron to create an effective upstream passage barrier (see Plate 14). Additionally, when the weir overtops, the ogee crest shape prevents free discharge directly onto the spillway apron allowing for the safe passage of juveniles downstream. As with the gate apron, the downstream invert of the weir's apron is set at the 4,000-cfs tailwater elevation preventing submergence during the river flow range when the trap is operated.

(d) Rubber Weirs

i) Two identically sized inflatable rubber weirs are located between the ogee crest weir and the fixed-crest panels. When fully inflated, each rubber weir crest spans 48-ft with a crest-to-apron height of 9.5-ft. The final 15-ft of the apron slopes down to the 4,000-cfs tailwater level. As with the ogee weir and radial gate, the apron remains unsubmerged during the river flow range when the trap is operated. The height of the rubber weirs in conjunction with the absence of a plunge pool below their crest creates an effective upstream passage barrier. A 12-ft wide service bridge from the right bank spans the radial gate, ogee crest and first rubber weir to provide service access to both rubber weirs.

(e) Access Road

i) The existing access road is improved to provide reliable access to the trap and barrier facilities at the 100-yr flood, and to remain intact at the MMD maximum regulated release (see Plate 13). Improvements include resurfacing, a bridge over an existing drainage, and riprap at vulnerable riverbank locations.

1.1.5.2 Facilities Operation

(a) The flow control operational schedule for Alternative 4 is summarized in a table on Plate 10. The combined facilities will be operated to maintain pool level EL 813.0 during normal operating conditions.

(b) Trap-and-Haul

i) The modifications to the trap-and-haul facilities will be designed for operation between river flows of 130 and 4,000-cfs. During river flows less than 130-cfs, the trap could be closed and all flow will pass over the ogee weir. During river flows exceeding 4,000-cfs, the trap ladder becomes increasingly flooded and conditions diverge from criteria. As flow exceeds 4,000-cfs the operator would use discretion on continuing operation, depending on river conditions and the occurrence of fish in the trap.

ii) When river flows allow, approximately 130-cfs will be diverted through the fish screens into the intake forebay. At 130-cfs, there is sufficient effective screen area to maintain screen approach velocities below the 0.4-fps velocity criteria. Louvers behind the screens will be adjusted to eliminate local velocity "hot-spots". The automated cleaning system will periodically brush the faces to prevent debris accumulation and maintain velocity criteria.

iii) The sediment control pump situated in the supply intake forebay will be operated as needed to minimize accumulation of sediment deposits. This system will sequentially discharge water through orifices in manifolds located along the bottom of the pools and ladder of the trap. After fish have been loaded, the system will be run to minimize disturbance to fish.

iv) Similar to existing trap-and-haul operations, between 35 and 45-cfs will be delivered to the holding and hopper pools. At these flows, flow depth across the 8-foot ladder weirs will be approximately 1.2 to 1.4-ft respectively. The remaining 85 to 95-cfs will be delivered to the trap entrance as supplementary attraction flow. The adjustable crest entrance slot will be operated to optimize the discharge jet for fish attraction during variable tailwater conditions.

v) In terms of trapping and hauling adult migratory fish, the facilities will be operated in a manner similar to the existing trap's current operation. Adult fish will volitionally enter the trap and travel up the ladder until entering the holding pool. The brail in the holding pool will then be raised to funnel trapped fish into the loading pool. Once all the fish have been collected in the loading pool, the hopper will then be operated to transfer the captured fish into a tanker truck. The tanker trucks when transporting the adult fish to an unloading site upstream of MMD will utilize the improved access road. The timing and frequency of this operational cycle will continue to be a function of the size and timing of fish runs.

(c) 16-ft Radial Gate

i) As mentioned previously, the primary purpose of the radial gate is to maintain the capacity of the supply intake by minimizing accumulation of bedload and debris in front of the supply intake fish screens. This is accomplished by operating the gate to develop sufficient velocities in front of the screen panels to mobilize bedload and debris to be discharged downstream. Additionally, operation of the gate will generate sweeping velocities in front of the fish screens to bypass juvenile fish downstream and minimize their exposure time to the intake screens. Water discharging through the radial gate will help attract fish along the left bank to the trap entrance. The radial gate, when open, will also function as a velocity-depth barrier.

ii) The gate will be operated to maintain the normal operating pool level. At flows exceeding the gate's capacity to maintain the normal operating pool level, the gate will remain fully open. The operation of the radial gate is subject to the following constraints. The minimum gate opening to prevent vibration is 0.8-ft. The minimum flow through the gate required to develop barrier velocities on the gate apron is 220-cfs. This corresponds with a minimum gate opening of 1.6-ft at the normal operating pool level.

(d) Ogee Weir

i) Because the ogee weir is a fixed structure with no mechanical or moving parts, the weir will function passively and not require any active operation. As discussed previously, it is expected that bedload deposition will raise the riverbed behind the weir.

(e) Rubber Weirs

i) The two inflatable rubber weirs will be operated in conjunction with the radial gate to maintain the normal pool level during trap operation. The rubber weirs have the capability to be incrementally inflated or deflated to achieve the desired pool level. During extreme flow events, both rubber weirs will be fully deflated to pass the high flows as well as bedload and debris. A more detailed description regarding the operation of the rubber weirs is provided in the flow control operational schedule on Plate 10.

1.1.5.3 Estimated Costs

(a) The capital cost for this alternative, in terms of 2003 dollars, are presented in Table 7, "Alternative 4 Capital Cost Summary". This table includes the construction cost, contingency, planning and design, and environment. The contingency is 30-percent of the construction cost. Planning and design are based on 15-percent of construction cost plus contingency. Environmental costs are 10-percent of construction cost plus contingency. The construction items included in each of the headings are summarized below. Details of the construction cost estimate are available in the "MCASES" cost estimating program report, which is submitted under a separate cover. Real estate costs were not estimated.

i) Mobilization and General Conditions

ii) Temporary Construction

a) Erosion and Sediment Control
b) Clearing and Grubbing
c) Cofferdams
d) De-watering
e) Temporary Access

iii) Demolition

a) Existing Fish Trap

iv) Earthworks

a) Dam Foundation
b) Fish Trap – Rock Excavation
c) Fish Trap – Soil Excavation
d) Care of River and Flow Handling
e) General Backfill
f) Rip Rap
g) Access Road Surfacing
h) New Precast Bridge over Creek

v) Structural Concrete

a) Dam
b) Fish Facilities
c) Screened Water Intake Structure
d) Upstream Aprons
e) General Reinforcing Steel
f) Bridge Deck
g) New Fish Trap

vi) Misc. Metals

a) Armor Plate on the invert of the gate bays and aprons
b) Structural Steel, Grating, Handrail, etc.
c) Stoplogs slots
d) 16-foot Radial Gate

vii) Incidentals

a) Landscaping
b) Fencing

viii) Buildings

a) Equipment Building
b) Control Building

ix) Specialized Process Equipment

a) General Electrical Systems
b) Power Service Extension
c) Inflatable Rubber Weirs
d) Fish Screen
e) Fish Screen Baffles
f) Fish Screen Structural Steel

g) Fish Screen Cleaner
h) Sediment Control System
i) Fish Screen Electrical and Controls
j) Gate Hydraulic System
k) Fish Trap Mechanical
l) Fish Trap Misc. Metals
m) Relocate Existing River Gaging Station

