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Evaluation of adult Pacific Lamprey upstream passage at Warm Springs National Fish Hatchery

FY 2018 Annual Report

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On the cover: *The Lamprey Passage System at Warm Springs National Fish Hatchery, Warm Springs, Oregon.*

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EVALUATION OF ADULT PACIFIC LAMPREY UPSTRAEM PASSAGE AT WARM SPRINGS NATIONAL FISH HATCHERY 2018 ANNUAL REPORT

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Abstract

Population declines of Pacific Lamprey *Entosphenus tridentatus* in the Columbia River Basin are partially attributed to impediments to upstream spawning migration of adults. To promote adult Pacific Lamprey passage, fishway modifications have been installed at both high-head and low-head dams across the basin. In 2014, the U.S. Fish and Wildlife Service completed an assessment of the low-head dam and fishway at Warm Springs National Fish Hatchery, Oregon and identified passage deficiencies for adult Pacific Lamprey. In the fall 2017, per the recommendations of the assessment, we installed a Lamprey Passage Structure (LPS) in the fishway and operation began in May 2018. Prior to installation, in 2017, we evaluated adult Pacific Lamprey passage efficiency and route selection at the hatchery using radio telemetry and found that at least some lamprey use the fish ladder to move upstream, exiting at the nearest opening. In June 2018, we began monitoring lamprey passage in the LPS using PIT detection and cameras. A total of 12 lamprey were detected using PIT detections successfully exiting the LPS. Camera monitoring produced excess footage and was difficult to determine lamprey passage. An additional camera was placed underwater at the LPS entrance in the fish ladder to monitor salmonid interactions with the LPS, however no adult salmonids were detected on the footage and no reports of negative impacts of the LPS on salmonids was reported by hatchery biologists. In 2019, the second year of the LPS operation, a PIT antenna will continue to monitor adult lamprey passage and camera monitoring is being refined. The combination of the two monitoring techniques can provide a ratio of tagged to untagged adult lamprey to inform population status in the Warm Springs watershed. The initial success of the LPS at passing adult lamprey is encouraging in its role to facilitate fish passage and in turn increase the population contribution of Pacific Lamprey in the Warm Springs River to the Columbia River Basin.

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Introduction

Pacific Lamprey *Entosphenus tridentatus* populations in the Columbia River Basin have declined from both their historic range and population sizes (Luzier et al. 2011). In 2003, a petition to list Pacific Lamprey on the Endangered Species Act was found not warranted, citing a lack of information (USFWS 2004). In response, the Pacific Lamprey Conservation Initiative (PLCI) was created in 2007 in an effort to determine the population status and address limiting factors (Luzier et al. 2011).

Passage impediments to upstream spawning habitat are among the identified factors contributing to the decline of populations in the Columbia River Basin (Chelgren and Dunham 2015, Clemens et al. 2017, Keefer et al. 2013, Moser et al. 2015,). To increase adult passage success, Lamprey Passage Structures (LPSs) have been installed on dams and water diversion structures throughout their range. These structures are effective at providing routes for lamprey passage, and use increases over time (Lamprey Technical Workgroup 2017, Moser et al. 2011). Low elevation dams have been shown to be barriers to lamprey passage (Jackson and Moser 2012). Some low-head dams include fishways for providing salmonid upstream access, however, these fishways may not be designed for efficient adult lamprey passage.

Warm Springs National Fish (NFH) hatchery, located at river kilometer 16 of the Warm Springs River on the Warm Springs Indian Reservation, began operation in 1978. The hatchery is co-managed by the United States Fish and Wildlife Service (USFWS) and the Confederated Tribes of the Warm Springs Reservation of Oregon. The primary purpose of the hatchery is to produce Spring-run Chinook Salmon for harvest. As part of the hatchery design, a low-head barrier dam blocks all upstream migrating fish and diverts them into a fishway at the hatchery (Gallion and Skalicky 2014). Upstream migrating fish can then be sorted to either be passed upstream or diverted into hatchery catch ponds. In 2006, the USFWS Pacific Region Hatchery Review Team assessed Warm Springs NFH and recommended that the effects of the dam and fishway on the upstream and downstream movement of native fishes, including Pacific Lamprey, be evaluated (USFWS 2006).

In 2014, the USFWS Columbia River Fish and Wildlife Conservation Office evaluated the hatchery ladder and barrier dam (Gallion and Skalicky 2014). The evaluation consisted of a physical inspection of the de-watered fishway, velocity measurements in the fishway, and a visual inspection of the barrier dam. These evaluations were then compared to lamprey passage recommendations of the following: 4-inch rounded corners and edges, absence of 90° angles, velocity < 1.2 m/s, and suitable attachment substrate (David Wills *pers. comm. in* Gallion and Skalicky 2014; *note: lamprey passage guidelines have since been established, as found in* Pacific Lamprey Technical Workgroup 2017). Areas identified as potential passage impediments include the 4-ft overhanging lip at the barrier dam and throughout the fishway where there are sharp angles and high velocities. Because significant passage deficiencies for Pacific Lamprey were identified, a LPS was recommended to improve upstream passage for adult lamprey in the Warm Springs River (Gallion and Skalicky 2014).

In 2015, the USFWS secured funding to design and install a LPS, which would be the first LPS installed at a National Fish Hatchery. The LPS design includes an aluminum flume and rest box design, similar to LPS designs at Bonneville Dam on the mainstem Columbia River, Three-mile Dam on the Umatilla River, and Prosser Dam on the Yakima River (Lamprey Technical Workgroup 2017). The LPS consists of a series of flume ramps connected to resting boxes leading from the entrance of the fishway with an exit into the

forebay (Appendix I). The components of the LPS were installed in September 2017 and the first season of operation began in May 2018.

Prior to the LPS installation, we evaluated adult Pacific Lamprey passage efficiency and route selection using radio telemetry at the hatchery. These data provide a baseline against which to compare the effectiveness of the LPS. In 2016, we captured, PIT-tagged, and released one adult Pacific Lamprey; in 2017, we captured nine adult Pacific Lamprey, six of which were PIT- and radio-tagged and released. Radio telemetry results showed three fish moved upstream of the dam using the fishway and exited at a turning pool located within the fishway instead of moving through the entire ladder. One additional lamprey was detected upstream of the dam but its route was not determined because it was not detected in the fishway. Two of the six tagged lamprey did not move upstream of the hatchery during our study.

After the installation of the LPS, operation began in May 2018. In June 2018 we initiated monitoring using a PIT array in the exit tube of the LPS and within the upper fish ladder, and cameras in the entrance and within the LPS. This report describes the activities in 2018, with the objectives of 1) determining if lamprey use the LPS and 2) if there are negative interactions of salmonids with the physical LPS structure at the ladder entrance.

Study Area

Within the Columbia River Basin, the Warm Springs River drains approximately 1,361 km^2 of area on the eastern slope of the Cascade mountain range into the Deschutes River at river kilometer (RKM) 135 (measuring from its confluence with the Columbia River; (Figure 1). The river is contained entirely within the Warm Springs Indian Reservation. Including tributaries, an estimated 111 RKM of stream habitat is available to anadromous fishes above the barrier dam (Cates 1992).

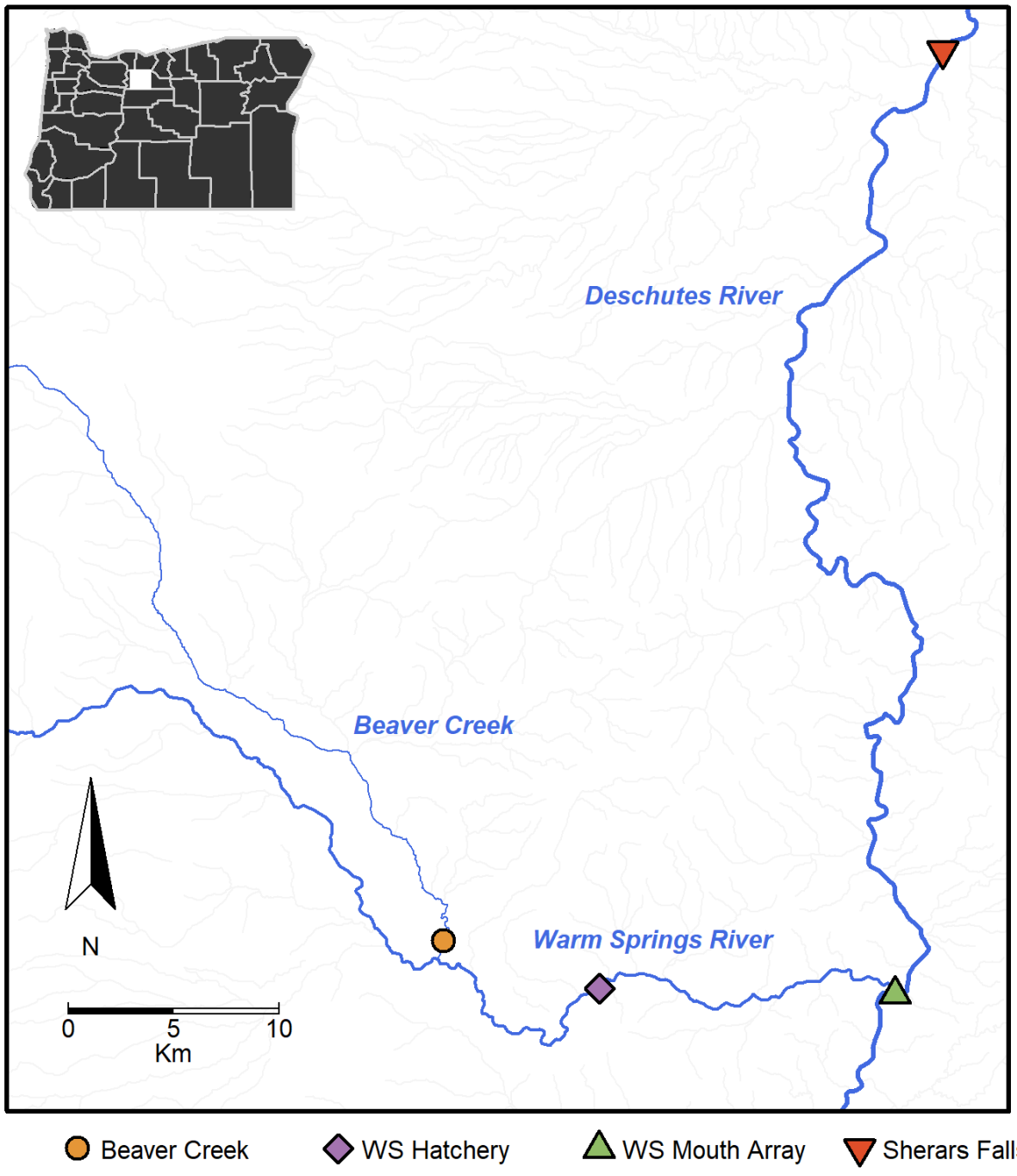

Figure 1. Warm Springs National Fish Hatchery (purple diamond) is located on the Warm Springs River at RKM 16, which is 481 RKM upstream from the mouth of the Columbia River. PIT arrays are at Sherars Falls on the Deschutes River (Red triangle; RKM 71), the mouth of Warm Springs River (Green triangle; RKM 135) and Beaver Creek (14 RKM upstream of WSNFH; Orange circle; RKM 8).

Methods

LPS Operation

The LPS became operational on May 10 2018 and the LPS PIT detector was installed on June 7 2018. A Xylem 85GS0-PE submersible pump sends 75 gal/min of water through the upwelling box (Figures 2 & 3) and provides water to both the LPS and the exit pipe. The water to the LPS ran continuously from May 10 2018 until it was turned off on 16 November 2018 . The LPS was winterized by draining water from the resting box and the upwelling box.

PIT Arrays

Because of low capture rates using pot traps in 2016 and 2017, the initial monitoring of the LPS will use PIT arrays and cameras instead of a radio telemetry study. Adult lamprey are previously tagged by the Confederated Tribes of Warm Springs at Sherars Falls on the Deschutes River, 80 RKM downstream from Warm Springs NFH. This provides the opportunity to determine the timing and movements of lamprey from Sherars Falls, past a PIT array at the mouth of the Warm Springs River, through the LPS or hatchery fish ladder, and upstream of the hatchery at Beaver Creek (Figure 1).

To detect lamprey successfully using the LPS, a circular antenna was installed around the 8” diameter corrugated plastic exit tube of the LPS (Figure 3) on June 7 2018. Two additional PIT antennas located in the WSNFH adult return fish ladder are able to detect lamprey moving through the fish ladder instead of using the LPS. All three antennas are connected to a Biomark Multiplexing Transceiver System (IS1001-MTS) switching between half and full duplex every 0.18 seconds. Data files are created daily and uploaded to PITAGIS.org.

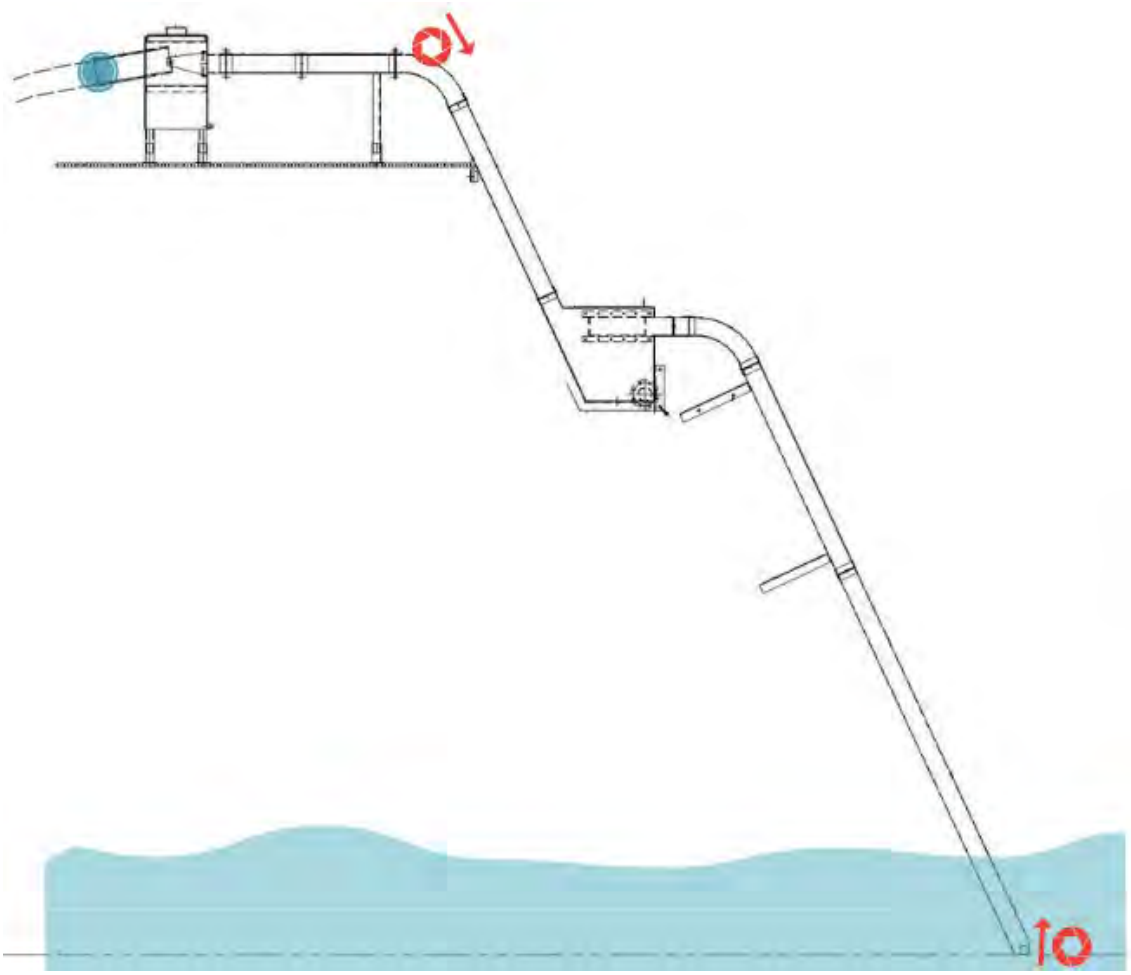

Figure 2. LPS side view showing the locations of cameras (red circles) and their orientation and the location of the stationary PIT reader (teal). The approximate water level of the fish ladder is shown.

Camera + IR Lights

In addition to PIT arrays, cameras were installed in the exit of the LPS and on the entrance (Figure 2). The camera in the LPS will help determine the number of non-tagged lamprey. A camera and light system mounted underwater on the LPS entrance will document any negative interactions of the LPS structure on salmonids entering the fish ladder. This is a pilot year of testing camera + lighting placements and data management and we did not record throughout the LPS operation season. Camera operation began on 18 August 2018 and ended on 16 November 2018.

Camera locations

Monitoring salmonid interactions. This camera was placed at the LPS entrance on the floor of the fish ladder, oriented up to record silhouettes of salmonids entering the fish ladder. An Infrared LED Light

emitter was a backup light source for short range low light purposes and was mounted behind the camera.

Monitoring lamprey movements through the LPS. This camera was mounted inside the LPS, oriented to record lamprey as they move past the final ramp towards the upwelling box. Because of the small scope of the recording, a generic 12 volt IR light source was sufficient.

Camera and IR Light Specs.

- Camera. InVid PAR-C2BSSUIR36 1080p HD-TVI Outdoor IR Bullet Camera, 3.6mm; (Resolution: 2 Megapixel 1080p Range: 42' range with underwater white LEDs, Material: Stainless Steel housing, Voltage: 12 VDC).

- Light at LPS Entrance. Larson Electronics LEDLB-16ET-IR LED Light Bar. (Watts: 48, Voltage: 9-42 VDC, Amps: 4 (on 12 volts) 2(on 24 volts), Lumens: 2880, LED Light Color: Infrared: 859 Nm or 940Nm, Materials: Aluminum housing, Polycarbonate Lens)

- Light interior LPS. Generic CCTV IR Infrared Night Vision Lamp (Voltage: 12 VDC; Amp: 3; Lumens: 1200; LED Light Color: Infrared: 859 Nm; Materials: Aluminum housing, Polycarbonate Lens)

Recording. Footage was recorded onto 2 InVid PD1A-4-2TB 4 Channel TVI/AHD/CVI/Analog/IP Universal Port Digital Video Recorder with 2 TB of storage. After two months one DVR was switched for another to prevent loss of data. At the end of the season both DVRs were backed up onto portable USB drives.

Data Review

Interior LPS Camera: The pilot study in 2018 was designed to determine the efficacy of monitoring using cameras. Based on the 2018 results, we determined that the amount of footage that would have to be reviewed in real-time or slower to capture lamprey movements was quite large and therefore impractical for long-term monitoring. A small subset of footage was reviewed in 2018.

Figure 3. View of Warm Springs NFH ladder viewing platform and the top section of the LPS.

