

**2018 Dinosaur Reservoir
Habitat Structure Monitoring**

**Fish and Wildlife Compensation Program
Peace Region**



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1 INTRODUCTION

Dinosaur Reservoir was formed in 1979 with the completion of the Peace Canyon Dam, which backs water up into a bedrock canyon for 21 km to the tailrace of W.A.C. Bennett Dam. Several studies conducted on the reservoir have postulated that fisheries potential is low because the steep drop off along most of the shoreline limits the amount of littoral habitat available. The bathymetry of Dinosaur Reservoir is extremely steep and littoral areas are largely absent (Pattenden and Ash 1993). In addition, a lack of aquatic vegetation and structure in the existing littoral areas further reduces fisheries capabilities.

In 2001, a boat electrofishing program was started by the former Peace/Williston Fish and Wildlife Compensation Program (PFWWCP) to monitor fish populations in the littoral area. The boat electrofishing program established index sites along the shoreline of the reservoir. Wherever there was existing woody debris (fallen trees etc.) there was a noticeable increase in fish numbers (primarily rainbow trout). As a result, in 2002, a program was started to add woody debris to small sheltered bays in the reservoir.

The PFWWCP implemented a five-year habitat improvement project that introduced woody debris structures along the shoreline of Dinosaur Reservoir to increase the amount of available rearing habitat for sport-fish, including rainbow trout. The project included the eventual placement of 84 structures at selected locations in the reservoir and the monitoring of fish use at treatment and control sites (Blackman et al 2004, Blackman and Cowie 2005, Bouillon 2014). The shoreline enhancement structures constructed between 2002 and 2006 are located in the lower two thirds of the reservoir.

In 2017 and 2018, the “local Board” of the current Peace Region’s FWCP requested another inspection of the habitat structures on Dinosaur Reservoir and BC Hydro’s Environmental Field Services department completed the work in May and June respectively. The project is identified and described in the Peace Region’s Reservoirs Action Plan (<http://fwcp.ca/region/peace-region/>) along with the following objective, action, and rationale:

Sub-objective 2b: Monitor status and trends of aquatic ecosystem health, review results and develop specific plans in response to results.

Action: Manage existing habitat structures in the Dinosaur Reservoir.

Rationale: Large woody debris structures were added to embayments to Dinosaur Reservoir in an attempt to enhance fish habitat (e.g., Blackman et al 2004). These enhancement structures need to be surveyed annually to ensure they are safely secured, and any necessary repairs need to be made. A plan must be developed and implemented for structure management, improvement, and where necessary, removal, over the next 5 years.

The goal of this 2018 report is to inform the Board with the necessary information to help make a decision on the future existence of these habitat structures. This includes:

1. provide background rationale and history of the habitat structure project;
2. document the 2018 Dinosaur Habitat Structure field monitoring results conducted by BC Hydro's Environmental Field Services Department, and
3. provide recommendations for future consideration.

2 2002/06 PFWWCP PROJECT BACKGROUND AND HISTORY

2002/06 Project Objectives: To provide improved habitat that was negatively affected by the formation of the reservoir. These habitat improvements should restore/increase recreational opportunities, reduce entrainment, and may increase fish abundance in Dinosaur Reservoir.

2002/06 Project Description:

Four types of woody debris enhancement structures were constructed, namely triangles, rafts, booms, and "other". Triangle structures consisted of whole tree trunks arranged in a triangle shape with the base or tree butts anchored to shore by cable. The tree tops, which protruded into the reservoir were pulled together to form the apex of the triangle and cabled together. The space within the triangle was filled with other logs and woody debris to create a floating mat of large woody debris. Raft structures consisted of bundles of tree trunks cabled together in a parallel fashion and anchored to shore by cable at one end of the raft. Booms consisted of remnant log-boom assemblies salvaged from within the reservoir or logs cabled end-to-end and anchored to shore at both ends of the series of logs. Structures described as "other" are believed to have been single or paired logs anchored to shore at one end. (Euchner 2017).

The following nine photos provide examples of how the 2002/06 habitat structures were constructed during this time frame.



Figure 1: Aerial view of one bay with “triangle” structures.



Figure 2: Aerial view of a “boom” type structure with other logs and woody debris inside.



Figure 3: Initial construction of a “raft” type structure.



Figure 4: Large rocks were used as anchors. A drill is used here to make a hole in the rock and then the cable (attached to the log) is inserted and glued in the hole of the rock.



Figure 5. Holes were first drilled in the log and attached together with cables and clamps.