Table 7 Alternative 4 - Construction Cost Summary

Cost Components	Total Cost
Mobilization / General Conditions	$ 381,230
Temporary Construction	$ 443,715
Demolition	$ 33,779
Earthworks	$ 271,868
Structural Concrete	$ 1,742,085
Misc. Metals	$ 396,207
Incidentals	$ 22,802
Buildings	$ 217,420
Specialized Process Equipment	$ 2.559,584
CONSTRUCTION TOTAL	**$ 6,068,690**
CONTINGENCY (30% OF CONST.)	**$ 1,820,607**
PLANNING & DESIGN (15% OF CONST. + CONT.)	**$ 1,183,395**
ENVIRONMENTAL (10% OF CONST. + CONT.)	**$ 1,183,395**
TOTAL CAPITAL COST	**$ 10,256,086**

(b) Operation and maintenance costs are estimated over a 50-year project life and presented in Table 8, titled "Alternative 4 Operation and Maintenance Cost – 50 year Life Cycle. The costs cover weekly operation and inspections, annual maintenance, and two replacements of major mechanical items on a 16-year cycle. These costs are converted to present value dollars based on a discount rate of 5.875 percent. A labor rate of $60 per hour is assumed. Power costs are based on $0.06 per kW-Hour. Items included for each component of operation include:

i) Fish Trap Operation: Includes operating the trap and haul 3-days a week, including trucking. Inspection of the screen cleaner and operation of the sediment control system is assumed to occur on a weekly basis. Power cost are included for screen cleaning, sediment control, and general lighting and control.

ii) Fish Trap Maintenance: Labor, equipment, and material are included for annual inspections and repairs of the fish trap facility.

iii) Dam Maintenance: Maintenance for the dam includes weekly and annual inspection of the radial gate and rubber dams. Power cost for the gate and rubber dams are also included. Labor, equipment, and material are included for annual debris and bedload management. This activity assumes minor handling of large woody debris with portable cranes and minor dredging. Replacement of the radial gate and rubber dam is allowed on a 16-year interval, twice over the 50 year life

Table 8 - Alternative 4 Operation and Maintenance Costs 50-year Life Cycle				
System Component	Annual Labor, Equip. & Material $/yr	Annual Power Cost	16-Year Interval Replacement Costs	Total Present Value of O&M
		0.06 $/kWhr	2003 $	2003 $
Fish Trap Operation:				5.875%
Fish Trap and Haul	82,880			1,329,483
Sediment Control	6,240	350		105,717
Screen Cleaning	6,240	1,007		116,256
General Lights and Control		44		703
Fish Trap Maintenance				
Annual Inspection	6,300			101,059
Repairs	5,600			89,830
Dam Maintenance				
16' Radial Gate	8,300	153	74,420	177,429
Rubber Dam	13,720	44	595,140	555,296
Debris Management	10,200			163,619
Bedload Management	7,040			112,929
Totals	146,520	1,599	669,560	2,752,320

1.1.6 Alternative 5 – Trap-and-Haul with Ogee Weir and Two Radial Gates @ USGS Gauging Station Site

1.1.6.1 Physical Description

(a) Trap-and-Haul

i) The proposed right bank trap-and-haul design retains much of the Corps' existing trap design, but also includes several upgrades and modifications (see Plates 11 and 15). Specifically, the design of the ladder, holding pool, loading pool and fish hopper remains largely the same, with the only significant change being two additional ladder weirs to account for the greater range in design tailwater levels. Major additions and modifications include the following: a modified supply intake with fish screens, new auxiliary water supply (AWS) and trap water supply channels, and a reconfigured trap entrance.

ii) The new trap-and-haul water supply intake is located on the right bank upstream of the radial gate. River flow enters the supply intake through a series of eight vertical fixed-plate fish screens aligned parallel to river flow and inline with the upstream right riverbank. The eight 6-ft high by 8-ft wide screen panels are designed to comply with current juvenile fish screen criteria while passing the maximum 130-cfs diversion flow. The tops of the screen panels are set below the normal pool level to remain submerged at all times. A brush-type system will automatically clean the upstream screen faces, and will be stowed out of the water when not in operation.

iii) The intake chamber behind the fish screens functions as a common forebay serving both the holding and loading pool flow demands as well as the new auxiliary water supply (AWS) channel. The existing control gates for the holding and loading pool water supply system will be retained. By default, the forebay also functions as a settling basin for suspended sediment, which pass through the screens and deposit on the forebay floor due to the relatively low flow velocities. To manage sediment deposition, within the forebay and throughout the fishway trap, a sediment control pump is located within the forebay. This pump will discharge water through manifolds placed, along the invert of the structure to create high velocity jets. The jets will resuspend sediment for flushing from the fish trap system.

iv) The new AWS channel delivers water from the supply intake forebay to the trap's new entrance pool. AWS flow is controlled by the AWS control gate located at the upstream end of the channel. A gate at the downstream end of the channel facilitates periodic flushing of the channel for sediment management. Flow from the AWS channel is introduced to the entrance pool via an upwell chamber situated under the entrance channel. To prevent false attraction, the upwell chamber is separated from the entrance pool by diffusion grating set in the channel floor.

v) The trap water supply channel, that services trap and ladder flow demands, branches from the AWS channel at its downstream end and runs parallel to the ladder terminating at the holding and loading pools. A gate at the upstream end of the channel controls flow.

vi) The fish trap entrance is located just downstream from the radial gate. The entrance's proximity to the radial gate discharge will enhance attraction. The entrance itself consists of a 3-foot wide slot with an adjustable crest for varying river flows and tailwater levels. As discussed previously, supplementary attraction water is introduced into the entrance pool through diffuser grating in the channel floor.

vii) An access road is provided between the hillside and the trap's intake supply system allowing O&M access to these facilities as well as to the service bridge.

