

Peace Project Water Use Plan

Williston Recreation Use

Reference: GMSMON-20

BC Hydro Williston Reservoir Recreation Use Monitoring Program, Data Report Year 1 (2009) – Year 5 (2013) Summary

Study Period: May – October 2013

Synergy Applied Ecology

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BC HYDRO WILLISTON RESERVOIR RECREATION USE MONITORING PROGRAM, DATA REPORT YEAR 1 (2009)-YEAR 5 (2013) SUMMARY

ABSTRACT

BC Hydro is planning new boat launches and improvements to existing boat launches at several recreation sites along the Williston Reservoir. A 10-year reservoir recreation use monitoring program was initiated in 2009 to assess use of boat launch sites before and after improvements. This is a summary report presenting the results of Year 1 (2009) to Year 5 (2013) pre-improvement use monitoring at 6 selected recreation sites. Sites include Elizabeth Creek and Dunlevy in the Peace Reach, and Finlay Bay (76 Mile), Six Mile Bay, Cut Thumb Bay (38 Mile), and Alexander Mackenzie Landing (22 Mile) in the Parsnip Reach. Boat launch condition varies among sites and no improvements to launch structures have been undertaken since monitoring commenced. Vehicle counters and remote cameras were used concurrently to evaluate 2 primary management objectives. Does recreational use of the Williston Reservoir boat launches? Average total use by site estimated from photo-corrected counter data varied from 303 visits at Finlay Bay to 976 visits at Alexander Mackenzie Landing between May 14 and October 31, 2009-2013. Average estimated boater use varied from 97 at Finlay Bay to 360 at Elizabeth Creek. Overall, there are currently 45,482 site use records in the project database with 24,217 (53%) photo-validated.



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INTRODUCTION

Boat launch facilities along the Williston Reservoir are to be enhanced as part of the Access, Navigation, and Safety Management Plan of the Peace Water Use Plan (WUP). Construction effort is intended to facilitate increased boater access to the reservoir at all water elevations. BC Hydro project GMSMON-20 is a 10-year site use monitoring program implemented to evaluate seasonal use of 6 boat launches before and after improvements and allocate future efforts relative to this objective appropriately (BC Hydro 2008). Results of the monitoring program are expected to address 2 primary management questions:

- Does recreational use of the Williston Reservoir boat launches increase after boat access is improved?
- What is the timing and frequency of use of newly constructed boat launches? Specifically, does seasonal use change with improved access to new areas of the reservoir, and improved access during low reservoir levels?

This report provides a 5 year summary of project activities and accomplishments between 2009 - 2013. Year 5 (2013) results can be found in Appendix A. Year 1 (2009), Year 2 (2010), Year 3 (2011), and Year 4 (2012) results were reported by Cubberley and Hengeveld (2010, 2011, 2012, 2013), and are available at:

http://www.bchydro.com/content/BCHydro/en/toolbar/about/sustainability/conservation/water_use_plann ing/northern_interior/peace_river/williston_reservoir.html/

METHODS

Study Area

Williston Reservoir

The Williston Reservoir is the largest man-made, hydroelectric reservoir in British Columbia with a surface area of $1,779 \text{ km}^2$ and a shoreline perimeter of 1,700 km (Figure 1). The reservoir offers considerable recreational fishing, hunting and wildlife viewing opportunities as boaters can access remote, undeveloped areas of the watershed with relative ease. The maximum licensed water elevation is 672 masl and a minimum elevation of 640 masl, with the lowest water elevation typically reached in April annually.



Figure 1. The Williston Reservoir and surrounding watershed boundary in northern British Columbia. The W.A.C. Bennett and Peace Canyon hydroelectric dams are located on the Peace River adjacent to the community of Hudson's Hope.

Six recreation sites that provide boater access to the Williston Reservoir were selected for monitoring (BC Hydro 2008). Two of these sites, Elizabeth Creek and Dunlevy, are in the Peace Reach while the other four sites, Finlay Bay (76 Mile), Six Mile Bay, Cut Thumb Bay (38 Mile), and Alexander Mackenzie Landing (22 Mile) are in the Parsnip Reach (Figure 2). We began monitoring Alexander Mackenzie Landing in Year 3 (2011) replacing Strandberg. Strandberg was monitored for 2 seasons (2009-2010) and removed due to low use. Boat launch conditions vary among sites (Table 1).

