



Dam Safety Management Program



February 2013

Table of Contents

Section	Title	Page
	Table of Contents	i
1	Dam Information	1
2	Dam Safety	5
3	Public Safety Around Dams	6
4	Dam Operations, Maintenance and Surveillance	7
5	Dam Inspection Data Review	9
6	Dam Engineering & Operations Staff Training	10
7	Emergency Preparedness	12
8	Activation and Initial Response	13
Appendices		
A1	Background Reference Information	
A2	Background File Information	
B	Dam Information	
C1	Map of dam locations within Nanaimo city boundary	
C2	Map of Jump Creek Dam and South Fork Dam	
C3	Map of Lower Chase River Dam, Middle Chase River Dam, Upper Chase River Dam, Reservoir #1 Dam and Westwood Lake Dam	
C4	Map of Harewood Lake Dam and Witchcraft Lake Dam	
D	Jump Creek Dam Photographs	
	South Fork Dam Photographs	
	Reservoir #1 Dam Photographs	
	Westwood Lake Dam Photographs	
	Upper Chase River Dam Photographs	
	Harewood Lake Dam Photographs	
	Witchcraft Lake Dam Photographs	
	Middle Chase River Dam Photographs	
	Lower Chase River Dam Photographs	
E	City of Nanaimo Dam Safety Policy October 2009	
F	Provincial Dam Safety Officer Contact List	
G	BC Dam Safety Regulation 163/2011	
H	BC Dam Failure Consequence Classification Guideline 108/2011	
I	BC Dam Safety – Dam Classification Correspondence	

1.0 Dam Information

The City's Water Resources and Water Supply Operations staff are responsible for managing and maintaining nine (9) dams. Most of these dams are located in the south west end of the City, other than Jump Creek and South Fork dams which are located approximately 27km and 21km south west the City respectively.

- Jump Creek dam
- South Fork dam
- Reservoir No.1 dam
- Westwood Lake dam
- Upper Chase River dam
- Middle Chase River dam
- Lower Chase River dam
- (Old) Harewood Lake dam
- Wichcraft (McGarrigle) Lake dam

Jump Creek, South Fork and Reservoir #1 dams are part of the City's potable water supply system. All the remaining dams are a legacy of early collieries or power generating operations. The water bodies created by the rest of these dams are within the City of Nanaimo or the Regional District of Nanaimo park areas and are used for recreational purposes.

1.1 **Jump Creek Dam**

Jump Creek Dam is located approximately 27 km southwest of Nanaimo on Jump Creek, a tributary to the South Nanaimo River, (see Appendix C2). Jump Creek Dam was constructed in 1974 and consists of two zoned earthfill embankments. The dams have been modified in several stages including the addition of flap gates to the spillway in 1987 and more recent modifications in 2000 that include a spillway entrance channel groin, new crest arrangements, modifications to the low level outlet and a new emergency overflow spillway which replaced the fuse plug spillway in the saddle dam. The main dam is 464m long, 25m high and comprised of a central low permeability till core together with upstream and downstream sand and gravel shell zones. The upstream face slopes at 2.5H:1V (horizontal:vertical) and is protected with riprap. The downstream face also slopes at 2.5H:1V and is unprotected.

The main service spillway located near the right abutment of the main dam includes two 2.4m high by 7.5m wide steel flap gates separated by a single pier which supports an access bridge. The spillway chute descends down the right hand groin of the dam and terminates in a plunge pool. The saddle dam is approximately 154m long and 6.7m high.

The low level outlet within the main embankment consists of an inclined sluice gate on the upstream face, a transition section, a reinforced concrete box culvert at the base of the dam, a vacuum break system, and an impact-type energy dissipater at the downstream end of the culvert. The culvert was constructed with two external collars to control seepage along the outside of the walls of the conduit. The upper transition section of the low level outlet which experienced severe cavitation damage was lined with steel in 1988.

1.2 South Fork Dam

The South Fork Dam is a concrete arch structure constructed in 1931 for water supply to the City of Nanaimo. The dam is situated in a steep bedrock canyon and is 25.6m high and 50.6m long. The dam is a variable radius non-reinforced concrete arch structure that has not been structurally modified since construction. The outer radius is 29.7m at the crest and 21.5m at its base. The thickness of the arch increases from 0.9m at the crest to 2.1m at its base. Horizontal construction lift joints are at about 1.5m spacing and a vertical pressure grout joint is located at the centerline of the dam. The dam is located on the Nanaimo River approximately 4 km downstream of the confluence of Jump Creek and, therefore, downstream of the Jump Creek Dam (see Appendix C2).

1.3 Reservoir No.1

Reservoir No. 1 Dam is used to balance raw water that is piped from South Fork dam located 21km away from this site and is an integral component of the City's water distribution network. The dam location is shown in Appendices C1 and C3. The reservoir is concrete lined and retained by the No. 1 dam. The dam is a concrete gravity structure originally built about 1910. It is 5.9m high and 40m long with a near vertical upstream face and a downstream face sloping at about 0.45H:1V. Nominal steel reinforcement is embedded in both faces. The dam was substantially remediated in 1996, including a new reinforced dam crest (utilized as a high strength beam) and installation of 21 -16mm diameter Dywidag threadbar anchors grouted into bedrock. The dam is situated in the old Chase River channel and is founded on bedrock with bedrock abutments. The right abutment is a 10m high subvertical bedrock face comprised of friable siltstone dipping into the abutment at about 10 degrees. The spillway is a 2.8m wide broad crested weir situated within the right flank of the dam; the sill is 1.2m below the dam crest. The spillway chute acts as an energy dissipater with a series of steps down the face of the dam. The capacity of the spillway has been estimated at approximately 6.5 m³/s at the onset of overtopping.

This dam's reservoir will no longer be used to store potable water for the City's drinking water after 2015.

1.4 Westwood Lake Dam

The Westwood Lake Dam (see Appendices C1 and C3) is comprised of a main dam and saddle dam. The main dam, first constructed in 1907, is an earthfill structure about 12m high and over 100m long. Although no construction records exist of the original structure, limited investigations indicate the dam has a puddled clay core with loose sandy silt fill forming the upstream and downstream shells. The upstream face is completed with a concrete face and is sloped at 1.6H:1V. Rehabilitation works in 1978 and 1980 included installation of a seepage collection and filter system, as well as backfilling of the low level outlet pipes through the dam. A seismic upgrade was also completed in 2007 (see construction report). The saddle dam was re-constructed in 1992. The original dam was stripped and the downstream core removed to expose adequate foundation and core. A compacted sand and gravel downstream shell and cap were placed over the old core and the upstream face was upgraded with cobble and boulder erosion protection. The spillway is comprised of an excavated trapezoidal outlet channel situated at the northwest end of the lake some distance from the dams, as shown on Figure 5. A concrete sill has been established down the channel as noted below. The spillway capacity was evaluated in 2004 by Water Management Consultants at 40 m³/s.

1.5 Upper Chase River Dam

The Upper Chase River Dam is the furthest upstream in a series of cascading dams on the Chase River (see Appendices C1 and C3). The Upper Chase River Dam was constructed about 1911 and currently diverts the Chase River around Reservoir No. 1. The Upper Chase River Dam is comprised of two sections. The right section is a reinforced concrete upstream retaining wall (buttressed on the upstream side) and a downstream supporting earthfill embankment. This structure was noted to be 5 to 6m high and 64m long. The left section is a low earthfill embankment about 2.5m high and 33m long and is reported to only retain about 0.3m above the spillway invert. Together, these structures impound a small reservoir of about 30,000 m³ of water. The spillway is located to the left of the dam and includes a free overflow rectangular concrete flume which discharges into two corrugated steel pipe culverts below Nanaimo Lakes Road. A study and conceptual design was done in 2011 for improvements necessary for upgrading this dam's spillway. A seismic hazard assessment was completed in 2005 for this dam.

1.6 Middle Chase River Dam

The Middle Chase River Dam (see Appendices C1 and C3) was originally constructed in 1910 and is comprised of a thin upstream concrete core supported by earthfill shells situated both upstream and downstream of the core. The dam is about 50m long and 12.5m in high. The concrete core is 0.6m thick and was raised about 0.3m in 1980. The OMS manual indicates the upstream shell has a slope of 1.5V:1H and likely consists of rockfill. The downstream shell has a nominal 2H:1V slope that was rebuilt in 1980. During rehabilitation in 1980, a gravel filter drain was installed to intercept seepage. Concentrated seepage was observed in 1992 and an additional drain was installed near the right abutment. A V-notch weir located at the downstream toe is used to monitor seepage. The spillway is located on the left abutment and is separated from the dam by a concrete wall. The spillway is a free-overflow rectangular concrete structure that discharges over bedrock and into an unlined channel situated along the left groin of the dam. The OMS manual suggests the spillway capacity is approximately 60 m³/s with lake level at the dam crest (no freeboard). In 2002 the total spillway capacity required to accommodate the probable maximum flood (PMF) was estimated to be about 192 m³/s. The 2010 seismic study indicated that this dam would fail at a relatively small seismic event. The 2012 inundation study indicated that the dam is an extreme consequence, therefore needs to withstand the 1:10,000 seismic and the PMF. The dam is deficient in both cases.

1.7 Lower Chase River Dam

The Lower Chase River Dam is the lowest of the series of dams on the Chase River cascade system (see Appendices C1 and C3). The Lower Chase River Dam was constructed in 1910 and is comprised of a thin upstream concrete core supported by upstream and downstream earthfill shells. The concrete core forms the upstream face at normal lake level and is 0.3m thick at the crest, but thickens to 1.2m thickness at a depth of 0.6m. The OMS manual indicates the upstream shell has a slope of 2H:1V but the nature of the fill is uncertain. The downstream shell, comprised of loose sand and gravel over rockfill, has a nominal slope of 1.5H:1V and has experienced some minor slumping and settlements. The dam is about 77m long and 23.3m high with about a 10m wide crest.

In 1980, a gravel filter drain was installed below the downstream shell to intercept seepage through the dam and abutments. Construction included a stabilization berm for the lower downstream slope and backfilling of the low level outlet pipes through the dam. In 1981, a washout or erosion incident was discovered on the left abutment (photographs are included in the 2003 Dam Safety Review report). A

more recent V-notch weir located at the downstream toe is used for monitoring seepage. The spillway is located on the right abutment and is separated from the dam by a concrete wall which forms the right side of the spillway. Upstream the channel is split and converges to a single channel downstream. The spillway is a free-overflow structure that discharges downstream over a steep bedrock slope. Figure 8 of the OMS manual indicates that the spillway capacity is approximately 35 m³/s with lake level at the dam crest (no freeboard). In 2002 the total spillway capacity required to accommodate the probable maximum flood (PMF) was estimated to be about 198 m³/s. The 2010 seismic study indicated that this dam would fail, due to cascade failure of the Middle Chase, at a relatively small seismic event. The 2012 inundation study indicated that the dam is an extreme consequence, therefore needs to withstand the 1:10,000 seismic and the PMF. The dam is deficient in both cases.

1.8 (Old) Harewood Lake Dam

The (old) Harewood Dam is located to the southeast of the Chase River system and discharges into the Chase River downstream of the Lower Chase River Dam (see Appendices C1 and C4). The dam is a concrete gravity structure constructed about 1911 for the coal mining industry in the City. The dam is about 34m long, approximately 4m high, with a crest width of 2.9m. It incorporates a vertical upstream face and a backslope of 72 degrees. A shallow sloping bench approximately 11.7m wide extends downstream from the concrete dam to a 1.9m high rockwall. A low level outlet is set into this wall and the bench appears to provide backfill over the outlet. The low level outlet pipes are capped with the upper outlet containing a small valve for fisheries purposes. It is understood that the outlet was once controlled by an upstream sluice gate, but that this is not functioning. The gate stem was noted to be bent and distorted and is not operable. A two bay spillway is incorporated into the crest of the dam near the right abutment. The inlet bays measure approximately 1.2m wide and 1.3m high and are separated by a centre wall 0.6m thick. Stoplogs, which had been fastened into the base of the bays, have been permanently removed. Discharge through the spillway is contained within a concrete chute measuring 1.36m wide, 10.6m long and 0.6m wall height. Beyond the chute, a small discharge channel can be seen. Information regarding the PMF and capacity of the spillway has not been determined.