Results

Lamprey Detections in the LPS

Lamprey successfully used the LPS to move upstream of Warm Springs NFH. A total of 12 lamprey were detected in 2018 in the LPS exit tube after the PIT detector was installed on June 7 2018. All 12 tags were implanted into adult Pacific lamprey at Sherars Falls by the Confederated Tribes of the Warm Springs. Seven of the 12 tags were released in 2018 and the remaining five were tagged and released in 2017, indicating that some lamprey overwinter between Sherars Falls and the Warm Springs River. All five Lamprey tagged in 2017 were detected in the LPS in mid-June, whereas 2018 tagged fish were detected from late July to early September (see Figure 4).

Of the 12 lamprey tags detected in the LPS, 11 were detected at the Sherars Falls PIT array (after fish are tagged they are released downstream below the array), all 12 were detected at the Warm Springs River mouth array and 7 were detected upstream of the LPS in Beaver Creek. In 2018, a total of 19 lamprey tags were detected in Beaver Creek, eight of which were tagged in 2018 after the LPS PIT detector was installed. Only two of the eight tags (tagged in 2018 and detected at Beaver Creek) were detected in the LPS, indicating that a proportion of fish used an alternate route, either through or around the hatchery.

Migration travel rates were similar between detection sites for all 2018 tagged lamprey. Lamprey migration speed averaged about 3.8 kilometers per day (see Table 2).

Table 2. Lamprey migration rates from Sherars Falls to Warm Springs Mouth; Warm Springs Mouth to Warm Springs Hatchery; and Warm Springs Hatchery to Beaver Creek (2018).

	minimum	median	mean	maximum	sd
Warm Springs Mouth	1.6	3.0	3.5	6.5	1.6
Warm Springs Hatchery	1.2	4.0	4.5	7.3	1.7
Beaver Creek	2.3	3.5	3.4	4.9	0.8

All detections occurred at night or early morning. Given a detection period from dusk till dawn, median LPS detection time was 23:34:00 PST, the earliest LPS detection occurred at 21:41:00 PST and the latest at 03:58:00 PST. Lamprey PIT tags were detected at a rate of about six per second within the antenna's field, allowing us to measure how long it took lamprey to pass through the corrugated exit tube. All detected lamprey passed through the antenna's detection range quickly; median detection duration was 1.8 seconds with the quickest duration being 0.5 seconds and the longest being 3.6 seconds.

Two lamprey tags were detected in the Warm Springs adult ladder PIT array (see Table 3), which is upstream of the LPS entrance as well as a previously identified passage opportunity (i.e., turning pool B). The route selection and traveling direction of these two lamprey are unknown as they were not detected at any location afterwards.

Two lamprey were detected in the camera footage after reviewing footage around the time of the PIT detections. This helped verify that the camera can record lamprey movements but are difficult to detect in footage review using this setup.

Salmonid Interactions with the LPS Entrance

Camera footage did not show negative salmonid interactions with the entrance of the LPS, which is anchored to the side of the fish ladder entrance. Salmonids are able to navigate around the small (~1 m of the ramp) underwater portion of the LPS and move through the fish ladder. There were no reports from hatchery biologists of visible scarring or a concern about delay due to the LPS. The LPS does create an eddy which juvenile fish use, however they are not holding.

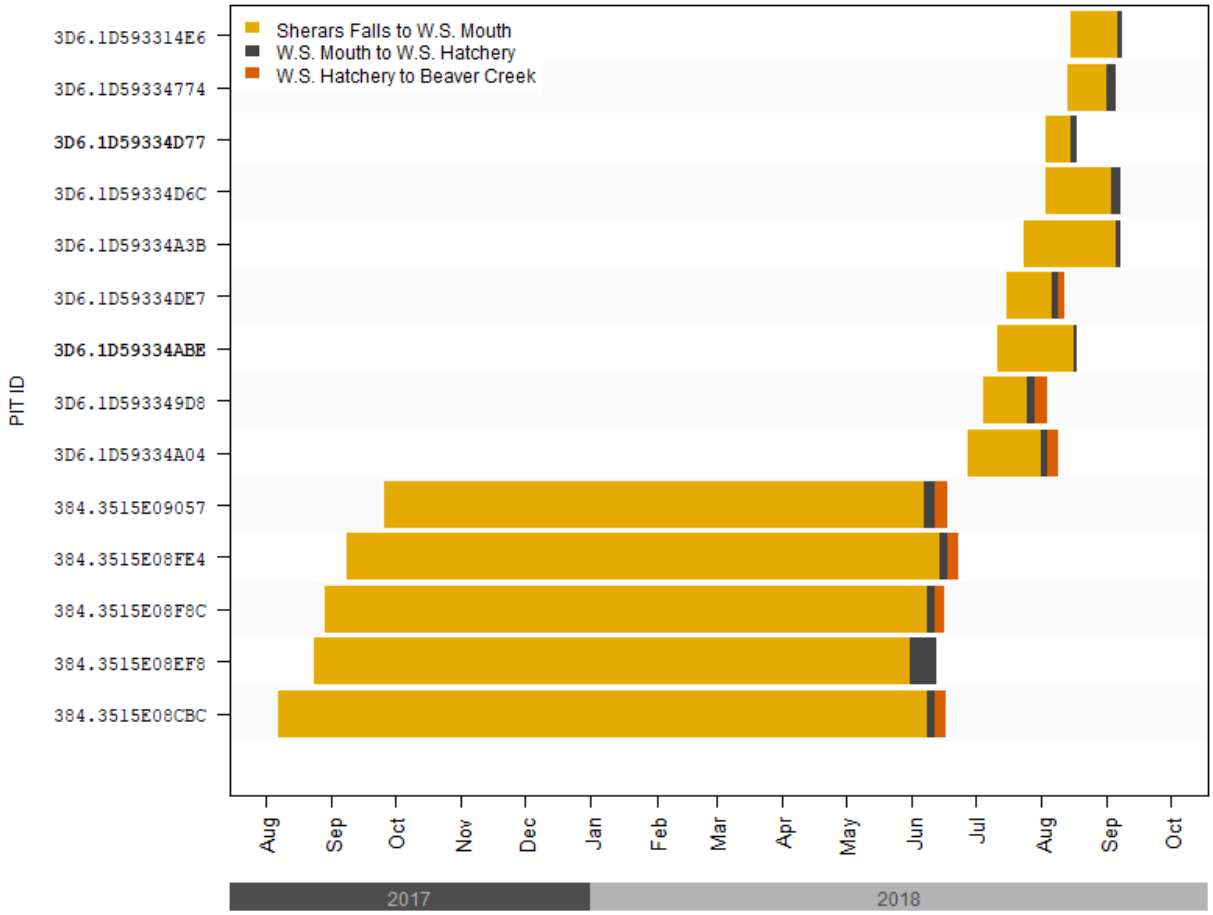

Figure 4. Duration between PIT tagging at Sherars Falls and PIT detections of individual lamprey (each bar) from downstream to upstream: Sherars Falls tagging to Warm Springs mouth (yellow), Warm Springs mouth to Warm Springs NFH (black), and Warm Springs NFH to Beaver Creek (orange). All tags were detected in the Warm Springs NFH LPS with the exception of two tags indicated in bold, which were detected in the Warm Springs NFH fishway.

Table 3. List of tags detected at the WSNFH Lamprey Passage System (LPS/Adult-Ladder) and previous/post detection histories at Sherars Falls (DSF), Warm Springs River mouth (WSR) and Beaver Creek PIT array.

	PIT ID	Sherars Falls Tagged	Sherars Falls Detection	Warm Springs Mouth PIT Array	Warm Springs Hatchery	Beaver Creek PIT Array
1	384.3515E08CBC	8/7/2017	8/8/2017	6/8/2018	6/12/2018	6/17/2018
2	384.3515E08EF8	8/24/2017	9/9/2017	5/31/2018	6/13/2018	NA
3	384.3515E08F8C	8/29/2017	9/13/2017	6/8/2018	6/12/2018	6/16/2018
4	384.3515E08FE4	9/8/2017	5/3/2018	6/14/2018	6/18/2018	6/23/2018
5	384.3515E09057	9/26/2017	5/24/2018	6/7/2018	6/12/2018	6/18/2018
6	3D6.1D59334A04	6/27/2018	7/4/2018	8/1/2018	8/4/2018	8/9/2018
7**	3D6.1D593349D8	7/5/2018	7/11/2018	7/25/2018	7/29/2018	8/4/2018
8*	3D6.1D59334ABE	7/11/2018	7/16/2018	8/16/2018	8/18/2018	NA
9	3D6.1D59334DE7	7/16/2018	NA	8/6/2018	8/9/2018	8/12/2018
10	3D6.1D59334A3B	7/24/2018	7/27/2018	9/5/2018	9/7/2018	NA
11†	3D6.1D59334D6C	8/3/2018	8/5/2018	9/3/2018	9/7/2018	NA
12*	3D6.1D59334D77	8/3/2018	8/5/2018	8/15/2018	8/18/2018	NA
13†	3D6.1D59334774	8/13/2018	8/20/2018	9/1/2018	9/5/2018	NA
14	3D6.1D593314E6	8/15/2018	8/16/2018	9/6/2018	9/8/2018	NA

* These tags were detected in the Warm Springs NFH adult ladder, not the LPS. All other tags were detected in the LPS.

** Tagging data was not available for this PIT tag. Its tagging date (Sherars Falls) was estimated based on tagging dates from the same batch of PIT tags.

† Lamprey also found on camera footage.

Discussion

Our PIT detection results in the Lamprey Passage System at Warm Springs NFH show that lamprey use the LPS to migrate upstream of the hatchery barrier dam. Previous results from radio-tracking, albeit with small sample sizes, showed that at least some lamprey can effectively navigate the hatchery dam and ladder, however not all do. The installation of the LPS provides a favorable route for lamprey passage.

Lamprey are able to find the LPS entrance and are moving at night. All of the tracked lamprey were detected in the LPS exit tube at night suggesting that both monitoring efforts and operations of the ladder and LPS are critical during night. Corrugated PVC was chosen as exit tube material with the intention that lamprey would have difficulty latching on to it, dissuading lamprey from reversing migratory direction. Given that each lamprey was detected in the exit tube for only a matter of seconds, the exit tube material is working as expected.

Route selection appears to be favorable in the LPS, however not all routes were monitored. For example, 2017 radio tracking results indicated that some lamprey move through the ladder and exit upstream at a turning pool. Detection data in 2018 also verified some lamprey are using alternate routes around the LPS. In 2018 our monitoring efforts were focused on determining if lamprey use the LPS and not of determining all routes used by lamprey.

This study, in addition to radio telemetry results from 2017, provides some of the first information about the timing of adult lamprey movements at Warm Springs NFH and the use of a new LPS. In 2016 and 2017, lamprey were captured in our pot traps between early July and late August. In 2018, PIT tagged lamprey monitoring occurred in the LPS from 7 June through 16 November 2018. Detected lamprey were tagged in both 2017 and 2018, indicating overwintering occurred for some lamprey in between Sherars and the mouth of Warm Springs River. In the Deschutes River Basin, most adults overwinter in the Deschutes River before moving into its tributaries including the Warm Springs River beginning in early spring (Baker 2015). All fish detected in the LPS that overwintered downstream were detected at the LPS significantly earlier than fish tagged the same year (see Figure 4). If this pattern continues, the LPS may prove useful providing information of overwintering timing. Our PIT detections began late in the migration season and therefore may not be indicative of the complete migration timing at Warm Springs NFH.

Camera Issues and Future

In the 2018 pilot year of the camera, we discovered two issues. First, the camera's motion sensor was constantly triggered by running water, thereby generating a high volume of footage that would be impractical to review. A second issue we discovered is that even with small cameras the design of the LPS only allowed for a very narrow viewing window for a camera. In reviewing the footage of two lamprey in the LPS, they both used the edge making it difficult to record both sides in frame with our initial cameras.

For 2019, to solve our triggering problem we designed a raspberry pi based system that is weatherproof, records in IR 1080p, and triggers using an infrared break beam sensor instead of motion. This system will also log all detections to a log file and can be accessed remotely through WiFi SSH. We will still run our initial camera system as a redundancy until we can ensure that our new system effectively catches all detections through the LPS.

To enlarge the viewing field of the camera, we also designed and fabricated an extension camera box.

Future

The 2018 monitoring of lamprey in the LPS shows that lamprey are finding the entrance, and effectively moving upstream of the hatchery using a newly created route. Under an adaptive management approach, our future objectives are to continue monitoring lamprey passage in the LPS using both PIT and video detections. This may give us the ability to determine the total number lamprey using the LPS, and in conjunction with the PIT arrays and tagging effort at Sherars Falls, contribute to an estimate of adult lamprey in the Warm Springs basin. Currently, lamprey are using the ladder and no negative effects on salmonids of the placement of the entrance have been documented, therefore no major modifications or future monitoring are recommended.

Acknowledgements

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Appendix I. Design and Install of the Lamprey Passage System

The following is a description of the Lamprey Passage System design and installation. Installation occurred from 11-15 September 2017. The LPS began operation on 10 May 2018.

The design of the Lamprey Passage System was initially sketched by Jim Simonson (NOAA), technical drawings were produced in the USFWS Region 1 Headquarters, and fabrication drawings were completed by Yanke Machine Shop (Boise, ID), who also fabricated and installed the LPS. Underwater dive installation was contracted to Cascade Dive Co. (Pasco, WA). Plumbing was completed by the USFWS Columbia River Gorge complex staff led by Jorge Alcala.

The LPS is constructed of varying types and thicknesses of aluminum, which are listed in the fabrication drawings. For installation, water to the fishway was turned off (*note: ammocoetes were observed in sediment accumulations within the dry fishway*). The lower flume section was lowered into the raceway and secured to the concrete by underwater divers using pneumatic drills and stainless steel bolts. Individual sections of the LPS were bolted together as the installation progressed and then sealed with silicon at the seams (other options for the future could include neoprene gaskets). A 4” 150# stainless steel flanged ball valve (ASTM A351, ball and stem 316 S.S. with 1/8” rubber gasket for 4”-150# flange end, 8 bolts: 5/8”11 nc 18-8 S.S. bolts X 3 ¼” w/ HN, LW & FW; purchased from Yanke Machine Shop) was installed at the rest box to drain water for winterization. Water flow to the upwelling box is 80 gal/min and is provided by a Goulds 85GS30CBM 3HP 8STG 4” H.C. SUB pump (purchased from Xylem Water Solutions, Tualatin, OR), installed behind the hatchery intake screen. Plumbing from the submersible pump to the LPS upwelling box (on the fishway deck) is supplied through 3” PVC. An exit tube made of 8”corrugated plastic is attached to the 8” aluminum connector welded to the upwelling box. Modifications are expected of the exit tube and nearby flume sections to install a PIT reader and camera for monitoring.

Attached below are the following LPS install images:
Installation Pictures (3)
Design Sketches by Jim Simonson, NOAA (4)
Technical Drawings by USFWS (6)
Fabrication Drawings by Yanke Machine Co. (10)

Figure a

Figure a. Installation was ordered from the in-water portion of the LPS (the lower half) to the upper half. This section was bolted to the fishway by an underwater diver.

