

PUBLIC SAFETY MEASURES PLAN

BALA FALLS DAMS

PREPARED FOR:

ONTARIO MINISTRY OF NATURAL RESOURCES SOUTHERN REGION 300 WATER STREET FOURTH FLOOR, SOUTH TOWER PETERBOROUGH, ON K9J 8M5







FINAL REPORT

PUBLIC SAFETY MEASURES PLAN

BALA FALLS DAMS

Prepared for:

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1.0 PURPOSE

In June 2009, WESA Inc. was contracted by the Ontario Ministry of Natural Resources to conduct a Public Safety Assessment (PSA) at the Bala Falls Dams (North Dam and South Dam) and produce a Public Safety Measures Plan (PSMP) documenting findings and recommendations.

The key considerations of the project include understanding and documenting any potentially significant public safety hazards that are either known or anticipated to occur due to public interactions with the dam structures, or due to their operations. The Ministry of Natural Resources' *Technical Guidelines and Requirements for Approval Under the Lakes and Rivers Improvement Act, Volume Four - PUBLIC SAFETY AROUND DAMS (DRAFT), September 2009* was used as the policy framework to systematically identify any such hazards, and evaluate methods by which the Ministry could eliminate or mitigate them.

The dam hazard identification exercise and the public safety assessment were conducted in accordance with the *MNR Risk Assessment Tool*, March 2010. The assessment is based on the current operating strategy as defined in the Ministry's *Muskoka River Dam Operation Manual* (2007). Identification of various risks to the public dictates the need for the development of a Public Safety Measures Plan for the Bala Falls dams.

This PSMP documents the existing site conditions and operational practices as well as the identified public safety hazards, risk assessment results, recommended measures to either eliminate or mitigate the risks and suggested practices for raising public awareness of the hazards, all related specifically and only to the dams and their operation. It does not address any other potential hazards at or around the site, whether naturally occurring or man-made which are not directly related to the dam structures or their operation.

Prepared by:

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Health & Safety Specialist, WESA Inc.

March 30, 2011





2.0 ACCOUNTABILITY

Roles and responsibilities for public safety for the structure include:

Dam Owner: Ontario Ministry of Natural Resources

The Dam Owner must ensure that:

- policy for public safety around dams is established and implemented;
- accountability to the policy is defined;
- all personnel responsible for the management and operation of the structure are trained in the requirements of the PSMP and aware of their responsibilities, including both the identification of hazards and reporting of incidents (occupational and involving the public);
- progress with the recommendations and standards of this Public Safety Measures Plan is made and monitored;
- any change in site conditions is managed and addressed in subsequent versions of this PSMP;
- every incident at the site is investigated to minimise the risk of recurrence;
- The PSMP review is conducted on schedule and findings are reported to MNR decision makers.

Dam Operator: Ontario MNR, Parry Sound District Water Resources, Bracebridge office

The Dam Operator must ensure that:

- all personnel responsible for the operation of the structure are trained in the requirements of the PSMP and aware of their responsibilities, including both the identification of hazards and reporting of incidents (occupational and those involving the public);
- dam operation, inspection and maintenance is in accordance with the recommendations and standards of this Public Safety Measures Plan;
- public education and communication protocols are adhered to and updated as required;
- every incident at the site is investigated to minimise the risk of recurrence.

PSMP Development: WESA Inc.

The PSMP for Bala Falls Dams was developed to:

- provide assistance to the owner in defining accountabilities;
- identify hazards to members of the public;
- document a public safety risk assessment;
- provide recommendations to assist the owner in management of the identified risks.





At the time of the public safety assessment, there were no known third parties who may have authorization to access the site and or impact its operations.

3.0 SITE DESCRIPTION

The Balls Falls site is located in the township of Muskoka Lakes, Village of Bala, and District of Muskoka and consists of a dam on each of the bifurcated channels on the Moon/Musquash River maintaining water levels on Lake Muskoka at Bala Bay. A third outlet discharging from Lake Muskoka is channeled through a small hydroelectric generating station some distance north of the North Dam. The North Dam is located on Lot 14, Concession A, Medora Township. The South Dam is located on Lot 33, Concession 7, Wood Township.

Details of existing site arrangements are shown on the following figures in Appendix A:

- Figure 1. Public Safety Measures Site Plan Bala Falls North Dam
- Figure 2. Public Safety Measures Site Plan Bala Falls South Dam
- Figure 3. Dangerous Water Areas, Bala Falls

Site descriptions were prepared based on a review of MNR supplied dam information, interviews with MNR dam operators and staff familiar with the site, and a site visit on July 8, 2009. A photo log of the site visit is provided in Appendix B. For the purposes of this report all location descriptions are oriented in an upstream facing direction. A description of the dams and their operations as well as the surrounding area and any known public interactions around the structures is provided below:

Bala Falls North Dam

A detailed map showing the location of the dam and its associated appurtenant facilities and surrounding area is included as Figure 1 in Appendix A. The Bala Falls North Dam is located at the top of "Bala Falls" on the historic natural outlet from Lake Muskoka.

The Bala Falls North Dam is a concrete structure with six sluiceways; two of the sluiceways are equipped with seven stoplogs, the remaining sluiceways have eight stoplogs. The dam operation details for this dam are provided in Section 29 of the Muskoka River Dam Operation Manual (MRDOM).