1.9 Witchcraft (McGarrigle) Lake Dam

The location of Witchcraft Lake Dam is shown in Appendices C1 and C4. The Witchcraft Lake Dam is an old timber crib structure constructed about 1930 used to store water which was released to Westwood Lake, whereby hydro electricity was generated. The facility was apparently abandoned about 1950 and subsequently a breach developed. Although difficult to assess on the ground due to the fairly mature vegetation growing on and around the dam, it is about 50m long, approximately 5m high with a crest width of 3m to 4m where it remains intact.

2.0 Dam Safety

As a responsible dam owner the City of Nanaimo is committed to adhering to the *BC Dam Safety Regulations 44/2000* (including amendments *B.C. Reg. 163/2011* dated November 30, 2011) and following recommended best practices of the *Canadian Dam Association Dam Safety Guidelines 2007*.

The City's dams have the following dam failure consequence classification rating as stipulated by the BC Provincial Dam Safety branch.

Dam	Dam Safety Branch dam number	Current dam failure consequence classification rating
Jump Creek (main dam) Jump Creek (saddle dam)	D-720005-01 D-720005-02	Very High
South Fork	D-720007-00	Very High
Reservoir No.1	D-720121-00	High
Westwood Lake (main dam) Westwood Lake (saddle dam)	D-720003-01	High Significant
Upper Chase River	D-720122-00	Significant
Middle Chase River	D-720001-00	Extreme Risk Level 1
Lower Chase River	D-720002-00	Extreme Risk Level 1
Harewood Lake	D-720110-00	Low
Witchcraft Lake	D-720147-00	Low

As per the *British Columbia Dam Safety Regulations 44/2000* (including amendments 163/2011) the City performs Dam Safety Reviews at the suggested time lines;

Dam Class	Frequency
Extreme	Every 7 years
Very High	Every 10 years
High	Every 10 years
Significant	Every 10 years
Low	(note 1)
Note 1: Dam Safety Review (DSR) not required, however consequences of failure should be reviewed periodically since they may change with downstream development. Also if the classification increases a DSR is required at that time.	

Furthermore the City also conducts Formal Annual Dam Safety Inspections on all nine of the City dams and a database of all issues raised from these formal annual inspections is maintained and updated from time to time.

Both the Dam Safety Reviews and the Formal Annual Dam Safety Inspections should be undertaken by a Professional Engineer registered to practice in British Columbia.

In addition to the Dam Safety Reviews and Formal Annual Dam Safety Inspections the City undertakes routine inspections of all dams (see section on Dam Operations, Maintenance and Surveillance).

3.0 Public Safety Around Dams

The City endeavours to ensure the safety of the general public around its dams and facilities.

In the watershed the two drinking water reservoir dams, namely Jump Creek dam and South Fork dam, are located in private property owned by Islands Timberlands. Public access to the watershed property is restricted and controlled by locked gates. In addition Island Timberlands have a security patrol that operate seven days a week to watch over the daily forestry operations within their property.

At Reservoir No.1, the City's other drinking water reservoir, the dam and reservoir is entirely fenced off and the gated access is restricted to City staff only. Furthermore there is a presence at the reservoir five business days a week as City Parks and Recreation Department crews utilize the area for operational purposes.

The remaining six City dams are all located on City owned Park land that is utilised by the public for recreational purposes. Where reasonably practicable, safety measures are taken to ensure that the public are safe around dams.

4.0 Dam Operations, Maintenance and Surveillance

All of the City's dams have Operations, Maintenance and Surveillance (OMS) Manuals. Copies of these documents are located in Public Works, the Engineering library in the Service and Resource Centre and electronically.

Typically these OMS manuals include the following information; dam descriptions, electrical and mechanical equipment operation documents, reservoir operation levels, emergency planning and contact information, original construction drawings (if available), flood inundation mapping (if available), photographs, dam safety correspondence, inspection report forms, a copy of the water licence (for drinking water reservoir dams only), remedial works drawings and Islands Timberlands Emergency Preparedness and Response Plan (for watershed dams only).

4.1 **Maintenance**

The City Operations staff have maintenance programs for every dam that assists in keeping the integrity of each dam structure.

- Concrete structures are periodically cleaned and sealing of cracks and open joints completed.
- Embankment structures have vegetation removed (where possible), riprap replaced and drift wood removed and disposed of.
- Steel structures are cleaned and painted to prevent corrosion and mechanical fittings checked.
- Spillway structures and energy dissipaters are kept free of all debris and checked for cavitations.
- Penstocks, tunnels and low level outlets are inspected and repaired as necessary.
- Infrastructure road access is maintained and unsurfaced roads graded, snow removed (if possible), drainage culverts cleaned and watershed access bridges inspected.
- Instrumentation and telemetry electrical supply and manual gauges are routinely inspected and equipment replaced as needed.

4.2 **Surveillance**

Routine inspections of all the City's dams are an integral part of the City's dam operations. Details of all inspections are recorded, photographed and reviewed on a regular basis to identify any changes to the dam infrastructure. City staff follow the *Dam Safety Guidelines, Inspection and Maintenance of Dams* (produced by the British Columbia Provisional Dam Safety Branch Version 2, March 2011) as well as the dam safety regulations as the minimum benchmark for dam safety operations.

The City's Water Supply Operations staff (Watershed Inspectors) routinely inspect the City's dams at the following intervals:

Dam	Inspection Interval
Jump Creek	Weekly
South Fork	Weekly
Reservoir #1	Monthly
Westwood Lake	Weekly
Upper Chase River	Monthly
Middle Chase River	Weekly
Lower Chase River	Weekly
Harewood Lake	Monthly
Witchcraft Lake	Monthly

- All inspections and observation comments are recorded digitally in a custom City developed Mobile Dam Inspection database. Prior to the creation of the database the inspections were recorded on paper and filed records can be found in the General Forman of Waterworks Public Works office.
- Engineering inspections are also carried annually as part of the Formal Annual Dam Safety Inspections and less frequently the Dam Safety Reviews are carried out.
- The City also carries out an inspection of the upstream face of the South Fork Dam on an annual basis. For this purpose the City hires divers to inspect the upstream dam face and intakes and the dives usually take place in the month of June. The divers also inspect the upstream low level outlet slide gate and spillway abutments at Jump Creek dam annually.
- Special inspections are planned and undertaken after extreme events e.g. heavy rainfall, fast snow melt or earthquakes to name a few scenarios.
- Some instrumentation has also been installed at some of the City's dams to measure level and flow. Some dams have continuous electronic monitoring of spillway level and seepage collection weirs; whereby the City's SCADA system (at the Public Works yard) tracks and alarms at certain set points. However the majority of dam instrumentation are manually viewed and recorded into the Mobile Dam Inspection database by the Watershed Inspectors on their determined schedule.

5.0 Dam Inspection Data Review

The instrumentation data collected for each dam in the Mobile Dam Inspection database should be reviewed monthly by the Water Resources Specialist to ensure accuracy of data and note any variation in trends in the dam performance.

Regular inspection data collected by the Watershed Inspectors is reviewed on site and any anomalies are reported to the General Foreman of Waterworks who in turn would report this information to the Water Resources Specialist for further review.

If any significant changes in dam instrumentation are observed then these changes are discussed with a dam safety engineering professional to determine if corrective action is necessary.

6.0 Dam Engineering & Operations Staff Training

The City is committed to ensuring that the staff involved in the engineering planning and operational maintenance of dams receives appropriate training to perform their duties.

Operations staff should receive certified training every FIVE years so they are aware of any new regulations and procedures relating to dam safety, operations, maintenance and surveillance.

Water Resources staff could keep abreast of any new regulations and procedures relating to dam safety, operations, maintenance and surveillance by attending annual dam conferences

Typically training can be arranged through the following organisations;

- BC Water & Waste Water Association (BCWWA)
- Canadian Dam Association (CDA)
- International Commission on Large Dams (ICOLD)

Staff training courses attended by Water Resources staff

Staff Member	Section	Training course	Date
Bill Sims	Water Resources	BCWWA Dam Inspection & Maintenance (presenters Will Jolley & John Baldwin)	Jun 10
		Canadian Dam Association National Conference Whistler, BC	2010
Scott Pamminger	Water Resources	BCWWA Dam Inspection & Maintenance (presenters Will Jolley & John Baldwin)	19 Apr 12 & Jun 10
		Canadian Dam Association National Conference Whistler, BC	2010
		Canadian Dam Association National Conference Dam Safety Review Workshop, Victoria, BC	2002
Euan Wilson	Water Resources	BCWWA Dam Inspection & Maintenance (presenters Will Jolley & John Baldwin)	19 Apr 12

Staff training courses attended by Water Operations staff

Staff Member	Section	Training course	Date
Pat Barrett	Water Supply Operations	BCWWA Dam Inspection & Maintenance (presenters Will Jolley & John Baldwin)	19 Apr 12 & Jun 10
Bill Marshall	Water Supply Operations	BCWWA Dam Inspection & Maintenance (presenters Will Jolley & John Baldwin)	19 Apr 12 & Jun 10

7.0 Emergency Preparedness

The City has an *Emergency Preparedness Plan* and a *Water System Emergency Response Plan* that can be used in the event of an emergency situation pertaining to a dam.

In developing these plans, the City has extended a partnership to notify Island Timberlands (the watershed land owners), key stakeholders (e.g. Vancouver Island Health Authority, BC Ministry of Transportation, Regional District of Nanaimo and the BC Ministry of Forests Lands and Natural Resources) and the local Snuneymuxw First Nations.

These plans identify procedures that staff are to follow in the event of an emergency. The documents identify roles, responsibilities and priorities as well as key notifications and contact information.

It is recommended that these emergency preparedness documents are updated on a regular basis and reviewed annually.

Copies of these documents are located in the Public Works library, in the Engineering Library and with the City's Emergency Program Manager.

8.0 Activation and Initial Response Plan

In the event of a dam emergency the City's Emergency Coordination Centre will oversee and manage the emergency coordination efforts for all emergency and public works staff personnel.

There are three levels of response to an emergency, which increase the level of urgency

- Level 1 Hazardous incident – no immediate danger but it could develop into a more serious situation
- Level 2 Potential dam emergency – Downstream agencies and communities notified of situation with preparations required for evacuation
- Level 3 Imminent or actual dam emergency – widespread evacuation of downstream population

When instrumentation and telemetry equipment indicates an exceedance of the alert levels of reservoir or spillway levels then the operations staff will be required to inspect the appropriate location and report back to the appointed emergency coordinator.

Emergencies identified but are not limited to the following;

- Forecast of a major storm event
- Failure of essential equipment e.g. flood gates
- Slope failure with potential of dam failure
- Excessive dam seepage
- Earthquakes
- Dam breaching or over topping causing potential dam failure

Site access to dams should be reviewed, communication systems checked and inundation maps updated annually to keep the emergency plans up to date.