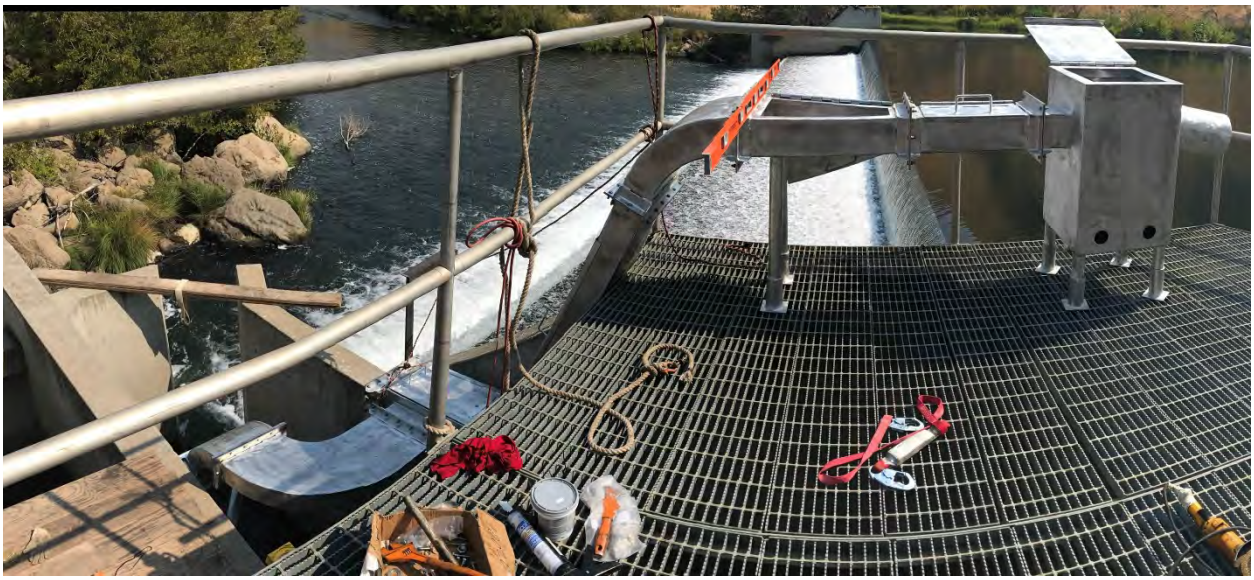
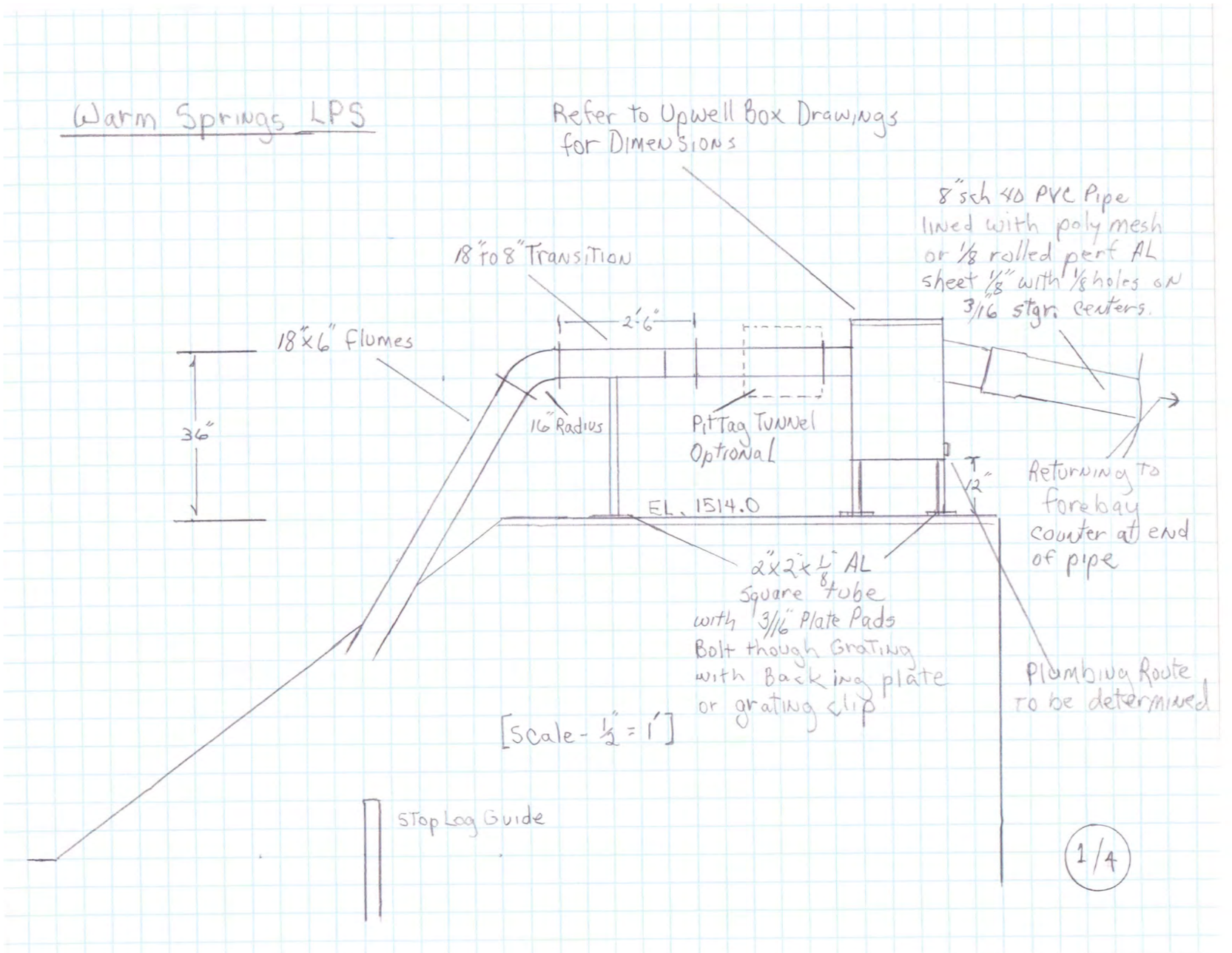
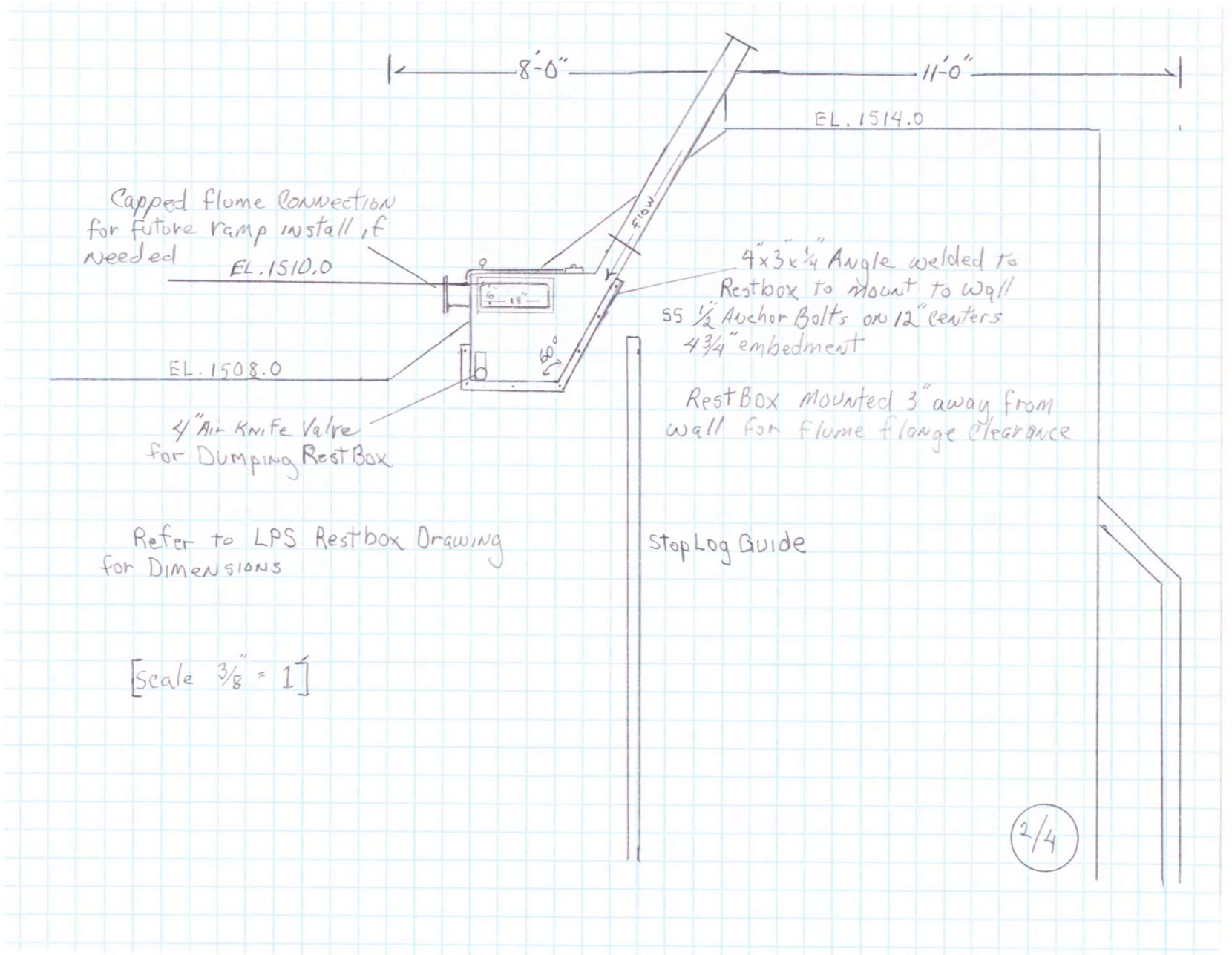
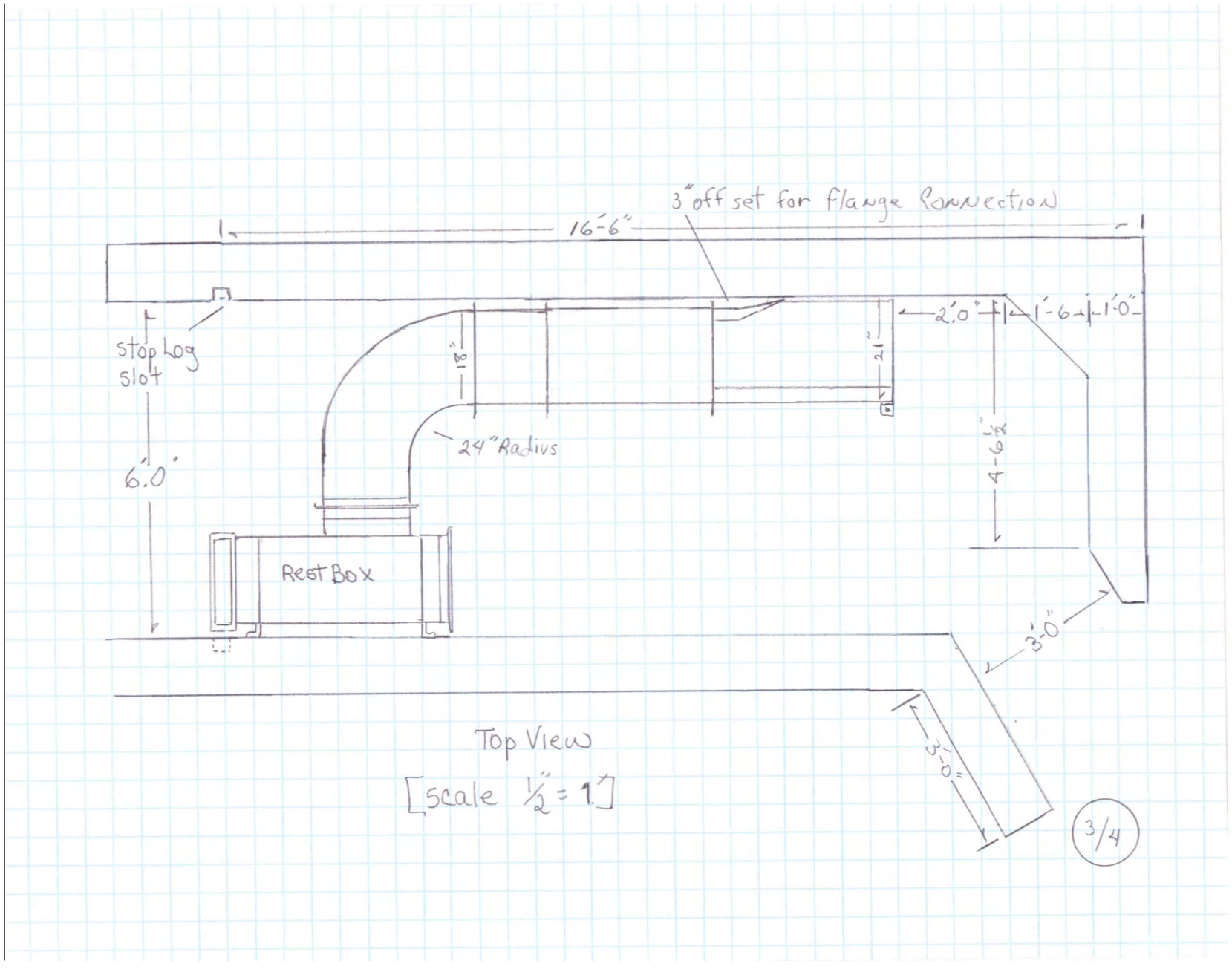


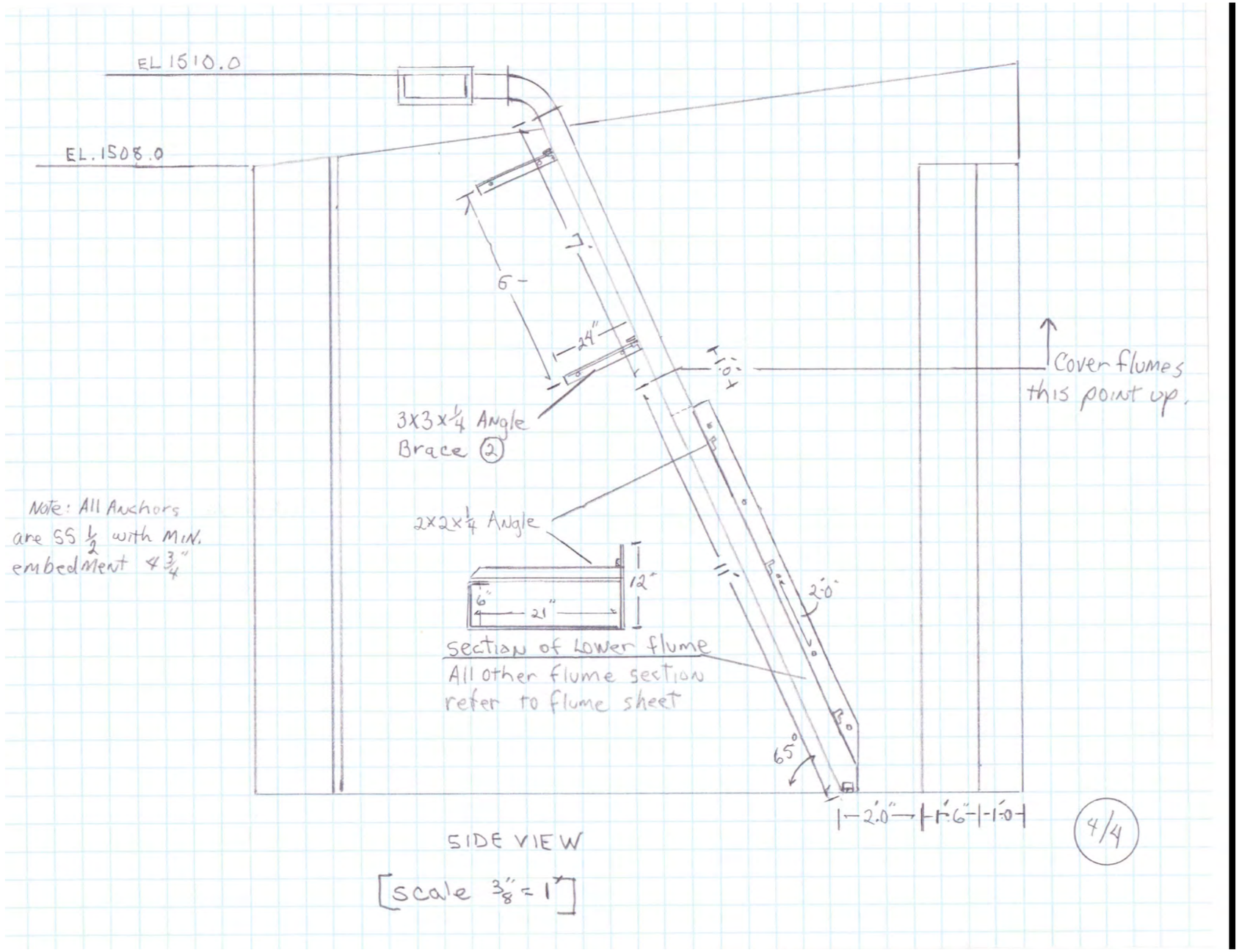
Figure b. This is the middle and upper parts of the LPS. The final section (far right) is an up-welling box that feeds water down the LPS towards both the downstream and upstream.

Figure c. The LPS installation was completed in September 2017. The plumbing for the LPS was completed April 2018 and marked the beginning of the operation of the LPS.


Warm Springs LPS
Refer to Upwell Box Drawings for Dimensions
8" sch 40 PVC Pipe lined with poly mesh or 1/8 rolled perf AL sheet 1/8" with 1/8 holes on 3/16 stgr. centers.
18" to 8" Transition
2'-6"
18"x6" Flumes
36"
16" Radius
Pit Tag Tunnel Optional
T
1/2"
EL. 1514.0
Returning to forebay counter at end of pipe
2"x2"x1/8" AL Square Tube with 3/16" Plate Pads Bolt though Grating with Backing plate or grating clip
Plumbing Route to be determined
[Scale - 1/2" = 1']
Stop Log Guide
1/4


8'-0"
11'-0"
EL. 1514.0
Capped flume connection for future ramp install, if needed
EL. 1510.0
EL. 1508.0
4"x3"x¼" Angle welded to Restbox to mount to wall
SS ½" Anchor Bolts on 12" centers 4¾" embedment
Rest Box mounted 3" away from wall for flume flange clearance
¼" Air Knife Valve for Dumping Rest Box
Refer to LPS Restbox Drawing for Dimensions
[Scale 3/8" = 1']
Stop Log Guide
FLOW
60°
2/4


3" off set for flange connection
16'-6"
stop log slot
6.0'
18"
24" Radius
Rest Box
21"
2'.0"
1'-6"
1'-0"
4'-6½"
3'-0"
3'-0"
Top View
[scale ½" = 1']
3/4


EL 1510.0
EL. 1508.0
7'
6'
24"
1'-0"
Cover flumes this point up.
3x3x1/4 Angle Brace (2)
2x2x1/4 Angle
12"
6"
21"
2'-0"
65°
Section of Lower flume
All other flume section refer to flume sheet
Note: All Anchors are SS 1/2 with MIN. embedment 4 3/4"
2'-0"
1'-6"
1'-0"
SIDE VIEW
[scale 3/8" = 1']
4/4

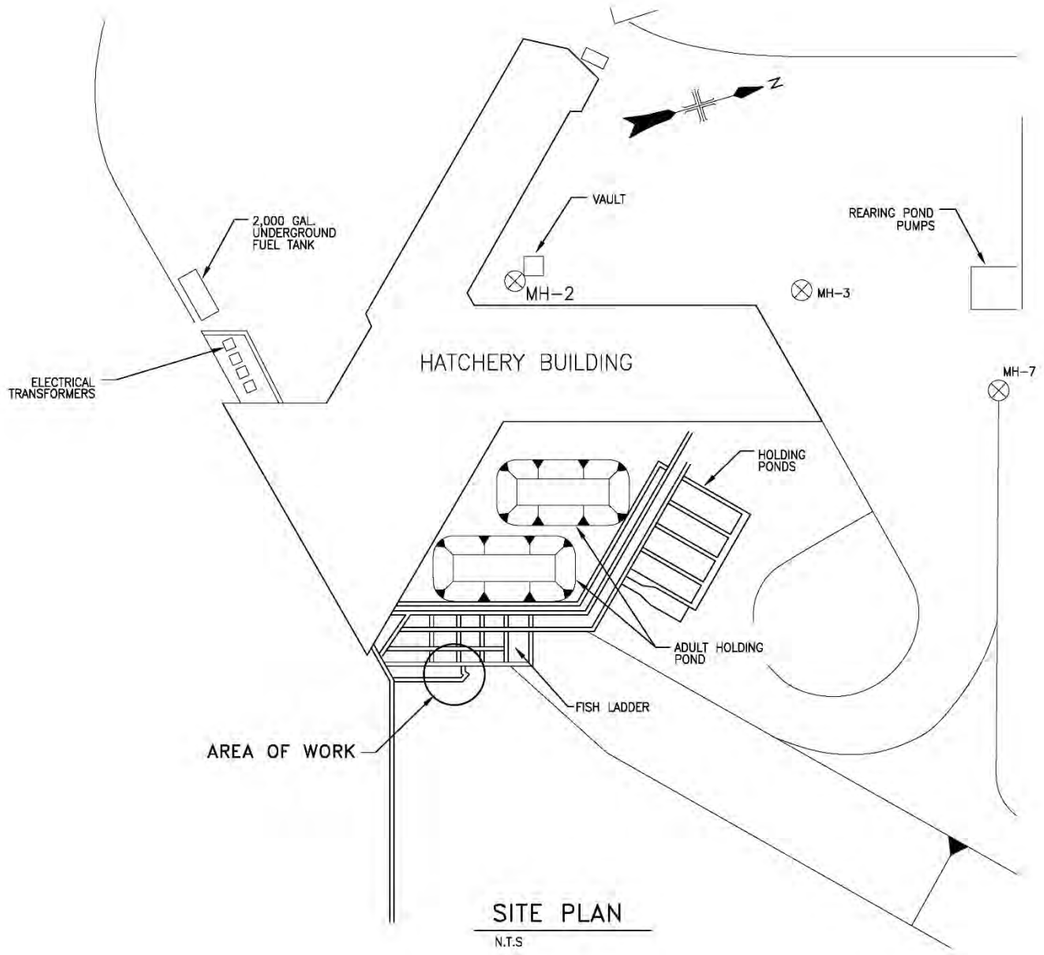
U.S. FISH & WILDLIFE SERVICE

DEPARTMENT OF THE INTERIOR

LAMPREY PASSAGE SYSTEM

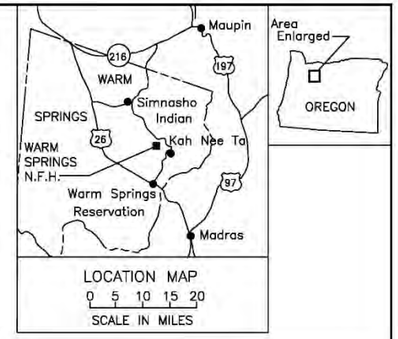
WARM SPRING NATIONAL FISH HATCHERY

WASCO COUNTY, OREGON



SITE PLAN

N.T.S

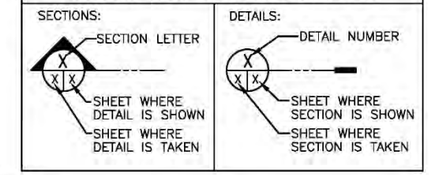


DRAWING INDEX		
TITLE	DWG No.	SHEET No.
SITE PLAN & COVER SHEET	1R-OR-772-265-1.0	1 OF 6
OVERALL PLAN VIEW	1R-OR-772-265-2.0	2 OF 6
UPWELL BOX & REST BOX ELEVATION	1R-OR-772-265-3.0	3 OF 6
LOWER FLUME ELEVATION	1R-OR-772-265-4.0	4 OF 6
UPWELL & REST BOX DETAILS	1R-OR-772-265-5.0	5 OF 6
STANDARD FLUME ELEV. & DETAILS	1R-OR-772-265-6.0	6 OF 6

