

FISHERIES MONITORING SYSTEM: CATHERINE CREEK PIT TAG INTERROGATION SYSTEMS

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February 29, 2012

Background

Currently, water is diverted from Catherine Creek, a tributary of the Grande Ronde River in Union County, Oregon, into a series of canals that are used to supply water for irrigation purposes. The impact of these water diversions on entrainment of local salmonid stocks, such as steelhead trout (*Oncorhynchus mykiss*) and Endangered Species Act (ESA) listed Snake River spring/summer Chinook salmon (*O. tshawytscha*), is currently unknown. Increasingly, fish passage near water diversion structures has been monitored using passive integrated transponder (PIT) tag interrogation systems to assess entrainment, behavior/movement, and loss/mortality of fish that have been previously implanted with PIT transmitters. In 2010, Abernathy Fish Technology Center (AFTC) was requested to construct and install four PIT tag interrogation systems within the Catherine Creek watershed. The goal of these systems was to provide at least a 90% detection/recognition rate for PIT-tagged salmon moving through the Catherine Creek watershed. This report details the construction, site locations, and installation methods for each PIT tag interrogation system, and a list of equipment delivered (Appendix 1).

Construction Methods and Site Descriptions

Site #1: Johnson

The first PIT tag interrogation system was located on Catherine Creek at N 45.30549° W 117.86732°. The system consisted of six antennas placed end to end that spanned the waterway in two parallel rows (Fig. 1). Each individual antenna was constructed of a single loop of Category-6 Ethernet cable encased in a waterproof housing of 4in Schedule 80 poly-vinyl chloride (PVC) pipe. The dimensions of all individual antennas were held constant at 12ft, 11-3/8in long by 2ft, 5-1/4in wide (Fig. 2). Given the potential for high flows and debris loading,

each antenna was anchored flush with the substrate of the creek in a pass-over configuration using six screw anchors, one at each corner of the antenna and two in the middle of the longest pipe segments. Antennas were connected to a Destron Fearing multiplexer (FS 1001M) mounted in a NEMA box placed on a bluff above the creek via a 53ft cable (12 gauge twinaxial). The multiplexer was powered by two solar panels (215W 29Vmp) (Fig. 3), and was connected to a fanless industrial computer (Advantech UNO-1150-S) for data storage (Fig. 4). The data storage computer was also connected to a cellular modem (Pantech UML290) to allow for automatic upload of data to the PIT Tag Information System (PTAGIS).

Fig. 1: Antenna configuration of the PIT tag interrogation system installed at the Johnson site.



Fig. 2: Line drawing of the dimensions of the antennas installed at the Johnson site.

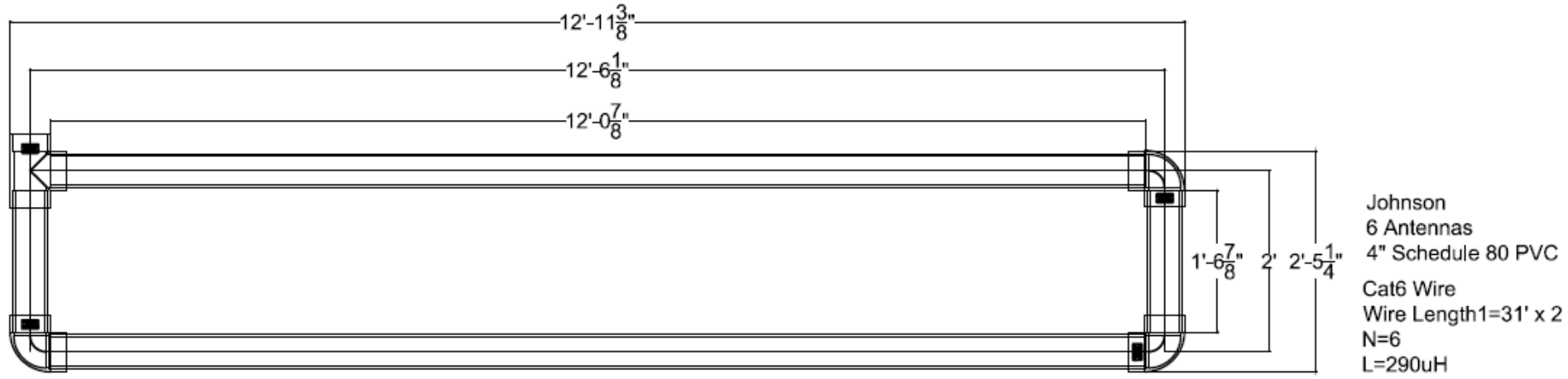


Fig. 3: NEMA box and solar panel installation on the bank above the Johnson site. The cabling at the base of the solar panel frame leads down to antennas that span the waterway.