Appendix A1 Dam Reference Information

General Material

Libr #	TITLE	DATE
765	Dam Safety Program – Phase 1 Summary	1992
	City of Nanaimo Council Policy – Dam Safety	2009
1861	2009 Formal Annual Dam Safety Inspections & Jump Creek Dam Instrumentation Monitoring	2010
	Formal Annual Dam Inspections (for all dams carried out annually from 2006 – 2012)	2012
	Emergency Preparedness Plan	

Jump Creek Dam

Libr #	TITLE	DATE
1049	Jump Creek Dam – Probable Maximum Flood & Review of Probably Maximum Precipitation Studies (2 books)	1997
1074	Jump Creek Dam – Low Level Outlet Study	1998
1158	Jump Creek Dam – 1998 & 1999 Piezometric Readings & Evaluation of Monitoring Records	2000
1189	Jump Creek Dam – Remedial Options Analysis – Final Report	2000
1228	Jump Creek Dam – 2000 Piezometric Readings & Evaluation of Monitoring Records	2001
1231	Jump Creek Low Level Outlet Hydraulic Model Study	2001
1353	Jump Creek Dam – 2003 Piezometric Readings & Evaluation of Monitoring Records	2004
1414	Jump Creek Dam 2004 Piezometric Readings & Evaluation	2005
1426	Preliminary Instrumentation Assessment Dam Safety Monitoring Jump Creek Dam	2005
1821	Jump Creek Dam 2007-2008 Monitoring Report	2009
	Jump Creek Operations and Surveillance Manual	2011

South Fork Dam

Libr #	TITLE	DATE
1216	South Fork Dam – Dam Safety Review	2001
1280	South Fork Dam – Safety Assessment & Dynamic Analysis – Concrete Quality Aspects	2001
1291	South Fork Dam – Safety Assessment & Dynamic Analysis	2002
	South Fork Dam Operations and Surveillance Manual	2011

Reservoir #1 Dam

Libr #	TITLE	DATE
	Reservoir #1 Operations and Surveillance Manuals	

Westwood Lake Dam

Libr #	TITLE	DATE
1303	Westwood Lake River Dam – Inspections & Rehabilitation (1977-1982) Dam Safety Branch	1982
712	Westwood Lake Dam – data file Dayton & Knight	1987
764	Westwood Lake River Dam – Data book EBA Engineering	1992
92	Letter and report to Willis, Cunliffe & Tait on inspection of Chase River dams and Westwood Lake dam - file V77241 & V78040 Golder Associates	1978
	Westwater Mining – Preliminary Geological Report on Seven Nanaimo Dams EBA Engineering Ltd. – file 759	1992
	Nanaimo Dams Investigation Willis, Cunliffe & Tait	1978
189	Dam Rehabilitation Program – contract documents Willis, Cunliffe & Tait	1979
1369	Westwood Lake Dam Inundation Study	2004
1713	Westwood Lake Dam Seismic Stabilization	2005
1795	Westwood Lake Dam Seismic Upgrade Construction Report	2008
	Westwood Lake dam Operations and Surveillance Manual	2011

Upper, Middle and Lower Chase River Dams

Libr #	TITLE	DATE
	BC Hydro Seismic Hazard Review of British Columbia, Report H2595	1992
1304	Lower Chase River Dam – Inspections & Rehabilitation. File containing inspector's reports and photographs for the period 1976-1981 Dam Safety Branch	1982
713	Lower Harewood Colliery Dam (a.k.a. Lower Chase River Dam and Harewood No. 1 Dam) - Data File Dayton & Knight	1987
760	Lower Chase River Dam - Data Book EBA Engineering	1992
92	Letter report to Willis, Cunliffe & Tait on inspection of Chase River and Westwood Lake Dams - File V77241 Golder Associates	1978
92	Report to Willis, Cunliffe & Tait - Site Investigation Nanaimo Dams - File V78040 Golder Associates	1978
1282	Middle & Lower Chase River Dams Spillway Hydrology Study Water Management Consultants	2002
	Report to EBA Engineering Ltd: Preliminary geological report on seven dams at Nanaimo	1992

	Westwater Mining	
5907	Nanaimo Dams Investigation. Report to City of Nanaimo, September Willis, Cunliffe & Tait	1978
189	Contact documents for Dam Rehabilitation Program issued for Tender Willis, Cunliffe & Tait	1979
1303	Lower Chase River Dam – Inspections & Rehabilitation. File containing inspector's reports and photographs for the period 1976-1981 Dam Safety Branch	1982
714	Upper Harewood Colliery Dam (a.k.a. Middle Chase River Dam and Harewood No. 1 Dam) - Data File Dayton & Knight	1987
759	Middle Chase River Dam - Data Book EBA Engineering	1992
	Letter report of City of Nanaimo: Middle Chase River Dam, Seepage Monitoring. Letter dated 1 November 1993, EBA File 0802-82320 EBA Engineering	1993
1289	Phase 1 of Incremental; Damage Assessment, Chase River Dams - Report to City of Nanaimo Water Management Consultants	2002
1309	Upper Chase River dam, Spillway Hydrology Study - Report to City of Nanaimo Water Management Consultants	2002
1862	Seismic Hazard Assessment Middle & Lower Chase Dams	2010
1907	Upper Chase Dam Conceptual Design (3 combined reports)	2011
1908	Upper & Middle Chase River Dams Seismic Hazard Analysis	2009
	Chase River Dam Breach Flood Inundation Study	2012
	Upper Chase River dam Operations and Surveillance Manual	2004
	Middle Chase River dam Operations and Surveillance Manual	2004
	Lower Chase River dam Operations and Surveillance Manual	2004

Harewood Lake Dam

Libr #	TITLE	DATE
	Harewood Lake dam Operations and Surveillance Manual	2010

Witchcraft Lake Dam (also known as McGarrigle Creek Dam)

Libr #	TITLE	DATE
	Witchcraft Lake dam Operations and Surveillance Manual	2010

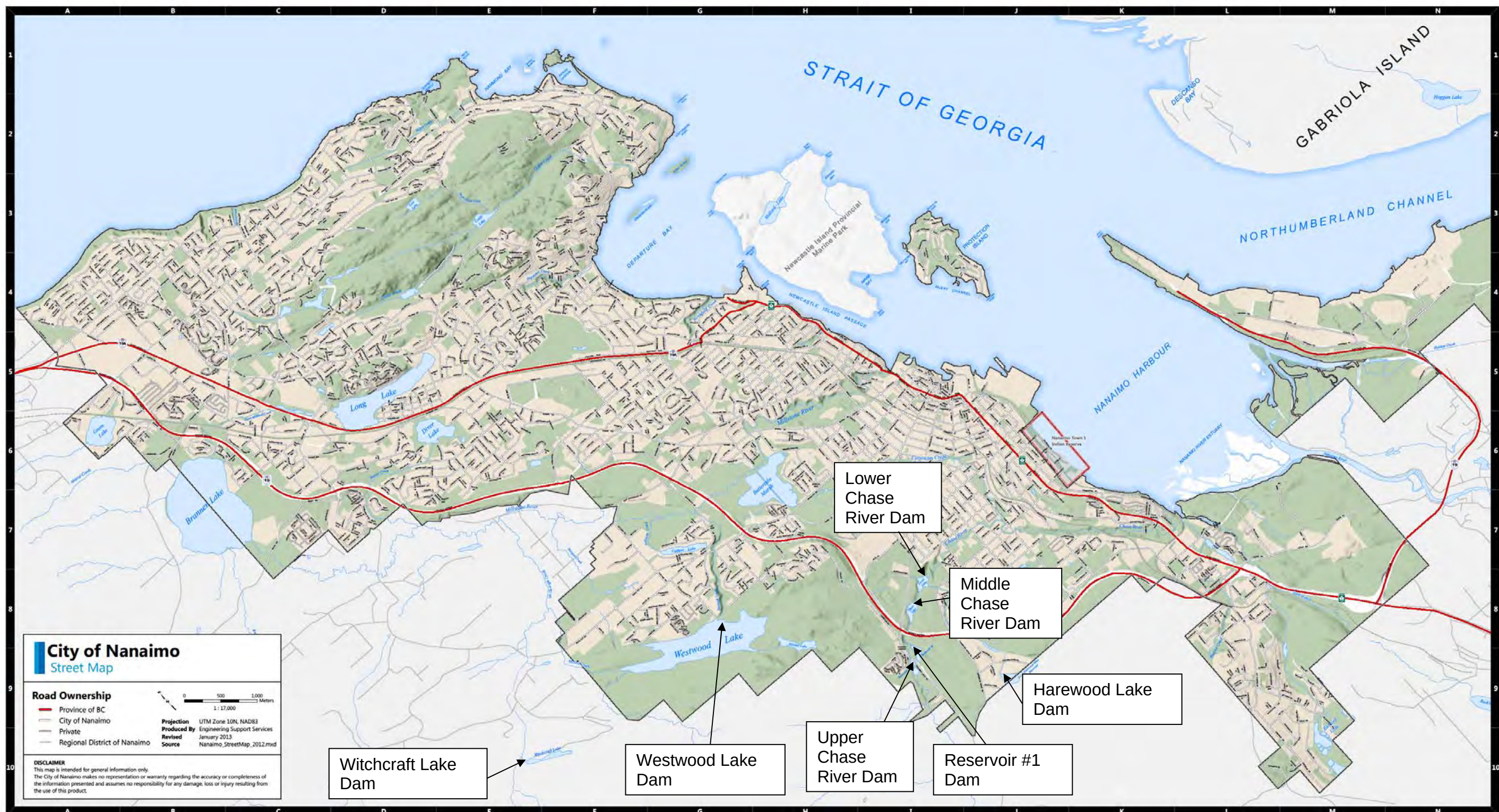
Appendix A2 Background File Information

File Number	Dam File Name
5600.12.01	Westwood Lake Dam
5600.12.02	Lower Chase River Dam
5600.12.03	Middle Chase River Dam
5600.12.05	Dam Safety - General
5600.12.06	Dam Inspections - General
5600.12.07	Westwood Lake Storage
5600.12.25	Jump Creek Dam (Dam Safety Analysis); 1999 - September 2000 Jump Creek Dam (Dam Safety Analysis); October 2000 -
5600.12.32	Water Licences;1986 -
5600.12.33	#1 Reservoir Repairs; 1996 -
5600.12.01	Reservoir #1 (1050 Nanaimo Lakes Road) General;1980 - 2004
5600.12.40	Dam Inspections; 1989 -
5600.12.43	South Fork Dam; 1996 – 2005 South Fork Dam; 2006 -
5600.12.64	Jump Creek Dam Repairs; 1999 -
5600.12.71	Jump Creek Dam Low Level Outlet; 2000
5600.12.76	Upper Chase River Dam; 2002 -
5600.12.83	Jump Creek Dam Additional Storage
5600.12.88	South Fork II Dam
5600.12.101	Jump Creek Dam Spillway
5600.12.104	Witchcraft Lake Dam (McGarrigle Creek)
5600.12.105	Jump Creek Dam - General
	Archived files
5600.25.54	Watershed Hydrology; 1995 - 1999
5600.25.57	Dams, City Owned (Colliery, Harewood, Westwood Lake); 1977 - 1991