Figure 6: Floating trees with large roots were ideal for fill material in the triangles and booms.



Figure 7: Initiation of a log boom. Note the “orange” marker for boater safety.



Figure 8: Another example of a “boom” structure with additional woody debris.



Figure 9: Multiple “triangle” structures along the north shore.

Yearly maintenance will be required on the habitat improvement structures as part of the Transport Canada Navigable Waters Protection permit requirements to insure the structures do not become a navigational hazard. Structural maintenance (checking anchors, cable clamps and cables, replacing any damaged boom logs, replacing markers) and increasing the complexity of the existing structures by adding new wood wherever possible will be carried out as well as documenting the maintenance requirements for the structures. The smaller materials used to fill the structures tend to deteriorate or get washed away at the more exposed sites so yearly replenishment is required to maintain the maximum benefit for the smaller size classes of fish. Maintenance of the structures along the shoreline will ensure boater safety, provide much needed littoral rearing habitat for native fish species and improve recreational angling opportunities.

3 PREVIOUS MAINTENANCE AND INSPECTION RESULTS

2014 Assessments

Post-construction inspections of the enhancement structures have occurred intermittently since 2006 and annually since 2014. An inspection undertaken by BC Hydro on June 5, 2014 (Bouillon 2014) did not include an assessment of habitat functionality and was only intended to identify potential issues of navigational and public safety. During this inspection three structures were described as missing and 81 were described as intact or partially intact.

2015 and 2016 Assessments

On June 15, 2015, Diversified Environmental Services (DES) conducted an assessment of the habitat functionality of the enhancement structures and concluded that the majority of the structures were in disrepair (n=61) or missing (n=7) (DES 2016). Only 16 enhancement structures (10 triangles, 2 booms and 4 rafts) appeared to resemble their original configuration. Of the remaining 10 triangles, 9 were no longer providing floating, overhead cover as originally intended due to sediment deposition underneath or water-logging and sinking of the logs forming the frame of the structure.

Based on preliminary results of the June 2015 inspection, plans to assess fish utilization of the structures were abandoned and effort was redirected toward trial remedial work of several structures. A cluster of triangle structures located at Site 10 was identified as having potential to provide increased habitat benefit with the least remedial effort. Repairs to 4 damaged structures were undertaken with the assistance of members of the West Moberly and Saulteau First Nations, using the residual components of 3 failed structures (DES 2016).

Three recommendations resulted from the 2015 assessment. These included:

- The inspection of the structures should be repeated prior to the annual Father's Day Fishing Derby in June. The goal of the inspection should be to confirm that none of the remaining structures or their remnant components pose a public hazard and take appropriate measures to eliminate any hazard identified.
- Residual cable, clamps and duckbill anchors should be collected from the shoreline of the reservoir as additional structures fail and hardware becomes non-functional. Cable still anchoring residual structure components to shore should be left in place to provide marginal rearing cover and shoreline erosion protection.
- For reasons discussed in DES 2016, the construction of new structures and repair of existing failed structures is not recommended at this time.

Based on the recommendations of the 2015 assessment, a public safety inspection of the 74 remaining intact and partially-intact structures was conducted in 2016 prior to the annual Dinosaur Reservoir Father's Day fishing Derby. The status and condition of the remaining structures was largely unchanged from 2015, with one partially-failed structure having disintegrated and one structure missing an individual component. In addition, non-functional cable, clamps, and anchors were salvaged from the shoreline at the site of failed structures during 2016. As per the 2015 recommendations, further repair of damaged structures and construction of new structures was not undertaken in 2016.

2017 Assessment

On May 11 and 12, 2017, a safety and integrity inspection of the remaining 74 shoreline enhancement structures was undertaken by BC Hydro's Environmental Field Services Department (BCH) (Zemlak 2017). Habitat structures were accessed by boat using UTM coordinates provided by DES 2016 and a site map created from the PFWWCP in 2010 (Figure 10). In addition, photographs of the structures from DES in 2016 were used to identify the structures and comments were made on how the structure safety and integrity compared to the previous year's inspection and condition.

At each structure location, a crew of 3 members got off the boat and physically inspected each of the structure's cable attachment points to shore. The presence or absence of a structure was confirmed and the condition of each structure was recorded. If a cable was broken, the structure was reattached to shore using poly rope.

Once the shore field crew confirmed the structure was secured to land, a photograph was taken to document its current condition and notes regarding anchor securement and boating hazard potential were recorded (Appendix 1). Structures deemed to be a potential boating hazard were also marked with orange flags.