The Muskoka District Road 169 and Canadian Pacific Railway (CPR) bridges cross the channel upstream of the dam; a public parking lot is located on the left bank. An orange 'TUFFBOOM' safety boom is located approximately 30 metres upstream of the dam and is anchored to each bank. The dam has mesh panels applied to guardrails at each end which are gated and locked; bilingual signage reading "DANGER Dam No Trespassing" (red with white lettering) is fastened

to each gate. Larger English-language signs reading "<u>DANGER</u> Fast Water Keep Away" are located on both faces of the dam, mounted to the railings. All signage was MNR standard issue and was observed to be in good condition. The view of the DANGER sign mounted on the upstream face was obstructed by the road bridge.

Bala Falls South Dam

A detailed map showing the location of the dam and its associated appurtenant facilities and surrounding area is included as Figure 2 in Appendix A.

The Bala Falls South Dam is a concrete structure with eight sluiceways each containing eight stoplogs. The dam operation details for this dam are provided in Section 29 of the MRDOM. The Bala "South" channel is man-made and is considered to be the main spillway for the South Dam.

The Bala Falls Road, CPR, and District Road 169 bridges cross the channel downstream of the dam; there is a gravel parking lot on the left bank adjacent to the dam. An orange 'TUFFBOOM' safety boom is located approximately 38 metres upstream of the dam with two in-stream concrete crib anchors. The boom is secured to the banks with concrete anchors. The dam has guardrails and is gated and locked at each end; there is no measure to prevent persons climbing on, or ducking under, the gate or guardrails. Bilingual signage reading "DANGER Dam No Trespassing" (red with white lettering) is fastened to each gate. Larger English-language signs reading "DANGER Fast Water Keep Away" are located on both faces of the dam, mounted to the railings facing upstream and downstream. All signage was MNR standard issue and was observed to be in good condition. The wood stoplog gain covers on the deck were not secured. Stoplogs were observed on the dam deck at the time of the visit.

Operating Practices and Procedures

The operational strategy for the Bala North and South dams is described in the Muskoka River Dam Operating Manual, 2007 (MRDOM). Stoplogs are added or removed at either dam by Ministry staff in order to stay within the normal operating zone and as close to the target operating level as possible. Most of the flow is directed through the South Dam, resulting in calmer water above the North Dam.





Although not documented, the operators report that they routinely drive over the road bridges on both Bala Falls Road and District Road 169 on the approach to the Bala Dams to view the entire channels that will be affected by dam operations. If individuals are in the water or on rocks in the areas to be affected, the operator warns them of the impending hazard and waits until they are clear before proceeding to operate the dam.

Informal site inspections are conducted during operational site visits; formal Ministry inspections are conducted yearly. As part of the formal inspection, the safety boom, guardrails, gates and signage are inspected.

According to the MRDOM Section 4.1., Paragraph 11, Ministry staff contact Ontario Power Generation (OPG) before and after all stoplog changes at Bala to allow for operational changes at OPG's Moon River Dam downstream.

Public Interaction

In the May to October open-water season activities include recreational boating, paddling, swimming, fishing and picnicking around the site with the summer holiday period (July and August) experiencing the highest level of public activity around the dams. Off season (November to April) activities are greatly reduced to mostly local residents who are considered more familiar with the waterway and dam water flow conditions than the peak summer and non-resident day users. No information was available regarding early spring, late fall and winter activities in the area but these might include cross-country skiing, skating, ice fishing, walking and snowmobiling.

During the site visit (July 2009), wading and swimming was observed adjacent to the parking lot immediately upstream of the South Dam safety boom on the left bank; no signage is posted in this area. An interview with the Dam Operator revealed that white water kayakers frequent the waters in the downstream channel below the South Dam, usually during high flow conditions. Media photographs posted on websites indicate that kayak paddlers navigate through the sluiceways at Bala South Dam.

A boat rental and convenience retail outlet business is located above the North Dam on the upstream right bank between the safety boom and a rail bridge. During the site visit swimmers and kayak paddlers were observed using a footpath which extends from the top of the rocky right bank just downstream of the dam, past the right hand side of the dam and over the Hwy 169 bridge to the boat rental business, upstream of the existing safety boom. Another footpath travels along the top of the rocky left bank downstream of the dam, extending along the east side of Hwy 169 Bridge, to the shoreline at the parking area, under the rail bridge and around the shoreline to the park docks. Kayak activity, swimming and wading was observed downstream of the falls; wading was also observed in fast flows on the rocky falls immediately downstream of the dam. Staff at the rental outlet reported that members of the public access the





rail bridge to dive/jump from the structure and swim in the waterway upstream of the safety boom.

There are no documented operating practices or procedures at the Bala Falls Dams to enhance public safety and dam operation awareness at the site. None of the existing signage identifies the Ministry as the dam owner or provides incident/emergency contact numbers.

There are no current initiatives (beyond the Operator reconnaissance prior to dam operation maneuvers) to promote public awareness of dam operations at Bala Falls. Ministry staff do not contact neighbouring private property owners prior to dam operations.

