Ministry of
Forests, Lands and
Natural Resource Operations

BC DAM SAFETY ANNUAL REPORT 2010/2011

INTRODUCTION

The BC Dam Safety Annual Report summarizes the activities undertaken by the Provincial Dam Safety Program and reports dam owner compliance for the period April 2010 – March 2011 inclusive. Also provided is an update on the Rapid Dam Assessment last reported on in the October 2010 Report: *Response to Recommendations Contained in the Report: "Review of the Testalinden Dam Failure"*. The Dam Safety Program Annual Report is a commitment under Recommendation #12 of the October 2010 Response report.

British Columbia is one of four provinces in Canada with a formal dam safety program. There are approximately 1,900 dams in the province including some of the largest structures in Canada. These dams are regulated under the British Columbia Dam Safety Regulation with oversight by the Dam Safety Program, Ministry of Forests, Lands and Natural Resource Operations. The Dam Safety Section, under the Comptroller of Water Rights, is responsible for administration of the provincial dam safety program and regulation of major dams (9m or higher) throughout the province. The regional component of the program, for dams less than 9 m high, is delivered by the Regional Dam Safety Officers. Each Dam Safety Officer is responsible for a portfolio of dams. Support to the Dam Safety Program is provided by the Compliance and Enforcement Branch and other Ministry staff as well as partner agencies including Emergency Management BC and the Ministry of Energy and Mines.

In British Columbia, dam owners are responsible for inspection and maintenance of their dams. The Dam Safety Officers ensure that dam owners are aware of and in compliance with the BC Dam Safety Regulation by completing audits and providing education and awareness to dam owners and maintaining information on each of their dams in the Provincial Dam Registry. Dam Safety Officers also review and approve project plans for new dams, the rehabilitation of existing dams or the removal of a dam and respond to emergencies and situation call-outs. Each year, owners of the approximately 290 high and very high consequence dams are requested to return an Inspection Compliance Monitoring report to determine if dams in the province are being inspected and maintained as required.

HIGHLIGHTS AND PROGRAM MANAGEMENT INITIATIVES

1. The 12 recommendations in the July 2010 Deputy Solicitor General's Report included enhancement of some existing programs and some new initiatives. The following activities were completed following the October 2010 Response to the Deputy Solicitor General's Report and up to March 31, 2011. Some activities are ongoing into 2011/12 and will be reported on in the next Annual Report:
   - Rapid Dam Assessment (Recommendation 8) – The data reported in October 2010 has since been finalized and an updated table is provided in the Rapid Dam Assessment section below.
   - Dam Registry in E-Licensing (Recommendations 1 & 9) – As a result of the Rapid Dam Assessment, major updating of the Dam Registry was undertaken with the assistance of 6 auxiliary employees and regular staff. Actions included license cancellations, new licenses, license amendments, extensions, removal of cancelled/abandoned licenses and follow-up letters to dam owners. As committed to in response to Recommendation 1, an audit was recently completed on the Dam Registry and is reported in the Audit of Dam Registry section below. In the spring of 2010, a project was also undertaken to have information about every dam in the Dam Registry geo-referenced to Google Earth and iMap BC. The Google Earth tool is available through the Dam Safety Program website and the BC Dams link and is current to May 2011 (see Figure 1 for example).