(b) 16-ft Radial Gate

i) A 16-ft radial gate is located directly downstream from the supply intake fish screens (see Plate 11). The gate will be used to remobilize bedload and debris that have accumulated in front of the fish screens. A training wall extends upstream from the radial gate pier parallel to the fish screen panels. The purpose of the training wall is to concentrate flow and increase flow velocities between the wall and the intake screens when the gate is operated, enhancing mobilization of accumulated bedload and debris.

ii) The concrete apron downstream of the gate initially slopes downstream at 7.5% for 20-feet, then extends horizontally an additional 33-feet (see Plate 14). During gate operation, this configuration allows sufficient flow velocities to develop along the apron to create an effective upstream passage barrier. The downstream invert of the apron is set at the 4,000-cfs tailwater elevation. This prevents apron submergence throughout the river flow range during which the trap is operated.

(c) 35-ft Radial Gate

i) Except for its width, the 35-ft radial gate is essentially identical to the 16-ft radial gate including its spillway apron (see Plate 14). However, there is no concrete channel upstream of this gate. The 35-ft gate provides additional flood flow capacity, and consequently reduces flood levels above the barrier. The gate will also help pass bedload downstream and reduce bedload buildup in the forebay. The gates and ogee crest are sufficient to maintain the normal pool level necessary to provide gravity water supply to the trap-and-haul facilities.

(d) Ogee Weir

i) An ogee shaped concrete weir spans 87-ft between the radial gate pier and the left bank abutment (see Plate 11). The ogee shape and weir height are designed such that sufficient flow velocities develop along the downstream apron to create an effective upstream passage barrier (see Plate 14). Additionally, when the weir overtops, the ogee crest shape prevents free discharge directly onto the spillway apron allowing for the safe passage of juveniles downstream. As with the gate aprons, the downstream invert of the weir's apron is set at the 4,000-cfs tailwater elevation preventing submergence during the river flow range when the trap is operated. Due to bedload, it is anticipated that over time the riverbed behind the weir will aggrade to nearly crest level, especially along the left bank.

(e) Access Road

i) The existing access road is improved to provide reliable access to the trap and barrier facilities at the 100-yr flood, and to remain intact at the MMD maximum regulated release (see Plate 13). Improvements include resurfacing, a bridge over an existing drainage, and riprap at vulnerable riverbank locations.

1.1.6.2 Facilities Operation

(a) The flow control operational schedule for Alternative 5 is summarized in a table on Plate 11. The combined facilities will be operated to maintain pool level EL 813.0 during normal operating conditions.

(b) Trap-and-Haul

i) The modifications to the trap-and-haul facilities will be designed for operation between river flows of 130 and 4,000-cfs. During river flows less than 130-cfs, the trap could be closed and all flow will pass over the ogee weir. During river flows exceeding 4,000-cfs, the trap ladder becomes increasingly flooded and conditions diverge from criteria. As flow exceeds 4,000-cfs the operator would use discretion on continuing operation, depending on river conditions and the occurrence of fish in the trap.

ii) When river flows allow, approximately 130-cfs will be diverted through the fish screens into the intake forebay. At 130-cfs, there is sufficient effective screen area to maintain screen approach velocities below the 0.4-fps velocity criteria. Louvers behind the screens will be adjusted to eliminate local velocity "hot-spots". The automated cleaning system will periodically brush the faces to prevent debris accumulation and maintain velocity criteria.

iii) The sediment control pump situated in the supply intake forebay will be operated as needed to minimize accumulation of sediment deposits. This system will sequentially discharge water through orifices in manifolds located along the bottom of the pools and ladder of the trap. After fish have been loaded, the system will be run to minimize disturbance to fish.

iv) Similar to existing trap-and-haul operations, between 35 and 45-cfs will be delivered to the holding and hopper pools. At these flows, flow depth across the 8-foot ladder weirs will be approximately 1.2 to 1.4-ft respectively. The remaining 85 to 95-cfs will be delivered to the trap entrance as supplementary attraction flow. The adjustable crest entrance slot will be operated to optimize the discharge jet for fish attraction during variable tailwater conditions.

v) In terms of trapping and hauling adult migratory fish, the facilities will be operated in a manner similar to the existing trap's current operation. Adult fish will volitionally enter the trap and travel up the ladder until entering the holding pool. The brail in the holding pool will then be raised to funnel trapped fish into the loading pool. Once all the fish have been collected in the loading pool, the hopper will then be operated to transfer the captured fish into a tanker truck. The tanker trucks, when transporting the adult fish to an unloading site upstream of MMD, will utilize the improved access road. The timing and frequency of this operational cycle will continue to be a function of the size and timing of fish runs.

(c) 16-ft Radial Gate

i) As mentioned previously, the primary purpose of the radial gate is to maintain the capacity of the supply intake by minimizing accumulation of bedload and debris in front of the supply intake fish screens. This is accomplished by operating the gate to develop sufficient velocities in front of the screen panels to mobilize bedload and debris to be discharged downstream. Additionally, operation of the gate will generate sweeping velocities in front of the fish screens to bypass juvenile fish downstream and minimize their exposure time to the intake screens. Water discharging through the radial gate will help attract fish along the left bank to the trap entrance. The radial gate, when open, will also function as a velocity-depth barrier.

ii) The gate will be operated to maintain the normal operating pool level. At flows exceeding the gate's capacity to maintain the normal operating pool level, the gate will remain fully open. The operation of the radial gate is subject to the following constraints. The minimum gate opening to prevent vibration is 0.8-ft. The minimum flow through the gate required to develop barrier velocities on the gate apron is 480-cfs. This corresponds with a minimum gate opening of 1.6-ft at the normal operating pool level.

(d) 35-ft Radial Gate

i) The purpose of the 35-ft gate is to pass high flow, bedload and debris. Additionally, it will be operated to maintain the normal operating pool level when the 16-ft gate has reached capacity. At flows exceeding the gate's capacity to maintain the normal operating pool level, the gate will remain fully open.

ii) As with the 16-ft gate, the operation of the 35-ft gate is subject to the following constraints. The minimum gate opening to prevent vibration is 0.8-ft. The minimum flow through the gate required to develop barrier velocities on the gate apron is 220-cfs. This corresponds with a minimum gate opening of 1.6-ft at the normal operating pool level.

(e) Ogee Weir

i) Because the ogee weir is a fixed structure with no mechanical or moving parts, the weir will function passively and not require any active operation. As discussed previously, it is expected that bedload will raise the riverbed behind the weir.