ABBREVIATIONS

AL.	ALUMINUM
CTR.	CENTER
C.C.	CENTER TO CENTER
DIA.	DIAMETER
EL./ELEV.	ELEVATION
MIN.	MAXIMUM
PER.	PERFORATED
R	RADIUS
SCH.	SCHEDULE
S.S.	STAINLESS STEEL
STAGG.	STAGGERED

DETAILING CONVENTIONS



VERIFY SCALE
THIS BAR IS ONE INCH ON ORIGINAL DRAWING
0" —— 1"
ADJUST SCALES ACCORDINGLY, IF NOT ONE INCH ON THIS SHEET

REV.	DATE	DESCRIPTION	BY

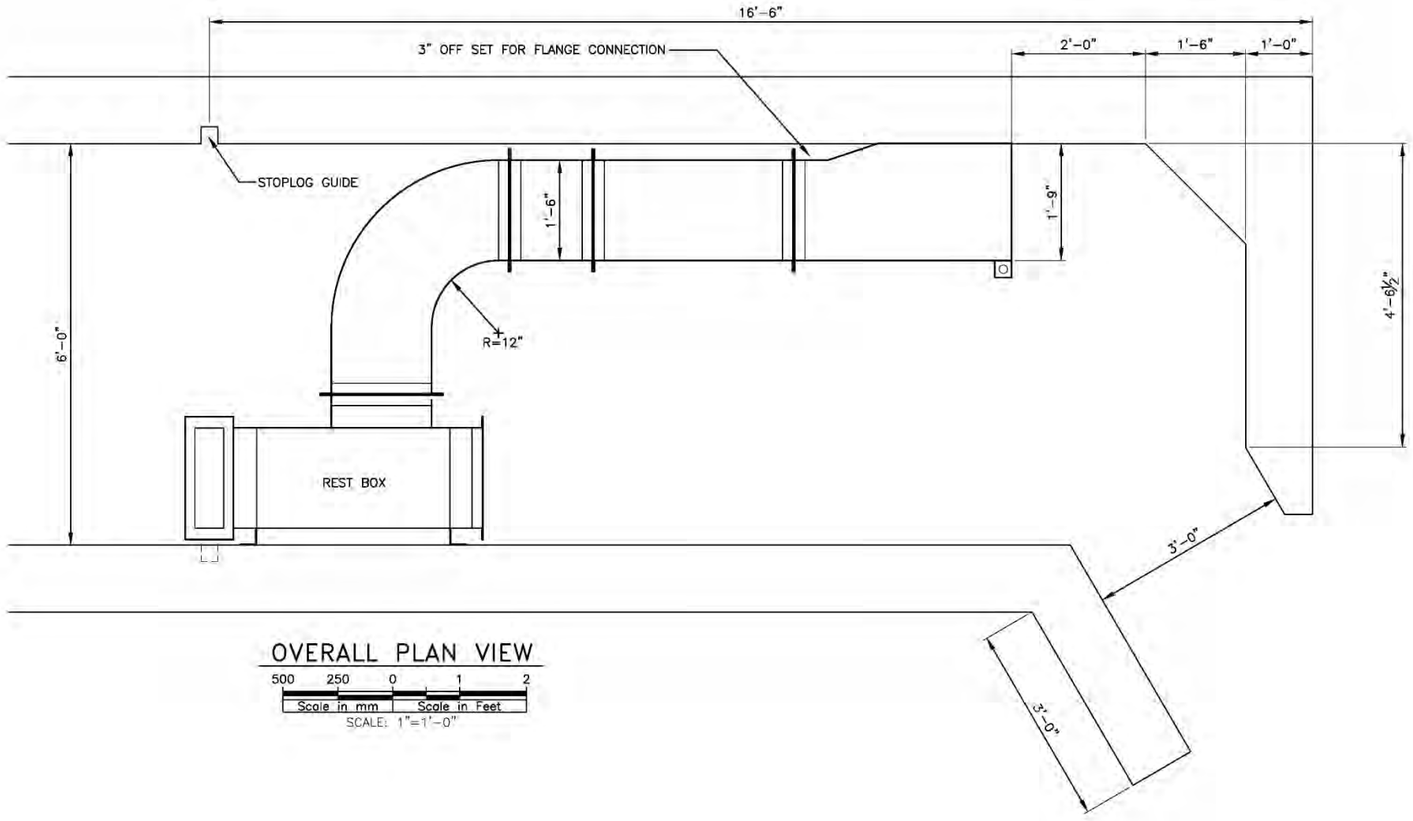
UNITED STATES DEPARTMENT OF THE INTERIOR

FISH AND WILDLIFE SERVICE

REGIONS 1, 7 & 8 OFFICE OF ENGINEERING

PORTLAND, OREGON

SUBMITTED BY PROJECT MANAGER	WARM SPRING NATIONAL FISH HATCHERY
REVIEWED FOR SAFETY COMPLIANCE	LAMPREY PASSAGE SYSTEM
REVIEWED FOR ENVIRONMENTAL COMPLIANCE	SITE PLAN
REVIEWED FOR ADA COMPLIANCE	COVER SHEET
CERTIFIED 10 CFR 435 COMPLIANCE (ENERGY)	WASCO COUNTY OREGON
SUBMITTED BY REGIONAL ENGINEER	SURVEYED / DESIGNED / DRAWN GAH / CHECKED
PROGRAMMATIC REVIEW	DATE 6/1/15 — DRAWING NO. 1R-OR-772-265-1.0



OVERALL PLAN VIEW

500 250 0 1 2

Scale in mm | Scale in Feet

SCALE: 1"=1'-0"

VERIFY SCALE
THIS BAR IS ONE INCH ON ORIGINAL DRAWING
0" —— 1"
ADJUST SCALES ACCORDINGLY, IF NOT ONE INCH ON THIS SHEET

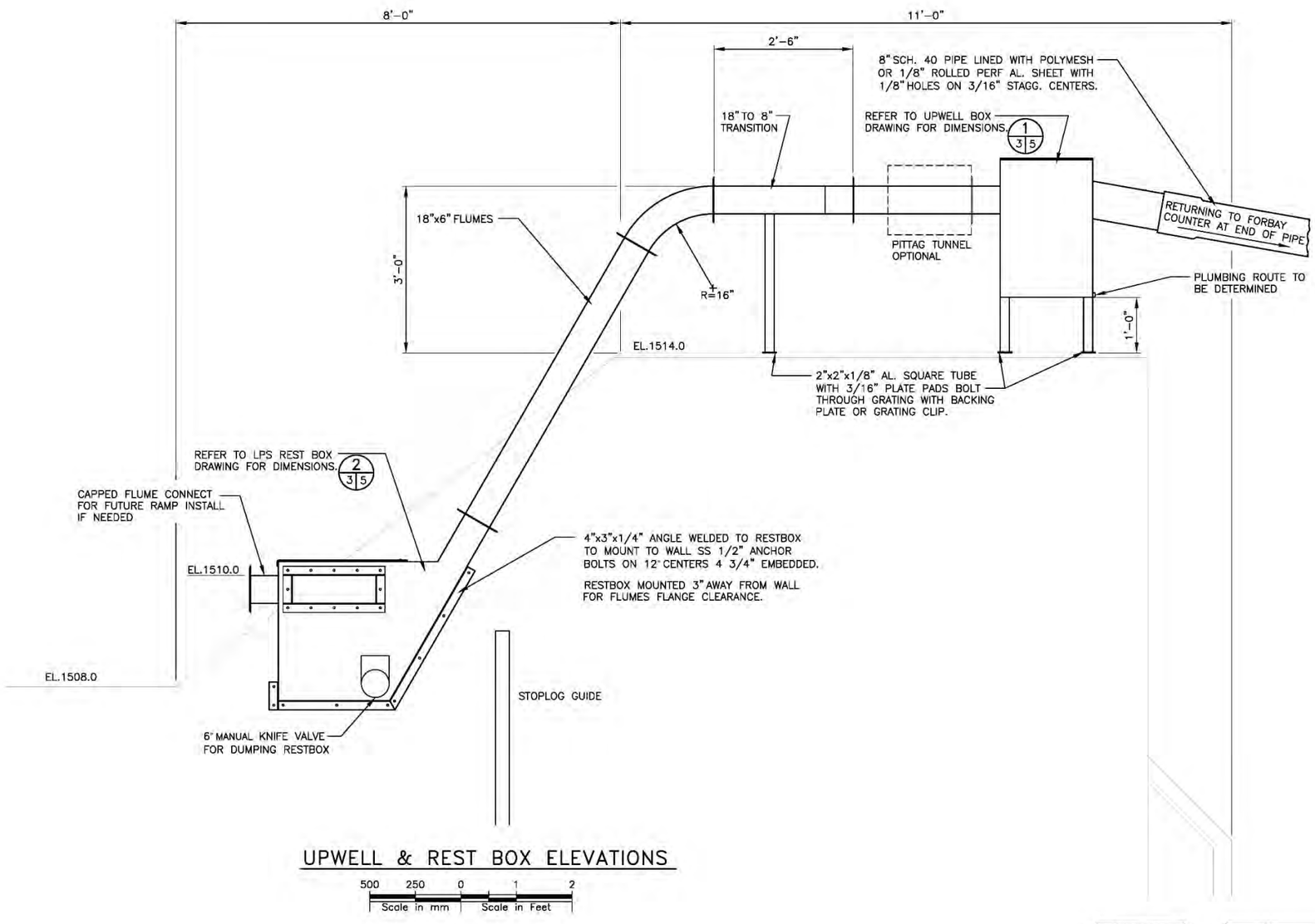
REV.	DATE	DESCRIPTION	BY
△			

WARM SPRING N.F.H.

LAMPREY PASSAGE SYSTEM — PLAN

OVERALL PLAN VIEW

DESIGNED	DRAWN	CHECKED	DATE	DRAWING NO.
	GAH		6/1/15	1R-OR-772-265-2.0



UPWELL & REST BOX ELEVATIONS

500 250 0 1 2
Scale in mm | Scale in Feet

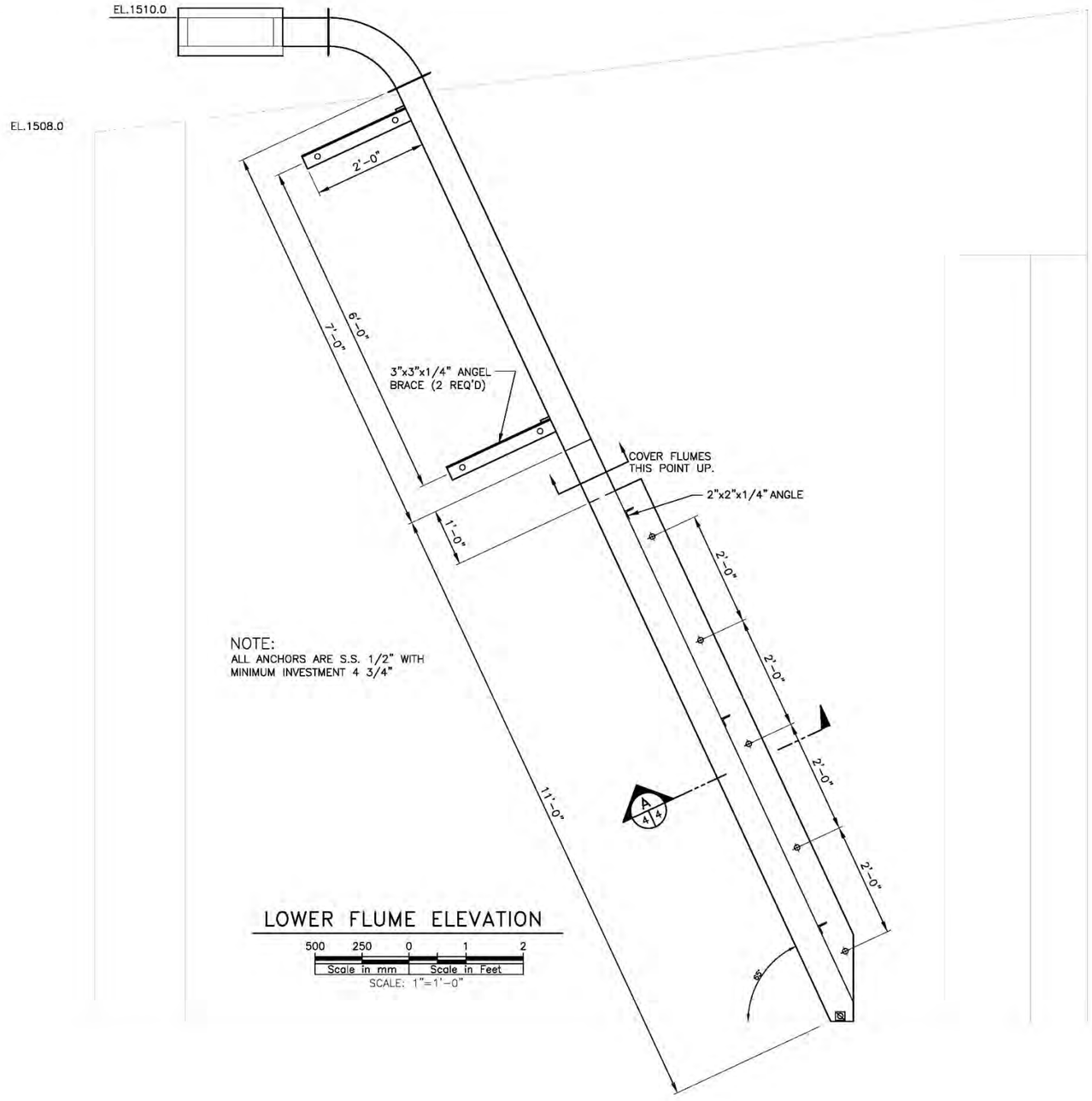
VERIFY SCALE
THIS BAR IS ONE INCH ON ORIGINAL DRAWING
0" —— 1"
ADJUST SCALES ACCORDINGLY, IF NOT ONE INCH ON THIS SHEET

REV.	DATE	DESCRIPTION	BY
△			

WARM SPRING N.F.H.

LAMPREY PASSAGE SYSTEM
UPWELL BOX & REST BOX ELEVATIONS — ELEVATIONS

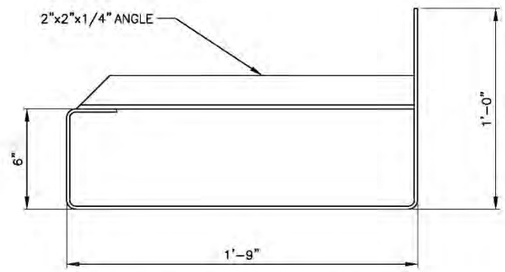
DESIGNED	DRAWN	CHECKED	DATE	DRAWING NO.
	GAH		6/1/15	1R-OR-772-265-3.0



NOTE:
ALL ANCHORS ARE S.S. 1/2" WITH MINIMUM INVESTMENT 4 3/4"

LOWER FLUME ELEVATION

500 250 0 1 2
Scale in mm | Scale in Feet
SCALE: 1"=1'-0"



LOWER FLUME SECTION A 4 4

ALL OTHER FLUME SECTIONS PREFERRED TO FLUMES

200 100 50 0 3 6 12
Scale in Millimeters | Scale in Inches
SCALE: 3"=1'-0"

VERIFY SCALE
THIS BAR IS ONE INCH ON ORIGINAL DRAWING
0" —— 1"
ADJUST SCALES ACCORDINGLY, IF NOT ONE INCH ON THIS SHEET

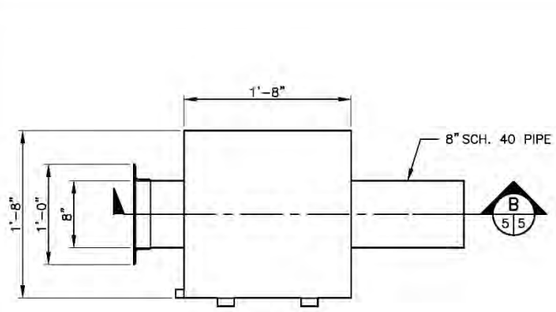
REV.	DATE	DESCRIPTION	BY
△			

WARM SPRING N.F.H.