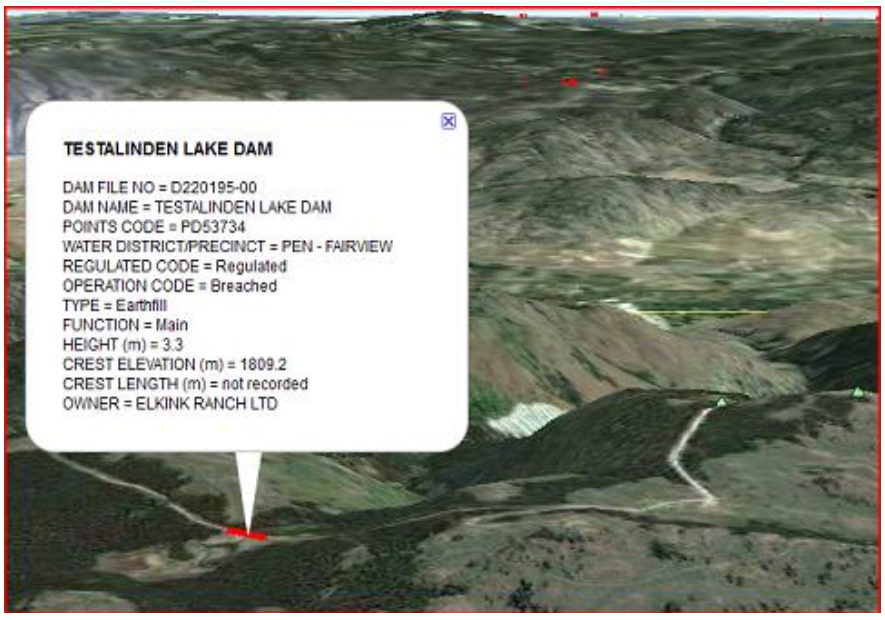


Figure 1. Testalinden Dam as viewed through on Google Earth BC Dams viewing tool.

   - BC Dam Safety Regulation (Recommendations 3 & 7) – A commitment was made to update the Dam Safety Regulation to incorporate best practices and a requirement for signage at dams. The regulation amendment was drafted and prepared for submission

in 2010/11. The Regulation amendment has since been approved and information related to the amendment is available on the Dam Safety Program website.

- Dam Incident Notification Process Improvements (Recommendations 4 & 5) – The requirement for signs on high and very high consequence dams located on crown land was included in the recently approved regulation amendment. The notification process for communication of dam incidents has been reconfirmed with Emergency Management BC and formal working relations have been established with Ministry Compliance & Enforcement staff.
- Signs for BC Government owned Dams – Prior to the end of March 2011, signs were made for all dams owned by the Province of BC (see Figure 2 for example) and installation of these signs is underway and will be completed by the end of 2011.

Figure 2. Signs have been made for all government owned dams on crown land to advise the public that it is a dam and the phone numbers to call should an issue with the dam be observed.

2. Education & Awareness
   - Dam Owners – 3 one-day Dam Owner Inspection and Maintenance Workshops were held in 2010 providing training to approximately 60 dam owners or their staff. This brings a total of approximately 580 dam owners that have been trained since 2001.
   - Stakeholder presentations – BC Cattleman's Association, Water Supply Association of BC, Emergency Preparedness Conference.
   - Dam Safety Officers - Rapid Dam Assessment (RDA) De-Brief Meeting, Osoyoos, November 1-3, 2010
   - Dam Safety Officers – 25th Annual Dam Safety Officer Community of Practice was held in conjunction with the Flood Hazard Management Community of Practice with over 60 Ministry staff participating across the two sessions. This is an opportunity to learn from

invited guest speakers and each other and to share experiences that are useful in the field.

- Compliance and Enforcement Officer Training – New to the Dam Safety Program, Dam Safety Officers provided training to Compliance and Enforcement Officers assisting with the Rapid Dam Assessment. More detailed training modules were subsequently prepared for training sessions being held early in 2011/12 so that Compliance and Enforcement Officers can provide ongoing support to the provincial Dam Safety Program.

3. Dam Owner Inspection Compliance Reporting – In 2003, the Victoria Dam Safety Section began formally tracking Dam Owner Inspection Compliance. All owners of High and Very High Consequence dams are required to annually report whether they have completed annual dam inspections and regular site surveillance as required under the Dam Safety Regulation. A project was initiated in September 2007 to improve inspection compliance reporting by dam owners. As a result, compliance reporting improved from 77% in 2006/2007 to 90% in 2008/2009. In 2009/10 it slipped to 87%, but in 2010/11 it improved to 93%. Details are provided in the Dam Owner Inspection Compliance section below.

4. Dam Project Reviews - Dam Safety Officers participate in the review and approval of project plans for new dams and dams undergoing rehabilitation or removal. Attachment 1 provides a summary of the projects reviewed in 2010/11 including 1 dam removal, 9 dam rehabilitations and 10 new dams.

