# Responses to FERC Additional Information Request AR-1

# Hells Canyon Fish Trap Modifications

## Final Report

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# 1. INTRODUCTION

## 1.1. Description of Additional Information Request

As part of the final license application for the Hells Canyon Complex (HCFLA; IPC 2003), Idaho Power Company (IPC) proposed to modify the existing fish trap facility located below Hells Canyon (HC) Dam. There were two primary goals of the proposed modification: 1) accommodate sorting and handling of anadromous fish at the location of the trap and 2) allow capture and transport of resident salmonids and other species migrating upstream. The additional information request (AIR) Aquatic Resources (AR)–1 from the Federal Energy Regulatory Commission (FERC) asked for detailed design drawings, an operations plan, and capital (construction) and operating and maintenance (O&M) costs associated with the proposed modifications. Consultation with Idaho Department of Fish and Game, Oregon Department of Fish and Wildife, National Oceanic and Atmospheric Administration (NOAA) - Fisheries, and the U.S. Fish and Wildlife Service. The consultation record for this AIR is presented in Appendix A.

Under the existing design, the fish trap is operated seasonally to collect steelhead (*Oncorhynchus mykiss*) and spring Chinook (*O. tschawytscha*) broodstock for the IPC hatchery program. Any fish captured are hauled to the Oxbow Fish Hatchery facility where sorting and holding takes place. If any species listed under the Endangered Species Act (ESA) are captured, they are transported back to the river below HC Dam for release. The proposed modifications to the trap would allow on-site handling and sorting of fish captured, provide a means of releasing fish back to the river, or allow holding of fish for transport back to Oxbow Fish Hatchery or elsewhere.

The existing facility also effectively sorts out smaller individuals with a fish separator before they enter the holding pool of the trap. The fish separator consists of 2-inch-diameter tubes covered with PVC pipe. There is approximately a 2.25-inch spacing between tubes that allows smaller fish to fall through and be discharged back into the river. Therefore, the existing trap is not useable for capturing small migrating resident fish such as bull trout (*Salvelinus confluentus*). The proposed modifications would allow capture of any fish that successfully migrates up the fish ladder and enters the trap. Fish would be transported to the Oxbow Fish Hatchery or released back into the river (on site), as recommended by state and federal management agencies.

These proposed modifications to the HC fish trap are included as part of the native salmonid plan (Section E.3.1.3.2.1. of the HCFLA), which proposes development of a fish passage plan (IPC 2003). Modification of the fish trap at HC Dam is considered the first phase of the fish passage plan. The second phase of the plan would be to construct a trap at Oxbow Dam similar in operations and design to the

HC fish trap. However, based on uncertainties about the use and objectives of a trap at Oxbow Dam, the construction of this trap was proposed to be delayed a minimum of five years after modifications to the HC fish trap were completed. This time period may allow for studies to be conducted on the behavior and response of transported resident salmonids that were captured in the HC fish trap and transported upstream.

## 1.2. Integration with Other Protection, Mitigation, and Enhancement Proposals

### *1.2.1. Hells Canyon Complex Native Salmonid Plan*

Modification of the HC fish trap could integrate with other measures included in the proposed native salmonid plan. The native salmonid plan also proposes to construct a permanent monitoring weir at the mouth of Pine Creek. The primary purpose of the weir would be to monitor movements of fluvial bull trout and other salmonids from Pine Creek. The weir could also be used to monitor movements of fish captured and transported above HC Dam. Fish trapped at HC Dam that are identified by fish managers to be transported into Pine Creek could be placed upstream of the Pine Creek weir. For example, fluvial (migrating) bull trout captured in the HC fish trap could be transported upstream of the Pine Creek weir into known spawning areas. If these fish exhibit downstream post-spawn movements as observed at other locations, the Pine Creek weir could be used as a trap and transport facility to return the fish to below HC Dam. The weir could also be used to document fish movement into Pine Creek from fish releases from the HC fish trap directly into HC Reservoir, depending on the objectives of the management agencies.

### *1.2.2. Hatchery Program*

Modification of the HC fish trap would also closely integrate with the design and proposed expansion of the Oxbow Fish Hatchery to accommodate the fall Chinook salmon program and other hatchery programs. With the ability to hold fish at the HC fish trap until they are ready for transport, the trap facility may reduce some need for additional holding facilities at the Oxbow Fish Hatchery, especially facilities that would hold surplus hatchery anadromous fish for transport to sport fisheries. The integration and operation of these two facilities (the Oxbow Fish Hatchery and the HC fish trap) would be closely coordinated. It is possible that all fish transported to other basins for sport-fishing opportunities could be handled entirely at the HC fish trap.

## 1.3. Species of Interest

After consultation with the National Oceanic and Atmospheric Administration's National Marine Fisheries Service (NOAA Fisheries), U.S. Fish and Wildlife Service (USFWS), Idaho Department of Fish and Game (IDFG), and Oregon Department of Fish and Wildlife (ODFW) on the design modifications specific to this AIR, species of interest for trapping and holding at the trap facility were identified. The species of interest for trapping and holding include hatchery-origin anadromous species of spring Chinook salmon (*Oncorhynchus tschawytscha*), fall Chinook salmon (*O. tschawytscha*), and steelhead (*O. mykiss*) as part of broodstock needs associated with the hatchery programs and sport-fishing programs. Fluvial bull trout were also identified, including the potential of any juveniles in the system to be captured. Lastly, although it was not identified as a specific target species, there were questions raised about the ability of the trap to capture Pacific lamprey (*Lampetra tridentata*). All other fish captured (including wild anadromous fish) would be released with minimal handling at the trap facility. The return timing of species targeted at the trap generally overlaps.

### *1.3.1. Spring Chinook*

The general migration timing of adult spring Chinook arriving at the HC fish trap ranges from approximately May 1 to July 15. Adult spring Chinook salmon are held at the Oxbow Fish Hatchery for periodic transport to the Rapid River Fish Hatchery,[1] where spawning, incubation,[2] and rearing occurs. Fish trapped in surplus of hatchery broodstock needs are also held for transport to various sport fisheries in Idaho and Oregon. Hatchery-origin spring Chinook salmon that return to HC Dam are not currently proposed as part of the Snake River spring/summer Chinook Evolutionarily Significant Unit (ESU) and are not listed under the ESA (69 FR 33102).

### *1.3.2. Fall Chinook*

Fall Chinook salmon are not currently targeted for collection at the HC fish trap, although this practice would likely change if smolt releases at HC Dam increase and adult returns to the trap are sufficient for broodstock. Fall Chinook salmon generally begin arriving in the Snake River below HC Dam in early October, and captures at the trap can extend into early December. Adult numbers in this reach may peak in early to mid-November. Trapping of hatchery adult returns would likely be limited to broodstock needs of the Oxbow Fish Hatchery, if such a program were developed.

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[1] Rapid River Fish Hatchery is located in the Salmon River basin on Rapid River, a tributary to the Little Salmon River that drains into the main Salmon River at Riggins, Idaho.

As part of the *1980 Settlement Agreement* (see Abbott and Stute 2001 for complete history of Oxbow Fish Hatchery and development of the settlement agreement), IPC is required to rear up to 1 million smolts, depending on their availability from Lyons Ferry Hatchery.[3] Due to the limited availability of eggs from Lyons Ferry Hatchery, the fall Chinook program at the Oxbow Fish Hatchery is still in the early stages of development. The current capacity for rearing fall Chinook at the Oxbow Fish Hatchery is approximately 200,000 subyearling smolts. As part of the HCFLA, expansion of the Oxbow Fish Hatchery to fully accommodate this program was proposed (section E.3.1.3.2.2.2.). Currently, eggs in excess of 200,000 have been reared under contract with ODFW at the Umatilla Hatchery in northeastern Oregon. In 2004, a large portion of the eggs made available to IPC and reared as part of this requirement were released at Pittsburg Landing (approximately 30 miles downstream of HC Dam) as part of the Nez Perce Tribe's acclimation pond program. This event is likely to occur again. Releasing these fish at Pittsburg Landing decreases the potential of adult returns to the HC trap. State and federal fish management agencies have expressed the desire to develop an Oxbow Fish Hatchery fall Chinook salmon broodstock to reduce reliance on the Lyons Ferry program. NOAA Fisheries has recently proposed that Lyons Ferry Hatchery, the fall Chinook acclimation pond program, the Nez Perce Tribal Hatchery, and the Oxbow Fish Hatchery program all be considered part of the Snake River fall Chinook ESU (69 FR 33102).

### 1.3.3. Summer Steelhead

Hatchery steelhead that return to the HC trap are part of the Oxbow Fish Hatchery program. These fish generally migrate during the fall and spring periods. Steelhead begin arriving in the HC Dam area in early to mid-October; the migration may peak sometime in late November to early December. As water temperatures start to cool, activity of these fish is reduced, and they hold over the winter period in the Snake River until temperatures begin to warm the following spring, after which they become active again. Trapping in the spring generally begins in mid- to late March and can extend until the first of May. Approximately 75% of the broodstock needs for the Oxbow Fish Hatchery are met from the fall trapping period, and the remainder is trapped in the spring. Surplus hatchery steelhead are trapped and made available to various sport fisheries. The most common sport-fishery releases have included HC Reservoir and the Boise River reach within the city of Boise. In its recent review, NOAA Fisheries did not include the Oxbow Fish Hatchery stock of summer steelhead as part of the Snake River basin steelhead ESU (69 FR 33102).

[2] A small portion of eggs is transferred to the Oxbow Fish Hatchery for incubation because of space limitations at Rapid River. With future expansion of the incubation facility at Rapid River, this practice would be eliminated.

[3] Lyons Ferry Hatchery is located on the lower Snake River and operated by the Washington Department of Fish and Wildlife as part of the Lower Snake River Compensation Program.

### 1.3.4. Pacific Lamprey

Pacific lamprey were identified as a species of concern during consultation with the agencies involved in this AIR. Pacific lamprey is the only species of lamprey in the HC project area (Groves et al. 2001). Petitions have been filed with the USFWS for listing of the Pacific lamprey, along with three other species of lamprey, under the ESA. Pacific lamprey have not been observed at the existing HC fish trap facility, and their presence in the river below HC Dam has not been recently documented. However, the current design and operation timing of the trap render little opportunity to trap Pacific lamprey. When the HC project was constructed, Pacific lamprey were relatively abundant and often captured in the fish traps used to target Chinook salmon and steelhead at the dams. It is believed that hydroelectric development in the Snake and Columbia rivers has impacted lamprey, especially during upstream passage of adults. Pacific lamprey are poor swimmers, and adults have difficulty successfully migrating upstream through hydroelectric fish passage facilities; in fact, fall back rates are very high (up to 50%) (Groves et al. 2001). During 2003, 282 adults were counted passing the Lower Granite Dam adult fish passage facility. The timing of their passage at Lower Granite Dam generally ranges from the end of May through early October, with peak passage occurring in early August (FPC 2004).

### 1.3.5. Fluvial Bull Trout

Bull trout are currently listed as threatened under the ESA. Providing the connectivity required to sustain migratory life histories of bull trout is of particular interest to fish management agencies. In the Snake River below HC Dam, fluvial bull trout migrate downstream in the fall following spawning. Fluvial bull trout have been observed to overwinter in the Snake River in both the river below HC Dam and in HC Reservoir (Chandler et al. 2001). As water temperatures begin to increase during the spring months, these fish begin to migrate back to tributary habitats and continue their movement upstream to colder water habitats. Bull trout generally migrate out of the mainstem habitat of the Snake River and could be captured in the HC fish trap from roughly April 15 to June 15. This period overlaps with spring Chinook salmon and steelhead trapping.

Bull trout have been captured in the HC fish trap during spring operations. It is unknown whether these fish originated from tributaries upstream of HC Dam such as Pine Creek. This question may be addressed through use of the Pine Creek monitoring weir to capture and mark downstream migrating fish and look for recaptures in the fish trap below HC Dam. It is further possible to transport any downstream migrating fish captured at the Pine Creek monitoring weir to below HC Dam and monitor for upstream return to the trap. There is much to be learned about the behavior of migrating and transported bull trout to fully explore management options concerning passage.

# 2. PASSAGE CRITERIA

## 2.1. Introduction

Section 2 presents design criteria for IPC's HC fish trap modifications. As outlined in AIR AR-1, IPC would prepare functional design drawings for proposed modifications to the existing HC fish trap facility. The drawings are intended to illustrate the proposed modifications that would allow on-site sorting and holding of resident fish and anadromous fish; a safe and efficient means of returning wild fish to the river after sorting; and scanning of fish for marks and/or tags such as PIT-tags and coded wire tags. Criteria presented in section 2 are intended to serve as the foundation for developing trap modification alternatives and for preparing functional design drawings for the recommended alternative.

These design criteria were developed jointly with the resource agencies as presented in Technical Memorandum No. 1, Revision (see Appendix B). The final design criteria incorporate comments discussed at the agency coordination meetings on August 11 and 12 and September 26, 2004.

## 2.2. Design Criteria

Proposed design criteria are presented in the following tables, the contents of which are briefly described below:

Table 2-1 Biological design criteria including fish species, size, timing, and expected numbers

Table 2-2 Water quality criteria including maximum holding temperature, minimum dissolved oxygen, and maximum nitrogen saturation

Table 2-3 Hydraulic and hydrologic criteria including stage-discharge relationships, mean monthly flows, flood return period, and low flow conditions

Table 2-4 Fish ladder design criteria including drop per pool, energy dissipation, transport and entrance velocities, flow range, fish density, oxygen consumption, orifice and slot velocities, orifice and slot size, length and width, wall height, auxiliary water flows, and ladder type

Table 2-5 Pre-lock/lift holding design criteria including trapping mechanism, holding density, flow, water supply, length, width, depth, wall height, surface spray, and brail floor

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|---|---|
| Table 2-6 | Lock/lift design criteria including trapping mechanism, holding density, flow, length, width, depth, wall height, and cycle time |
| Table 2-7 | Sorting/anesthetic/sampling/fish return criteria including identification, sorting, sampling, anesthetizing, fish return, and depth |
| Table 2-8 | Holding raceways criteria including number, size, flow rates, capacity, crowding, materials, diffuser velocity, jump prevention, and bird netting/shading |
| Table 2-9 | Truck loading/hauling criteria including hopper type and size, cycle time, transport type, and materials |
| Table 2-10 | Monitoring and evaluation criteria including tag identification, fish counting, species identification, and fish health determination |
| Table 2-11 | Mechanical systems criteria including entrance, pumps, gates, valves, controls, and standby power |

# 3. SUMMARY OF ALTERNATIVES REVIEW

## 3.1. Introduction

Section 3 presents the conceptual alternative development for HC fish trap modifications. The conceptual design alternatives were developed and presented in two technical design memorandums (TMs):

- TM No. 2, Alternative Development
- TM No. 3, Final Alternative Development, Revision 1

TM No. 2 presented the initial conceptual alternative development that included four basic alternatives, titled Alternatives 1 through 4. These alternatives were developed based on the criteria presented in section 2 and reflect the range of feasible alternatives for modifying the existing fish trap facility. The full range of available sorting and fish handling methods were presented within TM No. 2 as well.

The conceptual design alternatives were presented to the resource agencies on August 11 and 12, 2004. Based on a review meeting and field trip to the existing fish trap facility, it was determined that two alternatives would be advanced for additional evaluation. These two alternatives were selected as the most feasible to meet the operation and design criteria. The primary difference between the alternatives was the method for conveying fish to an elevated sorting and holding areas: either a fishway to create a volitional swim-in facility or a fish lock that would raise the fish vertically to the sorting and holding areas. These alternatives were titled Alternative 3 Revised and Alternative 5. Additional design details for these alternatives were presented in TM No. 3. The design details of these alternatives were provided to the resource agencies on September 22, 2004.

A summary of the alternative development as presented in TMs Nos. 2 and 3 is included in section 3. Full copies of both TMs are in Appendices C and D.

Following this section are additional sections covering the issues listed below:

- Sorting options
- Trap modification alternatives
- Construction cost estimates
- Alternative evaluation

## 3.2. Sorting Options

The HC fish trap facility is expected to attract anadromous fish including spring Chinook, fall Chinook, and steelhead; resident species including bull trout, rainbow trout, and mountain whitefish; and other species as indicated in section 2 about design criteria. Chinook and steelhead encountered at the trap are expected to be of wild and hatchery origin. In keeping with the facility's objective, IPC intends to trap and haul hatchery-origin Chinook and steelhead to Oxbow Fish Hatchery for broodstock and other uses and return all wild and resident fish to the river, with the exception of bull trout. Bull trout would be held and transported according to state and federal management direction.

Four basic sorting methods could be considered for the HC fish trap facility:

- automated sorting
- visual sorting
- hand sorting
- size sorting

These methods are briefly described in Table 3-1. Table 3-2 illustrates the applicability of sorting methods by species.

Based on the method used to identify fish, automated systems fall into two general categories, image recognition and tag identification. Image-recognition systems are becoming more reliable for counting fish but do not presently have the ability to differentiate between wild and hatchery fish. Tag-identification systems are only effective for sorting if all fish of a desired group are "tagged" or "not tagged."

Visual sorting is often used with a trained operator identifying fish as they slide down a flume. Once a fish is identified, it is directed to a holding area or returned to the river. This method is effective for sorting between species, though much less effective for sorting hatchery and wild fish. Hand sorting involves handling each fish, giving the trap personnel adequate time to identify and sort fish. While this method is the most labor intensive, it appears to be the most appropriate method for the HC fish trap facility at this time.

Size sorting, which is currently used at the HC fish trap facility, is effective for segregating large and small fish, such as anadromous and resident fish. The method works by dewatering the flow and sliding fish across a smooth bar rack where small fish slide beneath the bar rack and large fish continue across the rack. Size sorting could be continued at the HC fish trap, but its effectiveness would depend on the anticipated numbers of resident fish encountered in the system and the need to capture and handle bull trout.

## 3.3. Trap Modification Alternatives

As discussed in the introduction paragraph, four conceptual alternatives were initially considered for the HC fish trap modification (see Appendix C).

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|---|---|
| Alternative 1 | Existing fishway with trap, sorting, and holding |
| Alternative 2 | Extended fishway with trap, sorting, and holding |
| Alternative 3 | Existing fishway with narrow raceways |
| Alternative 4 | Downstream trap, sorting, and holding |

The first three alternatives are similar in that they involve additions in the immediate area of the existing fishway and trap; the fourth alternative involves extending the fishway downstream and providing new access to trapping, sorting, and holding areas. Following review by the resource agencies, a modified Alternative 3 and a new Alternative 5 were advanced for additional design development and evaluation (see Appendix D). All six alternatives are described below and illustrated in Appendix C, Figures C-1 through C-12, and Appendix D, Figures D-1 through D-9. The existing trap structure is shown in Figures C-2 and C-3.

### *3.3.1. Alternative 1—Existing Fishway with Trap, Sorting, and Holding*

Alternative 1 is shown in Figures C-4 through C-6. The work involves demolishing the floor of the existing sorting and crowding pool and removing the existing hopper. The area would be modified to provide a Vee trap ahead of a crowding pool and fish lock. The Vee trap is a passive device that helps prevent fall back of fish. Fish passing through the Vee trap would be crowded to the lock using a power crowder and a lifting brail. Once in the lock, fish would be raised to the flume level and transported to a holding area. The holding area would be fitted with a brail to allow fish to be “metered” onto a sorting table. From the sorting table, fish would be returned directly to the river or to one of four holding raceways. The raceways would be 30 feet long, 8 feet wide, and 8 feet deep. The normal water level in raceways would be 4 feet deep to provide a total holding volume of 960 cubic feet (cf) per raceway. Each raceway would be provided with a power crowder and punched plate screen to separate it from the crowding channel. A common crowding channel would be provided at the downstream end of the raceways, after which fish would be moved to a hopper using a power crowder. The hopper would be lifted by the existing jib crane to the upslope truck loading area.

The raceways and lock would likely be constructed of steel, and the hopper would likely be constructed of stainless steel and aluminum. The crowding pool and fishway modifications would be constructed of reinforced concrete.

As indicated in Figures C-4 and C-5, the raceways would extend past the existing facilities, to the southeast, and over the edge of the river at normal to high flows. Large piers would be required within the floodplain to support the elevated sorting and holding structure. The piers would be expected to impact the flow hydraulics near the fishway entrances, as well as potentially trap debris during spill events.

### *3.3.2. Alternative 2—Extended Fishway with Trap, Sorting, and Holding*

Alternative 2 is shown in Figures C-7 and C-8. It is similar to Alternative 1 except that the existing fishway is extended by 14 pools prior to the trap and lock facilities. This alternative has two advantages: it moves the elevated sorting and holding areas away from the river, approximately 14 feet and the extension of the fishway allows the trap to remain in operation under higher flows and tailwater conditions. The fish lock and elevated sorting and holding structure would be identical to those discussed for Alternative 1.

### *3.3.3. Alternative 3—Existing Fishway with Narrow Raceways*

Alternative 3 is shown in Figures C-9 and C-10. This alternative is similar to Alternative 1, except that the raceways have a narrower and longer footprint of 40 feet long and 6 feet wide. The depth remains the same at 8 feet. The raceways provide the same 960 cf of holding volume as they do in the other alternatives. Additionally, the raceways are moved 10 feet away from the river. This alternative was developed to limit the extension over the river at normal flows. The raceways could be cantilevered over the river and would not require piers within the river channel.

### 3.3.4. Alternative 4—Downstream Trap, Sorting, and Holding

Alternative 4 is shown in Figures C-11 and C-12. This alternative extends the trap and the sorting and holding areas approximately 250 feet downstream by adding 22 new fishway pools. Access to the site would be provided from the existing access road to the visitor center. The trapping, sorting, and holding areas are similar to those in the previous alternatives with the exception of the lock. In Alternative 4, the lock is unnecessary: the vertical rise that the lock provides for the sorting operation and flood protection is provided by the increased fishway length and attendant vertical rise in water surface.

As fish ascend the fish ladder, they would encounter a Vee trap and crowding pool similar to those in Alternatives 1 through 3. Once in the crowding pool, a power crowder would move fish to the brailing end of the pool where they would be raised directly to the sorting table. The brail would control the number of fish on the sorting table and prevent overloading of the sorting operation. Fish would be loaded from the hopper to transport trucks using the existing jib crane located adjacent to the hopper.

### 3.3.5. Alternative 3 Revised—Existing Fishway with Elevated Sorting/Holding and a Fish Lock

Alternative 3 Revised is shown in Figures D-2 through D-4. This alternative takes advantage of existing facilities, where possible, and provides significant improvements to meet the new operational objectives of the trap. The existing fishway entrance and lower portion of the fishway would remain in place, along with the water supply pumps, intake, and jib cranes. The bend in the existing fish ladder would be demolished and four additional pools added. A second fish entrance would be added to improve passage at high river flows. This second entrance would be located above weir 1475.0, near the end of the existing turning pool. At river flows below 30,000 cfs, the existing lower entrance would be used; at flows between approximately 30,000 and 50,000 cfs, the lower entrance would be closed and the upper entrance used.

The existing precast concrete fishway weirs would be removed and reconstructed above weir 1474.0, and the grade of the fishway would be floor raised. The existing trap area (including jump-over weirs, bar rack, holding pool/crowder, and hopper) would be demolished, and a new Vee trap, photoelectric counter, holding and crowding pool, and lock installed in the same area.

Once fish passed through the fishway and Vee trap, they would be crowded to the lock using a vertically oriented power crowder. A lower lock slide gate would contain crowded fish in the lock and provide a water-tight closure for lock filling. Once in the lock, fish would be raised to the flume level by pumping water into the lock and operating a trailing brail beneath the fish. Fish would be metered into the flume by varying the lock brail level, thereby controlling the rate at which fish entered the flume. Once in the flume, fish would be transported past a pneumatic sorting gate and into an anesthetic tank. The purpose of the pneumatic sorter would be to allow operators to direct fish back to the river, avoiding anesthetizing and manually sorting fish that are present in the system but not targeted for hauling or monitoring and evaluation. This operation feature would likely be useful when the trap was operated for Chinook or resident fish only, but high numbers of steelhead are present in the river. Target fish would be routed to an anesthetic tank located immediately downstream of the pneumatic gate.

Target anesthetized fish would be lifted from the tank to a manual sorting table where, after recovery, fish would be returned directly to the river or to one of three holding raceways. A sampling and research area would also be provided in the sorting area.

The holding facility would include three holding raceways and a crowding channel. The raceways would be 40 feet long, 6 feet wide, and 8 feet deep. Normal water levels in the raceways would be 4 feet deep to provide a total holding volume of 960 cf per raceway. Each raceway would be provided with a power crowder. Either a slide gate or punched plate screen would separate the raceways from the crowding channel. A common crowding channel would be provided at the downstream end of the raceways, after which fish would be moved to a hopper using a power crowder. The hopper would be lifted by the existing jib crane to the upslope truck loading area.

Water would be supplied to the raceways and crowding channel with floor diffusers; raceway discharge could be either through the punched plate into the crowding channel or through floor drains into the drain channel. Raceway and crowding channel water depth could be varied by isolating individual raceways with slide gates and varying the elevation of the overflow drain that discharged to the drain channel. This approach would allow water levels in individual holding raceways to be lowered for fish handling and maintenance.

The raceways and lock would likely be constructed of steel, and the hopper would likely be constructed of aluminum and stainless steel. The crowding pool and fishway modifications would be constructed of reinforced concrete.

### *3.3.6. Alternative 5—Lengthened Fishway with Elevated Sorting/ Holding*

Alternative 5 is shown in Appendix D, Figures D-5 through D-7. This alternative adds 18 pools to the existing fishway and provides “swim-in” access to the sorting area, eliminating the need for the fish lock included in Alternative 3 Revised. Key elements of the alternative include the fishway, trapping area, and sorting and holding areas.

Alternative 5 would the lower portion of the existing fishway from the entrance through pool no. 7. Beyond pool no. 7, the auxiliary water channel would be extended to deliver water to a new wall diffuser that provided water to a new high flow entrance. Similar to Alternative 3, the high flow entrance would operate at flows between approximately 30,000 and 50,000 cfs. Beyond the second entrance, the fish ladder would be extended north approximately 100 feet to provide the additional 18 pools (using a switchback and common wall design). Like the existing design, the fishway pools would be 6 feet wide by 10 feet long and use half Ice Harbor weirs.

Once fish ascended the ladder, they would encounter a Vee trap and photoelectric counter. At the throat of the Vee trap, a photoelectric counter would be installed to enumerate fish and provide operators an accurate estimate of how many fish were being held in the crowding/holding pool. The crowding/holding pool is a reinforced concrete channel measuring 7.5 feet wide, 34 feet long, and 4 feet deep (water depth). Water supplied to the pool by a floor diffuser and surface spray would help prevent jumping. A vertically oriented power crowder would move fish to a lifting area. After crowding, the lift area would be isolated from the holding pool with a sluice gate. The lift would have a sloping brail floor that raised fish 6 feet where they would be transferred to a transport flume.

The fish lift and flume would convey fish from the fishway level to the sorting and holding area. Similar to Alternative 3 Revised, the flume would include a visual sorting area and pneumatic gate to allow direct return of fish to the river. The sorting, holding, and transport operation for Alternative 5 would be the same as that discussed above for Alternative 3 Revised.

## 3.4. Construction Cost Estimates

Cost estimates for conceptual-level construction were prepared for each alternative and are included in Table 3-3. These estimates are based on facilities presented in Figures C-1 through C-12 and D-1 through D-9. Since the drawings and facilities are conceptual, estimates are assumed to be accurate to ±50% of actual construction costs. Changes in facility function, layout, materials, and pricing will affect construction costs. The cost of engineering, construction management, permitting, environmental compliance, and IPC’s internal construction overhead is not included in these estimates.

## 3.5. Alternative Evaluation

At the August 11 and 12, 2004, resource agency meeting, Alternatives 1 through 4 were presented and discussed. The meeting attendees agreed that, with revisions, Alternative 3 was the most feasible alternative presented. A fifth alternative was identified that would provide a volitional swim-in option for fish movement into the elevated sorting and holding area. Development of these two options was completed at the September 22, 2004, agency meeting. TM No. 3 includes additional descriptions and evaluations of Alternatives 3 Revised and 5 that helped IPC and the resource agencies select a recommended alternative.

Table 3-4 provides a summary of the key features of Alternatives 3 Revised and 5. The primary difference in functionality between the two alternatives is how fish would be elevated to the sorting and holding area. Alternative 3 Revised uses a lock while Alternative 5 uses a combination of fishway and lift. Figures D-8 and D-9 show hydraulic profiles of each alternative. These hydraulic profiles best illustrate the key differences between the alternatives.

Table 3-5 includes a preliminary list of advantages and disadvantages for Alternatives 3 Revised and 5.

## 3.6. Conclusions

At the September 22, 2004, agency meeting, Alternatives 3 Revised and 5 were presented and discussed with the resource agencies. IPC and the resource agencies agreed that Alternative 3 Revised provided the best alternative for modifications to the HC fish trap facility and agreed to advance it as the recommended alternative. Functional design details were developed based on the conceptual layout presented for Alternative 3 Revised, which is illustrated in Figures D-2 through D-4 and D-8.

# 4. FUNCTIONAL DESIGN OF PREFERRED ALTERNATIVE

## 4.1. Purpose, Scope, and Background

Section 4 includes the functional design basic features and operational characteristics for the recommended modifications to the HC fish trap facility as required by FERC's AIR AR-1. The design criteria used to develop the functional design are presented in section 2 of this report. Conceptual design drawings outlining the major features, a description of the proposed facility operation, and specific biological considerations are provided in this section. These proposed modifications would improve the trapping and sorting operation, add on-site holding capabilities, and add flexibility for handling multiple species, including anadromous and resident species.

Recommended modifications to the HC fish trap facility are based on an initial scoping meeting held July 7, 2004, to outline goals and objectives to consider when planning and evaluating potential trap modifications. From this meeting, four conceptual alternatives were developed that represented the range of potential modifications considered feasible for the HC fish trap facility. Following additional review with the resource agencies, the initial four alternatives were narrowed to one, Alternative 3 Revised.

A fifth alternative, Alternative 5, was also added at this time. The primary difference between these two alternatives is the mechanism proposed for vertically raising fish to the elevated sorting and holding areas. While Alternative 5 uses a full-length fishway to facilitate a volitional swim-in facility, Alternative 3 Revised uses a fish lock to provide the elevation gain. After review with the resource agencies, Alternative 3 Revised was recommended as the alternative to advance to the functional design level as the preferred alternative.

## 4.2. Facility Design Criteria

The proposed design modifications were developed based on design criteria developed jointly by IPC, USFWS, IDFG, ODFW, and NOAA Fisheries. These criteria are presented and discussed in Section 2.

## 4.3. Facility Description

The proposed modifications are designed to enhance the sorting and holding capabilities of the existing fish trap facility. The proposed facility included the following major elements:

- Fishway entrances
- Fishway
- Pre-lock holding area
- Fish lock
- Fish sorting
- Post-sort holding raceways
- Sampling and fish research area
- Crowding channel and truck loading area
- Fish return to the river
- Water supply system and drains

Facility modifications would maximize use of the existing facility while adding sorting and holding capabilities. The existing fishway entrance and auxiliary water supply system location and configuration would be maintained. The existing fishway would be extended, and a new fish lock and elevated sorting and holding areas would be added directly above the existing fish trap facility. The proposed trapping, sorting, and holding elements are described in the following paragraphs. Drawings 1 through 3 illustrate the existing fish trap facility layout for background and comparison purposes. The new facility layout and details are presented in Drawings 4 through 13.

### *4.3.1. General Operation*

The proposed fish trap facility would basically be operated the same as the existing fish trap facility is. The modifications would enhance the sorting and holding capabilities to allow handling of multiple species. Drawing 5 illustrates the overall facility site plan, while Drawing 13 illustrates fish-handling systems.

As currently configured, fish enter the fishway through one of two fishway entrances and then move through the fishway to a pre-lock holding area where they accumulate until a lock sequence is initiated. A power crowder is used to move fish into the fish lock where they are raised vertically to elevated sorting and holding areas. Fish are metered out of the fish lock into the sorting portion of the facility. The first element of the sorting facility is a pneumatic gate located just upstream of the anesthetic tank. The pneumatic gate allows the operator to visually identify fish and route excess steelhead or other species directly back to the river. Fish that are directed into the facility enter an anesthetic tank after which they are lifted with a brail floor to a sorting table. Each fish is sorted manually into a transport tube that carries it to one of three holding raceways. Fish are crowded from the holding raceway into the crowding channel and into the fish hopper. The hopper is lifted to the truck loading area with the existing 10-ton jib crane where the fish are then transferred to a truck for transport to their final destination.

The physical and operational characteristics of major facility elements are described in the following paragraphs.

### *4.3.2. Fishway Entrances*

The fishway would be provided with two entrances, the existing fishway entrance and a new entrance located upstream of weir 1475.0 (Drawing 5). The existing fishway entrance was originally designed with a telescoping weir gate to allow automated adjustment of the gate sill with tailwater fluctuations. The weir gate was designed to maintain a maximum of 8 feet of water depth across the gate to ensure a minimum head drop of 1.0 foot. The existing entrance was modified to remove the weir gate, and stop logs are currently used to adjust the gate sill elevation. A more automated system with a telescoping weir gate would be installed at the existing entrance to improve operation.

The second entrance, which would be located upstream of weir 1475.0, would allow operation at higher tailwater elevations without submerging the lower portion of the fishway. As configured, the entrance is 3 feet wide and fitted with a telescoping weir gate to maintain a maximum water depth over the gate sill of 8 feet. The head drop across the gate ranges from a minimum of 12 inches to a maximum of 18 inches. The existing auxiliary water supply channel is extended and a new diffuser screen, 5.5 feet tall by 19 feet long, installed to provide the full auxiliary water supply of 115 cfs to the second fishway entrance.

The two entrances would allow operation from the minimum discharge of 5000 cfs to a maximum discharge of 50,000 cfs. These flows correspond to tailwater conditions of 1467.0 to 1482.5 feet mean sea level (fmsl), respectively. The lower entrance would be the primary entrance up to a flow of 30,000 cfs, which is the powerhouse capacity. The upper entrance will be used from 30,000 to 50,000 cfs when spill conditions occur. Photoelectric fish counters at each entrance would allow enumeration of fish entering the fishway.

### *4.3.3. Fishway*

The existing fishway would be modified by adding pools and raising the upper leg of the fishway to reduce submerged conditions at the pre-lock holding area (Drawing 5). As configured, the fishway provides a vertical rise from the minimum tailwater level of 1467.0 fmsl to the pre-lock holding pool operating level of 1487.0 fmsl, a maximum vertical rise of 20 feet. The fishway pools are 6 feet wide by 10 feet long with a floor slope of 10%. Twenty weirs are provided, with a maximum of 1 foot of drop across each weir. The weirs are fitted with a 3-foot-long overflow weir and 1-foot-wide by 18-inch-high orifice. At the design head drop of 1 foot, the overflow weir passes approximately 9.6 cfs and the orifice, 7.2 cfs for a combined fishway flow of 16.8 cfs (Drawing 11).

The fishway extends from the primary entrance to the pre-lock holding area. Floor diffusers upstream and downstream of the pre-lock holding area provide the 16.8 cfs fishway flow. Auxiliary water supply is introduced upstream of weir 1475.0 to supply the new fishway entrance. The existing auxiliary water supply diffusers supply the existing fishway entrance.

### *4.3.4. Pre-Lock Holding Area*

In this configuration, migrating fish move up the fishway and enter a pre-lock holding area as shown on Drawing 6. This holding area consists of a Vee trap with a photoelectric counter, a holding pond, a power fish crowder, and floor diffusers. Fish are guided by the Vee trap to a photoelectric counter that counts the fish entering the pre-lock holding pond. The holding pond is 20 feet long by 7.5 feet wide, with an active water depth of 6 feet and a total holding volume of 900 cf. Water is introduced through a floor diffuser located in the middle of the holding pond. An additional 432 cf of holding capacity is provided in the area between weir 1486.0 and the fish counter. When the pond capacity has been reached or a fish-sorting operation is initiated, the fish crowder panel is lowered into the pool and fish crowded into the fish lock. The water level in the lock is maintained at the same level as the holding pond. The water supply for the fish lock is turned on to provide attraction water and help guide fish into the lock. The fish crowder moves fish into the lock and the lower lock gate is closed.

The pre-lock holding pond is fitted with a fish return pipe to allow either volitional or manual fish return to the river. The fish return pipe is located in the southeast corner of the holding pond and fitted with a manual stop gate. The stop gate can be removed to allow flow and fish to move from the holding pond back to the river.

The floor of the holding pond is set at 1481.0 fmsl, while the top of the wall is set at 1491.0 fmsl. With an operating water depth of 6 feet, the pond has active freeboard of 4 feet. A spray system and jump panels would minimize jumping.

### *4.3.5. Fish Lock*

A fish lock is used to raise fish from the pre-lock holding pond to the elevated sorting and holding areas (Drawings 6 and 7). As configured, the fish lock is located on the south end of the pre-lock holding pond in the area previously used as the fish hopper. The fish lock consists of a steel tower installed within the existing hopper well, a lower entrance gate, an upper exit gate, a brail floor, and a water supply with a floor diffuser. Fish are crowded into the lock from the pre-lock holding pond through the lower entrance gate. The brail floor is located at the bottom of the fish lock immediately above the floor diffuser. The entrance gate is a 4 foot square pneumatically operated slide gate. Once the crowder reaches the end of the pre-lock holding pond, the entrance gate is closed and the water supply fully opened. A flow of approximately 1000 gpm enters the lock through the floor diffuser, and the water level rises at a maximum rate of 3 feet per minute. The lock level rises from the pre-lock holding pond level of 1487.0 fmsl to the upper exit gate elevation of 1513.0 fmsl in approximately 8 minutes. When the water level in the fish lock reaches the upper exit gate, the water supply flow is reduced. The brail floor is used to raise the fish as the water level in the lock rises. The brail floor would be fitted with a cable lifting mechanism powered by an electric drive located on top of the fish lock tower.

Fish are metered out of the fish lock into a transport flume by raising the brail floor incrementally. The transport flume carries the fish to the sorting area. The water level in the lock is maintained to provide approximately 4 to 6 inches of flow across the exit gate width of 4 feet. A dewatering screen is located in the transport flume approximately 8 feet downstream of the exit gate (Drawing 7). The dewatering screen removes excess water, leaving only enough water to transport fish.

The top of the fish lock is fitted with a 3-foot-diameter ring opening designed to match the collar on the fish hopper (Drawing 7). This design provides the flexibility to release fish directly from the crowding channel back into the lock for sorting or holding if a transport truck is delayed or additional sorting is required.

### 4.3.6. Fish Sorting

Fish sorting is accomplished in the elevated sorting area, which is shown in Drawing 8. Fish are metered from the fish lock into a transportation flume. The flume carries fish with transportation water to a sorting area consisting of a pneumatic gate and bypass flume, anesthetic tank, and manual sorting area. The pneumatic gate is located upstream of the anesthetic tank. An operator visually identifies fish species as they exit the fish lock and sets the pneumatic gate position to guide fish to the anesthetic tank or back to the river. The gate allows the operator to direct excess steelhead or nontarget fish around the anesthetic tank and sorting area.

Fish that are directed into the anesthetic tank are then anesthetized and raised with a powered lift to the sorting table. Each fish is visually identified and manually sorted to the appropriate holding raceway through 12-inch transportation tubes. The raceway holding configuration may be modified, depending on the species, numbers, and destinations, to facilitate crowding and transportation needs.

The design also provides for the future incorporation of a bar separator to be installed upstream of the pneumatic gate. The bar separator would allow passive sorting of fish by size.

### 4.3.7. Sampling and Fish Research Area

In the configuration, an area adjacent to the sorting table has been provided to support potential fish sampling and research activities. The sampling and research area is fitted with a monitoring and evaluation table measuring approximately 3 feet wide by 10 feet long. Utility water, power, and lighting are provided to support sampling tanks, computers, and research equipment. The entire sorting, sampling, and fish research area is covered with a roof to protect personnel from the weather.

### 4.3.8. Post-Sort Holding Raceways

Three post-sort holding raceways are also provided. Each raceway is 40 feet long, 6 feet wide and 8 feet high with a 4 foot operating water depth, as shown on Drawing 8. The total active holding volume is 960 cf. Fish are directed from the sorting area via 12-inch transportation tubes to the raceways. The water supply enters through a 4-foot by 2-foot diffuser located at the north end of each raceway. A total flow of 240 gpm is provided to each raceway and controlled with a 6-inch butterfly valve. The water exits the raceway through a grated floor drain and is conveyed in an 8-inch drain pipe to a drain channel. Each raceway is fitted with a tilting weir drain that allows the water level to be varied without affecting the adjacent raceways. Raceway screen panels placed upstream of the floor diffuser allow collection of dead fish (or “morts”) and prevent blockage of the floor diffuser.

Each raceway is fitted with a punched plate screen and slide gate located at the downstream end. The punched plate screen is installed when the raceway water is discharged directly to the crowding channel. The slide gate allows positive closure of each raceway when the tilting weir and drain channel are in use. A power crowder is installed in each raceway to crowd fish to the crowding channel for loading and transport. The crowder is designed as an aluminum bar or punched plate rack with a power crowder trolley traveling on the top of the raceways. Full spray systems as well as jump panels are provided to minimize jumping within the raceways.

### *4.3.9. Crowding Channel and Truck Loading*

As configured, the holding facility allows crowding of the holding raceways into a single crowding channel that extends the full width of the raceways. The crowding channel is 6 feet wide by 20 feet long with an operating water depth of 4 feet. Fish are crowded from the raceways into the crowding channel and then into the fish hopper. The water supply enters through a floor diffuser, with the flow exiting through a grated drain and tilting weir arrangement similar to those in the raceways. The crowding channel is fitted with a power crowder, spray system, and jump panels.

The fish hopper is similar in design to the existing hopper. The fish hopper is recessed in a hopper well located in the crowding channel floor (Drawings 7, 8, and 9). Fish are crowded into the fish hopper area with the power crowder after which the hopper is raised with fish being confined to the lower tank portion of the hopper. The hopper is lifted from an approximate elevation of 1506.0 fmsl to 1540.0 fmsl adjacent to the truck loading area. The hopper is positioned over the fish truck where a wet-to-wet transfer of adults is executed from the hopper to the transport truck.

### *4.3.10. Fish Return to River*

In this configuration, fish can be returned to the river at four locations within the HC fish trap facility: 1) the pre-lock holding area, 2) the transport flume upstream of the anesthetic tank, 3) the sorting table, and 4) the crowding channel. A fish return pipe is provided in the pre-lock holding area to allow either volitional or manual return of the fish to the river. The 15-inch pipe extends from the pre-lock holding area to a release point immediately downstream of the secondary fish entrance.

A pneumatic gate is located in the transport flume downstream of the fish lock exit. The gate is used to direct fish back to the river or into the anesthetic tank and manual sorting area. Fish that are directed into the sorting facility enter the anesthetic tank and are then routed to the holding raceways for transport or recovery prior to release to the river. The choice of anesthetic determines whether fish can be returned directly to the river. If clove oil or other synthetic agent is used, a 21-day holding time is normally required before the fish can return to the river. If $CO_2$ is used, fish can be immediately returned to the river.

A fish return pipe is also located in the crowding channel to allow anesthetized fish to be returned to the river after recovery or fish that are not required for broodstock to be returned directly to the river. This system also allows operators to release fish if a mechanical failure of the pump system occurs that requires a major outage to repair.

## 4.4. Water Supply and Drains

As configured, the water supply to the facility is provided from the existing intake and modified pumping station located at the south end of the existing trap structure. The pump station supplies water to the fishway, pre-lock holding area, and sorting facility. The primary components of water supply and drain system are described in the following paragraphs. Drawing 12 illustrates the proposed water supply schematic for the modified sorting and holding plan, while Drawing 11 presents the hydraulic profile from the fishway through the sorting and holding areas.

### *4.4.1. Intake*

The water supply for the existing fish trap facility is located on the south abutment immediately below the powerhouse (Drawings 2 and 3). Water enters a 6-foot-diameter tunnel and flows into a pump chamber where it is pumped into the trapping and holding facility. The intake is currently fitted with a trash rack with horizontal bars spaced 1 inch apart. The flow velocities and patterns exiting the powerhouse provide a positive sweeping velocity across the intake, keeping the trash rack free of debris. A stop log system is located at the downstream end of the intake tunnel to allow dewatering of the pump chamber and trapping structure when the facility is taken out of operation for annual maintenance.

The intake is designed to provide a total flow of approximately 140 cfs to the fish trap facility and auxiliary water supply system.

### *4.4.2. Pump Station*

The existing pump station consists of four auxiliary water supply pumps and two trap supply pumps (Drawing 2). The existing auxiliary water supply pumps are low-head, high-volume pumps delivering up to 112 cfs to the auxiliary water supply channel. The trap pumps provide up to 19 cfs to the existing fish holding area, bar separator, finger weirs, and fishway.

With the proposed modifications, the pumps and water supply piping systems would be developed as three distinct and separate systems (Drawing 12):

- Fish lock and elevated sorting/holding
- Pre-lock holding and fishway
- Auxiliary water supply channel

In this configuration, pumps P-1 and P-2 supply the elevated sorting and holding areas by lifting water from the minimum tailwater level of 1467.0 fmsl to the maximum fish lock level of 1514.0 fmsl and the normal holding raceway level of approximately 1506.0 fmsl. The pump station is designed to provide a total discharge of 2200 gpm at a total discharge head (TDH) of approximately 80 feet. The pump station operates with one duty pump and one standby pump. Valves are provided to adjust the flow to each diffuser located at the fish lock, holding raceways, and crowding channel.