Fig. 4: Interior view of the electrical components housed within the NEMA box at the Johnson site.



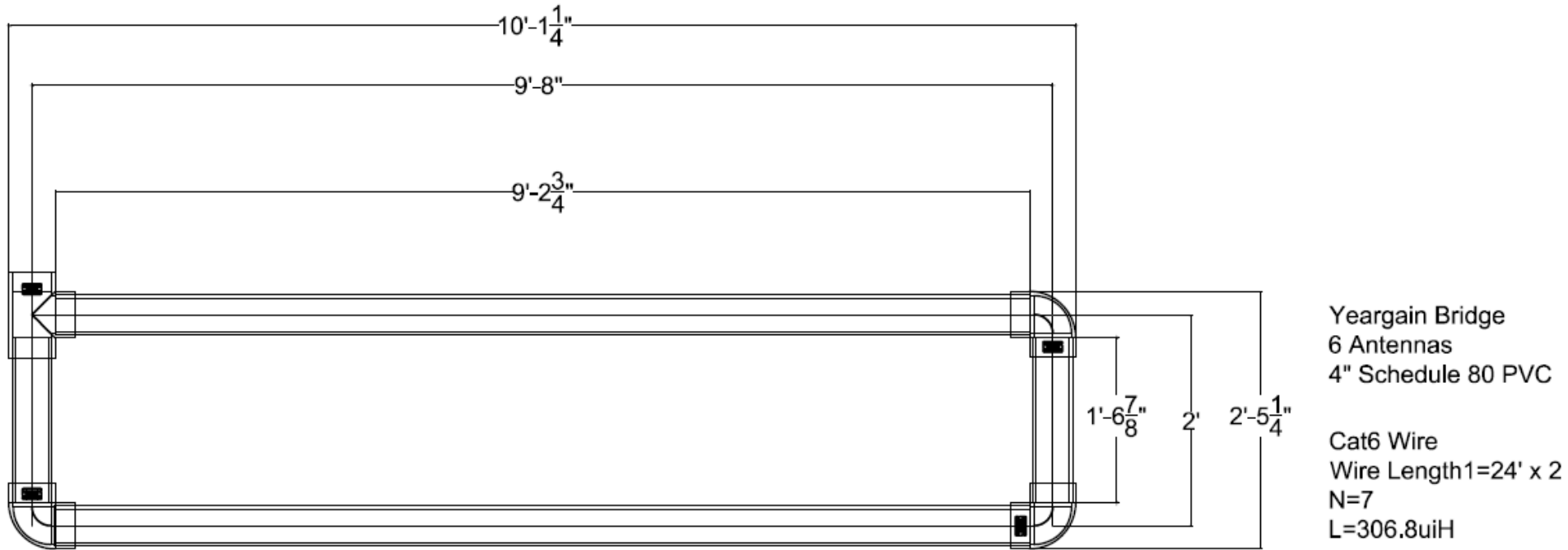
Site #2: Yeargain Bridge

The second PIT tag interrogation system was located just upstream of Yeargain Bridge on Catherine Creek at N 45.21534° W 117.90383°. The system consisted of six antennas with the ends of each antenna placed within two feet of each other to maximize coverage of the waterway in two parallel rows (Fig. 5). Each individual antenna was constructed of a single loop of Category-6 Ethernet cable encased in a waterproof housing of 4in Schedule 80 PVC pipe. The dimensions of all individual antennas were held constant at 10ft, 1-1/4in long by 2ft 5-1/4in wide (Fig. 6). Given the potential for high flows and debris loading, each antenna was anchored flush with the substrate of the creek in a pass-over configuration using six duckbill anchors driven into the cobble of the streambed with one at each corner of the antenna and two in the middle of the longest pipe segments. Antennas were connected to a Destron Fearing Multiplexer (FS 1001M) mounted in a NEMA box placed on the dry ground above the creek via 80ft cable (12 gauge twinaxial). The multiplexer was grid powered, modulated through a commercially available battery backup/surge protector (APC BK500), and was connected to a fanless industrial computer (Advantech UNO-1150-S) for data storage. The data storage computer was also connected to a cellular modem (Pantech UML290) to allow for automatic upload of data to PTAGIS.