5. Staffing of Dam Safety Officer Positions – All Regional Dam Safety Officer Positions are filled except Williams Lake where the Dam Safety Officer retired in March 2009. Staff from the Kamloops office covered the vacancy in 2010/2011. In Penticton and Nanaimo, two existing part-time Dam Safety Officers have increased the amount of time that they spend on dam safety (0.7 and 0.2 FTE's respectively). Following successful contributions from Ministry Compliance and Enforcement staff during the Rapid Dam Assessment, additional training is being provided to increase their support to the Dam Safety Program in the areas of Compliance and Emergency Response.

6. E-Licensing/Dam Registry Implementation – Change Requests for the Dam Registry are complete. Testing & training are ongoing. Additional changes to enhance E-Licensing have been identified for future work and have been prioritized with other E-Licensing initiatives.

7. Dam Audit Program – The Dam Audit Program requires Dam Safety Officers to meet with dam owners once every 5 years for high and very high consequence dams and once every 10 years for low consequence dams. Each year a target is set for the number of audits to be completed. The target was met in 2009/10 but not in 2010/11 due to the substantial workload created by the Rapid Dam Assessment. The shortfall will be addressed by the Dam Safety Officers completing extra audits over the next one to two years. Details are provided in the Dam Audit Program section below.

8. Dam Incidents, Failures and Construction – During 2010/11, Dam Safety Officers responded to 5 dam incidents, 1 flood incident involving a dam and 1 dam failure (Testalinden Dam). Details are provided in the Incidents and Failures section below.

9. Probable Maximum Flood Estimator (2010) – Agriculture and Agri-Food Canada funded a study to assist consultants and dam owners in estimating the Probable Maximum Flow potential at dam sites. The report is now available on the Dam Safety Program website or from the Dam Safety Officers for use by dam owners and their consulting engineers: Probable Maximum Flood Estimator for British Columbia

10. Outreach and Professional Development:
    - Canadian Dam Association National Conference (2010) – Will Jolley, Head, Dam Safety (Victoria) presented a paper "How BC's Dam Safety Program Evolved from the Cannon Creek Dam Failure, 1995".
    - Canadian Dam Association (CDA) Committees – Will Jolley, Head, Dam Safety (Victoria) continued as a member of the CDA Regulators' Committee & Mike Noseworthy, Dam Safety Officer (Penticton) became a member of the new Small Dams Committee.

PROGRAM ACTIVITIES AND INITIATIVES

Rapid Dam Assessment

As previously reported in the October 2010 Report: *Response to Recommendations Contained in the Report: "Review of the Testalinden Dam Failure"*, immediately following the Testalinden Dam failure a Rapid Dam Assessment project was undertaken to consider the status of each dam in the province and visit those dams that had not recently been visited. The following updates the results of the Rapid Dam Assessment and Table 1 in the October 2010 report.

Rapid Dam Assessment (RDA) - Recommendation #8, Solicitor General Report, July 2010 UPDATE to October 2010

Recommendation #8: *The Ministry of Environment should complete its Rapid Dam Assessment Project and update its consequence rating system accordingly to determine priority areas in need of attention. The Ministry should develop an action plan to address those areas needing immediate attention and schedule appropriate follow up based on overall findings.*

Of the 1900 dams currently in the Dam Registry, 1174 were included in the Rapid Dam Assessment. Issues with four dams that required immediate action by the dam owner have all been addressed. An additional 473 dams were identified as requiring less urgent follow-up, this work will continue into the 2011/12 fiscal year. Of the remaining

726 dams, dam owners were either safety program compliant or the dam otherwise was known not present a credible risk of failure. The Rapid Dam Assessment program provided the opportunity to update the Dam Registry improving government's ability to accurately report on and administer the dam safety program.