The pre-lock holding and fishway pumps lift water from the minimum tailwater level of 1467.0 fmsl to the normal pre-lock operating level of 1487.0 fmsl. Pumps P-3 and P-4 provide a total discharge of 450 gpm to each of the holding pools as well as 6640 gpm to the fishway diffuser. The pump system provides a total discharge of 7500 gpm at a TDH of approximately 30 feet. Again, two pumps are provided: one duty and one standby pump, and valves adjust flow to each of the diffusers (Drawing 12).

The auxiliary water supply system is served by pumps P-5 and P-6 (similar to the current operation). Initially, one pump provides the necessary attraction flow of 115 cfs to operate the fishway entrance with a minimum head differential of 1.0 feet. As the tailwater conditions rise, the second pump provides additional attraction water. The auxiliary water supply channel distributes flows to the fishway diffusers. The pumps are designed to provide up to 25,000 gpm at a discharge head of approximately 5 feet.

A dedicated pump, P-7, provides seal water to pumps P-1 through P-6. Utility water is provided by pump P-8, which is a submersible well pump. This pump provides up to 50 gpm to a dedicated utility water system routed throughout the facility. The utility water system is designed to provide a system discharge of 50 gpm with 20 pounds per square inch (psi) of pressure at the hydrants.

The proposed pumping systems would be located within the existing pumping well. The pump configuration and pipe routing depend on the final pump selection.

### 4.4.3. Diffusers

Water is introduced into the trapping and holding areas through floor and wall diffusers located throughout the facility (Drawings 6–10). In the fishway entrance pool and lower portions of the fishway, water is introduced through wall diffusers to supplement the ladder flows. The wall diffusers, which are located on the side of the existing auxiliary water supply channel, are designed to cumulatively supply up to 115 cfs into the lower area of the fishway.

Floor diffusers are located in the lock floor and the pre-lock holding pool (Drawing 6). The lock diffuser is designed to provide a 1000-gpm flow into the fish lock. Floor diffusers located within the pre-lock holding area and just upstream of weir 1486.0 provide water to the holding areas as well 16.8 cfs in fishway flow.

Diffusers are also located in the post-sort holding raceways and crowding channels (Drawing 8). These diffusers are designed to provide 240-gpm maximum flow to each raceway.

Floor diffusers are designed to provide a maximum of 0.5 feet per second (fps) across the gross diffuser area, while wall diffusers provide a maximum of 1.0 fps across the gross diffuser area. The diffuser panels are constructed of aluminum or galvanized bar grating with a maximum bar spacing of 1 inch clear. Smaller bar spacing may be required if the target resident species are less than 1 inch in girth.

The flow to each diffuser system is supplied from the auxiliary water supply or facility pump stations as discussed in section 4.4.2.

### 4.4.4. Raceways

The water for the holding raceways is supplied by the pump station through the floor diffusers located at the north end of each raceway (Drawing 12). Each raceway is designed to operate at a minimum of 240 gpm. Steel piping extends from the pump station to the raceway and crowding channel diffusers. The water supply piping is routed underneath the walkway grating and raceways. All valves are located directly under the walkways to ensure easy access for operation and maintenance.

### 4.4.5. Utility Water

Utility water is provided with a submersible pump located within the pump chamber. This pump is sized to provide up to 50 gpm of utility water to the truck loading area, elevated sorting and holding areas, and the fishway. A separate pump supply ensures that utility water is available in case the main pump stations are out of service. The separate utility water system is provided by pumps P-1 and P-2 and can supply up to 100 gpm to the elevated sorting and holding areas.

### *4.4.6. Drains*

The elevated holding raceways are fitted with tilting drain weirs located in a drain channel adjacent to the crowding channel (Drawing 8). Water flows through a drain diffuser located in the raceway floor, over the tilting drain weir, and is then routed to an 18-inch drain pipe at the end of the drain channel. The 18-inch overflow drain combines with the fish return pipe and extends to a downstream discharge location. The drains are constructed of PVC pipe or epoxy-lined steel pipe.

## 4.5. Electrical and Instrumentation

As configured, the HC fish trap facility is provided with 480-volt, 3-phase, 60-hertz power to feed the auxiliary water supply and facility pump stations. The site is also provided with 220/110-volt, single-phase power for electrical receptacles, lights, instrumentation, and other site power needs.

Instrumentation is initially limited to monitoring equipment and alarms since the facility is not designed to operate in a fully automatic trapping and sorting mode. A central PLC monitors the fishway, holding pools, and raceway levels. Pressure transducers are located on the outside and inside walls of the fishway entrance to allow determination of head differential across the openings and gate position. Pressure transducers are also located in the pre-lock and post-sorting raceways to monitor water levels. Float alarms are located in the holding raceways to alert operators to a drop in water level due to an interrupted water supply or incorrectly positioned drain weir. Flow alarms are installed on the discharge side of the pumps to alert operators if the pump flow is interrupted.

The instrumentation system for the HC fish trap facility is tied into the HC Dam system. Alarms activate the auto dialer to notify the Oxbow Fish Hatchery operator and the IPC plant operator. Provisions for remote monitoring via the IPC SCADIA system are also provided. The HC trap PLC would be programmed to provide information on water levels, pump status, and raceways through the project SCADIA system. Local control panels are provided at each pump and power crowder. PLC screens are located at the truck loading area and in an operator’s control room located adjacent to the fish lock.

## 4.6. Emergency Power Outage Provisions

As configured, standby power is provided to the facility in case the normal power supply is interrupted. Two options are available: 1) a dedicated standby generator located adjacent to the fish trap facility or 2) a tie into the main standby power facilities for HC Dam. For the first option, a standby generator would be located at the HC fish trap facility near the existing loading area. An automatic transfer switch would provide automatic transfer from the main power feed to the standby generator. The generator would be sized to power the full facility, with the pumps making up the major load. This option would ensure an adequate power feed to the fish trap facility no matter what operational conditions existed at HC Dam. With the second option, the power feed for the HC fish trap facility would be fed from the existing station power and standby power systems located at the dam.

## 4.7. Structural

The structural design involves modifying the existing concrete fishway structure and adding a new elevated sorting and holding area. Modifications to the existing fishway structure would be constructed of cast-in-place concrete, including the exterior seawall, new fishway floors and walls, and fishway baffles.

The fish lock would be constructed from structural steel. The lock, designed to be watertight, would be installed within the existing hopper well. The lock would be designed as a steel tank with the maximum water level located at the top of the fish lock structure.

The elevated sorting and holding area would likely be constructed of structural steel and aluminum. The columns and support structure for the new sorting facility and raceway would be structural steel. The steel columns would be supported on concrete foundations located in the walls of the concrete fishway. Hollow-core slabs would be installed across the structural steel support frame to create a floor on which the new raceways and sorting area rest. The hollow-core slabs would be oriented to allow installation of the water supply and drain piping directly underneath the slabs.

The raceways would be constructed of structural steel or aluminum. The raceway walls would be designed to support the power crowder rails and jump panels. Walkways, supported from the side of the raceways to provide access for operation and maintenance, would be constructed of aluminum or galvanized steel.

Access walkways, stairs, handrails, and grating would also be constructed of aluminum or galvanized steel. The fish crowder panels, brail floors, and miscellaneous fish handling equipment would be constructed of stainless steel or aluminum.

Basic structural design criteria for the facility modifications are included in Table 4-1.

## 4.8. Site Access and Utilities

The existing site access would be maintained with the proposed modifications to the HC fish trap facility. Vehicle access would be from the existing west-abutment access road to the truck loading area. No modifications are proposed for this area. The upper jib crane would be used to move material in and out of the trapping facilities. The upper jib crane would also be used to transport fish via the fish hopper from the hopper well to the transport truck located at the truck loading area.

Pedestrian access to the modified fish trap facility would be from the existing stairways. A new landing would provide operators direct access from the existing stairwell to the elevated sorting and holding areas. The new access walkway would tie into the existing stairwell at approximately 1510.0 fmsl, which is an existing landing location illustrated in Drawing 8. The existing stairwell would be used to access the lower trapping area.

Electrical power would be provided from the existing power feed to the fish trap facility. GFI receptacles would be located throughout the facility to allow operation of hand power tools and small equipment. Utility water would be provided throughout the facility as discussed in section 4.4.5. Sanitary service would consist of portable toilet facilities.

# 5. Operations Plan

## 5.1. Operation Period

After consultation with the resource agencies involved with this AIR, two seasons of continuous operation for the HC fish trap facility were identified. A fall trapping season would begin October 15 and continue through December 1. A spring trapping season would begin March 15 and continue through June 30.

There would be two objectives of the fall trapping season: 1) meet broodstock goals of the Oxbow Fish Hatchery facility and 2) meet management goals of providing fish to recreational fisheries. The target species this season would be steelhead. It is likely that fall Chinook salmon would be targeted in the near future. To meet the current steelhead hatchery-production goals, 600 steelhead are needed, 75% of which are generally trapped during the fall season. With increased steelhead returns over the last several years, meeting broodstock goals for steelhead could occur rapidly. However, managers generally distribute captures over the fall period to reduce selection of a certain component of the run. If the trap were operated solely for the capture of steelhead in the fall, operation of the trap would be intermittent, with possibly only a few days per week and only a few hours during those days. However, with the anticipation of future operations for fall Chinook salmon, it is likely that fall Chinook salmon broodstock goals would dictate the period of trap operation, especially early in the program when meeting broodstock goals may be difficult because of smaller returns to the trap.

The objectives of the spring trapping season would be threefold: 1) trap the remainder of steelhead necessary to meet broodstock goals, 2) capture hatchery spring Chinook salmon to meet broodstock goals, and 3) capture fluvial bull trout and handle them according to agency management objectives. Capturing bull trout during this period would dictate the period of trap operation. Because bull trout captures would be distributed over a wide time range (April 15–June 15), the facility would need to operate as continuously as possible during the spring season.

For purposes of this operations plan, we assumed that the trap would be operated 12 hours per day, 7 days per week with at least one individual on site during the trapping seasons. Operation of the facility for 7 days per week may be modified during the fall season to address angler perceptions that operating the trap diminishes their opportunity to catch steelhead. With the proposed design modifications, shutting down the facility at the end of a 12-hour operating period could involve two scenarios.

**Scenario 1—Catches of fish (target or nontarget) are high.** Under this scenario, numbers of fish passing the trap entrance and numbers of fish passing over the Vee trap weir would be tracked by means of the fish counters at the entrance. The trap entrance would be shut down when numbers in the ladder equal capacity of the pre-lock holding area. If time allowed, fish in the ladder could progress up and into the pre-lock holding area where they would be crowded into the fish lock for sorting at the sorting table or routed back to the river using the pneumatic slide gate. If time did not allow, depending on conditions, fish could either be held in the pre-lock holding area for sorting the following day or a gate in the pre-lock holding area could be opened that would return fish back to the river. The option of opening the gate in the pre-lock holding area could be used if numbers in the ladder were unknown (for example, if counters were not functioning) or numbers in the ladder exceeded the capacity of the pre-lock holding area.

**Scenario 2—Catch rates are low and not anticipated to exceed pre-lock holding tank capacity.** Under this scenario, the trap could be allowed to run continuously, and fish captured in the pre-lock holding area could be sorted the following day.

## 5.2. Sorting and Holding Management

With the proposed design of three holding raceways and a crowding channel, there are several ways fish could be managed relative to the objectives of the trapping season. As part of operating the HC fish trap facility, a seasonal trapping plan should be developed that generally plans, on a weekly basis, the number of fish to capture and the distribution of those numbers during the trapping period. This plan should be based on run forecasts and previous experience. It should not only include broodstock goals of the hatchery program, but also the anticipated numbers and timing of fish desired for providing recreational fisheries. This plan would also assist in scheduling necessary transportation.

During the fall season, only steelhead and fall Chinook salmon would be held at the fish trap facility. With this design, fall Chinook salmon could be held at the trap location in a holding raceway designated for fall Chinook until enough were captured to meet the capacity of a fish tanker truck for transport to Oxbow Fish Hatchery. Similarly, two holding raceways could be designated for steelhead. Both could be used to hold steelhead for transport to the hatchery, with each raceway holding one truckload. During more intensive periods of sampling (depending on the trapping season plan), one or more raceways could be designated for holding surplus steelhead for transport, and the crowding channel could also be used to hold steelhead for transport to the hatchery. There are several such combinations for using the raceways, depending on the trapping goals set for a given time period.

The advantage of the proposed design is that it would allow the operator to divert any fish back to the river anyone handling it. This task would be accomplished by operating the fish lock to slowly release fish out of the lock and into the lock flume where it could be visually examined and routed back to the river by use of the pneumatic gate. This gate would, for example, allow surplus hatchery steelhead to be routed back into the river if the trapping goals for that week were met, but the trap could continue to be operated for fall Chinook salmon collection.

During the spring season, a similar type of raceway holding design could allow bull trout, spring Chinook, and steelhead to be held, depending on the trapping goals. Once steelhead trapping goals were met, the holding raceways could be used for spring Chinook, while any captured steelhead would be immediately diverted back to the river with the pneumatic gate.

### *5.2.1. Counting*

The HC fish trap facility would incorporate fish counting systems at three locations within the facility: 1) at the fishway entrances, 2) at the entrance to the pre-lock holding area, and 3) at the sorting facility.

Photoelectric fish counters would be installed at both fishway entrances. The counters would track the number of fish entering the fishway to determine when the capacity of the fishway had been exceeded. A photoelectric counter would also be installed at the entrance to the pre-lock holding area (Vee trap). This counter would track the number of fish entering the holding area. When the predetermined number of fish had entered the pre-lock holding area, a lock sequence would be initiated to lift fish to the sorting area. Only the total number of fish would be tracked at the fishway entrances and pre-lock holding area. Species identification would not be feasible with the photoelectric fish counter.

Counting could also occur at the elevated sorting and holding area. The operator could visually track fish directed to the fish return pipeline. Those directed to the anesthetic tank would be manually sorted and directed to the holding raceways. The manual sorting operation would allow each fish to be identified by species.

All three counting locations would likely be used to facilitate efficient operation of the modified fish trap facility.

### 5.2.2. Pre-Lock Holding Area

The proposed design of the fish trap facility incorporates a pre-lock holding area to accommodate migrating adults prior to advancing them to the elevated sorting and holding area. The pre-lock holding area allows volitional entry and counting with a photoelectric counter. The Vee trap and counting system allow migrating species to enter the holding area. The holding area has an active volume of 900 cf, allowing long-term holding of approximately 120 spring Chinook. A fish return pipeline is provided in the pre-lock holding area to return fish to the river. The fish return pipeline could be set up to operate volitionally or through manual crowding and sorting.

The pre-lock holding area is designed with the flexibility to install a bar separator in the future if desired. The bar separator would allow sorting by size, holding either large fish or small fish in the pre-lock area, depending on the species desired.

### 5.2.3. Post-Sort Holding Raceways

Three raceways would be provided to hold adults that had been processed through the sorting facility. The raceways are designed to operate with a minimum of 960 cf, allowing long-term holding of 120 adult salmon. The water level in each raceway could be drawn down independently to allow hand sorting within a raceway. When the water level was lowered, personnel could enter the raceway and sort fish into the crowding channel or adjacent raceways if desired.

## 5.3. Transportation

With the abovementioned preseason trap plan and the proposal to hold fish until enough were ready to transport, transportation of hatchery broodstock would be much more efficient than it is under current operation, and the total number of trips should be significantly reduced. If each holding raceway and, at times, the crowding channel were properly managed to hold enough fish to fill a single truck, loading trucks would also be more efficient. The ability to hold surplus fish at the trap for transport to a recreational fishery would also allow more efficient use of vehicles and personnel.

In the HCFLA, the need for another fish tanker was identified as part of this proposal. In addition to a new tanker, a smaller trailer-type fish tanker may also be examined for use transporting fewer fish. One of the primary uses for a smaller vehicle would be the transportation of bull trout if management objectives required.

## 5.4. Personnel

### 5.4.1. Operations

If the facility was not operated 12 hours per day, 7 days per week, personnel requirements for the facility would include one person on site during periods of operation. During the more intensive periods, possibly while trapping surplus fish for recreational fishing or during peak periods of a run, two people on site may be necessary. The person(s) on site would account for fish entering the ladder and pre-lock holding areas (with assistance of fish counters at trap entrances and the Vee trap), operate the fish lock, and sort fish from the lock flume to either the river (through use of the pneumatic slide gate) or the sorting area.

If the facility operated for 12 hours per day, 7 days per week, a minimum of 84 personnel hours would be required per week. Assuming 40 hours per week per person, with an allowance for overtime, at least two full-time equivalents would be required to operate the facility during the trapping seasons. During high-use periods, the personnel requirements would double.

A separate crew would manage the transportation aspects of the facility, similar to the way existing operations are. As discussed above, transportation planning would be easier and more efficient because fish would no longer have to be returned from Oxbow Fish Hatchery to the river. However, as new programs developed, primarily the fall Chinook salmon component, transportation needs would increase.

### 5.4.2. Maintenance

Maintenance of the facility is not anticipated to increase greatly over the present level. However, there are additional mechanical components of the trap, so maintenance costs would increase.

### 5.4.3. Anesthetic

Anesthetic would be used to calm fish prior to manual sorting. A wide range of anesthetic agents have been used, including MS222, clove oil, $CO_2$, and electroshocking. Several key elements would be considered when selecting the appropriate anesthetic option:

- Species and size of fish

- Number of fish to be anesthetized at one time
- Required handling method and duration
- Holding requirements for the anesthetized fish following handling
- Available space for the anesthetic system
- Effluent discharge restrictions for the outfall containing the anesthetic agent

The species, size, and number of fish would affect the type of container used for anesthetizing the fish as well as the introduction method. The intended handling requirements, including monitoring and evaluation, tagging, and identification, would determine the dosage and strength of the anesthetic applied. The type of anesthetic agent used influences the holding time before fish can be returned to the river. Clove oil is a regulated agent requiring 21 days before the anesthetized fish can be returned to the river where human contact may occur. $CO_2$ does not require a holding period before direct release because of human contact, but a holding period during which fish can recover prior to release is required to minimize predation.

For the HC fish trap, the facility layout was developed to provide flexibility for all available anesthetic methods. Final selection of the preferred anesthetic agent would be determined during final engineering, and the facility design would be adapted to incorporate the specific features associated with the selected anesthetic system.

### 5.4.4. Safety

HC fish Trap modifications are designed to incorporate full safety protection for the operation and maintenance staff. Handrail protection is provided throughout the facility to prevent falls from the elevated sorting and holding areas to the lower fishway area, fish hopper well, and raceways. Electrical grounding systems, lockout procedures, and equipment controls and alarms are designed to protect the operator during operation and maintenance of the facility.

During inclement or unusual operating conditions, such as high spill events, operation of the HC fish trap would be suspended. High spill events produce standing waves in the dam tailrace that could result in injuries to staff working at the trap level. During these periods, the trap would be temporarily shut down until normal operating conditions returned.

# 6. COSTS

## 6.1. Capital Costs—Materials and Construction

Planning-level construction cost estimates, prepared for the recommended HC fish trap modifications, are summarized in Table 6-1. These estimates are based on the facilities illustrated in Drawings 1 through 13. The estimate for materials and construction is considered a planning-level estimate with an estimated accuracy of ±50% of the actual construction costs. Changes in the facility function, layout, materials, and pricing would affect the construction costs. Costs of engineering, construction management, permitting, and environmental compliance were not included in the cost estimates for materials and construction. These cost items are included as separate line items in Table 6-1.

## 6.2. Operating and Maintenance Costs

Operation and maintenance costs encompass annual activities required to operate and maintain the fish trap facility. The annual operation and maintenance costs associated with the recommended HC fish trap facility modifications were estimated and are summarized in Table 6-1. Major cost elements are described in the following paragraphs.

### *6.2.1. Personnel*

Section 5.4 discusses the personnel requirements for the modified HC fish trap facility. As discussed, if the facility was not operated 12 hours per day, 7 days per week, personnel requirements for the facility would include one person on site during periods of operation. During the more intensive periods, possibly while trapping surplus fish for recreational fishing or during peak periods of a run, two people on site may be necessary. Person(s) on site would account for fish entering the ladder and pre-lock holding areas (with assistance of fish counters at trap entrances and the Vee trap), operate the fish lock, and sort fish from the lock flume to either the river (through use of the pneumatic slide gate) or the sorting area.

If the facility operated for 12 hours per day, 7 days per week, a minimum of 84 personnel hours would be required per week. Assuming 40 hours per week per person, with an allowance for overtime, at least two full-time equivalents would be required to operate the facility during the trapping seasons. During high-use periods, the personnel requirements would double.

### 6.2.2. Transportation

A separate crew would manage the transportation aspects of the facility, similar to the way existing operations are. As discussed in section 5.4.1, transportation planning would be easier and more efficient because fish would no longer have to be returned from Oxbow Fish Hatchery to the river. However, as new programs developed, primarily the fall Chinook salmon component, transportation needs would increase. For cost-estimating purposes, transportation costs were assumed to match the current budget expenditures.

### 6.2.3. Maintenance

Maintenance costs would consist of the activities required to maintain the facility in peak operating condition. In general, maintenance activities fall into three categories: 1) preventative maintenance, 2) normal operation maintenance, and 3) emergency maintenance. Preventative maintenance includes activities designed and performed annually to ensure that the equipment and systems are operating properly. Typical preventative maintenance activities include replacing coolant and oil in a standby generator motor, testing the PLC controls, and inspecting and replacing pump seals. Normal maintenance activities include greasing bearings, exercising gates and valves, and replacing worn gaskets. Emergency maintenance activities are unplanned and normally require mobilization of additional staff and equipment to complete. Cleanup following the 1997 flood event is an example of an emergency maintenance activity.

For the purposes of this report, estimated operation and maintenance costs include preventative and normal activities. Emergency maintenance activities are not included in the estimate. Maintenance costs include the materials, equipment, and personnel required to complete these annual maintenance activities.

## 6.3. Total Project Cost

Table 6-1 summarizes the estimated total project cost for the recommended HC fish trap modifications. The capital cost includes costs for materials and construction, engineering, environmental and permitting support, and supervision and administration during construction. Operation and maintenance costs were estimated based on costs for projected personnel needs, pump station operation, supplies required for operation, transportation costs, and maintenance activities. These estimates are considered planning level and have an accuracy range of ±50%.

# 7. Conclusions and Recommendations

## 7.1. Conclusion

As outlined in this report, a wide range of alternatives was considered for modifications to the HC fish trap facility. These alternatives were developed based on criteria developed jointly by IPC and the involved resource agencies. Current and future program goals were considered for each alternative layout to maximize the flexibility for sorting and holding of multiple species. From this analysis, Alternative 3 Revised was found to provide the best overall system for modifications to the HC fish trap facility when considering operation and maintenance, flexibility, fish movement and handling, environmental impact, and overall program goals and objectives.

## 7.2. Recommendations

Alternative 3 Revised is the recommended alternative for modifications to the HC fish trap facility. This alternative modifies the existing fishway and fish trap facility by extending the existing fish ladder; adding a second fishway entrance; raising the exterior wall to improve flood protection; building a new pre-lock holding and fish counting area, fish lock, and elevated sorting and holding areas; and modifying the existing water supply pumping station.

## 7.3. Acknowledgments

We extend our appreciation to Scott Grunder, Tom Rogers, Kent Hills, and Ralph Steiner of the Idaho Department of Fish and Game; Colleen Fagan of the Oregon Department of Fish and Wildlife; Herb Pollard, John Johnson, and Ritchie Graves of NOAA Fisheries; Jim Esch and Michael Morse of the U.S. Fish and Wildlife Service; and Stan Becktold, Ryan Adelman, Paul Abbott, and Scott Larrondo of Idaho Power Company for their valued input, participation, and review of materials to complete this response to AIR AR-1.

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**Table 2-1. Biological design criteria for the Hells Canyon fish trap.**

| Criteria | Units | Value | Comments |
|---|---|---|---|
| Fish species—anadromous | | Steelhead<br>fall Chinook<br>spring Chinook<br>lamprey | |
| Fish species—resident | | bull trout | Additional species may include rainbow trout, mountain whitefish, brown trout, large-scale suckers, bridgelip suckers, carp, northern pike minnow, and chisel mouth |
| Fish size | | | |
| Steelhead | lbs | 8 | Average size |
| Fall Chinook | lbs | 15 | Average size |
| Spring Chinook | lbs | 15 | Average size |
| Bull trout | lbs | < 5 | Average size |
| Swimming capabilities | | | |
| Steelhead | fps | <13/<26 | Prolonged/burst |
| Fall Chinook | fps | <10/<22 | Prolonged/burst |
| Spring Chinook | fps | <10/<22 | Prolonged/burst |
| Bull trout | fps | <1.6 | Prolonged (fork length > 15 cm) |
| | | <2.6 | Prolonged (fork length > 40 cm) |
| Timing | | | Broodstock collection |
| Steelhead | mo/da | 10/23 to 12/15<br>3/20 to 5/1 | Water temperatures < 60 °F/broodstock collection in early winter and spring run |
| Fall Chinook | mo/da | 10/23 to 12/15 | |
| Spring Chinook | mo/da | 5/1 to 7/15 | Water temperatures < 72 °F |
| Bull trout | mo/da | 4/15 to 6/15 | |
| Numbers of fish | | | |
| Steelhead | | | |
| Broodstock target | | 600 | 25% spring collection |
| Maximum per day | | ±500 | 75% fall collection |
| Average per day | | ±125 | |
| fall Chinook | | | |
| Target | | 856 | Based on production goals |
| Maximum per day | | — | No data at present |
| Average per day | | — | No data at present |
| Spring Chinook | | | |
| Target | | 748 | |
| Maximum per day | | ±170 | |
| Average per day | | ±42 | |
| Bull trout | | n/a | No target, small numbers trapped |

**Table 2-2. Water quality criteria for the Hells Canyon fish trap.**

| Criteria | Units | Value | Comments |
|---|---|---|---|
| Maximum holding temperature | °F | <70 | In holding units |
| Minimum dissolved oxygen | % sat. | >65 | In holding units |
| | | >50 | In fishway at max. loading |
| Maximum nitrogen saturation | % sat. | <110 | In holding units; aeration and nitrogen stripping required for holding raceways |

**Table 2-3. Hydraulic and hydrological criteria for the Hells Canyon fish trap.**

| Criteria | Units | Value | Comments |
|---|---|---|---|
| Maximum HC tailwater elevation | ft | 1494 | at 103,000 cubic feet per second (cfs) |
| Min HC tailwater elevation | ft | 1469 | at 5000 cfs |
| Trap operating range | | | |
| Minimum tailwater elevation | ft | 1467 | Corresponds to 5000 cfs |
| Maximum tailwater elevation | ft | 1482.5 | Corresponds to 45,000 to 50,000 cfs |
| Maximum flow | cfs | 103,000 | Occurred January 2, 1997 |
| 10% exceedence | cfs | 38,300 | Exceedence based on HC gage, No. 13290450, period of record July 1965 to present |
| 50% exceedence | cfs | 16,300 | |
| 90% exceedence | cfs | 8990 | |

**Table 2-4. Fish ladder design criteria for the Hells Canyon fish trap.**

| Criteria | Units | Value | Comments |
|---|---|---|---|
| Drop per pool, maximum | ft | 1.0 | |
| Energy dissipation, per cf, minimum | ft-lb/sec | 4.0 | |
| Transport velocity | fps | 1.0–2.0 | Over gross area of fish ladder |
| Entrance velocity | fps | 4.0–8.0 | |
| Fish ladder flow | cfs | See comment | Based on transport velocity and energy dissipation criteria |
| Fish density in pools | lb/cf | 5 | |
| Maximum day | % of run | 10 | |
| Maximum hour | % of max. day | 10 | |
| Oxygen consumption | oz/hr/lb | $4 \times 10^{-4}$ | |
| Orifice/slot velocities | fps | 4.0–8.0 | |
| Orifice/slot size, minimum | ft | 1.5 high | Matches existing fishway |
| | | 1.0 wide | |
| Fishway size | | | |
| Length, minimum | ft | 10.0 | Matches existing fishway |
| Width, minimum | ft | 6.0 | |
| Wall height, minimum | ft | 8.0 | |
| Auxiliary water flow | cfs | See comment | Based on entrance velocity criteria |
| Ladder type | — | Ice Harbor or vertical slot | |

**Table 2-5. Pre-lock/lift holding design criteria for the Hells Canyon fish trap.**

| Criteria | Units | Value | Comments |
|---|---|---|---|
| Trapping mechanism | — | Vee trap or finger weir | |
| Holding density | lb/cf | 4.0 | Total volume based on 1/3 of peak day run |
| Flow | Gallons per minute (gpm)/fish | 0.5 | |
| Water supply | — | Floor diffuser | |
| Length, minimum | ft | 12.0 | |
| Width, minimum | ft | 8.0 | |
| Depth, minimum | ft | 8.0 | |
| Wall height | ft | 10.0 | |
| Jump prevention | — | Surface spray and jump panels | |
| Cycle time, min. | hr | 0.5 | Cycle time for complete brail operation |

**Table 2-6. Lock/lift design criteria for the Hells Canyon fish trap.**

| Criteria | Units | Value | Comments |
|---|---|---|---|
| Trapping mechanism | — | Bar rack | |
| Holding density | lb/cf | 8.0 | |
| Lock | | | |
| Size | ft | 6.5 x 6.5 | Length x width |
| Fill rate | gpm | 1000 | |
| Cycle time | min | 10-15 | |
| Crowding mechanism | — | Brail floor | |
| Lift | | | |
| Size | ft | 6.5 x 6.5 | Length x width |
| Cycle time | min | 10 –15 | |

**Table 2-7. Sorting/anesthetic/sampling/fish return criteria for the Hells Canyon fish trap.**

| Criteria | Units | Value | Comments |
|---|---|---|---|
| Identification | | | |
| Visual | — | Manual identification | Requires full-time operator |
| Video | — | Video recognition software | Depends on effectiveness of the video recognition software |
| Sorting | | | |
| Manual | — | Handle each fish or bar separator | |
| Automated gates/chute | — | Air-actuated gates to direct fish to holding raceways | Requires visual identification or video recognition software |
| Fish size | — | Down to 40 cm | Separator required to collect smaller resident fish |
| Sampling | | | |
| Frequency | | Daily | |
| Species | | All | |
| Anesthetic | | | |
| Tank size | gals | 150 | |
| Flow | gpm | 5 | |
| Handling | | Manual | |
| Method | | clove oil/$CO_2$ | More evaluation required in this area and investigation of electroshocking |
| Fish Return | | | |
| Flume size, minimum | inch | 18 | |
| Pipe size, minimum | inch | 12 | |
| Flow | gpm | See comment | Depends on return pipe or flume slope |
| Depth | inch | 6 | |
| Materials | | PVC, HDPE | All smooth interior and fittings |

**Table 2-8. Holding raceways criteria for the Hells Canyon fish trap.**

| Criteria | Units | Value | Comments |
|---|---|---|---|
| Number | ea | 3 | Depends on the number of species/stock or transport destination |
| Capacity | fish | 120 Chinook<br>384 steelhead | Match the capacity of the transport truck or trailer. Raceway has capacity to hold 384 steelhead. |
| Size | cf | 960 | |
| Flow rate | cfs | 2 turnovers per hour | Based on temperature/DO |
| Crowding | — | Powered traveling crowder | One per raceway |
| Materials | — | Concrete/steel/aluminum | |
| Diffuser velocity | fps | 1.0 | Wall diffusers |
| | | 0.5 | Floor diffusers |
| Freeboard | ft | 1-foot minimum on the raceways<br>4-foot minimum for fish jumping | |
| Jump prevention | | Surface spray and jump panels | |
| Other | | | |
| Bird netting | | Not required | |

**Table 2-9. Truck loading/transport criteria for the Hells Canyon fish trap.**

| Criteria | Units | Value | Comments |
|---|---|---|---|
| Hopper | | | |
| Size | gals | 1000 | |
| Loading density | lb/cf | 6.7 | |
| Capacity | | 120 | |
| Freeboard | | Greater than the water depth within the hopper | Measured from the hopper water surface to the top of the hopper |
| Transfer | | Water-to-water | |
| Transport | | | |
| Truck size | gals | 500/1000 | IDFG/Idaho Power |
| Truck capacity | fish | 120 | |
| Trailer size | gals | 500 | |
| Trailer capacity | fish | 60 | |
| Oxygen supplementation | | Yes | Oxygen tanks and recirculation pumps |
| Maximum hauling water temperature | °F | <65 | Acclimate to within 5 °F of receiving water temperature |
| Tank insulation | — | Yes | |
| Cycle time | | | |
| Crowding/hopper loading | min | 10–15 | |
| Hopper | min | 20 | Depends on jib crane lift time, unload to transport truck, return to hopper well |
| Transport | hrs | 3 hours | 1 hour each way transport time plus 1 hour tank filling and general preparation |
| Materials | | | |
| Hopper | | Aluminum and stainless steel | |
| Transport | | Aluminum and stainless steel | |
| Piping | | Stainless steel/PVC | |

**Table 2-10. Monitoring and evaluation criteria for the Hells Canyon fish trap.**

| Criteria | Units | Value | Comments |
|---|---|---|---|
| PIT-tag detection | | | |
| Type | — | Tube or channel | |
| Location | — | Entrance or sorting area | |
| Coded wire tag detection | | | |
| Type | — | | |
| Location | — | Entrance or sorting area | |
| Counting | | | |
| Type | — | Automated/resistance board or video/manual | |
| Location | — | Ladder entrance and/or fish sorter | Need ability to count fish at the entrance to control numbers entering ladder |
| Wild | — | Count and return to river | |
| Fish Health | — | — | May provide evaluation work area |

**Table 2-11. Mechanical systems criteria for the Hells Canyon fish trap.**

| Criteria | Units | Value | Comments |
|---|---|---|---|
| Entrance | | | |
| Type | — | Telescoping | |
| Tailwater range | ft | 1467 to 1482.5 | 5000 to 50,000 cfs |
| Width | ft | 3 | Existing configuration |
| Auxiliary water pumps | | | |
| Number | — | 4 | Existing system |
| Capacity | cfs | 112 | |
| Standby pumps | — | One standby | |
| Controls | — | HOA | PLC controlled |
| Lock/trap pumps | | | |
| Number | — | 2 | |
| Capacity | cfs | ? | Based on lock cycle time and trap flow |
| Standby pumps | — | One standby | |
| Controls | — | HOA | PLC controlled |
| Holding raceways pumps | | | |
| Number | — | 2 | |
| Capacity | cfs | | To be determined |
| Standby pumps | — | One standby | |
| Controls | — | HOA | PLC controlled |
| Separator/sorter/crowder | | | |
| Length | — | | To be determined |
| Width | — | | To be determined |
| Finger weirs | — | | To be determined |
| Water supply | — | | To be determined |
| Controls and alarms | — | — | Single PLC with alarms and monitors transmitted to central control |
| Standby power | — | Yes | Either dual feed or standby generator |

**Table 3-1. Description of available sorting methods.**

| Sorting Method | Description | Comments |
|---|---|---|
| Automated sorting (tag or video) | Fish species are recognized by tag or image processing and directed to their destination using automated gates. | Is not presently applicable to HC since not all hatchery fish are tagged and visual recognition equipment is not sufficiently reliable to accurately identify and sort fish. |
| Visual sorting | Operators visually identify fish and direct them to their destination using automated gates. | Is not practical for HC since wild and hatchery fish require close inspection to differentiate. |
| Hand sorting | Fish are moved to a sorting table and individually inspected to determine destination. | Provides the greatest degree of reliability for sorting, though it is the most labor-intensive method. |
| Size sorting | Fish are sorted by size with small fish falling through a dewatered/slotted chute, and large fish traveling over the bars. | Works well to sort between most resident and anadromous fish. Wild and hatchery fish still require hand sorting. Is ineffective for bull trout because of a wide range of sizes and life stages. |

**Table 3-2. Applicability of sorting method by species.**

| Fish | Automated Sorting | Visual Sorting | Hand Sorting | Size Sorting |
|---|---|---|---|---|
| Wild steelhead | Poor | Poor | Good | Poor |
| Hatchery steelhead | Poor | Poor | Good | Poor |
| Wild Chinook | Poor | Poor | Good | Poor |
| Hatchery Chinook | Poor | Poor | Good | Poor |
| Bull trout | Poor | Good | Good | Poor |
| Other resident fish | Poor | Good | Good | Fair |

**Table 3-3. Conceptual level construction cost estimates for each alternative.**

| Alternative | Low Range | Estimate | High Range |
|---|---|---|---|
| 1—Existing fishway with trap, sorting, and holding | $1,120,000 | $2,240,000 | $3,360,000 |
| 2—Extended fishway with trap, sorting, and holding | $1,570,000 | $3,140,000 | $4,710,000 |
| 3—Existing fishway with narrow raceways | $1,415,000 | $2,830,000 | $4,245,000 |
| 4—Downstream trap, sorting, and holding | $1,680,000 | $3,360,000 | $5,040,000 |
| 3 Revised—Existing fishway with elevated sorting/holding and a fish lock | $1,550,000 | $3,100,000 | $4,650,000 |
| 5—Lengthened fishway with elevated sorting/holding | $2,055,000 | $4,110,000 | $6,165,000 |

**Table 3-4. Key features of Alternatives 3 Revised and 5.**

| Feature | Alternative 3 Revised | Alternative 5 |
|---|---|---|
| Entrances | Low and high flow | Low and high flow |
| Elevation gain to sorting | Lock | Extended fishway and lift |
| Number of fishway pools | 19 | 33 |
| Trapping method | Vee trap | Vee trap |
| Counting | Photoelectric | Photoelectric |
| Sorting method | Hand and gate | Hand and gate |
| Number of holding raceways | 3 | 3 |
| Truck loading method | Hopper | Hopper |

**Table 3-5. Advantages and disadvantage of Alternatives 3 Revised and 5.**

| Alternatives | Advantages | Disadvantages |
|---|---|---|
| Alternative 3 Revised | • Lower construction cost<br>• Least impact to sensitive area<br>• Greater flume length for visual sorting | • Longer cycle time w/ lock |
| Alternative 5 | • Shorter cycle time w/ lift | • Higher construction cost<br>• Greater exposure to rock falls on fishway<br>• Extensive construction in difficult and sensitive area<br>• Not feasible for a full swim-in facility with automated sorting |

**Table 4-1. Structural design criteria for the facility modifications.**

| Description | Value |
|---|---|
| A36 steel | Fy = 36,000 psi<br>Fu = 58,000 psi |
| 6061-T6 aluminum | Fy = 35,000 psi nonwelded areas<br>Fu = 42,000 psi nonwelded areas<br>Fy = 20,000 psi welded areas<br>Fu = 24,000 psi welded areas |
| Stainless steel bolts | Ft = 26,000 psi for all bolts, inserts, etc. |
| A572 carbon bolts | Ft = 21,500 psi |
| Existing concrete | 3000 psi |
| New concrete | 4000 psi |

**Table 6-1. Total project cost summary for trap modifications recommended for Hells Canyon.**

| Item | Item Cost ($) | Total Cost ($) |
|---|---|---|
| Capital cost | | 3,658,000 |
| Materials and construction | 3,100,000 | |
| Engineering (10%) | 310,000 | |
| Environmental and permitting (5%) | 155,000 | |
| Construction S&A (3%) | 93,000 | |
| Operation and maintenance | | 259,000 |
| Personnel | | |
| Operation | 165,000 | |
| Transportation | 52,000 | |
| Maintenance | 20,000 | |
| Power | 20,000 | |
| Supplies | 2,000 | |

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# IDAHO POWER COMPANY

IDAHO POWER
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| INDEX OF DRAWINGS | |
|---|---|
| DRAWING NO. | DRAWING TITLE |
| 1 | COVER SHEET, LOCATION MAP, VICINITY MAP, AND INDEX OF DRAWINGS |
| 2 | EXISTING FACILITIES – SITE PLAN |
| 3 | EXISTING FACILITIES – CROSS SECTIONS |
| 4 | EXISTING FACILITIES – DEMOLITION PLAN |
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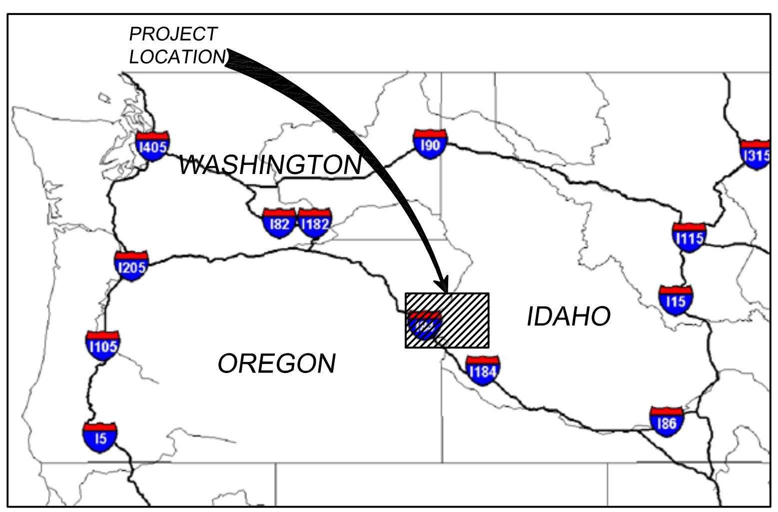
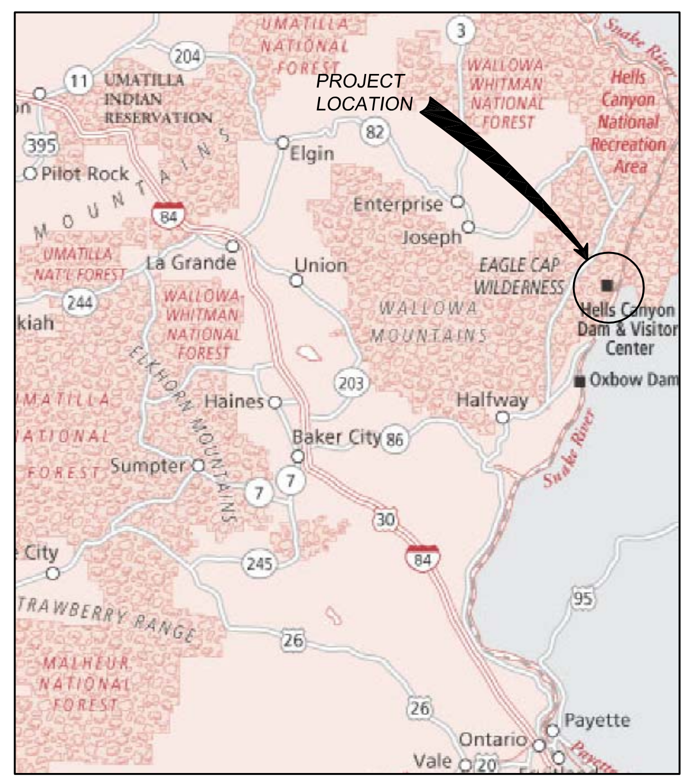
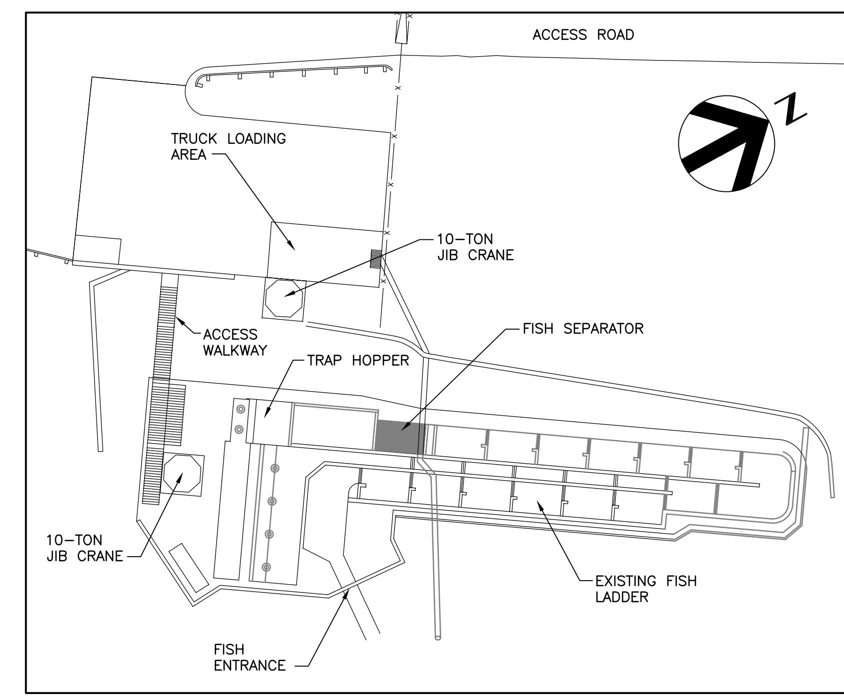
# HCC AIR AR-1
# HELLS CANYON DAM
# FISH TRAP MODIFICATIONS
# FUNCTIONAL DESIGN DRAWINGS




**LOCATION MAP**
NOT TO SCALE




**VICINITY MAP**
NOT TO SCALE




**EXISTING HELLS CANYON DAM FISH TRAP**
NOT TO SCALE

HDR
HDR Engineering, Inc.

| ISSUE | DATE | DESCRIPTION |
|---|---|---|
| 0 | 11/10/04 | |
| A | 10/22/04 | – |

| | |
|---|---|
| PROJECT MANAGER | M. McMILLEN |
| MECH'L. ENGINEER | R. ELDRIDGE |
| DESIGNER | S. WHITE |
| PROJECT NUMBER | – |