Appendix B Dam Information

Dam Name	Date of Construction	Dam Address	Current Dam Failure Consequence Classification	Ministry Dam No:	Water Licence Number	Dam Type	Dam Purpose	Dam Height	Dam Width	Volume of Water Retained	Dam Breach Flood Inundation Assessed?	Original Design Drawings Available	Date of last Dam Safety Review	Date of last Annual Dam Inspection
Jump Creek	1974	Nanaimo Watershed, South Nanaimo River Road	Very High	D-720005-01 D-720005-02	41112 100838	Zoned Earthfill Embankment & Saddle Dam	Retain drinking water supply	25m 6.7m	464m 154m	16,600ML	Yes 1990	Yes	Never done	Nov-12
South Fork	1931	Nanaimo Watershed, South Nanaimo River Road	Very High	D-720007-00	022272 022273 C007001	Concrete Arch	Retain drinking water supply	25.6m	50.6m	2,000ML	Yes 1990	Yes	2001	Nov-12
Reservoir #1	1910	1151 Nanaimo Lakes Road	High	D-720121-00	C126285	Concrete Gravity	Retain drinking water supply	5.9m	40m	64ML	No	Yes	Never done	Nov-12
Westwood Lake	1906	399 Westwood Road	High Significant	D-720003-01	C124242 C124775	Zoned Earthfill Embankment & Saddle Dam	Recreational use – walking, boating and swimming	12m 2m	100m 130m	2,300ML	Yes Oct 2004	Yes (recent upgrade only)	2003	Nov-12
Upper Chase	~1910	801 Nanaimo Lakes Road	Significant	D-720122-00	C022585	Earthfill Concrete Wall ('L' shaped)	Recreational use – fishing	5.5m 2.5m	64m 33m	30,000m ³	Yes Sept 2012	No	2003	Nov-12
Middle Chase	~1910	645 Wakesiah Avenue	Extreme Risk Level 1	D-720001-00	C022585	Earthfill Concrete Wall	Recreational use – walking, fishing and swimming	12.5m	50m	110,000m ³	Yes Sept 2012	No	2003	Nov-12
Lower Chase	~1910	645 Wakesiah Avenue	Extreme Risk Level 1	D-720002-00	C022585	Earthfill Concrete Wall	Recreational use – walking, fishing and swimming	23.3m	77m	112,000m ³	Yes Sept 2012	No	2003	Nov-12
Harewood Lake	1911	713 Shorthorn Crescent	Low	D-720110-00		Concrete Gravity	Recreational use – walking, fishing and swimming	4m	34m	32,000m ³	No	No	N/A	Nov-12
Witchcraft Lake	~1910	Benson View Road	Low	D-720147-00	C124243	Timber Crib Earthfill	Recreational use – walking	5m	50m	31,200m ³	No	No	N/A	Nov-12

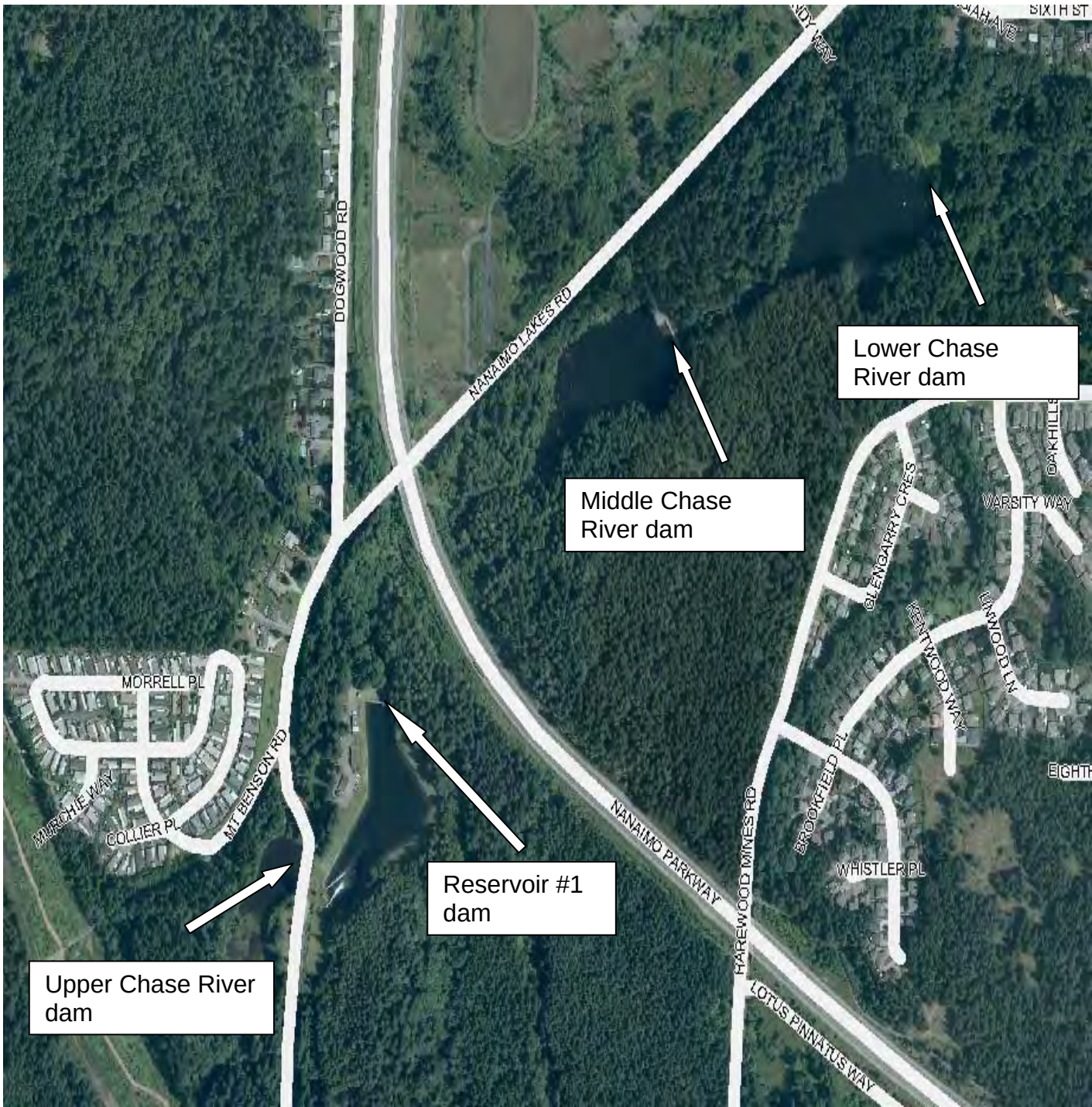
Appendix C1 Map of dam locations within Nanaimo city boundary



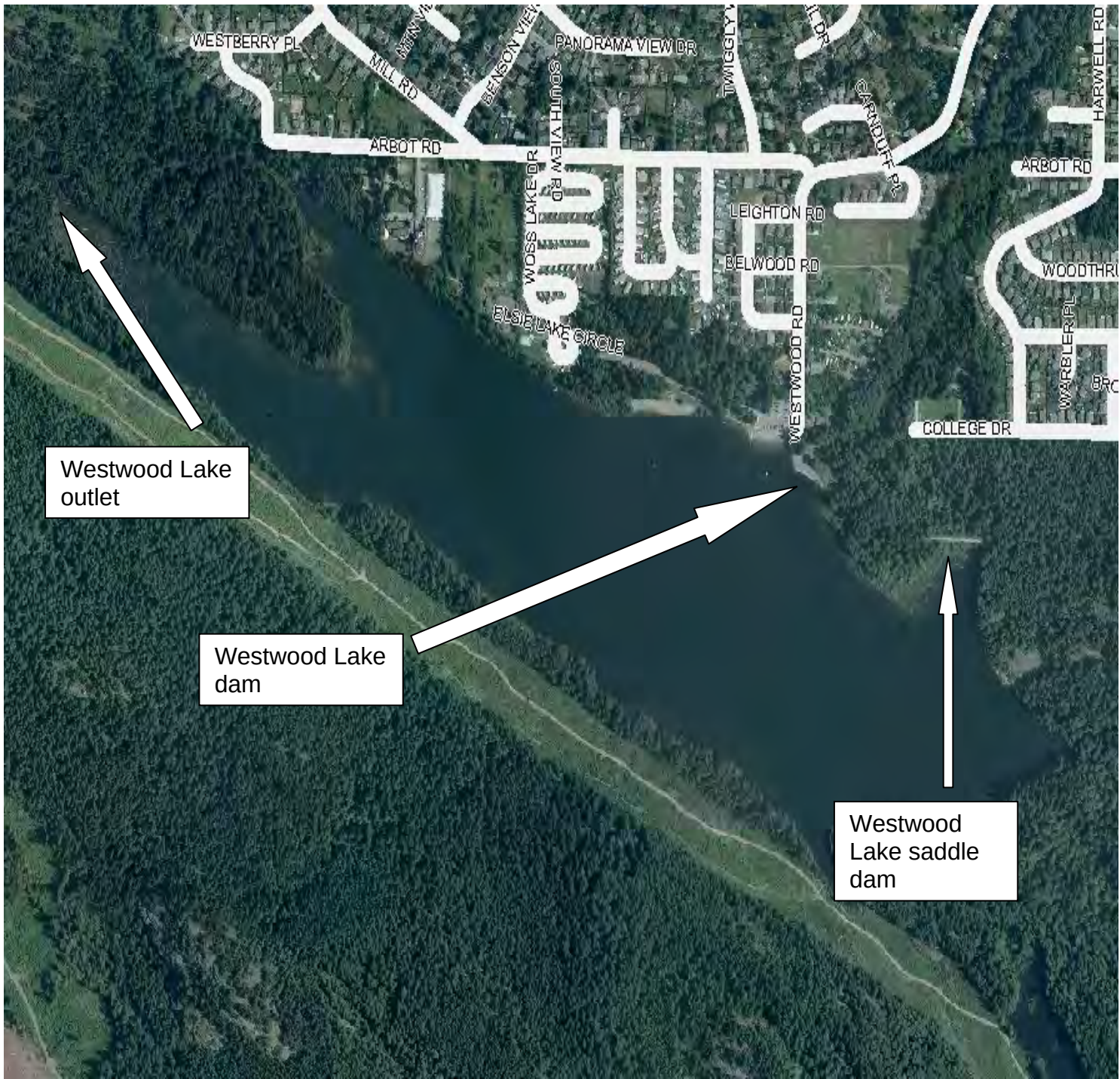
Jump Creek Dam and South Fork Dam



Upper Chase River Dam, Middle Chase River Dam, Lower Chase River Dam & Reservoir #1 Dam