The inspection of the habitat structures took 2 days to complete. There were 74 structures examined and comments were made at each site (Table 1, Appendix 1) indicating:

1. whether the structure could pose as a future boating hazard;
2. the current anchoring condition; and
3. whether or not the structure changed from the previous 2016 survey.

The photos from the 2016 inspections assisted with assessing whether a structure changed physically and had deteriorated further. If there was a change, this could mean that either there were less logs present, a lack of securement to shore, or the structure has come apart. Boating hazard structures were mostly identified when a triangular structure came apart from the apex and the single log could then extend out in the water at higher water levels. Anchoring conditions included duckbill earth anchors, cables attached to trees/stumps, and concrete/rock anchors.

Table 1. Summary of 2017 field inspection results.

Type	Total	New	Absent	Hazard?	Changed?
Triangle	55	1	6	33	23
Boom	7			6	3
Raft	10		1	2	4
Other	2			1	1

Due to the fact that many of the triangular structures (n = 33) have come apart at the apex, it was deemed a possible boating hazard as some of the logs were over 10 m in length. Most of the boom structures were located further out from shore and also have the potential to be a boating hazard. As such, orange flags were tied to the structures that posed a boating hazard. There was one site documented in 2017 that was not documented in the 2016 survey. In addition, six sites were absent in 2017 as compared to 2016 and these structures likely broke free from shore. It was also noted that an orange flag attached to a log was found at the Peace Canyon forebay site (Appendix 2).

The type of anchoring system used to better understand the longevity of these structures remaining attached to shore. For example, structures cabled to a tree will likely last for many years, but some structures were anchored to a previous dead stump (n = 2) and may not last another year. Some earth anchors are no longer functional as the earth has slumped in a few areas (n = 4). In some cases, the structure has broken free from its anchoring system so additional securement to shore was provided with poly rope (n = 4).

4 2018 BCH ENVIRONMENTAL FIELD SERVICES INSPECTION

On June 5 and 6, 2018, the same methodology as the 2017 assessments was employed. However, almost all of the habitat structures were broken apart. It was impossible to report on the total number of structures remaining intact. Instead, all the survey crew could do was report the results of the structures by site. In total, there were 14 sites and the results have been reported by site in Appendix 1.

By site, the survey crew recorded the number of structures along with the total number of cables/anchors present, and whether the structures were secure. If a structure was not secure, rope was used to temporarily secure it to shore for another year. For example, a normal triangle structure would have two main logs and two anchors. During this year's survey, almost all triangles were broken apart and it was impossible to know

which structure belonged together. Structures remained on land parallel to shore during normal PCN operating generation.

During the morning of June 6, a concurrent study was briefly being conducted on Dinosaur Reservoir. The dam was artificially lowered by approximately 1 m resulting in some of the existing habitat structures out of water. The survey crew took advantage of this rare event and took further photos documenting their current state (Appendix 3).

5 RECOMMENDATIONS

5.1 BCH Environmental Field Services Recommendations

Yearly maintenance is required on the habitat improvement structures as part of the original Transport Canada Navigable Waters Protection permit requirements to ensure the structures do not become a navigational hazard. Structural maintenance (checking anchors, cables, and cable clamps, replacing markers) is a yearly requirement for this project. Determining the habitat “functionality” of these structures was not conducted due to time constraints. The majority of structures have broken apart and lost the smaller fill materials that were originally ideal for the smaller size classes of fish. In addition, many of the logs have become waterlogged and are now sitting on the bottom of the reservoir as oppose to them floating at the surface. While the existing structures may provide some marginal fish habitat, the current state of the remaining habitat structures are not providing the same quality fish habitat as in their original state. The following points should be taken into consideration when determining the future of this project:

- the poly rope used to secure the structures this year will require replacing in 2019;
- future assessments/maintenance should be done when the reservoir is below 500 m for ease of work and visibility;
- many triangular structures are secured by only one attachment point to shore, these logs (10 m in length), when suspended, could become a boating hazard;
- many structures have weak anchor points and are at risk of not lasting another year due to the hill slumping ; and
- previous 2002/06 PFWWCP construction and addition of new structures and maintenance of existing structures ranged from \$12,500 for only maintenance

activities up to \$38,600 annually for additional construction of new structure activities (i.e. development of “X” number of structures, crew members and contractors assistance, etc.), not including boat usage costs.