Summary of Rapid Dam Assessment (RDA) Program, June – September 2010
Updated December 20, 2010

Category	Number of dams	Status of Dams from the RDA	
		Status #1 Immediate Attention	**Status #2** Follow-up Action
RDA June through September 2010	**1174**	4[1]	473
Not Included in the RDA Status Confirmed by:	726		
• Dam Owner[2]	257		
• DSO Audit [3]	348		
• DSO Observation [4]	121		
Total Dams Assessed to date	**1900**		
BC Provincial Dam Registry Total	**1900**		

Photo: During the Rapid Dam Assessment in 2010, Short Creek Dam spillway was discovered intentionally blocked. The owner was sent a letter directing them to clear the spillway. Photo credit: Brian Nuttall.

[1] Dam Owners were contacted right away – remedial action is complete or underway.

[2] Dam owners with a known compliant Dam Safety Program, e.g. BC Hydro, Ducks Unlimited, GVRD, etc.

[3] Dam was assessed within the past 5 years by a Dam Safety Officer (DSO) under the Dam Safety Audit Program.

[4] Based on the Dam Safety Officers (DSO) observation, judgment and personal knowledge, these dams do not present a credible risk of failure at this time.

Audit of Dam Registry

The Dam Registry within E-Licensing contains numerous fields that must be completed by staff when a new dam is licensed, when new information is received about an existing dam, or to complete missing information about an existing dam. As a result of E-Licensing being newly implemented and with the Rapid Dam Assessment generating substantial new information there was a large backlog needing entry into the Dam Registry. The Dam Safety Officers supported by a number of temporary staff undertook to add the new information into the registry. As committed to in the Response to the Deputy Solicitor General's Report (October

2010) Recommendation #1 an audit of the database has been completed to evaluate progress with data entry. An assessment of 6 key parameters was made, comparing the number of data fields completed in June 2010 and June 2011 (Figure 3). In all cases, there has been an increase in the number of data fields completed but clearly additional data entry is required to ensure that the dam registry contains the necessary information. Populating the new database will continue to be a focus for Dam Safety Officers over the next couple of years to ensure that it is brought up-to-date and contains all of the required information.