4.0 PUBLIC SAFETY ASSESSMENT DISCUSSION

The assessment of public safety at the Bala Falls dams included a meeting between MNR staff and WESA Group Inc. staff at Bracebridge MNR office in Bracebridge, Ontario and the completion of a site visit to the Bala Falls Dams site at Bala, Ontario on July 8, 2009. A number of assumptions were made in the completion of this assessment. These assumptions are documented in the Risk Assessment Tool in Appendix D. It is important to note that the assessment only documents hazards which are directly related to the dams or their operation.

The completion of this Public Safety Measures Plan addressing site conditions and recommendations will assist the Ministry, as the Dam Owner, to satisfy the principles established in the Ministry's Draft *Technical Guideline Volume 4 – Public Safety Around Dams* (September, 2009) document and, when recommendations are implemented, will ensure the Ministry demonstrates due diligence.

A summary of the hazards identified is listed in Tables 1 and 2 below for each dam. The identified hazards are also displayed on Figures 1 and 2 in Appendix A. Figure 3 in Appendix A shows the approximate dangerous water areas for the Bala Falls Dams site.

While flow conditions at the dams vary due to natural seasonal and climatic fluctuations, operational changes can result in short term changes in flows upstream and downstream of the structures which may pose an additional hazard to the public. The upstream and downstream dangerous water area, defined as those areas which may exhibit fast flowing and/or turbulent conditions as a result of dam operations, is shown in Figure 3. In lieu of a hydrological assessment, the determination of the approximate extent of the upstream dangerous water areas were based on Transport Canada's Point of No Return Calculations and discussions with Ministry staff. An examination of photos of the Bala Falls site under high flow conditions and discussions with Ministry staff has resulted in an approximation of the downstream dangerous water areas.





Table 1:	North Dam Identified Hazards
Hazard	Hazard Description
Number on	
Site Plan	
(Figure 1)	
1	Trespass onto dam, Falls
2	Swimming in upstream dangerous water area, Drowning
3	Wading / swimming in downstream dangerous water area, Drowning
4	Paddling through the dam, Capsize, Drowning
5	Swimming in upstream dangerous water area upstream of safety boom,
	Drowning

Table 2:	South Da	am Identified	Hazards
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Hazard	Hazard Description	
Number on		
Site Plan		
(Figure 2)		
1	Trespass onto dam, Falls	
2	Swimming in upstream dangerous water area, Drowning	
3	Wading / Swimming in areas upstream of existing boom yet within the	
	calculated dangerous water area, Drowning	
4	Wading / swimming in downstream dangerous water area (spillway),	
	Drowning	
5	Paddling through dam, Drowning	

Risk Analysis and Priority Ranking

Based on the probability and consequence identification, the dam owner must ensure that a competent person assess the relative risk posed by each hazard which has the potential to cause a risk to public safety. Seasonal changes in public use around the dam structure and the risk posed by seasonal operating changes must also be taken into account in the risk analysis. Based on the methodology used to determine risk, this public safety assessment priority ranks interaction events from highest risk to lowest risk and includes recommendations for measures to assist the Ministry to better plan its actions with regards to public safety and hazard prevention.

The following tables summarize the risk analysis of public safety at the Bala Falls Dams sites. The risks were determined following the MNR's *Risk Assessment Tool*, March 2010 (See Appendix D). The risk assessment evaluation and scoring criteria are presented in Tables 3, 4 and 5. Tables 6 and 7 present the results of the risk assessment and recommended measures for the north and south dams respectively.





Table 3:Incident Likelihood (Probability) - L

Definition: Expected level of public interaction for the activity and associated hazards present (either known or estimated)

Level	Descriptor	Example Description
5	Almost Certain to Occur	is expected to occur in most circumstances
4	Likely	will probably occur in most circumstances
3	Possible	will occur at some time
2	Unlikely	might occur at some time
1	Rare	may occur only in exceptional circumstances

Table 4: Incident Severity (Consequence) - C

Definition: Most likely outcome of the potential interaction that could reasonably be experienced as a result of dam operations or interaction with MNR facilities by a member of the public engaging in that activity

Level	Descriptor	Example Description
1	Insignificant	no 1st aid required
2	Minor	1st aid may be required (by non-EMS personnel)
3	Moderate	could result in medical treatment or rescue
4	Major	critical injury is possible (EMS services are required)
5	Catastrophic	fatality or permanent total disability is likely to result (drowning,
		severe trauma)

Table 5:Public Safety Risk Rating

Classify the risk rating for the particular activity, according to Low, Medium or High Risk: LOW Risk - A LOW RISK would not require further reduction but reasonable and obvious measures should be implemented as appropriate. MEDIUM Risk - A MEDIUM RISK determination means that the Ministry should evaluate all reasonable means to reduce risks as a 2nd priority. HIGH Risk - A HIGH RISK determination requires the Ministry to take all reasonable

measures to mitigate this risk as a 1st priority.