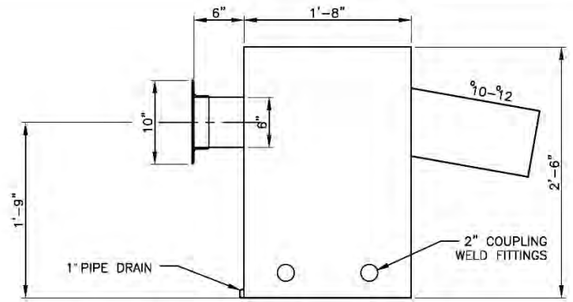
LAMPREY PASSAGE SYSTEM
LOWER FLUME ELEVATION

FLUME SECTION

DESIGNED	DRAWN	CHECKED	DATE	DRAWING NO.
	GAH		6/1/15	1R-OR-772-265-4.0



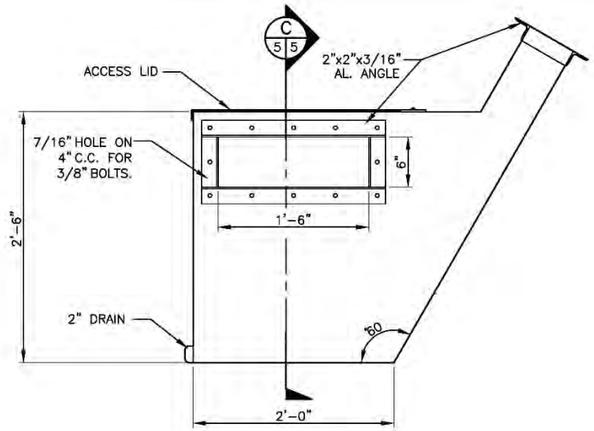
TOP PLAN



SIDE ELEVATION

1 5 3 UPWELL BOX

12 6 0 100 200 300
Scale in Inches Scale in mm
SCALE: 1 1/2"=1'-0"



SIDE VIEW

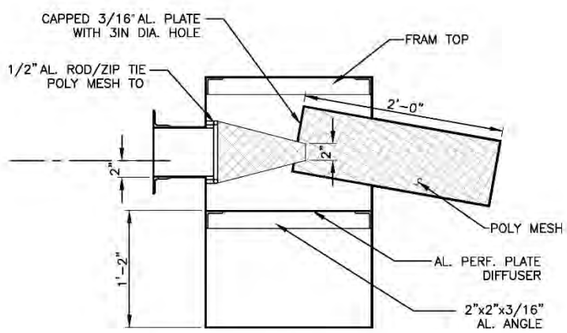
2 5 3 REST BOX

12 6 0 100 200 300
Scale in Inches Scale in mm
SCALE: 1 1/2"=1'-0"

NOTE:
DIMENSIONS CAN BE CHANGED TO FIT DESIGN. ACCESS LID NOT SHOWN: .125" AL. SHEET WITH PIANO HING. FIELD VERIFY ALL DIMENSION AND FLUME ANGLE.

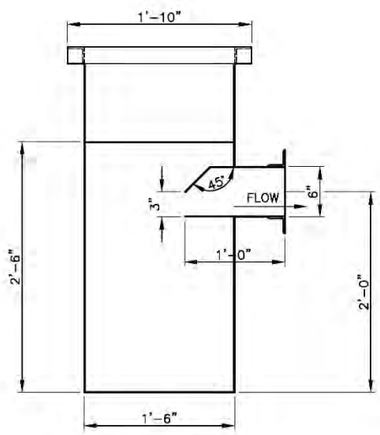
MATERIAL:
3/16" ALUMINUM SHEET/ALLOY 5052
2"x2"x3/16" AL. ANGLE / ALLOY 6061

DIFFUSER:
PERF. PLATE – 3/16" DIA. 1/2" STAGG. CTRS. 50% O/A .125" AL. SHEET 8" SCH. 40 AL. PIPE POLYETHYERE DIAMOND MESH.
McMASTER-CARR #9314T35



B 5 5 SECTION

12 6 0 100 200 300
Scale in Inches Scale in mm
SCALE: 1 1/2"=1'-0"



NOTE:
DIRECTION & DIMENSIONS CAN BE CHANGED TO FIT DESIGN.

MATERIAL:
3/16" AL. SHEET/ALLOY 5052
LID – 1/8" AL. SHEET / ALLOY 5052
2"x2"x3/16" AL. ANGLE / ALLOY 6061

C 5 5 SECTION

12 6 0 100 200 300
Scale in Inches Scale in mm
SCALE: 1 1/2"=1'-0"

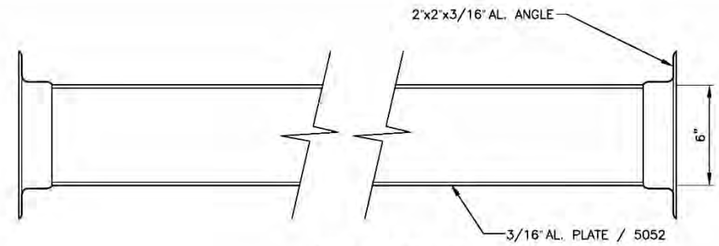
VERIFY SCALE
THIS BAR IS ONE INCH ON ORIGINAL DRAWING
0" —— 1"
ADJUST SCALES ACCORDINGLY, IF NOT ONE INCH ON THIS SHEET

REV.	DATE	DESCRIPTION	BY
△			

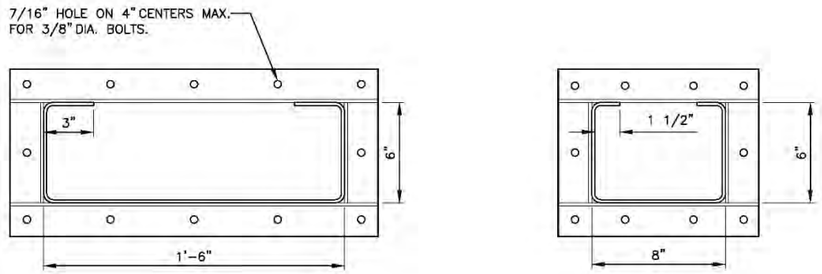
WARM SPRING N.F.H.

LAMPREY PASSAGE SYSTEM
UPWELL BOX & REST BOX DETAILS SECTION

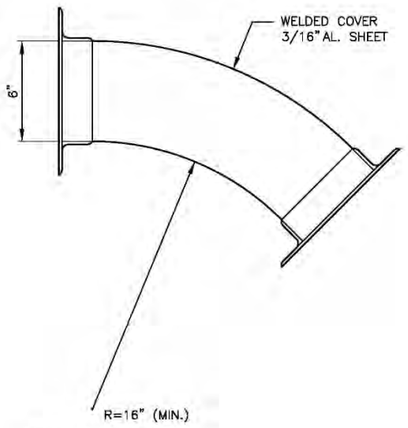
DESIGNED	DRAWN	CHECKED	DATE	DRAWING NO.
	GAH		6/1/15	1R-OR-772-265-5.0



SIDE ELEVATION



END ELEVATIONS



TYPICAL ELBOW

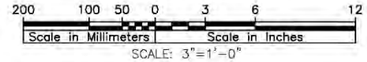
ELBOW ANGLES MAY CHANGE TO FIT DESIGN BUT 16" RADIUS REMAINS THE SAME.

NOTES:
END VIEWS ARE COMMON FLUME SIZES. STRAIGHT FLUME SECTIONS ARE 12'-0" MAX. LENGTH.

MATERIALS:
3/16" ALUMINUM SHEET/ALLOY 5052
2"x2"x3/16" AL. ANGLE / ALLOY 6061
ALL FASTNERS ARE STAINLESS STEEL
1/8" NEOPRENE RUBBER GASKETS (NOT SHOWN)

ALL FLUMES ARE COVERED TO WATER LINER 1/8" AL. SHEET/5051 AND POP RIVETED OR HINGED FOR INSPECTION.

FLUME ELEVATIONS



SCALE: 3"=1'-0"

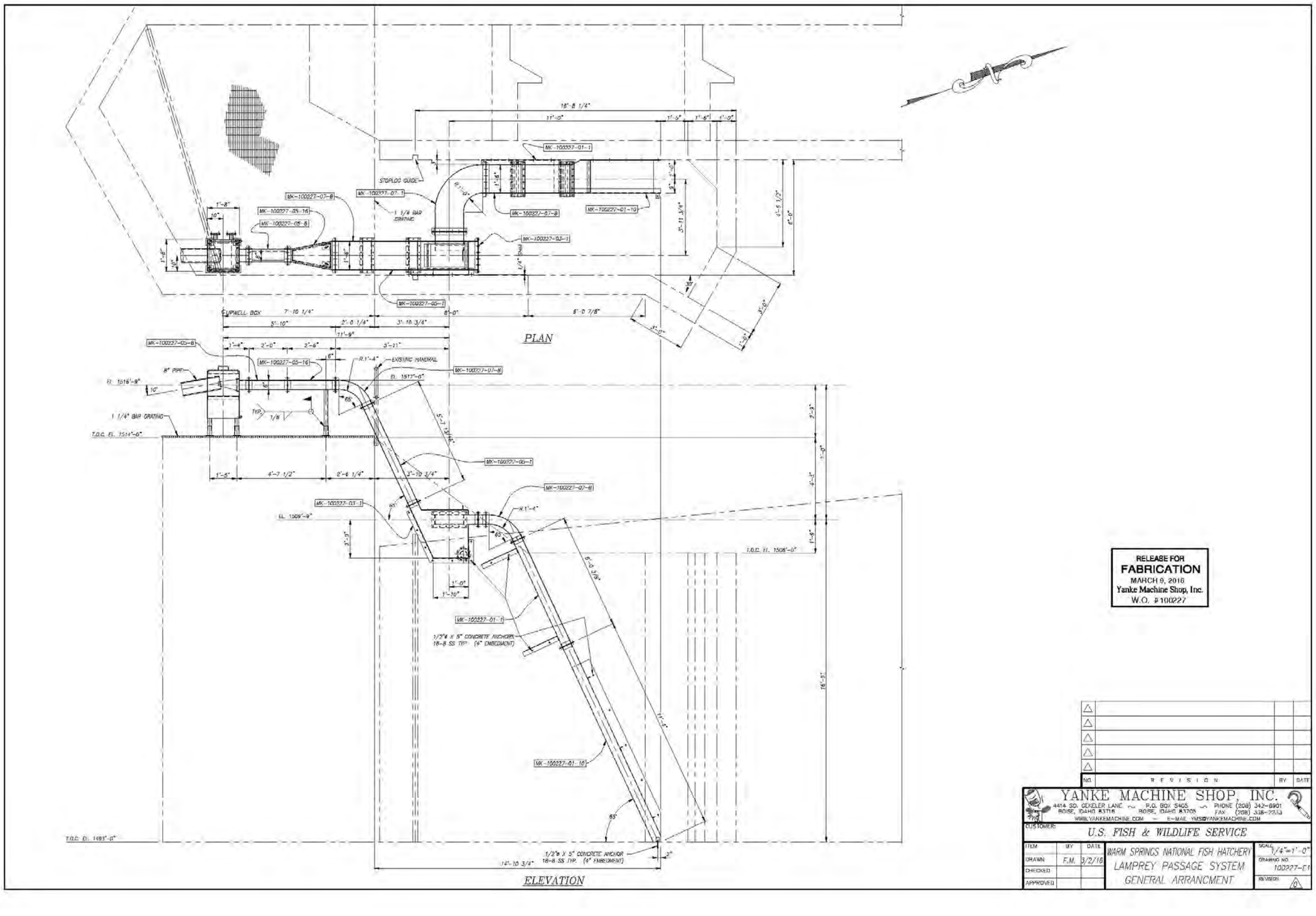
VERIFY SCALE
THIS BAR IS ONE INCH ON ORIGINAL DRAWING
0" —— 1"
ADJUST SCALES ACCORDINGLY, IF NOT ONE INCH ON THIS SHEET

REV.	DATE	DESCRIPTION	BY
△			

WARM SPRING N.F.H.

LAMPREY PASSAGE SYSTEM
STANARD FLUME ELEVATIONS — DETAIL

DESIGNED	DRAWN	CHECKED	DATE	DRAWING NO.
	GAH		6/1/15	1R-OR-772-265-6.0



RELEASE FOR
FABRICATION
MARCH 9, 2016
Yanke Machine Shop, Inc.
W.O. #100227

NO.	REVISION	BY	DATE
△			
△			
△			
△			
△			

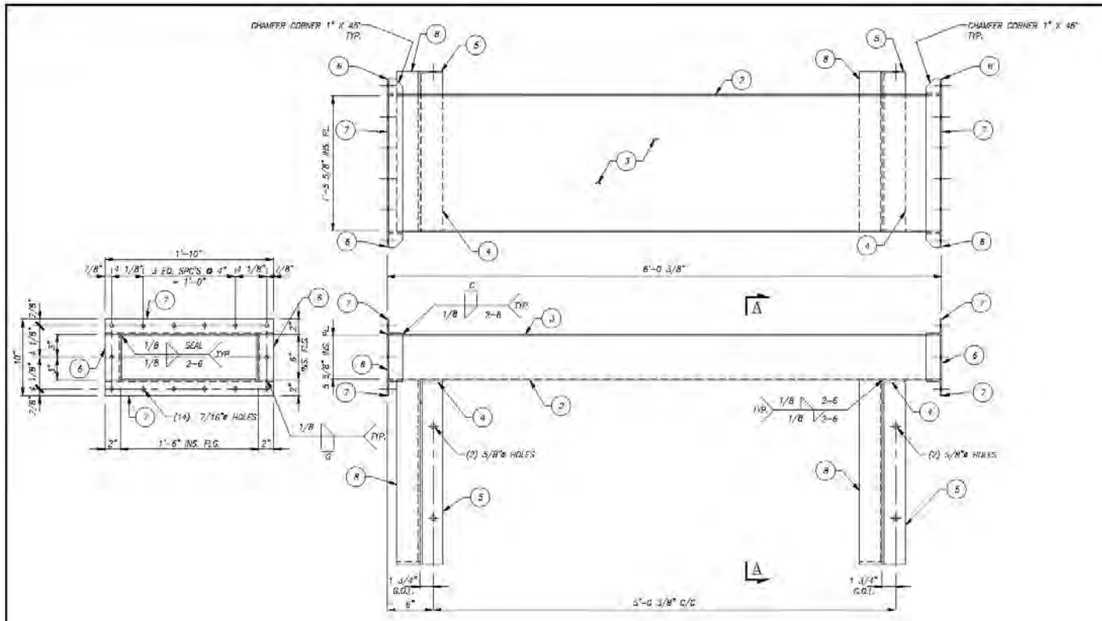
YANKE MACHINE SHOP, INC.
4414 SO. GEKELER LANE ~ P.O. BOX 5405 ~ PHONE (208) 342-0901
BOISE, IDAHO 83716 BOISE, IDAHO 83705 FAX (208) 338-9353
WWW.YANKEMACHINE.COM ~ E-MAIL YMS@YANKEMACHINE.COM

CUSTOMER: *U.S. FISH & WILDLIFE SERVICE*

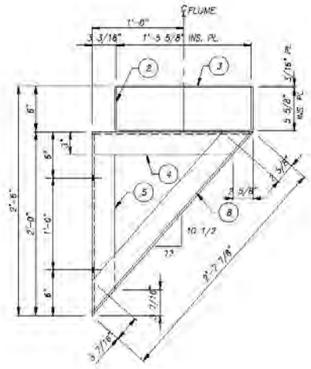
ITEM	BY	DATE
DRAWN	F.M.	3/2/16
CHECKED		
APPROVED		

WARM SPRINGS NATIONAL FISH HATCHERY
LAMPREY PASSAGE SYSTEM
GENERAL ARRANGMENT

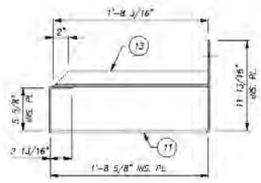
SCALE: 1/4"=1'-0"
DRAWING NO. 100227-G1
REVISION: 0



MK-100227-01-1 ~ ONE REQ'D.



SECTION A-A



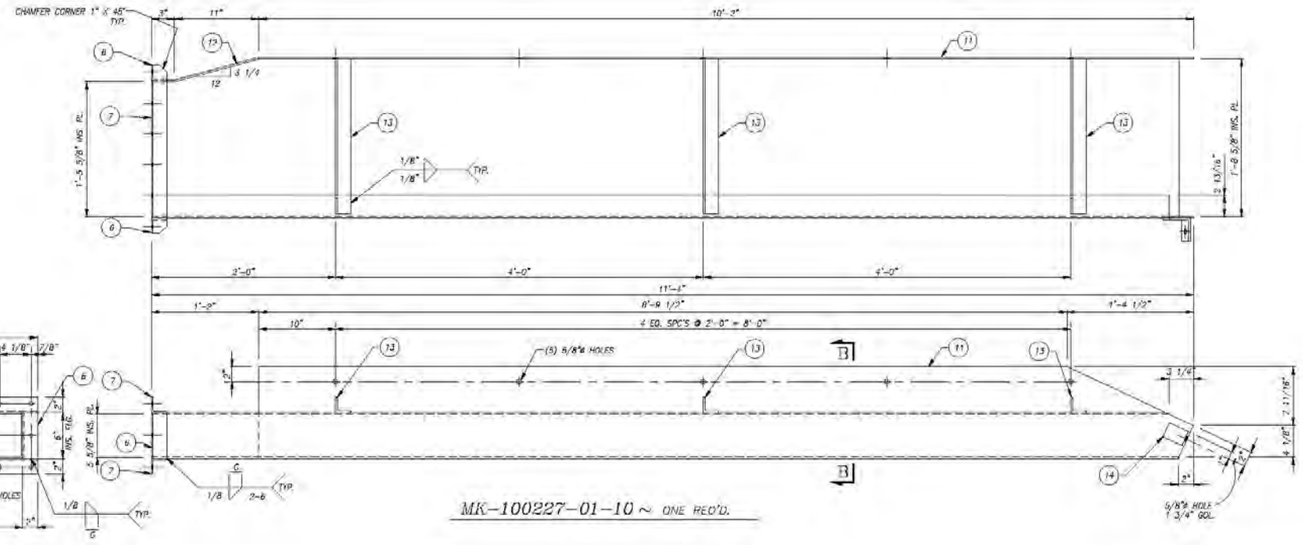
SECTION B-B

ITEM	NO. REQ'D	D E S C R I P T I O N		LENGTH	TOTAL QUANT.	UNIT WT.	TOTAL WT.
	1	MK-100227-01-1~ LOWER FLUME:					33
2	1	PL. 3/16 X 2'-4 7/8" (BEND)	ALUM. 5052-H32	6'-0 3/8"	14.51	2.66	39
3	1	PL. 3/16 X 1'-5 5/8"	ALUM. 5052-H32	6'-0 3/8"	8.86	2.66	24
4	2	L 3 X 3 X 1/4 (MITER)	ALUM. 6061-T6	1'-9"	3.5'	1.68	6
5	2	L 3 X 3 X 1/4 (MITER-COPE)	ALUM. 6061-T6	1'-11 3/4"	3.96'	1.68	7
6	4	L 2 X 2 X 3/16	ALUM. 6061-T6	0'-6"	2.0'	0.85	2
7	4	L 2 X 2 X 3/16	ALUM. 6061-T6	1'-10"	7.33'	0.85	6
8	2	L 3 X 3 X 1/4 (MITERED)	ALUM. 6061-T6	2'-7 7/8"	5.31'	1.68	9
	1	MK-100227-01-10~ LOWER FLUME					121
11	1	PL. 3/16 X 3'-4 7/8" (BEND)	ALUM. 5052-H32	11'-4"	38.81	2.66	103
12	1	PL. 3/16 X 0'-5 13/16" (BEND)	ALUM. 5052-H32	1'-2 3/8"	0.38	2.66	2
13	3	L 2 X 2 X 1/4 (MITERED)	ALUM. 6061-T6	1'-8 3/16"	5.05'	1.11	6
14	1	L 3 X 3 X 1/4	ALUM. 6061-T6	0'-2"	0.17'	1.68	1
6	2	L 2 X 2 X 3/16	ALUM. 6061-T6	0'-6"	1.0'	0.85	1
7	2	L 2 X 2 X 3/16	ALUM. 6061-T6	1'-10"	3.67'	0.85	3

THIS SHEET WEIGHT = 314 LBS

FIELD HOLTS:
(28) 3/8"ø-16 NC 18-8 SS. BOLTS X 1 1/4" W/ HN & LW (FLANGE)
(10) 1/2"ø- CONCRETE ANCHORS 18-8 SS. X 5" HEX HEAD (MK100227-01-1, MK100227-01-10 TO WALL)

RELEASE FOR
FABRICATION
MARCH 9, 2016
Yanke Machine Shop, Inc.
W.O. #100227



MK-100227-01-10 ~ ONE REQ'D.