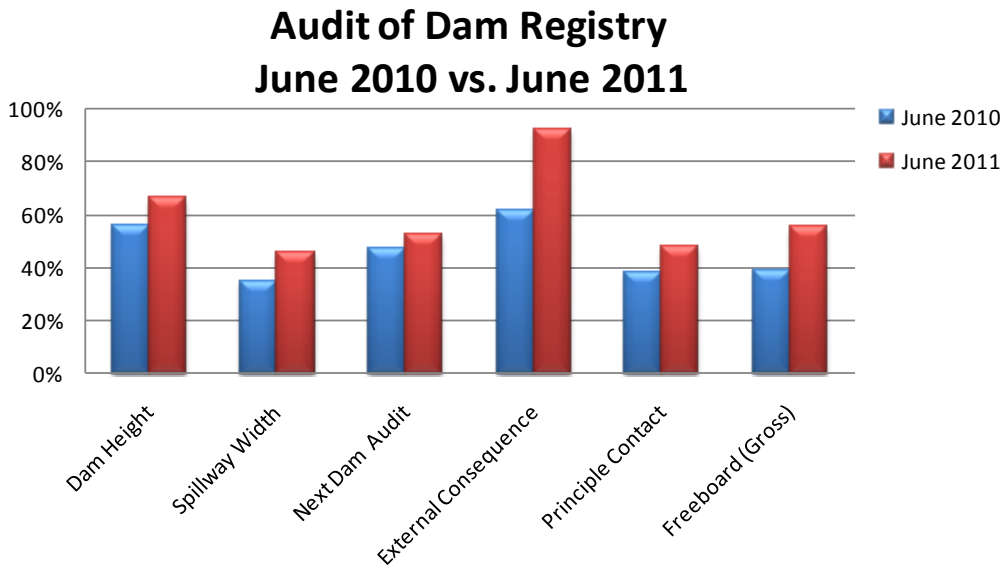
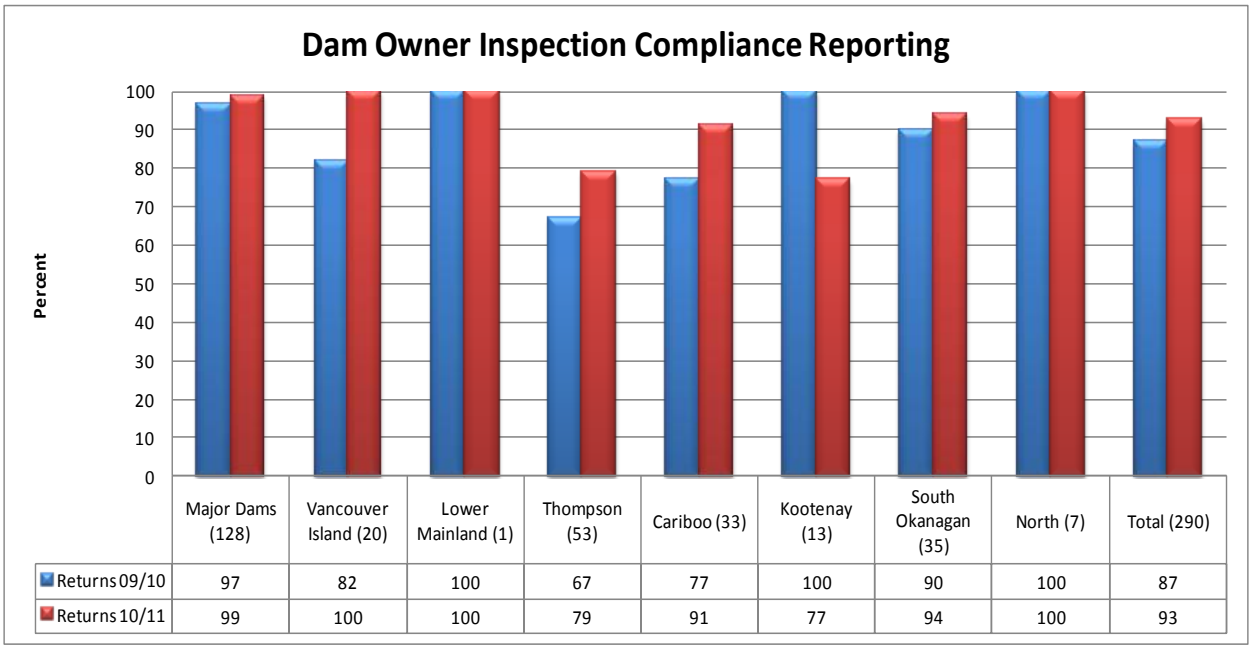


Figure 3. Six key dam safety parameters were audited within the Dam Registry to assess the utilization of the database by the Dam Safety Officers.

Dam Owner Inspection Compliance

As described in the Highlights section above, in 2003 the Victoria Dam Safety Section began formally tracking Dam Owner Inspection Compliance. As of April 2011, the Ministry reported a 93% return rate in compliance reporting by dam owners, up from 87% last year (Figure 4). Of the 93% that returned their Inspection Compliance Form, 97% indicated that they had completed the required inspections. Follow-up will be done by Dam Safety Officers and Compliance and Enforcement staff with those dam owners that did not submit their Inspection Compliance Form or that did not complete the required inspections. The changes in compliance reporting between years can be attributed largely to the effort made by Ministry staff in directly contacting individual dam owners to ensure that they return their compliance report. A recent additional question on the Dam Owner Inspection Compliance form asks dam owners about the status of their Dam Safety Review. Responses from dam owners have been

inconsistent and therefore difficult to interpret. In the next Dam Owner Inspection Compliance survey, this question will be crafted more clearly for dam owners to understand and respond appropriately.



	Major Dams (128)	Vancouver Island (20)	Lower Mainland (1)	Thompson (53)	Cariboo (33)	Kootenay (13)	South Okanagan (35)	North (7)	Total (290)
Returns 09/10	97	82	100	67	77	100	90	100	87
Returns 10/11	99	100	100	79	91	77	94	100	93

Figure 4. Percent of dam owners returning the Dam Owner Inspection Compliance reports in 2009/10 and 2010/11. The numbers in brackets are the number of High and Very High Consequence dams in that region.