McMILLEN ELDRIDGE

IDAHO POWER
An IDACORP Company

HELLS CANYON FISH TRAP
IDAHO POWER CO.
BOISE, IDAHO

COVER SHEET, LOCATION MAP, VICINITY MAP, AND INDEX OF DRAWINGS

0 1" 2"

| | |
|---|---|
| FILENAME | 15616-1.dwg |
| SCALE | NO SCALE |

DRAWING
1

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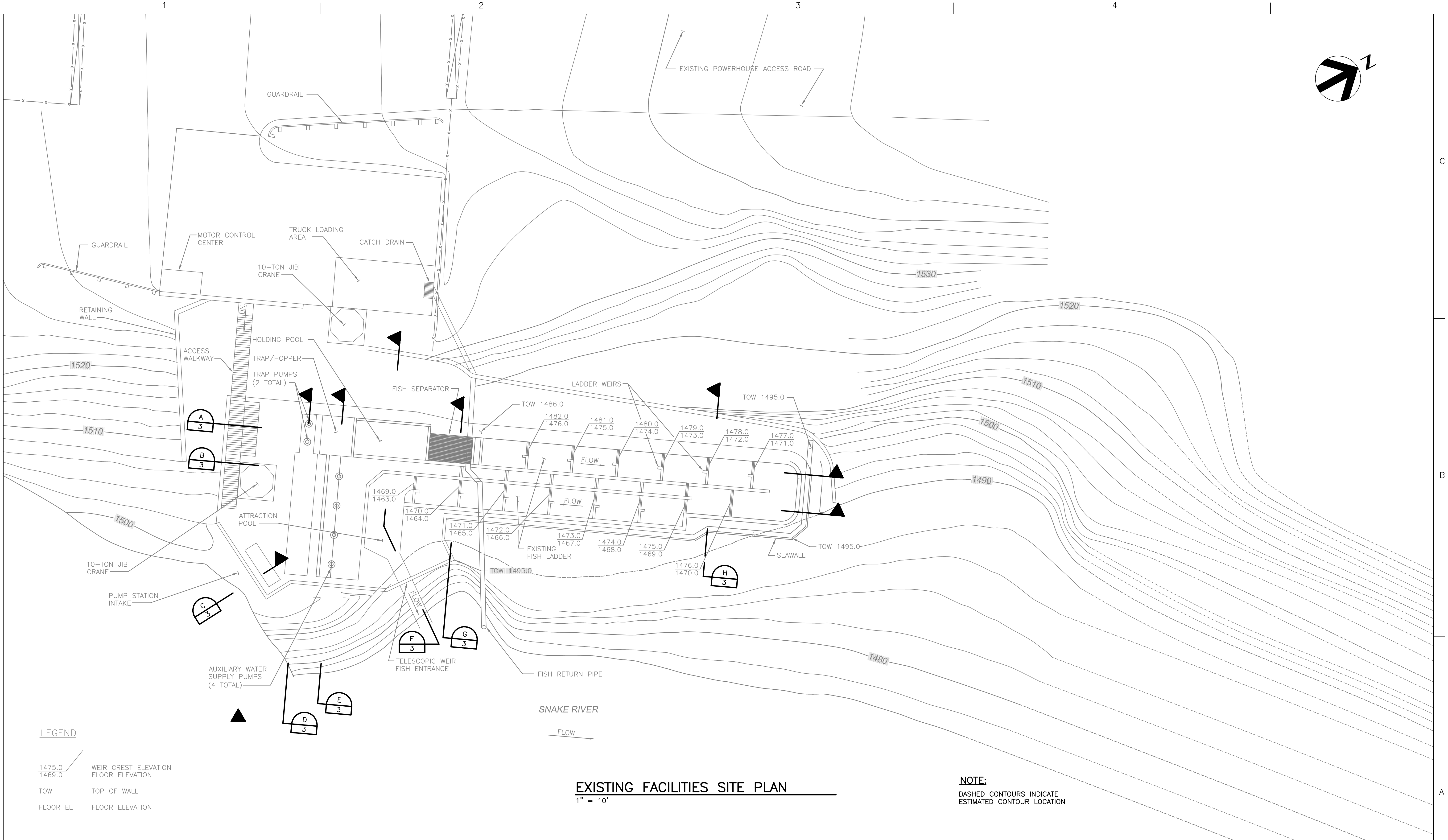


## EXISTING FACILITIES SITE PLAN

1" = 10'

**NOTE:**

DASHED CONTOURS INDICATE ESTIMATED CONTOUR LOCATION

HDR
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| PROJECT MANAGER | M. McMILLEN |
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| DESIGNER | S. WHITE |
| PROJECT NUMBER | – |

ME McMILLEN ELDRIDGE

IDAHO POWER An IDACORP Company

HELLS CANYON FISH TRAP
IDAHO POWER CO.
BOISE, IDAHO

EXISTING FACILITIES SITE PLAN

0 1" 2"

FILENAME 15616-2
SCALE 1" = 10'
DRAWING 2

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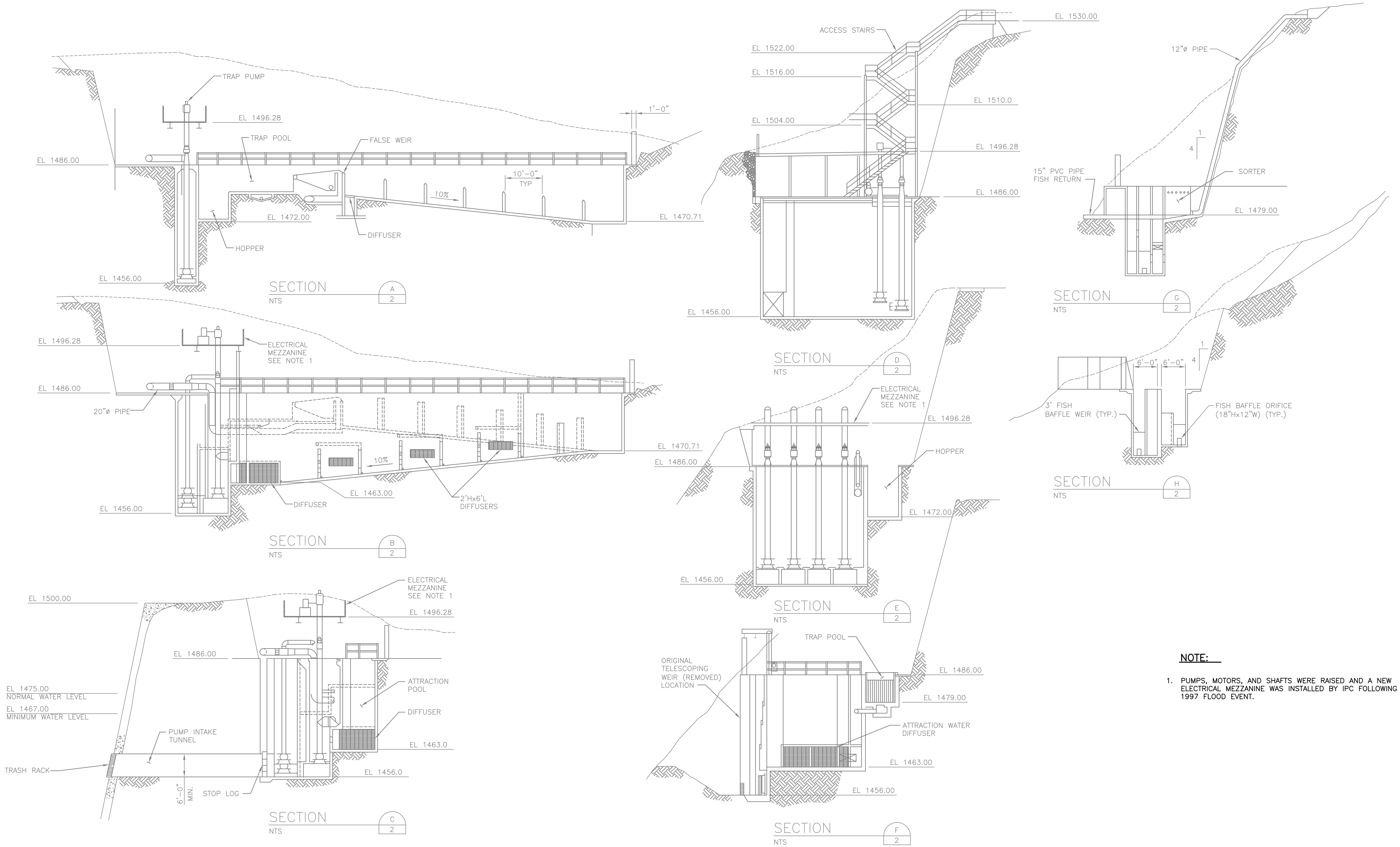


NOTE:

1. PUMPS, MOTORS, AND SHAFTS WERE RAISED AND A NEW ELECTRICAL MEZZANINE WAS INSTALLED BY IPC FOLLOWING THE 1997 FLOOD EVENT.

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| DESIGNER | S. WHITE |
| PROJECT NUMBER | – |

ME McMILLEN ELDRIDGE

IDAHO POWER
An IDACORP Company

**HELLS CANYON FISH TRAP**
**IDAHO POWER CO.**
**BOISE, IDAHO**

**EXISTING FACILITIES CROSS SECTIONS**

0 1" 2"

| | |
|---|---|
| FILENAME | 15616-3 |
| SCALE | NO SCALE |

DRAWING 3

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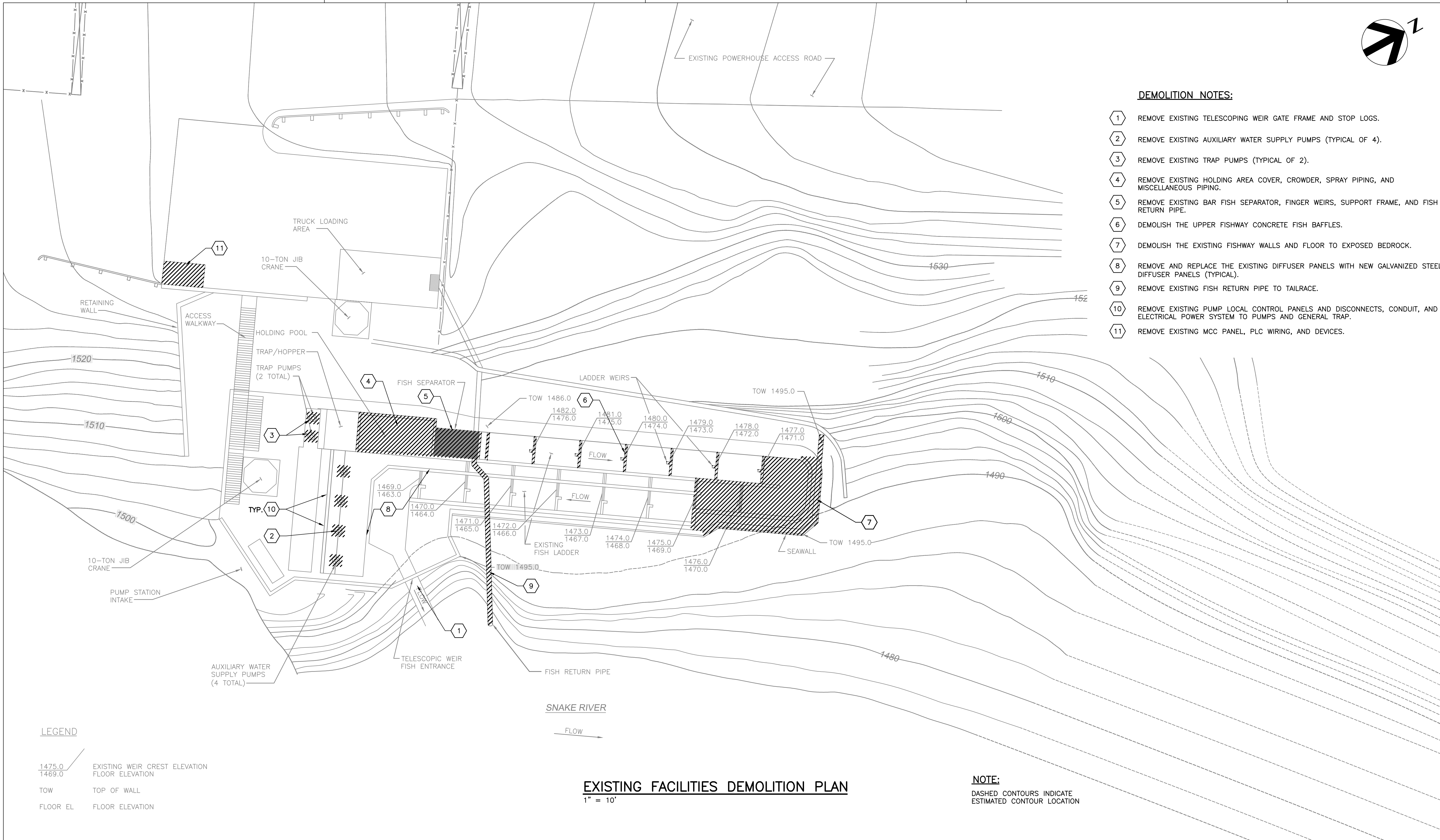


## DEMOLITION NOTES:

1. REMOVE EXISTING TELESCOPING WEIR GATE FRAME AND STOP LOGS.
2. REMOVE EXISTING AUXILIARY WATER SUPPLY PUMPS (TYPICAL OF 4).
3. REMOVE EXISTING TRAP PUMPS (TYPICAL OF 2).
4. REMOVE EXISTING HOLDING AREA COVER, CROWDER, SPRAY PIPING, AND MISCELLANEOUS PIPING.
5. REMOVE EXISTING BAR FISH SEPARATOR, FINGER WEIRS, SUPPORT FRAME, AND FISH RETURN PIPE.
6. DEMOLISH THE UPPER FISHWAY CONCRETE FISH BAFFLES.
7. DEMOLISH THE EXISTING FISHWAY WALLS AND FLOOR TO EXPOSED BEDROCK.
8. REMOVE AND REPLACE THE EXISTING DIFFUSER PANELS WITH NEW GALVANIZED STEEL DIFFUSER PANELS (TYPICAL).
9. REMOVE EXISTING FISH RETURN PIPE TO TAILRACE.
10. REMOVE EXISTING PUMP LOCAL CONTROL PANELS AND DISCONNECTS, CONDUIT, AND ELECTRICAL POWER SYSTEM TO PUMPS AND GENERAL TRAP.
11. REMOVE EXISTING MCC PANEL, PLC WIRING, AND DEVICES.

LEGEND

| | |
|---|---|
| 1475.0 / 1469.0 | EXISTING WEIR CREST ELEVATION / FLOOR ELEVATION |
| TOW | TOP OF WALL |
| FLOOR EL | FLOOR ELEVATION |

## EXISTING FACILITIES DEMOLITION PLAN

1" = 10'

NOTE:

DASHED CONTOURS INDICATE ESTIMATED CONTOUR LOCATION

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McMILLEN ELDRIDGE

IDAHO POWER
An IDACORP Company

HELLS CANYON
FISH TRAP
IDAHO POWER CO.
BOISE, IDAHO

EXISTING FACILITIES DEMOLITION PLAN

0 1" 2"

FILENAME 15616–4
SCALE 1" = 10'
DRAWING 4

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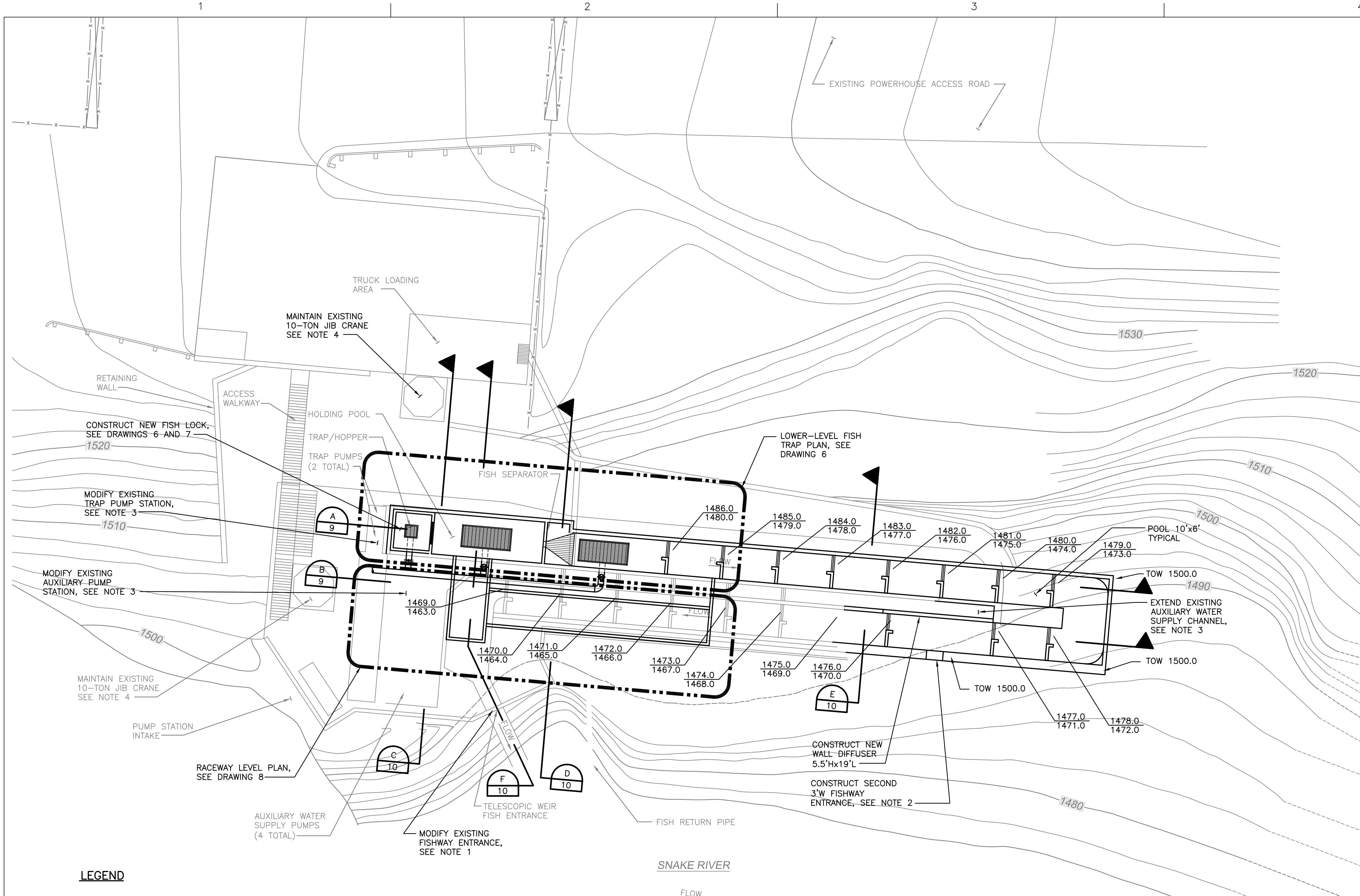


## NOTES:

1. REPLACE EXISTING TELESCOPIC WEIR FISH ENTRANCE WITH NEW FISHWAY ENTRANCE DESIGNED TO MAINTAIN A MINIMUM OF 1 FOOT DROP ACROSS THE FISHWAY ENTRANCE.
2. ADD SECOND FISHWAY ENTRANCE FOR OPERATION AT HIGHER TAILWATER ELEVATIONS ABOVE PROJECT DISCHARGE OF 30,000 CFS.
3. MODIFY THE EXISTING AUXILIARY WATER SUPPLY AND TRAP WATER SUPPLY PUMP STATIONS TO SUPPLY THE NEW FISHWAY AND SORTING FACILITY.
4. MAINTAIN EXISTING 10–TON JIB CRANES TO REMOVE FISH HOPPER AND EQUIPMENT (UPPER LEVEL) AND AUXILIARY WATER SUPPLY PUMPS (LOWER LEVEL).

## LEGEND

| | |
|---|---|
| 1475.0 / 1469.0 | WEIR CREST ELEVATION / FLOOR ELEVATION |
| TOW | TOP OF WALL |
| FLOOR EL | FLOOR ELEVATION |

## PROPOSED MODIFICATIONS – OVERALL SITE PLAN

1" = 10'

**NOTE:**

DASHED CONTOURS INDICATE ESTIMATED CONTOUR LOCATION

HDR Engineering, Inc.

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| MECH'L. ENGINEER | R. ELDRIDGE |
| DESIGNER | S. WHITE |
| PROJECT NUMBER | – |

MCMILLEN ELDRIDGE

IDAHO POWER An IDACORP Company

HELLS CANYON FISH TRAP
IDAHO POWER CO.
BOISE, IDAHO

PROPOSED MODIFICATIONS OVERALL SITE PLAN

0 1" 2"

| | |
|---|---|
| FILENAME | 15616–5 |
| SCALE | 1" = 10' |

DRAWING 5

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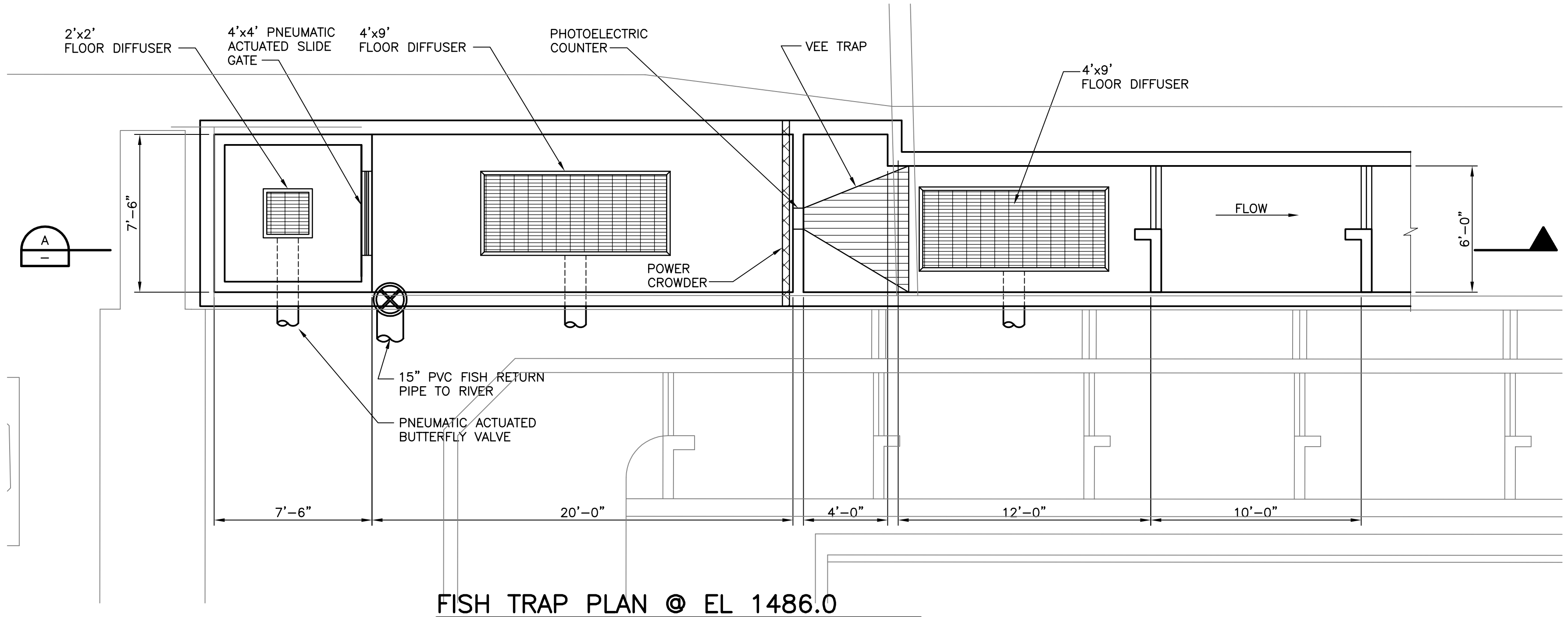
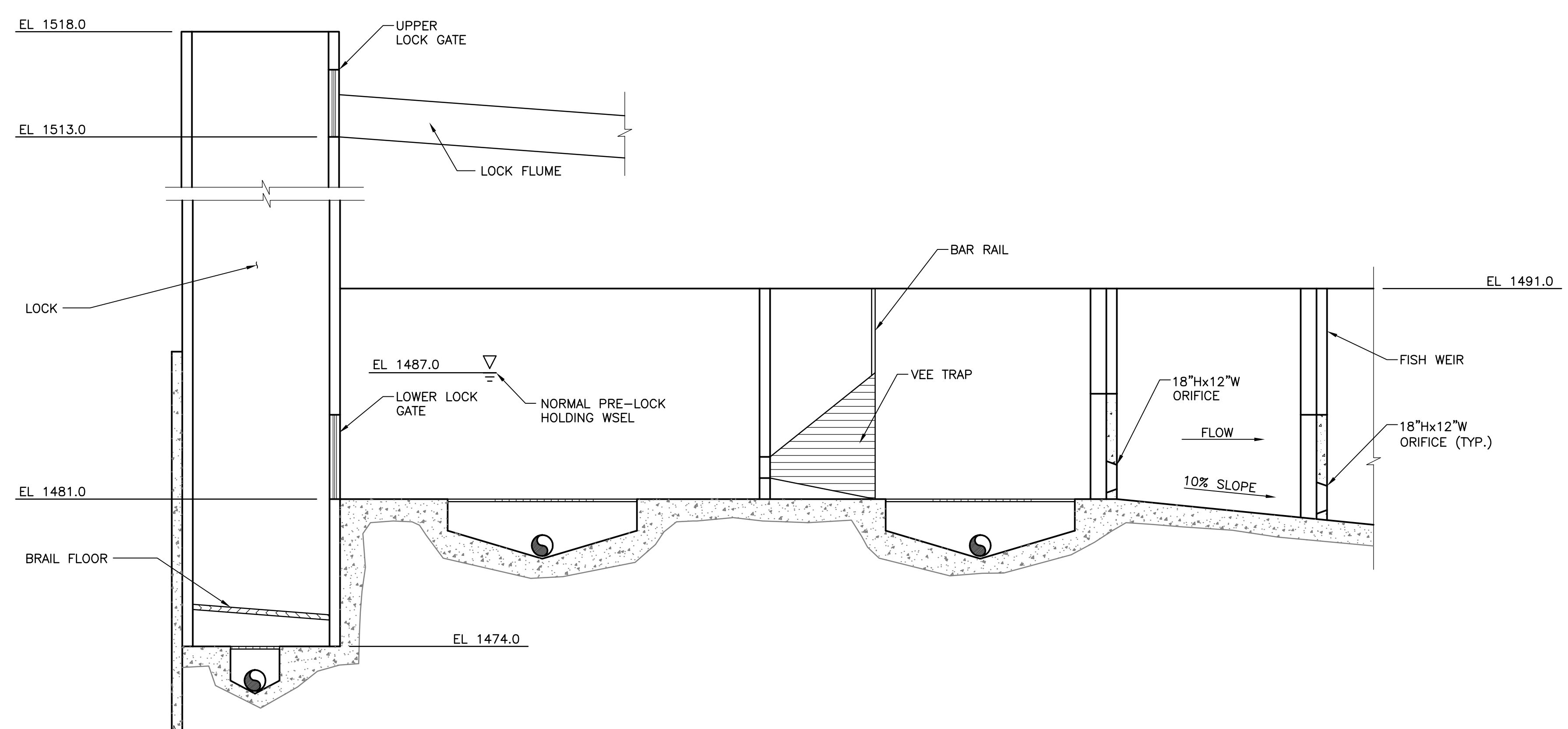



FISH TRAP PLAN @ EL 1486.0
1/4" = 1'-0"




SECTION A
1/4" = 1'-0"

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|---|---|---|
| 0 | 11/10/04 | |
| A | 10/22/04 | – |

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|---|---|
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| MECH'L. ENGINEER | R. ELDRIDGE |
| DESIGNER | S. WHITE |
| PROJECT NUMBER | 15616 |

ME McMILLEN ELDRIDGE

IDAHO POWER An IDACORP Company

HELLS CANYON FISH TRAP
IDAHO POWER CO.
BOISE, IDAHO

FISHWAY AND PRE-LOCK LEVEL PLAN AND SECTIONS

0 1" 2"

| | |
|---|---|
| FILENAME | 15616-6.dwg |
| SCALE | 1/4" = 1'-0" |

DRAWING 6

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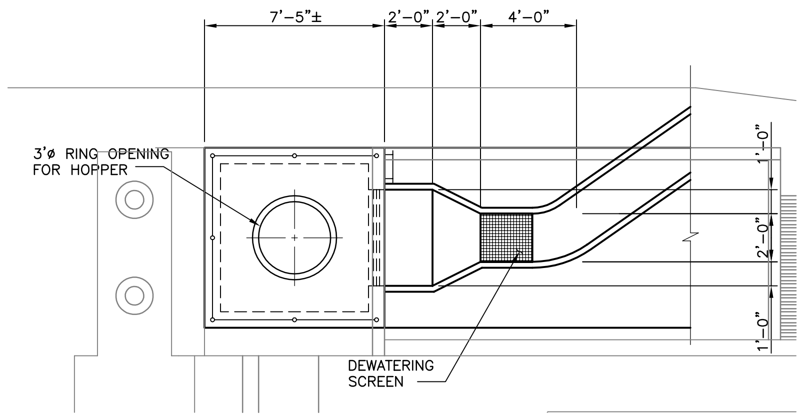
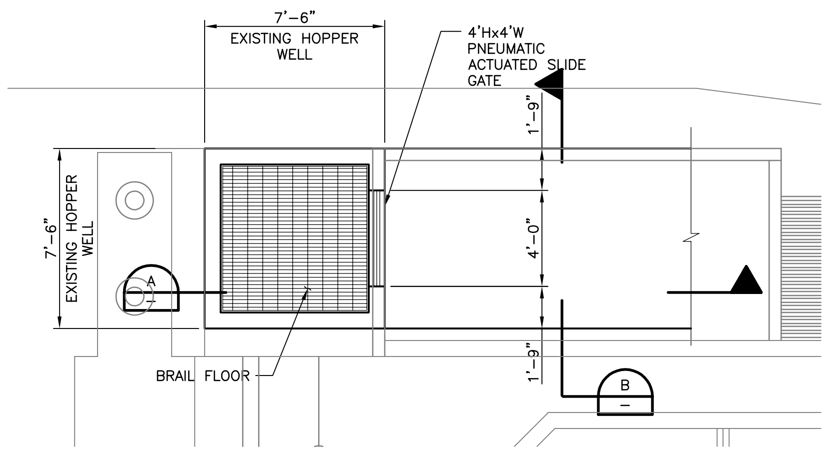
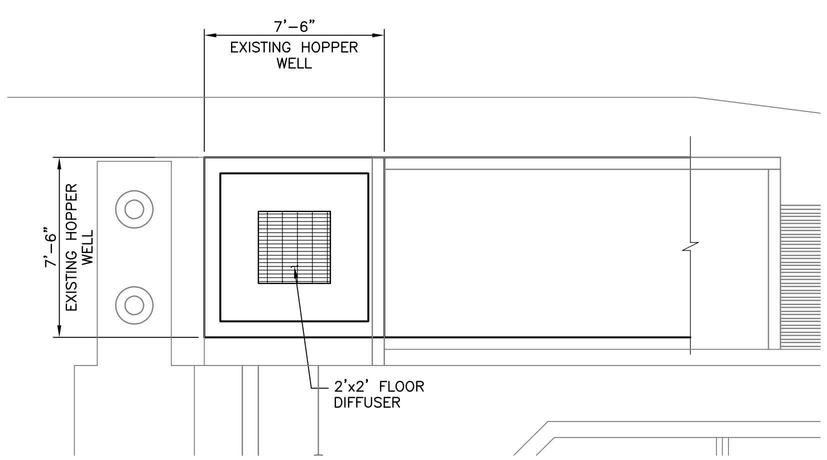


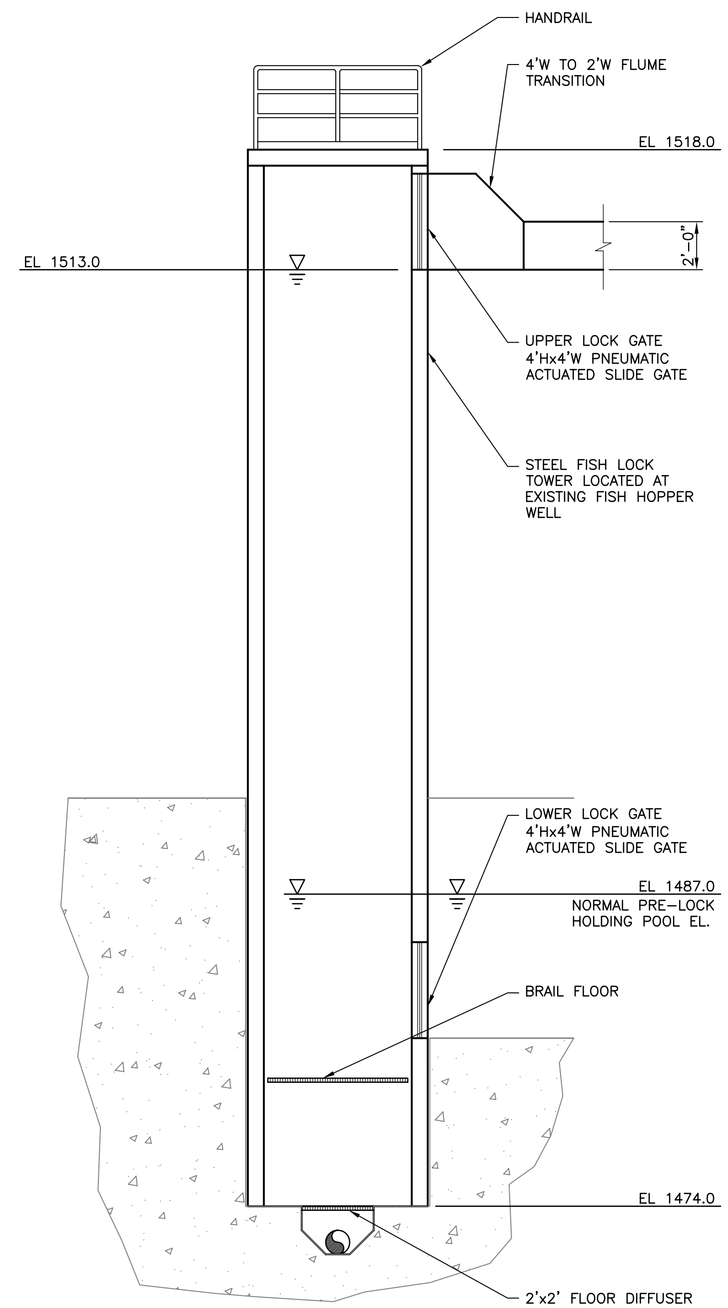

FISH LOCK PLAN @ EL 1518.0
1/4" = 1'-0"



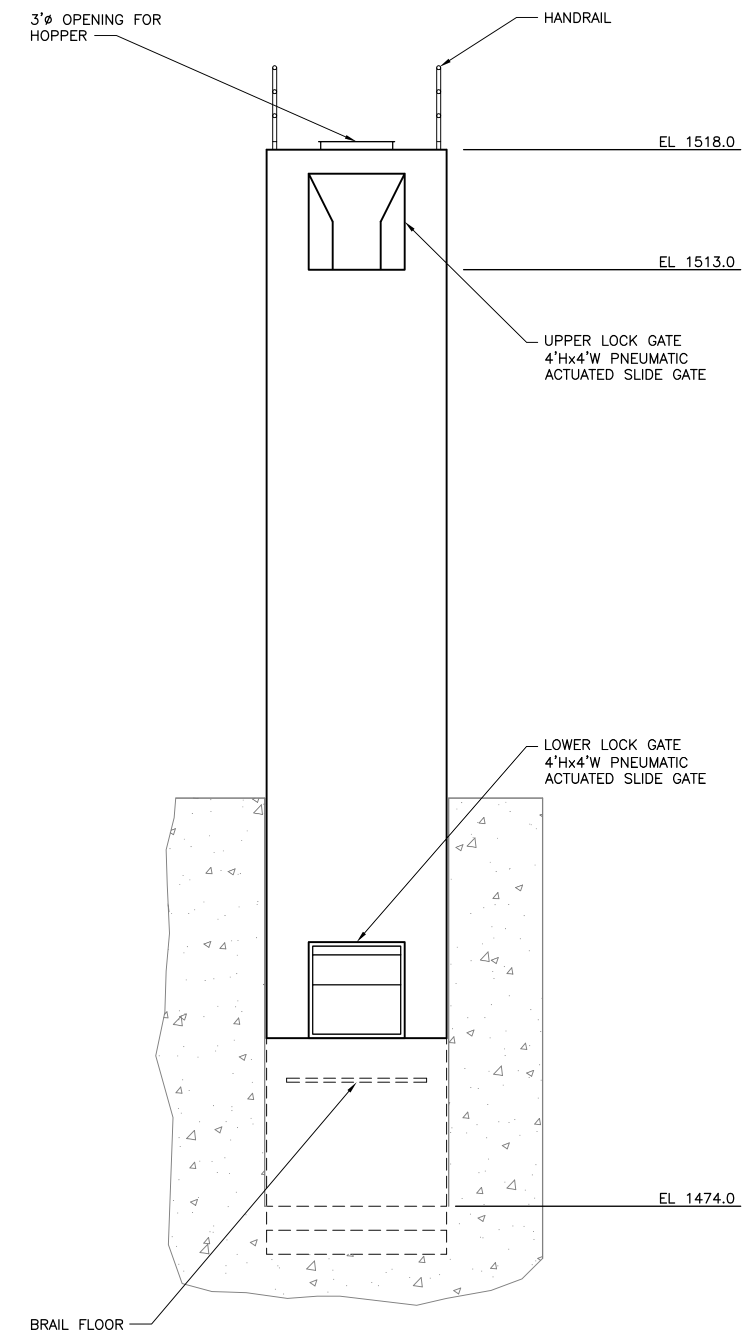

FISH LOCK PLAN @ EL 1486.0
1/4" = 1'-0"




FISH LOCK PLAN @ EL 1474.0
1/4" = 1'-0"




SECTION A
1/4" = 1'-0"




SECTION B
1/4" = 1'-0"

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|---|---|---|
| 0 | 11/10/04 | |
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| | |
|---|---|
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| MECH'L. ENGINEER | R. ELDRIDGE |
| DESIGNER | S. WHITE |
| PROJECT NUMBER | 15616 |

ME McMILLEN ELDRIDGE

IDAHO POWER
An IDACORP Company

**HELLS CANYON FISH TRAP**
**IDAHO POWER CO.**
**BOISE, IDAHO**

**FISH LOCK PLAN AND SECTIONS**

0 1" 2"

| | |
|---|---|
| FILENAME | 15616-7.dwg |
| SCALE | AS NOTED |

DRAWING
7

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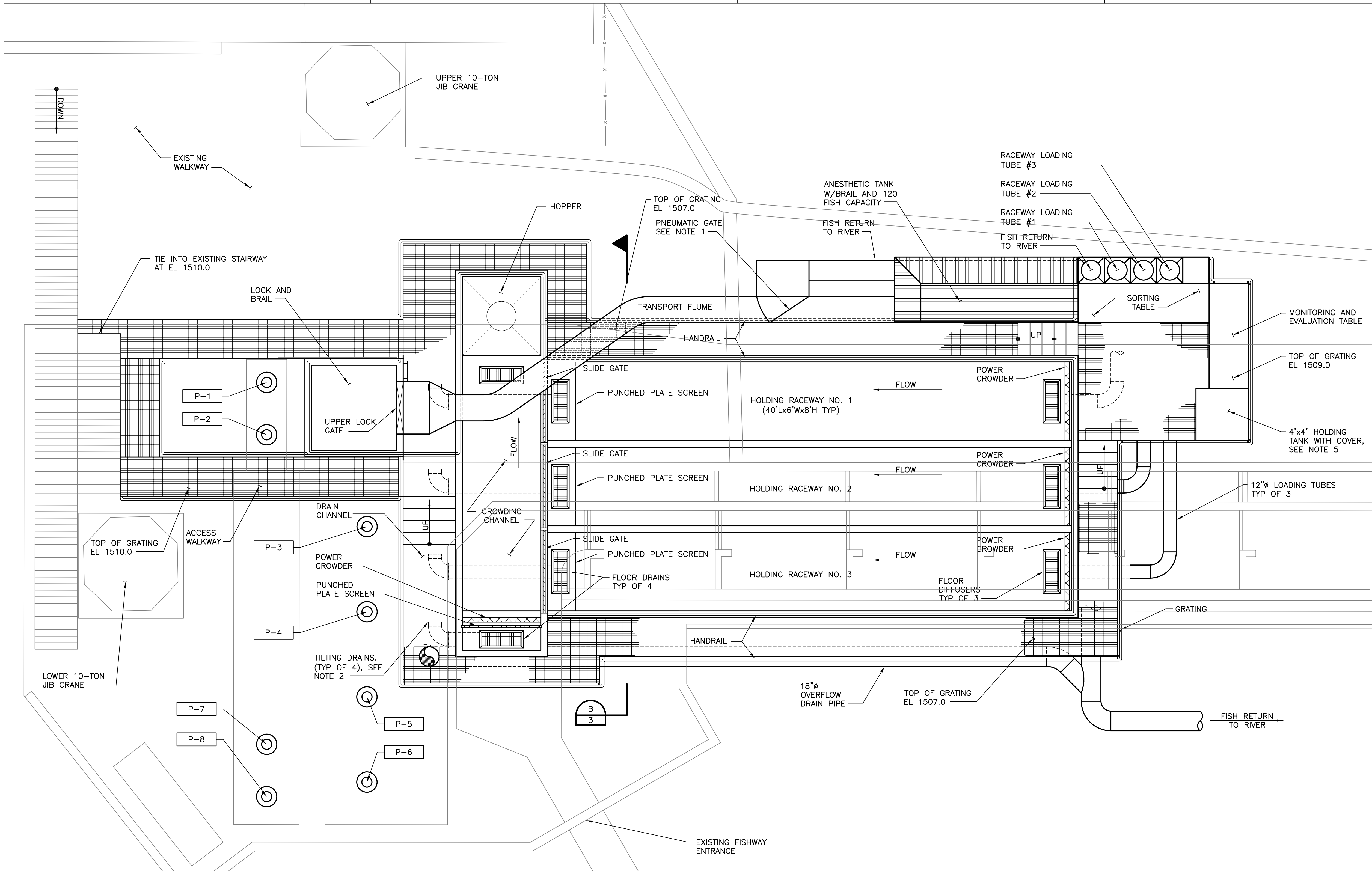


PLAN
1/4" = 1'-0"

NOTES:

1. DESIGN PNEUMATIC GATE TO ALLOW DIRECT ROUTING OF EXCESS STEELHEAD OR OTHER SPECIES TO RIVER IF HOLDING IS NOT REQUIRED.
2. INSTALL TILTING DRAINS ON EACH RACEWAY AND CROWDING CHANNEL TO ALLOW ADJUSTMENT OF WATER SURFACE ELEVATION IN EACH CHANNEL/RACEWAY INDEPENDENTLY.
3. SEE DRAWING 12 FOR WATER SUPPLY SCHEMATIC AND PUMP ARRANGEMENT.
4. SEE DRAWING 13 FOR FISH HANDLING FLOW SCHEMATIC.
5. PROVIDE A 4'x4' HOLDING TANK FOR SMALL NUMBERS OF BULL TROUT OR SHORT-TERM HOLDING OR MONITORING PURPOSES.
6. PROVIDE SORTING AREA WITH A ROOF TO PROTECT PERSONNEL FROM WEATHER. ROOF NOT SHOWN FOR CLARITY.
7. PROVIDE RECESSED GUIDES AT 3 LOCATIONS FOR SCREW PANELS IN EACH RACEWAY.

HDR Engineering, Inc.