The original intent of creating these habitat structures was a worthy effort to enhance fish habitat on Dinosaur Reservoir. The results of the 2004 assessment of habitat improvements in Dinosaur Reservoir is believed to have reduced entrainment by providing additional rearing cover for fish (Blackman and Cowie 2005). Nearly five times as many fish were captured at five enhanced sites in comparison with five control sites (48 vs. 11) using the traps nets, and four times as many fish were captured by angling at the enhanced vs. control sites (8 vs. 2). In 2017 and especially in 2018, the integrity of these structures has changed dramatically (broken apart, lack of additional fill material, and many structures are now submerged), and they no longer afford “high” value fish habitat. In addition, many of the structures, including booms, possibly pose as boating hazard (submerged cables). Therefore, it is recommended that the Board implements a directed project to remove all cables, hardware; anchors etc. in the near future and eliminate the risk they pose with the *Navigable Waters Act*. As part of this decision, it is important to speak to the BCH Peace Canyon Manager and ensure that as logs drift from their current location, they are not a concern for BCH operations. The back side of the dam contains a log boom which keeps debris away from the intakes and is also in place to keep the general public away from the dam. This structure does collect natural debris each year and has to be removed as part of the annual maintenance of the site and is generally conducted in the fall.

Alternatively, the Board could direct a similar program to address the Reservoir Action Plan for this Reservoir, sub-objective 2b, and increase littoral habitat by recreating “additional” habitat structures. But this work would require an extensive cost commitment to initiate and maintain, as evidenced by the previous structure addition and maintenance costs. A plan would have to be first developed and then implemented for structure management which factors in the longevity of structures and associated maintenance costs.

5.2 Evaluation and Recommendations from EDI (2008)

In 2008, EDI Environmental Dynamics Inc. (EDI 2008) was commissioned by PFWWCP to evaluate the effectiveness of these habitat structures and identified several recommendations to consider if the habitat structures were maintained or new structures were built. The recommendations from EDI 2008 are provided in this report for the Board's consideration when determining the best option for enhancing fish habitat in Dinosaur Reservoir. Recommendations included:

- Implementation of a rigid sampling plan with clear, measureable targets for effectiveness monitoring (i.e. effectiveness of structures at providing fish habitat);
- Consistent reporting between years to improve measurability of effectiveness;
- Cost analysis to assess the social benefit or value of fish habitat conservation for this project (e.g. can it be shown that the project provided increased recreational opportunities?)
- Consideration for other factors that influence the ultimate goal to increase fish numbers within Dinosaur Reservoir, including quantifying the amount that Williston Reservoir contributes to Dinosaur Reservoir productivity; effects of entrainment rates on fish populations by both WAC Bennet and Peace Canyon dams; recruitment opportunities in Johnson and Gething Creeks; and monitoring rainbow trout population and recruitment events in Dinosaur Reservoir.

6 REFERENCES

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Appendix 1

2017 and 2018 Habitat Structure Comments

Site #	2016 Type	Hazard?	2017 Comments and anchoring method/type	2018 Results	
1a	triangle	No	same as 2016, only 1 cable anchor point to tree	5 original structures, found only 4, all secure. Used rope to resecure a group of 3 loose structures. Only 1 cable per structure. Other cables are gone. Some cable salvage needed here at site. 17 original sites, 27 cables present, 2 rope repairs needed. East half has lots of big logs but could pull off shore and anchors being pulled out. 2 structures were in tact but buried by sand. Also a sign present in the bush for salvage at west end. Added 2 flags for boating hazard awareness.	
1b	triangle	No	no 2016 photo, 1 log, 1 log loose, earth anchor, other logs around		
1c	raft	No	no longer a raft, 1 cable, 1 earth anchor		
1d	raft	No	four logs cabled together to a single log attached to shore, 1 earth anchor		
1e	triangle	No	single log cabled with an earth anchor, 2 ends are attached		
2a	triangle	No	no 2016 photo, one log secure with earth anchor, but earth has slumped, problem next year		
2b	triangle	Possible	1 log, 1 anchor to tree, could be a boat hazard if log protrudes out		
2c	triangle	Possible	single log, 1 earth anchor, could be a boat hazard if log protrudes out		
2d	triangle	Possible	single log now, single earth anchor, could become a hazard at high water levels		
2e	triangle	Possible	single log now, 1 earth anchor, could become a hazard at high water levels		
2f	triangle	Possible	two logs present, each cabled to shore at one end, earth anchors, no longer forming apex, possibly water-logged		
2g	other	Possible	single log now, secure with earth anchor		
2h	triangle	No	3 logs present, 2 anchors, 1 to tree, 1 to earth anchor		
2i	triangle	Possible	2 logs, 2 earth anchors, split apart in the middle		
2j	triangle	Possible	2 logs, 2 earth anchors, split apart in the middle		
2k	triangle	Possible	2 logs, 2 earth anchors, split apart in the middle		
2l	triangle	Possible	2 logs, 2 earth anchors, split apart in the middle, one eroding away		
2m	triangle	Possible	single broken log remaining anchored to shore, earth anchor		
2n	triangle	Possible	single log, 1 earth anchor, could be a boat hazard if log protrudes out		
2o	triangle	No	intact triangle, 2 earth anchors and triangle secure		
2p	triangle	No	intact triangle, 2 earth anchors and triangle secure		
2q	triangle	No	intact triangle, 2 earth anchors and triangle secure		
3a	triangle	Possible	1 log, possibly 2, no anchoring, secured by root wad, added a 3rd flag just in case		9 original structures, 10 cables present and secure. Large boom needed to be secure again to land with rope.
3b1	triangle	Possible	1 log now, 1 earth anchor		
3b2	triangle	Possible	1 log now, 1 earth anchor		
3c1	triangle	No	triangle, intact and logs waterlogged, few other logs, earth anchors, flagged		