Dam Audit Program

Audits are conducted with dam owners of very high and high consequence dams once every 5 years and low consequence dams every 10 years. Very low consequence dams are not audited. During an audit, Dam Safety Officers review the files maintained by the dam owner and visit the dam with the owner. This is an opportunity to ensure that the dam owner is aware of and meeting their obligations with respect to record keeping and dam maintenance and repair, to share expertise with the dam owner and to identify possible deficiencies in a dam. Where deficiencies are identified, follow-up is required by the Dam Safety Officer or their designate to ensure that the deficiencies are corrected. Targets are set each year for the number of dam audits that each Dam Safety Officer will undertake (Figure 5). In 2010/11 the provincial audit target of 113 was not met since staff were focused on completing the Rapid Dam Assessment and required follow-up (Figure 6). While several regions were unable to meet their audit targets, Vancouver Island, the Kootenays and the Okanagan met or exceeded their targets (Figures 5).

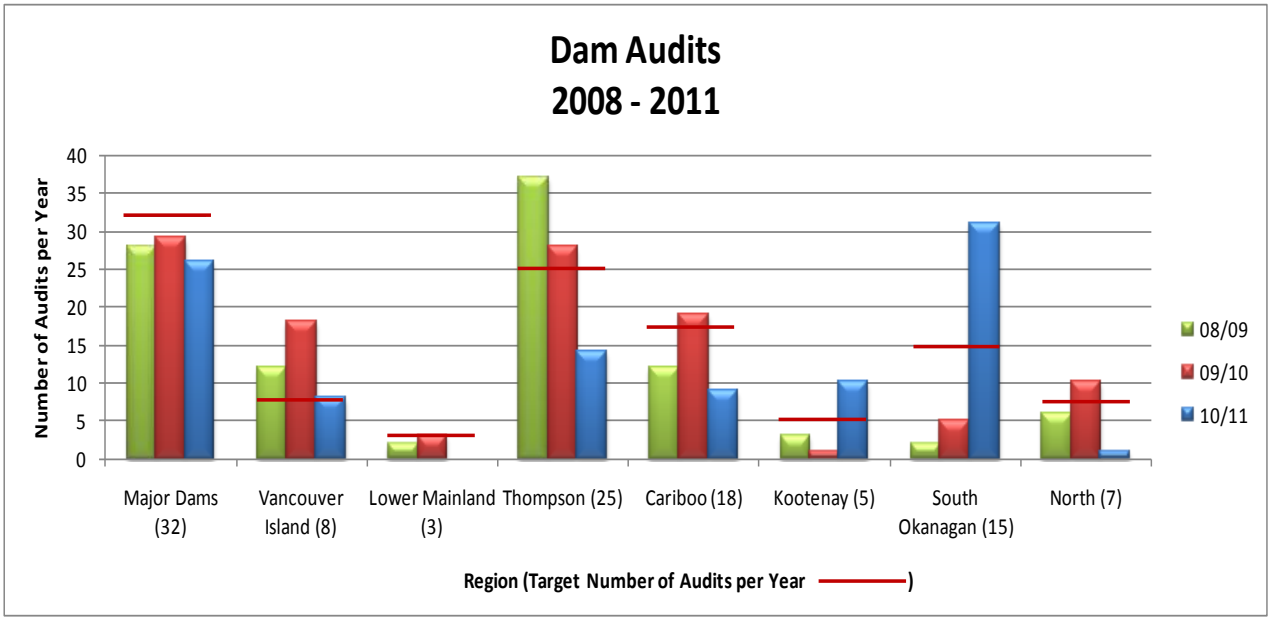


Figure 5. Number of audits completed by Dam Safety Officers in each region over three years compared to the target.