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| PROJECT NUMBER | – |

McMILLEN ELDRIDGE

IDAHO POWER
An IDACORP Company

HELLS CANYON
FISH TRAP
IDAHO POWER CO.
BOISE, IDAHO

SORTING, HOLDING, AND TRANSPORT LEVEL PLAN

0 1" 2"

| | |
|---|---|
| FILENAME | 15616-8.dwg |
| SCALE | 1/4" = 1'-0" |

DRAWING
8

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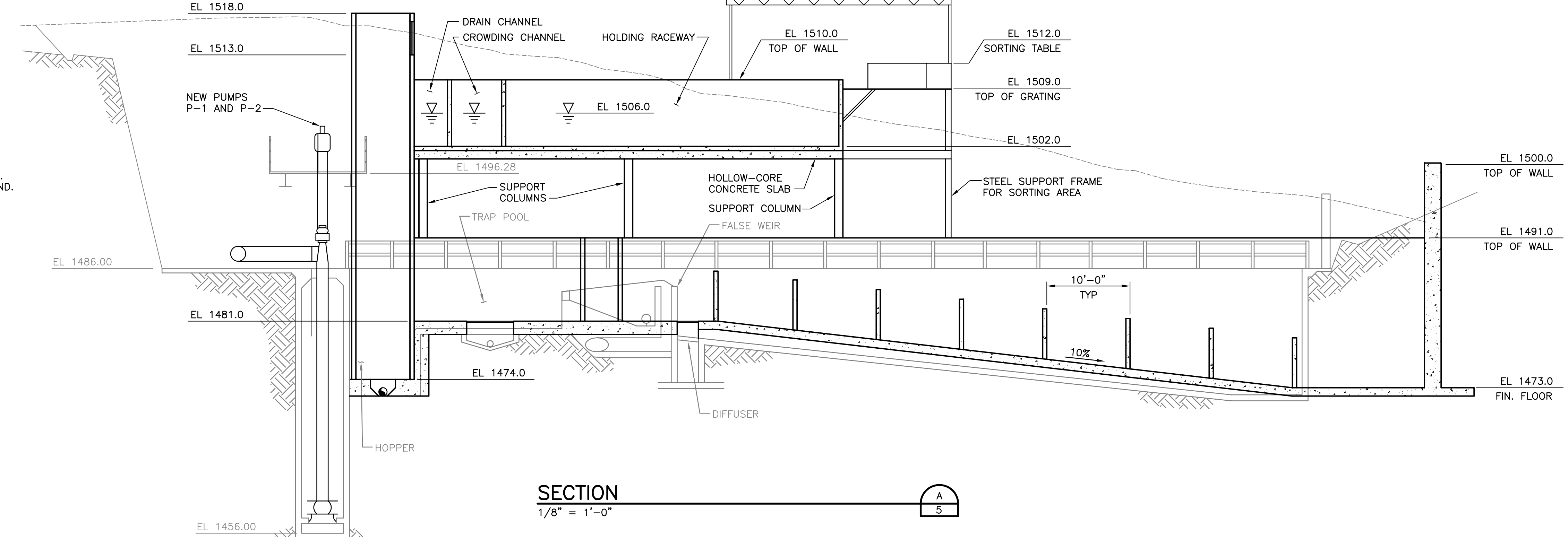
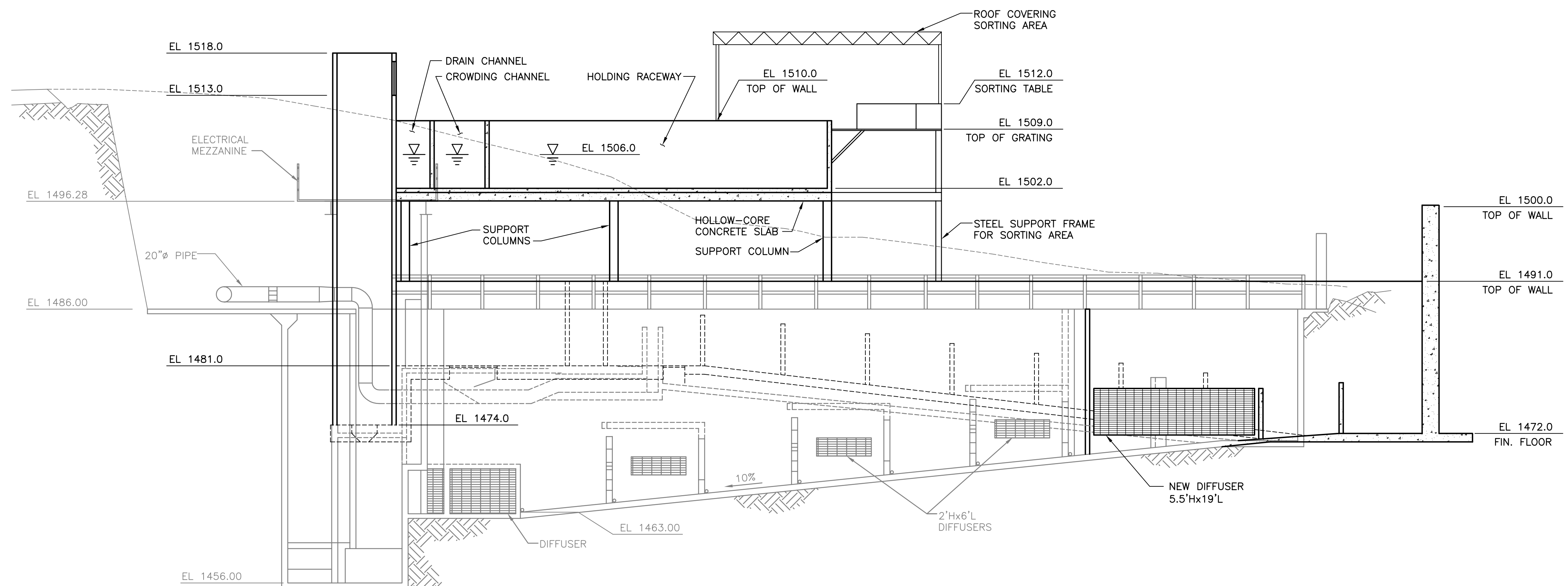
NOTE:

1. THE EXISTING FISH LADDER PROFILE AND EQUIPMENT LOCATIONS ARE SHOWN FOR COMPARISON PURPOSES. EXISTING FACILITIES ARE SHOWN IN GRAY BACKGROUND.




SECTION A/5
1/8" = 1'-0"




SECTION B/5
1/8" = 1'-0"

HDR
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| PROJECT NUMBER | – |

ME McMILLEN ELDRIDGE

IDAHO POWER
An IDACORP Company

HELLS CANYON FISH TRAP
IDAHO POWER CO.
BOISE, IDAHO

SECTIONS 1

0 1" 2"

| | |
|---|---|
| FILENAME | 15616-9.dwg |
| SCALE | 1/4" = 1'-0" |

DRAWING 9

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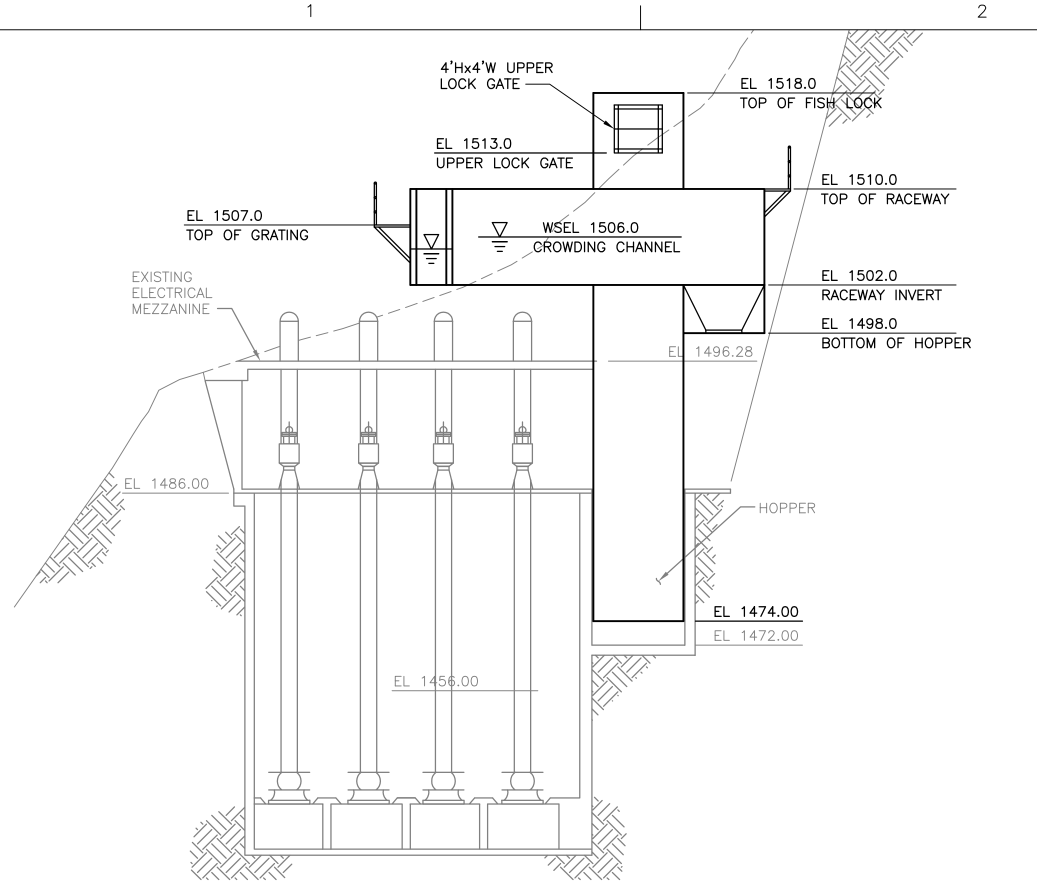
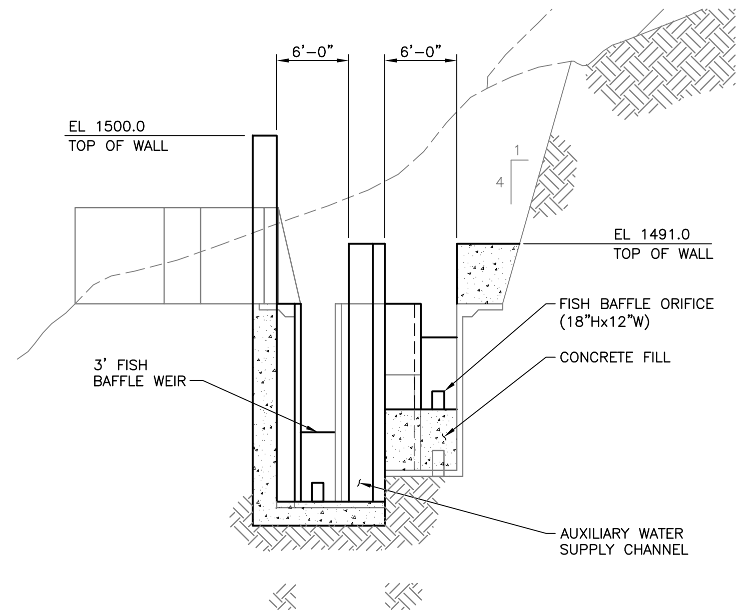
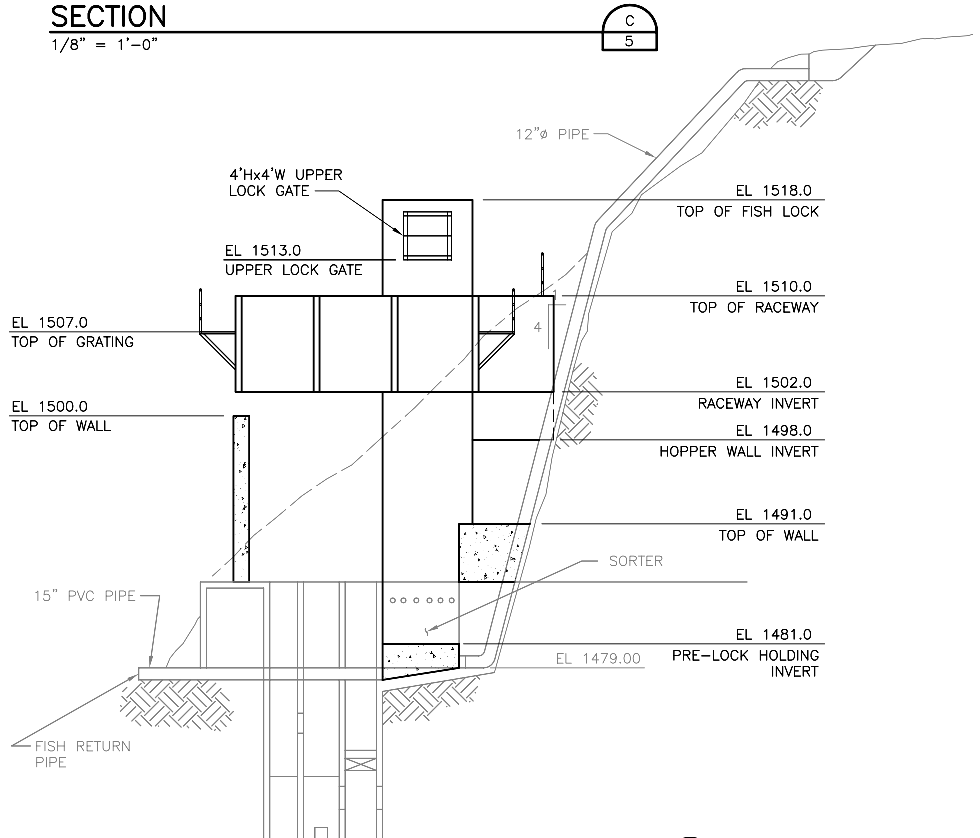


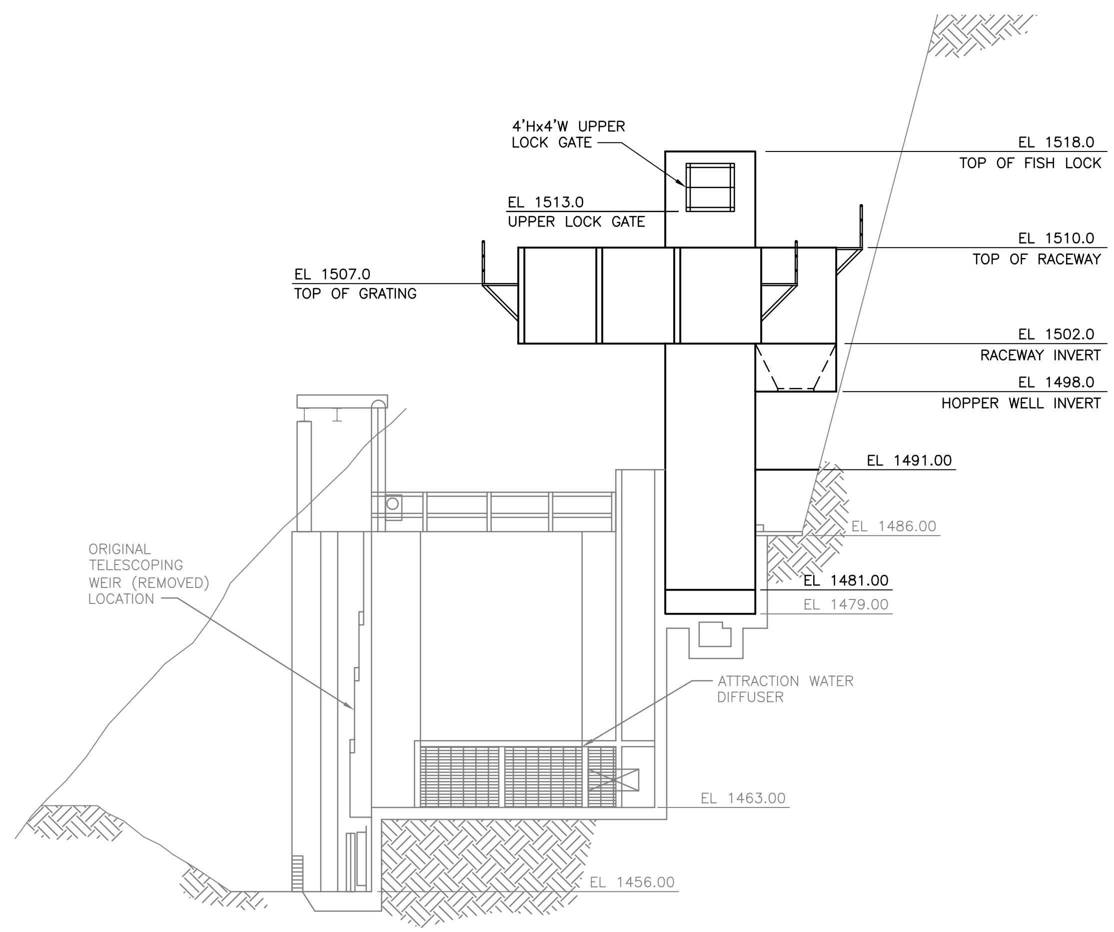

SECTION C/5
1/8" = 1'-0"




SECTION E/5
1/8" = 1'-0"




SECTION D/5
1/8" = 1'-0"




SECTION F/5
1/8" = 1'-0"

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| DESIGNER | S. WHITE |
| PROJECT NUMBER | – |

ME McMILLEN ELDRIDGE

IDAHO POWER An IDACORP Company

**HELLS CANYON FISH TRAP**
**IDAHO POWER CO.**
**BOISE, IDAHO**

**SECTIONS 2**

0 1" 2"

| | |
|---|---|
| FILENAME | 15616–10.dwg |
| SCALE | 1/4" = 1'–0" |

DRAWING 10

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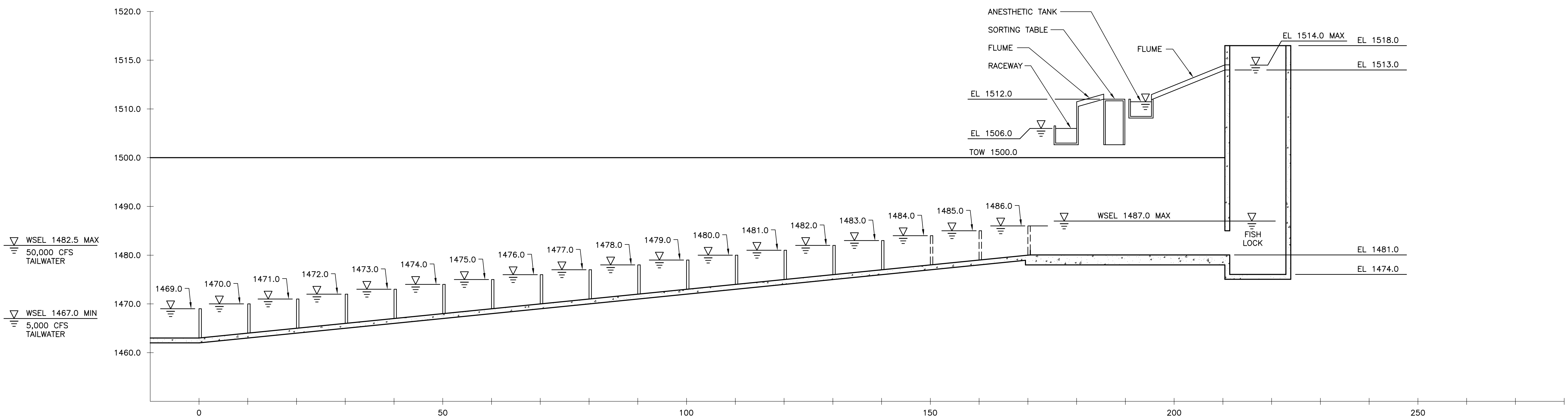


## HYDRAULIC PROFILE

3/32" = 1'-0"

| FISHWAY DESIGN CRITERIA | |
|---|---|
| CRITERIA | VALUE |
| DROP PER POOL | 1.0 ft. |
| ENERGY DISSIPATION | 4.0 ft-lb/sec-min/cf |
| ENTRANCE VELOCITY | 4.0 TO 8.0 fps |
| ORIFICE/SLOT VELOCITIES | 4.0 TO 8.0 fps |
| ORIFICE SIZE | 18 INCHES HIGH x 12 INCHES WIDE |
| FISHWAY SIZE | |
| LENGTH, MIN. | 10.0 ft. |
| WIDTH, MIN. | 6.0 ft. |
| WALL HEIGHT, MIN. | 8.0 ft. |
| AUXILIARY WATER SUPPLY | 50 TO 112 cfs |

| HYDRAULIC AND HYDROLOGIC CRITERIA | | |
|---|---|---|
| CRITERIA | VALUE | COMMENTS |
| MIN. HCTWEL | 1494 ft. | @ 103,000 cfs |
| MAX. HCTWEL | 1467 ft. | @ 5000 cfs |
| TRAP OPERATING RANGE | | |
| MIN. TWEL | 1467 ft. | @ 5000 cfs |
| MAX. TWEL | 1482.5 ft. | @ 50 kcfs |
| MAXIMUM FLOW | 103,000 cfs | OCCURRED 01/02/97 |
| 10% EXCEEDENCE* | 38,300 cfs | |
| 50% EXCEEDENCE* | 16,300 cfs | |
| 90% EXCEEDENCE* | 8,990 cfs | |

* EXCEEDENCE BASED ON HELLS CANYON GAGE NO. 13290450, PERIOD OF RECORD JULY 1965 TO PRESENT

HDR Engineering, Inc.

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McMILLEN ELDRIDGE

IDAHO POWER An IDACORP Company

**HELLS CANYON FISH TRAP IDAHO POWER CO. BOISE, IDAHO**

**HYDRAULIC PROFILE AND DESIGN CRITERIA**

0 1" 2"

| | |
|---|---|
| FILENAME | 15616-11 |
| SCALE | 3/32" = 1'-0" |

DRAWING 11

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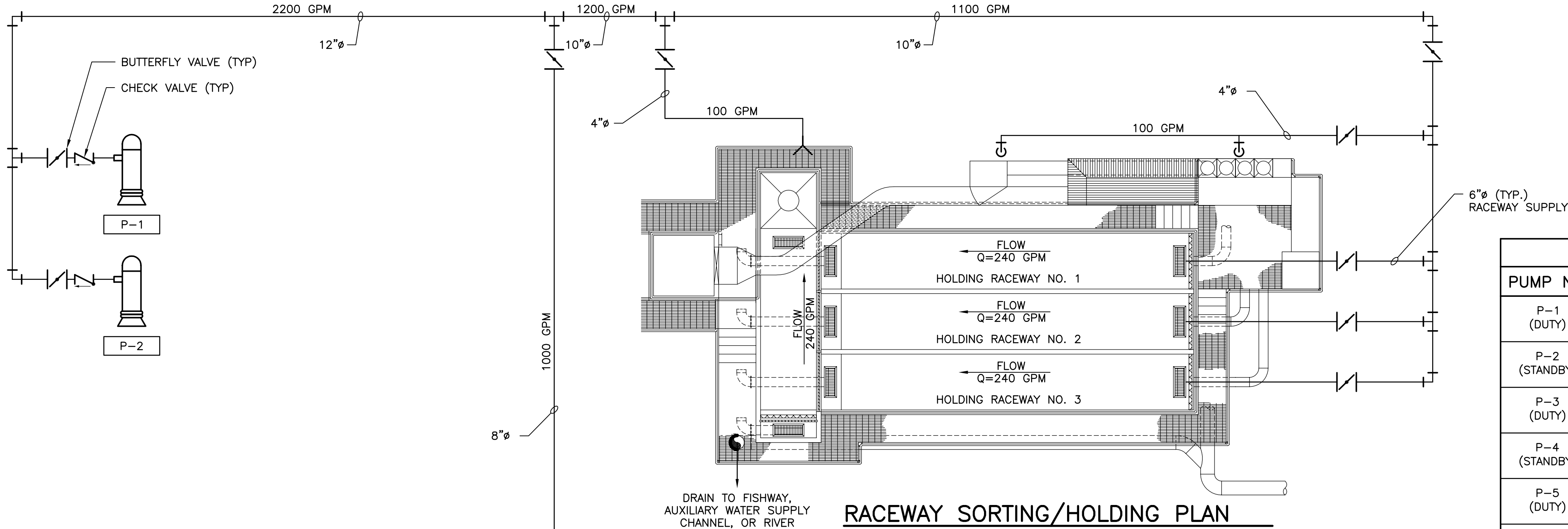
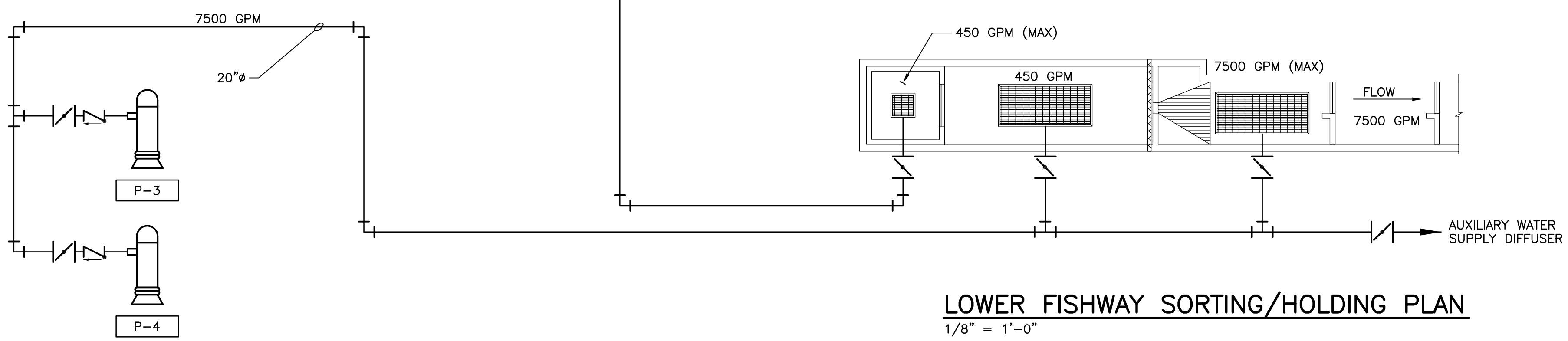



RACEWAY SORTING/HOLDING PLAN

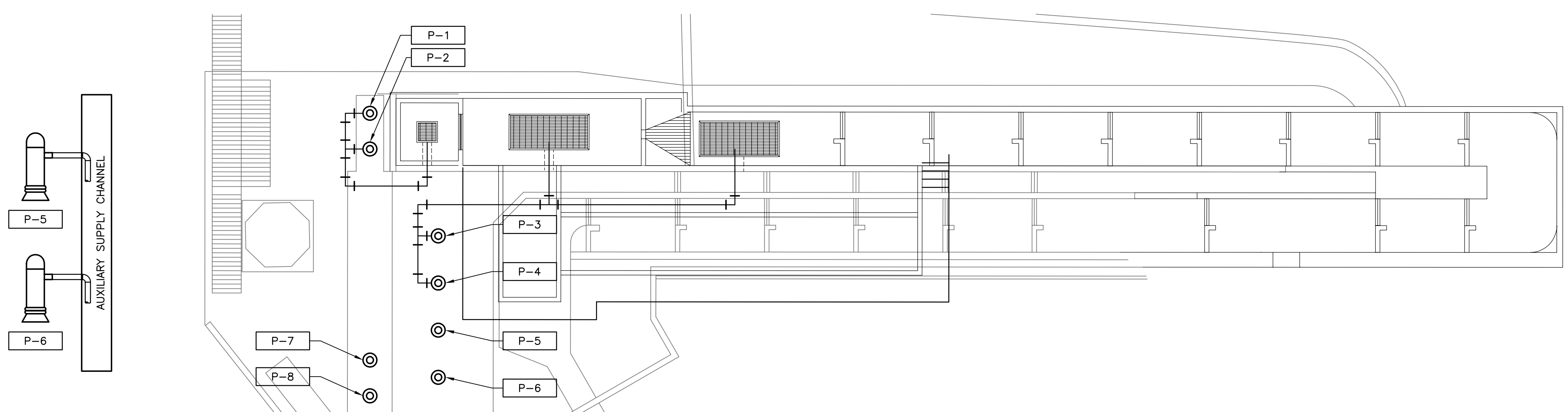
1/8" = 1'-0"

| WATER SUPPLY PUMP DATA | | | | |
|---|---|---|---|---|
| PUMP NO. | SUPPLY TO | MAXIUM FLOW (gpm) | MOTOR SIZE (hp) | PUMP TYPE |
| P-1 (DUTY) | FISH LOCK AND ELEVATED SORTING/HOLDING | 2,200 | 50 | VERTICAL TURBINE |
| P-2 (STANDBY) | FISH LOCK AND ELEVATED SORTING/HOLDING | 2,200 | 50 | VERTICAL TURBINE |
| P-3 (DUTY) | PRE-LOCK HOLDING AND FISHWAY | 7,500 | 50 | VERTICAL TURBINE |
| P-4 (STANDBY) | PRE-LOCK HOLDING AND FISHWAY | 7,500 | 50 | VERTICAL TURBINE |
| P-5 (DUTY) | AUXILIARY WATER SUPPLY CHANNEL | 25,000 | 30 | VERTICAL TURBINE |
| P-6 (STANDBY) | AUXILIARY WATER SUPPLY CHANNEL | 25,000 | 30 | VERTICAL TURBINE |
| P-7 (DUTY) | PUMP SEAL WATER | 10 | 5 | VERTICAL TURBINE |
| P-8 (DUTY) | UTILITY WATER | 50 | 2 | SUBMERSIBLE WELL PUMP |




LOWER FISHWAY SORTING/HOLDING PLAN

1/8" = 1'-0"




AUXILIARY PUMP STATION LOWER FISHWAY PLAN

1/8" = 1'-0"

HDR Engineering, Inc.

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| | |
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| MECH'L. ENGINEER | R. ELDRIDGE |
| DESIGNER | S. WHITE |
| PROJECT NUMBER | – |

McMILLEN ELDRIDGE

IDAHO POWER An IDACORP Company

HELLS CANYON FISH TRAP
IDAHO POWER CO.
BOISE, IDAHO

WATER SUPPLY FLOW SCHEMATIC

FILENAME 15616-2.dwg

SCALE 1/8" = 1'-0"

DRAWING 12

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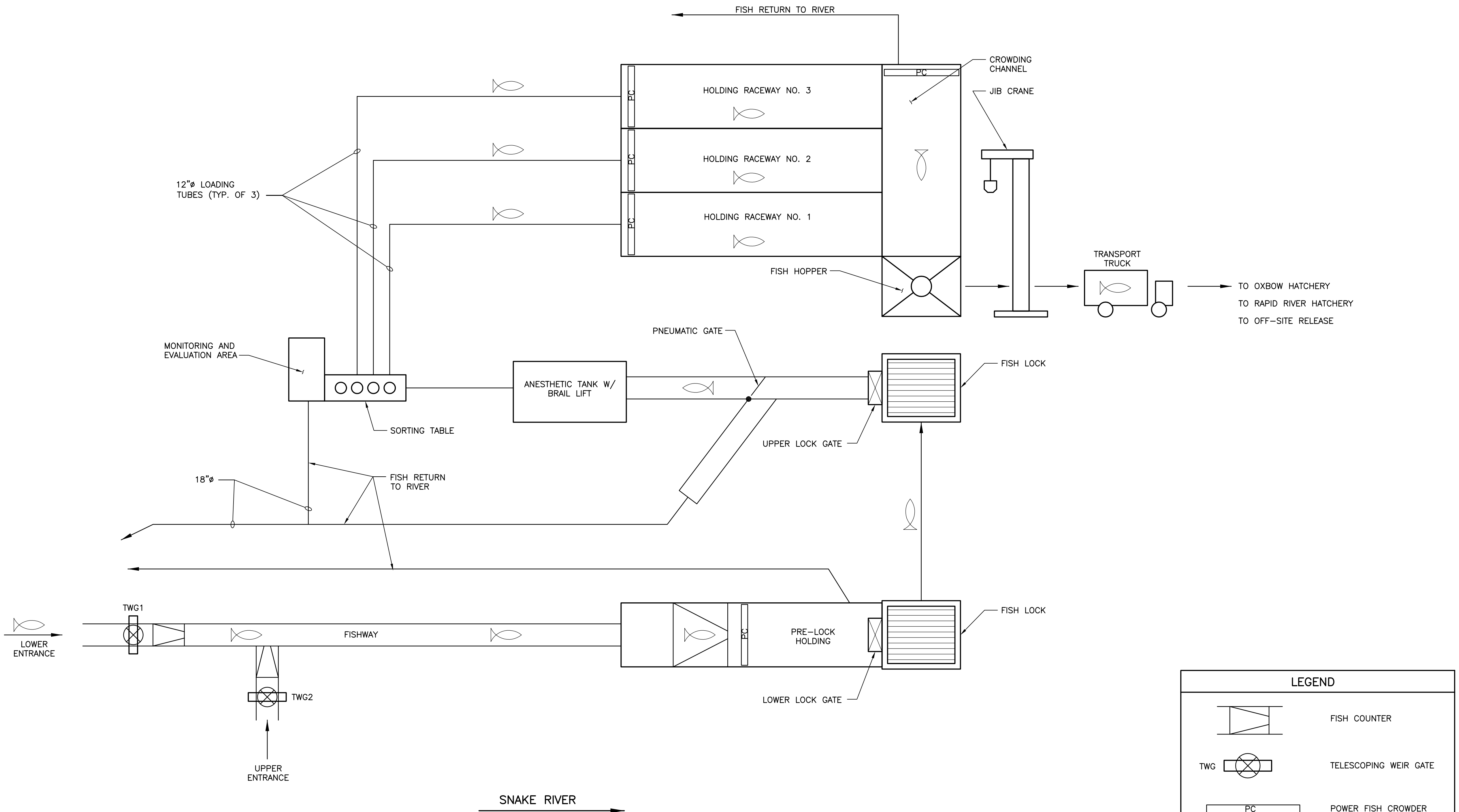


HDR

HDR Engineering, Inc.

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McMILLEN ELDRIDGE

IDAHO POWER
An IDACORP Company

**HELLS CANYON FISH TRAP**
**IDAHO POWER CO.**
**BOISE, IDAHO**

**FISH HANDLING FLOW SCHEMATIC**

0 1" 2"

| | |
|---|---|
| FILENAME | 15616-13.dwg |
| SCALE | NO SCALE |

DRAWING
**13**

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## Appendix A. Consultation Record

Three agency consultations meetings were conducted as part of this AIR. Agencies included in the consultation included the National Oceanic and Atmospheric Administration's National Marine Fisheries Service (NOAA Fisheries), U.S. Fish and Wildlife Service (USFWS), Idaho Department of Fish and Game (IDFG), and Oregon Department of Fish and Wildlife (ODFW). The purpose of the meetings were to present information on the current design, function and use of the existing trap facility, and to seek agency objectives and priorities for the future use of the trap facility to allow development of design alternatives and proceed with a preferred alternative to recommend for development of functional design. Meetings were held on July 8, August 11 and 12, and September 24, 2004. The meeting minutes are included as part of this consultation record. The final draft was sent to the consultation agencies on December 14, 2004 for a 30-day review and comment period. Comments were received from Idaho Department of Fish and Game on December 29, 2004 and the Oregon Department of Fish and Wildlife on January 14, 2005. A letter was received from NOAA Fisheries on September 1, 2004, prior to the decision of a preferred alternative. The above letters are included in this consultation record with IPC responses.

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**Meeting Minutes—July 8, 2004**

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|---|---|
| **Project Name:** | Idaho Power Company<br>HCC AIR – A1<br>Hells Canyon Fish Trap Modifications |
| **Subject:** | Agency Consultation Meeting<br>Final Meeting Minutes |
| **Prepared for:** | Aquatic Resources Group |
| **Prepared by:** | Mort McMillen |
| **Date Prepared:** | July 8, 2004 |
| **Meeting Date:** | July 7, 2004, 9:00 a.m.-12:00 p.m. |
| **Meeting Location:** | Idaho Power Company, West Auditorium |
| **Attendees:** | See attendance list. |
| **Meeting Materials:** | (1) Agenda<br>(2) Presentation Slides<br>(3) Existing Trap Operations Summary |

## 1.0 INTRODUCTION

Jim Chandler opened the meeting with a round table introduction of the meeting participants (see attached attendance list). Jim identified the roles of each of the Idaho Power staff which included: Jim Chandler – project manager; Ryan Adelman – engineering lead; Scott Larrondo – manager engineering power production; Paul Abbott – fisheries and production support; Stan Becktold – operations. Mort McMillen from McMillen Eldridge will provide engineering design support for developing trap modification alternatives.

Jim reviewed the language presented in AR-1, Hells Canyon Trap Modifications. The meeting is organized to discuss the Hells Canyon Trap modifications and solicit information from the meeting attendees on potential design and operational criteria which will be used to develop trap modification alternatives.

Jim Chandler reviewed the Native Salmonid Plan which was presented in the HCC Final License Application.

## 2.0 PROCESS AND SCHEDULE REVIEW

Jim Chandler reviewed the proposed process and timeline for the Hells Canyon Trap modifications project. The general timeline is as follows:

- Today – review the existing facility, establish future objectives of the trap facility
- August 11 – review the design alternatives
- September 22 – review design progress/initiate operations plan
- November 3 – present final design/operations plan/cost
- December 12 – Internal review
- February 4, 2005 – filing date

The group discussed the general review periods and agency coordination. Craig Jones confirmed that only the four agencies (IDFG, NOAA Fisheries, USFWS, and ODFW) listed by FERC will be receiving the design documents for formal review. The schedule is organized to provide formal review by the participating agencies to allow for the February 4, 2005 filing date.

## 3.0 REVIEW EXISTING FISH TRAP DESIGN – PRESENTATION BY IPC

Paul Abbott and Ryan Adelman presented a summary of the existing fish trap design and operation. The information presented is summarized in the attached slide show printout. A summary of the major discussion points is presented in the following paragraphs.

### History

- The existing trapping structure was put in operation in 1984 and was intended to replace the floating barge traps. IPC would like to retire the remaining floating trap structure when modifications to the trap facility are complete.

- Daylight only operation hours were implemented due to a combination of increasing adult returns and ESA listing of fall Chinook. The increased return numbers require oversight of the trap operation to ensure that overcrowding and stress do not occur. ESA listing of fall Chinook requires that trapped wild fall Chinook be removed and returned to the river immediately.

### Steelhead Trapping

- There is a well established steelhead sports fishery located downstream from Hells Canyon Dam. Paul Abbott indicated that there is a perception within the steelhead fisherman that when IPC runs their trap, the fishing success declines. In response, IPC operates their trap 4 days a week initially dropping to 3 days as the trapping season progresses. IPC also operates the trap during weekdays to support the sport fishery.

- Kent Hills indicated that they typically collect 75% of their broodstock during the fall portion of the run and the remaining 25% during the spring (latter part of March and April).

- During the early years of trap operation, the run size was small which necessitated running the trap longer hours to collect the required broodstock numbers. The run sizes have increased dramatically resulting in a sharp reduction in the operation days and hours to collect the required broodstock.

- Typically, the trap is put into operation when the river temperatures drop below 60 degrees Fahrenheit.

**Spring Chinook Trapping**

- Paul Abbott indicated that the trap operation for spring Chinook typically begins in May and is dependent on the Rapid River run size, fishery requirements, and the river water temperature. There are times when no spring Chinook are trapped at Hells Canyon for broodstock. This occurs when there are sufficient broodsotck available at the Rapid River collection facility. Some fish are transported for release into streams to support a sport fishery.

- Colleen Fagan asked when bull trout are typically captured in the trap facility. Jim Chandler indicated bull trout are seen in May in very small numbers.

**Current Catch**

- Operation of the trap is limited to no more than 4 trips per day from the trap to the Oxbow Hatchery, which corresponds to no more than 600 fish processed per day. Limited count data have not exceeded 600 fish per day, but actual numbers may now exceed this value in just a few hours of operation (steelhead numbers).

- Maximum hourly count data is very limited. Numbers from a 1985 count indicate a maximum catch per hour of 211 for steelhead. Maximum hourly count now would be expected to exceed this value.

**Non-target Fish Species**

- Very limited information is available on the number of fish entering the trap.

- Question was raised on the disposition of non-target fish. Kent indicated that they typically trap several hundred non-target fish with the majority of these fish being suckers.

- The disposition of non-target fish has been managed in part to prevent disease transfer to the upstream reservoirs.

- Brown trout have been captured (2 fish) in the trap.

- Typically, a lot of the smaller fish which would be non-target fish fall through the separator which has a bar spacing of 1-1/2 inch clear. Paul Abbott indicated that a 40 cm spring Chinook is about the smallest fish handled at the trap. The type of fish makes a difference as well since some species have a narrow girth which would allow passage through the separator versus a larger girth fish which would hang up on the separator (i.e. trout versus suckers).

**Steelhead and Chinook at Lower Granite Dam**

- The figure presented by Paul Abbott would suggest that steelhead may be reaching the trap early in the year since steelhead pass over Lower Granite Dam beginning in July. IPC does not start operation of the trap until October, so early returning fish would not be trapped or counted.

- Fall Chinook releases at Hells Canyon Dam did not begin until 4 years ago.

**Hells Canyon Fish Trap Overview**

- Ryan indicated that the existing telescopic weir has never operated correctly. Stoplogs are currently used to control the depth at the entrance to maintain adequate attraction velocities. Typically, 2 to 3 attraction water pumps are used.

- IPC currently attempts to count fish at the telescopic weir to control the number of fish entering the ladder. The main purpose of fish counting is to keep fish from overloading the fish ladder. A grate is placed at the entrance to stop fish from entering the ladder when excessive numbers are experienced.

- The fish return pipe exits below the fish separator and crosses the fish ladder to a discharge point downstream from the fish ladder entrance. An extension pipe is placed on the fish return discharge to extend the pipe to reach the river during lower tailwater conditions. Stan Becktold indicated that fish have been observed swimming up the fish return pipe during high tailwater conditions. The sorting area is also flooded during higher tailwater conditions from backflows through the fish return pipe. IPC currently has no way of shutting this pipe off to prevent backflow conditions.

- The fish separator currently has a 1-1/2 inch bar spacing which allows smaller jacks, steelhead, and bull trout to fall through. Paul Abbott indicated that break point size is approximately 42-56 cm. The current PVC pipe arrangement and bar spacing in the trap has been used for the past 10 years of operation.

- The current configuration of the trap has no way to selectively move fish into the hopper and transport trucks. All fish in the holding area are crowded into the hopper for transport. It is very important to maintain someone counting fish during operation to ensure the trap box is not overloaded which subsequently overloads the fish hopper and transport truck.

- Question was asked about what happens to the fish ladder and trap operation when the river tailwater rises 15 feet. Ryan indicated that the high tailwater will cause the water surface to increase in the fish ladder eventually flooding out the ladder and trapping facilities. Scott Larrondo indicated that the sorting and trap facility is inoperable on average 1 out of 3 years for one week to a month due to high flows.

**Operation Issues**

- The seawall keeps debris out of the fish ladder up to total river flows of approximately 70,000 cfs. With one spillway gate wide open, standing waves can reach the pump platform.

- Large flow events similar to the 1997 event have occurred twice since the project was placed in operation.

- Access to the trap and sorting facility is difficult. The existing walkway is the only access for people to operate and maintain the facility. The upper jib crane is used to move fish out of the facility as well as maintenance equipment in and out of the facility. The lower jib crane is used to lift the pumps out for maintenance. The access road to facility is narrow and provides very limited opportunity for improvements to the facility. Access to the powerhouse must also be maintained which limits the available space. The roadway also slopes away from the facility very quickly.

- Scott Larrondo indicated that an access road was once located on the downstream side of the trapping and sorting facility. This road was washed out during flood events and no signs of the road are now visible.

## 4.0 ANADROMOUS OBJECTIVES

Jim Chandler stated that the purpose of this portion of the meeting was to discuss the objectives for anadromous fish passage at the Hells Canyon Trap as envisioned by each of the participating agencies. Jim asked each of the agency representatives to outline their objectives which would then be used to formulate design criteria for potential trap modifications. A summary of this discussion is presented in the following paragraphs.

**Idaho Power Company**

- Paul Abbott and Jim Chandler indicated that IPC did not propose any changes in production in the new license. The total production numbers for steelhead and spring Chinook would remain the same. Broodstock collection would remain at the Hells Canyon Trap for steelhead and at the Rapid River and Hells Canyon Facility for spring Chinook.

- Paul Abbott indicated that IPC has received eyed eggs for up to 200,000 fall Chinook production at Oxbow Hatchery. Production in excess of 200,000 has been contracted to Umatilla Hatchery. All adult collection has occurred at Lyons Ferry Hatchery for the fall Chinook program. IPC has started releasing smolts at Hells Canyon Dam and have started seeing some adult returns.

**NOAA Fisheries**

- Herb Pollard indicated that NOAA Fisheries would like to see a local Hells Canyon fall Chinook broodstock developed. When the original settlement agreement was signed back in 1980, there was no clear definition of where the fall Chinook eggs would come from to support the multiple program commitments. As a result, there have been insufficient eggs available to meet all program requirements in the past. NOAA Fisheries would like to see the local stock developed for the following reasons:

  1) Provide a consistent source of fall Chinook eggs to support the IPC program.
  2) Allow development of a local based Hells Canyon stock to make use of the river reach from Lyons Ferry to Hells Canyon Dam.
  3) Develop a local stock which adapts to the specific flow and temperature regime of Hells Canyon.

- Herb indicated that NOAA Fisheries would like to see the trap modified to support trapping and holding of at least 856 fall Chinook brood stock to meet the egg take requirements for IPC's program. Both Herb and Tom Rogers agreed that at least 10% of the run should be composed of jacks. As a result, the trap modifications should support trapping jacks. This may be a design issue when trying to trap smaller jacks (less than 20 inches).

- Trapping for fall Chinook should provide for (1) broodstock collection, (2) jacks for broodstock, (3) small jacks for distribution, (4) jacks for return to river, and (5) wild fish return directly to the river.

- Paul Abbott asked the question on whether NOAA Fisheries saw an overlap with the Lyons Ferry stock and whether the agency saw the Hells Canyon stock as a distinctly separate stock. Herb responded that there would likely be an overlap early in the program, but eventually these stocks should be separated. Potential stocks would include (1) Lower Clearwater (Nez Perce Tribe), (2) Hells Canyon upstream from the Salmon River, (3) Snake River below the Salmon River, and (4) Lyons Ferry.

- John Johnson from NOAA Fisheries will be the engineer with whom the design aspects of the trap will be coordinated.

- The trap and sorting facility modifications will have to consider the challenges from sorting and holding steelhead and fall Chinook at the same time.

**IDFG**

Tom Rogers and Kent Hills from IDFG concurred with the NOAA Fisheries objectives and added the following specific comments:

1) Provide the ability to return the wild fish directly to the river efficiently and safely.
2) Provide the ability to sort at the dam, not at Oxbow Hatchery.
3) Provide the ability to sort and route steelhead back to the river.
4) Provide the ability to read PIT/coded wire tags.
5) Provide the ability to hold fish for multiple destinations including broodstock, subsistence fishing, out planting, etc., for all three species.
6) Provide ability to count fish at the trap, both numbers and species. Consider the video recognition software used at the mid-Columbia projects as a potential information source. The Canadian resistance board was specifically mentioned by the group as technology to follow up on.
7) Provide the ability to shut down the ladder to keep excess fish out of the ladder. The counting system has to provide for both enumeration and ladder operation.
8) Provide the ability to pass excess fish through the trap instead of shutting down operation. This flexibility is needed to support overall management goals.
9) The ability to differentially mark the fish will probably be required in the future to allow effective enumeration.