1.1.6.3 Estimated Costs

(a) The capital cost for this alternative, in terms of 2003 dollars, are presented in Table 9, "Alternative 5 Capital Cost Summary". This table includes the construction cost, contingency, planning and design, and environment. The contingency is 30-percent of the construction cost. Planning and design are based on 15-percent of construction cost plus contingency. Environmental costs are 10-percent of construction cost plus contingency. The construction items included in each of the headings are summarized below. Details of the construction cost estimate are available in the "MCASES" cost estimating program report, which is submitted under a separate cover. Real estate costs were not estimated.

i) Mobilization and General Conditions

ii) Temporary Construction

- a) Erosion and Sediment Control
- b) Clearing and Grubbing
- c) Cofferdams
- d) De-watering
- e) Temporary Access

iii) Demolition

- a) Existing Fish Trap

iv) Earthworks

- a) Dam Foundation
- b) Fish Trap – Rock Excavation
- c) Fish Trap – Soil Excavation
- d) Care of River and Flow Handling
- e) General Backfill
- f) Rip Rap
- g) Access Road Surfacing
- h) New Precast Bridge over Creek

v) Structural Concrete

- a) Dam
- b) Fish Facilities
- c) Screened Water Intake Structure
- d) Upstream Aprons
- e) General Reinforcing Steel
- f) Bridge Deck
- g) New Fish Trap

vi) Misc. Metals

- a) Armor Plate on the invert of the gate bays and aprons
- b) Structural Steel, Grating, Handrail, etc.
- c) Stoplogs slots
- d) 16-foot Radial Gate
- e) 35-foot Radial Gate

vii) Incidentals

- a) Landscaping
- b) Fencing

viii) Buildings

a) Equipment Building
b) Control Building

ix) Specialized Process Equipment

a) General Electrical Systems
b) Power Service Extension
c) Fish Screen
d) Fish Screen Baffles
e) Fish Screen Structural Steel
f) Fish Screen Cleaner
g) Sediment Control System
h) Fish Screen Electrical and Controls
i) Gate Hydraulic System
j) Fish Trap Mechanical
k) Fish Trap Misc. Metals
l) Relocate Existing River Gaging Station

Table 9 - Alternative 5 - Capital Cost Summary

Cost Components		**Total Cost**
Mobilization / General Conditions	$	381,230
Temporary Construction	$	403,187
Demolition	$	33,779
Earthworks	$	271,868
Structural Concrete	$	1,547,088
Misc. Metals	$	607,819
Incidentals	$	22,802
Buildings	$	217,420
Specialized Process Equipment	$	1,990,879
CONSTRUCTION TOTAL	**$**	**5,476,072**
CONTINGENCY (30% OF CONST.)	**$**	**1,642,822**
PLANNING & DESIGN (15% OF CONST. + CONT.)	**$**	**1,067,834**
ENVIRONMENTAL (10% OF CONST. + CONT.)	**$**	**711,889**
TOTAL CAPITAL COST	**$**	**8,898,617**

(b) Operation and maintenance costs are estimated over a 50-year project life and presented in Table 10, titled "Alternative 5 Operation and Maintenance Cost – 50 year Life Cycle. The costs cover weekly operation and inspections, annual maintenance, and two replacements of major mechanical items on a 16-year cycle. These costs are converted to present value dollars based on a discount rate of 5.875 percent. A labor rate of $60 per hour is assumed. Power costs are based on $0.06 per kW-Hour. Items included for each component of operation include:

i) Fish Trap Operation: Includes operating the trap and haul 3-days a week, including trucking. Inspection of the screen cleaner and operation of the sediment control system is assumed to occur on a weekly basis. Power cost are included for screen cleaning, sediment control, and general lighting and control.

ii) Fish Trap Maintenance: Labor, equipment, and material are included for annual inspections and repairs of the fish trap facility.

iii) Dam Maintenance: Maintenance for the dam includes weekly and annual inspection of the radial gates. Power cost for the gates is also included. Labor, equipment, and material are included for annual debris and bedload management. This activity assumes minor handling of large woody debris with portable cranes and minor dredging. Replacement of the radial gates is allowed on a 16-year interval, twice over the 50 year life.

Table 10 Alternative 5 Operation and Maintenance Costs
50-year Life Cycle

System Component	Annual Labor, Equip. & Material $/yr	Annual Power Cost	16-Year Interval Replacement Costs	Total Present Value of O&M
		0.06 $/kWhr	2003 $	2003 $
Fish Trap Operation:				5.875%
Fish Trap and Haul	82,880			1,329,483
Sediment Control	6,240	350		105,717
Screen Cleaning	6,240	1,007		116,256
General Lights and Control		44		703
Fish Trap Maintenance				
Annual Inspection	6,300			101,059
Repairs	5,600			89,830
Dam Maintenance				
16' Radial Gate	8,300	153	74,420	177,429
35' Radial Gate	12,250	219	142,466	280,091
Debris Management	10,200			163,619
Bedload Management	7,040			112,929
Totals	145,050	1,774	216,886	2,477,116

1.1.7 Alternative 6 – Trap-and-Haul with Ogee Weir and Radial Gate @ USGS Gauging Station Site

1.1.7.1 Physical Description

(a) Trap-and-Haul

i) The proposed right bank trap-and-haul design retains much of the Corps' existing trap design, but also includes several upgrades and modifications (see Plates 12 and 15). Specifically, the design of the ladder, holding pool, loading pool and fish hopper remains largely the same, with the only significant change being two additional ladder weirs to account for the greater range in design tailwater levels. Major additions and modifications include the following: a modified supply intake with fish screens, new auxiliary water supply (AWS) and trap water supply channels, and a reconfigured trap entrance.

ii) The new trap-and-haul water supply intake is located on the right bank upstream of the radial gate. River flow enters the supply intake through a series of eight vertical fixed-plate fish screens aligned parallel to river flow and inline with the upstream right riverbank. The eight 6-ft high by 8-ft wide screen panels are designed to comply with current juvenile fish screen criteria while passing the maximum 130-cfs diversion flow. The tops of the screen panels are set below the normal pool level to remain submerged at all times. A brush-type system will automatically clean the upstream screen faces, and will be stowed out of the water when not in operation.

iii) The intake chamber behind the fish screens functions as a common forebay serving both the holding and loading pool flow demands as well as the new auxiliary water supply (AWS) channel. The existing control gates for the holding and loading pool water supply system will be retained. By default, the forebay also functions as a settling basin for suspended sediment, which pass through the screens and deposit on the forebay floor due to the relatively low flow velocities. To manage sediment deposition, within the forebay and throughout the fishway trap, a sediment control pump is located within the forebay. This pump will discharge water through manifolds placed, along the invert of the structure to create high velocity jets. The jets will resuspend sediment for flushing from the fish trap system.