Table 1. Present boat launch status at Williston Reservoir recreation sites monitored between 2009 - 2013.

Site	Description
Cut Thumb	No formal boat launch suitable for use at most water levels
Six Mile Bay	Constructed gravel boat launch suitable for use at mid-high water levels
	Small boats can be walked in at low water levels
Finlay Bay	Constructed gravel boat launch suitable for use at most water levels
Elizabeth Creek	Constructed concrete boat launch suitable for most water levels
Dunlevy	Constructed concrete boat launch suitable for high water levels only
Mackenzie Landing	Constructed concrete boat launch suitable for use at most water levels
-	Rudimentary road used to access reservoir at low water levels



Figure 2. Williston Reservoir recreation sites monitored in Year 1-5 (2009-2013). Mackenzie Landing was monitored in Year 3-5 (2011-2013).

Recreation Site Descriptions

Cut Thumb Bay recreation site is located approximately 35-40 minutes driving time from Mackenzie. Access is via the Parsnip West Forest Service Road (FSR), a well-maintained, radio-assisted gravel mainline, turning west between the 33 and 34 km markers onto a 4 km long gravel spur road. In Year 1 (2009) the site consists of 9 camp stalls with picnic tables and 3 outhouses. During low reservoir elevation there is a large gravel bar where users can park, camp, and launch boats (Appendix B). The narrow road that leads to the gravel bar becomes the boat launch at highest water elevation. The reservoir water elevation dictates how much room users have to launch boats at this site.

Six Mile Bay recreation site is located approximately 45-50 minutes driving time from Mackenzie. Access is via the Parsnip West FSR, turning west at the 41 km marker onto an approximately 1 km long, dirt access road. There is one camping spot at high water, located right beside the top of the boat launch, with one outhouse available. At low reservoir elevation, an open, gravel area provides additional parking or camping space. Access to this gravel bar is via the dirt road that also serves as the boat launch (Appendix B). At low water elevation, it may be difficult to launch boats as there is a steep drop off to the water and the sandy substrate may cause vehicles to become stuck. If the one camp spot is taken at high water elevation, it constrains the amount of room that visitors have to maneuver, and may deter use of the launch and limit parking.

Finlay Bay recreation site is located approximately 1.5-2 hours driving time from Mackenzie. Access is via the Parsnip West FSR. At the 96 km marker, the Parsnip terminates and there is a turn off onto a 1 km long, narrow (approx. 4 m wide) gravel road leading to the recreation site. The site consists of 11 camp stalls with picnic tables and 3 outhouses. There is also a large open field area where many users prefer to camp and where boat trailers are parked. The boat launch is a short gravel road that is approximately 4 m wide (Appendix B). There are remnants of old slabs of concrete and pieces of rebar laying off to the side, indicating that a concrete launch once existed. At low reservoir elevation, vehicles must drive over rocks and sand to reach the water.

Elizabeth Creek recreation site is located approximately 20 minutes driving time from Hudson's Hope. Access is via paved Highway 29, turning right (north) approximately 300 m after crossing the crest of the WAC Bennett Dam. The site is intended for day-use, as there are no defined camp stalls, but overnight parking is common. There are two outhouses on site and a modest gravel parking lot with sufficient area for large vehicles. The boat launch is approximately 6 m wide, constructed of concrete and in good condition (Appendix B). The boat launch has been constructed to allow all sizes of boats to access the reservoir at both low and high water elevation. Elizabeth Creek will not be improved and is the designated control site for the monitoring program.

Dunlevy recreation site is located approximately 40 minutes driving time from Hudson's Hope. Access is via Highway 29, turning north on 12 Mile Road and following this well-maintained gravel road to the site. There is a large open area for parking and 2 outhouses. Although the site is intended as a day use site, there is evidence that the site is used for overnight camping. The boat launch is not usable during low reservoir elevation due to a steep sandy drop-off (Appendix B). As well, the launch is in disrepair, as the concrete slabs on one side of the launch have collapsed due to shoreline erosion, rendering only one side (3 m wide) of the launch usable. This site is part of Butler Ridge Provincial Park.