**ODFW**

Colleen Fagan concurred with NOAA Fisheries and IDFG and added the following specific comments:

1) Provide the ability to sort and hold for up to several days.
2) Provide the flexibility to separate stocks in the holding facility to support upstream passage objectives such as Pine Creek.
3) Provide the ability to acclimate within the holding ponds.

Colleen specifically requested that the trap design consider lamprey passage. There was not specific design guidelines presented by the group. Additional research will be required to address this issue.

**USFWS**

Jim Esch indicated that he concurs with the comments of the other participating agencies, but USFWS does not have management authority over these species.

## 5.0 RESIDENT FISH TRAP/PASSAGE OBJECTIVES

Jim Chandler asked the group to discuss their trap and passage goals as related to resident trout. Specific comments from the group are outlined in the following paragraphs. Resident fish species of interest may include:

- Bull trout
- Rainbow trout
- Mountain whitefish
- Largescale suckers
- Brown trout
- Bridgelip suckers
- Carp
- Northern pikeminnow
- Chiselmouth

**NOAA Fisheries**

Herb Pollard indicated that NOAA Fisheries has no management authority or interest for resident species.

**USWFS/IDFG/ODFW**

- Jim Esch indicated that other than the Bull Trout recovery plan, the USFWS has no other substantial comments. They may want to transport from Hells Canyon Dam to as far up the system as Wildhorse Creek. Jim Esch indicated that the USFWS may use a formal consultation process such as the BA and BO to outline their requirements.

- Jim Esch indicated that he would like to see the resident species provided with fish passage options. USFWS does not currently have an official position on fish passage for resident species. They may require that resident species captured in the trap be transported in the future. This would probably involve that all resident species be held and transported as a group.

- The USFWS would like to see expanded hours of operation (24 hours per day). IDFG through video monitoring at other locations have found most movement of resident species to occur from dusk to daylight. USFWS indicated that they could not nail down the migration periods or hours of operation for the trap at this point in the process.

- Paul Abbott asked Jim Esch to clarify how he envisioned working through the system design as part of the BA or BO process. The group responded that they did not see the specific hours of operation and details of annual operation being tied down. Rather, these criteria would be part of an annual operations plan developed jointly by the agencies and IPC to reflect the goals of the various programs. The goals would be expected to change based on environmental conditions and policy guidelines.

- The question was raised by the group on whether we could design a passive separation system to allow moving steelhead or Chinook back to the river while keeping resident trout. The answer was probably yes through a simple bar separation system.

- The group concurred that carp passage or trapping would not be required.

- Potential species which would be removed from the river via the trap would include brook trout, brown trout, and carp.

- Colleen Fagan indicated that ODFW would like to see the ability to trap down to the fluvial bull trout size. The actual size of fish will need to be confirmed.

- Colleen indicated that she would like to consider the capability of passing fish, specifically bull trout. This could be by truck transport. At this point, the capability to provide passage should be considered in the facility design.

## 6.0 NEXT MEETING DATE/OBJECTIVES

The next meeting was scheduled for August 11th. Jim Chandler will look into setting up a joint field trip to the Hells Canyon Trap and review meeting down at the Hells Canyon Complex. The purpose of the meeting will be to review the existing facilities then discuss potential alternatives for the trap modifications developed by Idaho Power and their consultant. The site visit will probably be a two day trip with the first day for the site visit and the second to discuss the design alternatives.

## 7.0 ADJOURN

The meeting was adjourned at 12:00 pm. Meeting minutes will be distributed by IPC.

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**Meeting Minutes—August 11 and 12, 2004**

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|---|---|
| **Project Name:** | Idaho Power Company<br>HCC AIR – A1<br>Hells Canyon Fish Trap Modifications |
| **Subject:** | Agency Consultation Meeting – Site Visit<br>Final Meeting Minutes |
| **Prepared for:** | Aquatic Resources Group |
| **Prepared by:** | Mort McMillen<br>Ray Eldridge |
| **Date Prepared:** | August 20, 2004 |
| **Meeting Date:** | August 11-12, 2004 |
| **Meeting Location:** | August 11, 2004 – Oxbow School<br>August 12, 2004 – Hells Canyon Trapping Facility |
| **Attendees:** | See attendance list. |
| **Meeting Materials:** | (1) Agenda<br>(2) Design Criteria Technical Memorandum, TM No. 1<br>(3) Alternatives Technical Memorandum, TM No. 2 |

## AUGUST 11TH MEETING SUMMARY

### 1.0 INTRODUCTION

Jim Chandler opened the meeting with a round table introduction of the meeting participants (see attached attendance list).

### 2.0 PROCESS AND SCHEDULE REVIEW

Jim Chandler reviewed the proposed process and timeline for the Hells Canyon Trap modifications project. The general timeline is as follows:

- August 11-12 – review the conceptual design alternatives and select one or two to advance for design development
- September 22 – review design progress/select one alternative to advance for functional design development/initiate operations plan

- November 3 – present final design/operations plan/cost
- December 12 – Internal review
- February 4, 2005 – filing date

## 3.0 REVIEW OF DESIGN CRITERIA AND ASSUMPTIONS

Mort McMillen reviewed the Design Criteria Technical Memorandum (TM No. 1). The criteria are draft in nature and will be developed in more depth as the design development advances. A copy of the TM was provided to the meeting participants at the meeting. In general, the design criteria as proposed and summarized in the draft TM were accepted by the meeting participants. Modifications to TM No. 1 were made to reflect the discussions at the meeting (see attached). Specific issues discussed during the meeting included:

a) A considerable discussion occurred related to how fish are held and how the trapping facility is operated to prevent overloading of the trap. The trapping facility design modifications are intended to provide as much flexibility as possible, but the ultimate operation of the trapping facility rests on management objectives and decisions. The overlap between steelhead and chinook passage complicates the handling and sorting operation. The ability to collect fall chinook broodstock while also returning steelhead to the river is required.

b) There is a high likelihood that nitrogen stripping from the water source prior to introduction into the holding raceways will be required. Paul Abbott suggested that we include strippers on the water supply. Stripping would also provide aeration increasing the oxygen levels in the water source.

c) The type and disposal method for the proposed anesthetic is a major concern in the trap design. Several methods were discussed including electro-shocking, carbon dioxide, MS222, and clove oil. The issues to consider include number of fish held in the anesthetic tank, tank volume, anesthetic dosage, disposal requirements, and location of the anesthetic tank. The EPA and state requirements for handling and discharge of each potential anesthetic method will have to be reviewed prior to selecting the preferred method.

d) It was pointed out that there are differences between the IPC and the IDFG transport trucks. The IPC trucks are designed to allow a water-to-water transfer between the hopper and the truck. The IDFG trucks are not designed to allow a water-to-water transfer. The difference in truck design and the number of truck cycles needs to be evaluated as part the trapping facility modifications. It was also noted that the tank volumes vary between IPC and IDFG trucks.

e) Both IPC and IDFG indicated that their trucks are insulated and the water temperature is monitored throughout the transport cycle.

f) For planning purposes, the 5000 gallon transport truck is designed to carry approximately 333 fish.

## 4.0 REVIEW SORTING OPTIONS

A summary of sorting options which was presented in TM No. 2, Alternative Development. The basic sorting options presented were:

- Automated sorting
- Visual sorting
- Hand sorting
- Size sorting

The group discussed the basic sorting options and their application to the Hells Canyon Trap. Tables 1 and 2 in TM No. 2 present a brief description of the available sorting methods and their application to the Hells Canyon Trap facility.

The Hells Canyon trapping facility will see a variety of species, sizes, and destination requirements. Since very few of the fish will be radio or PIT tagged, using an automated sorting system which recognizes tags or the absence (wild fish) will not be effective. The technology associated with video recognition systems has not advanced to the level to provide an effective identification tool. As a result, hand sorting will be required to allow identification and sorting by species.

Hand sorting will be used for the facility design. Provisions for adding an automated sorting facility in the future will be made. A fish counting system will be incorporated into the fishway entrance and/or at the sorting facility.

## 5.0 REVIEW DESIGN ALTERNATIVES

Mort McMillen reviewed the conceptual design alternatives. These alternatives are presented in TM No. 2. Four preliminary alternatives were considered for the Hells Canyon Trap Modifications:

- Alternative 1 – Existing Fishway with Trap, Sorting, and Holding
- Alternative 2 – Extend Fishway with Trap, Sorting, and Holding
- Alternative 3 – Existing Fishway with Narrow Raceways
- Alternative 4 – Downstream Trap, Sorting, and Holding

The first three alternatives are similar in that they involve additions in the immediate area of the existing fishway and trap. The fourth alternatives involves extending the fishway downstream and providing access to a new trapping, sorting, and holding facility. A complete description of each alternative is presented in TM No. 2 along with conceptual drawings of each layout. Specific points of discussion are presented in the following paragraphs.

a) The existing fishway and trapping facility layout and operation was presented. The major features were discussed including the entrance, fishway, auxiliary water supply, trapping/holding facility water supply, and the separator operation.

b) John Johnson asked if the design included provisions for screening the pump intake? John indicated that NOAA Fisheries criteria required screening of all intakes unless there are no species of concern found at the intake. John added that USFWS or IDFG may require screening for bull trout or resident fish. Additional evaluation of screening the existing pump station intake will be required as the conceptual design advances.

c) Alternative 1 consists of using the existing fishway and trap facility with new elevated sorting and holding facility located immediately above. A fish lock would be used to raise the fish from the existing fishway to the new sorting and holding facility. The fish lock would be located in the existing fish hopper well. The existing separator and holding area would be used to construct pre-lock holding area. Alternative 1 was designed to maximize the use of the existing facility and use a fish lock for transporting fish.

d) For all four alternatives, a counting system would be incorporated at the entrance to the fishway. The counting station would be used to count the number of fish entering the fishway. When a pre-determined number of fish had entered, the fishway entrance would be shut down to keep from overloading the fishway. This condition could occur frequently when large numbers of steelhead are present in the river.

e) The selection of the design flood event for the facility was discussed. Two design conditions have to be set for the final configuration: (1) maximum operating tailwater level and (2) flood protection level. The operating range was identified as between 30,000 and 45,000 cfs while the flood protection level should approach the 100-year flood event. The IPC operations staff indicated that the existing trap is operated up to approximately a flow range of 30,000 to 45,000 cfs. Above this flow range, the separator floods out and the trap is inoperable. The highest flow on record is 103,000 cfs which resulted in overtopping of the seawall and debris accumulation within the fish ladder. Additional evaluation will be completed as the conceptual design advances to optimize both of these design parameters.

f) IDFG indicated that they are concerned with constructing a longer ladder. The existing ladder passes fish very well and extending the ladder may create conditions where delay occurs or certain species may not pass the ladder at all. This is a major concern for the long ladder Alternatives such as Alternative 4.

g) The conceptual level cost estimates were summarized in Table 3 of TM No. 2. As outlined in Table 3, Alternative 4 has the highest estimated cost. This is due to construction of a new sorting/holding facility and a new fishway from the existing fishway to the new facility. Alternative 1 which consists of using the existing fishway with a new lock and elevated sorting/holding facility has the lowest estimated cost. These cost estimates were prepared based on the conceptual design drawings and are intended to provide an approximate comparison between the alternatives.

h) A list of advantages and disadvantages for each alternative was developed jointly by the meeting attendees and are summarized in the following table.

| Alt. No. | Advantages | Disadvantages |
|---|---|---|
| 1 | • Least impact from construction<br>• Existing ladder works well<br>• Lowest costs | • Limited to existing tailwater range<br>• More mechanically complex<br>• Holding/sorting facility extends over the river |
| 2 | • Allows operation over a higher tailwater range<br>• Allows use of a second entrance<br>• Same advantages as Alt. 1 | • Potential to destabilize existing slope from construction |
| 3 | • Does not extend as far over the river | |
| 4 | • Swim up passage to sorting facility<br>• Ground access if road is stable<br>• Easy to incorporate multiple entrances<br>• Maximizes bull trout handling | • Highest environmental impact<br>• Highest maintenance<br>• Difficult permitting<br>• Public safety<br>• Highest cost |
| 5 | • Swim up passage to sorting<br>• Maximizes bull trout handling<br>• Allows for a second entrance | |

As a result of the discussion of the advantages and disadvantages for each alternative, the group agreed that Alternative 3 and a new Alternative 5 should be advanced for additional evaluation. The reasons for removing Alternatives 1, 2 and 4 will be documented and provided to the group for review prior to the next coordination meeting. Additional details on the design, layout, and operation of Alternatives 3 and 5 will be developed and presented at the September 22 meeting. Alternative 3 consists of a new fish lock with an elevated sorting/holding facility. Under the Alternative 3 layout, 6 foot wide raceways will be evaluated to decrease the overall facility width. Alternative 5 consists of the same sorting/holding facility layout, but utilizes a new fishway to allow fish to swim into the new sorting/holding facility. The existing fishway will be extended downstream to provide sufficient length to gain the vertical rise necessary.

Each alternative would be reviewed briefly at the project site the following day. This will allow the group to physically locate the proposed alternative at the project site and visualize the physical limitations of the existing site, how the proposed layout fits onto the site, and the feasibility of each alternative. The objective of the site visit is to bring the attendees up to speed on the existing trapping facility operation, review the proposed alternatives, and confirm the decision to advance Alternatives 3 and 5 for additional evaluation.

## 6.0 NEXT MEETING DATE/OBJECTIVES

Jim Chandler reviewed the schedule for project development. The next scheduled meeting is September 22, 2004. The purpose of the September 22 meeting is to review the short list of alternatives advanced from the August 11-12 meetings. The two alternatives selected were Alternative 3 and Alternative 5.

## 7.0 ADJOURN

The meeting was adjourned at 5:30 pm. The group will assemble for travel to the Hells Canyon Trap facility on at 7 am on August 12th.

## AUGUST 12TH SITE VISIT SUMMARY

The August 12th, 2004 meeting was conducted at the Hells Canyon Trap Facility. The purpose of the site visit was to familiarize the meeting participants with the existing trapping facility and to review the conceptual design alternatives. A summary of the major discussion points is presented in the following paragraphs.

1) Stan Becktold walked the group through the physical characteristics and operation of the existing fishway and trapping facility. Stan pointed out that stoplogs are installed or removed from the fishway entrance as the tailwater conditions change to maintain a constant hydraulic drop across the entrance. Stan also explained how fish are counted as they enter the fishway and pointed out the bar rack which is installed in the fishway entrance to prevent the fishway from being overwhelmed. Stan walked through the operation of the fish separator, trapping facility including the fish crowder, and the hopper/truck loading.

2) The conceptual design alternatives were reviewed with the group. The footprint of the proposed facilities in relation to the existing fishway was identified. Specific observations and conclusions related to the alternatives development included the following paragraphs.

3) The site topography downstream from the existing trapping facility (on the right bank) is very steep and makes Alternative 4 very difficult if not impossible to construct. The new fishway associated with Alternative 4 would require deep excavation in bedrock to construct through an area which currently experiences landslides. Scott Larrondo and Stan Becktold pointed out where the unstable bank conditions have occurred in the past. Mort pointed out the location of the proposed trapping and holding facility on a small knob about 300 feet downstream. The actual site conditions are steeper and less accessible than illustrated on the available topographic maps. Construction of the proposed Alternative 4 facility would require extensive rock excavation similar to that found at the existing facility. Field observation of the proposed access road for Alternative 4 revealed that the access road would be very difficult and expensive to construct. A jib crane and truck transport facility similar to the existing trapping facility would most likely be required to transport fish due to the steep bank conditions and limited area. The environmental impact from construction of this facility would be significant. Based on the field observations and discussion, the group agreed that Alternative 4 did not appear to be a feasible approach and should be removed from additional evaluation.

4) Alternative 2 was reviewed which consisted of extending the fish ladder to allow operation through a higher tailwater range. This alternative called for excavating the existing rock face to add additional fish ladder length. Field observation of this exposed rock face revealed that further excavation could result in destabilizing the embankment and would impact the existing jib crane foundation.

Extending the fish ladder downstream would be required to gain length in the fish ladder. Excavating the existing rock face is not practical. For this reason, Alternative 2 was removed from further evaluation.

5) Using narrower raceways as proposed for Alternative 3 appears to be beneficial to the facility layout. The narrower width would allow the facility to be designed as a cantilevered section which would remove the requirement for river piers as outlined for Alternative 1. Additional review of the number of raceways required could also further reduce the width of the facility. Several meeting attendees indicated that 3 raceways may be sufficient for holding adults rather than the four raceways illustrated on the design alternatives. The number of raceways will be evaluated in more depth as the conceptual design is developed.

6) Incorporation of a gravity water supply was discussed in depth during the site tour. Scott Larrondo indicated that a study had been completed by IPC looking at installing a surface intake with a siphon to supply water to the trapping facility. This study did not recommend incorporating the gravity water supply because of the significant economic loss from lost power generation. There were also biological concerns that the higher water temperatures from a surface water intake would create a barrier to the fish ladder entrance since the river water temperature downstream from the powerhouse would be much cooler. Stan Becktold suggested tapping the penstock immediately upstream from the turbines. Stan led a tour of the powerhouse and pointed out the location for tapping the penstock to provide a gravity water supply. Additional evaluation of this option will be considered as the alternative development is advanced.

Based on the site visit and review of the conceptual design alternatives, the group agreed that Alternatives 3 and 5 should be advanced. These alternatives will be developed in more depth and presented at the September 22 review meeting. The reasons for removing Alternatives 1, 2 and 4 are as follows:

1) Alternative 1 would be removed since the facility layout creates footprint which is too wide to fit on the existing trapping facility site. River piers would be required to support the extension out into the river channel. Narrowing the raceways as proposed in Alternative 3 is a better arrangement and is preferred to Alternative 1. For this reason, Alternative 1 is removed from further evaluation.

2) Alternative 2 requires excavation into the steep rock slope which would be very expensive and could result in destabilizing the slope. This alternative was determined to be infeasible based on this condition.

3) Alternative 4 requires extensive clearing and rock excavation to construct a new fishway and sorting/holding facility. Access to the new facility would be difficult and require extensive disturbance to the existing riverbank to construct. Permitting of the proposed facility would be very difficult to complete because of

the extent of land disturbance adjacent to the river channel. The length of the fishway is also a concern for passage of resident species.

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**Meeting Minutes—September 24, 2004**

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| | |
|---|---|
| **Project Name:** | Idaho Power Company<br>HCC AIR – A1<br>Hells Canyon Fish Trap Modifications |
| **Subject:** | Agency Consultation Meeting<br>Final Meeting Minutes |
| **Prepared for:** | Aquatic Resources Group |
| **Prepared by:** | Mort McMillen<br>Ray Eldridge |
| **Date Prepared:** | September 24, 2004 |
| **Meeting Date:** | September 22, 2004 |
| **Meeting Location:** | IPC CHQ – CR 2 West |
| **Attendees:** | See attendance list. |
| **Meeting Materials:** | (1) Agenda<br>(2) Meeting Minutes, August 11-12 Meeting<br>(3) TM No. 3, Final Alternative Development with Figures 1 through 9<br>(4) TM No. 1, Design Criteria – Revision No. 2<br>(5) September 22 Meeting PowerPoint Slides<br>(6) Functional Design and Operations Plan Draft Outline<br>(7) Seasonal Trapping Plan Summary |

## 1.0 INTRODUCTION

Jim Chandler opened the meeting with a round table introduction of the meeting participants (see attached attendance list). Jim summarized the purpose of the meeting which was to review the alternatives selected for advancement at the August 11-12th meeting, Alternatives 3 and 5. From these two alternatives, a recommended alternative will be selected for development of function design drawings, operational plan, and cost estimates for submittal to FERC.

## 2.0 PROCESS AND SCHEDULE REVIEW

Jim Chandler reviewed the proposed process and timeline for the Hells Canyon Trap modifications project. The general timeline is as follows:

- August 11-12 – review the conceptual design alternatives and select one or two to advance for design development
- September 22 – review design progress/select one alternative to advance for functional design development/initiate operations plan
- November 3 – present final design/operations plan/cost
- December 12 – Internal review
- February 4, 2005 – filing date

## 3.0 REVIEW OF ALTERNATIVES CARRIED FORWARD FROM 8/11/04 MEETING

Mort McMillen walked through a PowerPoint presentation of the alternatives selection process. A copy of the PowerPoint slides is attached to the meeting minutes. A summary of the comments related to the design and operation of Alternatives 3 and 5 are presented in the following paragraphs.

1) Two alternatives were selected for advancement at the August 11-12 meeting. The first was Alternative 3 which consisted of a fish lock with modifications to the existing fish ladder to improve operation at higher tailwater conditions. The second was a new Alternative 5 which involved lengthening the existing fish ladder to allow migrating fish to swim into an elevated sorting and holding area. The basic difference between these two alternatives is the method in which fish are lifted to an elevated sorting/holding facility. Alternative 3 uses a fish lock while Alternative 5 uses a fish ladder.

2) The previous documents used in the development of these alternatives include the revised design criteria as outlined in TM No. 1, Revision 2; TM No. 2 which was presented at the August 11-12 meeting where the four conceptual design alternatives were summarized, and a new TM No. 3 which presented additional details for Alternatives 3 and 5. TM No. 3 with the attached nine figures will be discussed at today's meeting.

3) Figure 1 illustrates the existing fish ladder layout. The floor and weir crest elevations were added to allow comparison to the new facility layouts presented in Alternatives 3 and 5. Photographs of the existing fish trapping facility were presented and discussed.

4) Figure 2 illustrates the proposed new Alternative 3 layout. Alternative 3 consists of adding new pools on the north end of the existing fish ladder to allow the pre-lock holding facility to operate without submergence up to 50,000 cfs. A second

entrance was added with a new wall diffuser near the turning pool. The second entrance will be placed in operation when the river discharge exceeds 30,000 cfs which corresponds to the initiation of spill conditions. The fish ladder allows migrating adults to swim up to a pre-lock holding area. A photoelectric fish counter is located at the entrance to the holding area. A similar counting device was envisioned at the fishway entrances to allow tracking of the total number of fish within the fishway. A powered crowder is used to push adults in the pre-lock holding area into the lock. The fish lock door is then closed and a pump used to raise the water surface to approximately elevation 1511.0 where they will be metered out into a transport flume and sorting area.

5) Figures 3 and 4 illustrate the elevated sorting/holding area. Fish exit the lock via a flume and are routed to an anesthetic tank or routed back to the river with a pneumatic gate located upstream from the sorting facility. Fish are hand sorted and sent to holding raceways via transport flumes. Each holding raceway is fitted with a power crowder designed to crowd fish to the crowding channel where they will be loaded into the transport hopper.

6) Mort showed photographs of the tailwater conditions at a discharge of 67,000 cfs. The wave run-up and overtopping of the walls of the existing trapping structure were evident from the photographs. Mort pointed out that the conditions in the tailrace are very turbulent and the entrance(s) to the fishway would be very difficult to find by migrating fish under these conditions. Based on these observed conditions and a review of the duration curves, 50,000 cfs was selected as the operational upper limit design flow.

7) Figures 5, 6, and 7 illustrate the basic layout for Alternative 5. This alternative consists of a much longer fish ladder designed to allow fish to gain elevation by swimming up the fish ladder. The fish ladder leads to a pre-lift holding area with a power crowder. Fish are trapped in the holding area with a v-trap fitted with a photoelectric fish counter. All fish are lifted to an elevated flume and routed to the sorting/holding area. The operation is the same as for Alternative 3. The original concept for Alternative 5 was to allow fish to volitionally swim into the sorting/holding raceways. This system would only work if all fish were tagged or smaller fish were excluded. With the current trapping protocol requiring separation of hatchery versus wild fish, steelhead and salmon broodstock collection, and resident species handling, all fish will have to be hand sorted. This will require an aesthetic tank prior to the sorting area. A lift is required to move the fish with this arrangement. A pure volitional system is not feasible to meet the multiple objectives for fish handling and sorting.

8) Figures 8 and 9 illustrate the hydraulic profiles for Alternatives 3 and 5, respectively. As shown on these figures, the primary difference between the alternatives is the method for gaining vertical distance. As previously discussed, with Alternative 3, a fish lock is used. For Alternative 5, a fish ladder is used.

The group had brief discussion of the advantages and disadvantages for each alternative. In general, Alternative 3 has the least environmental impact since the ladder modifications are minimized and most of the facility is located at or above the existing fish ladder and trap. Alternative 5 has a significant environmental impact since the new fish ladder extends downstream requiring extensive excavation and disturbance to the river bank. From an operational standpoint, Alternative 3 has the least risk for rejection by resident species since the fish ladder length is nearly the same as the existing facility. The addition of a second entrance provides the same benefit to both alternatives.

Alternative 3 is the least cost alternative. The new fish ladder proposed with Alternative 5 is the major cost difference between the two alternatives.

## 4.0 DECISION OF FINAL ALTERNATIVE TO PRESENT TO FERC IN AR1

Following a break, Jim Chandler reviewed the two alternatives and polled the group as to their preferred alternative for advancement to functional design and submittal to FERC. In general, the group agreed that Alternative 3 was the recommended alternative. Specific comments related to selection of Alternative 3 included the following:

1) IDFG liked the layout of Alternative 3 in terms of operation and maintenance. The shorter fish ladder is preferred because it allows the fish ladder to be drained and fish salvage operations to be completed more efficiently and in a shorter period of time.

2) IDFG would like to see the ability to move fish back to the river from the pre-lock holding area added to the design. This could be accomplished by adding a pipe or a flume from the pre-lock holding area back to the river. This would allow fish to be crowded or return volitionally.

3) IDFG likes the second entrance, but do not trust fish counters based on their past experience.

4) NOAA Fisheries indicated that either option would work fine. More information on the lock design will be required to confirm the operation and maintenance associated with this design feature. Additional design details will be provided as the functional design advances.

5) USFWS has no real concerns with the design, but expressed concern about the handling protocol for bull trout once they are in the trap. Jim Chandler indicated that this is a management issue and not really a design issue. USFWS prefers a volitional swim in facility but understands the complexity associated with designing a facility which must operate for both small and large fish, multiple species, and hatchery and wild fish.

6) ODFW expressed concern with why we moved away from a volitional swim in facility originally intended for Alternative 5. The major question is why will a

volitional facility not work? Mort McMillen summarized that Alternative 5 as envisioned at the August 11-12 meeting was intended to be a volitional swim in facility, but when developing the design details for the facility, it became apparent that a volitional facility would not work because: (1) hand sorting is required to separate wild from hatchery fish as well as multiple species, (2) finger weirs which are normally used with swim in facilities may not pass lamprey and other resident species, and (3) without automated sorting, the fish will still have to be lifted onto a sorting table instead of allowing volitional swim in.

7) NOAA Fisheries asked if the fish would have trouble finding the second entrance. Adding a groin or a wing wall might improve the attraction conditions at the second entrance.

8) Jim Chandler handed out the September 1, 2004 letter from NOAA Fisheries Engineering with comments on the conceptual design alternatives for the Hells Canyon Trap. Jim reviewed the letter and noted that NOAA Fisheries supported the engineering work done to date and the approach to improving the trapping facility. Jim also indicated that addressing the transportation truck portion of NOAA's letter is part of this project including whether trucks would be replaced or modified.

9) IDFG indicated that one of their biggest operational problems is getting fish out of the ladder and back to the river when the trapping facility is shut down for the day.

## 5.0 PREPARATION OF OPERATIONS PLAN

Jim Chandler provided the meeting participants with a handout presenting a draft outline for the Functional Design and Operations Plan. Jim reviewed the outline with the group and summarized the intent for the plan development. The major discussion items are summarized below.

1) Will need backup pumps to ensure the facility will remain in operation in the event of an equipment failure.

2) May be better to hold at the trapping facility because of colder water temperatures at the trap versus at the Oxbow facility. This operation decision will require actual operation data from the new facility in order to optimize the facility operation.

3) Jim Chandler summarized the operation at 12 hours per day, seven days per week.

4) The ability to volitionally pass fish through the pre-lock holding pond was requested.

5) It was pointed out that when collecting broodstock, the required broodstock collection may be completed with 6 hours so operation of the trap would be unnecessary. The trap operation may still be required to collect other species, such as bull trout.

6) The question was raised on when bull trout are typically moving. Based on trapping experience from IDFG and the Bureau of Reclamation, bull trout are found to move during the night or early morning. The trap operation schedule will have to account for bull trout movement periods.

7) ODFW indicated that unless there was an ESA reason for trapping longer hours, they would support the proposed 12 hour operation schedule.

8) IDFG pointed out that the longer operation hours would result in increased recycling and handling of excess steelhead. The group acknowledged this point and agreed that the operations scenario would have to account for the steelhead recycling scenario.

9) Jim Chandler brought up the scenario of only operating the trap 5 days a week and not trapping during the weekend to maintain the steelhead sports fishery. The agencies indicated that this would probably be a good idea. For cost estimating purposes, 7 days per week was assumed to support preparation of the operations plan.

10) Scott Larrondo asked if the operations plans considered adverse conditions when operation would not occur. It was recognized that there would be conditions when the trap would not be operable. Adding a section to the operations plan which discussed safety and adverse conditions was suggested.

11) The question was raised on how many people would be required to run the facility. Jim indicated that he assumed one in putting the draft outline together. The staffing requirements will be reviewed in more depth as the plan is developed. The maintenance costs will be reviewed in more depth to firm up the actual numbers.

12) The issue was raised about how to address chemical handling, anesthetic, etc. The group agreed that chemical handling requirements should be included in the plan. The selected anesthetic is potentially s big issue. Clove oil and $CO_2$ are currently used of which clove oil is provides the best biological solution. $CO_2$ tends to make the fish thrash around more prior to knocking them out. $CO_2$ has the advantage of not being regulated by EPA or DEQ for discharge limits or fish holding requirements. Clove oil provides better conditions for the fish but requires EPA and DEQ approvals for discharge as well as a 21 day hold time for all fish which are anesthetized. Additional research and consideration of this issue will be required.

## 6.0 NEXT MEETING DATE/OBJECTIVES

Jim Chandler reviewed the schedule for project development. The next scheduled meeting is November 3, 2004. The purpose of the November 3 meeting is to review the draft operations and functional design report.

## 7.0 ADJOURN

The meeting adjourned at 11:45 am.

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**Agency Comment Letters and IPC Response**

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**NOAA Fisheries—September 1, 2004**

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UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
525 NE Oregon Street
PORTLAND, OREGON 97232-2737

F/NWR5

September 1, 2004

Jim Chandler
Fisheries Program Supervisor
Idaho Power Company
PO Box 70
Boise, ID 83707

RE: Hell's Canyon Trap Modifications

Dear Mr. Chandler:

These comments are made following an oral request from Mort McMillan of the engineering firm of McMillan Eldridge, retained by Idaho Power Company (IPC) to examine options to improve the existing Hell's Canyon trap. On August 11 and 12, 2004, McMillan Eldridge and IPC hosted stakeholders at a meeting at Hells Canyon Dam (HC Dam) to discuss these options, and to receive agency feedback.

In preparing these comments, the National Marine Fisheries Service (NOAA Fisheries) considers potential future uses that an adult trap at the base of HC Dam might serve. One use that comes to mind would be transporting Endangered Species Act (ESA)-listed adult fish upstream of HC Dam in an effort to reestablish fish access to historical fish habitat. Due to lack of information, we have not yet come to any conclusion with respect to the feasibility of, nor the timelines associated with, any future reintroduction efforts. We take this opportunity to again inform IPC of this possibility and reiterate that we do not want to foreclose future options by being short-sighted in current trap design considerations.

A factor that complicates design is not knowing whether this trap will be used only to meet artificial production goals, or will be part of a larger purpose such as being an essential component in a reintroduction effort, or for other, as yet undefined needs which might require the handling and transportation of large numbers of adults (e.g., to support large-scale sport fishing in upstream locations). As an example, a trap operated solely to meet artificial propagation goals can be built to lesser standards than one that ESA-listed upstream migrants depend upon to complete migrations essential to their life cycle. Should it be determined that ESA-listed adult fish need to migrate upstream past the dam, then different, more comprehensive trapping operations encompassing the entire migration period of the various fishes, rather than being only operated sporadically to meet hatchery needs, would likely be the focus of our collective deliberations. IPC should weigh the risk of building a trap for the limited purpose of meeting only today's hatchery goals versus the likelihood that a trap designed only for hatchery purposes will have major inadequacies if reintroduction or other management is undertaken.

Some areas of potential deficiencies (if used for more than hatchery goals) include, but are not necessarily limited to:

1. Ladder Hydrology: If fish are reintroduced upstream, then we would expect the ladder to operate over the entire migration period for the collective group of fishes that need to pass. 50,000 cfs was mentioned as the upper limit of consideration for this current project. We have not yet determined how that aligns with our usual standards of passage throughout the 5-95% exceedance range that is typically our goal if listed fish were to be passed upstream.

2. Ladder Flows: Normally, ~200 cfs of attraction flow when the river is running 50,000 cfs would not be considered sufficiently attractive, though we would not object to it if artificial production was the only goal. We would not accept this slight amount of attraction flow if there were upstream bound ESA-listed fish. If later testing, however, proved that fish were not unduly delayed at high flows, or if the duration of the fish passage impairment caused by high flows was not a material problem, we could potentially accept lower attraction flows.

3. Tagging: If fish are reintroduced upstream, we will likely expect tagging to be greatly enhanced so that hatchery fish can be differentiated from naturally reproducing fish or study fish can be separated from the run at large, enabling automatic fish routing technology to be employed at the trap.

4. Transport Vehicles: We consider the trap to be a component of a trapping and transport system. Newer or more appropriate trucks will need to be considered in conjunction with trap upgrades.

5. Juveniles: Because no anadromous fish are currently present upstream of HC Dam, we do not feel that the intake pumps for the trap need to be screened at this time. However, should juvenile anadromous fish be reestablished upstream in the future, we would likely require these pumps be screened or that IPC complete a study to determine entrainment, so that NOAA Fisheries can assess whether or not these pumps require screening.

Regarding the proposals presented at our meetings on August 11 and 12, we understand that these were based entirely on supporting current artificial production obligations under the current license. With the caveats noted above, we have no objection to any of the concepts proposed by McMillan Eldridge.

Sincerely,

Ritchie J. Graves

for

Keith Kirkendall, Chief
FERC & Water Diversions Branch
Hydropower Division

cc: Mort McMillan, McMillan Eldridge

**IPC response to NOAA Fisheries letter**

IPC extends its sincere appreciation to NOAA Fisheries for its valued participation and input concerning AIR-AR1 Hells Canyon Fish Trap Modification. We acknowledge the comments of NOAA Fisheries regarding their uncertainty on the potential use of this facility and applicability of the evaluated alternatives should reintroduction of anadromous fish upstream of the Hells Canyon Complex be pursued. However, reintroduction of anadromous fish was not proposed as part of the Hells Canyon Final License Application. Relative to the language of the AIR regarding the modification of the trap as proposed in the Application, the functional design of the facility was relative to the goals of the hatchery programs, and providing passage of resident fish as determined by management agencies. IPC notes that NOAA Fisheries has no objections to any of the alternatives evaluated under this AIR under those stated goals.

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**Idaho Department of Fish and Game—December 29, 2004**

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**IDAHO FISH & GAME**
600 South Walnut
P.O. Box 25
Boise, Idaho 83707-0025

**Dirk Kempthorne** / Governor
**Steven M. Huffaker** / Director

December 29, 2004

Jim Chandler
Idaho Power Company
P.O. Box 70
Boise, Idaho 83703

Re: Hells Canyon Additional Information Request AR-1
Hells Canyon Fish Trap, FERC Project No. 1971

Dear Mr. Chandler:

The Idaho Department of Fish and Game (IDFG) have reviewed Additional Information Request AR-1, Hells Canyon Fish Trap, and we offer the following brief comments for your consideration in preparation of the final response to the Federal Energy Regulatory Commission. We appreciate being involved in the consultation meetings that occurred regarding this document.

The IDFG believes the appropriate changes have been made to the proposal and incorporated into the design for the Hells Canyon fish trap. We concur with Alternative 3 as the best opportunity to make a successful and efficient trapping, holding, and sorting facility at this site. There are a number of physical obstacles that prevent some of the more desirable fish handling methods from being incorporated, so Alternative 3 continues to be the most logical solution.

High water events will still impact trapping success, but that is probably unavoidable under any circumstances. The fish ladder works well in its current configuration and we don't advocate changing its design substantially. There are still some issues that need to be discussed regarding fish counting equipment, hours of operation, personnel needs at the facility, and transportation requirements for fish; however, these should not slow down the next design phase.

Anesthetic methods are still uncertain, but can be incorporated into the design regardless of the procedure. Thank you for the opportunity to comment. Questions should be referred to Tom Rogers, Anadromous Hatchery Manager, at 287-2776.

Sincerely,

Tracey Trent

Tracey Trent, Chief
Natural Resources Policy Bureau

TT:TR:sag

Cc: IDFG Fisheries Bureau (Rogers, Sharon Kiefer)
Ralph Steiner (Rapid River Hatchery)
Kent Hills (Oxbow Hatchery)
John Johnson (NOAA Fisheries)
Colleen Fagan (ODFW-LaGrande)
Jim Esch (USFWS)

**IPC response to Idaho Department of Fish and Game letter**

IPC extends its sincere appreciation to the Idaho Department of Fish and Game (IDFG) for its valued participation and input concerning AIR-AR1 Hells Canyon Fish Trap Modification. IPC concurs that there are still some final details regarding design and operation of the facility that will need to be considered further. IPC considers these minor relative to the overall functional design and agrees that there will be opportunity to address these issues at the final design phase. IPC notes the acceptance by IDFG of the Alternative 3, as the preferred alternative that would be carried forward to final design.

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**Oregon Department of Fish and Wildlife—January 14, 2005**

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January 14, 2005

Jim Chandler
Idaho Power Company
P.O. Box 70
Boise, ID 83707

Re: Hells Canyon Complex, FERC Project No. 1971
Additional Information Request AR-1, Hells Canyon Fish Trap Modifications

Dear Mr. Chandler:

Within Additional Information Request AR-1, the Federal Energy Regulatory Commission (FERC) directs Idaho Power Company (IPC) to consult with the Oregon Department of Fish and Wildlife (ODFW) and other agencies on Hells Canyon trap modifications. ODFW would like to commend IPC on its extensive consultation process that resulted in a collaborative approach to identifying trap criteria and design alternatives. Because of the process IPC developed for consulting on its response to AIR AR-1, consulted agencies and IPC were able to develop and agree on a preferred design for modifications to the Hells Canyon fish trap. ODFW would like to offer the following comments for your consideration in developing the final report for FERC.

ODFW has authority pursuant to Section 10(j) of the Federal Power Act and the Fish and Wildlife Coordination Act (16 U.S.C. 661 et seq.) to provide recommended terms and conditions to FERC regarding protection, mitigation, and enhancement of fish and wildlife and their habitat affected by operation and management of the Hells Canyon Complex Hydroelectric Project (HCC). In addition, ODFW's goals, objectives, and management authorities for the fish and wildlife populations affected by the Project are found in Oregon Revised Statutes (ORS), Oregon Administrative Rules (OAR) and associated management plans.

Oregon's fish passage law (ORS 509.580-509.645) establishes a state policy that upstream and downstream passage is required at all artificial obstructions in those Oregon waters in which migratory native fish are currently or have historically been present. At existing hydroelectric projects, relicensing by FERC and reauthorization of a hydroelectric license or water right by Oregon's Water Resources Department are the "triggers" that initiate consideration of fish passage. Native migratory fish are present within Hells Canyon and the HCC project area, requiring IPC's compliance with Oregon's fish passage law.

IPC has proposed modification of the Hells Canyon trap to collect and haul resident salmonids upstream as part of its Native Salmonid Plan. On July 04, 2004 IPC held its first consultation meeting on trap modifications to solicit information from attendees on potential design and operational criteria which will be used to develop trap modification alternatives. ODFW provided its objectives and design criteria for passage at Hells Canyon Dam, including:

1. Compliance with Oregon's Fish Passage Law (ORS 509.580-509.645)
2. Capability to operate 365 days per year, 24 hours per day
3. Ability to handle multiple species, sizes, and life stages
4. Capability for smolt acclimation for release at dam with focus on spring chinook salmon
5. Adult holding and sorting for transport to hatchery, transport for fisheries, and immediate return to river
6. Broodstock collection to maintain run timing
7. Fall chinook broodstock collection for a program at Oxbow Hatchery
8. Separate holding containers for adult fish stocks, i.e. Pine Creek if passage program implemented
9. Passive grading system
10. Ability to trap juvenile fluvial fish (200-250 mm)
11. Pacific lamprey passage
12. Tag detection and sampling

Finalized passage plans and installed structures at the Hells Canyon trap will need to comply with ODFW fish passage criteria (enclosed). Furthermore, approval of IPC's final design plans will be needed from ODFW's Fish Passage Coordinator.

Following additional meetings ODFW agreed with IPC and other consulted agencies that Alternative 3 Revised is the best alternative for modifications to the Hells Canyon fish trap facility. This design generally meets ODFW's objectives and criteria for trapping and passage at Hells Canyon Dam. Although ODFW agrees with selection of this preferred alternative, clarification is needed on some design criteria:

1. IPC includes water quality criteria in Table 2-2. Please provide clarification on how these numbers were developed and whether they comply with state water quality standards.

2. Table 2-4 contains fish ladder design criteria for the Hells Canyon fish trap. ODFW's fish passage criteria identify a maximum jump height of 6" for trout, juvenile steelhead and salmon. ODFW has indicated design criteria need to provide for passage of redband trout and fluvial juvenile bull trout. Please provide information on passage success for fluvial juveniles with a 12" jump height.

3. Within Table 2-10, monitoring and evaluation criteria for the Hells Canyon fish trap, IPC indicates that an evaluation work area may be provided for fish health

monitoring. ODFW understood that a fish health evaluation area would be provided on site. Please provide an explanation for possibly not providing this work area.

4. The preferred alternative design provides for the future incorporation of a bar separator to be installed upstream of the pneumatic gate to allow passive sorting of fish by size. ODFW criteria for the trap continue to include the ability to trap redband trout and fluvial juveniles down to a size of approximately 250 mm. What is IPC's projected timeframe for installing a bar separator?

Lastly, within the draft report IPC includes an operations plan. ODFW anticipates meeting with IDFG, NOAA, USFWS, and IPC to develop an operations plan for the Hells Canyon trap. The developed plan will include trapping dates and duration, target species and numbers, and fish handling, sampling, and operational protocols. ODFW also anticipates working with these same agencies and IPC to develop a seasonal trapping plan.

Thank you for the opportunities provided to develop a consensus alternative for Hells Canyon fish trap modifications. ODFW is looking forward to working further with IPC to finalize the engineering and operations plans for the trap. If you have any questions or need additional information please call me at (541) 963-2138.

Sincerely,

Colleen Fagan
Hydropower Coordinator
NE Region ODFW

Cc: Craig Ely, ODFW
Ken Homolka, ODFW
Alan Mitchnick, FERC
Scott Grunder, IDFG
Jim Esch, USFWS
Ritchie Graves, NOAA

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**IPC response to Oregon Department of Fish and Wildlife letter**

IPC extends its sincere appreciation to the Oregon Department of Fish and Wildlife (ODFW) for its valued participation and input concerning AIR-AR1 Hells Canyon Fish Trap Modification. IPC acknowledges the management authorities of ODFW as defined in the Federal Power Act and the Fish and Wildlife Coordination Act, and in the Oregon Revised Statutes and Oregon Administrative Rules and their management plans. However, relative to Oregon's fish passage law (ORS 509.580-509.645), it is the opinion of IPC that in the Federal Power Act, Congress has preempted this statute as it purports to apply to federally licensed hydropower projects.

As you acknowledge in your letter, IPC made extensive efforts to collaborate on the objectives and design criteria among the four agencies involved in this consultation. IPC believes that through this process, the preferred alternative (Alternative 3 - Revised) meets most objectives and criteria as presented among the agencies and further notes that ODFW agrees that the Revised Alternative 3 provides the best alternative for modifications to the Hells Canyon Fish Trap facility.

As to specific clarifications requested in the comment letter, IPC offers the following responses.

1.) **Water quality criteria in Table 2-2.** With the exception of total dissolved gas, which is consistent with Oregon state standards, the criteria listed in the table do not comply with Oregon State water quality standards. These values in the table are recommendations based on general aquaculture practices. However, the water supply for the facility is to be pumped from the river as it is under the existing design. During the proposed periods of operation, it is unlikely that temperatures will approach the 70 F (21.1 C) listed in Table 2-2. Similarly, the DO conditions during the proposed periods of operations will likely be higher than those listed in Table 2-2.

2). **Table 2-4, 6" jump vs. 12" jump height.** As discussed during the consultation meetings, the existing facility has 12" jump heights associated with the ladder leading to the trap. The existing facility functions very well for anadromous fish. As such, it was the groups desire to keep modifications to the ladder minimal. A change to a 6" jump would require significant rebuild to the existing facility, and require a much longer ladder to reach the elevations and flows desired for the trapping facility to operate. The existing ladder design does incorporate orifices (1-foot-wide by 18-inch-high) should smaller individuals be unable to pass over the 12" jump.