NOTES:
1.- ALL CORNER WELDS (FILLET OR BEVEL) SHALL BE 1/8" MIN U.N.O.
2.- ALL HOLES 7/16"ø U.N.O.
3.- INSIDE OF FLUME SHALL BE SMOOTH, ALL BURRS, SHARP EDGES AND CORNERS SHALL BE GROUND OFF.
4.- WORK THIS SHEET WITH DWG 100227-02

NO.	REVISION	BY	DATE
△			
△			
△			
△			
△			

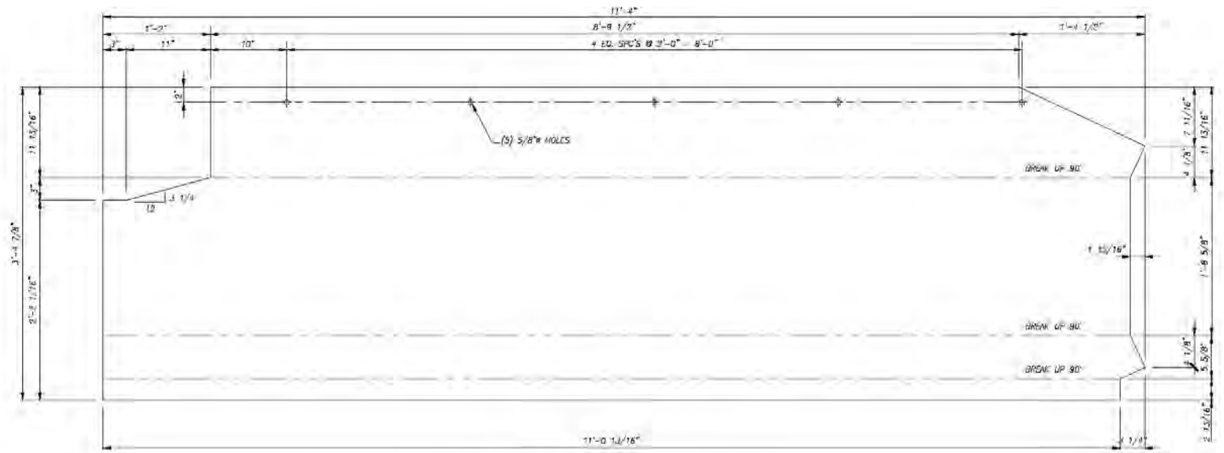
YANKE MACHINE SHOP, INC.
4414 SO. GEKELER LANE ~ P.O. BOX 5405 ~ PHONE (208) 342-0901
BOISE, IDAHO 83716 BOISE, IDAHO 83705 FAX (208) 338-7353
WWW.YANKEMACHINE.COM E-MAIL YMS@YANKEMACHINE.COM

CUSTOMER: U.S. FISH & WILDLIFE SERVICE

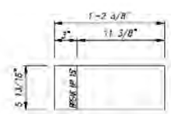
ITEM	BY	DATE
DRAWN	D.T.	2/17/16
CHECKED		
APPROVED		

WARM SPRINGS NATIONAL FISH HATCHERY
LAMPREY PASSAGE SYSTEM
FABRICATION DETAILS

SCALE: 1 1/2"=1'-0"
DRAWING NO. 100227-01
REVISION: 0



DETAIL ITEM (11) ONE REQ'D



DETAIL ITEM (12) ONE REQ'D

RELEASE FOR
FABRICATION
MARCH 9, 2016
Yanke Machine Shop, Inc.
W.O. #100227

NOTES:
1.- ALL HOLES 5/8"ø U.N.O.
2.- WORK THIS SHEET WITH DWG 100227-01

NO.	REVISION	BY	DATE
1			
2			
3			
4			
5			

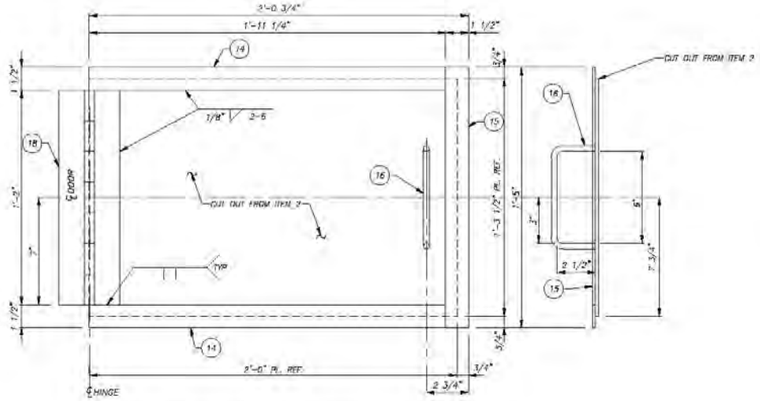
YANKE MACHINE SHOP, INC.
4414 SO. GEKELER LANE ~ P.O. BOX 5405 ~ PHONE (208) 342-8901
BOISE, IDAHO 83716 BOISE, IDAHO 83705 FAX (208) 338-2353
WWW.YANKEMACHINE.COM ~ E-MAIL YMS@YANKEMACHINE.COM

CUSTOMER: U.S. FISH & WILDLIFE SERVICE

ITEM	BY	DATE
DRAWN	D.T.	2/17/16
CHECKED		
APPROVED		

WARM SPRINGS NATIONAL FISH HATCHERY
LAMPREY PASSAGE SYSTEM
PLATE DETAILS

SCALE: 1 1/2"=1'-0"
DRAWING NO. 100227-02
REVISION: 1

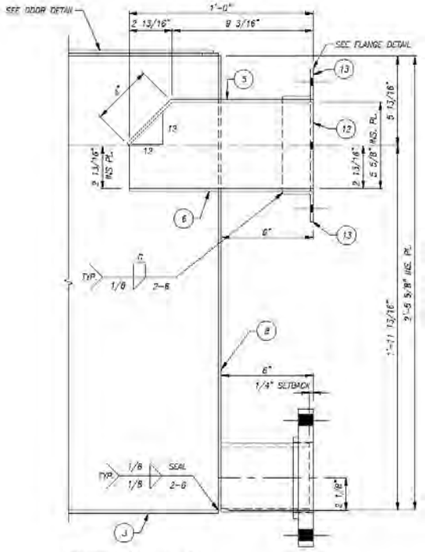


DOOR DETAIL ~ ONE REQ'D.
3"=1'-0"

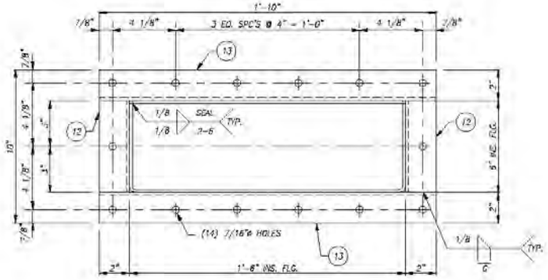
RELEASE FOR
FABRICATION
MARCH 9, 2016
Yanke Machine Shop, Inc.
W.O. #100227

ITEM	NO. REQ'D	DESCRIPTION	LENGTH	TOTAL QUANT.	UNIT WT.	TOTAL WT.
	1	MK-7X13X9-03-1 ~ REST BOX				141
2	1	PL. 3/16 X 1'-5 5/8" (BEND) ALUM. 5052-H32	3'-7 11/16"	5.35	2.66	14
3	1	PL. 3/16 X 1'-5 5/8" (BEND) ALUM. 5052-H32	7'-0 3/8"	10.53	2.66	27
4	1	PL. 3/16 X 10" ALUM. 5052-H32	1'-10"	1.53	2.66	4
5	1	PL. 3/16 X 1'-1 3/16" (BEND) ALUM. 5052-H32	1'-5 5/8"	3.01	2.66	8
6	1	PL. 3/16 X 1'-0" (BEND) ALUM. 5052-H32	2'-4 7/8"	2.41	2.66	6
7	1	PL. 3/16 X 2'-10 7/8" ALUM. 5052-H32	3'-7 1/16"	10.43	2.66	28
8	1	PL. 3/16 X 2'-10 7/8" ALUM. 5052-H32	3'-7 1/16"	10.43	2.66	28
9	1	L 4 X 3 X 1/4 (MITERED) ALUM. 6061-T6	3'-11"	3.83'	1.99	8
10	1	L 4 X 3 X 1/4 (MITERED) ALUM. 6061-T6	1'-11 15/16"	1.99'	1.99	4
11	1	L 4 X 3 X 1/4 ALUM. 6061-T6	1'-9 1/2"	1.21'	1.99	3
12	6	L 2 X 2 X 3/16 ALUM. 6061-T6	0'-8"	3.0'	0.85	3
13	6	L 2 X 2 X 3/16 ALUM. 6061-T6	1'-10"	11.0'	0.85	9
14	2	FB 1 1/2 X 3/16 ALUM. 6061-T6	1'-11 1/4"	3.88'	0.33	1
15	1	FB 1 1/2 X 3/16 ALUM. 6061-T6	1'-5"	1.42'	0.33	1
16	1	RD 3/8 R ALUM. 6061-T6	0'-11"	0.92'	0.13	1
17	1	4"Ø SCH. 40 PIPE ALUM. 6061-T6	0'-5 3/4"	0.48'	3.73	2
18	1	PIANO HINGE 5052 ALUMINUM .120 X 4" – 3/8"Ø PIN X 1'-2" I.C. McMASTER-CARR 1581A172				–
19	1	4"Ø 125# S.O.R.F. FLANGE 356 ALUMINUM			–	–
20	14	3/8"Ø– 16 NC 18-8 SS. BOLT X 1 1/4" W/ HN & LW			–	–

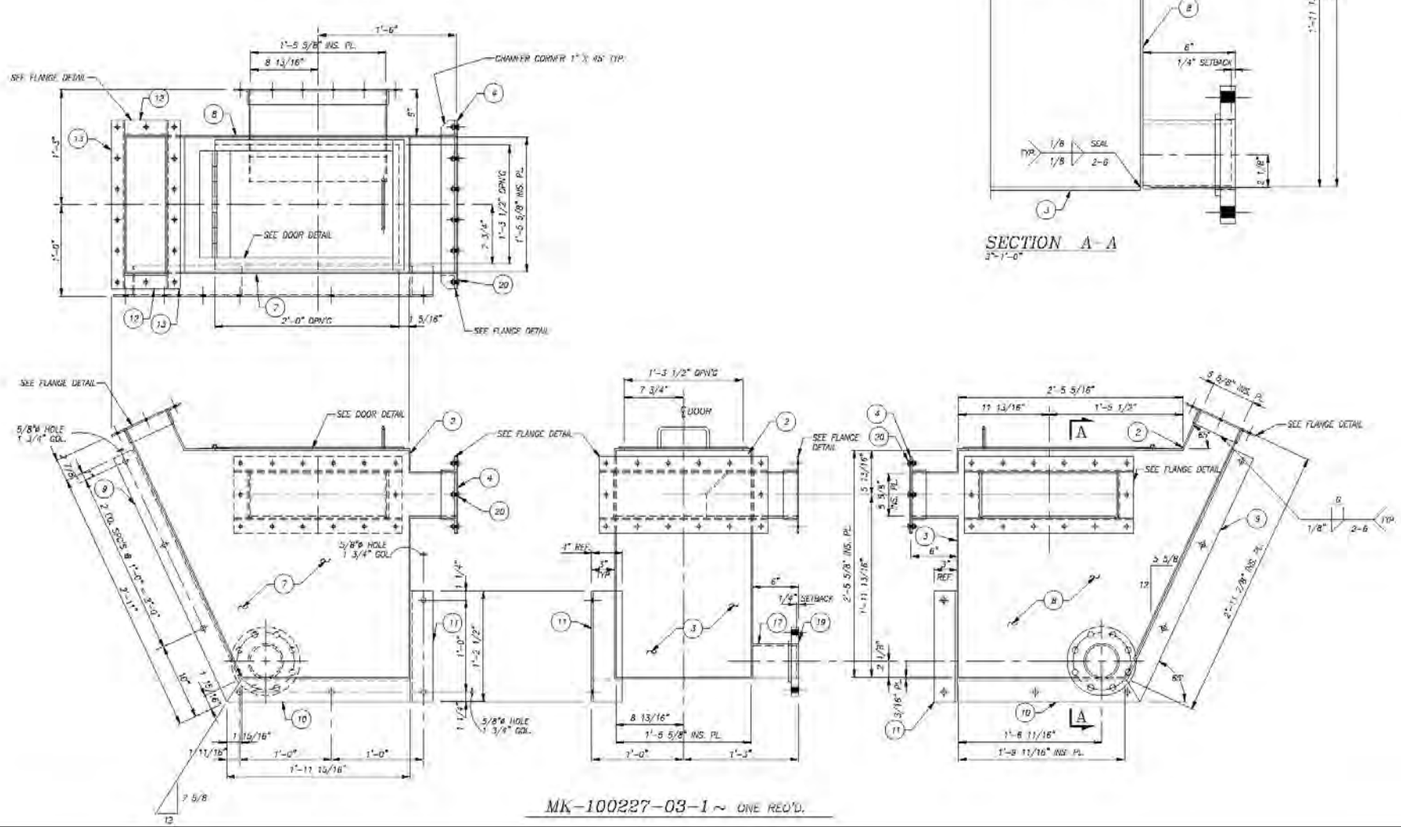
FIELD BOLTS:
(14) 3/8"ø–16 NC 18-8 SS. BOLTS X 1 1/4" W/ HN & LW (FLANGE)
(7) 1/2"ø– CONCRETE ANCHORS 18-8 SS. X 5" HEX HEAD (MK100227-03-1 TO WALL)



SECTION A-A
3"=1'-0"



FLANGE DETAIL ~ THREE REQ'D.
3"=1'-0"



MK-100227-03-1 ~ ONE REQ'D.

NOTES:
1. ALL CORNER WELDS (FILLET OR BEVEL) SHALL BE 1/8" MIN U.N.O.
2. ALL HOLES 7/16"ø U.N.O.
3. INSIDE OF FLUME SHALL BE SMOOTH. ALL BURRS, SHARP EDGES AND CORNERS SHALL BE GROUND OFF.
4. WORK THIS SHEET WITH DWG 100227-04

NO.	REVISION	BY	DATE
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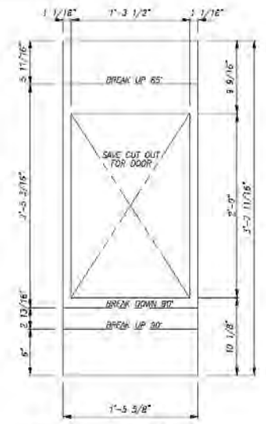
YANKE MACHINE SHOP, INC.
4414 SO. GEKELER LANE ~ P.O. BOX 5405 ~ PHONE (208) 342-8901
BOISE, IDAHO 83716 BOISE, IDAHO 83705 FAX (208) 338-2253
WWW.YANKEMACHINE.COM ~ E-MAIL YMS@YANKEMACHINE.COM

CUSTOMER: U.S. FISH & WILDLIFE SERVICE

ITEM	BY	DATE
DRAWN	D.T.	2/17/16
CHECKED		
APPROVED		

WARM SPRINGS NATIONAL FISH HATCHERY
LAMPREY PASSAGE SYSTEM
FABRICATION DETAILS

SCALE: 1 1/2"=1'-0"
DRAWING NO. 100227-03
REVISION: 0



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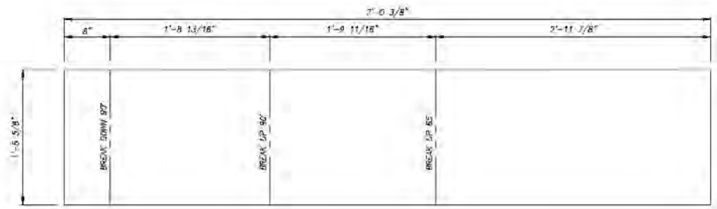
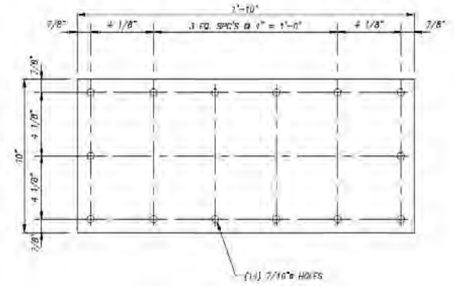
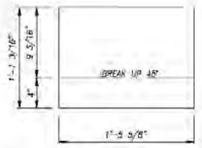


DETAIL ITEM (3) ONE REQ'D



DETAIL ITEM (4) ONE REQ'D



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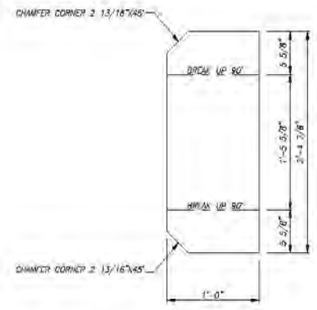
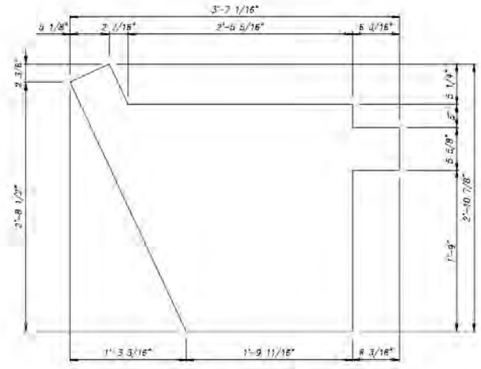
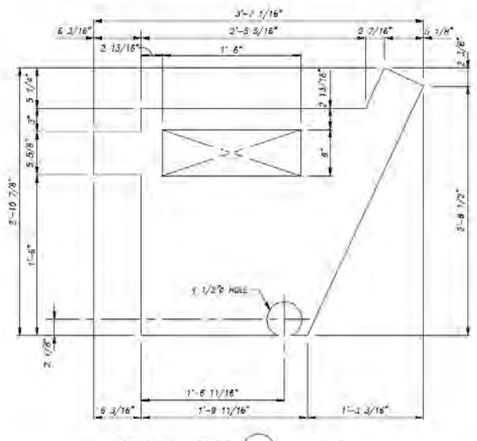