Site #	2016 Type	Hazard?	2017 Comments and anchoring method/type	2018 Results
3c2	triangle	Possible	2 logs not together, earth anchors	Boom is attached by a 3 inch cable, flags were added to warn boaters at both ends. West end has 1 inch cable to tree. 3 other smaller structures were secure with 4 cables and 1 yellow rope was added. See photos of boom at low reservoir elevation, it shows cable better.
3d	triangle	Possible	single log, anchored to tree	
3e1	triangle	Possible	2 or 3 logs, secured with earth anchor	
3e2	raft	Possible	2 logs, 1 anchor, 1 not secured, buried in sediment	
3f	raft	?	did not see it, raft is gone!	
3boom(g)	boom	Yes	log boom has come apart between first and second booms, log 1 secure to shore	
3boom(h)	boom	Yes	used poly rope and tied to shore to keep boom intact, hard to determine status of rest of boom	
3j1	triangle	Possible	2 logs anchored to trees but apart now, no triangle	
3j2	triangle	Possible	2 logs anchored to a tree and a stump, but apart in the middle, no triangle	
3j3	triangle	Possible	only 1 log now, no anchors or cables	
4a	boom	Yes	photo does not match 2016 photo, perhaps it has moved to the other side as this single log has a cable running the length of it, cant secure it and could be a boat hazard at higher water level	1 log now, cable running length of log (10 m?), flagged it, has not moved from last year.
5a	boom	No	4 logs cabled in a row, west anchor broke so secured with poly rope	4 logs still, secure both ends (1 rope and 1 cable), flagged both ends.
6a	boom	Possible	2 logs, 1 anchor secure, 2nd concrete earth anchor has slumped	1 long log now, 1 anchor. 1 small log and is short, added 1 flag.
7a	boom	Possible	3 logs, wasn't secured, used rope to tie it to a tree, 2 other smaller logs secured together at the shoreward end of the bay	2 logs, separate, 1 is still tied with yellow rope, 1 is deep in bay. Photos are at low water.
8a0	NEW	No	New site not mentioned in 2016, 1 log, anchored to shore, one end loose	18 original structures, 21 cables present on south shore, lots of triangles broken apart. East shore around the corner has 8 cables 2 logs attached, 1 raft present. Very shallow in this area as sediment built up from Johnson Creek.
8a1	triangle	Possible	2 logs secured to shore - only 1 log mentioned in 2016	
8c	triangle	Possible	2 logs cabled together, not anchored to shore, logs moved?	
8d	other	No	1 log, small cable, not too secure	
8e	triangle	Possible	2 logs tied together at one end, anchored to a tree at one end	
8f	triangle	Possible	1 log, anchored to a tree	
8g	triangle	Possible	1 log, anchored to a tree	
8h1	triangle	Possible	1 log now, anchored to a tree	
8h2	triangle	No	2 logs cabled at butt going into the water, can not see apex	
8i	triangle	No	single log remaining and submerged, cable to shore	
8j	triangle	No	single log remaining and submerged, cable to shore	
8k	triangle	No	multiple log clusters tied off to shore, multiple trees	
8l	triangle	No	2 logs remaining and submerged, secured to tree	
8m	triangle	No	2 logs cabled to shore, parallel to each other and protruding into water but submerged	
8n	triangle	Possible	1 log now, anchored	