Westwood Lake Dam



Harewood Lake Dam



Witchcraft Lake Dam



Appendix D Photographs

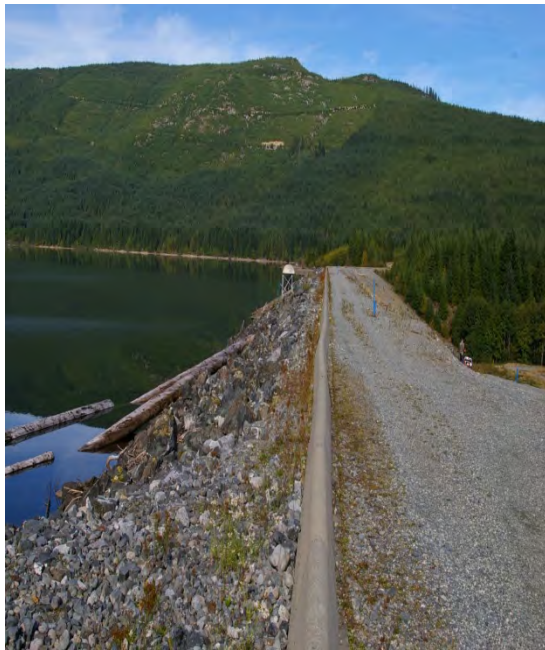
Jump Creek Dam



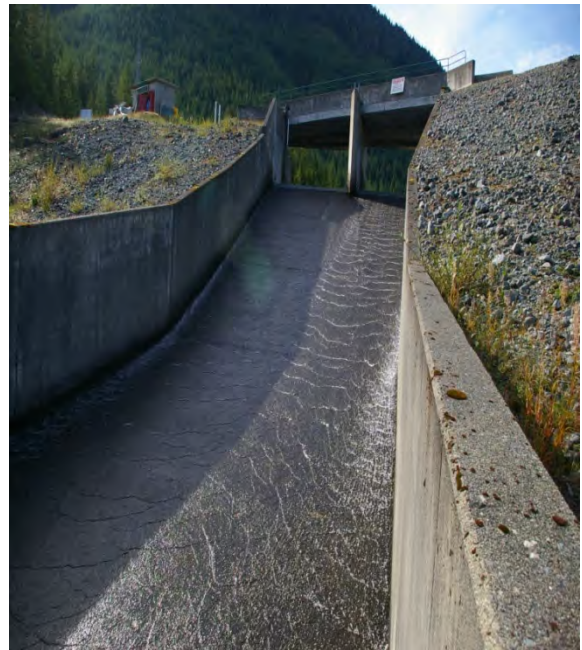
Jump Creek Auxiliary Spillway



Jump Creek Dam



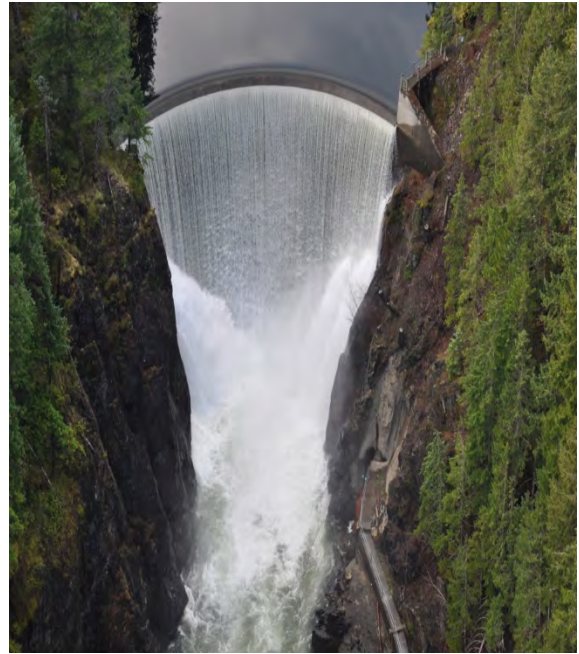
Jump Creek Dam Main Spillway



South Fork Dam



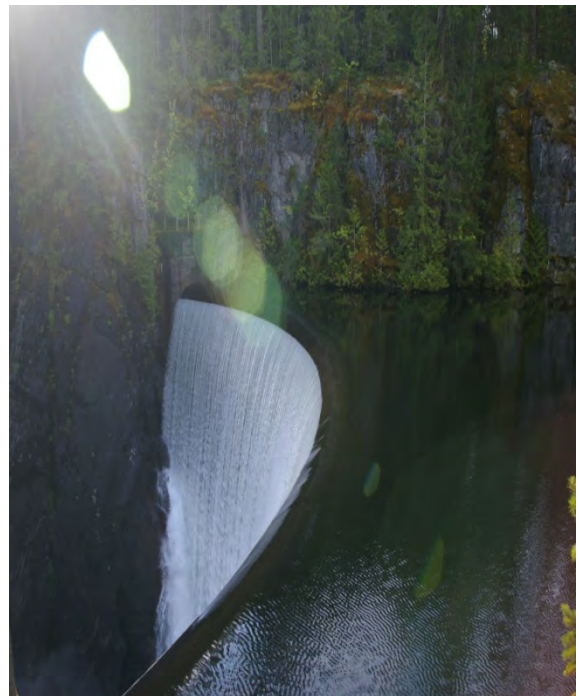
South Fork Dam



South Fork Dam abutments



South Fork Dam crest



Reservoir #1 Dam



Reservoir #1 Dam – upstream face



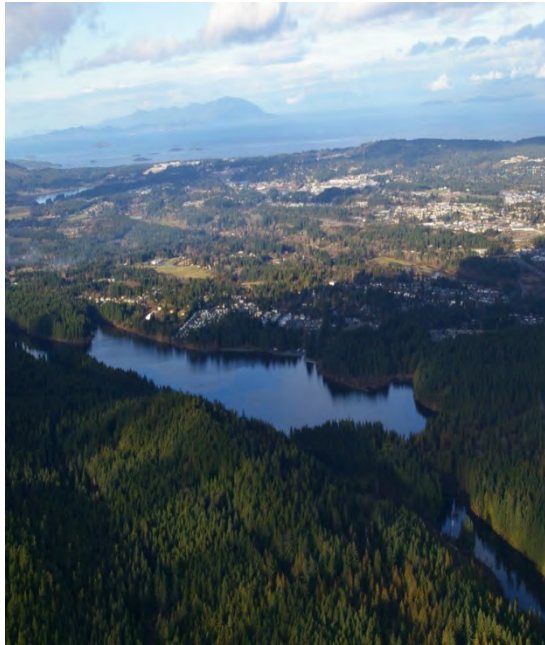
Reservoir #1 Dam - downstream face



Reservoir #1 Dam Spillway



Westwood Lake



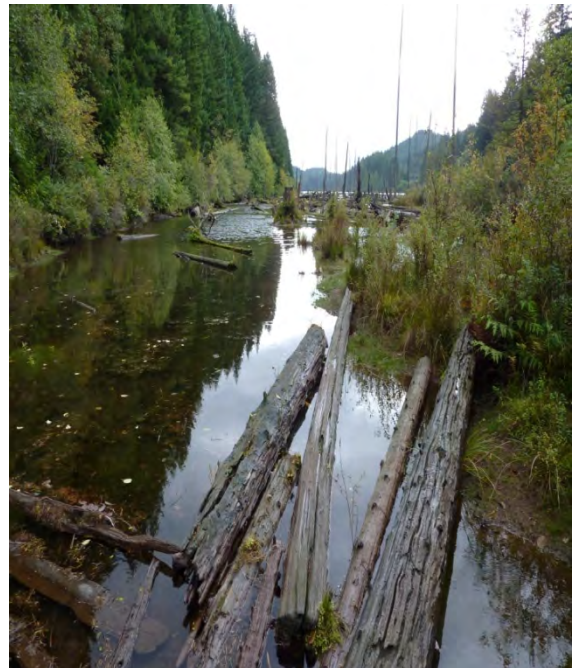
Westwood Lake Dam



Westwood Lake Saddle Dam



Westwood Lake Outlet



Upper Chase River Dam



Upper Chase River Dam



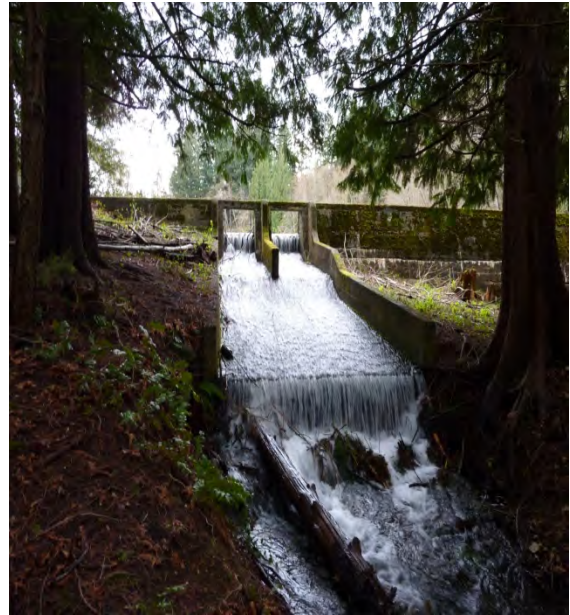
Upper Chase River Dam Spillway



Harewood Lake Dam



Harewood Lake Dam Spillway



Harewood Lake Dam Downstream



Harewood Lake Dam Spillway



Witchcraft Lake Dam



Witchcraft Lake Dam



Witchcraft Lake Dam



Witchcraft Lake Dam breach area



Middle Chase River Dam



Middle Chase River Dam



Middle Chase River Dam Spillway



Lower Chase River Dam



Lower Chase River Dam downstream



Lower Chase River Dam



Lower Chase River Dam Spillway



APPENDIX E

City of Nanaimo Dam Safety Policy



CITY OF NANAIMO

COUNCIL POLICY MANUAL

Pages: 1 of 2

Approval Date: 2009-OCT-19

SECTION: ENGINEERING, PUBLIC WORKS AND TRANSPORTATION SUBJECT: Dam Safety
--

PURPOSE:

Under the *Provincial Water Act*, the B.C. Dam Safety Regulation places responsibility for dam safety on the dam owner.

The purpose of this Dam Safety Policy (the "Policy") is to set out the City of Nanaimo's (the "City's") commitment to dam safety for all dam structures.

POLICY:

The City will:

- design and construct new dams in a conservative manner in accordance with regulatory requirements and consistent with industry standards;
- manage, inspect, maintain, improve and decommission existing dams in a manner which meets the Dam Safety Regulation;
- use its Dam Safety Management Program to identify, assess and manage risks.
- reduce Dam Safety risks to as low as reasonably practicable.

ROLES AND RESPONSIBILITIES:

- The Manager of Water Resources is responsible for administering the dam safety management program and ensuring all dams owned by the City meet regulatory requirements;
- The General Foreman – Waterworks is responsible for managing the daily operations of staff who maintain, inspect, measure, and report the performance of all City dams;
- The Manager of Water Resources is responsible for maintaining current Emergency Response Plans, providing timely notification to agencies, downstream facilities and stakeholders, and providing clear response procedures for site personnel;
- The Director of Engineering and Public Works reports to City Council annually on the status and safety of all the City's dams, and any regulatory changes which impact dam safety;
- The Director of Engineering and Public Works will inform City Council in a timely manner of any significant dam safety incident or emerging issue which either violates or has the potential to breach the intent of this policy.

DAM SAFETY MANAGEMENT PROGRAM:

The City will maintain a dam safety management program that meets regulatory requirements and considers the Canadian Dam Safety Guidelines.

The key elements in the dam safety management system include:

- program planning;
- safety assessment and risk management;
- review, program assessment, and ongoing training for continuous improvement;
- detailed inspection and surveillance practices;
- documented Operation, Maintenance and Surveillance procedures;
- documented and detailed Emergency Response Plans;
- dam security;
- regulatory communications;
- external oversight and independent review; and
- appropriate document management.

Previous Revision/s: None

APPENDIX F

Provincial Dam Safety Office Contact List



CONTACT INFORMATION

Province of BC Dam Safety Officers

DIRECTOR		
Glen Davidson, P.Eng. Director, Water Management Branch, Forests, Lands and Natural Resource Operations PO Box 9340 Stn Prov Govt Victoria BC V8W 9M1		
DAM SAFETY OFFICERS	TELEPHONE	FAX
HEADQUARTERS		
Scott Morgan Section Head, Dam Safety Section Water Management Branch, Min. of FLNRO PO Box 9340 Stn Prov Govt Victoria BC V8W 9M1	250 387-3265	250 952-6792
Monty Miedreich Senior Dam Safety Officer, Dam Safety Section Water Management Branch, Min. of FLNRO PO Box 9340 Stn Prov Govt Victoria BC V8W 9M1	250 387-3264	250 952-6792
Will Jolley (Auxiliary) Senior Dam Safety Training Officer, Dam Safety Section Water Management Branch, Min. of FLNRO PO Box 9340 Stn Prov Govt Victoria BC V8W 9M1	250 952-6759	250 952-6792
REGIONAL OPERATIONS – COASTAL AREA		
WEST COAST		
John Baldwin, Dam Safety Officer Water Stewardship, Min. of FLNRO 2080A Labieux Road Nanaimo BC V9T 6J9	250 751-3179	250 751-7079
SOUTH COAST		
Mike Bristol, Dam Safety Officer Water Stewardship, Min. of FLNRO 10470 152nd Street, 2 nd Floor Surrey BC V3R 0Y3	604 930-7102	604 582-5235
REGIONAL OPERATIONS – SOUTH AREA		
CARIBOO		
Duane Hendricks, Dam Safety Officer Water Stewardship, Min. of FLNRO Suite 400 - 640 Borland Street Williams Lake V2G 4T1	250 398-4443	Faxcom 250 398-4214
THOMPSON		
Brian Nuttall, Dam Safety Officer Water Stewardship, Min. of FLNRO 2nd fl 1259 Dalhousie Kamloops BC V2C 5Z5	250 371-6329	250 828-4000
OKANAGAN		
Mike Noseworthy, P. Geo., Eng. L. Senior Regional Dam Safety Officer Water Stewardship, Min. of FLNRO 102 Industrial Place Penticton BC V2A 7C8	250 490-2291	250 490-2231
KOOTENAY/BOUNDARY		
Sarah Crookshanks, P. Geo., Dam Safety Officer Water Stewardship, Min. of FLNRO 401-333 Victoria St Nelson BC V1L 4K3	250 354-6384	250 354-6332
REGIONAL OPERATIONS – NORTH AREA		
SKEENA		
Chelton van Geloven, Dam Safety Officer Water Stewardship, Min. of FLNRO #325 - 1011 4th Ave Prince George BC V2L 3H9	250 565-4462	250 565-6629
OMINECA & NORTHEAST		
Darren DeFord, Dam Safety Officer Water Stewardship, Min. of FLNRO #325 - 1011 4th Ave Prince George BC V2L 3H9	250 565-6079	250 565-6629

APPENDIX G

Provincial Dam Safety Regulation 44/2000 and amendment 163/2011



Copyright (c) Queen's Printer,
Victoria, British Columbia, Canada

IMPORTANT INFORMATION

B.C. Reg. 44/2000

Deposited February 10, 2000

O.C. 131/2000

NOTE: This copy of the Dam Safety Regulation has been reformatted from the original to improve readability when printed. In case of discrepancy between this copy and the original posted by Queen's Printer, the original takes precedence and is available at: http://www.bclaws.ca/EPLibraries/bclaws_new/document/ID/freeside/10_44_2000.