Fig. 5: Antenna configuration of the PIT tag interrogation system installed at Yeargain Bridge. Antennas were spaced approximately two feet apart to maximize coverage of the waterway.



Fig. 6: Line diagram of the dimensions of antennas installed at Yeargain Bridge.



Site #3: Elmer Dam

Of the selected sites, Elmer Dam was considered the most challenging site for installation of a PIT tag interrogation system due to high water discharge and velocities, extreme flooding, and the water depth that would need to be covered by the antenna. As such, the AFTC staff installed two PIT tag interrogation systems at this site using atypical antenna configurations.

One PIT tag interrogation system was located approximately 100 meters upstream of Elmer Dam on Catherine Creek at 45.36769° W 117.86140°. The system consisted of six antennas placed end to end spanning the waterway in a single row and mounted along the substrate of the waterway. Each individual antenna was constructed of a single loop of Category-6 Ethernet cable encased in a waterproof housing of 4in Schedule 80 PVC pipe. The dimensions of all individual antennas were held constant at 13ft, 11-1/4in long by 2ft, 5-1/4in wide (Fig. 7). Given the potential for high flows and debris loading, each antenna was anchored flush with the substrate of the creek in a pass-over configuration using six screw anchors driven into the streambed with one at each corner of the antenna and two in the middle of the longest pipe segments. Antennas were mounted on the substrate of the waterway to detect fish in the lower portion of the water column. To add additional weight and ensure that the array remained flush with the substrate of the waterway, additional concrete weights were placed at each corner and along the length of the individual antennas. Antennas were connected to a Destron Fearing multiplexer (FS 1001M) mounted in a NEMA box placed on the dry ground above the creek via 99ft cable (12 gauge twinaxial). The multiplexer was powered by grid power modulated through a commercially available battery backup/surge protector (APC BK500), and was connected to a fanless industrial computer (Advantech UNO-1150-S) for data storage (Fig. 8). The data storage

computer was also connected to a cellular modem (Pantech UML290) to allow for automatic upload of data to PTAGIS.

Fig. 7: Line diagram of the dimensions of antennas installed upstream of Elmer Dam on the substrate of the waterway.