			Incident Consequences						
R	ISK RATING		Insignificant	Minor	Moderate	Major	Catastrophic		
			1	2	3	4	5		
	Almost Certain	5	М	М	Н	Н	Н		
Incident	Likely	4	L	М	Н	Н	Н		
Likelihood	Possible	3	L	М	М	Н	Н		
Likelinood	Unlikely	2	L	L	М	М	Н		
	Rare	1	L	Ĺ	L	L	M		





Table 6: Risk Analysis of Hazards at the North Dam

For Likelihood (L) and Consequence (C) descriptions, see MNR Risk Assessment Tool, March 2010

RD BER	Step 1			Step 2	Step 3	Step 4	Step 5
AZAUMU				L LEVEL (1.2.3.4.5)	C LEVEL (1.2.3.4.5)	RISK RATING (High/Medium/Low)	RECOMMENDED CONTROLS
ΪŹ	ACTIVITY	HAZARD	EXISTING CONTROLS	(-,_,_,_,_,_,	(-,_,_,,,,_,	(
1	Trespass on	Falls	"No Trespass" Signage,	1	4	Low	Maintain at each end of the dam: Gate and
	dam		locked gate and mesh				Guardrail mesh infill panels, and; "No Trespass"
							signs.
							Maintain on each face of the dam: Guardrails
							with part mesh infill at each end, and; Danger
							signs.
							Install at each end of dam: Signage with name
2	Culture and in a	Duousning	"Dangar" Ggnaga at dans	2	F	Lligh	of dam owner and contact information.
2	Swimming	Drowning	banger Signage at dam;	5	5	Fign	Recession, install and maintain:
	upstream		"No Swimming" sign				Qualified Engineer):
			installed by third party on				New "Danger" sign on unstream side of
			left bank between dam and				Road 169 bridge: Physical barrier on accessible
			Road 169 bridge				banks along upstream dangerous water area.
3	Wading /	Drowning	"Danger" Signage at dam	2	5	High	Install: Warning signage downstream of the dam
	swimming						to warn of potential changes in flows;
	downstream						Document practice of conducting visual
							inspections of downstream dangerous water
							area prior to removing stoplogs to ensure
							communication to all MNR personnel (revise
							MRDOM).
							Consider increasing amount of normal
4	Paddling	Cansize	"Danger" Signage at dam.	1	5	Medium	Install: New "Danger" sign on unstream side of
Т	through dam	Drowning	kafety boom	•	5	Mediam	Road 169 bridge
	in ough dann	Diowining	sulety boom				Maintain: Safety Boom.
							Consider vessel operation restriction.
5	Swimming /	Drowning	"Danger" Signage at	2	5	High	As Hazard 2 above and;
	Wading		dam; Safety Boom				Ensure physical barriers deter access to the
	upstream						water between the dam and the safety boom.





Table 7: Risk Analysis of Hazards at the South Dam

For Likelihood (L) and Consequence (C) descriptions, see MNR Risk Assessment Tool, March 2010

ZARD ABER	Step 1 IDENTIFY			Step 2 L LEVEL	Step 3 C LEVEL	Step 4 RISK RATING	Step 5 RECOMMENDED CONTROLS
HAZ NUN	ACTIVITY	HAZARD	EXISTING CONTROLS	(1,2,3,4,5)	(1,2,3,4,5)	(High/Medium/Low)	
1	Trespass on dam	Trips / Falls	"No Trespass" Signage; locked gate	2	4	Medium	Install at each end of the dam: Gate and Guardrail mesh infill panels; "No Trespass" signs; Signage with name of dam owner and contact information. Secure stoplog gain covers. Maintain on each face of the dam: Guardrails.
2	Swimming upstream	Drowning	"Danger" Signage at dam; safety boom	3	5	High	Redesign, Install and maintain: Safety Boom and components (requires Qualified Engineer)
3	Swimming / Wading upstream	Drowning	"Danger" Signage at dam; Safety Boom	2	5	High	As Hazard 2 above and; Install physical barrier and "Danger" signage on left bank between dam and new left bank boom anchor.
4	Swimming / wading / fishing downstream	Drowning	"Danger" signage at dam; Uninviting flows	2	5	High	Install: "Danger" signage on downstream road bridges; Physical barriers at fall hazards on accessible banks along downstream dangerous water area. Liaise with landowners on downstream banks as necessary.
5	Paddling through dam	Capsize, Drowning	Signage at dam, Safety Boom	1	5	Medium	Redesign, install and maintain: Safety Boom and components (requires Qualified Engineer). Consider vessel operation restriction.





5.0 **RECOMMENDATIONS**

In light of the public safety assessment undertaken for this site and in accordance with draft guidelines that indicate that a PSMP must be undertaken for a dam where public safety hazards exist, recommended measures to mitigate the risks to public safety are described below. In most cases, full elimination of the risks assessed is not possible.

The objective of a PSMP is to ensure hazards are controlled to minimize risks to public safety around dams and appurtenances through public safety measures, recommended in accordance with the following hierarchy:

- Eliminate the hazard wherever possible;
- Install safeguard devices to restrict access by the public to hazardous areas;
- Install warning devices;
- Install illumination and surveillance devices;
- Install protective devices to allow for response to incidents and emergencies;
- Support the development and delivery of information, education and training programs for the public.

The rationale for recommendations is based primarily upon the principles set out in the MNR *Technical Guidelines Volume Four - PUBLIC SAFETY AROUND DAMS (DRAFT),* September 2009. Recommendations were identified by the Public Safety Assessment above in Tables 6 and 7 and are summarised in the Section 7.0 Conclusions and Priorities for Implementation.