iv) The new AWS channel delivers water from the supply intake forebay to the trap's new entrance pool. AWS flow is controlled by the AWS control gate located at the upstream end of the channel. A gate at the downstream end of the channel facilitates periodic flushing of the channel for sediment management. Flow from the AWS channel is introduced to the entrance pool via an upwell chamber situated under the entrance channel. To prevent false attraction, the upwell chamber is separated from the entrance pool by diffusion grating set in the channel floor.

v) The trap water supply channel that services trap and ladder flow demands branches from the AWS channel at its downstream end and runs parallel to the ladder terminating at the holding and loading pools. A gate at the upstream end of the channel controls flow.

vi) The fish trap entrance is located just downstream from the radial gate. The entrance's proximity to the radial gate discharge will enhance attraction. The entrance itself consists of a 3-foot wide slot with an adjustable crest for varying river flows and tailwater levels. As discussed previously, supplementary attraction water is introduced into the entrance pool through diffuser grating in the channel floor.

vii) An access road is provided between the hillside and the trap's intake supply system allowing O&M access to these facilities as well as to the service bridge.

(b) 16-ft Radial Gate

i) A 16-ft radial gate is located directly downstream from the supply intake fish screens (see Plate 12). The gate will be used to remobilize sediments and debris that have accumulated in front of the fish screens. A training wall extends upstream from the radial gate pier parallel to the fish screen panels. The purpose of the training wall is to concentrate flow and increase flow velocities between the wall and the intake screens when the gate is operated, enhancing mobilization of accumulated sediment and debris.

ii) The concrete apron downstream of the gate initially slopes downstream at 7.5% for 20-feet, then extends horizontally an additional 33-feet (see Plate 14). During gate operation, this configuration allows sufficient flow velocities to develop along the apron to create an effective upstream passage barrier. The downstream invert of the apron is set at the 4,000-cfs tailwater elevation. This prevents apron submergence throughout the river flow range during which the trap is operated.

(c) Ogee Weir

i) An ogee shaped concrete weir spans 127-ft between the radial gate pier and the left bank abutment (see Plate 12). The ogee shape and weir height are designed such that sufficient flow velocities develop along the downstream apron to create an effective upstream passage barrier (see Plate 14). Additionally, when the weir overtops, the ogee crest shape prevents free discharge directly onto the spillway apron allowing for the safe passage of juveniles downstream. As with the gate aprons, the downstream invert of the weir's apron is set at the 4,000-cfs tailwater elevation preventing submergence during the river flow range when the trap is operated. Due to bedload deposition, it is anticipated that over time the riverbed behind the weir will aggrade to nearly crest level.

(d) Access Road

i) The existing access road is improved to provide reliable access to the trap and barrier facilities at the 100-yr flood, and to remain intact at the MMD maximum regulated release (see Plate 13). Improvements include resurfacing, a bridge over an existing drainage, and riprap at vulnerable riverbank locations.

1.1.7.2 Facilities Operation

(a) The flow control operational schedule for Alternative 6 is summarized in a table on Plate 12. The combined facilities will be operated to maintain pool level EL 813.0 during normal operating conditions.

(b) Trap-and-Haul

i) The modifications to the trap-and-haul facilities will be designed for operation between river flows of 130 and 4,000-cfs. During river flows less than 130-cfs, the trap could be closed and all flow will pass over the ogee weir. During river flows exceeding 4,000-cfs, the trap ladder becomes increasingly flooded and conditions diverge from criteria. As flow exceeds 4,000-cfs the operator would use discretion on continuing operation, depending on river conditions and the occurrence of fish in the trap.

ii) When river flows allow, approximately 130-cfs will be diverted through the fish screens into the intake forebay. At 130-cfs, there is sufficient effective screen area to maintain screen approach velocities below the 0.4-fps velocity criteria. Louvers behind the screens will be adjusted to eliminate local velocity "hot-spots". The automated cleaning system will periodically brush the faces to prevent debris accumulation and maintain velocity criteria.

iii) The sediment control pump situated in the supply intake forebay will be operated as needed to minimize accumulation of sediment deposits. This system will sequentially discharge water through orifices in manifolds located along the bottom of the pools and ladder of the trap. After fish have been loaded, the system will be run to minimize disturbance to fish.

iv) Similar to existing trap-and-haul operations, between 35 and 45-cfs will be delivered to the holding and hopper pools. At these flows, flow depth across the 8-foot ladder weirs will be approximately 1.2 to 1.4-ft respectively. The remaining 85 to 95-cfs will be delivered to the trap entrance as supplementary attraction flow. The adjustable crest entrance slot will be operated to optimize the discharge jet for fish attraction during variable tailwater conditions.

v) In terms of trapping and hauling adult migratory fish, the facilities will be operated in a manner similar to the existing trap's current operation. Adult fish will volitionally enter the trap and travel up the ladder until entering the holding pool. The brail in the holding pool will then be raised to funnel trapped fish into the loading pool. Once all the fish have been collected in the loading pool, the hopper will then be operated to transfer the captured fish into a tanker truck. The tanker trucks when transporting the adult fish to an unloading site upstream of MMD will utilize the improved access road. The timing and frequency of this operational cycle will continue to be a function of the size and timing of fish runs.

(c) 16-ft Radial Gate

i) As mentioned previously, the primary purpose of the radial gate is to maintain the capacity of the supply intake by minimizing accumulation of bedload and debris in front of the supply intake fish screens. This is accomplished by operating the gate to develop sufficient velocities in front of the screen panels to mobilize bedload and debris to be discharged downstream. Additionally, operation of the gate will generate sweeping velocities in front of the fish screens to bypass juvenile fish downstream and minimize their exposure time to the intake screens. Water discharging through the radial gate will help attract fish along the left bank to the trap entrance. The radial gate, when open, will also function as a velocity-depth barrier.

ii) The gate will be operated to maintain the normal operating pool level. At flows exceeding the gate's capacity to maintain the normal operating pool level, the gate will remain fully open. The operation of the radial gate is subject to the following constraints. The minimum gate opening to prevent vibration is 0.8-ft. The minimum flow through the gate required to develop barrier velocities on the gate apron is 220-cfs. This corresponds with a minimum gate opening of 1.6-ft at the normal operating pool level.

(d) Ogee Weir

i) Because the ogee weir is a fixed structure with no mechanical or moving parts, the weir will function passively and not require any active operation. As discussed previously, it is expected that bedload movement will raise the riverbed behind the weir.