Water Act**BRITISH COLUMBIA DAM SAFETY REGULATION**

[includes amendments up to B.C. Reg. 163/2011, September 12, 2011]

Contents

- 1 Definitions
- 2 Application
- 3 Operation and maintenance of a dam
 - 3.1 Emergency preparedness plan
 - 3.2 Change of classification
- 4 Alteration of a dam
- 5 Inspections and tests
- 6 Reporting
 - 6.1 Review of downstream conditions
- 7 Dam safety review and report
 - 7.1 Potential safety hazard at a dam
- 8 Hazardous conditions at a dam
- 9 Suspension of normal operation or removal of a dam
- 10 Information and evaluation
- 11 Instrumentation
- 12 Expert opinion
- 13 Acceptance by dam safety officer
- 14 Transition — dam safety review and report

Schedule 1**Schedule 2****Definitions****1** In this regulation:

"Act" means the *Water Act*;

"classification" means the dam failure consequences classification of a dam under Schedule 1;

"dam" means

(a) a barrier constructed across a stream, or

(b) a barrier constructed off-stream and supplied by diversion of water from a stream,

for the purpose of enabling the storage or diversion of water, and includes all works which are incidental to or necessary for the barrier;

"dam owner" means, with respect to a dam, any or all of the following:

(a) the person who holds the current licence or is required to hold a licence for the dam;

(b) the person who last held a licence for the dam, including a licence that has been suspended, cancelled, abandoned or terminated;

(c) if there is no person to whom paragraph (a) or (b) applies, the owner of the land on which the dam is located or the person who had the dam constructed;

"dam safety officer" means an engineer or officer who is designated in writing by the comptroller as a dam safety officer;

"dam safety review" means a review carried out by a professional engineer under section 7 or 14;

"emergency preparedness plan" means

(a) a plan prepared by a dam owner under section 3.1 (1) and accepted by a dam safety officer, and

(b) any revisions to the plan prepared by the dam owner and accepted by a dam safety officer;

"height" means the vertical distance to the top (crest) of a dam measured,

(a) in the case of a dam across a stream, from the natural bed of the stream at the downstream outside limit of the dam, or

(b) in the case of a dam that is not across a stream, from the lowest elevation at the outside limit of the dam;

"instrumentation" means, but is not limited to, survey monuments and stations, inclinometers, extensometers, piezometers or measuring weirs;

"maintain" or **"maintenance"** means the performance of those tasks required to keep the dam in good operating condition;

"operation, maintenance and surveillance manual" means

(a) a manual prepared by a dam owner under section 3 (2) and accepted by a dam safety officer, and

(b) any revisions to the manual prepared by the dam owner and accepted by a dam safety officer;

"professional engineer" means a person registered, and in good standing, as a professional engineer under the *Engineers and Geoscientists Act*;

"Provincial Emergency Program" means the Provincial Emergency Program continued under the *Emergency Program Act*; .

"Schedule 2 table" means the table in section 2 of Schedule 2;

"volume of water" means the total storage volume of the reservoir at full supply level measured in accordance with one of the following:

- (a) between the natural bed of the stream and the spillway crest;
- (b) between the upstream outside limit of the dam and the spillway crest;
- (c) if a low level outlet is excavated to an elevation lower than the general foundation of the dam, between the bottom of that outlet and the spillway crest.

[am. B.C. Reg. 108/2011, App. 1, s. 1; App. 2, s. 1.]

Application

2 (1) This regulation applies to all of the following:

- (a) a dam 1 metre or more in height that is capable of impounding a volume of water greater than 1 000 000 m³;
- (b) a dam 2.5 metres or more in height that is capable of impounding a volume of water greater than 30 000 m³;
- (c) a dam 7.5 metres or more in height;
- (d) a dam that does not meet the criteria under paragraph (a), (b) or (c) but has a classification of significant, high, very high or extreme.

(2) This regulation does not relieve a dam owner from any other requirements that may be imposed under the Act, the Water Regulation or any other applicable enactment.

[am. B.C. Reg. 108/2011, App. 1, s. 1; App. 2, s. 1.]

Operation and maintenance of a dam

3 (1) A dam owner must operate and maintain a dam in accordance with all of the following:

- (a) this regulation;
- (b) any applicable licence or approval;
- (c) any order made by the comptroller, a regional water manager or an engineer under the Act or this regulation or any requirement specified by a dam safety officer under this regulation;
- (d) the emergency preparedness plan for the dam;
- (e) the operation, maintenance and surveillance manual for the dam.

(2) A dam owner of a dam that has a classification of significant, high, very high or extreme must, in the form and manner and within the time period specified by the comptroller or regional water manager,

- (a) prepare a manual that describes the dam owner's operation, maintenance and surveillance procedures for the dam, and

(b) submit the manual to a dam safety officer for acceptance by the dam safety officer.

(3) Subsection (2) applies whether or not there is a term or condition in an approval granted or licence issued that requires the preparation of such a manual for the dam.

(3.1) A dam owner of a dam that has a classification of significant, high, very high or extreme must

(a) review, and revise if necessary, the operation, maintenance and surveillance manual for the dam no less frequently than is specified for the classification of the dam in item 6 in the Schedule 2 table, and

(b) submit any revisions to a dam safety officer for acceptance by the dam safety officer.

(4) A dam owner must ensure that the dam is adequately safeguarded to prevent unauthorized operation of the dam by someone other than the dam owner or an agent of the dam owner.

(5) A dam owner of a dam that is located partially or entirely on Crown land and that has a classification of significant, high, very high or extreme must ensure that there is at all times posted on the land at both ends of the top of the dam a sign that meets all of the following criteria:

(a) the sign must contain, in lettering that is clearly visible from 15 metres, the following information:

(i) the name of the dam;

(ii) the name of the stream that is dammed;

(iii) the following words: "If you see any dam safety concerns, please contact:", followed by

(A) the name and emergency telephone numbers for both day and night of a dam owner, and

(B) the emergency telephone number for the Provincial Emergency Program;

(b) the sign must be at least 75 centimetres high and 60 centimetres wide;

(c) the sign must be clearly visible under seasonal conditions to persons approaching the dam;

(d) the sign and post must be constructed from metal or other durable materials having strength suited to the location and environment of the sign;

(e) the sign must meet any other requirement specified by the comptroller or a regional water manager.

(6) Subsection (5) applies whether or not the dam owner has an authorization or other right to use or occupy the Crown land on which the dam is partially or entirely located.

(7) For the purposes of subsection (5) (a) (iii) (A), if there is more than one dam owner, the dam owner whose name and emergency telephone numbers must be on the sign is the dam owner who

- (a) the dam owners agree is the emergency contact for the dam, or
- (b) if there is no agreement by the owners, the dam owner specified by a dam safety officer.

[am. B.C. Reg. 108/2011, App. 1, s. 3; App. 2, s. 2.]

Emergency preparedness plan

3.1 (1) A dam owner of a dam that has a classification of significant, high, very high or extreme must, in the form and manner and within the time period specified by the comptroller or regional water manager,

- (a) prepare a plan that describes the actions to be taken by the dam owner in the event of an emergency at the dam, and
- (b) submit the plan to a dam safety officer for acceptance by the dam safety officer.

(2) Subsection (1) applies whether or not there is a term or condition in an approval granted or licence issued that requires the preparation of such a plan for the dam.

(3) A dam owner of a dam that has a classification of significant, high, very high or extreme must

- (a) review, and revise if necessary, the emergency preparedness plan for the dam no less frequently than is specified for the classification of the dam in items 5 and 6 in the Schedule 2 table, and
- (b) submit any revisions to a dam safety officer for acceptance by the dam safety officer.

[en. B.C. Reg. 108/2011, App. 1, s. 4.]

Change of classification

3.2 If the classification of a dam changes, a dam owner must, in a timely manner,

- (a) meet the requirements of this regulation that apply in respect of the new classification, and
- (b) review, and revise if necessary, the operation, maintenance and surveillance manual and the emergency preparedness plan, if any, for the dam and submit any revisions to a dam safety officer for acceptance by the dam safety officer.

[en. B.C. Reg. 108/2011, App. 1, s. 4.]

Alteration of a dam

4 (1) Any alteration, improvement or replacement to all or any part of a dam must be authorized by an approval, licence or order.

(2) Subsection (1) does not apply to an alteration, improvement or replacement for the purpose of

- (a) maintaining the dam as authorized under section 3, or
- (b) addressing a hazardous condition under section 8.

(3) On completion of an alteration, improvement or replacement to all or any part of a dam, a dam owner must, in a timely manner,

- (a) submit to a dam safety officer a report on the work and the manner in which the alteration, improvement or replacement was performed, and
- (b) review, and revise if necessary, the operation, maintenance and surveillance manual and the emergency preparedness plan, if any, for the dam and submit any revisions to a dam safety officer for acceptance by the dam safety officer.

[am. B.C. Reg. 108/2011, App. 1, s. 5.]

Inspections and tests

5 A dam owner must do all of the following:

- (a) inspect the dam and dam site no less frequently than is specified for the classification of the dam in items 1 and 2 in the Schedule 2 table in order to assess the condition of the dam during the construction, operation or alteration of the dam;
- (b) test the operation of the outlet facilities, spillway gates and other mechanical components of the dam no less frequently than is specified for the classification of the dam in item 4 in the Schedule 2 table;
- (c) record the results of every inspection or test performed under this section;
- (d) comply with section 7.1 or 8, if applicable.

[en. B.C. Reg. 108/2011, App. 1, s. 6.]

Reporting

6 (1) If an inspection or test is carried out under section 5 or any other inspection, test or review is carried out with respect to a dam, a dam owner must, if required by a dam safety officer, submit to the dam safety officer, in the form and manner and within the time period specified by the dam safety officer,

- (a) a record of the results of the inspection, test or review, and
- (b) the results and analysis of any test or measurement taken including, but not limited to,
 - (i) instrumentation readings and analysis,
 - (ii) visual records or observations,
 - (iii) drawings,
 - (iv) soil, aggregate and concrete test results, and
 - (v) any other test results.

(2) Despite subsection (1), if an inspection, test or review carried out with respect to a dam reveals a potential safety hazard referred to in section 7.1 or a hazardous condition referred to in section 8, a dam owner must promptly submit to a dam safety officer the records referred to in subsection (1).

(3) A dam owner must, if required by a dam safety officer, submit to the dam safety officer copies of the following records relating to the design, construction or alteration of the dam:

- (a) all design notes, drawings and specifications;
- (b) hydraulic, hydrologic, geological and geotechnical data;
- (c) reports and other similar records.