Alexander Mackenzie Landing recreation site is located approximately 10 minutes driving time from Mackenzie. Access is via the Parsnip West FSR for approximately 7 km with several signs that lead users to the site from Highway 39. The site is well-maintained and designated for day use with a picnic area, cooking shelter and amphitheater. There is parking with 2 outhouses on site. Immediately adjacent to the day use site is the BC Hydro Alexander Mackenzie Landing campsite which contains 10 camp stalls suitable for all RVs. A maintained foot path joins the two sites. The boat launch is approximately 6 m

wide, constructed of concrete and in good condition (Appendix B). Users launch directly from the concrete slab at high reservoir elevation, but must travel further down foreshore area on a rudimentary, gravel road to access the reservoir at low elevation.

Recreation Site Improvement Summary

Modifications were made to Dunlevy, Cut Thumb, and Mackenzie Landing recreation sites during the monitoring period. The condition of the Dunlevy launch was improved by BC Hydro in May 2013 by the removal of concrete slabs that were undermined by shoreline erosion. The launch was reduced in width, safety barriers installed, and the shoreline slope stabilized with rip rap material. Work or launch closure did not interfere with monitoring. The improvements did not extend the launch to early season water elevation. Launching in May and June when elevation is less than 667 masl is still difficult (Appendix B).

The number of campsites at Cut Thumb Bay was expanded in 2013. Fourteen new sites were cleared and graveled. Four new outhouses were built as well. No improvements were made to the launches but woody debris that accumulated at the 2 launching sites from high reservoir elevation in 2012 was removed.

Improvements to Mackenzie Landing were undertaken by BC Hydro in June 2011 to repair the access road to the site and stabilize an eroding bank adjacent to the parking lot. Work was sporadic and stretched into July and August. The site was closed in June for road repair but was open for the remainder of the Year 3 (2011) season. Work to expand the parking lot was completed in Year 5 (2013).

Data Collection and Analysis

Recreation site use monitoring was accomplished using remote vehicle counters and motion-sensitive digital cameras synchronized by date and time. Counters provide primary data, while camera data adds redundancy and increase confidence in monitoring trends by identifying 'false' events such as maintenance vehicles and ATVs. The combination of counter and camera data provide estimates of the following:

- The number of recreation site users with boats
- The duration of site user visits with and without boats
- The number of repeat users at each site

We favoured placing the monitoring equipment along the access roads into each site in order to keep data capture consistent between sites and among years, as well as during and after launch improvements. At designated day use sites, Elizabeth Creek and Mackenzie Landing, remote monitoring equipment was installed directly adjacent to the concrete boat launch. All data are compiled in a secure MS Access database. A detailed description of data collection methods and equipment settings can be found in Cubberley (2012).

RESULTS

Recreation Site Use

A total of 17,445 new data were added to the site use database in Year 5 (2013) and 12,311 event data used to estimate monthly site use. Year 5 (2013) results can be found in Appendix A. Vehicle counters have operated very consistently. Overall, there are currently 45,482 site use records in the project database. Of these counter records, 24,217 (53%) are photo-validated (Table 2). Average annual use estimates ranged from 303 visits at Finlay Bay to 976 visits at Mackenzie Landing between 2009 - 2013 (Figure 3).

Patterns of monthly use throughout the season are reasonably consistent from year to year (Figure 4). Typically in the spring, access road closures have occurred infrequently during monitoring reducing the number of site users in certain years. Often, we observed several repeat users who launched in spring and continued all season long.

It appears that trends in boater visits have increased steadily since the commencement of the monitoring program with notable increases at Finlay Bay and Dunlevy (Figure 5). At all sites, groups of users with a variety of recreational vehicles, boats, and equipment arrived and departed together. With the exception of Mackenzie Landing, average duration of boater visits was around 24 hrs or more suggesting that boaters are sleeping on their boats or camping at adjacent recreation sites (Table 3).