1.1.7.3 Costs

(a) The capital cost for this alternative, in terms of 2003 dollars, are presented in Table 11, "Alternative 6 Capital Cost Summary". This table includes the construction cost, contingency, planning and design, and environment. The contingency is 30-percent of the construction cost. Planning and design are based on 15-percent of construction cost plus contingency. Environmental costs are 10-percent of construction cost plus contingency. The construction items included in each of the headings are summarized below. Details of the construction cost estimate are available in the "MCASES" cost estimating program report, which is submitted under a separate cover. Real estate costs were not estimated, but the land area required for each alternative is included in Table 16, titled "Alternatives Comparison Matrix".

i) Mobilization and General Conditions

ii) Temporary Construction

a) Erosion and Sediment Control
b) Clearing and Grubbing
c) Cofferdams
d) De-watering

- e) Temporary Access

iii) Demolition

- a) Existing Fish Trap

iv) Earthworks

- a) Dam Foundation
- b) Fish Trap – Rock Excavation
- c) Fish Trap – Soil Excavation
- d) Care of River and Flow Handling
- e) General Backfill
- f) Rip Rap
- g) Access Road Surfacing
- h) New Precast Bridge over Creek

v) Structural Concrete

- a) Dam
- b) Fish Facilities
- c) Screened Water Intake Structure
- d) Upstream Aprons
- e) General Reinforcing Steel
- f) Bridge Deck
- g) New Fish Trap

vi) Misc. Metals

- a) Armor Plate on the invert of the gate bays and aprons
- b) Structural Steel, Grating, Handrail, etc.
- c) Stoplogs slots
- d) 16-foot Radial Gate

vii) Incidentals

- a) Landscaping
- b) Fencing

viii) Buildings

- a) Equipment Building
- b) Control Building

ix) Specialized Process Equipment

- a) General Electrical Systems
- b) Power Service Extension
- c) Fish Screen
- d) Fish Screen Baffles
- e) Fish Screen Structural Steel
- f) Fish Screen Cleaner
- g) Sediment Control System
- h) Fish Screen Electrical and Controls
- i) Gate Hydraulic System
- j) Fish Trap Mechanical
- k) Fish Trap Misc. Metals

l) Relocate Existing River Gaging Station

Table 11 - Alternative 6 - Capital Cost Summary

Cost Components		Total Cost
Mobilization / General Conditions	$	381,230
Temporary Construction	$	403,187
Demolition	$	33,779
Earthworks	$	271,868
Structural Concrete	$	1,483,505
Misc. Metals	$	364,790
Incidentals	$	22,802
Buildings	$	217,420
Specialized Process Equipment	$	1,879,637
CONSTRUCTION TOTAL	**$**	**5,058,218**
CONTINGENCY (30% OF CONST.)	**$**	**1,517,465**
PLANNING & DESIGN (15% OF CONST. + CONT.)	**$**	**986,352**
ENVIRONMENTAL (10% OF CONST. + CONT.)	**$**	**657,568**
TOTAL CAPITAL COST	**$**	**8,219,604**

(b) Operation and maintenance costs are estimated over a 50-year project life and presented in Table 12, titled "Alternative 6 Operation and Maintenance Cost – 50 year Life Cycle. The costs cover weekly operation and inspections, annual maintenance, and two replacements of major mechanical items on a 16-year cycle. These costs are converted to present value dollars based on a discount rate of 5.875 percent. A labor rate of $60 per hour is assumed. Power costs are based on $0.06 per kW-Hour. Items included for each component of operation include:

i) Fish Trap Operation: Includes operating the trap and haul 3-days a week, including trucking. Inspection of the screen cleaner and operation of the sediment control system is assumed to occur on a weekly basis. Power costs are included for screen cleaning, sediment control, and general lighting and control.

ii) Fish Trap Maintenance: Labor, equipment, and material are included for annual inspections and repairs of the fish trap facility.

iii) Dam Maintenance: Maintenance for the dam includes weekly and annual inspection of the radial gate. Power cost for the gate is also included. Labor, equipment, and material are included for annual debris and bedload management. This activity assumes minor handling of large woody debris with portable cranes and minor dredging. Replacement of the radial gate is allowed on a 16-year interval, twice over the 50 year life.

Table 12 - Alternative 6 Operation and Maintenance Costs 50-year Life Cycle				
System Component	Annual Labor, Equip. & Material $/yr	Annual Power Cost	16-Year Interval Replacement Costs	Total Present Value of O&M
		0.06 $/kWhr	2003 $	2003 $
Fish Trap Operation:				5.875%
Fish Trap and Haul	82,880			1,329,483
Sediment Control	6,240	350		105,717
Screen Cleaning	6,240	1,007		116,256
General Lights and Control		44		703
Fish Trap Maintenance				
Annual Inspection	6,300			101,059
Repairs	5,600			89,830
Dam Maintenance				
16' Radial Gate	8,300	153	74,420	177,429
Debris Management	10,200			163,619
Bedload Management	5,280			84,697
Totals	131,040	1,555	74,420	2,168,792

1.1.8 Alternative 7 – Trap-and-Haul @ Mud Mountain Dam Site

1.1.8.1 Physical Description

(a) Only one alternative is considered at the Mud Mountain Dam (MMD) site. This site is located near the downstream toe of the dam adjacent to the 9-ft diameter tunnel outlet (see Plate 16). Typically this tunnel is used to pass flows under the dam (up to 4,600-cfs). Higher flow is passed with the 23-ft diameter tunnel located approximately 160-feet downstream of the 9-foot diameter tunnel outlet.

(b) The MMD at this location acts as a barrier, and therefore only a fish trap is needed. The existing PSE diversion is assumed to be modified to allow fish passage at this site, however the fish passage improvements at the existing PSE diversion are not directly included in these alternatives. Section 7 includes further discussion and costs for fish passage at the PSE site, when a trap is located upstream. Extreme velocities and turbulence at this location may be detrimental to attracting fish to the proposed trap. Depending on flow, the velocity exiting the 9-foot diameter tunnel will range from 20 to 70-fps. Siting the facility further downstream is likely unfeasible due to very difficult access and exposure to discharge from the 23-foot diameter tunnel. Discharge velocity in the 23-foot diameter tunnel will be approximately 26-fps (assuming full tunnel flow at the maximum discharge, from the rating curve, of 10,800-cfs).