Site #	2016 Type	Hazard?	2017 Comments and anchoring method/type	2018 Results
8o	triangle	Possible	1 log now	
8p	triangle	Possible	1 log now	
8q	triangle	Possible	1 log remaining	
9a	NEW	No	Not reported on in 2016 but on 2010 map, no sign of cables or logs	
9b	boom	Possible	2 large logs, root ends not cabled but secure in dirt, flagged one end, narrow ends cabled together and earth anchors compromised with slumping dirt	2 large structures present by creek and was high and dry, we flagged it but was not a boom, north logs are natural, no cable. Small raft present too, chicken wire to salvage.
10a	NEW	No	Not reported on in 2016 but on 2010 map, no sign of cables or logs	
10b	NEW	No	Not reported on in 2016 but on 2010 map, 2 logs cabled together, no anchors	
10c	NEW	Possible	Not reported on in 2016, but on 2010 map, 1 log, no anchor	
10d	triangle	No	2 logs cabled together	
10e	triangle	No	single logs now, all cabled	
10f1	triangle	Possible	6 logs cabled together with butts on shore and protruding into lake, added flags	
10f2	triangle	No	did not see in 2017	
10g	triangle	No	2 logs, both anchored	
10h	triangle	No	multiple cluster of 7 logs together and submerged, all cabled to shore	
10i	triangle	Possible	2 logs cabled at butts, apex not attached, flagged	
10j	triangle	Yes	only 1 log now, root wad, flagged	
10k	triangle	No	no evidence of log in 2017	
11a	raft	No	4 logs, 2 anchors to 2 trees, secure	
11b	raft	No	2 logs cabled together, one anchor to tree is broken so used poly rope, 2nd anchor to tree is secure	2 original structures, 4 cables, west end had a broken cable, flagged both ends.
12a	NEW	No	No longer exists	No log, no cable, no structure.
13a	raft	Yes	only 1 log now floating by natural slide site, anchored to old stump	This is a natural slide area and can't determine original structures. Large debris pile present. Nothing present on south side of pile. Flagged it. 5 structures on north end and flagged them. 4 cables present. Missing one structure. Flagged end.
13b	raft	No	2 logs anchored and protruding into lake submerged, attached to old stump, gone next year?	
13c	raft	No	4 logs cabled together to a tree, a floating raft	
13d	raft	No	6 logs cabled at butts, anchored to a tree	
13e	NEW	No	No report for 2016, no longer exists	
14a	triangle	Yes	3 logs cabled and lying parallel to shore, 1 slumping root wad, other secured to a tree, flagged	2 anchors, 1 spare, secure, old flag present from last year.
New	log	No	2 new logs found near dam site. 100 m east of site 14. Removed flags, no cable observed.	Flags removed. Not ours anymore.

Appendix 2

2017 Monitoring Field Photos



Site 2a: earth anchor in place but land has slumped.



Site 2b and 2c: single anchors but can be a boat hazard at higher water levels.



Site 2i triangle: structure secured with 2 earth anchors but came apart in the middle.



Site 3 boom: log boom has broken apart near east shore.



Site 3 boom: boom is resecured to land with poly rope.



Site 3 boom: boom contains many steel rods and large cables under water.



Site 3j2 triangle: note right anchor is tied to a stump, may come loose after a year



Site 8l triangle: structure submerged, unknown if attached at apex



Site 10i triangle: apex is apart and possibly a boating hazard now



Site 10j triangle: root wad forms a possible boating hazard.



Site 13a: a natural slide created this floating debris pile.



Site 13a: another example of an old stump used for an anchor point.



Site 13c raft: is still in place secured to a tree.



PCN Dam (lost structure): one habitat structure appears to have broken free and floated to the dam forebay site.

Appendix 3

2018 Monitoring Field Photos



Site 1: An example on how cables are broken and structures are to be secured to the earth anchor again.



Site 1: An example of the broken cables found on shore that have come apart and requiring salvage.



Site 3: Log boom is not secure at normal water level. Crew secured to shore with rope.



Site 3: Same log boom as above photo at low water level offering very little habitat as a stand-alone structure.



Site 3: Log boom at normal water level. Note 3 inch cable running along entire boom length.



Site 3: Log Boom at lower water level.



An example of little habitat existing when structure is broken apart.



Site 10. This structure is still providing some habitat when at normal water levels.



Site 5: Another example where cable clamps rust out and structure is free which can become a boating hazard.



New Observation: From a previous site, no cables were present, but flag was removed.