[en. B.C. Reg. 108/2011, App. 1, s. 6.]

Review of downstream conditions

6.1 A dam owner must

- (a) annually conduct a review of conditions downstream of the dam to assess whether there has been any change to the classification of the dam, and
- (b) immediately notify a dam safety officer if there has been a change to the classification of the dam.

[en. B.C. Reg. 108/2011, App. 1, s. 6.]

Dam safety review and report

7 (1) A dam owner of a dam that has a classification of high, very high or extreme must, no less frequently than is specified for the classification of the dam in item 7 in the Schedule 2 table,

(a) have a professional engineer with qualifications and experience in dam safety analysis,

(i) carry out a review, in accordance with the requirements of the comptroller or regional water manager,

(A) to determine whether the dam is safe, and

(B) if it is determined that the dam is not safe, to determine what actions are required to make the dam safe; and

(ii) prepare, in the form and manner specified by the comptroller or regional water manager, a dam safety report, and

(b) submit to a dam safety officer, for acceptance by the dam safety officer, a copy of the dam safety report prepared by the professional engineer.

(2) Despite subsection (1), if a dam classification increases due to an increase in the consequences of a failure of the dam, other than an increase from a low classification to a significant classification, the dam owner must meet the requirements of paragraphs (a) and (b) of subsection (1) no later than 2 years from the earlier of the following dates:

- (a) the date on which a dam safety officer notifies the dam owner of the change in classification;
- (b) the date on which the dam owner notifies a dam safety officer of the change in classification;

unless the comptroller, regional manager or a dam safety officer specifies that the requirements must be met by another date.

(3) For the purposes of subsections (1) and (2), if a dam owner meets the requirements of paragraphs (a) and (b) of subsection (1) on or before December 31 of the year in which the requirements must be met under those subsections, the dam owner is deemed to have met the requirements within the time required.

(4) After completion of a dam safety review the dam owner must comply with section 7.1 or 8, if applicable.

[en. B.C. Reg. 108/2011, App. 1, s. 6.]

Potential safety hazard at a dam

7.1 If

- (a) an inspection or test under section 5,
- (b) a dam safety review,
- (c) monitoring, under section 11, the instrumentation installed at a dam, or
- (d) any other inspection, test or review carried out with respect to a dam

reveals a potential safety hazard to which section 8 does not apply, a dam owner must prepare a plan that identifies and prioritizes any actions required to correct the potential safety hazard and, in accordance with section 4, if applicable, must implement the plan in a timely manner based on the priorities identified in the plan.

[en. B.C. Reg. 108/2011, App. 1, s. 6.]

Hazardous conditions at a dam

8 If conditions exist which are or are likely to be hazardous to a dam, or if conditions may reasonably be anticipated to cause a dam, or any part of a dam, or any operation or action at or in connection with a dam, to be or become potentially hazardous to public safety, the infrastructure or works, other property or the environment, a dam owner must promptly do all of the following:

- (a) if an emergency preparedness plan exists, modify the operation of the dam, or any part of the dam, in accordance with the emergency preparedness plan;
- (b) if an emergency preparedness plan does not exist, operate the dam in a manner, and initiate any remedial actions, that will
 - (i) safeguard the public,
 - (ii) minimize damage to the infrastructure or works or to other property, including that not owned by the dam owner, and
 - (iii) minimize damage to the environment;

- (c) contact the Provincial Emergency Program;
- (d) notify a dam safety officer, or the comptroller or regional water manager, of
 - (i) the nature of the existing or anticipated conditions,
 - (ii) all things done by the dam owner to rectify the conditions, and
 - (iii) the time and exact nature of any information or warning of existing or anticipated conditions issued to any person under this section;
- (e) inform local authorities, and persons who may be in immediate danger from the potential failure of the dam, of the nature of the existing or anticipated conditions and, if necessary, advise those persons who may be in immediate danger to vacate and remove any property from the endangered area;
- (f) modify the operation of the dam to minimize or prevent damage which may be caused by the failure of the dam, and undertake any other hazard response activity required by a dam safety officer or engineer or by the comptroller or regional water manager.

[am. B.C. Reg. 108/2011, App. 2, s. 3.]

Suspension of normal operation or removal of a dam

- 9** (1) A dam owner must give the comptroller or regional water manager at least 60 days written notice before undertaking any of the following activities:
- (a) removing all or a significant part of a dam;
 - (b) decommissioning or abandoning a dam;
 - (c) stopping the normal operation of a dam for a period of time longer than one year.
- (2) The dam owner must prepare, and submit to a dam safety officer for approval,
- (a) a plan respecting an activity under subsection (1) (a) or (b), or
 - (b) if required by the dam safety officer, a plan respecting an activity under subsection (1) (c).
- (3) The dam owner must, at least 14 days before the date on which the work is expected to commence, notify a dam safety officer before commencing any work under the approved plan.
- (4) The dam owner must submit to a dam safety officer, on the completion of the work performed under the approved plan, a report on the work and the manner in which it was performed.
- (5) The dam owner must undertake any further actions that the comptroller or regional water manager requires to alleviate any adverse consequences to any person, the infrastructure or works, other property or the environment that may be affected by any work performed on the dam.
- (6) An approval under subsection (2) respecting the decommissioning of a dam is subject to the Environmental Assessment Act and to approvals, if any, required under that Act.

Information and evaluation

10 (1) A dam owner must, if required by a dam safety officer, submit to the dam safety officer the following information in order to evaluate the condition or hazard potential of a dam:

(a) information with respect to the dam including, but not limited to,

- (i) foundation investigation results,
- (ii) design details and as-built plans,
- (iii) construction records,
- (iv) operation manuals,
- (v) records of instrumentation,
- (vi) inspection reports,
- (vii) safety reports, and
- (viii) inundation studies and emergency preparedness plans;

(b) information with respect to the nature of the land and the stream, and the use of the land and the stream, downstream from or adjacent to the dam or reservoir, including the hydraulic, hydrologic, geological and geotechnical characteristics and the uses of the land and stream;

(c) information with respect to the watershed upstream of the dam.

(2) The information required under subsection (1) must be submitted to a dam safety officer, in the form and manner and within the time period specified by the comptroller or regional water manager.

(3) The dam owner must conduct any inspection, investigation, survey or test that is necessary to provide the information required by subsection (1).

(4) If a dam owner conducts an investigation that involves drilling, trenching, excavating a test pit or other invasive activity within the dam or in close proximity to the dam, the dam owner must ensure that the activity is directly supervised by a professional engineer with qualifications and experience in dam design, construction and analysis.

[am. B.C. Reg. 108/2011, App. 1, s. 7.]

Instrumentation

11 A dam owner must do all of the following:

- (a) install any instrumentation necessary to adequately monitor the performance of a dam;
- (b) maintain or replace instrumentation installed at a dam to ensure continuity of readings;
 - (b.1) monitor the instrumentation installed at a dam no less frequently than is specified for the classification of the dam in item 3 in the Schedule 2 table;
- (c) if required by a dam safety officer, submit to the dam safety officer instrumentation readings and evaluations in the form and manner and within the time period specified by the dam safety officer;

- (c.1) comply with section 7.1 or 8, if applicable;
- (d) submit, to a dam safety officer for acceptance by the dam safety officer,
 - (i) notice of any planned modifications to, changes to or removal of the instrumentation at least 60 days before the proposed modification, change or removal, or
 - (ii) an annual plan outlining intended changes to the instrumentation.

[am. B.C. Reg. 108/2011, App. 1, s. 8.]

Expert opinion

- 12** (1) If, based on information submitted in respect of a dam or related works, the comptroller or regional water manager considers that a question has arisen as to what is proper practice for resolving an issue involving a dam or related works, the comptroller or regional water manager may require a dam owner to retain an independent expert, satisfactory to the comptroller or regional water manager, with qualifications and experience as follows:
- (a) in the case of a dam, in dam design, construction and analysis;
 - (b) in the case of related works, in hydraulic, hydrological, geological, geotechnical, mechanical or structural engineering or other appropriate disciplines.
- (2) The expert retained under subsection (1) must provide a report to the comptroller or regional water manager on the issue.

[am. B.C. Reg. 108/2011, App. 1, s. 9.]

Acceptance by dam safety officer

- 13** (1) If a record that is submitted under this regulation by a dam owner to a dam safety officer for acceptance by the dam safety officer is not in a form that is acceptable to the dam safety officer, the dam safety officer may return the record to the dam owner together with a written notice specifying the deficiencies in the record and requiring that they be corrected.
- (2) If a dam safety officer provides a written notice to a dam owner under subsection (1)
- (a) the dam owner must correct the deficiencies identified in the notice in a timely manner, and
 - (b) the dam safety officer is not required to accept the record referred to in subsection (1) until the dam owner has corrected the deficiencies set out in the notice.

[en. B.C. Reg. 108/2011, App. 1, s. 10.]

Transition — dam safety review and report

- 14** (1) Despite section 7, if a dam
- (a) had a downstream consequence classification of low or very low under this regulation as it read immediately before June 9, 2011, and
 - (b) had a classification of high, very high or extreme on June 9, 2011,

the dam owner must meet the requirements of paragraphs (a) and (b) of section 7 (1) no later than December 31, 2013.

(2) Despite section 7, subsection (3) of this section applies to a dam if

(a) the dam had a downstream consequence classification of high or very high under this regulation as it read immediately before June 9, 2011,

(b) the dam had a classification of extreme on June 9, 2011, and

(c) on June 9, 2011 the immediately preceding dam safety review in respect of the dam was conducted in a year set out in column 1 of the table in subsection (3).

(3) For the purposes of subsection (2) of this section, the dam owner must meet the requirements of paragraphs (a) and (b) of section 7 (1) no later than the date specified in column 2 in the table below opposite the year in which the immediately preceding dam safety review was conducted as set out in column 1 of the table below:

	Column 1	Column 2
Item	Year of immediately preceding dam safety review	Date by which requirements in paragraphs (a) and (b) of section 7 (1) must be met
1	2001 or 2002	10 years from the date on which the dam safety report in respect of the immediately preceding review was submitted to a dam safety officer.
2	2003, 2004 or 2005	December 31, 2013.
3	2006 and thereafter	The date specified for the classification of the dam in item 7 in the Schedule 2 table.

(4) In respect of Items 1 and 3 of the table in subsection (3) of this section, if a dam owner meets the requirements of paragraphs (a) and (b) of section 7 (1) on or before December 31 of the year in which the requirements must be met under subsection (3) of this section, the dam owner is deemed to have met those requirements within the time required.

[en. B.C. Reg. 163/2011.]

Schedule 1

[en. B.C. Reg. 108/2011, App. 1, s. 11.]

(sections 1, 2 (1) (d), 3 (2) and (3.1), 3.1 (1) and (3), 3.2, 5, 6.1, 7, 11 (b.1) and 14)

Dam Classification

Definitions

1 In this Schedule:

"category", with respect to consequences of failure, means one of the following:

- (a) loss of life;
- (b) environment and cultural values;
- (c) infrastructure and economics;

"consequences of failure" means losses or damages that

- (a) are caused by the failure of a dam, and
- (b) result from impacts on areas that are at the dam or are downstream or upstream of the dam;

"failure", in respect of a dam, means the partial or complete collapse of the dam and the uncontrolled release of all or part of the water stored by the dam, caused by either flood-induced failure or non flood-induced failure;

"flood-induced failure" means a dam failure that is caused by a natural flood of a magnitude that is greater than the magnitude that the dam can pass at the time of the failure;

"non flood-induced failure" means a dam failure that occurs during normal dam operation that is caused by conditions such as internal erosion, piping, an earthquake or an error in operation leading to overtopping.

Determination of classification

2 The dam failure consequences classification of a dam is determined in accordance with the following steps:

- (a) for each category of consequences of failure in the following table, identify the losses or damages specified in the table that most closely describe the losses or damages that are the worst potential consequences of a failure of the dam;
- (b) identify the classification that is specified in the following table for the losses or damages referred to in paragraph (a) for each category;
- (c) the classification identified under paragraph (b) with the worst potential consequences is the classification of the dam.