Site	Total Records	Total Photo-validated	Avg. Repeat Visitors
Cut Thumb Bay	11976	6982 (58%)	65
Six Mile Bay	4867	2846 (51%)	40
Finlay Bay	3516	1575 (45%)	16
Elizabeth Creek	8428	4380 (52%)	97
Dunlevy	8862	3682 (42%)	51
Mack. Landing	7577	5048 (67%)	170
Strandberg ¹	256	64 (25%)	
Total	45,482	24,217	439

Table 2. Total number of site use records in the GMSMON-20 database between May 14 and October 31 2009 - 2013.

¹ Strandberg was monitored Year 1-2 (2009-2010) but discontinued due to low use. Mackenzie Landing was added in Year 3 (2011).



Figure 3. Annual Year 1-5 (2009 - 2013) total photo-validated use by site estimated from counter data corrected using photo success between May 14 and October 31.



Figure 4. Five year average monthly total use by site estimated from counter data corrected using photo success between May 14 and October 31 (2009 - 2013).



Figure 5. Estimated number of users with boats to recreation sites between May 14 and October 31 2009 - 2013. No camera was installed at Elizabeth Creek in Year 1 (2009).

	Boaters			Non-boaters		
Site	n	mean	range	n	mean	range
Cut Thumb Bay	284	23.3	0.08 - 285.6	232	33.3	0.04 - 236.0
Six Mile Bay	185	23.1	0.03 - 262.5	277	14.5	0.02 - 351.1
Finlay Bay	84	64.7	0.07 - 343.8	116	25.1	0.09 - 257.4
Elizabeth Creek	808	22.2	0.04 - 436.4	420	1.1	0.001 - 242.4
Dunlevy	220	28.8	0.02 - 262.8	264	8.8	0.01 – 185.7
Mackenzie Landing	350	9.2	0.02 - 216.9	1188	0.4	0.001 - 24.8

Table 3. Mean duration of stay (hours) for site users with or without boats between 2009 -2013.

Effects of reservoir elevation on boat launch use

Reservoir elevation has been variable through the monitoring program (Figure 6). Water elevation was low in Year 2 (2010) throughout the monitoring period declining to the lowest elevation in 10 years by the spring of Year 3 (2011). However, spring inflow raised the reservoir to above average elevation by mid-July 2011. Conversely, reservoir elevation reached maximum level in 2012, necessitating spilling at W.A.C Bennett Dam since 2002. While the spillway was open, Elizabeth Creek was closed for safety reasons (Cubberley and Hengeveld 2013). High reservoir elevation mobilizes large woody debris that accumulates around recreation sites and hinders boat launching. This was particularly an issue at Cut Thumb in Year 4 (2012).



Figure 6. Williston Reservoir daily average elevation during recreation site monitoring period Year 1 (2009) - Year 5 (2013) compared to the mean of daily average reservoir elevation between 2000 and 2013. Monitoring day 1 corresponds to May 14 while monitoring day 171 corresponds to October 31.

Site use by boaters between Year 1 (2009) - Year 5 (2013) was spread throughout the monitoring period at Cut Thumb Bay, Finlay Bay, Elizabeth Creek, and Mackenzie Landing regardless of reservoir elevation (Figure 7). Six Mile Bay, and Dunlevy are used little early in the season, limited to car-topper style boats which can be carried to the water, but increased in appeal to boaters as the reservoir elevation rose above 664 masl (Figure 8). Cut Thumb, Elizabeth Creek, and Finlay Bay offer the easiest option for those launching larger boats such as cabin cruisers early in the season. Zero counts (days with no boats) are common at all sites. Cursory examination of the aggregate datasets (2009-2013) found that Six Mile, the least used site based on boater counts only, had 120 zero count days throughout the 171 day monitor period. Elizabeth Creek, most used by boaters, had no boat visits 85 days in the same period.



Figure 7. Daily boater use count (points) as a function of monitoring day and 5 year average reservoir elevation (line) for each recreation site between 2009 - 2013. Monitoring day 1 corresponds to May 14 while monitoring day 171 corresponds to October 31.



Figure 8. Daily boater use count (points) as a function of reservoir elevation for each recreation site between 2009 – 2013. Plots highlight overdispersion of count data. Red regression line indicates an increasing or decreasing trend in use. Monitoring day 1 corresponds to May 14 while monitoring day 171 corresponds to October 31.