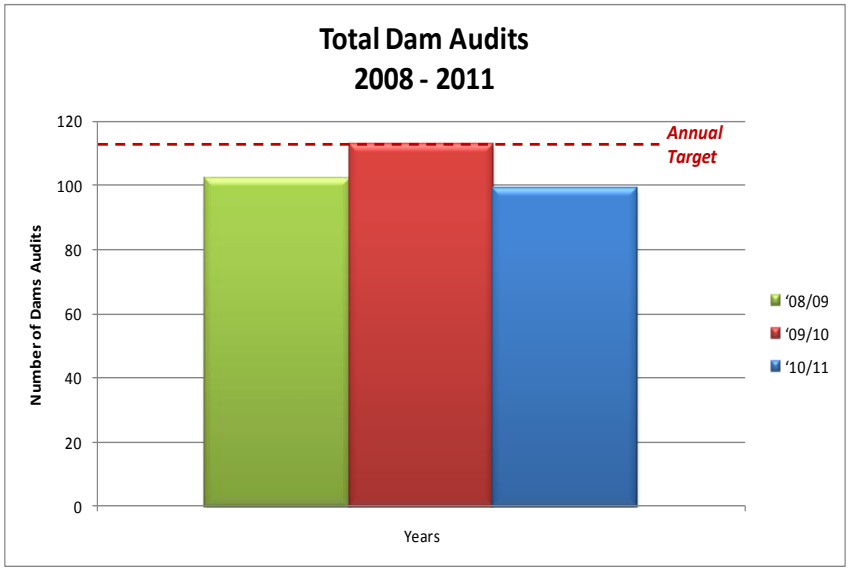


Figure 6. Total number of dams audited by the Dam Safety Program compared to the Annual Target of 113 dams.

Incidents and Failures

1. **Dam Incidents**
   a. Goertzen Pond Dam - During the initial Rapid Dam Assessment the reservoir water level was found to be near cresting. The owner was immediately informed and diversion

pumping was halted. The owner was ordered to reduce the level by a minimum of 3 feet. Deficiencies identified at the dam site are expected to be rectified by the dam owner within 2011.

b. Grafton Lake Dam – A beaver dam of logs and mud was completely blocking the spillway. This deficiency is common in spillways and possible failure modes include overtopping and erosion of embankment. The beaver dam was gradually removed by the owner and the owner conducts weekly inspections to ensure that the spillway remains clear.
c. Eagle Rock Reservoir – The spillway was found blocked by earth-fill. This deficiency could result in failure through overtopping and erosion of embankment. The owner immediately began lowering the reservoir through the spillway in a controlled manner. The spillway is now clear of all obstructions and the freeboard has been re-established.
d. Allan Springs Dam – The spillway was blocked with no freeboard remaining in the reservoir. Failure modes could include overtopping and embankment washout. The owner removed vegetation and lowered the spillway to increase freeboard.
e. John Hart Dam – Following a drilling investigation program in August 2010, BC Hydro determined that a moderate earthquake could lead to failure of the upstream slope of the North Earthfill Dam. Under an Interim Risk Management Plan; the reservoir level was reduced as a risk mitigation measure. A jet grouting program is planned for June 2011 to mitigate the problem until a permanent rehabilitation is completed.

2. **Flood Incidents.** These are incidents where a Dam Safety Officer is called upon to investigate a flood that was reported to be the result of a problem or mis-operation at a dam, dam conditions during freshet flooding (dam assessments), beaver dam incident or failure, or another problem not caused by the deficiency of a dam.
   a. Meager Creek Landslide Dam – A massive landslide on August 6, 2010 caused the formation of a landslide dam across the Meager Creek in the upper watershed of the Lillooet River, potentially threatening the town of Pemberton. Victoria Dam Safety staff worked with Kerr Wood Leidal Consultants Limited to determine if the ensuing dam failure would impact the town of Pemberton. An Evacuation Alert was posted by Emergency Management BC. Fortunately the breach flow was less than expected and an evacuation was not required.

3. **Dam Failures**

   a. Testalinden Dam – On June 13, 2010, a privately-owned earthen dam on a man-made reservoir on Testalinden Creek failed, causing a debris and mud torrent that impacted a number of homes and an agricultural area eight kilometres south of Oliver, B.C. The cause of failure was likely overtopping of the embankment due to an inadequate sized spillway and insufficient freeboard. The breach has since been stabilized by the dam owner. This unfortunate event was the driver for immediate action to further improve dam safety in British Columbia and shaped much of the Dam Safety Program activities for the remainder of the year. Immediately following the Testalinden Dam breach, staff from the Ministry of Environment conducted a review of the Provincial Dam Safety

Program and initiated a Rapid Dam Assessment for the majority of dams in the province. In July 2010, the Deputy Solicitor General completed a *Review of the Testalinden Dam Failure* and provided 12 recommendations for improving dam safety in BC, all of which have been and continue to be addressed. A progress report was provided in October 2010: *Response to Recommendations Contained in the Report: "Review of the Testalinden Dam Failure".* The Dam Safety Annual Report will continue to provide updates as appropriate.