(c) Site Access

i) Two separate existing access roads lead to the vicinity of the proposed site for this alternative (see Plate 16). The first road is located on the downstream face of MMD and leads to the outlets of both the 9-ft and 23-ft tunnels. While this road extends down near the water directly to the proposed site at approximately elevation 900-fmsl (see Plate 17), it is very steep (up to a 20-percent grade) and includes several tight switchbacks. Consequently, it is not very suitable for routine fish hauling.

ii) The second road approaches the site from below the dam along the north valley wall. This road is relatively straight with a maximum grade of about 13-percent. However, it terminates below the MMD emergency spillway and above the 23-ft tunnel at approximately 1000-fmsl, over 100-ft above the river. Also, the structural integrity of the bridge trestle below the spillway is suspect, and currently no vehicles are allowed on the bridge deck.

iii) While each of the access roads have difficulties in terms of use for a trap-and-haul operation, the second access road was eliminated due to the condition of the bridge trestle and the landslide exposure. Therefore, the first access road was selected for this alternative with the option of providing a fish gondola from the trap to the MMD crest.

(d) Fish Trap

i) The proposed trap design is partially modeled on the Corps' existing trap design. Similar features include the ladder, holding pool, loading pool, and fish hopper. Two additional ladder weirs were provided to account for the greater range in design tailwater levels. Major additions and modifications include the following: a modified supply intake with fish screens a pumped water supply system for both trap water and auxiliary water supply (AWS), and a reconfigured trap entrance.

ii) The water supply intake is located on the left bank downstream from the 9-ft tunnel outlet (see Plate 17). River flow enters the supply intake through a series of eight vertical fixed-plate fish screens angled slightly away from the tunnel discharge flowline. The eight 6-ft high by 8-ft wide screen panels are designed to comply with current juvenile fish screen criteria while passing the maximum 130-cfs diversion flow. The tops of the screen panels are set below the normal pool level to remain submerged at all times. A brush-type system will automatically clean the upstream screen faces, and will be stowed out of the water when not in operation.

iii) The intake chamber behind the fish screens functions as a common forebay serving both the holding and loading pool flow demands as well as the new auxiliary water supply (AWS) channel. By default, the forebay also functions as a settling basin for suspended sediment, which pass through the screens and deposit on the forebay floor due to the relatively low flow velocities. To manage sediment deposition, within the forebay and throughout the fishway trap, a sediment control pump is located within the forebay. This pump will discharge water through manifolds placed, along the invert of the structure to create high velocity jets. The jets will resuspend sediment for flushing from the fish trap system.

iv) To provide the necessary head for operating the trap, two 150-HP, 42-inch diameter pumps (one primary and one backup) are provided to lift water from the intake forebay to a head box adjacent to the holding pool. Two 24-in pipes deliver water from the head box to the loading pool and holding pool respectively, while a 48-in pipe supplies the entrance pool with supplementary attraction flow. Supplementary attraction water is introduced to the entrance pool via an upwell chamber situated below the entrance pool (see Plate 18). To prevent false attraction, the upwell chamber is separated from the entrance pool by diffusion grating set in the channel floor.

v) The fish trap entrance is located on the left bank at the downstream end of the intake fish screens approximately 90-ft downstream from the 9-ft tunnel outlet. The entrance itself consists of a 3-foot wide slot with an adjustable crest for varying river flows and tailwater levels. As discussed previously, supplementary attraction water is introduced into the entrance pool through diffuser grating in the channel floor.

vi) A 15-kilovolt overhead power line will supply power to the fish trap. The line will lead from the existing MMD facilities on the north side of the dam and down the dam face to the trap (see Plate 16). The power line alignment will be such that it is accessible from the existing access road.

(e) New Bridge

i) An existing concrete bridge leading from the base of the dam to the 9-ft tunnel outlet is partially located within the proposed footprint of the trap facilities (see Plate 17). Therefore, this bridge would be demolished during construction of the proposed trap. Once completed, a new bridge would be constructed from the trap to the tunnel outlet to replace the existing bridge.

(f) Fish Gondola (Optional)

i) As discussed previously, the steepness of the access road leading down the dam face is not very suitable for tanker truck hauling operations. Therefore, an optional feature for this alternative is a fish gondola. The gondola would transport the fish hopper from the loading pool to the dam crest for transfer to tanker trucks (see Plate 16). Consequently, the tanker trucks would not be required to travel down the dam face access road under normal operating conditions. However, in the event there are problems with operating the gondola, the tanker trucks could still use the access road until the problems are resolved. This option is distinguished as Alternative 7B as opposed to no gondola, which is 7A.

1.1.8.2 Facilities Operation

(a) Trap-and-Haul

i) The modifications to the trap-and-haul facilities will be designed for operation between river flows of 130 and 4,000-cfs. During river flows less than 130-cfs, the trap could be closed. During river flows exceeding 4,000-cfs, the trap ladder becomes increasingly flooded and conditions diverge from criteria. As flow exceeds 4,000-cfs the operator would use discretion on continuing operation, depending on river conditions and the occurrence of fish in the trap. Within this operational flow range, approximately 130-cfs will be diverted through the fish screens into the intake forebay. At the 130-cfs maximum diversion, there is sufficient effective screen area to maintain screen approach velocities below the 0.4-fps velocity criteria. Louvers behind the screens will be adjusted to eliminate local velocity "hot-spots". The automated cleaning system will periodically brush the faces to prevent debris accumulation and maintain velocity criteria. The sediment control pump situated in the supply intake forebay will be operated as needed to minimize accumulation of sediment deposits. This system will sequentially discharge water through orifices in manifolds located along the bottom of the pools and ladder of the trap. After fish have been loaded, the system will be run to minimize disturbance to fish.

ii) As mentioned previously, one of the two 150-HP variable speed pumps will supply water to the trap's water supply head box. The second pump will serve as a backup. Pump speed will be adjusted depending on tailwater levels and trap flow demand.

iii) Similar to existing trap-and-haul operations, between 35 and 45-cfs will be delivered to the holding and hopper pools, from where it will flow down the ladder. At these flows, depth across the 8-foot ladder weirs will be approximately 1.2 to 1.4-ft, respectively. The remaining 85 to 95-cfs will be delivered to the trap entrance as supplementary attraction flow. The adjustable crest entrance slot will be operated to optimize the discharge jet for fish attraction during variable tailwater conditions.

iv) In terms of trapping and hauling adult migratory fish, the facilities will be operated in a manner similar to the existing trap's current operation. Adult fish will volitionally enter the trap and travel up the ladder until entering the holding pool. The brail in the holding pool will then be raised to funnel trapped fish into the loading pool. Once all the fish have been collected in the loading pool, the hopper will then be operated to transfer the captured fish into a tanker truck. The timing and frequency of this operational cycle will continue to be a function of the size and timing of fish runs.