DISCUSSION

Total recreation site use has increased since Year 1 (2009) with Year 5 (2013) estimated boater use highest since project inception. With over 45,000 records collected in 5 years of monitoring 6 recreation sites, trends in use support the assumption that boat usage increases with increasing reservoir elevation. Trends also support the management intent to improve access at lower elevation with physical works to launches. Decreasing trends in boater use at Elizabeth Creek and Mackenzie Landing reflect more regular use throughout the boating season and the higher appeal of constructed ramps in the early spring. Project success will be measured by consistent use throughout the monitoring season.

Although to date there has not been any improvements or new construction at boat launch facilities under BC Hydro's WUP, other construction activity at Cut Thumb, Mackenzie Landing, and W.A.C Bennett Dam (Elizabeth Creek) has influenced the upper estimates for these sites due to increased numbers of blank photos and unverified counter events. On several occasions it was difficult to distinguish between a legitimate user visit and construction traffic as it is common for users to bring commercial vehicles for personal recreation purposes. Launch closure and construction activity at Elizabeth Creek influenced the amount of boater use resulting in lower estimates for 2011 and 2012.

Frequent access road maintenance at monitored sites has affected photo validation. Recreation site access roads are maintained to a standard that allows for high vehicle speed that is logged by the counter unit but is too fast for the camera trigger speed (0.968 sec). As a result, Dunlevy, Cut Thumb, and Mackenzie Landing had higher numbers of blank photos. Because site layouts differ, ensuring consistency in the location of monitoring equipment among sites and among years is important. However, impending site improvements will require some setups to be relocated. Reliable operation of the cameras influence the overall quality of data and enhanced the monitoring program because relying on counter data alone can only provide an index of site use that may or may not reflect use by boaters.

There is some degree of bias associated with site use estimates. Variable camera function has created differences in monitoring effort within and among years. While we are using quality cameras, they require more labour to maintain in northern climatic conditions. The cameras function well in warm (15-25°C) temperature and dry weather but sporadic operation is often evident during cool, wet weather common early and late in the monitoring season. To reduce downtime and maximize data capture, site maintenance visits are purposely scheduled a few days before weekends and holidays when boater use is expected to be high. Variability in effort has implications for the estimates and will need to be accounted for in final analyses of pre-post changes in use.

Project data analyses will have to consider changes in local population, reservoir elevation, monitoring equipment effort / efficiency as well as closures, construction effects and fishing derbies. Including the standardizing parameter *monitoring day* will reduce variance created by day of the week and statutory holidays in statistical models. Boat count data do not follow normal (Gaussian) data distributions (Sutherland 2006; Cubberley and Hengeveld 2010). Patterns of non-use vary among sites and less used recreation sites will typically have more zero-use day counts. Mixed-effect models are robust even when observations are sparse and unevenly distributed across grouped data structures (Gelman and Hill 2007). As such, modeling pre-post boat counts using generalized linear mixed-model regression capable of accounting for overdispersion and zero-inflation should be considered (Crawley 2007)).

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APPENDIX A. YEAR 5 (2013) RESULTS

A total of 17,445 new data were added to the site use database in Year 5 (2013) and 12,311 event data used to estimate monthly site use. Vehicle counters were deployed at all sites May 16 - 17 2013 and operated continuously at Cut Thumb, Six Mile, Dunlevy, and Elizabeth Creek until the end of the monitoring period, October 31 2013 (169 days). Finlay Bay and Mackenzie Landing counters malfunctioned in July. A faulty batch of batteries is suspected. Remote cameras at these sites were fully functional and minimal data was lost.



Figure A1. Year 5 (2013) monthly use by site estimated from counter data corrected using photo success between May 16 and October 31 2013.



Figure A2. Year 5 (2013) proportion of site users with boats between May 16 and October 31 2013.

Table A1. Total use by site estimated for monitoring Year 3 (2011), Year 4 (2012) and Year 5 (2013). Estimates include both boaters and non-boaters. Parentheses indicate lower and upper confidence limits among sites.