Due to the aesthetic appeal of the Bala Falls area, the MNR specifies the use of aesthetically pleasing fencing to discourage public access to areas of the water near dams that are considered dangerous. While the banks do not directly relate to the dam structures or their operations and do not pose a hazard to the public, they may provide easy and attractive access for the public to dangerous water areas.

One area where a physical barrier is recommended is the left bank upstream of the South Dam extending to the proposed safety boom anchor location (see hazard (3) South Dam). Further, physical barriers are required along accessible banks upstream of the North Dam extending to the safety boom. Design of physical barriers should consider the fact that this area is an established public access point for parking, swimming and wading and that fencing should be designed to deter climbing over or passing under the barrier.

Trespass onto the dam decks is potentially hazardous to members of the public. The Bala North Dam has mesh panels applied to guardrails and gates at each end of the dam. It is recommended that similar measures be applied to the Bala South Dam. Stoplog gain covers of the Bala South





Dam should be secured to prevent unauthorized removal. It is recommended that galvanized steel mesh gain covers, similar to those located on the Bala North Dam, be installed on the Bala South Dam.

Mandatory signage for navigation and to warn against trespass is present at both dams. However, the North Dam upstream navigation DANGER sign, while situated in a location that is visible from the road bridge, is not visible to upstream navigation due to obstruction by the low deck of the road bridge. Consideration should be given to adding an identical sign to the upstream side of the Hwy 169 Bridge and additional visual cues, such as buoys, upstream of the rail bridge.

Warning signage is recommended along both shorelines of the North Dam (see Figure 1) to safely guide the public around hazardous areas;

 downstream of the dam at points where the public is known to access the waterway within the approximate dangerous water area for wading, fishing and paddling (see Figure 3).

At the South Dam site warning signs are recommended (see Figure 2);

• on both shorelines along the dangerous water areas where vegetation is not dense enough to deter public access or where no other structures are present to restrict entry to the water's edge.

Educational interpretive signage that may include an introduction to the history of the site, but also communicates hazards associated with the Bala Falls is recommended at access points near both dams.

It is recommended that in addition to identifying the dangers associated with waterway use, signage should also warn of hazards associated with changing flow conditions around dams. The upstream and downstream dangerous water areas are considered as those areas which may exhibit fast flowing and/or turbulent conditions as a result of dam operations. While it is recognized that flows are not altered frequently and that flow patterns stabilize quickly after the stoplogs are manipulated at the dams, operational changes may still result in flows that are significantly stronger than natural conditions alone. These factors may not be immediately apparent to the casual visitor, hence the need for danger, warning and educational signage to augment warnings by operators prior to dam operations.

The extent of Dangerous Water Area upstream of the dams was evaluated by application of the Point of No Return (PoNR) concept as defined by Transport Canada.





PoNR exclusion zone calculations were completed for the site using the two-yr (2-yr) return period flow, which was derived from historical flow data downstream at the Moon River stream gauge (Environment Canada station # 02EB006). The resulting Method 2 (Drawdown Distance) calculation determined that the dangerous water area extends for a distance of 50.1 meters upstream of the North Dam, and 37.6 meters upstream of the South Dam (See Appendix E).

The existing orange 'TUFFBOOM' safety boom at the North Dam is positioned within the exclusion zone as defined by Transport Canada Point of No Return (PoNR) calculations and directs self-rescue towards an informal boat launch on Crown Land on the right hand shoreline. The existing orange 'TUFFBOOM' safety boom at the South Dam is positioned within the exclusion zone as defined by Transport Canada PoNR calculations but directs self-rescue to safe areas at either shoreline. Therefore, the safety booms at both Bala Dams meet the *NWPA* standards and MNR draft provincial guidelines for visual cue and self-rescue but not for distance.

The navigation safety booms should be designed at the recommended distance to be compliant with the PoNR requirements.

Under typical operating conditions, water levels and flows at the site are maintained within the limits of the normal operating zone (i.e. remain steady along a flat target operating level range for the busy summer recreation period and are adjusted gradually during transitional periods). Most of the operational changes occur during periods of decreased public use outside of this flat summer range. Further, the dam operators currently ensure the downstream areas are clear of people prior to removing stop logs. Thus, the risk assessment has determined that, if the operator's current practice is documented and communicated, operational hazards at the site are not significant and no mitigating operational procedures are recommended for the site while operations remain within the normal operating zone.

For those operating procedures initiated in response to rising water levels in anticipated flood conditions (flood control zone on rule curve), operational changes may result in an increase in risk of hazardous conditions in the dangerous water areas downstream of the dam (see Figure 3). For this scenario the identified operational change, identified hazard and the recommended mitigating measure are presented in Table 8.





č		1 0
Operational Change	Identified Hazard	Mitigating Procedure
Respond to flood control zone	Dangerous water areas in	MNR personnel continue the
conditions by removing stoplogs	the dam spillways and	operational practice that prior
to pass the flood flow	Moon River downstream	to operational changes, visual
	of the spillways; areas are	surveillance to ensure no
	described on Figure 3.	persons are in the dangerous
		water area and to warn persons
		to stay clear while changes
		affecting water flow and level
		are made.