(b) Fish Gondola (Optional)

i) With addition of the fish gondola feature to this alternative, the tanker trucks used to haul the trapped fish would not have to travel down the dam face. Instead, the fish hopper would be transported from the trap to the dam crest for transfer to the tanker trucks. This system would be comprised of a cable system supported by towers at the top, bottom, and intermediate points. It would be similar to a ski lift, but would simply transport the loading hopper up and down the dam. The drive system would be controlled at either the top or the bottom with emergency shutdown control at both ends. Rather than operating in a circular motion the cable would run the hopper down then back. A variable speed drive would allow smooth acceleration and deceleration. Otherwise, the operation of this alternative would be essentially the same as without the gondola.

1.1.8.3 Costs

(a) The capital cost for this alternative, in terms of 2003 dollars, are presented in Table 13, "Alternative 7 Capital Cost Summary". This table includes the construction cost, contingency, planning and design, and environment. The contingency is 30-percent of the construction cost. Planning and design are based on 15-percent of construction cost plus contingency and an additional $250,000 for hydraulic modeling to evaluate fish attraction conditions. Environmental costs are 10-percent of construction cost plus contingency. The construction items included in each of the headings are summarized below. Details of the construction cost estimate are available in the "MCASES" cost estimating program report, which is submitted under a separate cover. Real estate costs were not estimated.

i) Mobilization and General Conditions

ii) Temporary Construction

a) Erosion and Sediment Control
b) Clearing and Grubbing
c) Cofferdam
d) De-watering

iii) Demolition

a) Existing Fish Trap
b) Concrete Bridge at base of MMD

iv) Earthworks

a) Fish Trap – Rock Excavation
b) Fish Trap – Soil Excavation
c) Care of River and Flow Handling
d) General Backfill
e) Rip Rap
f) Access Road Surfacing
g) Access Road Switchback Improvements

v) Structural Concrete

a) Fish Trap
b) Screened Water Intake Structure
c) Upstream Aprons
d) General Reinforcing Steel
e) New Bridge

f) New Fish Trap

vi) Misc. Metals

a) Structural Steel, Grating, Handrail, etc.
b) Stoplogs slots

vii) Buildings

a) Control Building

viii) Specialized Process Equipment

a) General Electrical Systems
b) Power Service Extension
c) Fish Screen
d) Fish Screen Baffles
e) Fish Screen Structural Steel
f) Fish Screen Cleaner
g) Sediment Control System
h) Fish Screen Electrical and Controls
i) Hydraulic System
j) Fish Trap Mechanical
k) Fish Trap Misc. Metals
l) Fish Trap Water Supply Pumps
m) Fish Trap Water Supply Pumps Electrical

ix) Fish Hauling Gondola (Alternative 7B only)

Table 13 - Alternative 7 - Capital Cost Summary

Cost Components	Total Cost
Mobilization / General Conditions	$ 381,230
Temporary Construction	$ 227,135
Demolition	$ 78,812
Earthworks	$ 318,948
Structural Concrete	$ 757,220
Misc. Metals	$ 188,200
Buildings	$ 126,580
Specialized Process Equipment	$ 1,893,654
Gondola	$ 900,775
CONST. TOTAL, 7A (w/o Gondola)	**$ 3,971,779**
CONST. TOTAL, 7B (w/ Gondola)	**$ 4,872,554**
7A CONTINGENCY (30% OF CONST.)	**$ 1,191,534**
7B CONTINGENCY (30% OF CONST.)	**$ 1,461,766**
7A PLANNING & DESIGN (15% OF CONST. + CONT.)	**$ 774,497**
7B PLANNING & DESIGN (15% OF CONST. + CONT.)	**$ 950,148**
7A EXTRA HYDRAULIC MODELING	**$ 250,000**
7B EXTRA HYDRAULIC MODELING	**$ 250,000**
7A ENVIRONMENTAL (10% OF CONST. + CONT.)	**$ 516,331**
7B ENVIRONMENTAL (10% OF CONST. + CONT.)	**$ 633,432**
7A TOTAL CAPITAL COST	**$ 6,704,141**
7B TOTAL CAPITAL COST	**$ 8,167,901**

(b) Operation and maintenance costs are estimated over a 50-year project life and presented in; Table 14, titled "Alternative 7A Operation and Maintenance Cost – 50 year Life Cycle" and in Table 15, titled "Alternative 7B Operation and Maintenance Cost – 50 year Life Cycle". The costs cover weekly operation and inspections, annual maintenance, and two replacements of major mechanical items on a 16-year cycle. These costs are converted to present value dollars based on a discount rate of 5.875 percent. A labor rate of $60 per hour is assumed. Power costs are based on $0.06 per kW-Hour. Items included for each component of operation include:

i) Fish Trap Operation: Includes operating the trap and haul 3-days a week, including trucking and operation of the gondola (alternative 7-B only). Inspection of the fish trap water supply pumps, screen cleaner, and operation of the sediment control system is assumed to occur on a weekly basis. Power cost are included for fish trap water supply water pumps, screen cleaning, sediment control, gondola (alternative 7-B only), and general lighting and control. Replacement of the fish trap water supply water pumps is allowed on a 16-year interval, twice over the 50 year life

ii) Fish Trap Maintenance: Labor, equipment, and material are included for annual inspections and repairs of the fish trap facility and fish trap water supply pumps.

Table 14 - Alternative 7A Operation and Maintenance Costs				
50-year Life Cycle				
System Component	**Annual Labor, Equip. & Material $/yr**	**Annual Power Cost**	**16-Year Interval Replacement Costs**	**Total Present Value of O&M**
		0.06 $/kWhr	2003 $	2003 $
Fish Trap Operation:				5.875%
Fish Trap and Haul	81,280			1,303,818
Sediment Control	6,240	350		105,717
Screen Cleaning	6,240	1,007		116,256
General Lights and Control		44		703
Fish Trap Maintenance				
Annual Inspection	6,300			101,059
Repairs	5,600			89,830
Pump Station Maintenance				
Pumps	15,240	28,470	402,600	927,444
Totals	120,900	9,872	402,600	2,644,826

Table 15 - Alternative 7B Operation and Maintenance Costs				
50-year Life Cycle				
System Component	**Annual Labor, Equip. & Material $/yr**	**Annual Power Cost**	**16-Year Interval Replacement Costs**	**Total Present Value of O&M**
		0.06 $/kWhr	2003 $	2003 $
Fish Trap Operation:				5.875%
Fish Trap and Haul	81,280			1,303,818
Sediment Control	6,240	350		105,717
Screen Cleaning	6,240	1,007		116,256
General Lights and Control		44		703
Fish Trap Maintenance				
Annual Inspection	6,300			101,059
Repairs	5,600			89,830
Pump Station Maintenance				
Pumps	14,640	28,470	402,600	917,819
Gondola	21,120	175	100,000	397,805
Totals	141,420	30,047	502,600	3,033,005