Site	2	2011	4	2012	2013	
Cut Thumb Bay	699	(499-1180)	725	(541-1606)	639	(444-1827)
Six Mile Bay	386	(295-524)	439	(330-578)	415	(271-539)
Finlay Bay	272	(162-440)	296	(185-384)	420	(316-490)
Elizabeth Creek	473	$(468-2585^1)$	468	$(306-735^2)$	638	(449-951)
Dunlevy	727	(475-983)	824	(525-1063)	911	(580-1005)
Mackenzie Landing	1097	$(899-1092^2)$	878	(570-1224)	953	(788-1125)
Total visits	2,5	557	2,7	752		3,976

Monitoring periods: May 17 – October 31 2011, May 23 – October 31 2012, and May 16 - October 31 2013.

¹Includes Construction vehicles using boat launch

²Counter events excluded while launch closed.

Site	2011	2012	2013	
Cut Thumb Bay	37.7 (499)	37.9 (541)	45.7 (444)	
Six Mile Bay	31.5 (295)	33.9 (330)	28.4 (271)	
Finlay Bay	37.7(162)	46.5 (185)	33.2 (316)	
Elizabeth Creek	55.8 (468)	79.1 (306)	76.2 (449)	
Dunlevy	29.5 (475)	33.5 (525)	34.0 (580)	
Mackenzie Landing	18.7 (899)	17.5 (570)	23.4 (788)	

Table A2. Proportion (%) of photo-validated vehicles bringing boats to recreation sites during the Year 3 (2011), Year 4 (2012), and Year 5 (2013) monitoring periods. Parentheses indicate total number of photo-verified site users annually.

Monitoring periods: May 17 - October 31 2011, May 23 - October 31 2012, and May 16 - October 31 2013.

Table A3. Average duration of stay for site users identified as boaters or non-boaters in Year 5 (2013). Duration is a minimum biased estimate of hours per visit based on a subset of photo-validated counter data; see text for explanation of method.

	Boaters		Non-b	oaters		
Site	n	mean	range	n	mean	range
Cut Thumb Bay	50	32.8	0.3 - 140.8	46	61.7	0.08 - 236.0
Six Mile Bay	35	27.6	0.05 - 168.9	43	18.4	0.03 - 95.0
Finlay Bay	43	55.1	0.07 – 188.3	51	30.7	0.13 - 257.4
Elizabeth Creek	271	17.7	0.04 - 120.3	95	0.19	0.003 - 3.3
Dunlevy	57	29.8	0.03 - 120.9	59	8.3	0.01 - 69.4
Mackenzie Landing	147	7.9	0.09 - 211.5	436	0.5	0.002 - 8.7

Table A4. Number of easily recognized repeat visitors per site during the Year 5 (2013) monitoring period, May 16 – October 31 2013.

Site	Repeat visitors	
Cut Thumb Bay	59	
Six Mile Bay	32	
Finlay Bay	23	
Elizabeth Creek	140	
Dunlevy	53	
Mack. Landing	250	
Mack. Landing	250	

APPENDIX B. SITE PHOTOS





Cut Thumb alternate launch May 16 2013



Cut Thumb June 26 2013



Cut Thumb alternate launch June 26 2013



Cut Thumb July 30 2013



Cut Thumb alternate launch August 24 2013



Six Mile Bay May 16 2013

Six Mile Bay May 16 2013



Six Mile Bay May 16 2013



Six Mile Bay June 26 2013



Six Mile Bay July 30 2013



Six Mile Bay August 29 2013





Finlay Bay May 16 2013



Finlay Bay May 16 2013



Finlay Bay June 26 2013





Finlay Bay July 30 2013

Finlay Bay November 6 2013









Elizabeth Creek June 27 2013



Elizabeth Creek August 2 2013



Elizabeth Creek August 30 2013

Elizabeth Creek August 2 2013



Elizabeth Creek November 4 2013







Dunlevy May 17 2013



Dunlevy May 17 2013



Dunlevy June 27 2013



Dunlevy June 27 2013



Dunlevy August 2 2013



Mackenzie Landing May 7 2013



Mackenzie Landing July 2 2013



Mackenzie Landing May 16 2013



Mackenzie Landing July 30 2013



Mackenzie Landing October 1 2013



Mackenzie Landing November 6 2013