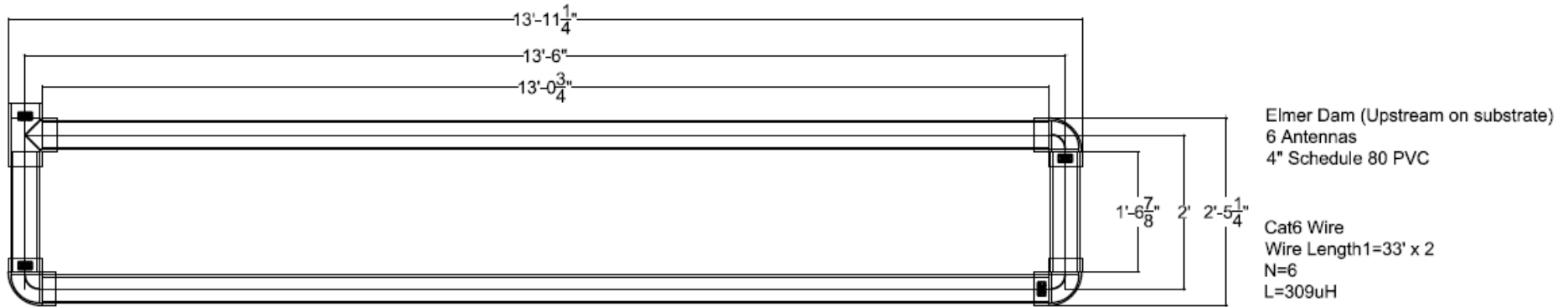
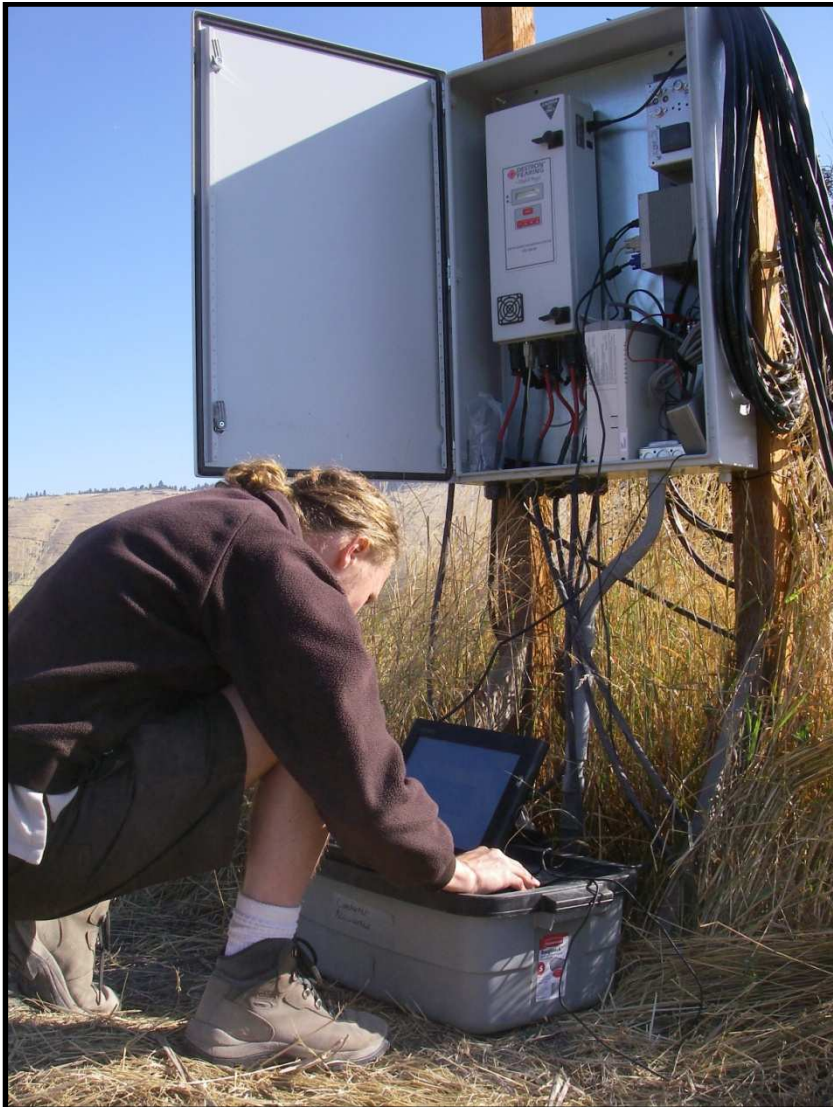


Fig. 8: Interior view of the electrical components housed within the NEMA box at Elmer Dam.



The second PIT tag interrogation system was located upstream of Elmer Dam at N 45.21534° W 117.90383°. The system consisted of six antennas placed in a single row and mounted on plywood boards suspended from a steel cable (1/2" galvanized) that crossed over the surface of the waterway at a height of 2.6m by a pulley and chain system (Fig. 9). Antennas were mounted on the surface of the waterway allowing the antennas to detect fish in the upper portion of the water column as well as deflect and 'ride over' large floating debris. Each individual antenna was constructed of a single loop of Category-6 Ethernet cable encased in a waterproof housing of 3in Schedule 40 PVC pipe. The dimensions of all individual antennas were held constant at 12ft 10in long by 2ft 4in wide (Fig. 10). Antennas were connected to a Destron Fearing multiplexer (FS 1001M) mounted in a NEMA box placed on the dry ground above the creek via 92ft cable (12 gauge twinaxial). The multiplexer was powered by grid power modulated through a commercially available battery backup/surge protector (APC BK500), and was connected to a fanless industrial computer (Advantech UNO-1150-S) for data storage (Fig. 11). The data storage computer was also connected to a cellular modem (Pantech UML290) to allow for automatic upload of data to PTAGIS.