Table 8:	Mitigation Measure for Hazards Identified Due to Operational Change
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The mitigation procedure outlined in Table 8 above should be added to the operating procedure in the MRDOM to ensure that all operators follow the same practice.

In order to increase visibility of the dangerous water area downstream of the North Dam, the Ministry should consider modifying the operational regime at the Bala Falls Dams in such a way that a portion of the flows typically passed by the South Dam is diverted through the North Dam. This operational change would ideally result in higher flows at the North Dam which would act as a visual deterrent to members of the public and potentially reduce the use of the falls immediately downstream of the dam for wading and swimming. Public entry to the waterway immediately downstream of the South Dam is less likely due to the restricted access from banks.

Sirens and warning lights are not recommended for the Bala Falls Dams as stoplogs rather than gates are in use and are manually operated at the site by an operator (not a remotely controlled site).

Recommendations were selected with respect to local sensitivities and the aesthetic appeal of the area wherever possible. For example, the selection of physical barriers will have to consider visual impact. Signage recommendations were kept to a minimum for similar reasons, particularly where the hazard is very apparent.

Signage is required to ensure that Emergency Response Protocols are communicated to the public. There was no sign posted on site to identify the owner/operator of the dam. The Ministry reported that an internal review with respect to the information to be placed on the signage was with the Regional Dam Safety Forum at the time of writing. It is understood that recommendations from this group will be implemented as required.

We recommend that improving public safety awareness at MNR Dam sites would benefit both the Ministry and the Ontario community. Measures that increase public safety awareness include;





- public safety awareness events (i.e. at existing community events)
- local radio, billboard, website, or newspaper public service announcements at the start of the boating/tourist season
- educational signage at public interaction points

The Ministry is advised to liaise with the community (i.e. municipality, OPG, local emergency services) in creating a Public Safety Awareness Plan.

6.0 INSPECTION AND MAINTENANCE REQUIREMENTS

Inspection and maintenance requirements are specific to each dam site. The inspection and maintenance requirements for maintaining public safety measures at the Bala Falls Dams site include, but will not be limited to:

During Informal Inspections

Inspect:

- 1. Both upstream and downstream channels ensure no person will be endangered by dam operations.
- 2. Barriers ensure fences are not damaged and look for signs of entry to the water in dangerous locations.
- 3. Signage ensure all signs are present, in good condition, and free of graffiti.
- 4. Safety boom visual check that boom is secured and not damaged.
- 5. Dam infrastructure visually check site for signs of damage/trespass.

During Formal Inspections

In addition to items 1-5 above, inspect:

6. Guardrails – check structural integrity, signs of rust, loose bolts, damage.

Inspection and maintenance schedules are established by the Ministry for each dam site. The record keeping template currently in use by the Ministry should be updated with the implementation of any new measures or changes to existing measures at the site. If damage is observed during an inspection, the Dam Inspector should assess whether he/she can perform a temporary repair with high-visibility mesh fencing or simply highlight the hazard with tape. All damage and /or deterioration must be reported to the Inspector's Supervisor for initiating permanent work to remedy any damage as soon as reasonably possible, dependant on the risk to the public.





7.0 CONCLUSIONS AND PRIORITIES FOR IMPLEMENTATION

WESA Inc. was commissioned in June 2009 to conduct a Public Safety Assessment at the Bala Falls Dams (North Dam and South Dam) and produce a Public Safety Measures Plan documenting findings and recommendations.

The Balls Falls site, located in the township of Muskoka Lakes, Village of Bala, and District of Muskoka, consists of a dam on each of the bifurcated channels on the Moon/Musquash River maintaining water levels on Lake Muskoka at Bala Bay.

The project included understanding and documenting the existing site conditions; identifying hazards associated with each dam structure, appurtenant facilities and the associated operational activities which may affect the public during their interaction around each dam site.

Following inspection of the Bala Falls North and South Dam sites and further consideration of the risks to public safety, WESA Inc. recommends this Public Safety Measures Plan for acceptance by the Ministry. WESA Inc. further recommends that the Ministry adopt the measures identified in Section 5.0 of this report and summarised in priority order in Tables 9 & 10 below.

A PSMP Review, Reporting and Amendments Schedule and Record are included in Appendix C. We recommend that the Bala Falls PSA and PSMP be reviewed and amended as necessary, specifically whenever physical and/or operational changes are implemented that may affect public safety and at least at the frequency of formal inspections at the dams.