CONCLUSION

Following the Testalinden Dam failure, government placed a reemphasis and priority on dam safety. As recommended by the Deputy Solicitor General, a number of improvements to the Provincial Dam Safety Program have been and continue to be made. These include completion of the Rapid Dam Assessment, prioritization and initiation of follow-up with owners whose dams were identified as requiring non-urgent action, the BC Dam Safety Regulation amendment, ongoing updating of the Dam Registry and greater access to information by dam owners, local governments and the public with tools such as iMap and Google Earth. Additional training has been prepared and is being delivered by Dam Safety Officers to both government staff and dam owners and their staff to update them on program and regulatory changes and bring focus to the responsibilities of dam owners. The additional support being provided across the province by Compliance and Enforcement staff enhances the Dam Safety Program in British Columbia.

Additional work in 2011/12 is required in Dam Owner Compliance Monitoring and specifically the question sent to dam owners related to Dam Safety Reviews. As mentioned above, in 2010/11 the responses to this question were so variable that it was clear that there is confusion over what is meant by the question. This will be clarified in the 2011/12 Dam Owner Compliance Monitoring form to improve reporting in the future; if necessary follow-up with dam owners will occur to ensure that Dam Safety Reviews are being completed by owners of High and Very High Consequence dams. To assist dam owners in hiring qualified consultants to complete the Dam Safety Reviews, the Ministry has contacted the Association of Professional Engineers and Geoscientists to assist with setting qualifications. In addition, the guidelines for undertaking Dam Safety Reviews will be improved in 2011/12. While improvements in data entry were noted in the audit of key fields within the Dam Registry, this is clearly an area requiring ongoing effort by Dam Safety Officers to ensure a robust database and accurate information in iMap and Google Earth. Also planned for 2011/12 is updating of the Dam Safety Templates: Operation, Maintenance and Surveillance Plan and Emergency Preparedness Plan.

ATTACHMENT 1

Summary of Project Review and Construction for Dams in BC 2010/11

(Complied May 2011)

Region	New Dams[1]		Rehabilitations		Removals	
	Project Review	Construction	Project Review	Construction	Project Review	Construction
Major Dams	• Vance Creek • Black Mtn Res	• Vance Creek	• Buck Lake • Ruskin • Ophir • Brilliant	• John Hart • Ruskin • Ocean Falls • Ophir • Cheakamus		
Vancouver Island						• Prevost Lake[2]
Lower Mainland	• Tyson Lake • Stl'ixwim	• Upper Stave • Lamont Cr • Stokke Cr • Tipella Cr • Fire Cr • Douglas Cr • Tyson Lk				
Interior		• Swatter Lake	• Mamit Lake • Parke Lk			
South Okanagan			• Glenrosa • King Edward	• Glenrosa • King Edward		
Kootenay						
Northern	• Stanley Lake	• Stanley Lake (2011)				
Cariboo	• Tingley Lk		• Toosey • Rough Lake	• Beechers • Lincoln Lk		
Total	**6**	**10**	**10**	**9**	**0**	**0**

Compiled by Victoria Dam Safety with information from the Regional Dam Safety Officers:

John Baldwin	Nanaimo	Chelton Van Gelovan	Prince George, Skeena
Steve Rowe	Penticton	Darren DeFord	Prince George, Omineca-Peace
Mike Noseworthy	Penticton	Mike Bristol	Surrey
Brian Nuttall	Kamloops	Monty Miedreich	Nelson
Brian Nuttall (2010)	Williams Lake		

[1] Includes raising a dam to create new storage.
[2] Removed without authorization in 2009.