Fig. 9: Side view of the antenna configuration at Elmer Dam with antennas hanging from a steel cable crossing above the surface of the waterway.



Fig. 10: Line diagram of the dimensions of antennas installed upstream of Elmer Dam and mounted to a steel cable crossing above the surface of the waterway.

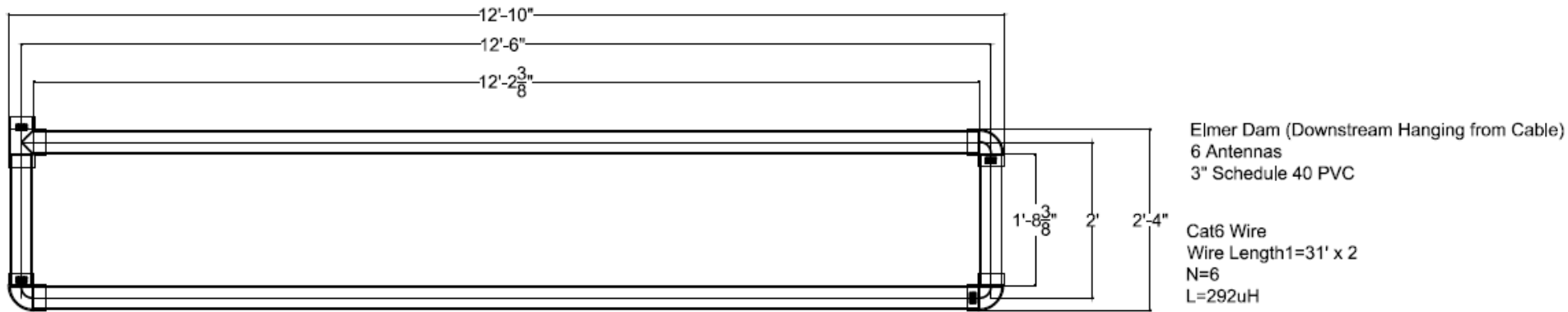


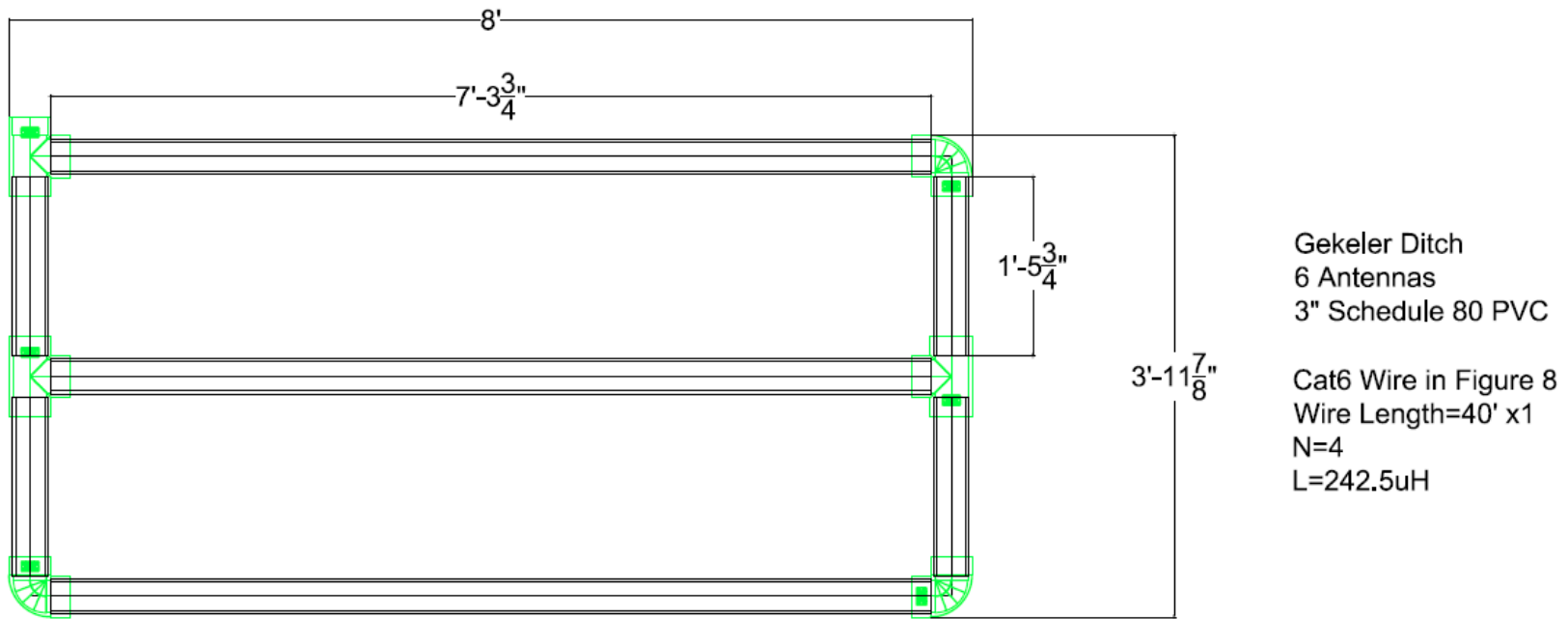
Fig. 11: Interior view of the electrical components housed within the NEMA box at Elmer Dam