Identified Hazard Number (Figure 1)	Activity	Hazard	Risk Rating	Recommended Measures
2	Swimming upstream	Drowning	High	 Redesign and maintain: Safety Boom and components (requires Qualified Engineer)
5	Swimming upstream of existing safety boom	Drowning		 Install "Danger" sign on upstream side of Road Bridge to improve visibility. Install physical barrier(s) on accessible banks along upstream dangerous water area.
3	Wading / swimming downstream	Drowning	High	 Install "Warning" signage downstream of the dam warning of potential change in flows due to operations. Install Educational/Interpretive signage at entry points on both banks. Document practice of conducting visual inspections of downstream dangerous water area prior to removing stoplogs to ensure communication to all MNR personnel (revise MRDOM).
4	Paddling through dam	Capsize, Drowning	Medium	 Redesign and maintain: Safety Boom and components (requires Qualified Engineer) Maintain "Danger" signage Consider application to Transport Canada for a vessel operation restriction.
1	Trespass on dam	Falls	Low	 Maintain at each end of the dam: Gate and Guardrail mesh infill panels, and No Trespassing signs Maintain on each face of the dam: Guardrails with part mesh infill at each end, and Danger signs Install at each end of the dam: Signage including name of dam owner and contact information

 Table 9:
 Bala North Dam – Prioritized Recommendations





ldentified Hazard	Activity	Hazard	Risk Rating	Recommended Measures	
Number					
2	Swimming upstream Swimming /	Drowning Drowning	High	 Redesign and maintain: o Safety Boom and components (requires Qualified Engineer) Install fence and "Danger" signage on upstream left bank between dam and proposed 	
	upstream			 Install educational/interpretive signage in parking area 	
4	Swimming, wading or fishing downstream	Drowning	High	 Install: "Danger" signage on downstream road bridges Physical barriers at fall hazards on accessible banks along downstream dangerous water area Liaise with downstream landowners to ensure all occupants understand the dangers of fast flowing water and changing conditions following dam operations. 	
1	Trespass on dam	Falls	Medium	 Install at each end of the dam: Gate and guardrail mesh infill panels similar to those on the North dam, and Meshed, secured stoplog gain covers, and "No Trespass" signs, and Signage including name of dam owner and contact information. Maintain on the dam: Gates and guardrails on structure, and Danger signs. Secure stoplog gain covers. 	
5	Paddling through dam	Capsize, Drowning	Medium	 Redesign and maintain: o Safety Boom and components (requires Qualified Engineer) Maintain "Danger" signage Consider application to Transport Canada for a vessel operation restriction. 	

 Table 10:
 Bala South Dam – Prioritized Recommendations





APPENDIX A

Site Plans









<u>LEGEND</u>



UPSTREAM DANGEROUS WATER AREA

<u>NOTE:</u>

The approximate extent of the upstream dangerous water areas are based on Transport Canada's Point of No Return Calculations.

The downstream waterway areas that may be influenced by dam operations can be conservatively estimated to roughly correspond to the white water areas immediately downstream of the dam structures and extending out into the Moon River under high flow conditions.

PROJECT NUMBER: 0E7935	DRAWN BY: C.M.R.	DESIGNED BY: R.P.
DATE: 17 DEC. 2010	CHECKED BY:	
SCALE: AS SHOWN	CAD FILE NO.: 0E793	5-BALA DAM

FIGURE: 3

DANGEROUS WATER AREAS

BALA FALLS



APPENDIX B

Photographs



PHOTOGRAPHS - PACKAGE B BALA FALLS NORTH DAM



OE7935-PH1



BALA FALLS NORTH DAM

OE7935-PH1







PHOTOGRAPHS - PACKAGE B BALA FALLS SOUTH DAM



OE7935-PH2

APPENDIX C

PSA/PSMP Review

PSMP Review, Reporting and Amendments Record

SPECIAL NOTE: PLEASE USE 'N/A' NOTATION IF NOT APPLICABLE - DO NOT LEAVE SPACE BLANK

Owners should review the PSMP on a regular basis. The frequency of review should depend on whether changes occurring at the site are likely to affect public safety or the owner's assumptions in developing the PSMP. As a minimum the frequency of review of the PSMP should correspond to the frequency of the dam safety periodic review prescribed for the site.

Review Date	Amendments Required	Report Submitted By: (Name/Title)	Approved By: (Name/Title)	Signature	Date

APPENDIX D

MNR Risk Assessment Tool – March 2010

MNR RISK ASSESSMENT TOOL Mar 2010

I) Guiding Principles/ Planning Assumptions

This process is subjective and qualitative. However, decision-making should be as realistic as possible (i.e. avoid being overly conservative). Any public safety initiatives and/or measures present at the time of the assessment must be identified and included in the risk analysis. Public Safety initiatives should consider hazards produced as a result of water control structures and their operations. Natural hazards which are located on

Crown Land should not be included as hazards, except where the MNR is encouraging or licensing uses (e.g. trails).

When assessing sites where existing measures are in place, consider:

Physical barriers are intended to act as deterrents and are not designed to prevent access from those seeking to unlawfully gain access to an owner's property or controlled areas.

Physical barriers are not intended to address naturally occurring hazards: both water based (e.g. rapids, submerged boulders, etc.) and landforms (e.g. cliffs); that occur on lakes and rivers and at dam sites and waterpower facilities.

Recreational use of waterways (e.g. boating, swimming, etc.) is assumed to occur during periods of the year when the reservoir/river is ice free (i.e. does not occur when there is floating ice in the waterway).

Partially open water and cracked ice is part of the normal river/reservoir conditions from late fall through spring seasons and no special protective measures are required to address these hazards.

Illumination of signs and barriers is intended to come from the motorized vehicles and watercraft which may be operated outside of daylight hours or other periods of low visibility

Evaluation of public interaction must include interviews with the water control structure operators.

The upstream dangerous water zone is to be established using MNR and Transport Canada (TC) criteria and guidelines.