3). **Table 2-10.** Table 2-10 established some of the original design objectives relative to evaluation and monitoring requirements. Later, when advancing the preferred alternative, a work area was contemplated and incorporated into the design. Section *4.3.7. Sampling and Fish Research Area* states the following:

*In the configuration, an area adjacent to the sorting table has been provided to support potential fish sampling and research activities. The sampling and research area is fitted with a monitoring and evaluation table measuring approximately 3 feet wide by 10 feet long. Utility water, power, and lighting are provided to support sampling tanks, computers, and research equipment. The entire sorting, sampling, and fish research area is covered with a roof to protect personnel from the weather.*

4). **Bar separator timeframe.** It was the understanding of IPC, as discussed in the operation plan (section 5.1) that management agencies during our consultation meetings decided that the capture of resident salmonids would be limited to bull trout. As such, the period that it would be operated for bull trout would be in the spring period from April 15 through June 15. During this time period, the bar separator would not be in place, so that all sizes of fish that entered the lock could be captured. During the fall period, the only trap objectives that were presented were to meet the needs of the steelhead and fall chinook hatchery programs, and no resident fish would be targeted. As such, the bar separator would be installed to minimize the sorting requirements during this period. If ODFW has changed its position to include targeting other resident fish such as redband trout, the bar separator would not be installed. This will increase the sorting requirements during the fall period.

5.) **Operations Plan.** IPC discussed the details incorporated into the Operations Plan provided with this AIR at the September consultation meeting which included discussion on trapping dates and durations, target species and numbers, and fish handling, sampling and operational protocols. IPC concurs that there are still some further considerations to detail in the operations plan, but generally believe these to be minor. IPC also anticipates the need for regular annual in-season meetings with the management agencies to concur on the details of the operation of the facility, as program needs change.

## Appendix B. Technical Memorandum No. 1, Revision 2—Design Criteria

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# TECHNICAL MEMORANDUM

**To:** Jim Chandler, Idaho Power Company

**Subject:** Hells Canyon Trap Modifications
TM No. 1 - Design Criteria – Revision 2

**Prepared By:** Mort McMillen
Ray Eldridge

**Date:** July 30, 2004

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## INTRODUCTION

This technical memorandum presents design criteria for Idaho Power Company's (IPC) Hells Canyon Fish Trap Modifications. As outlined in AR-1, IPC will prepare functional design drawings for proposed modifications to the existing Hells Canyon trap facility. The drawings are intended to illustrate the proposed modifications which would allow onsite sorting and holding of resident fish and anadromous fish; a safe and efficient means of returning wild fish to the river after sorting; and scanning of fish for PIT-tags and coded wire tags. The criteria presented within this technical memorandum are intended to serve as the foundation for developing trap modification alternatives, as well as preparation of functional design drawings for the recommended alternative.

This second revision of the Design Criteria reflects comments made by the resource agencies at the site visit that was held at the Hells Canyon complex on August 11 and 12, 2004.

## DESIGN CRITERIA

The proposed design criteria are presented in the following tables. A brief description of the contents of each table is as follows:

- **Table 1. Biological** criteria including fish species, size, timing, and expected numbers
- **Table 2. Water quality** criteria including temperature, dissolved oxygen, and nitrogen levels
- **Table 3. Hydraulic and hydrologic** criteria including stage-discharge relationships, mean monthly flows, flood return period and low flow conditions
- **Table 4. Fish ladder** criteria including drop per pool, energy dissipation, flow range, orifice and slot velocities, length and width, wall height, auxiliary water flows, and ladder type.
- **Table 5. Pre-Lock/Lift Holding** criteria including holding density, flow, length, width, depth, wall height, surface spray, and brail floor.

- **Table 6. Lock/Lift** criteria including trapping mechanism, holding density, flow, length, width, depth, wall height, and cycle time.
- **Table 7. Sorting/Anesthetic/Sampling/Fish Return** criteria including chutes, gates, visual and automated identification, anesthetic tank and recovery, and materials.
- **Table 8. Holding Raceways** criteria including number, size, flow rates, capacity, crowding, surface spray, and bird netting/shading.
- **Table 9. Truck Loading/Hauling** criteria including hopper type and size, cycle time, truck and/or trailer type.
- **Table 10. Monitoring and evaluation** criteria including tag identification, counting, and species identification.
- **Table 11. Mechanical systems** criteria including pumps, gates, valves, and controls.

**Table 1. Hells Canyon Fish Trap, Biological Design Criteria.**

| Criteria | Units | Value | Comments |
|---|---|---|---|
| Fish Species – Anadromous | | steelhead<br>fall chinook<br>spring chinook<br>lamprey | |
| Fish Species – Resident | | bull trout | Additional species may include rainbow trout, mountain whitefish, brown trout, large-scale suckers, bridgelip suckers, carp, northern pike minnow, and chisel mouth |
| Fish Size | | | |
| steelhead | lbs | 8 | Average size |
| fall chinook | lbs | 15 | Average size |
| spring chinook | lbs | 15 | Average size |
| bull trout | lbs | < 5 | Average size |
| Swimming Capabilities | | | |
| steelhead | fps | <13.7/<26.5 | Prolonged/Burst |
| fall chinook | fps | <10.8/<22.4 | Prolonged/Burst |
| spring chinook | fps | <10.8/<22.4 | Prolonged/Burst |
| bull trout | fps | <1.6<br><2.6 | Prolonged (fork length > 15cm)<br>Prolonged (fork length > 40cm) |
| Timing | | | Broodstock collection |
| steelhead | mo/da | 10/23 to 12/15<br>3/20 to 5/1 | Water temperatures < 60F/broodstock collection in early winter and spring run |
| fall chinook | mo/da | 10/23 to 12/15 | |
| spring chinook | mo/da | 5/1 to 7/15 | Water temperatures < 72F |
| bull trout | mo/da | 4/15 to 6/15 | |
| Numbers of Fish | | | |
| Steelhead<br>Broodstock Target<br>Max Day<br>Ave. Day | | <br>600<br>500 +/-<br>125 +/- | <br>25% spring collection<br>75% fall collection |
| Fall Chinook<br>Target<br>Max Day<br>Ave. Day | | <br>856<br>-<br>- | <br>Based on production goals<br>No data at present<br>No data at present |

| | | | |
|---|---|---|---|
| Spring Chinook<br>Target<br>Max Day<br>Ave. Day | | <br>748<br>170 +/-<br>42 +/- | |
| Bull Trout | | n/a | No target, small numbers trapped |

**Table 2. Hells Canyon Fish Trap, Water Quality Criteria.**

| Criteria | Units | Value | Comments |
|---|---|---|---|
| Max Holding Temperature | F | <70 | In holding units |
| Minimum D.O. | % Sat. | >65<br>>50 | In holding units<br>In fishway @ max loading |
| Max Nitrogen Saturation | % Sat. | <110 | In holding units. Aeration and nitrogen stripping required for holding raceways |

**Table 3. Hells Canyon Fish Trap, Hydraulic and Hydrologic Criteria.**

| Criteria | Units | Value | Comments |
|---|---|---|---|
| Max HC Tail Water Elev. | ft | 1494 | @ 103,000 cfs |
| Min HC Tail Water Elev. | ft | 1469 | @ 5,000 cfs |
| Trap Operating Range<br>Min. Tail Water Elev.<br>Max Tail Water Elev. | <br>ft<br>ft | <br>1467<br>1482.5 | <br>Corresponds to 5000 cfs<br>Corresponds to 45,000 to 50,000 cfs |
| Max Flow<br>10% Exceedence<br>50% Exceedence<br>90% Exceedence | cfs<br>cfs<br>cfs<br>cfs | 103,000<br>38,300<br>16,300<br>8,990 | Occurred January 2, 1997<br>Exceedence based on Hells Canyon gage, No. 13290450, period of record July 1965 to present |

**Table 4. Hells Canyon Fish Trap, Fish Ladder Design Criteria.**

| Criteria | Units | Value | Comments |
|---|---|---|---|
| Drop per Pool, max | ft | 1.0 | |
| Energy Dissipation, per cf, min. | ft-lb/sec | 4.0 | |
| Transport Velocity | fps | 1.0 – 2.0 | Over gross area of fish ladder |
| Entrance Velocity | fps | 4.0 to 8.0 | |
| Fish Ladder Flow | cfs | See Comment | Based on transport velocity and energy dissipation criteria |
| Fish Density in Pools | lb/cf | 5 | |
| Max Day | % of Run | 10 | |
| Max Hour | % of max day | 10 | |
| Oxygen Consumption | oz/hr/lb | $4 \times 10^{-4}$ | |
| Orifice/Slot Velocities | fps | 4.0 – 8.0 | |
| Orifice/Slot Size, min. | ft | 1.5<br>1.0 | High<br>Wide |
| Fishway Size<br>Length, min.<br>Width, min.<br>Wall Height, min. | <br>ft<br>ft<br>ft | <br>10.0<br>6.0<br>8.0 | |
| Auxiliary Water Flow | cfs | See Comment | Based on entrance velocity criteria |
| Ladder Type | - | Ice Harbor or Vertical Slot | |

**Table 5. Hells Canyon Fish Trap, Pre-Lock/Lift Holding Design Criteria**

| Criteria | Units | Value | Comments |
|---|---|---|---|
| Trapping Mechanism | - | Vee Trap or Finger Weir | |
| Holding Density | lb/cf | 4.0 | Total volume based on 1/3 of peak day run |
| Flow | gpm/fish | 0.5 | |
| Water Supply | - | Floor Diffuser | |
| Length, min. | ft | 12.0 | |
| Width, min. | ft | 8.0 | |
| Depth, min. | ft | 8.0 | |
| Wall Height | ft | 10.0 | |
| Jump Prevention | - | Surface Spray and Jump Panels | |
| Cycle Time, min. | hr | 0.5 | Cycle time for complete brail operation |

**Table 6. Hells Canyon Fish Trap, Lock/Lift Design Criteria.**

| Criteria | Units | Value | Comments |
|---|---|---|---|
| Trapping Mechanism | - | Bar Rack | |
| Holding Density | lb/cf | 8.0 | |
| Lock | | | |
| Size | ft | 6.5 x 6.5 | Length x Width |
| Fill Rate | gpm | 1,000 | |
| Cycle Time | min | 10-15 | |
| Crowding Mechanism | - | Brail Floor | |
| Lift | | | |
| Size | ft | 6.5 x 6.5 | Length x Width |
| Cycle Time | min | 10 - 15 | |

**Table 7. Hells Canyon Fish Trap, Sorting/Anesthetic/Sampling/Fish Return Criteria.**

| Criteria | Units | Value | Comments |
|---|---|---|---|
| Identification | | | |
| Visual | - | Manual identification | Requires full time operator |
| Video | - | Video recognition software | Depends on effectiveness of the video recognition software |
| Sorting | | | |
| Manual | - | Handle each fish or bar separator | |
| Automated Gates/Chute | - | Air actuated gates to direct fish to holding raceways | Requires visual identification or video recognition software |
| Fish Size | - | Down to 40 cm | Smaller resident fish will require separator to collect smaller fish |
| Sampling | | | |
| Frequency | | Daily | |
| Species | | All | |
| Anesthetic | | | |
| Tank Size | gals | 150 | |
| Flow | gpm | 5 | |
| Handling | | Manual | |
| Method | | clove oil/CO2 | More evaluation required in this area and investigation of electro shocking |
| Fish Return | | | |
| Flume Size, min | inch | 18 | |
| Pipe Size, min. | inch | 12 | |
| Flow | gpm | See comment | Depends on return pipe or flume slope |
| Depth | inch | 6 | |
| Materials | | PVC, HDPE | All smooth interior and fittings |

**Table 8. Hells Canyon Fish Trap, Holding Raceways Criteria.**

| Criteria | Units | Value | Comments |
|---|---|---|---|
| Number | ea | 4 | Depends on the number of species/stock or transport destination |
| Capacity | fish | 120 | Match the capacity of the transport truck or trailer |
| Size | cf | 960 | |
| Flow Rate | cfs | 2 turnovers per hour | Based on temperature/DO |
| | | | |
| Crowding | - | Powered traveling crowder | One per raceway |
| Surface Spray | - | | |
| Materials | - | Concrete/steel/aluminum | |
| Diffuser Velocity | fps | 1.0<br>0.5 | Wall diffusers<br>Floor diffusers |
| Freeboard | ft | 1 foot minimum on the raceways/4 feet minimum for fish jumping | |
| Jump Prevention | | Surface spray and jump panels | |
| Other<br>Bird netting | | <br>Not required | |

**Table 9. Hells Canyon Fish Trap, Truck Loading/Transport Criteria.**

| Criteria | Units | Value | Comments |
|---|---|---|---|
| Hopper | | | |
| Size | gals | 1000 | |
| Loading Density | lb/cf | 6.7 | |
| Capacity | | 120 | |
| Freeboard | | Greater than the water depth within the hopper | Measured from the hopper water surface to the top of the hopper |
| Transfer | | Water-to-water | |
| Transport | | | |
| Truck Size | gals | 500/1000 | IDF&G/Idaho Power |
| Truck Capacity | fish | 120 | |
| Trailer Size | gals | 500 | |
| Trailer Capacity | fish | 60 | |
| Oxygen Supplementation | | Yes | Oxygen tanks and recirculation pumps |
| Max Hauling Water Temp. | F | <65 | Acclimate to w/in 5F of receiving water temperatue |
| Tank Insulation | - | Yes | |
| Cycle Time | | | |
| Crowding/hopper loading | min | 10-15 | |
| Hopper | min | 20 | Depends on jib crane lift time, unload to transport truck, return to hopper well |
| Transport | hrs | 3 hours | 1 hour each way transport time plus 1 hour tank filling and general preparation |
| Materials | | | |
| Hopper | | Aluminum and stainless steel | |
| Transport | | Aluminum and stainless steel | |
| Piping | | Stainless steel/PVC | |

**Table 10. Hells Canyon Fish Trap, Monitoring and Evaluation Criteria.**

| Criteria | Units | Value | Comments |
|---|---|---|---|
| PIT Tag Detection | | | |
| Type | - | Tube or channel | |
| Location | - | Entrance or sorting area | |
| Coded Wire Tags Detection | | | |
| Type | - | | |
| Location | - | Entrance or sorting area | |
| Counting | | | |
| Type | - | Automated/resistance board or video/manual | |
| Location | - | Ladder entrance and/or fish sorter | Need ability to count fish at the entrance to control numbers entering ladder |
| Wild | - | Count and return to river | |
| Fish Health | - | - | May provide evaluation work area |

**Table 11. Hells Canyon Fish Trap, Mechanical Systems Criteria.**

| Criteria | Units | Value | Comments |
|---|---|---|---|
| Entrance | | | |
| Type | - | Telescoping | |
| Tailwater range | ft | 1467 to 1482.5 | 5,000 cfs to 45,000 – 50,000 cfs |
| Width | ft | 3 | Existing configuration |
| Auxiliary Water Pumps | | | |
| No. | - | 4 | Existing system |
| Capacity | cfs | 112 | |
| Standby pumps | - | One standby | |
| Controls | - | HOA | PLC controlled |
| Lock/Trap Pumps | | | |
| No. | - | 2 | |
| Capacity | cfs | ? | Based on lock cycle time and trap flow |
| Standby pumps | - | One standby | |
| Controls | - | HOA | PLC controlled |
| Holding Raceways Pumps | | | |
| No. | - | 2 | |
| Capacity | cfs | | To be determined |
| Standby pumps | - | One standby | |
| Controls | - | HOA | PLC controlled |
| Separator/Sorter/Crowder | | | |
| Length | - | | To be determined |
| Width | - | | To be determined |
| Finger Weirs | - | | To be determined |
| Water Supply | - | | To be determined |
| Controls and Alarms | - | - | Single PLC with alarms and monitors transmitted to central control |
| Standby Power | - | Yes | Either dual feed or standby generator |

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## Appendix C. Technical Memorandum No. 2—Alternative Development

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# TECHNICAL MEMORANDUM

**To:** Jim Chandler, Idaho Power Company

**Subject:** Hells Canyon Trap Modifications
TM No. 2 - Alternative Development

**Prepared By:** Mort McMillen
Ray Eldridge

**Date:** August 10, 2004

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## INTRODUCTION

This technical memorandum presents the conceptual alternative development for Idaho Power Company's (IPC) Hells Canyon Fish Trap Modifications. The alternatives presented here are intended to facilitate a discussion between IPC and the resource agencies during a site visit on August 11 and 12, 2004.

The memorandum is organized into the following three secions:

- Sorting Options
- Trap Modification Alternatives
- Construction Cost Estimates

## SORTING OPTIONS

The Hells Canyon trap is expected to attract anadromous fish including spring chinook, fall chinook, and steelhead, and resident species including bull trout, rainbow trout, mountain whitefish, and other species as indicated in Technical Memorandum No. 1 – Design Criteria. Chinook and steelhead encountered at the trap are expected to be of wild and hatchery origin. In keeping with the facility's objective, IPC intends to return all wild and resident fish to the river, and trap and haul hatchery origin chinook and steelhead to Oxbow Hatchery for broodstock and other uses.

There are four basic sorting methods that may be considered for the Hells Canyon trap, including:

- automated sorting
- visual sorting
- hand sorting
- size sorting

A brief description of each of these methods is presented in Table 1. Table 2 shows the applicability of sorting methods by species.

**Table 1. Description of Available Sorting Methods**

| Sorting Method | Description | Comments |
|---|---|---|
| **Automated Sorting (tag or video)** | Fish species are recognized by tag or image processing and directed to their destination using automated gates. | Not presently applicable to HC since all hatchery fish are not tagged and visual recognition equipment is not sufficiently reliable to accurately identify and sort fish. |
| **Visual Sorting** | Operators visually identify fish and direct them to their destination using automated gates. | Not practical for HC since wild and hatchery fish require close inspection to differentiate. |
| **Hand Sorting** | Fish are moved to a sorting table and individually inspected to determine destination. | Provides the greatest degree of reliability for sorting, though it is the most labor intensive method. |
| **Size Sorting** | Fish are sorted by size with small fish falling through a dewatered/slotted chute, and large fish traveling over the bars. | Works well to sort between most resident and anadromous fish, wild and hatchery fish will still require hand sorting. |

**Table 2. Applicability of Sorting Method by Species**

| Fish | Automated Sorting | Visual Sorting | Hand Sorting | Size Sorting |
|---|---|---|---|---|
| **Wild Steelhead** | poor | poor | good | poor |
| **Hatchery Steelhead** | poor | poor | good | poor |
| **Wild Chinook** | poor | poor | good | poor |
| **Hatchery Chinook** | poor | poor | good | poor |
| **Bull Trout** | poor | good | good | fair |
| **Other Resident Fish** | poor | good | good | fair |

Automated systems fall into two general categories, based on the method used to identify fish, image recognition and tag identification. Image processing systems are becoming more reliable for counting fish but do not presently have the ability to differentiate between wild and hatchery fish. Tag reading systems are only effective for sorting if all of a desired group of fish is "tagged" or "not tagged." While IPC intends to install and operate PIT tag readers at Hells Canyon, they will not be effective for sorting fish since many hatchery fish are not currently PIT tagged. In the future when most, or all, of hatchery origin fish are PIT tagged, automated sorting may be an effective sorting method.

Visual sorting is often used with a trained operator identifying fish as they slide down a flume. Once a fish is identified it is directed to a holding area or returned to the river. This method is effective for sorting between species, though much less effective when sorting hatchery and wild fish. Hand sorting involves handling each fish, giving the trap personnel adequate time to identify and sort fish. While this method is the most labor intensive, it appears to be the most appropriate method for Hells Canyon at this time.

Size sorting is currently used at Hells Canyon and is effective for segregating large and small fish, such as anadromous and resident fish. The method works by dewatering the flow and sliding fish across a smooth bar rack, where small fish slide beneath the bar rack and large fish continue across the rack. Size sorting could be continued at the Hells Canyon trap; its real value will depend upon the anticipated numbers of resident fish encountered in the system.

## TRAP MODIFICATION ALTERNATIVES

Four preliminary alternatives were considered for the Hells Canyon Fish Trap Modification:

- Alternative 1 – Existing Fishway with Trap, Sorting and Holding
- Alternative 2 – Extend Fishway with Trap, Sorting and Holding
- Alternative 3 – Existing Fishway with Narrow Raceways
- Alternative 4 – Downstream Trap, Sorting and Holding

The first three alternatives are similar in that they involve additions in the immediate area of the existing fishway and trap; the fourth alternative involves extending the fishway downstream and providing new access to trapping, sorting and holding facilities. A brief description of each alternative is presented below and illustrated on Figures 4 -12. The existing trap structure is shown on Figures 2 and 3.

### Alternative 1 – Existing Fishway with Trap, Sorting and Holding

Alternative 1 is shown on Figures 4, 5 and 6. The work involves demolishing the floor of the existing sorting pool and crowding pool and removal of the existing hopper. The area would be modified to provide a Vee trap ahead of a crowding pool and fish lock. Fish passing through the Vee trap will be crowed to the lock using a vertical power crowder and a lifting brail. Once in the lock, fish will be raised to a flume level and transported to a holding area. The holding area will have a brail that allows fish to be metered onto a sorting table where fish will be returned directly to the river or to one of four holding raceways. The raceways would be 30 feet in length, 8 feet in width, and 8 feet in depth. The normal water level in raceways will be 4 feet to provide a total holing volume of 960 cubic feet per raceway. Each raceway would be provided with a power crowder and punched plate screen to separate it from the crowding channel. A common crowding channel will be provided at the downstream end of the raceways that will move fish to a hopper using a power crowder. The hopper would be lifted by the existing jib crane to the up-slope truck loading area.

It is expected that the raceways and lock will be constructed of steel and the hopper will be constructed of aluminum. The crowding pool and fishway modifications would be constructed of reinforced concrete.

As indicated on Section B, Figure 6, the raceways extend past the existing facilities, to the southeast, and over the edge of the river at normal to high flows. This requires that large piers be founded within the flood plain to support the elevated sorting and holding structure.

**Alternative 2 – Extend Fishway with Trap, Sorting and Holding**

Alternative 2 is shown on Figures 7, 8 and 9. It is similar to Alternative 1, except that the existing fishway is extended 14 pools before the trap and lock facilities are placed. This alternative has two advantages; it moves the elevated sorting and holding facilities away from the river, approximately 14 feet, and it allows the trap to remain in operation under higher flows and tailwater conditions with the extension of the fishway.

**Alternative 3 – Existing Fishway with Narrow Raceways**

Alternative 3 is shown on Figures 9 and 10. This alternative is similar to Alternative 1, except that the raceways use a narrow and longer foot print; 40 feet in length, 6 feet in width, and 8 feet in depth; and provide the same 960 cubic feet of holding volume as other alternatives. Additionally, the raceways are moved 10 feet away from the river. This alternative was developed to limit the extension over the river at normal flows. The raceways could be cantilevered over the river and would not require piers within the river channel.

**Alternative 4 – Downstream Trap, Sorting and Holding**

Alternative 4 is shown of Figures 11 and 12. This alternative extends the trap, sorting and holding facilities approximately 250 feet downstream by adding 22 new fishway pools; access to the site would be provided from the visitor center access road. The trapping, sorting and holding facility is similar to the previous alternatives with the exception of the lock. In Alternative 4, the lock is not needed – the vertical rise that the lock provides for the sorting operation and flood protection is provided by the increased fishway length and attendant vertical rise in water surface.

Once fish ascend the fish ladder, they will encounter a Vee trap and crowding pool similar to Alternatives 1 – 3. Once in the crowding pool, a power crowder will move fish to the brailing end of the pool where they will be raised directly to the sorting table. The brail will serve to control the number of fish on the sorting table and prevent overloading the sorting operation. Fish would be loaded from the hopper to hauling trucks using a jib crane located adjacent to the hopper.

## CONSTRUCTION COST ESTIMATES

Conceptual level construction cost estimates were prepared for each of the alternatives and are included in Table 3. These estimates were based on the facilities presented in Figures 4 – 12. Since the drawings and facilities are conceptual, the estimates are assumed to be accurate to +/-50% of actual construction costs. Changes in facility function, layout, materials and pricing will materially affect construction costs. The cost of engineering, construction management, permitting and environmental compliance, and IPC's internal construction overhead is not included in the estimates.

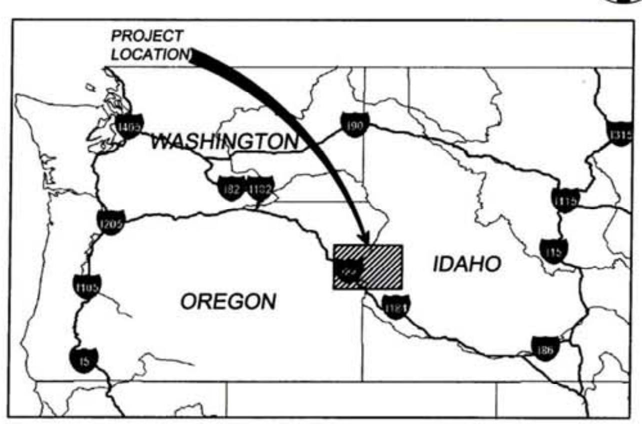
**Table 3. Conceptual Level Construction Cost Estimates**

| Alternative | Low Range | Estimate | High Range |
|---|---|---|---|
| **1 – Existing Fishway with Trap, Sorting and Holding** | $1,120,000 | $2,240,000 | $3,360,000 |
| **2 – Extend Fishway with Trap, Sorting and Holding** | $1,570,000 | $3,140,000 | $4,710,000 |
| **3 – Existing Fishway with Narrow Raceways** | $1,410,000 | $2,830,000 | $4,240,000 |
| **4 – Downstream Trap, Sorting and Holding** | $1,680,000 | $3,360,000 | $5,040,000 |

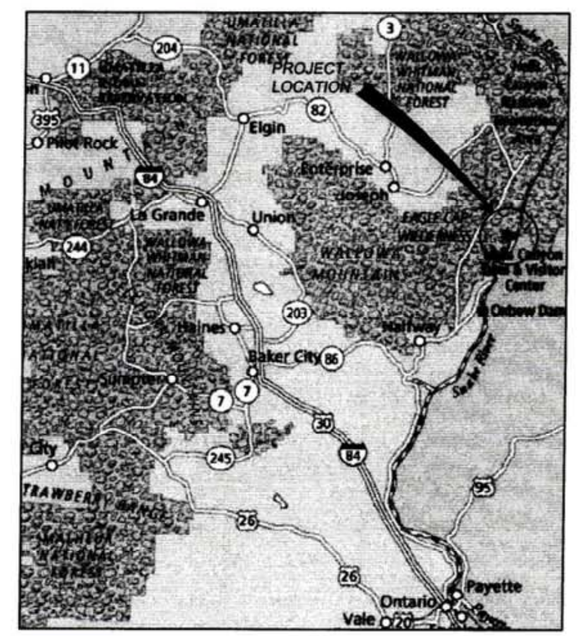
# IDAHO POWER COMPANY

IDAHO POWER
An IDACORP Company

# HCC AIR - AR1
# HELLS CANYON DAM
# FISH TRAP MODIFICATIONS




LOCATION MAP
NOT TO SCALE




VICINITY MAP
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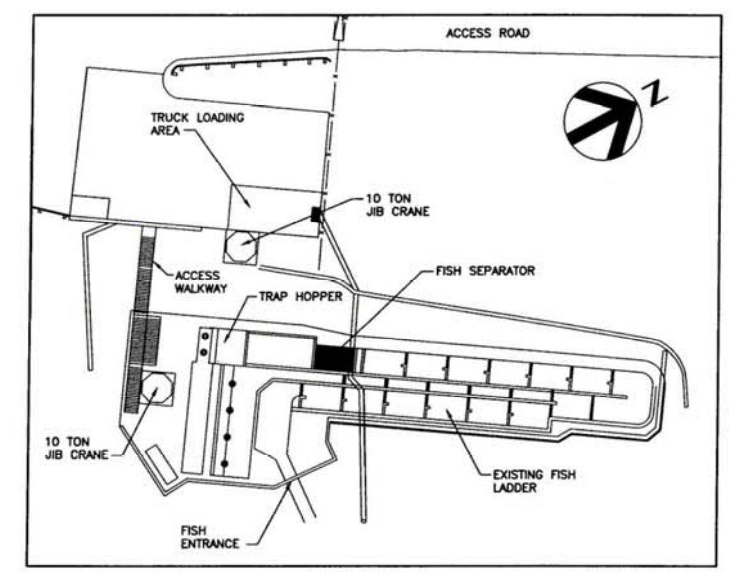


HELLS CANYON DAM FISH TRAP
NOT TO SCALE

HDR
HDR Engineering, Inc.

| ISSUE | DATE | DESCRIPTION |
|---|---|---|
| A | 8/10/04 | – |

| | |
|---|---|
| PROJECT MANAGER | M. McMILLEN |
| MECH'L. ENGINEER | R. ELDRIDGE |
| DESIGNER | S. WHITE |
| PROJECT NUMBER | – |

McMILLEN ELDRIDGE

IDAHO POWER
An IDACORP Company

HELLS CANYON
FISH TRAP
IDAHO POWER CO.
BOISE, IDAHO

TITLE SHEET, LOCATION MAP, VICINITY MAP, AND FISH TRAP

| | |
|---|---|
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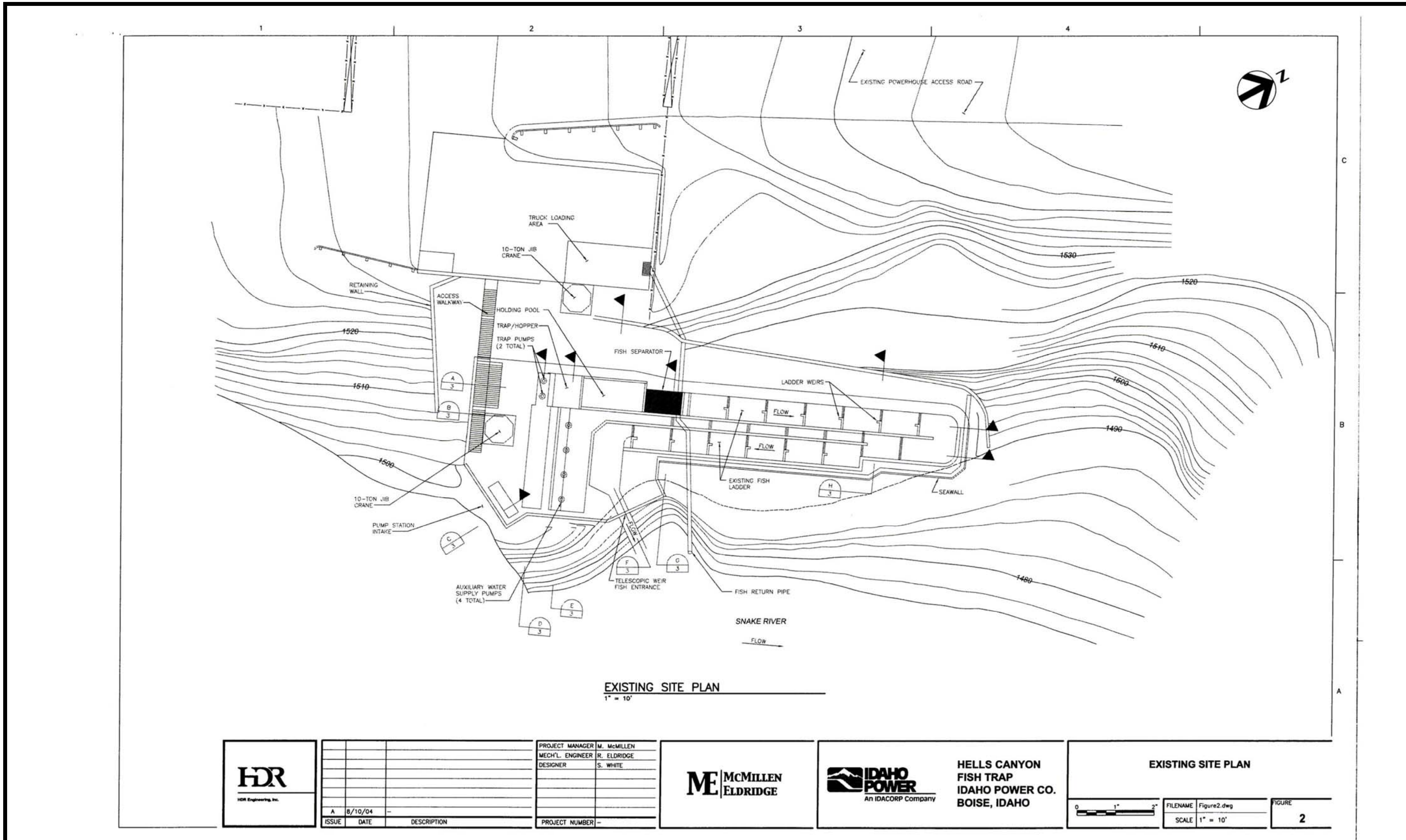
| SCALE | NO SCALE |
| FIGURE | 1 |

**FIGURE C-1**



EXISTING POWERHOUSE ACCESS ROAD
TRUCK LOADING AREA
10-TON JIB CRANE
RETAINING WALL
ACCESS WALKWAY
HOLDING POOL
TRAP/HOPPER
TRAP PUMPS (2 TOTAL)
FISH SEPARATOR
LADDER WEIRS
FLOW
EXISTING FISH LADDER
SEAWALL
10-TON JIB CRANE
PUMP STATION INTAKE
AUXILIARY WATER SUPPLY PUMPS (4 TOTAL)
TELESCOPIC WEIR FISH ENTRANCE
FISH RETURN PIPE
SNAKE RIVER
1530
1520
1510
1500
1490
1480
EXISTING SITE PLAN
1" = 10'
HDR
HDR Engineering, Inc.
A 8/10/04 –
ISSUE DATE DESCRIPTION
PROJECT MANAGER M. McMILLEN
MECH'L. ENGINEER R. ELDRIDGE
DESIGNER S. WHITE
PROJECT NUMBER –
McMILLEN ELDRIDGE
IDAHO POWER
An IDACORP Company
HELLS CANYON FISH TRAP
IDAHO POWER CO.
BOISE, IDAHO
EXISTING SITE PLAN
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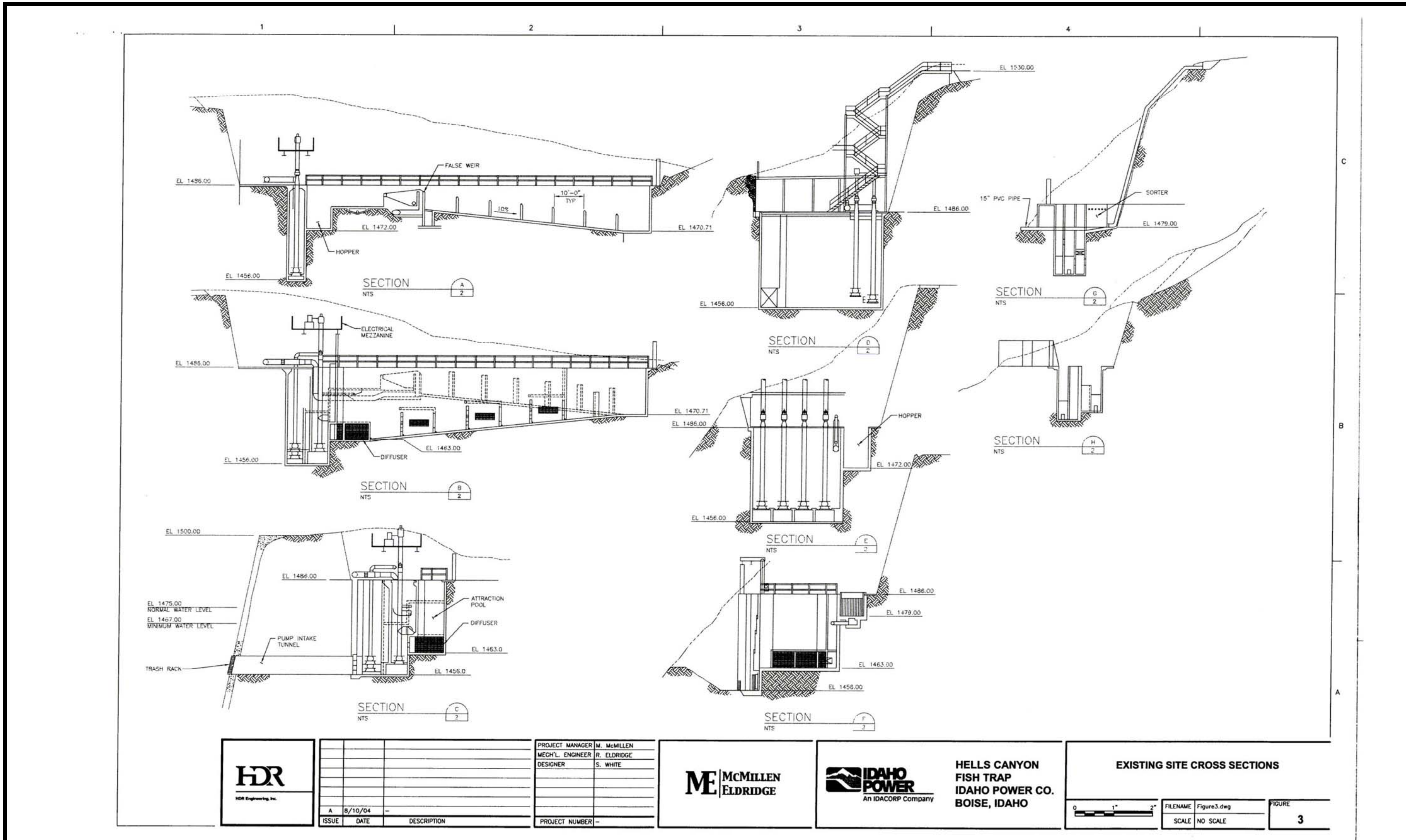
SCALE 1" = 10'
FIGURE 2


**FIGURE C-2**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10%
EL 1486.00
EL 1472.00
EL 1470.71
HOPPER
EL 1456.00
SECTION A 2
NTS
ELECTRICAL MEZZANINE
EL 1463.00
DIFFUSER
SECTION B 2
NTS
EL 1500.00
EL 1475.00 NORMAL WATER LEVEL
EL 1467.00 MINIMUM WATER LEVEL
PUMP INTAKE TUNNEL
TRASH RACK
ATTRACTION POOL
EL 1463.0
EL 1456.0
SECTION C 2
NTS
EL 1530.00
SECTION D 2
NTS
SECTION E 2
NTS
EL 1479.00
SECTION F 2
NTS
15" PVC PIPE
SORTER
SECTION G 2
NTS
SECTION H 2
NTS
HDR
HDR Engineering, Inc.
A 8/10/04 –
ISSUE DATE DESCRIPTION
PROJECT MANAGER M. McMILLEN
MECH'L. ENGINEER R. ELDRIDGE
DESIGNER S. WHITE
PROJECT NUMBER –
McMILLEN ELDRIDGE
IDAHO POWER
An IDACORP Company
HELLS CANYON FISH TRAP
IDAHO POWER CO.
BOISE, IDAHO
EXISTING SITE CROSS SECTIONS
FILENAME Figure3.dwg
SCALE NO SCALE
FIGURE 3

**FIGURE C-3**

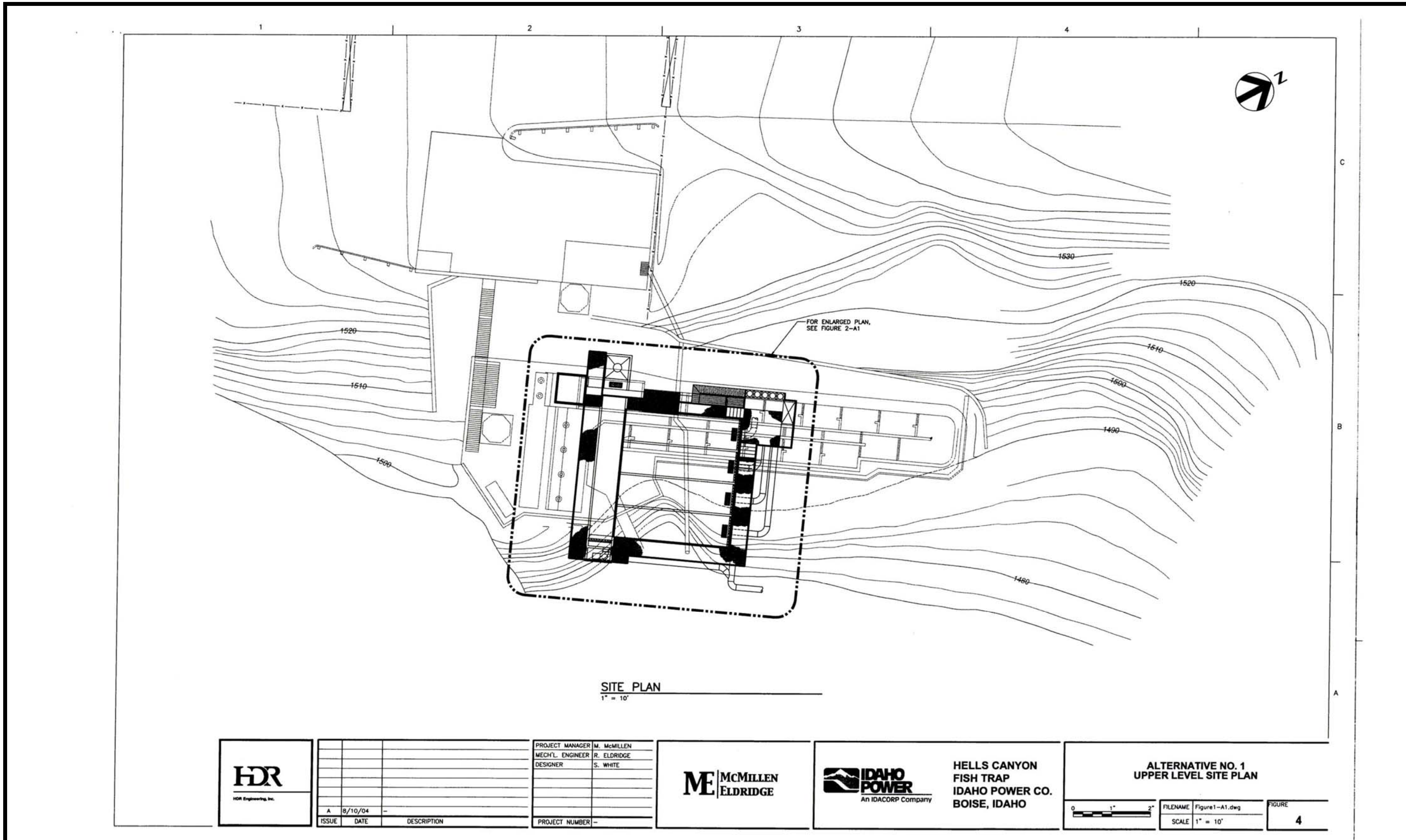

FOR ENLARGED PLAN, SEE FIGURE 2-A1
1530
1520
1510
1500
1490
1480
SITE PLAN
1" = 10'
PROJECT MANAGER M. McMILLEN
MECH'L. ENGINEER R. ELDRIDGE
DESIGNER S. WHITE
A 8/10/04 –
ISSUE DATE DESCRIPTION
PROJECT NUMBER –
HDR
McMILLEN ELDRIDGE
IDAHO POWER
An IDACORP Company
HELLS CANYON
FISH TRAP
IDAHO POWER CO.
BOISE, IDAHO
ALTERNATIVE NO. 1
UPPER LEVEL SITE PLAN
FILENAME Figure1-A1.dwg
SCALE 1" = 10'
FIGURE 4