Site #4: Gekler Ditch

AFTC staff constructed a PIT tag interrogation system to be installed at the Gekler Ditch site, however landowner permission for installation was not acquired in time for installation. The PIT tag interrogation site equipment was instead delivered to Oregon Department of Fish and Wildlife (ODFW) staff. The system consists of six antennas to be placed end to end spanning the waterway in two parallel rows. Each individual antenna was constructed of a double loop of Category-6 Ethernet cable encased in a waterproof housing of 3in Schedule 80 PVC pipe. The dimensions of all individual antennas were held constant at 8ft long by 3ft, 11-7/8in wide (Fig. 12). Given the low potential for high flows and debris loading, each antenna was to be configured as a pass through design with only the bottom end of the antenna anchored to the substrate of the waterway. Antennas were to be connected to a Destron Faering multiplexor (FS 1001M) mounted in a NEMA box placed on the dry ground above the creek via 40ft cable (12 gauge twinaxial). The multiplexor was to be powered by two solar panels (215W 29Vmp), and was to be connected to a fanless industrial computer (Advantech UNO-1150-S) for data storage. The data storage computer was also to be connected to a cellular modem (Pantech UML290) to allow for automatic upload of data to PTAGIS.

Fig. 12: Line diagram of the dimensions of antennas that were to be installed at Gekeler Ditch.



Acknowledgements

The findings and conclusions in this article are those of the author and do not necessarily represent the views of the U.S. Fish and Wildlife Service. Reference to trade names does not imply endorsement by the U.S. Government. We thank the USFWS, BOR, and ODFW staff who assisted in the installation of the PIT tag interrogation systems. We thank Scott Favrot (ODFW) for coordination of site installation and landowner approval.

Appendix 1

Table A.1: Itemized list of all equipment purchased and delivered for the installation of PIT tag interrogation system sites on Catherine Creek.

ITEM	QTY
Destron Faering FS1001 Multiplexing Transceiver	5
NEMA 4 enclosure, 36"x24"x8" with hasp	3
NEMA 4 enclosure, 36"x30"x16" with hasp	2
Advantech 500Mhz Geode industrial computer with Win XP Embedded and 4Gb CF (.3A @ 24V)	5
500VA, 120V UPS battery back up	3
24V AC/DC linear power supply	3
215W 29Vmp solar panel	4
Aluminum panel solar array frame	2
24V 16A temperature compensated Charge Controller with load disconnect	2
12V 120AH AGM Sealed Lead Acid Rechargeable Battery	4
13' 11-1/4"x2' 5-1/4", single loop, 4" schedule 80 PVC antenna	6
12' 10"x2' 4" single loop, 3" schedule 40 PVC, antenna on hanging frame	6
8'x3'11-7/8" single loop 3" schedule 80 PVC antenna	6
12' 11-3/8"x2' 5-1/4" single loop 4" schedule 80 PVC antenna	6
10' 1-1/4"x2' 5-1/4" single loop 4" schedule 80 PVC antenna	6
99' Antenna cable	6
92' Antenna cable	6
40' Antenna cable	6
53' Antenna cable	6
80' Antenna cable	6