DETAIL ITEM (6) ONE REQ'D



DETAIL ITEM (7) ONE REQ'D



DETAIL ITEM (8) ONE REQ'D

RELEASE FOR
FABRICATION
MARCH 9, 2016
Yanke Machine Shop, Inc.
W.O. #100227

NOTES:
1.- ALL HOLES 7/16"ø U.N.O.
2.- WORK THIS SHEET WITH DWG 100227-03

NO.	REVISION	BY	DATE
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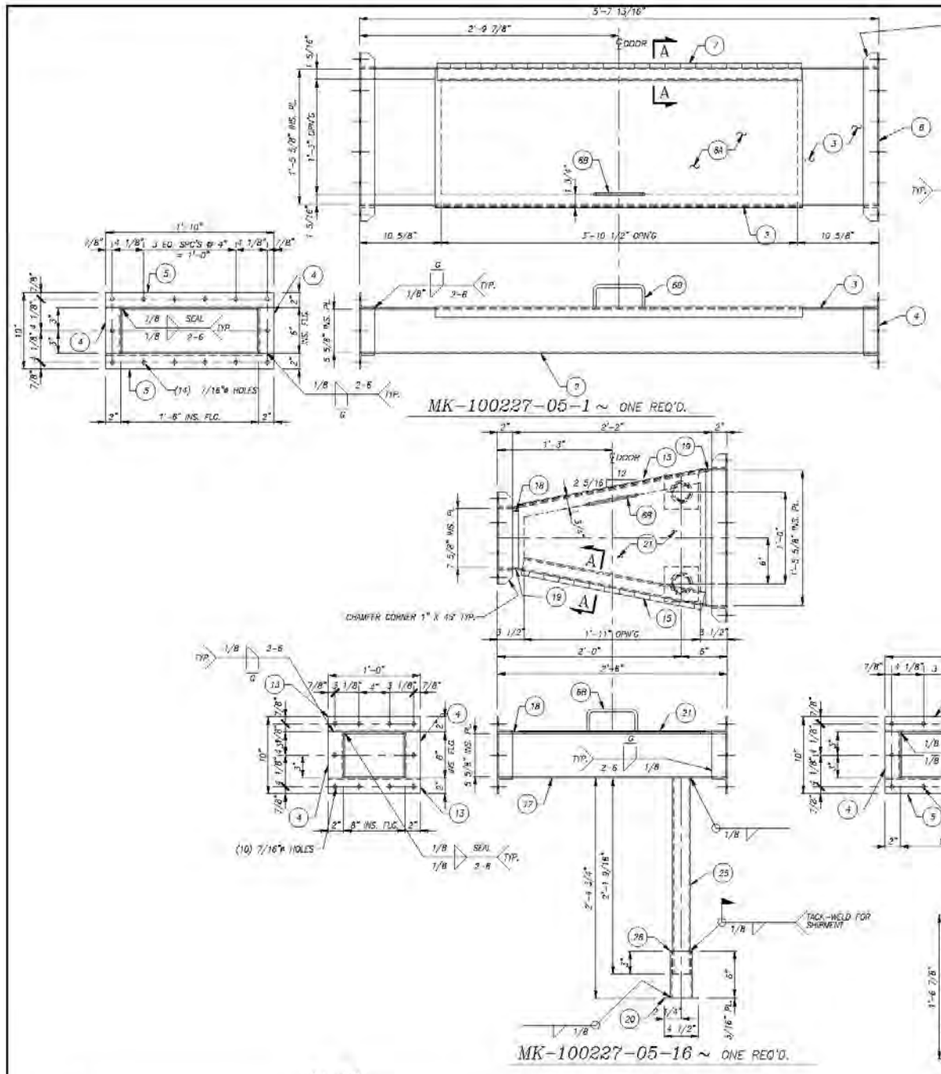
YANKE MACHINE SHOP, INC.
4414 SO. GEKELER LANE ~ BOISE, IDAHO 83716
P.O. BOX 5405 ~ BOISE, IDAHO 83705
PHONE (208) 342-8901
FAX (208) 338-2333
WWW.YANKEMACHINE.COM ~ E-MAIL YMS@YANKEMACHINE.COM

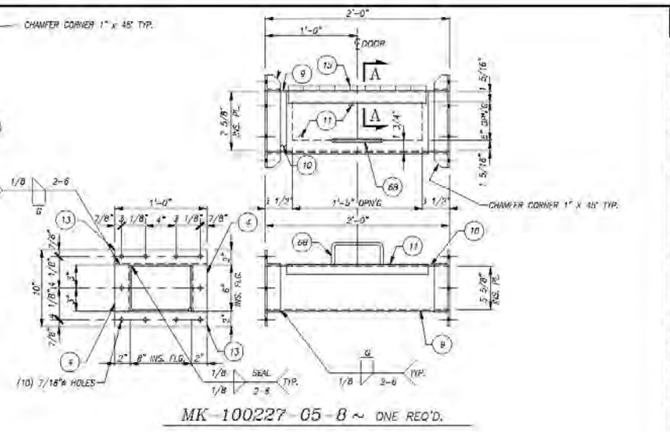
CUSTOMER: U.S. FISH & WILDLIFE SERVICE

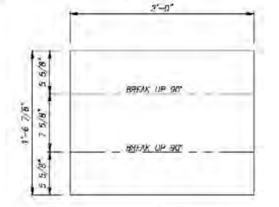
ITEM	BY	DATE
DRAWN	D.T.	2/17/16
CHECKED		
APPROVED		

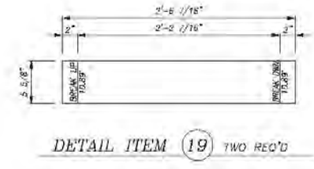
WARM SPRINGS NATIONAL FISH HATCHERY
LAMPREY PASSAGE SYSTEM
PLATE DETAILS

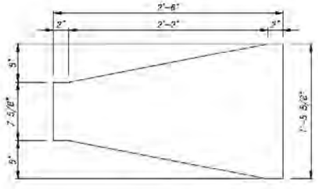
SCALE: 1 1/2"=1'-0"
DRAWING NO. 100227-04
REVISION: △

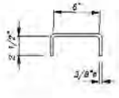


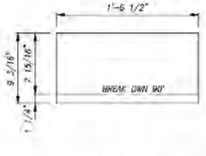


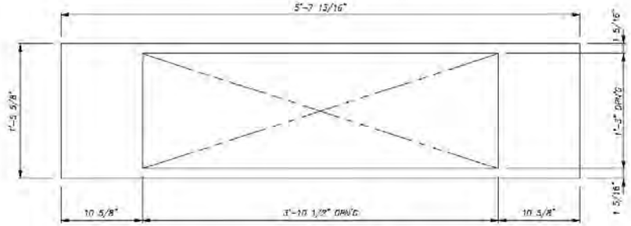












ITEM	NO. REQ'D	D E S C R I P T I O N	LENGTH	TOTAL QUANT.	UNIT WT.	TOTAL WT.
	1	MK-100227-05-1~ FLUME				78
2	1	PL. 3/16 X 2'-4 7/8" ALUM. 5052-H32	5'-7 13/16"	13.60	2.66	36
3	1	PL. 3/16 X 1'-5 5/8" ALUM. 5052-H32	5'-7 13/16"	8.30	2.66	22
4	4	L 2 X 2 X 3/16 ALUM. 6061-T6	0'-6"	2.0'	0.85	2
5	4	L 2 X 2 X 3/16 ALUM. 6061-T6	1'-10"	7.33'	0.85	6
6A	1	PL. 1/8 X 1'-7 3/16" (BEND) ALUM. 5052-H32	4'-0"	6.4	1.75	11
6B	1	RB 3/8 ø (BEND) ALUM. 6061-T6	0'-11"	0.92'	0.13	1
7	1	PIANO HINGE 5052 ALUMINUM .120 X 4" – 3/8"ø PIN X 3'-11 1/2" LG. McMASTER-CARR 1581A172				
	1	MK-100227-05-8~ FLUME				15
8	1	PL. 3/16 X 1'-6 7/8" (BEND) ALUM. 5052-H32	2'-0"	3.15	2.66	8
10	1	PL. 3/16 X 1' 3/8" ALUM. 5052-H32	2'-0"	1.27	2.66	3
11	1	PL. 1/8 X 9 3/16" (BEND) ALUM. 5052-H32	1'-6 1/2"	1.18	1.75	2
4	4	L 2 X 2 X 3/16 ALUM. 6061-T6	0'-6"	2.0'	0.85	3
13	4	L 2 X 2 X 3/16 ALUM. 6061-T6	1'-0"	4.0'	0.85	3
6B	1	RB 3/8 ø (BEND) ALUM. 6061-T6	0'-11"	0.92'	0.13	1
15	1	PIANO HINGE 5052 ALUMINUM .120 X 4" – 3/8"ø PIN X 1'-6" LG. McMASTER-CARR 1581A172				
	1	MK-100227-05-16~ TRANSITION FLUME				40
17	1	PL. 3/16 X 1'-5 5/8" ALUM. 5052-H32	2'-6"	3.67	2.66	10
18	1	PL. 3/16 X 1'-5 5/8" ALUM. 5052-H32	2'-6"	3.67	2.66	10
19	2	PL. 3/16 X 5 5/8" ALUM. 5052-H32	2'-6 7/16"	2.38	2.66	6
20	2	PL. 3/16 X 4 1/2" ALUM. 5052-H32	0'-4 1/2"	0.28	2.66	1
21	1	PL. 1/8 X 1'-6 7/8" (BEND) ALUM. 5052-H32	3'-0 3/4"	3.24	1.75	6
4	4	L 2 X 2 X 3/16 ALUM. 6061-T6	0'-6"	2.0'	0.85	2
13	2	L 2 X 2 X 3/16 ALUM. 6061-T6	1'-0"	2.0'	0.85	2
5	2	L 2 X 2 X 3/16 ALUM. 6061-T6	1'-10"	3.67'	0.85	3
25	1	2 ø SCH. 40 PIPE ALUM. 6061-T6	3'-1 9/16"	2.13'	1.26	3
26	1	3 1/2 ø SCH. 40 PIPE ALUM. 6061-T6	0'-6"	0.5'	2.00	1
6B	1	RB 3/8 ø (BEND) ALUM. 6061-T6	0'-11"	0.92'	0.13	1
15	1	PIANO HINGE 5052 ALUMINUM .120 X 4" – 3/8"ø PIN X 2'-0" LG. McMASTER-CARR 1581A172				

THIS SHEET WEIGHT = 142 LBS

FIELD BOLTS:

(24) 3/8"ø-16 NC 1A-B SS. BOLTS X 1 1/4" W/ HN & LW (FLANGE)

SECTION A-A

3"= 1'-0"

RELEASE FOR FABRICATION
MARCH 9, 2016
Yanke Machine Shop, Inc.
W.O. # 100227

NOTES:

1.- ALL CORNER WELDS (FILLET OR BEVEL) SHALL BE 1/8" MIN U.N.O.

2.- ALL HOLES 7/16"ø U.N.O.

3.- INSIDE OF FLUME SHALL BE SMOOTH. ALL BURRS, SHARP EDGES AND CORNERS SHALL BE GROUND OFF.

4.- WORK THIS SHEET WITH DWG 100227-06.

NO.	R E V I S I O N	BY	DATE
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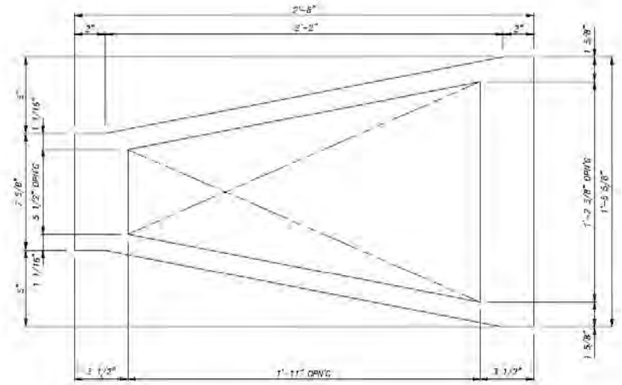
YANKE MACHINE SHOP, INC.
4414 SO. GEKELER LANE ~ P.O. BOX 5405 ~ PHONE (208) 342-0901
BOISE, IDAHO 83716 BOISE, IDAHO 83705 FAX (208) 338-7353
WWW.YANKEMACHINE.COM E-MAIL YMS@YANKEMACHINE.COM

CUSTOMER: U.S. FISH & WILDLIFE SERVICE

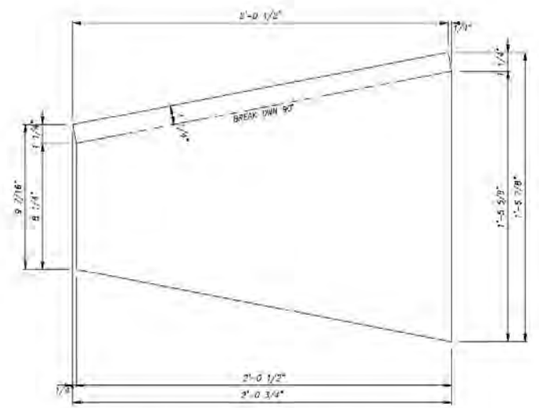
ITEM	BY	DATE
DRAWN	D.T.	2/17/16
CHECKED		
APPROVED		

WARM SPRINGS NATIONAL FISH HATCHERY
LAMPREY PASSAGE SYSTEM
FABRICATION DETAILS

SCALE: 1 1/2"=1'-0"
DRAWING NO. 100227-05
REVISION: 0

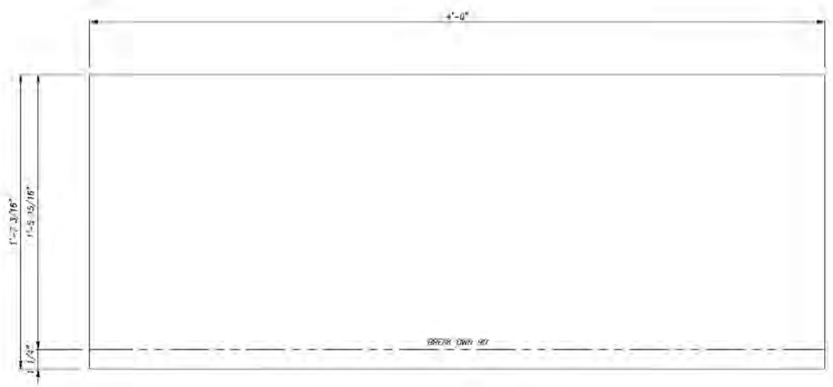


DETAIL ITEM (18) ONE REQ'D



DETAIL ITEM (21) ONE REQ'D

RELEASE FOR
FABRICATION
MARCH 9, 2016
Yanke Machine Shop, Inc.
W.O. #100227



DETAIL ITEM (6) ONE REQ'D

NOTES:
1.- WORK THIS SHEET WITH DWG 100227-02

NO.	REVISION	BY	DATE
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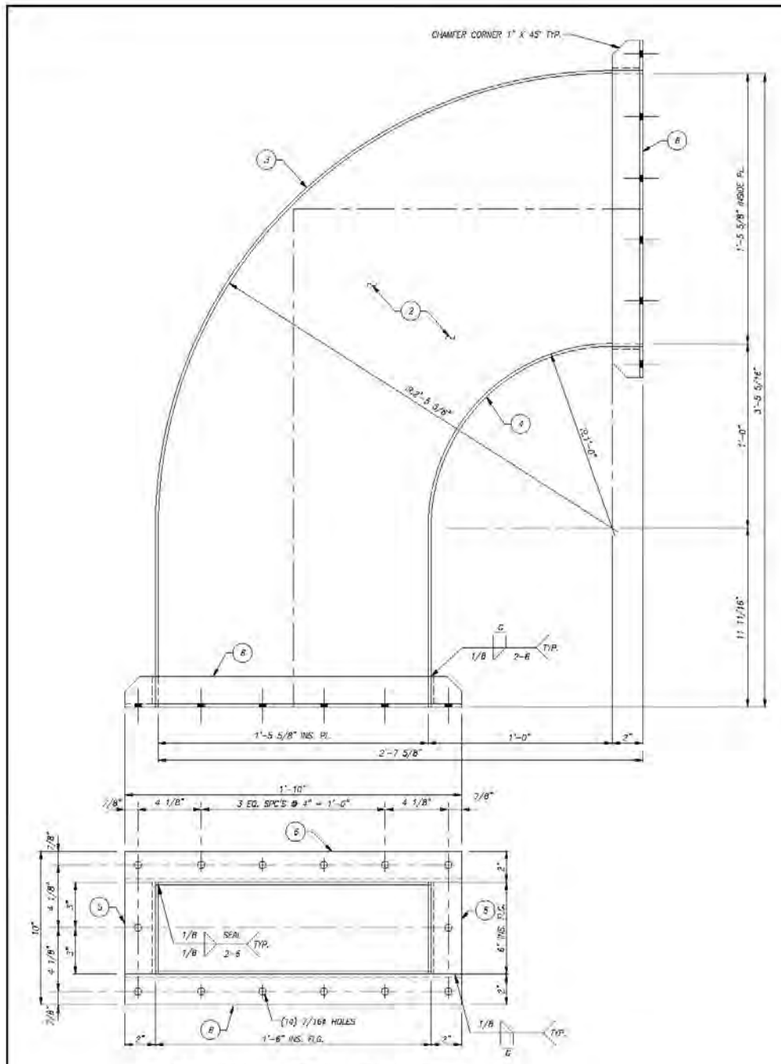
YANKE MACHINE SHOP, INC.
4414 SO. GEKELER LANE ~ P.O. BOX 5405 ~ PHONE (208) 342-0901
BOISE, IDAHO 83705 BOISE, IDAHO 83705 FAX (208) 338-2333
WWW.YANKEMACHINE.COM — E-MAIL YMSI@YANKEMACHINE.COM

CUSTOMER: U.S. FISH & WILDLIFE SERVICE

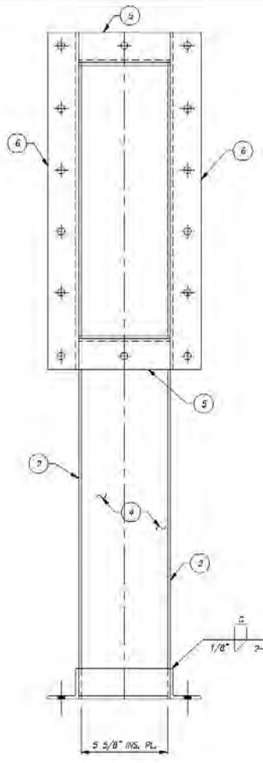
ITEM	BY	DATE
DRAWN	D.T.	2/17/16
CHECKED		
APPROVED		

WARM SPRINGS NATIONAL FISH HATCHERY
LAMPREY PASSAGE SYSTEM
PLATE DETAILS

SCALE: 3"=1'-0"
DRAWING NO. 100227-06
REVISION: 0



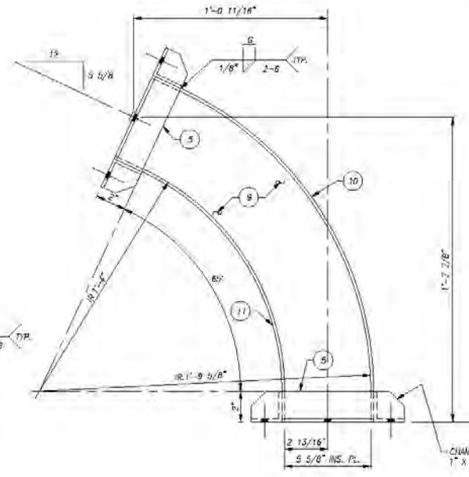
MK-100227-07-1 ~ ONE REQ'D.