**FIGURE C-4**

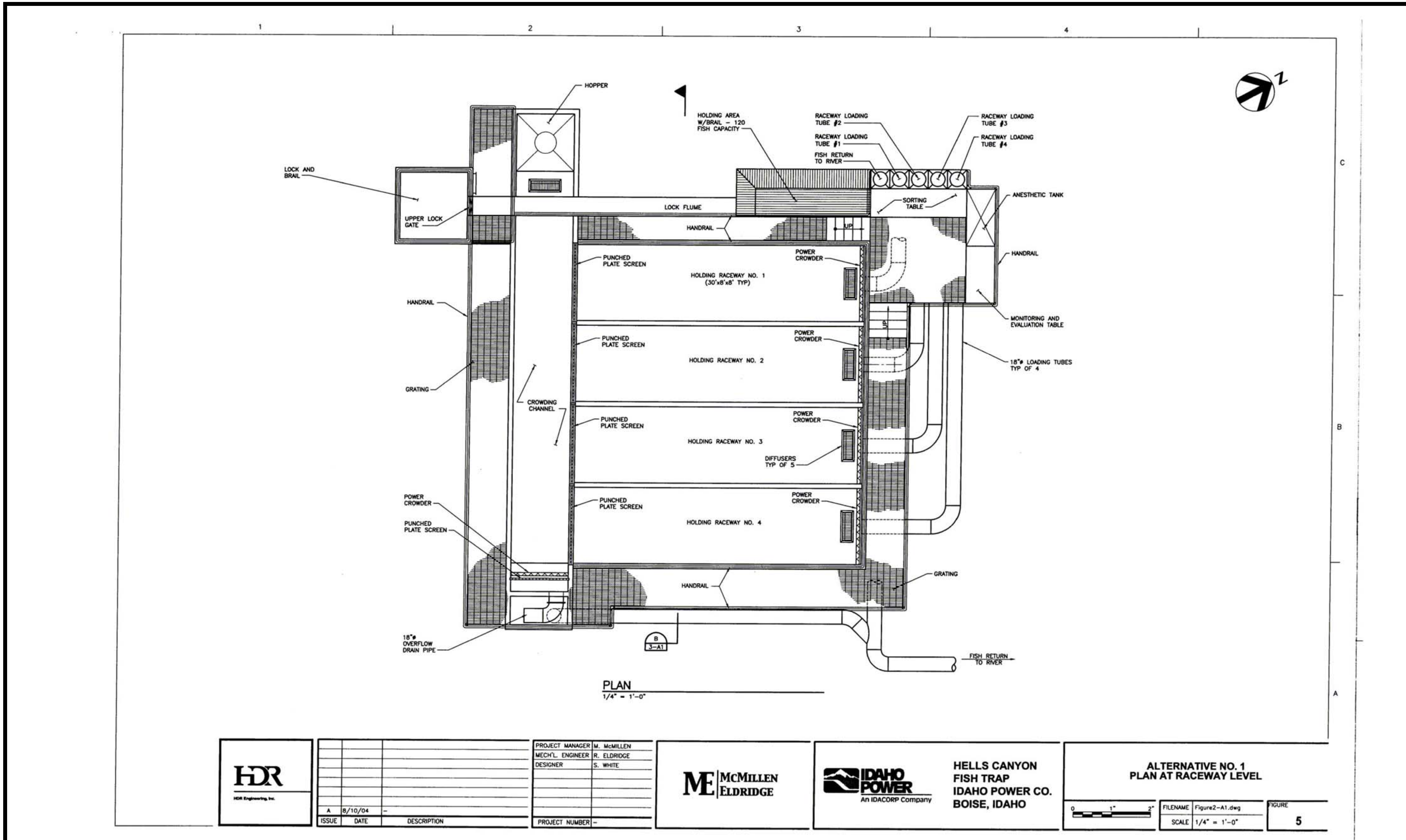
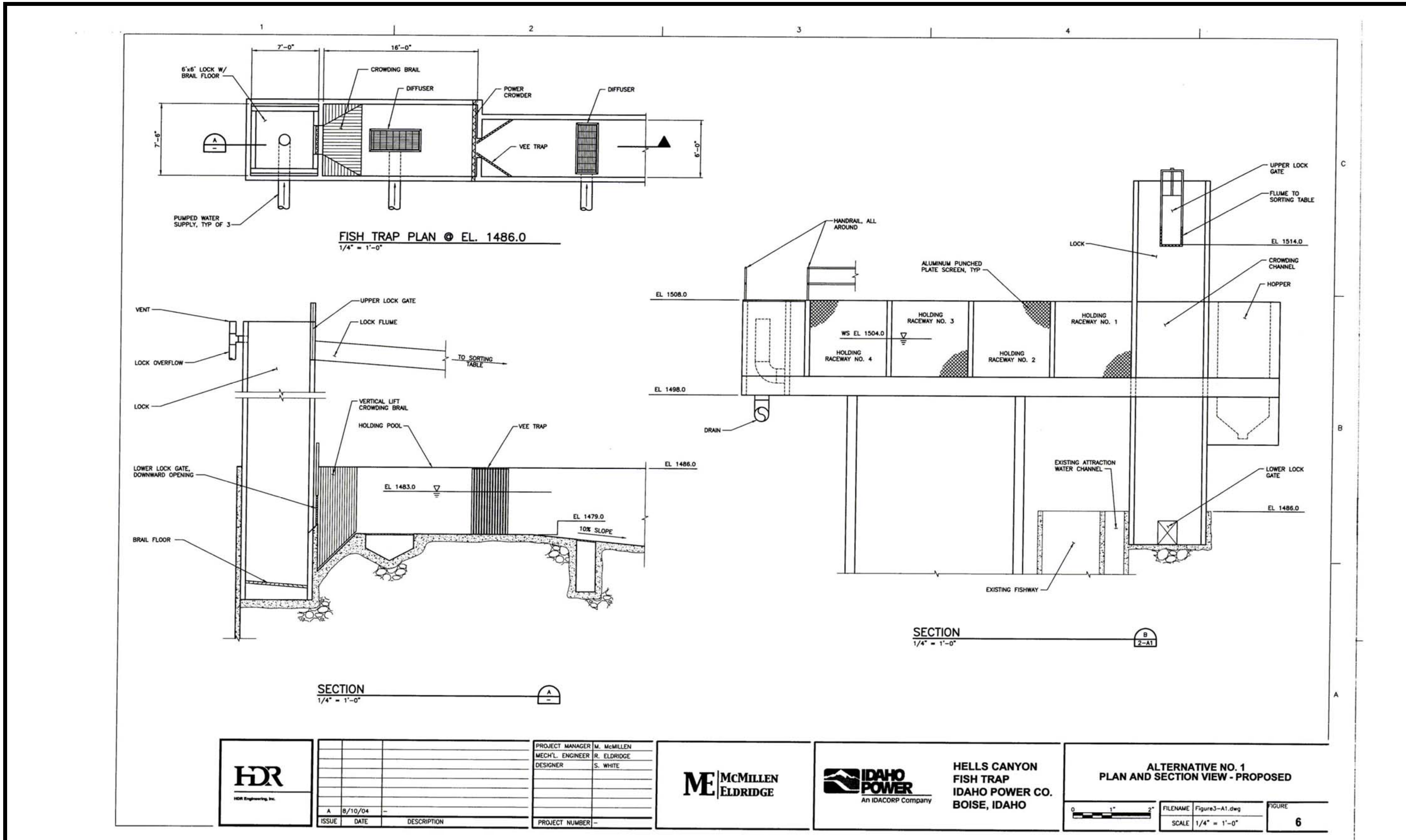

HOPPER
HOLDING AREA W/BRAIL - 120 FISH CAPACITY
RACEWAY LOADING TUBE #2
RACEWAY LOADING TUBE #1
FISH RETURN TO RIVER
RACEWAY LOADING TUBE #3
RACEWAY LOADING TUBE #4
LOCK AND BRAIL
UPPER LOCK GATE
LOCK FLUME
SORTING TABLE
ANESTHETIC TANK
HANDRAIL
PUNCHED PLATE SCREEN
POWER CROWDER
HOLDING RACEWAY NO. 1 (30'x8'x8' TYP)
HOLDING RACEWAY NO. 2
HOLDING RACEWAY NO. 3
HOLDING RACEWAY NO. 4
MONITORING AND EVALUATION TABLE
18"ø LOADING TUBES TYP OF 4
GRATING
CROWDING CHANNEL
DIFFUSERS TYP OF 5
18"ø OVERFLOW DRAIN PIPE
FISH RETURN TO RIVER
PLAN
1/4" = 1'-0"
HDR
PROJECT MANAGER M. McMILLEN
MECH'L. ENGINEER R. ELDRIDGE
DESIGNER S. WHITE
A 8/10/04 -
ISSUE DATE DESCRIPTION
PROJECT NUMBER -
McMILLEN ELDRIDGE
IDAHO POWER An IDACORP Company
HELLS CANYON FISH TRAP
IDAHO POWER CO.
BOISE, IDAHO
ALTERNATIVE NO. 1
PLAN AT RACEWAY LEVEL
FILENAME Figure2-A1.dwg
SCALE 1/4" = 1'-0"
FIGURE 5

**FIGURE C-5**



FISH TRAP PLAN @ EL. 1486.0
1/4" = 1'-0"
6'x6' LOCK W/ BRAIL FLOOR
CROWDING BRAIL
DIFFUSER
POWER CROWDER
VEE TRAP
PUMPED WATER SUPPLY, TYP OF 3
SECTION
1/4" = 1'-0"
VENT
UPPER LOCK GATE
LOCK FLUME
LOCK OVERFLOW
TO SORTING TABLE
LOCK
VERTICAL LIFT CROWDING BRAIL
HOLDING POOL
LOWER LOCK GATE, DOWNWARD OPENING
EL 1486.0
EL 1483.0
EL 1479.0
10% SLOPE
BRAIL FLOOR
HANDRAIL, ALL AROUND
ALUMINUM PUNCHED PLATE SCREEN, TYP
EL 1508.0
WS EL 1504.0
HOLDING RACEWAY NO. 4
HOLDING RACEWAY NO. 3
HOLDING RACEWAY NO. 2
HOLDING RACEWAY NO. 1
EL 1498.0
DRAIN
UPPER LOCK GATE
FLUME TO SORTING TABLE
EL 1514.0
CROWDING CHANNEL
HOPPER
EXISTING ATTRACTION WATER CHANNEL
LOWER LOCK GATE
EXISTING FISHWAY
HDR
HDR Engineering, Inc.
A | 8/10/04 | –
ISSUE | DATE | DESCRIPTION
PROJECT MANAGER | M. McMILLEN
MECH'L. ENGINEER | R. ELDRIDGE
DESIGNER | S. WHITE
PROJECT NUMBER | –
McMILLEN ELDRIDGE
IDAHO POWER
An IDACORP Company
HELLS CANYON FISH TRAP
IDAHO POWER CO.
BOISE, IDAHO
ALTERNATIVE NO. 1
PLAN AND SECTION VIEW - PROPOSED
FILENAME Figure3-A1.dwg
SCALE 1/4" = 1'-0"
FIGURE 6


**FIGURE C-6**

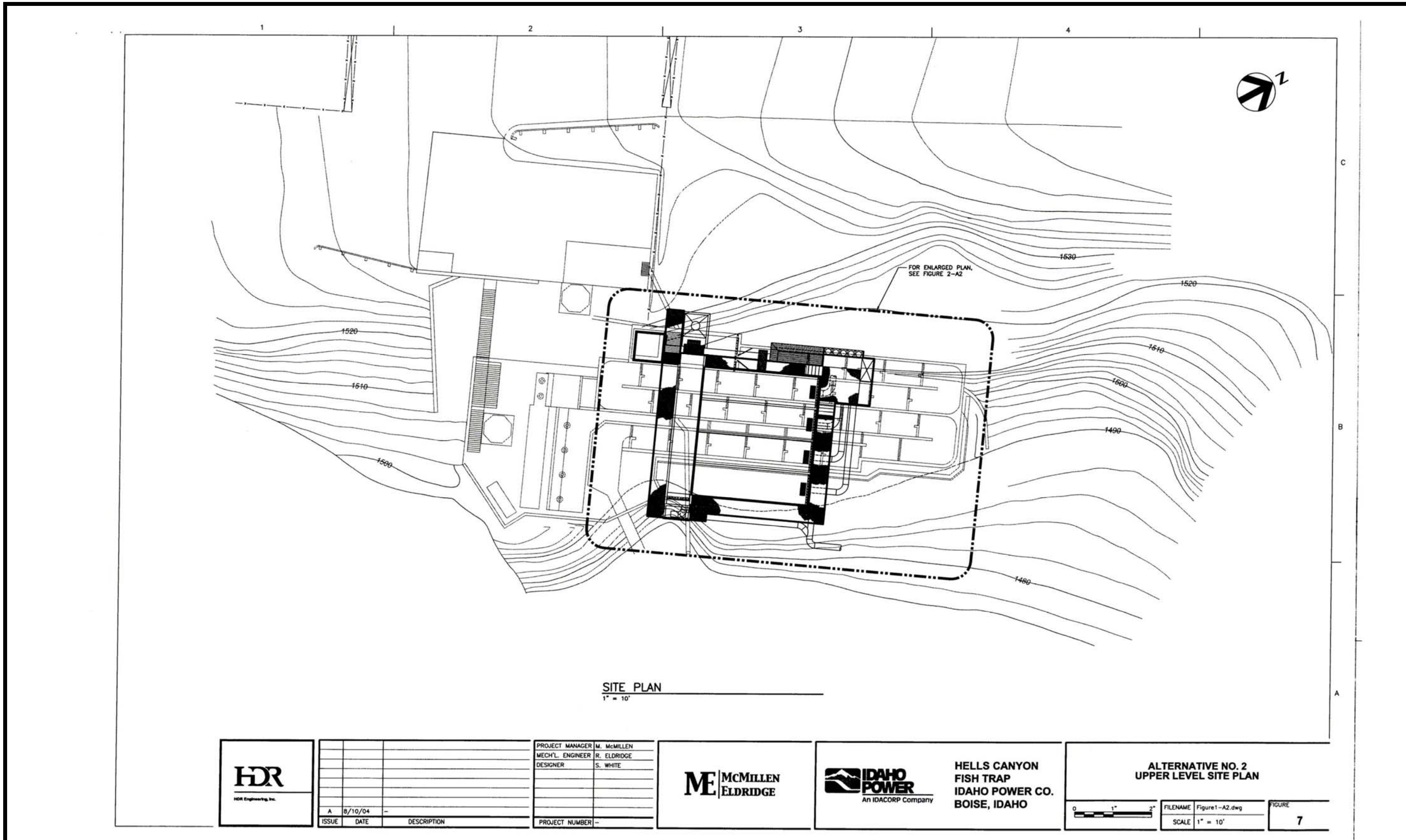
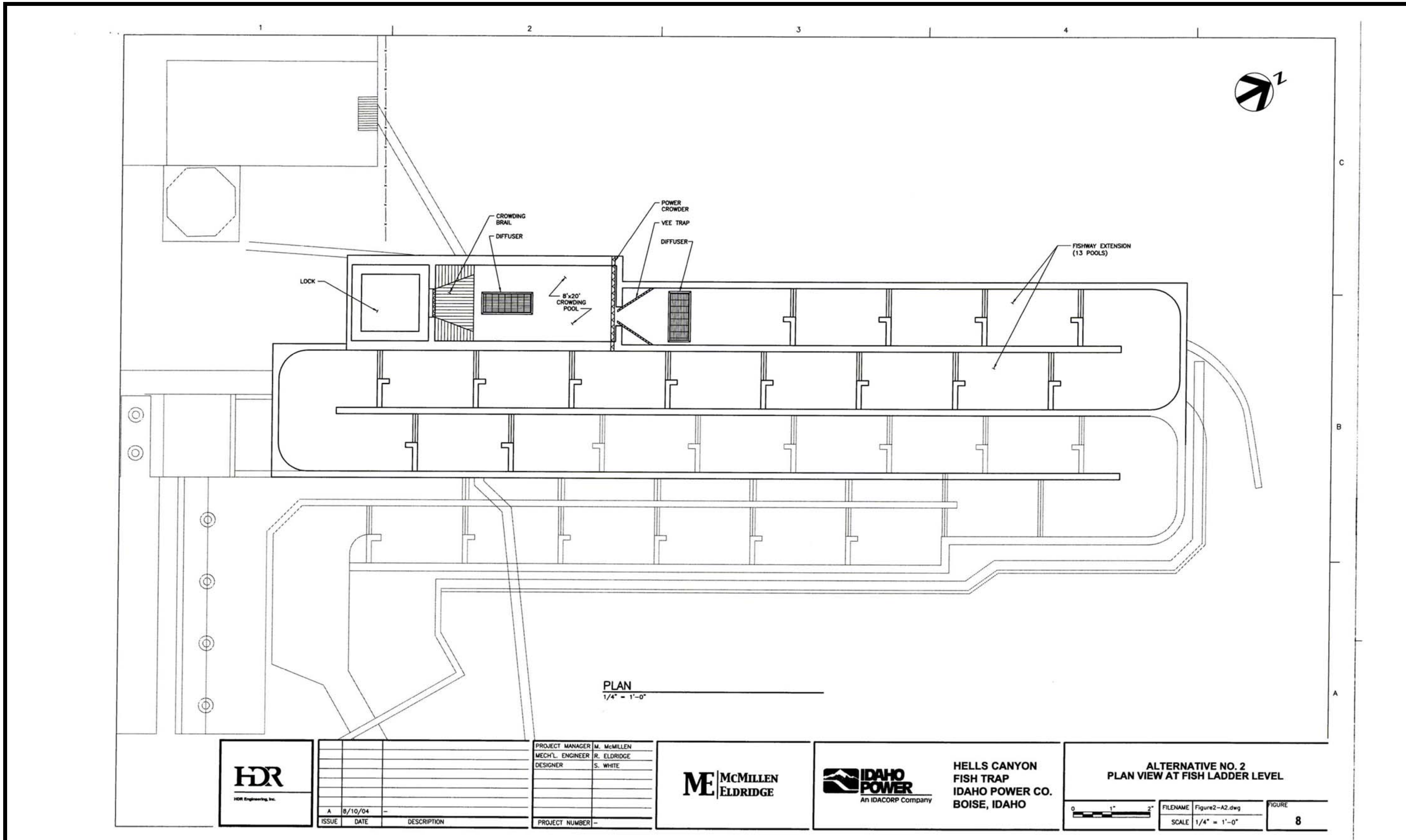
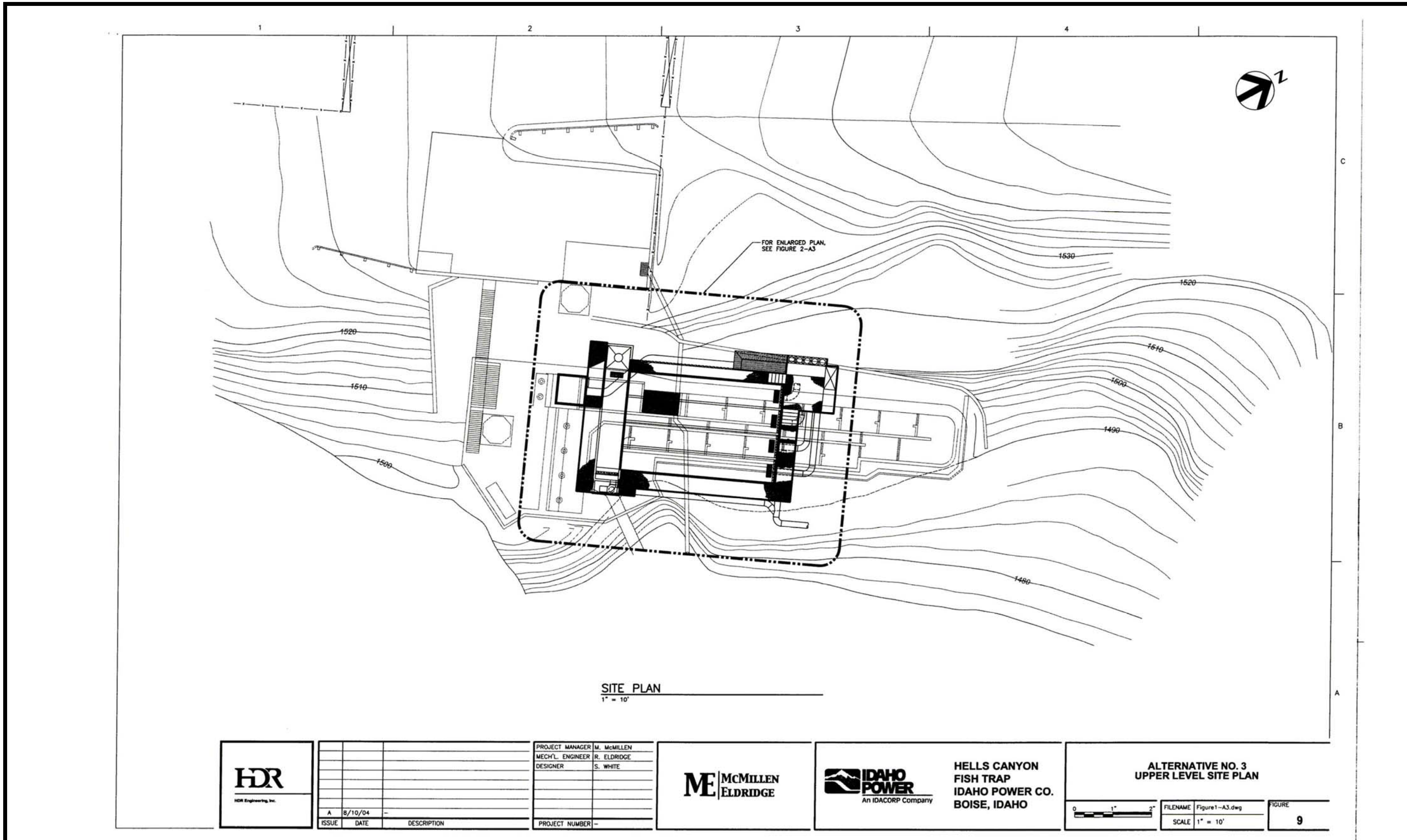

FOR ENLARGED PLAN, SEE FIGURE 2-A2
1530
1520
1510
1500
1490
1480
SITE PLAN
1" = 10'
PROJECT MANAGER M. McMILLEN
MECH'L. ENGINEER R. ELDRIDGE
DESIGNER S. WHITE
PROJECT NUMBER -
A 8/10/04 -
ISSUE DATE DESCRIPTION
HDR
McMILLEN ELDRIDGE
IDAHO POWER
An IDACORP Company
HELLS CANYON
FISH TRAP
IDAHO POWER CO.
BOISE, IDAHO
ALTERNATIVE NO. 2
UPPER LEVEL SITE PLAN
FILENAME Figure1-A2.dwg
SCALE 1" = 10'
FIGURE
7

FIGURE C-7



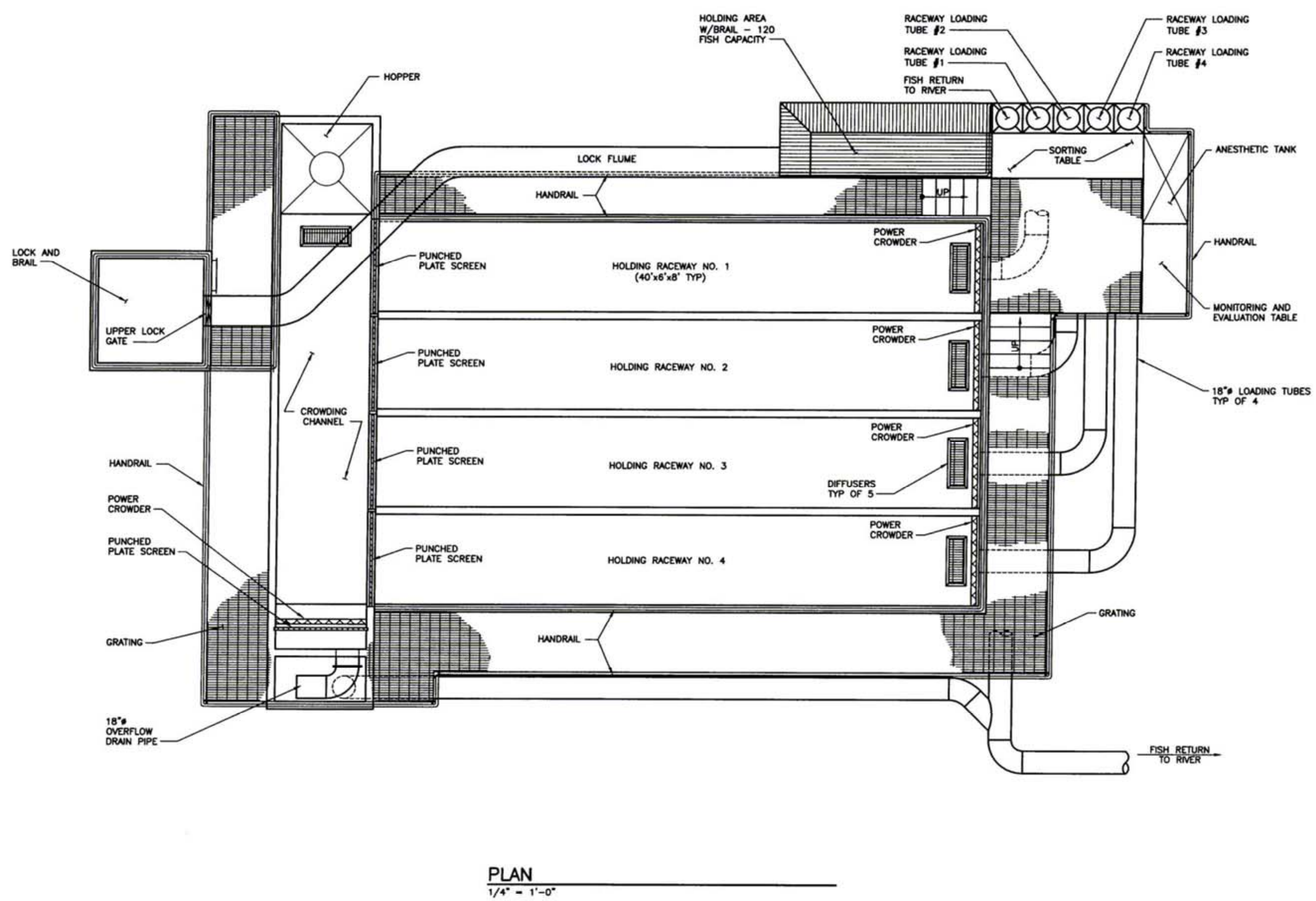
CROWDING BRAIL
DIFFUSER
POWER CROWDER
VEE TRAP
DIFFUSER
FISHWAY EXTENSION (13 POOLS)
LOCK
8'x20' CROWDING POOL
PLAN
1/4" = 1'-0"
PROJECT MANAGER M. McMILLEN
MECH'L. ENGINEER R. ELDRIDGE
DESIGNER S. WHITE
A 8/10/04 -
ISSUE DATE DESCRIPTION
PROJECT NUMBER -
HDR
McMILLEN ELDRIDGE
IDAHO POWER
An IDACORP Company
HELLS CANYON
FISH TRAP
IDAHO POWER CO.
BOISE, IDAHO
ALTERNATIVE NO. 2
PLAN VIEW AT FISH LADDER LEVEL
FILENAME Figure2-A2.dwg
SCALE 1/4" = 1'-0"
FIGURE
8


**FIGURE C-8**



1
2
3
4
C
B
A
Z
FOR ENLARGED PLAN, SEE FIGURE 2-A3
1530
1520
1510
1500
1490
1480
1520
1510
1500
SITE PLAN
1" = 10'
HDR
HDR Engineering, Inc.
A | 8/10/04 | –
ISSUE | DATE | DESCRIPTION
PROJECT MANAGER | M. McMILLEN
MECH'L. ENGINEER | R. ELDRIDGE
DESIGNER | S. WHITE
PROJECT NUMBER | –
ME McMILLEN ELDRIDGE
IDAHO POWER
An IDACORP Company
HELLS CANYON
FISH TRAP
IDAHO POWER CO.
BOISE, IDAHO
ALTERNATIVE NO. 3
UPPER LEVEL SITE PLAN
0 1" 2"
FILENAME Figure1-A3.dwg
SCALE 1" = 10'
FIGURE
9


**FIGURE C-9**




| | | |
|---|---|---|
| A | 8/10/04 | - |
| ISSUE | DATE | DESCRIPTION |

| | |
|---|---|
| PROJECT MANAGER | M. McMILLEN |
| MECH'L. ENGINEER | R. ELDRIDGE |
| DESIGNER | S. WHITE |
| PROJECT NUMBER | - |

HDR
HDR Engineering, Inc.

McMILLEN ELDRIDGE

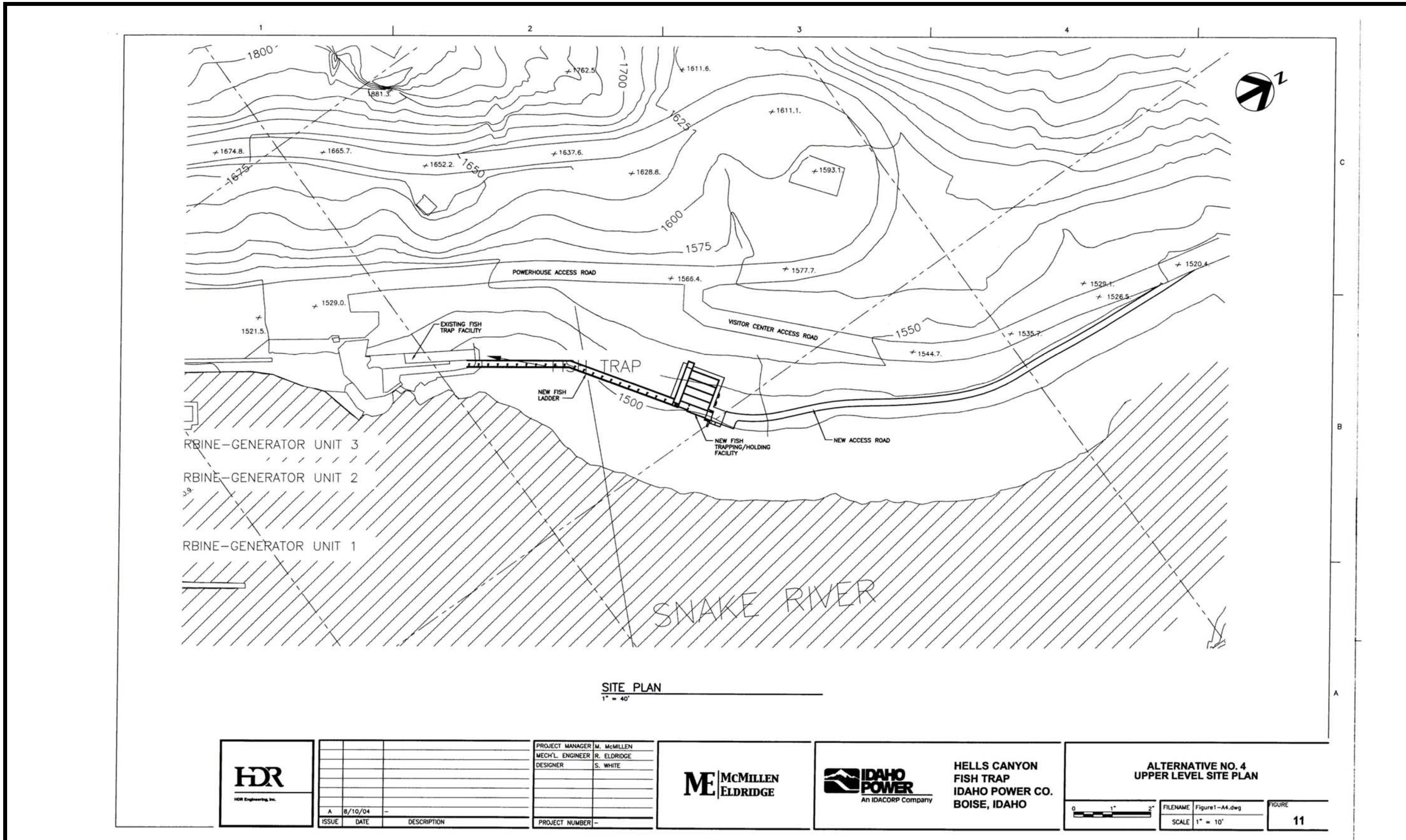
IDAHO POWER
An IDACORP Company

HELLS CANYON
FISH TRAP
IDAHO POWER CO.
BOISE, IDAHO

ALTERNATIVE NO. 3
PLAN AT RACEWAY LEVEL

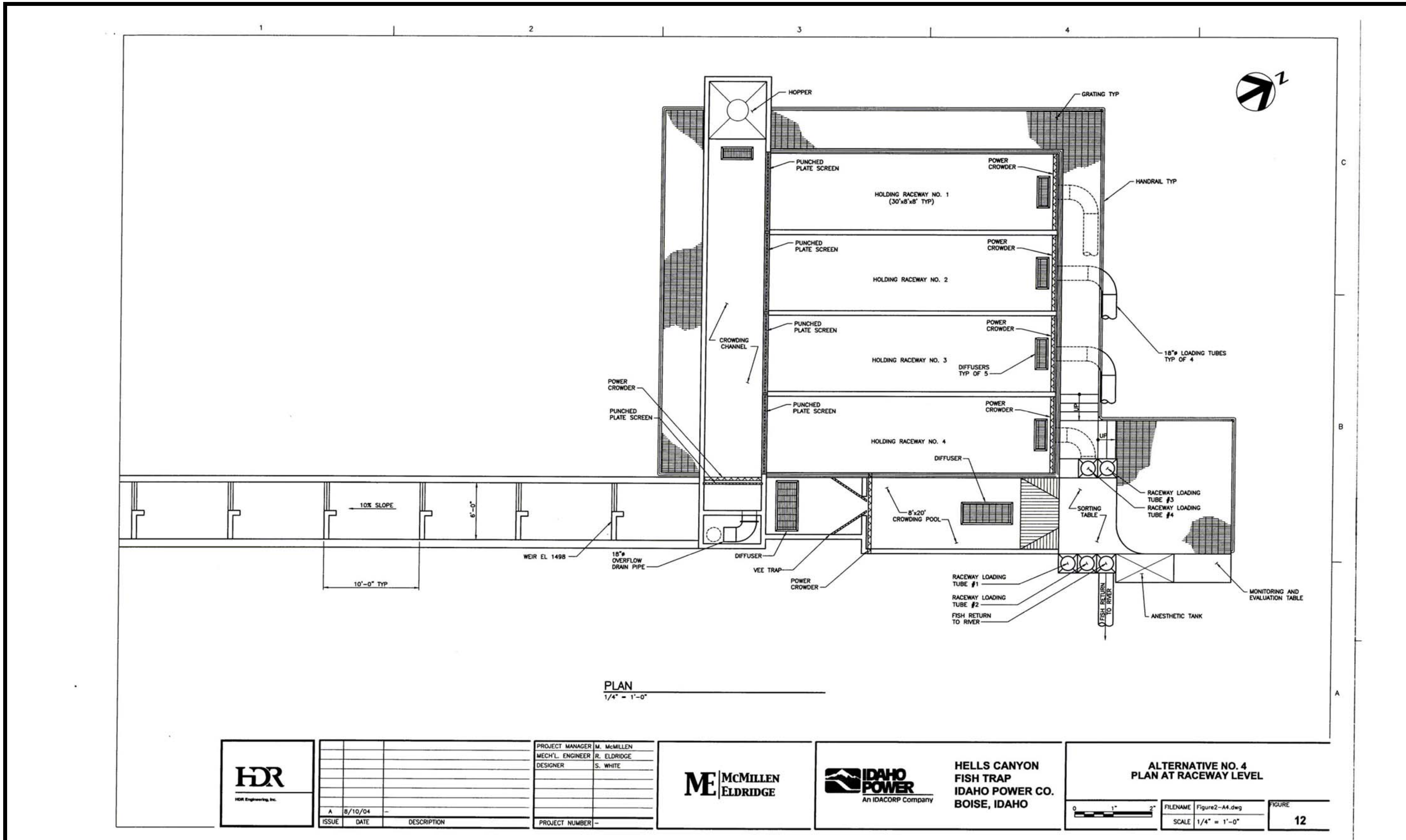
FILENAME Figure2-A3.dwg
SCALE 1/4" = 1'-0"
FIGURE 10

**FIGURE C-10**



POWERHOUSE ACCESS ROAD
VISITOR CENTER ACCESS ROAD
EXISTING FISH TRAP FACILITY
FISH TRAP
NEW FISH LADDER
NEW FISH TRAPPING/HOLDING FACILITY
NEW ACCESS ROAD
RBINE–GENERATOR UNIT 3
RBINE–GENERATOR UNIT 2
RBINE–GENERATOR UNIT 1
SNAKE RIVER
SITE PLAN
1" = 40'
PROJECT MANAGER M. McMILLEN
MECH'L. ENGINEER R. ELDRIDGE
DESIGNER S. WHITE
PROJECT NUMBER –
A 8/10/04 –
ISSUE DATE DESCRIPTION
HDR
McMILLEN ELDRIDGE
IDAHO POWER
An IDACORP Company
HELLS CANYON FISH TRAP
IDAHO POWER CO.
BOISE, IDAHO
ALTERNATIVE NO. 4
UPPER LEVEL SITE PLAN
FILENAME Figure1-A4.dwg
SCALE 1" = 10'
FIGURE 11


**FIGURE C-11**



HOPPER
GRATING TYP
PUNCHED PLATE SCREEN
POWER CROWDER
HOLDING RACEWAY NO. 1 (30'x8'x8' TYP)
HANDRAIL TYP
HOLDING RACEWAY NO. 2
HOLDING RACEWAY NO. 3
HOLDING RACEWAY NO. 4
CROWDING CHANNEL
18"φ LOADING TUBES TYP OF 4
DIFFUSERS TYP OF 5
DIFFUSER
10% SLOPE
6'-0"
8'x20' CROWDING POOL
SORTING TABLE
RACEWAY LOADING TUBE #3
RACEWAY LOADING TUBE #4
WEIR EL 1498
18"φ OVERFLOW DRAIN PIPE
VEE TRAP
10'-0" TYP
RACEWAY LOADING TUBE #1
RACEWAY LOADING TUBE #2
FISH RETURN TO RIVER
ANESTHETIC TANK
MONITORING AND EVALUATION TABLE
UP
PLAN
1/4" = 1'-0"
HDR
PROJECT MANAGER M. McMILLEN
MECH'L. ENGINEER R. ELDRIDGE
DESIGNER S. WHITE
A 8/10/04 –
ISSUE DATE DESCRIPTION
PROJECT NUMBER –
McMILLEN ELDRIDGE
IDAHO POWER An IDACORP Company
HELLS CANYON FISH TRAP IDAHO POWER CO. BOISE, IDAHO
ALTERNATIVE NO. 4 PLAN AT RACEWAY LEVEL
FILENAME Figure2-A4.dwg
SCALE 1/4" = 1'-0"
FIGURE 12


FIGURE C-12

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## Appendix D. Technical Memorandum No. 3, Revision 1—Final Alternative Development

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# TECHNICAL MEMORANDUM

| | |
|---|---|
| **To:** | Jim Chandler, Idaho Power Company |
| **Subject:** | Hells Canyon Trap Modifications<br>TM No. 3 – Final Alternative Development – Rev. 1 |
| **Prepared By:** | Mort McMillen<br>Ray Eldridge |
| **Date:** | September 15, 2004 |

## INTRODUCTION

This technical memorandum presents additional details for the conceptual alternative development for Idaho Power Company's (IPC) Hells Canyon Trap Modifications. This technical memorandum is the third of three, including:

- TM No. 1 Design Criteria
- TM No. 2 Alternative Development
- TM No. 3 Final Alternative Development

TM No. 1 outlined the design criteria which is being used to develop the conceptual design alternatives as well as the functional design details for the recommended alternative. These criteria include biological, water quality, hydraulic and hydrology, fish passage, sorting and holding, anesthetic, fish return, holding raceways, and truck loading and mechanical systems.

TM No. 2 presented conceptual design alternatives for modifying the existing trapping facility. The TM outlined four basic alternatives which were presented at the August 11-12, 2004 agency meeting. The alternatives presented at this meeting were designed to facilitate discussion between IPC and the resources agencies.

From this meeting, two alternatives were identified for additional analysis and evaluation. These alternatives were a modified Alternative 3 and a new Alternative 5. Alternative 3 consists of modifying the existing fish ladder and holding area, adding a fish lock/lift, and an elevated sorting/holding/loading facility. Alternative 5 is similar, with a lengthened fish ladder that eliminates the lock ahead of the sorting/holding/loading facility.

TM No. 3 presents additional description and evaluation of Alternatives 3 and 5, to assist IPC and the resource agencies in selecting a recommended alternative.

## DESCRIPTION OF ALTERNATIVES

The two final alternatives for the Hells Canyon Fish Trap Modifications, referred to as Alternatives No. 3 and 5 are described in the following text and figures. Figure 1 shows the existing site plan for reference.

**Alternative 3**

Alternative 3 is shown on Figures 2 – 4. The alternative takes advantage of existing facilities, where possible, and provides significant improvements to meet the new operational objectives of the trap. The existing fishway entrance and lower portion of the fishway will remain in place, along with the water supply pumps, intake, and jib cranes. The bend in the existing fish ladder would be demolished and four additional pools would be added. A second fish entrance would be added to improve passage at high flows. This second entrance would be located in pool No. 9, near the end of the existing turning pool. At river flows below 30,000 cfs, the existing lower entrance would be used; at flows between approximately 30,000 cfs and 50,000 cfs, the lower entrance would be closed and the upper entrance would be used.

The existing precast concrete fishway weirs would be removed and reconstructed above pool number seven and the grade of the fishway floor would be raised. The existing trap area (including jump over weirs, bar rack, holding pool/crowder, and hopper) would be demolished and a new Vee trap, photoelectric counter, holding and crowding pool, and lock would be installed in the same area.

Once fish pass through the fishway and Vee trap, they would be crowded to the lock using a vertically oriented power crowder. A lower lock slide gate will contain crowded fish in the lock as well as provide a water-tight closure for lock filling. Once in the lock, fish will be raised to a flume level by pumping water into the lock and operating a trailing brail beneath the fish. Fish will be "metered" into the flume by varying the lock brail level, thereby controlling the rate at which fish load the flume. Once in the flume, fish will be transported past a pneumatic sorting gate and on to an anesthetic tank. The purpose of the pneumatic sorter is to allow operators to direct fish back to the river, avoiding anesthetizing and manual sorting of fish which are present in the system but not targeted for hauling or monitoring and evaluation. This is expected to be useful when the trap is operated for chinook or resident fish, only, and high numbers of steelhead are present in the river.

There are two anesthetic options considered at present, including clove oil and $CO_2$; the facilities shown on the drawings can accommodate either method. Anesthetized fish will be lifted from the tank to a manual sorting table where fish will be returned directly to the river, after recovery, or to one of three holding raceways. A monitoring and evaluation and recovery area are also provided in the sorting area.

The raceways would be 40 feet in length, 6 feet in width, and 8 feet in depth. The normal water level in raceways will be 4 feet to provide a total holding volume of 960 cubic feet per raceway. Each raceway would be provided with a power crowder. Either a slide gate or punched plate screen will separate the raceways from the crowding channel. A common crowding channel will be provided at the downstream end of the raceways that will move fish to a hopper using a power crowder. The hopper would be lifted by the existing jib crane to the up-slope truck loading area.

Water would be supplied to the raceways and crowding channel with floor diffusers; raceway discharge can be either through the punched plate into the crowding channel or through floor drains into the drain channel. Raceway and crowding channel water depth can be varied by isolating individual raceways with slide gates and varying the elevation of the overflow drain which discharges to the drain channel. This will allow individual raceways to be dropped for fish handling and maintenance.

It is expected that the raceways and lock will be constructed of steel and the hopper will be constructed of aluminum. The crowding pool and fishway modifications would be constructed of reinforced concrete.

**Alternative 5**

Alternative 5 is shown on Figures 5 – 7. This alternative adds 18 pools to the existing fishway and provides “swim-in” access to the sorting facilities, eliminating the need for the fish lock presented in Alternative 3. Key elements of the alternative include the fishway, trapping area, and sorting and holding facilities.

Alternative 5 uses the lower portion of the existing fishway from the entrance through Pool No. 7. Beyond Pool No. 7, the auxiliary water channel is extended to deliver water to a new wall diffuser that provides water to a new high flow entrance. Similar to Alternative 3, the high flow entrance will operate at flows between approximately 30,000 cfs and 50,000 cfs. Beyond the second entrance, the fish ladder is extended north approximately 100 feet to provide the additional 18 pools (using a switchback, common wall design). Like the existing design, fishway pools will be nominally six feet wide by ten feet in length and use half Ice Harbor weirs.

Once fish ascend the ladder, they will encounter a Vee trap and photoelectric counter. The Vee trap is a passive device that helps prevent fall back of fish. At the throat of the Vee trap, a photoelectric counter will be installed to enumerate numbers of fish and provide operators an accurate estimate of how many fish are being held in the crowding/holding pool. The crowding/holding pool is a 7.5-foot wide x 34-foot long x 4-foot deep (water depth) reinforced concrete channel. Water supplied to the pool by a floor diffuser and surface spray will help prevent jumping. A vertically oriented power crowder will move fish to a lifting area. After crowding, the lift area will be isolated from the holding pool with a sluice gate. The lift will have a sloping brail floor that raises fish six feet vertically where they will transfer to a flume.

The fish lift and flume transition fish from the fishway level to the sorting and holding area. Similar to Alternative 3, the flume will include a visual sorting area and pneumatic gate to allow direct return of fish to the river. The sorting, holding and hauling operation for Alternative 5 is the same as discussed above for Alternative 3.

## ALTERNATIVE EVALUATION

Table 1 presents a summary of the key features of the two alternatives. There is no significant difference in the functionality between the alternatives, only in how fish are elevated to the sorting and holding area – Alternative 3 uses a lock to accomplish this while Alternative 5 uses a combination of fishway and lift. Figures 8 and 9 show hydraulic profiles of each alternative. The hydraulic profile best illustrates the key differences between the alternatives.

**Table 1. Key Features of Alternatives**

| Feature | Alternative 3 | Alternative 5 |
|---|---|---|
| Entrances | Low and High Flow | Low and High Flow |
| Elevation Gain to Sorting | Lock | Extended Fishway & Lift |
| Number of Fishway Pools | 19 | 33 |
| Trapping Method | Vee Trap | Vee Trap |
| Counting | Photoelectric | Photoelectric |
| Sorting Method | Hand and Gate | Hand and Gate |
| Number of Holding Raceways | 3 | 3 |
| Truck Loading Method | Hopper | Hopper |

Table 2 presents a preliminary listing of advantages and disadvantages of each alternative.

**Table 2. Advantages and Disadvantage of Alternatives**

| | Advantages | Disadvantages |
|---|---|---|
| **Alternative 3** | • Lower construction cost<br>• Least impact to sensitive area<br>• Greater flume length for visual sorting | • Longer cycle time w/ lock |
| **Alternative 5** | • Shorter cycle time w/ lift | • Higher construction cost<br>• Greater exposure to rock falls on fishway<br>• Extensive construction in difficult and sensitive area |

## CONSTRUCTION COST ESTIMATES

Conceptual level construction cost estimates were prepared for each of the alternatives and are included in Table 3. These estimates were based on the facilities presented in Figures 2 - 7. Since the drawings and facilities are conceptual, the estimates are assumed to be accurate to +/- 50% of actual construction costs. Changes in facility function, layout, materials and pricing will materially affect construction costs. The cost of engineering, construction management, permitting and environmental compliance, and IPC’s internal construction overhead is not included in the estimates.