Risk Assessment must consider the difference between intentional and unintentional/accidental interactions with hazard areas.

Risk Assessment must be completed using a standard, formalized risk assessment process. Risk must be classified as Low, Medium, and High Risk.

LOW Risk - A LOW Risk would not require further reduction but reasonable and obvious measures should be implemented as appropriate.

MEDIUM Risk - A MEDIUM RISK determination means that the Ministry should evaluate all reasonable means to reduce risks as a 2nd priority.

HIGH Risk - A HIGH RISK determination requires the Ministry to take all reasonable measures to mitigate this risk as a 1st priority.

It must be recognized that residual risk may still occur for a particular interaction in spite of all best efforts to eliminate or mitigate an identified risk.

II) RISK ANALYSIS

Incident Likelihood (Probability)

Expected level of public interaction for the activity and associated hazards present (either known or estimated)

Level	Descriptor	Example Description
5	Almost Certain to Occur	is expected to occur in most circumstances
4	Likely	will probably occur in most circumstances
3	Possible	will occur at some time
2	Unlikely	might occur at some time
1	Rare	may occur only in exceptional circumstances

Incident Severity (Consequence)

Most likely outcome of the potential interaction that could reasonably be experienced as a result of dam operations or interaction with MNR facilities by a member of the public engaging in that activity

Level	Descriptor	Example Description
1	Insignificant	no 1st aid required
2	Minor	1st aid may be required (by non-EMS personnel)
3	Moderate	could result in medical treatment or rescue
4	Major	critical injury is possible (EMS services are required)
5	Catastrophic	fatality or permanent total disability is likely to result (drowning, severe trauma)

III) Risk Assessment

Classify the risk rating for the particular activity, according to Low, Medium or High Risk

RISK RATING			Incident Consequences				
			Insignificant	Minor	Moderate	Major	Catastrophic
			1	2	3	4	5
	Almost Certain to Occur	5	М	М	Н	H	Н
Incident Likelihood	Likely	4	L	М	Н	Н	Н
	Possible	3	L	М	М	Н	Н
	Unlikely	2	L	L	М	М	Н
	Rare	Rare 1		L	L	L	М

Legend:

Low Risk Medium Risk High Risk

To score a risk, use the matrix like a look-up table. Example: for Likelihood = 1 and Consequence = 5 --> Risk = Medium (bottom right corner) NOTE: OPG format with WESA/MOE wording

The Risk analysis process is conducted for all known activities and for each component of the facility/property. A summary table lists all risks for the site which can then be assessed for appropriate mitigation measures

The implementation of control measures is expected to reduce site specific risks. The measure chosen should target the specific hazard/public interaction using a phased approach

Reference Documents:

Draft Criteria Tables, WESA Inc., February 26, 2010 (adapted from MOE Drinking Water Systems Risk Assessment tools) Final Draft, Public Safety Measures Plan, Bala Falls Dams, WESA Inc., November 2009 Risk Assessment for Waterways Public Safety, Document No: DS-LP-PRO-007, Ontario Power Generation, Hydro, June 17, 2009 APPENDIX E

Transport Canada Point of No Return (PoNR) Calculations

Transport Canada Point of No Return Calculations

			Values
PoNR Q2 hw dez DV1 DV2	Point of no return Two Year flow return level (Q= flow) Water surface elevation above the weir or spillway Exclusion Zone Warning Zone - 3 times the exclusion zone Warning Zone - 2 times the exclusion zone	=	117 1.67
ddraw	3 x hw at Q2	=	5.01
fs Ww	# of YES + # of unknown (method2) Weir width	=	10 46

Method 1 - Point of No Return (dez1)

Used where waterflow spans the entire width of the river, and is not notched

PoNR=	Q2 hw@Q2	PoNR=	70.05988 m
dez1=	1/2PoNR	dez1=	35.02994 m

Method 2 - Drawdown distance (dez2)

Answer

1 Is the structure obscured or difficult to see from upstream (low head dam, bend in river, vegetation??)	1
2 Does the river constrict by more that 1/2 the river width within 5 times the river width upstream?	1
3 Do powered recreational vessels use the waterway?	1
4 Do unpowered vessels use the waterway?	1
5 Do commercial vessels use the waterway?	1
6 Are there entry points to the waterway (boat launch, portage route, parking lots) within 1 river width of the structure?	1
7 Is the flow such that a small vessel or person is likely to be drawn into the hazardous zone?	1
8 Is the prevailing wind in the direction of water flow?	0
9 Will impingement on the dam or passing over the dam likely result in capsize, injury or death?	1
10 Have any accident, near accidents, or incidents occurred at the site?	0
11 Do vessels use the area at night?	1
12 Are there any other hazards, obstructions or instream structures in the vicinity?	1
13 Is any part of the dam operation done remotely?	0
14 Is access to emergency rescue restricted (remote location, bank vegetation, steep slopes?)	0

dez2= ddraw x fs dez2= 50.1 m

Method 3 - Spillway Width (dez3)

4073-	10/10/	de73-	46	m
uezs=	V V VV	uezo=	40	

GREATEST DISTANCE = 50 m per Method 2 DISTANCE VARIES FROM 35-50m BOOM CURRENTLY ABOUT 35m FROM DAM