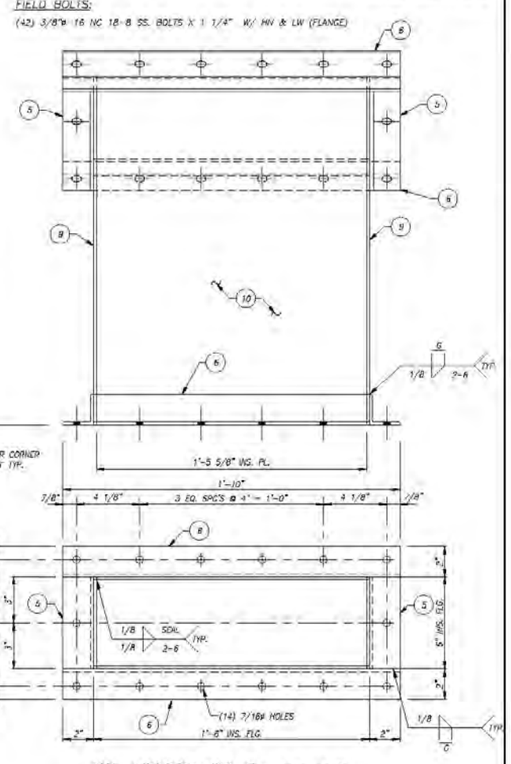


RELEASE FOR
FABRICATION
MARCH 9, 2016
Yanke Machine Shop, Inc.
W.O. #100227

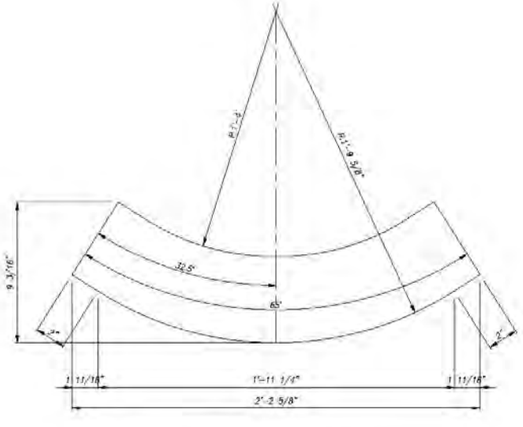
ITEM	NO. REQ'D	DESCRIPTION		LENGTH	TOTAL QUANT.	UNIT WT.	TOTAL WT.
	1	MK-100227-07-1~ ELBOW 60°					63
2	2	PL. 3/16 X 2'-7 5/8"	ALUM. 5052-H32	3'-5 5/16"	18.15	2.66	48
3	1	PL. 3/16 X 5 5/8"	ALUM. 5052-H32	5'-0 3/8"	7.39	2.66	5
4	1	PL. 3/16 X 5 5/8"	ALUM. 5052-H32	2'-8 3/8"	3.88	2.66	3
5	4	L 2 X 2 X 3/16	ALUM. 6061-T6	0'-6"	2.0'	0.85	2
6	4	L 2 X 2 X 3/16	ALUM. 6061-T6	1'-10"	7.33'	0.85	6
	2	MK-100227-07-8~ ELBOW 60°				33	66
8	4	PL. 3/16 X 8 3/16"	ALUM. 5052-H32	2'-2 5/8"	8.78	2.66	18
10	2	PL. 3/16 X 1'-5 5/8"	ALUM. 5052-H32	2'-4 5/8"	7.0	2.66	15
11	2	PL. 3/16 X 1'-5 5/8"	ALUM. 5052-H32	1'-10 1/16"	5.4	2.66	14
5	8	L 2 X 2 X 3/16	ALUM. 6061-T6	0'-8"	4.0'	0.85	3
6	8	L 2 X 2 X 3/16	ALUM. 6061-T6	1'-10"	11.67'	0.85	12

THIS SHEET WEIGHT = 128 LBS





MK-100227-07-8 ~ TWO REQ'D.



DETAIL ITEM (9) FOUR REQ'D.

NOTES:
1.- ALL CORNER WELDS (FILLET OR BEVEL) SHALL BE 1/8" MIN WELD U.N.O.
2.- ALL HOLES 7/16"ø U.N.O.
3.- INSIDE OF FLUME SHALL BE SMOOTH. ALL BURRS, SHARP EDGES AND CORNERS SHALL BE GROUND OFF.

NO.	REVISION	BY	DATE
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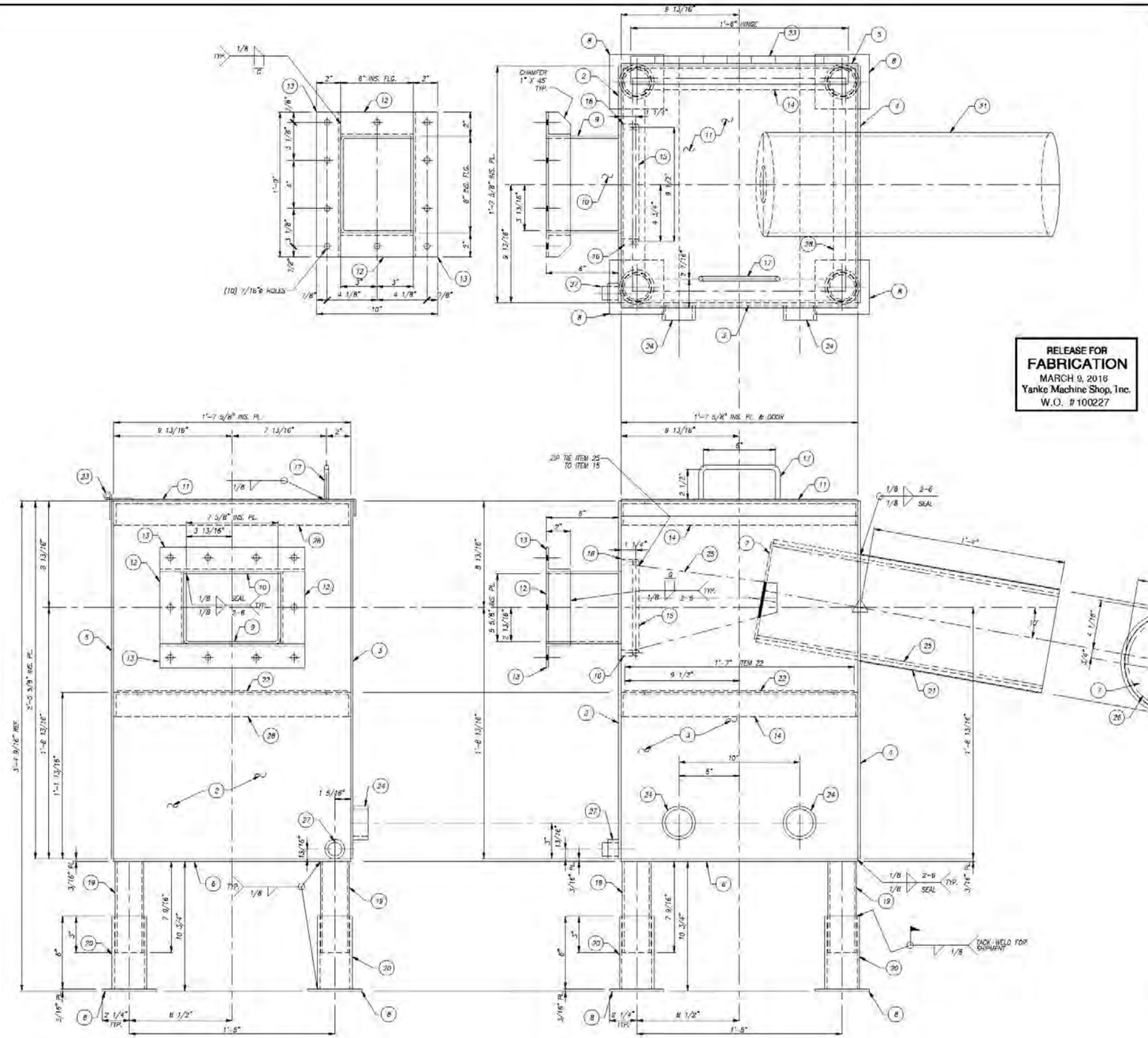
YANKE MACHINE SHOP, INC.
4414 SO. CEDELER LANE ~ P.O. BOX 5405 ~ PHONE (208) 342-8901
BOISE, IDAHO 83716 BOISE, IDAHO 83705 FAX (208) 338-2533
WWW.YANKEMACHINE.COM ~ E-MAIL YMS@YANKEMACHINE.COM

CUSTOMER: U.S. FISH & WILDLIFE SERVICE

ITEM	BY	DATE
DRAWN	D.T.	2/17/16
CHECKED		
APPROVED		

WARM SPRINGS NATIONAL FISH HATCHERY
LAMPREY PASSAGE SYSTEM
FABRICATION DETAILS

SCALE: 3"=1'-0"
DRAWING NO. 100227-07
REVISION: 0



ITEM	NO. REQ'D	D E S C R I P T I O N	LENGTH	TOTAL QUANT.	UNIT WT.	TOTAL WT.
	1	MK-100227-08-1~ UPWELL BOX				165
2	1	PL. 3/16 X 1'-7 5/8" ALUM. 5052-H32	2'-5 5/8"	4.04	2.66	11
3	1	PL. 3/16 X 1'-7 5/8" ALUM. 5052-H32	2'-5 5/8"	4.04	2.66	11
4	1	PL. 3/16 X 1'-7 5/8" ALUM. 5052-H32	2'-5 3/8"	4.04	2.66	11
5	1	PL. 3/16 X 1'-7 5/8" ALUM. 5052-H32	2'-5 5/8"	4.04	2.66	11
6	1	PL. 3/16 X 1'-7 5/8" ALUM. 5052-H32	1'-7 5/8"	2.67	2.66	7
7	1	PL. 3/16 X 8 1/8" ø ALUM. 5052-H32	0'-8 1/8"	0.68	2.66	1
8	4	PL. 3/16 X 0'-4 1/2" ALUM. 5052-H32	0'-4 1/2"	0.56	2.66	1
9	1	PL. 3/16 X 0'-6" (BEND) ALUM. 5052-H32	1'-6 7/8"	0.78	2.66	2
10	1	PL. 3/16 X 0'-6" ALUM. 5052-H32	0'-7 5/8"	0.02	2.66	1
11	1	10 GA. PL. X 1'-7 5/8" (BEND) ALUM. 5052-H32	1'-9 3/16"	3.89	1.75	5
12	2	L 2"X 2 X 3/16 ALUM. 6061-T6	0'-6"	1.0'	0.85	1
13	2	L 2 X 2 X 3/16 ALUM. 6061-T6	1'-0"	2.0'	0.85	2
14	4	L 3 X 3 X 3/16 ALUM. 6061-T6	1'-7 5/8"	6.54'	0.85	6
15	1	RB 1/2 ø (BEND) ALUM. 6061-T6	2'-8"	2.67'	0.23	1
16	4	RB 1/2 ø ALUM. 6061-T6	0'-1"	0.33'	0.23	1
17	1	RB 3/8 ø (BEND) ALUM. 6061-T6	0'-11"	0.92'	0.13	1
18	–	NOT USED.	–	–	–	–
19	4	2" ø SCH. 40 PIPE ALUM. 6061-T6	0'-7 9/16"	3.53'	1.26	3
20	4	2" 1/2 ø SCH. 40 PIPE ALUM. 6061-T6	0'-6"	2.0'	2.00	4
21	2	8" ø SCH. 40 PIPE ALUM. 6061-T6	2'-0"	2.0'	9.88	20
22	1	PERFORATED 10 GA. PL. – 3/16"ø HOLES @ 1/2 STAGGERED CENTERS 6061 ALUMINUM 1'-7" X 1'-7"				
23	1	PIANO HINGE 5052 ALUMINUM .120 X 4" – 1/8"ø PIN X 1'-6" LG. McMASTER-CARR 1581A12				–
24	2	2"ø HALF COUPLING 6061 ALUMINUM				
25	1	POLYETHLYNE DIAMOND MESH McMASTER-CARR #9314735 X 1'-1 3/8" X 2'-2 5/8"				
26	1	POLYETHLYNE DIAMOND MESH McMASTER-CARR #9314735 X 2'-0" X 2'-1"				
27	1	1"ø HALF COUPLING 6061 ALUMINUM W/ SQUARE HEAD PLUG				
28	4	L 2 X 2 X 3/16 (COPE) ALUM. 6061-T6	1'-7 1/4"	6.42'	0.85	5
29	12	ZIP-TIES X 4" LG.				

RELEASE FOR FABRICATION
MARCH 9, 2016
Yanke Machine Shop, Inc.
W.O. # 100227

NOTES:
1.- ALL CORNER WELDS (FILLET OR BEVEL) SHALL BE 1/8" MIN U.N.O.
2.- ALL HOLES 7/16"ø U.N.O.
3.- INSIDE OF FLUME SHALL BE SMOOTH. ALL BURRS, SHARP EDGES AND CORNERS SHALL BE GROUND OFF.
4.- ATTACH POLYETHLYN DIAMOND MESH. (ITEM 25) TO ROUND BAR (ITEM 15) WITH ZIP-TIES (ITEM 29)
5.- WORK THIS SHEET WITH DWG 100227-08

NO.	REVISION	BY	DATE
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MK-100227-08-1~ ONE REQ'D.

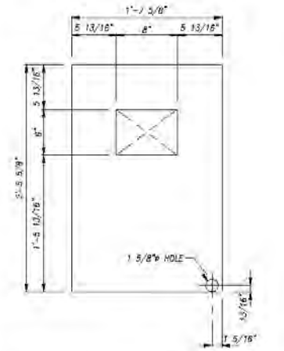
YANKE MACHINE SHOP, INC.
4414 SO. GEKELER LANE ~ P.O. BOX 5405 ~ PHONE (208) 342-8901
BOISE, IDAHO 83716 BOISE, IDAHO 83705 FAX (208) 338-2333
WWW.YANKEMACHINE.COM ~ E-MAIL YMS@YANKEMACHINE.COM

CUSTOMER: U.S. FISH & WILDLIFE SERVICE

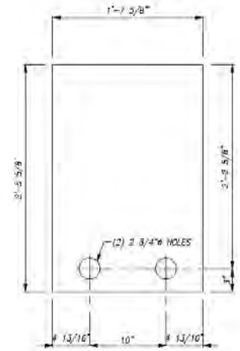
ITEM	BY	DATE
DRAWN	D.T.	2/17/16
CHECKED		
APPROVED		

WARM SPRINGS NATIONAL FISH HATCHERY
LAMPREY PASSAGE SYSTEM
FABRICATION DETAILS

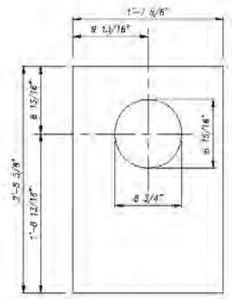
SCALE: 3"=1'-0"
DRAWING NO. 100227-08
REVISION: 0



DETAIL ITEM (2) ONE REQ'D

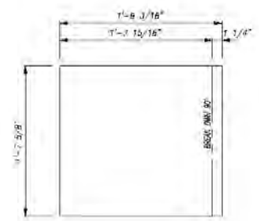


DETAIL ITEM (3) ONE REQ'D

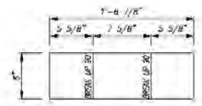


DETAIL ITEM (4) ONE REQ'D

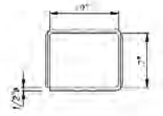
RELEASE FOR
FABRICATION
MARCH 9, 2016
Yanke Machine Shop, Inc.
W.O. #100227



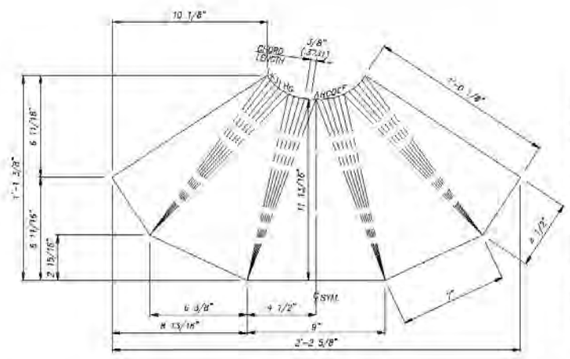
DETAIL ITEM (11) ONE REQ'D



DETAIL ITEM (9) ONE REQ'D



DETAIL ITEM (15) ONE REQ'D



STA.	LENGTH
A	1'-0 5/8"
B	1'-0 1/2"
C	1'-0 7/16"
D	1'-0 3/8"
E	1'-0 3/8"
F	1'-0 7/16"
G	1'-0 7/8"
H	1'-0 13/16"
I	1'-0 3/4"
J	1'-0 3/4"
K	1'-0 13/16"
L	1'-0 15/16"

DETAIL ITEM (25) ONE REQ'D

NOTES:
1.- WORK THIS SHEET WITH DWG 100227-08

NO.	REVISION	BY	DATE
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YANKE MACHINE SHOP, INC.
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WWW.YANKEMACHINE.COM ~ E-MAIL YMS@YANKEMACHINE.COM

CUSTOMER: U.S. FISH & WILDLIFE SERVICE

ITEM	BY	DATE
DRAWN	D.T.	2/17/16
CHECKED		
APPROVED		

WARM SPRINGS NATIONAL FISH HATCHERY
LAMPREY PASSAGE SYSTEM
ITEM DETAILS

SCALE: 1 1/2"=1'-0"
DRAWING NO. 100227-09
REVISION: 0

U.S. Fish and Wildlife Service
Columbia River Fish and Wildlife Conservation Office
1211 SE Cardinal Court, Suite 100
Vancouver, WA 98683

August 2019
www.fws.gov/columbiariver