**Table 3. Conceptual Level Construction Cost Estimates**

| | Low Range | Estimate | High Range |
|---|---|---|---|
| **Alternative 3** | $1,550,000 | $3,100,000 | $4,650,000 |
| **Alternative 5** | $2,060,000 | $4,110,000 | $6,170,000 |

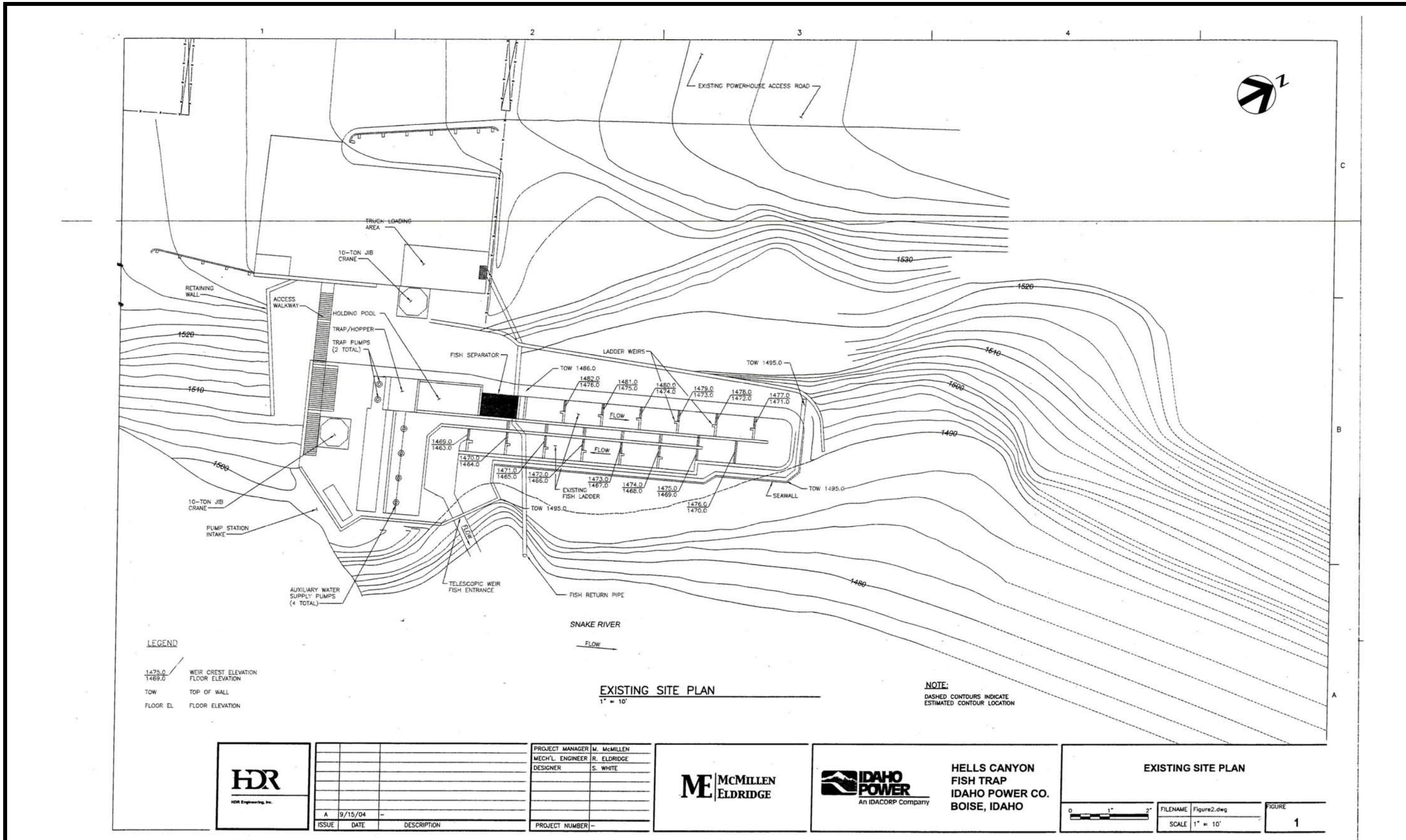

EXISTING POWERHOUSE ACCESS ROAD
TRUCK LOADING AREA
10-TON JIB CRANE
RETAINING WALL
ACCESS WALKWAY
HOLDING POOL
TRAP/HOPPER
TRAP PUMPS (2 TOTAL)
FISH SEPARATOR
TOW 1486.0
LADDER WEIRS
TOW 1495.0
1482.0
1476.0
1481.0
1475.0
1480.0
1474.0
1479.0
1473.0
1478.0
1472.0
1477.0
1471.0
FLOW
1469.0
1463.0
1470.0
1464.0
1471.0
1465.0
1472.0
1466.0
1473.0
1467.0
1474.0
1468.0
1475.0
1469.0
1476.0
1470.0
EXISTING FISH LADDER
TOW 1495.0
SEAWALL
10-TON JIB CRANE
PUMP STATION INTAKE
AUXILIARY WATER SUPPLY PUMPS (4 TOTAL)
TELESCOPIC WEIR FISH ENTRANCE
FISH RETURN PIPE
1530
1520
1510
1500
1490
1480
SNAKE RIVER
FLOW
LEGEND
1475.0 / 1469.0 WEIR CREST ELEVATION FLOOR ELEVATION
TOW TOP OF WALL
FLOOR EL FLOOR ELEVATION
EXISTING SITE PLAN
1" = 10'
NOTE:
DASHED CONTOURS INDICATE ESTIMATED CONTOUR LOCATION
HDR
HDR Engineering, Inc.
A 9/15/04 –
ISSUE DATE DESCRIPTION
PROJECT MANAGER M. McMILLEN
MECH'L. ENGINEER R. ELDRIDGE
DESIGNER S. WHITE
PROJECT NUMBER –
McMILLEN ELDRIDGE
IDAHO POWER
An IDACORP Company
HELLS CANYON FISH TRAP
IDAHO POWER CO.
BOISE, IDAHO
EXISTING SITE PLAN
FILENAME Figure2.dwg
SCALE 1" = 10'
FIGURE 1

**FIGURE D-1**

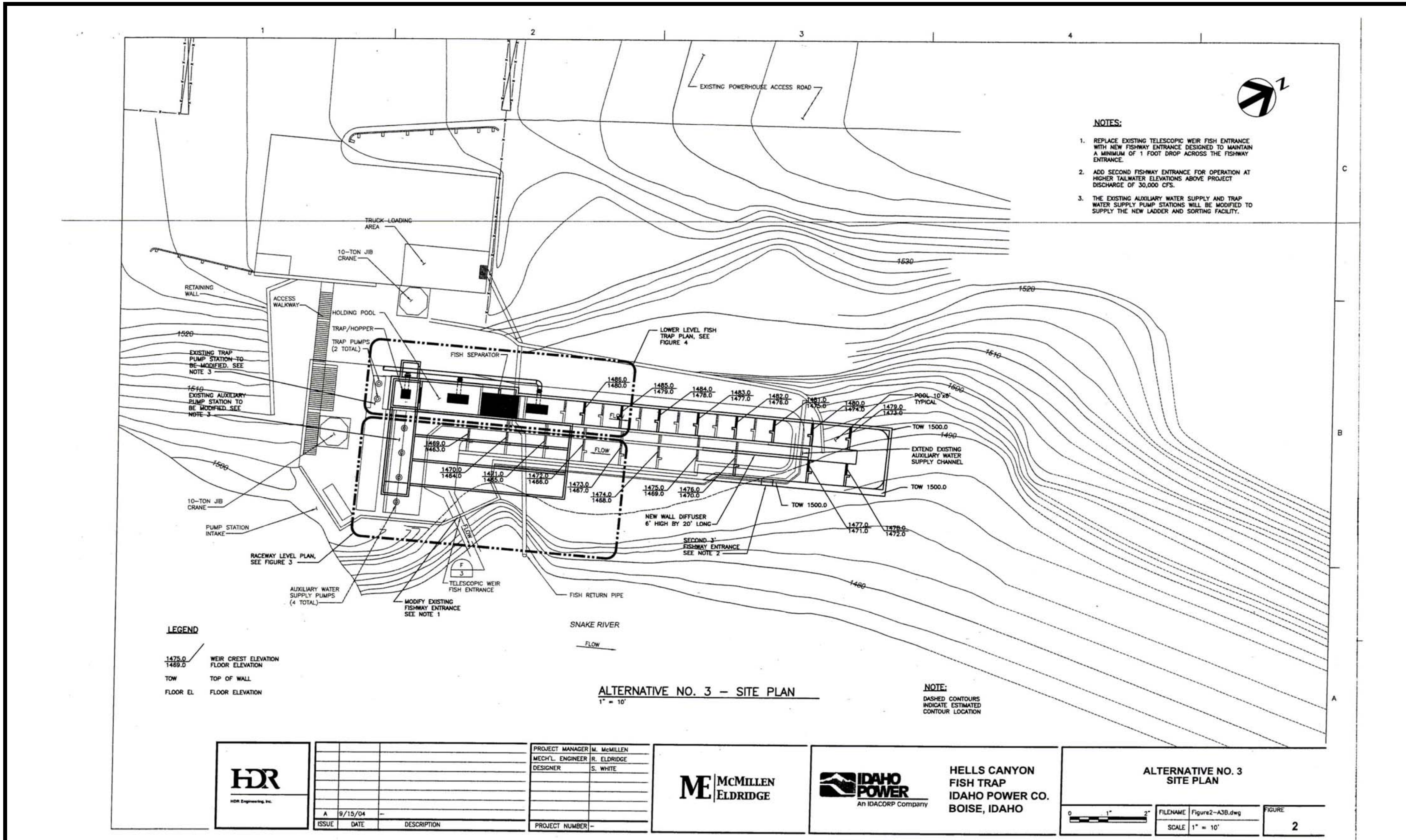
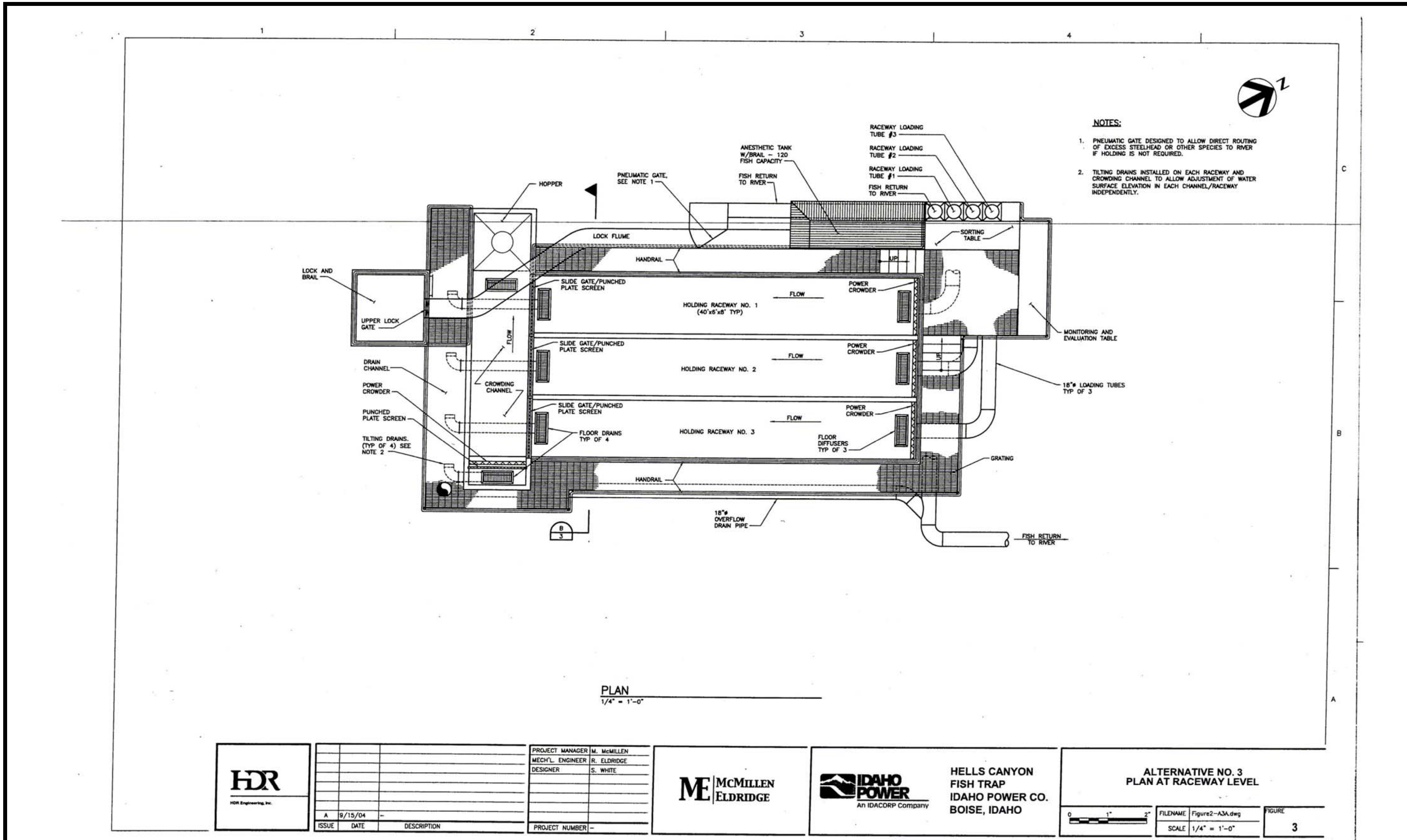

EXISTING POWERHOUSE ACCESS ROAD
NOTES:
1. REPLACE EXISTING TELESCOPIC WEIR FISH ENTRANCE WITH NEW FISHWAY ENTRANCE DESIGNED TO MAINTAIN A MINIMUM OF 1 FOOT DROP ACROSS THE FISHWAY ENTRANCE.
2. ADD SECOND FISHWAY ENTRANCE FOR OPERATION AT HIGHER TAILWATER ELEVATIONS ABOVE PROJECT DISCHARGE OF 30,000 CFS.
3. THE EXISTING AUXILIARY WATER SUPPLY AND TRAP WATER SUPPLY PUMP STATIONS WILL BE MODIFIED TO SUPPLY THE NEW LADDER AND SORTING FACILITY.
TRUCK LOADING AREA
10-TON JIB CRANE
RETAINING WALL
ACCESS WALKWAY
HOLDING POOL
TRAP/HOPPER
TRAP PUMPS (2 TOTAL)
EXISTING TRAP PUMP STATION TO BE MODIFIED, SEE NOTE 3
EXISTING AUXILIARY PUMP STATION TO BE MODIFIED SEE NOTE 3
FISH SEPARATOR
LOWER LEVEL FISH TRAP PLAN, SEE FIGURE 4
POOL 10'x8' TYPICAL
TOW 1500.0
EXTEND EXISTING AUXILIARY WATER SUPPLY CHANNEL
NEW WALL DIFFUSER 6' HIGH BY 20' LONG
SECOND 3' FISHWAY ENTRANCE SEE NOTE 2
10-TON JIB CRANE
PUMP STATION INTAKE
RACEWAY LEVEL PLAN, SEE FIGURE 3
AUXILIARY WATER SUPPLY PUMPS (4 TOTAL)
MODIFY EXISTING FISHWAY ENTRANCE SEE NOTE 1
TELESCOPIC WEIR FISH ENTRANCE
FISH RETURN PIPE
SNAKE RIVER
FLOW
LEGEND
1475.0 / 1469.0 WEIR CREST ELEVATION / FLOOR ELEVATION
TOW TOP OF WALL
FLOOR EL FLOOR ELEVATION
ALTERNATIVE NO. 3 – SITE PLAN
1" = 10'
NOTE:
DASHED CONTOURS INDICATE ESTIMATED CONTOUR LOCATION
PROJECT MANAGER M. McMILLEN
MECH'L. ENGINEER R. ELDRIDGE
DESIGNER S. WHITE
A 9/15/04 –
ISSUE DATE DESCRIPTION
PROJECT NUMBER –
HDR Engineering, Inc.
McMILLEN ELDRIDGE
IDAHO POWER An IDACORP Company
HELLS CANYON FISH TRAP
IDAHO POWER CO.
BOISE, IDAHO
ALTERNATIVE NO. 3 SITE PLAN
FILENAME Figure2-A3B.dwg
SCALE 1" = 10'
FIGURE 2

**FIGURE D-2**


NOTES:
1. PNEUMATIC GATE DESIGNED TO ALLOW DIRECT ROUTING OF EXCESS STEELHEAD OR OTHER SPECIES TO RIVER IF HOLDING IS NOT REQUIRED.
2. TILTING DRAINS INSTALLED ON EACH RACEWAY AND CROWDING CHANNEL TO ALLOW ADJUSTMENT OF WATER SURFACE ELEVATION IN EACH CHANNEL/RACEWAY INDEPENDENTLY.
RACEWAY LOADING TUBE #3
RACEWAY LOADING TUBE #2
RACEWAY LOADING TUBE #1
FISH RETURN TO RIVER
ANESTHETIC TANK W/BRAIL – 120 FISH CAPACITY
FISH RETURN TO RIVER
PNEUMATIC GATE, SEE NOTE 1
HOPPER
LOCK FLUME
HANDRAIL
SORTING TABLE
UP
LOCK AND BRAIL
UPPER LOCK GATE
SLIDE GATE/PUNCHED PLATE SCREEN
HOLDING RACEWAY NO. 1 (40'x6'x8' TYP)
FLOW
POWER CROWDER
MONITORING AND EVALUATION TABLE
DRAIN CHANNEL
SLIDE GATE/PUNCHED PLATE SCREEN
HOLDING RACEWAY NO. 2
FLOW
POWER CROWDER
18"⌀ LOADING TUBES TYP OF 3
POWER CROWDER
CROWDING CHANNEL
FLOW
PUNCHED PLATE SCREEN
SLIDE GATE/PUNCHED PLATE SCREEN
HOLDING RACEWAY NO. 3
FLOW
POWER CROWDER
FLOOR DRAINS TYP OF 4
FLOOR DIFFUSERS TYP OF 3
TILTING DRAINS. (TYP OF 4) SEE NOTE 2
GRATING
HANDRAIL
18"⌀ OVERFLOW DRAIN PIPE
B
3
FISH RETURN TO RIVER
PLAN
1/4" = 1'-0"
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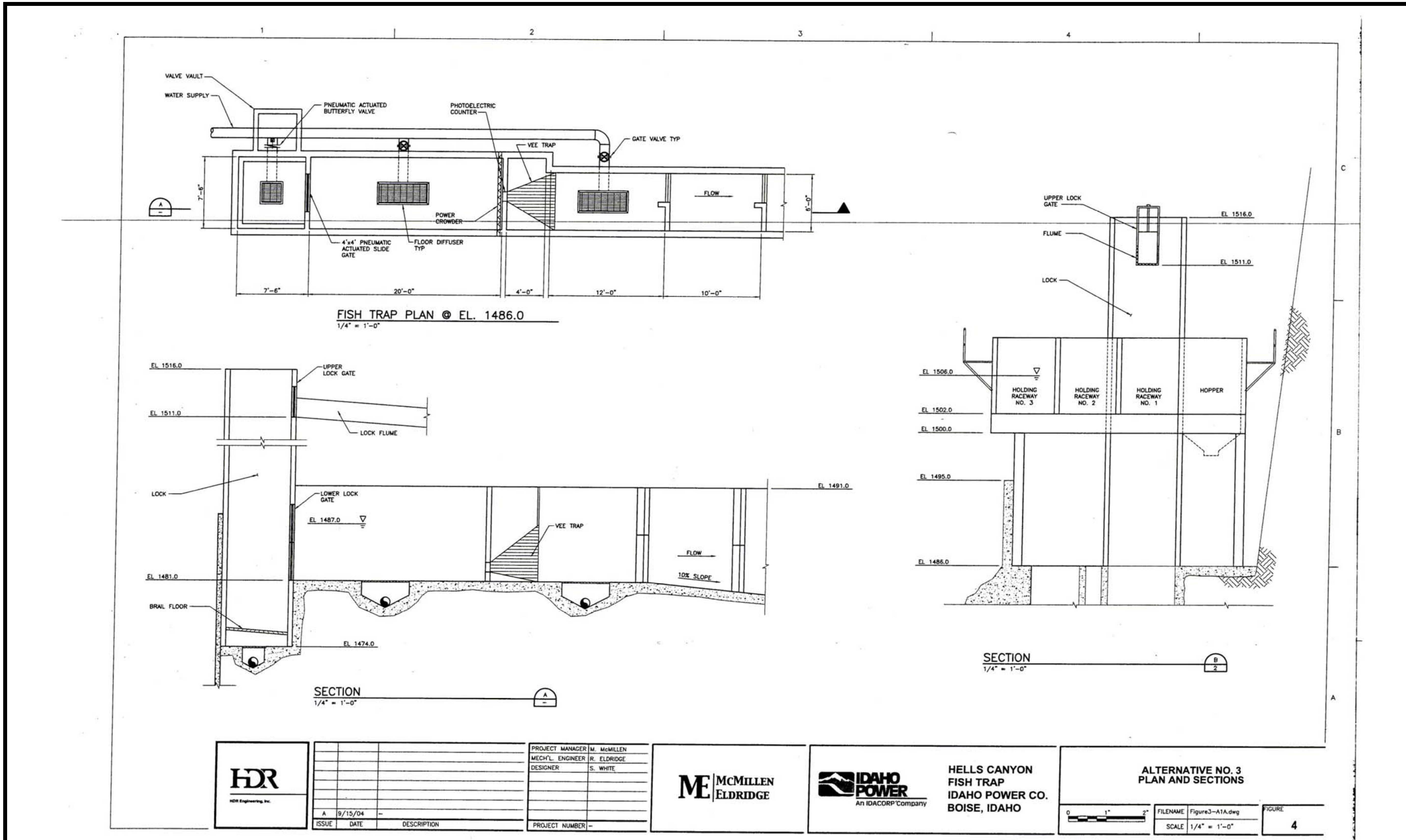
MECH'L. ENGINEER R. ELDRIDGE
DESIGNER S. WHITE
PROJECT NUMBER –
ME McMILLEN ELDRIDGE
IDAHO POWER An IDACORP Company
HELLS CANYON FISH TRAP
IDAHO POWER CO.
BOISE, IDAHO
ALTERNATIVE NO. 3
PLAN AT RACEWAY LEVEL
0 1" 2"
FILENAME Figure2–A3A.dwg
SCALE 1/4" = 1'-0"
FIGURE 3

**FIGURE D-3**



VALVE VAULT
WATER SUPPLY
PNEUMATIC ACTUATED BUTTERFLY VALVE
PHOTOELECTRIC COUNTER
VEE TRAP
GATE VALVE TYP
FLOW
POWER CROWDER
4'x4' PNEUMATIC ACTUATED SLIDE GATE
FLOOR DIFFUSER TYP
7'-6"
20'-0"
4'-0"
12'-0"
10'-0"
FISH TRAP PLAN @ EL. 1486.0
1/4" = 1'-0"
EL 1516.0
UPPER LOCK GATE
EL 1511.0
LOCK FLUME
LOCK
LOWER LOCK GATE
EL 1487.0
VEE TRAP
EL 1491.0
FLOW
10% SLOPE
EL 1481.0
BRAIL FLOOR
EL 1474.0
SECTION
1/4" = 1'-0"
UPPER LOCK GATE
EL 1516.0
FLUME
EL 1511.0
LOCK
EL 1506.0
HOLDING RACEWAY NO. 3
HOLDING RACEWAY NO. 2
HOLDING RACEWAY NO. 1
HOPPER
EL 1502.0
EL 1500.0
EL 1495.0
EL 1486.0
SECTION
1/4" = 1'-0"
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An IDACORP Company
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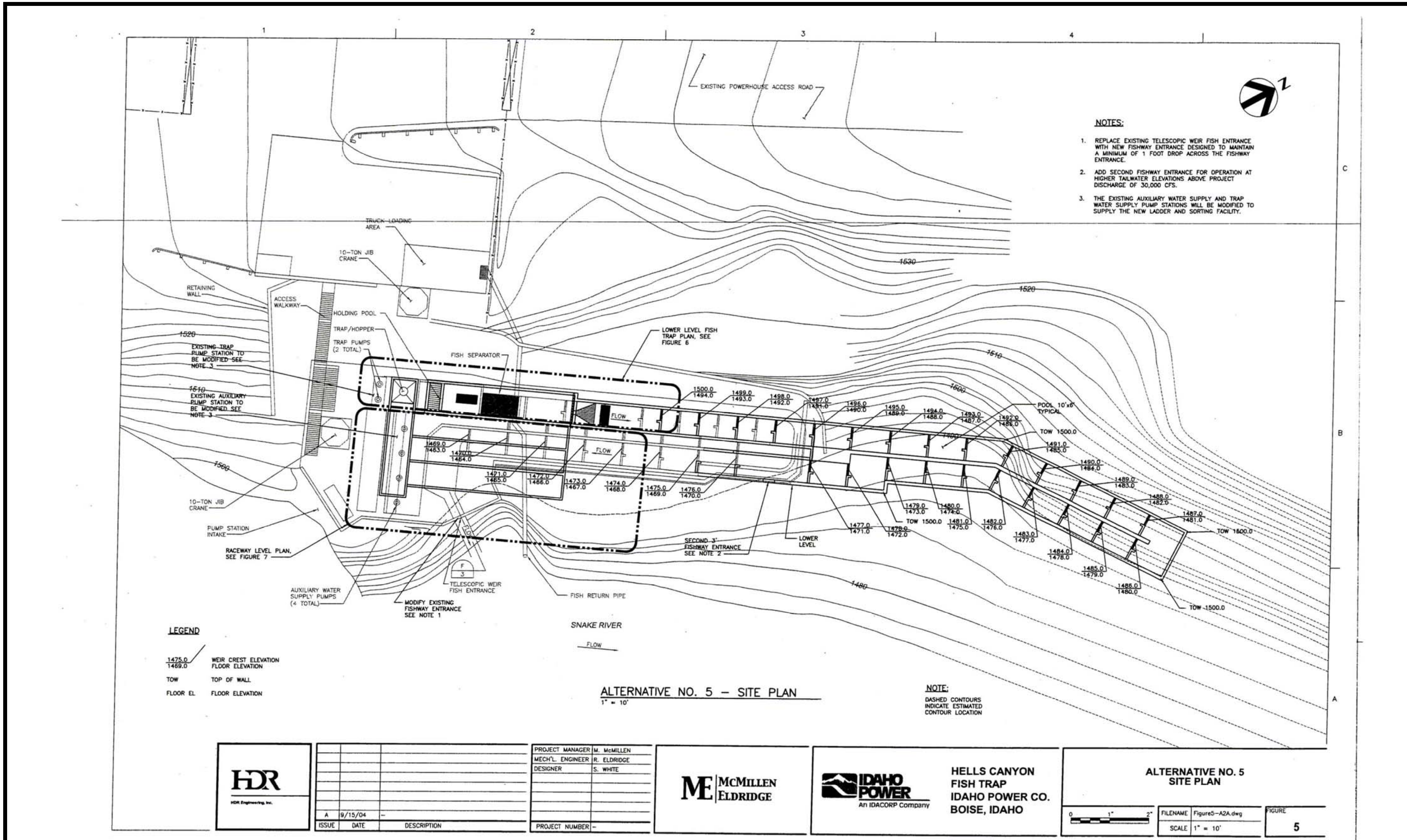
IDAHO POWER CO.
BOISE, IDAHO
ALTERNATIVE NO. 3
PLAN AND SECTIONS
FILENAME Figure3-A1A.dwg
SCALE 1/4" = 1'-0"
FIGURE 4


**FIGURE D-4**


EXISTING POWERHOUSE ACCESS ROAD
NOTES:
1. REPLACE EXISTING TELESCOPIC WEIR FISH ENTRANCE WITH NEW FISHWAY ENTRANCE DESIGNED TO MAINTAIN A MINIMUM OF 1 FOOT DROP ACROSS THE FISHWAY ENTRANCE.
2. ADD SECOND FISHWAY ENTRANCE FOR OPERATION AT HIGHER TAILWATER ELEVATIONS ABOVE PROJECT DISCHARGE OF 30,000 CFS.
3. THE EXISTING AUXILIARY WATER SUPPLY AND TRAP WATER SUPPLY PUMP STATIONS WILL BE MODIFIED TO SUPPLY THE NEW LADDER AND SORTING FACILITY.
TRUCK LOADING AREA
10-TON JIB CRANE
RETAINING WALL
ACCESS WALKWAY
HOLDING POOL
TRAP/HOPPER
TRAP PUMPS (2 TOTAL)
FISH SEPARATOR
LOWER LEVEL FISH TRAP PLAN, SEE FIGURE 6
EXISTING TRAP PUMP STATION TO BE MODIFIED SEE NOTE 3
EXISTING AUXILIARY PUMP STATION TO BE MODIFIED SEE NOTE 3
POOL 10'x6' TYPICAL
TOW 1500.0
10-TON JIB CRANE
PUMP STATION INTAKE
RACEWAY LEVEL PLAN, SEE FIGURE 7
SECOND 3' FISHWAY ENTRANCE SEE NOTE 2
LOWER LEVEL
TELESCOPIC WEIR FISH ENTRANCE
FISH RETURN PIPE
AUXILIARY WATER SUPPLY PUMPS (4 TOTAL)
MODIFY EXISTING FISHWAY ENTRANCE SEE NOTE 1
SNAKE RIVER
FLOW
LEGEND
1475.0 / 1469.0 WEIR CREST ELEVATION / FLOOR ELEVATION
TOW TOP OF WALL
FLOOR EL FLOOR ELEVATION
ALTERNATIVE NO. 5 – SITE PLAN
1" = 10'
NOTE:
DASHED CONTOURS INDICATE ESTIMATED CONTOUR LOCATION
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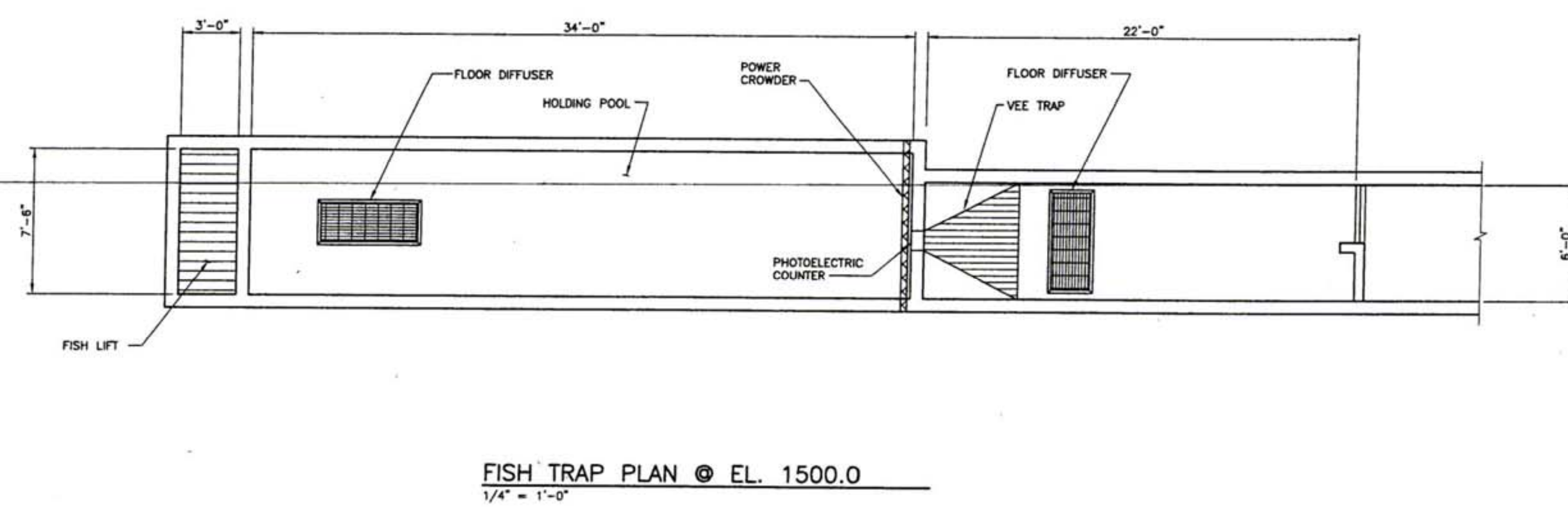
An IDACORP Company
HELLS CANYON FISH TRAP
IDAHO POWER CO.
BOISE, IDAHO
ALTERNATIVE NO. 5 SITE PLAN
FILENAME Figure5–A2A.dwg
SCALE 1" = 10'
FIGURE 5

**FIGURE D-5**

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An IDACORP Company

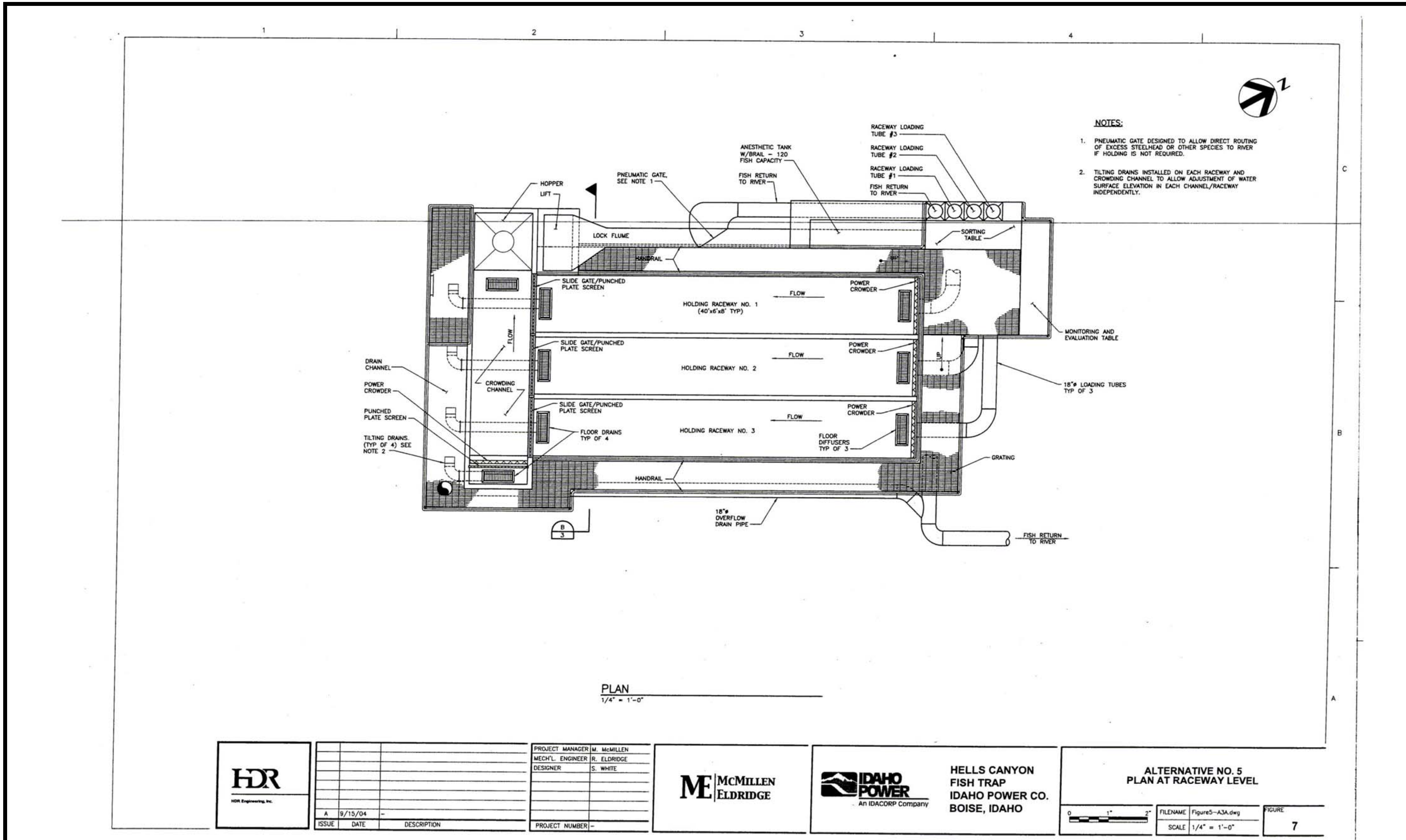
HELLS CANYON
FISH TRAP
IDAHO POWER CO.
BOISE, IDAHO

ALTERNATIVE NO. 5
FISH TRAP PLAN @ EL. 1500.0

0 1" 2"

FILENAME Figure5–A1A.dwg
SCALE 1/4" = 1'-0"
FIGURE 6

**FIGURE D-6**


NOTES:
1. PNEUMATIC GATE DESIGNED TO ALLOW DIRECT ROUTING OF EXCESS STEELHEAD OR OTHER SPECIES TO RIVER IF HOLDING IS NOT REQUIRED.
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RACEWAY LOADING TUBE #3
RACEWAY LOADING TUBE #2
RACEWAY LOADING TUBE #1
FISH RETURN TO RIVER
ANESTHETIC TANK W/BRAIL – 120 FISH CAPACITY
FISH RETURN TO RIVER
PNEUMATIC GATE, SEE NOTE 1
HOPPER
LIFT
LOCK FLUME
HANDRAIL
SORTING TABLE
SLIDE GATE/PUNCHED PLATE SCREEN
HOLDING RACEWAY NO. 1 (40'x6'x8' TYP)
FLOW
POWER CROWDER
MONITORING AND EVALUATION TABLE
SLIDE GATE/PUNCHED PLATE SCREEN
HOLDING RACEWAY NO. 2
FLOW
POWER CROWDER
DRAIN CHANNEL
POWER CROWDER
CROWDING CHANNEL
18"ø LOADING TUBES TYP OF 3
SLIDE GATE/PUNCHED PLATE SCREEN
HOLDING RACEWAY NO. 3
FLOW
POWER CROWDER
PUNCHED PLATE SCREEN
FLOOR DRAINS TYP OF 4
FLOOR DIFFUSERS TYP OF 3
TILTING DRAINS. (TYP OF 4) SEE NOTE 2
GRATING
HANDRAIL
18"ø OVERFLOW DRAIN PIPE
FISH RETURN TO RIVER
PLAN
1/4" = 1'-0"
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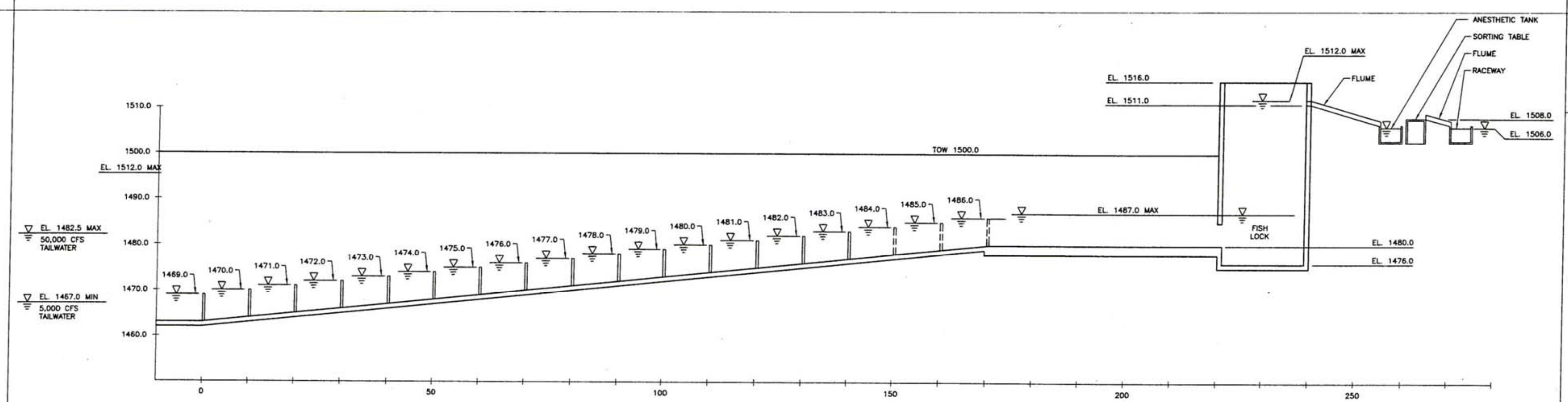
ALTERNATIVE NO. 5
PLAN AT RACEWAY LEVEL
FILENAME Figure5–A3A.dwg
SCALE 1/4" = 1'-0"
FIGURE 7

**FIGURE D-7**




HYDRAULIC PROFILE – ALTERNATIVE 3

3/32" = 1'-0"

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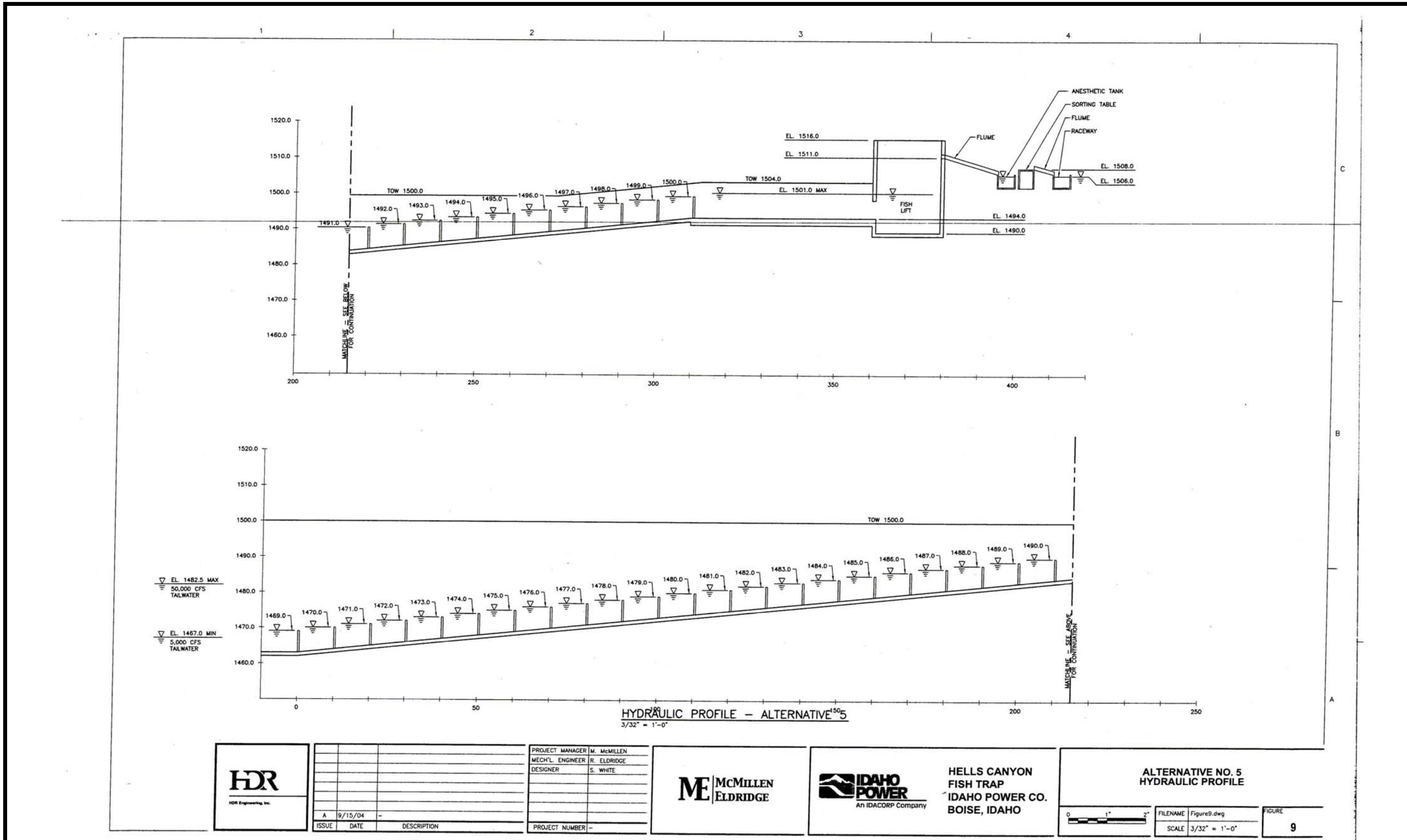
An IDACORP Company

HELLS CANYON
FISH TRAP
IDAHO POWER CO.
BOISE, IDAHO

ALTERNATIVE NO. 3
HYDRAULIC PROFILE

FILENAME Figure8.dwg
SCALE 3/32" = 1'-0"
FIGURE 8

**FIGURE D-8**


ANESTHETIC TANK
SORTING TABLE
FLUME
RACEWAY
EL. 1516.0
EL. 1511.0
TOW 1504.0
EL. 1501.0 MAX
FISH LIFT
EL. 1508.0
EL. 1506.0
EL. 1494.0
EL. 1490.0
TOW 1500.0
MATCHLINE – SEE BELOW FOR CONTINUATION
MATCHLINE – SEE ABOVE FOR CONTINUATION
EL. 1482.5 MAX
50,000 CFS TAILWATER
EL. 1467.0 MIN
5,000 CFS TAILWATER
HYDRAULIC PROFILE – ALTERNATIVE 5
3/32" = 1'-0"
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IDAHO POWER CO.
BOISE, IDAHO
ALTERNATIVE NO. 5
HYDRAULIC PROFILE
FILENAME Figure9.dwg
SCALE 3/32" = 1'-0"
FIGURE 9

**FIGURE D-9**