Table (Schedule 1)

Dam failure consequences classification	Population at risk	Consequences of failure		
		Loss of life	Environment and cultural values	Infrastructure and economics
Low	None ¹	There is no possibility of loss of life other than through unforeseeable misadventure.	Minimal short-term loss or deterioration and no long-term loss or deterioration of (a) fisheries habitat or wildlife habitat, (b) rare or endangered species, or (c) unique landscapes or sites of cultural significance.	Minimal economic losses mostly limited to the dam owner's property, with virtually no pre-existing potential for development within the dam inundation zone.
Significant	Temporary only ²	Low potential for multiple loss of life.	No significant loss or deterioration of (a) important fisheries habitat or important wildlife habitat, (b) rare or endangered species, or (c) unique landscapes or sites of cultural significance, and restoration or compensation in kind is highly possible.	Low economic losses affecting limited infrastructure and residential buildings, public transportation or services or commercial facilities, or some destruction of or damage to locations used occasionally and irregularly for temporary purposes.
High	Permanent ³	10 or fewer	Significant loss or deterioration of (a) important fisheries habitat or important wildlife habitat, (b) rare or endangered species, or (c) unique landscapes or sites of cultural significance, and restoration or compensation in kind is highly possible.	High economic losses affecting infrastructure, public transportation or services or commercial facilities, or some destruction of or some severe damage to scattered residential buildings.
Very high	Permanent ³	100 or fewer	Significant loss or deterioration of (a) critical fisheries habitat or critical wildlife habitat, (b) rare or endangered species, or (c) unique landscapes or sites of cultural significance, and restoration or compensation in kind is possible but impractical.	Very high economic losses affecting important infrastructure, public transportation or services or commercial facilities, or some destruction of or some severe damage to residential areas.
Extreme	Permanent ³	More than 100	Major loss or deterioration of (a) critical fisheries habitat or critical wildlife habitat, (b) rare or endangered species, or (c) unique landscapes or sites of cultural significance, and restoration or compensation in kind is impossible.	Extremely high economic losses affecting critical infrastructure, public transportation or services or commercial facilities, or some destruction of or some severe damage to residential areas.

¹ There is no identifiable population at risk.² People are only occasionally and irregularly in the dam-breach inundation zone, for example stopping temporarily, passing through on transportation routes or participating in recreational activities.³ The population at risk is ordinarily or regularly located in the dam-breach inundation zone, whether to live, work or recreate.

Schedule 2

[en. B.C. Reg. 108/2011, App. 1, s. 11; am. B.C. Reg. 163/2011.]

(sections 1, 3 (3.1), 3.1 (3), 5, 7, 11 (b.1) and 14)

Minimum Frequency of Safety Activities

Interpretation of Schedule

1 In this Schedule:

"EPP" means the emergency preparedness plan for a dam;

"formal inspection" means a thorough on-site inspection performed by the representative of the dam owner who is responsible for dam safety;

"OMS manual" means the operation, maintenance and surveillance manual for a dam;

"site surveillance" means the close monitoring of dam behaviour through visual inspections and, in addition, may include the systematic collection, analysis and interpretation of data obtained through automated instrumentation.

Frequency of activities

- 2** In the following table, column 1 sets out an activity that must be carried out by a dam owner under a provision in this regulation and columns 2, 3, 4 and 5 set out the minimum frequency with which the activity must be carried out for each classification.

Table (Schedule 2)

	Column 1	Column 2	Column 3	Column 4	Column 5
Item	Activity	Frequency of activity			
		Extreme classification	Very high and high classifications	Significant classification	Low classification
1	Site surveillance	Weekly ¹	Weekly ¹	Monthly ¹	Quarterly
2	Formal inspection	Semi-annually	Annually	Annually	Annually
3	Monitor instrumentation	Annually unless otherwise specified in the OMS manual	Annually unless otherwise specified in the OMS manual	Annually unless otherwise specified in the OMS manual	If and when required by a dam safety officer
4	Test operation of outlet facilities, spillway gates and other mechanical components	Annually unless otherwise specified in the OMS manual	Annually unless otherwise specified in the OMS manual	Annually unless otherwise specified in the OMS manual	Annually
5	Update the emergency contact information in the EPP	Annually	Annually	Annually	Not applicable
6	Review, and revise if necessary, the OMS manual and the EPP	Every 7 years	Every 10 years	Every 10 years	Not applicable
7	Conduct dam safety review and submit dam safety report	Every 7 years	Every 10 years	Not applicable	Not applicable
8	Review downstream conditions, as set out in section 6.1, and notify a dam safety officer of any change in classification	Annually	Annually	Annually	Annually
¹ The frequency of visual inspections may be reduced if provided for in the OMS manual.					

[Provisions relevant to the enactment of this regulation: *Water Act*, R.S.B.C. 1996, c. 483, section 101 (1), (2), (3), (5) and (8)]

APPENDIX H

Provincial Dam Failure Consequence Classification Guideline 108/2011

INFORMATION SHEET

Dam Failure Consequence Classification Conversion Guideline For Dams in British Columbia, BC Reg. 108/2011

Background to Dam Classification in BC

In 1999 the Canadian Dam Association (CDA) published Dam Safety Guidelines to establish safety requirements for new and existing dams, enable the consistent evaluation of dam safety deficiencies and to provide a basis for dam safety legislation and regulation. The Guidelines included a 4-tier failure consequence classification system: very low, low, high and very high. In February 2000, the BC Dam Safety Regulation (44/2000), under the *Water Act* of BC, was enacted. Schedule 1 of the Regulation defined 4 dam classifications similar to those provided by the CDA. In 2007, the CDA Guidelines were rewritten and the consequence classification system changed to 5 tiers: low, significant, high, very high and extreme. The Province has recently amended the BC Dam Safety Regulation bringing the provincial consequence classification system in-line with the CDA Guidelines.

2011 BC Dam Safety Regulation Amendment

On June 9, 2011, the BC Dam Safety Regulation was amended: B.C. Reg. 108/2011. Schedule 1 of the amended Regulation includes a 5-tier dam failure consequence classification (Attachment 1). This change aligns the consequence classification of BC dams with the current CDA Guidelines thus ensuring BC's dam safety requirements are consistent with the current CDA Guidelines.

Conversion to the New 2011 Dam Failure Consequences Classifications

The dam failure consequence classifications for all dams in BC have been converted to the new 5-tier classifications as per Schedule 1 of the BC Regulation 108/2011 (Attachment 1). The conversions are based on the Dam Consequence Conversion Table provided in Attachment 2. Dam owners are being advised of the Regulation change and provided with confirmation of their dam failure consequence classification by registered letter during August and September 2011. Many dam owners have undertaken dam break inundation studies to confirm the consequence classification or to provide evidence for a revised classification. If a dam owner does not receive notice of their new dam classification by October 2011, or if you have additional information that might influence the dam failure consequence classification, please contact your local Dam Safety Officer.

Additional Information

It is important to note that the BC Dam Safety Regulation dam failure consequence classification determines the requirements that a **dam owner** must meet. The CDA Guidelines classifications are for **dam design** criteria. Please refer to the CDA website to order the CDA Guidelines (<http://www.cda.ca/>).

Please note that under the amended BC Dam Safety Regulation (108/2011), there are some additional dam safety requirements for dam owners based on the consequence classifications. For example, owners of Significant Consequence Classification dams (formally Low Consequence Classification dams, BC Reg. 44/2000) are now required to prepare Emergency Preparedness Plans. Also, effective November 30, 2011, all owners of dams located on Crown land, except those dams classified as Low Consequence, are required to post signs at their dams. For further information please refer to the Dam Signage Requirement Information Sheet and OIC 237/2011 available on the BC Dam Safety website.

BC Dam Safety Website: http://www.env.gov.bc.ca/wsd/public_safety/dam_safety/index.html

Attachments:

Attachment 1 –BC Dam Safety Regulation (108/2011), Schedule 1. June 9, 2011.

Attachment 2 – BC Dam Consequence Classification Conversion Table. August 5, 2011.

Schedule 1 – Dam Safety Regulation (108/2011), June 9, 2011¹
Downstream Dam Failure Consequences Classification Table

Dam failure consequences classification	Population at risk	Consequences of failure		
		Loss of life	Environment and cultural values	Infrastructure and economics
Low	None ²	There is no possibility of loss of life other than through unforeseeable misadventure.	Minimal short-term loss or deterioration and no long-term loss or deterioration of (a) fisheries habitat or wildlife habitat, (b) rare or endangered species, or (c) unique landscapes or sites of cultural significance.	Minimal economic losses mostly limited to the dam owner's property, with virtually no pre-existing potential for development within the dam inundation zone.
Significant	Temporary only ³	Low potential for multiple loss of life.	No significant loss or deterioration of (a) important fisheries habitat or important wildlife habitat, (b) rare or endangered species, or (c) unique landscapes or sites of cultural significance, and restoration or compensation in kind is highly possible.	Low economic losses affecting limited infrastructure and residential buildings, public transportation or services or commercial facilities, or some destruction of or damage to locations used occasionally and irregularly for temporary purposes.
High	Permanent ⁴	10 or fewer	Significant loss or deterioration of (a) important fisheries habitat or important wildlife habitat, (b) rare or endangered species, or (c) unique landscapes or sites of cultural significance, and restoration or compensation in kind is highly possible.	High economic losses affecting infrastructure, public transportation or services or commercial facilities, or some destruction of or some severe damage to scattered residential buildings.
Very high	Permanent ⁴	100 or fewer	Significant loss or deterioration of (a) critical fisheries habitat or critical wildlife habitat, (b) rare or endangered species, or (c) unique landscapes or sites of cultural significance, and restoration or compensation in kind is possible but impractical.	Very high economic losses affecting important infrastructure, public transportation or services or commercial facilities, or some destruction of or some severe damage to residential areas.
Extreme	Permanent ⁴	More than 100	Major loss or deterioration of (a) critical fisheries habitat or critical wildlife habitat, (b) rare or endangered species, or (c) unique landscapes or sites of cultural significance, and restoration or compensation in kind is impossible.	Extremely high economic losses affecting critical infrastructure, public transportation or services or commercial facilities, or some destruction of or some severe damage to residential areas.

¹ This table is a copy of Schedule 1 of the Dam Safety Regulation 108/2011. In case of discrepancy between this table and the approved Regulation, the Regulation takes precedence.

² There is no identifiable population at risk.

³ People are only occasionally and irregularly in the dam-breach inundation zone, for example stopping temporarily, passing through on transportation routes or participating in recreational activities.

⁴ The population at risk is ordinarily or regularly located in the dam-breach inundation zone, whether to live, work or recreate.

BC Dam Failure Consequences Classification Conversion Table (August 5, 2011) ¹									
Consequence Classification NEW BC Dam Safety Regulation 108/2011	Population at Risk	Loss of Life		Environment and Cultural Values ²		Infrastructure & Economics ²		Consequence Classification OLD BC Dam Safety Regulation 44/2000	
		BC Reg. 108/2011	BC Reg. 44/2000 ³	BC Reg. 108/2011	BC Reg. 44/2000	BC Reg. 108/2011	BC Reg. 44/2000		
Low	None	No possibility of loss of life	Minimal	Minimal short-term and no long-term loss or deterioration	No significant loss of habitat or sites	Minimal economic losses mostly limited to dam owner's property	< \$100K Minimal	Very Low	
Significant	Temporary Only	Low potential for multiple loss of life ⁶	Some Possible	No significant loss or deterioration incl. Important habitat Restoration or compensation possible	Loss or deterioration of regionally important habitat & sites – High chance for restoration or compensation	Low economic losses to buildings, services, public transportation, infrastructure, etc.	< \$1M Limited Infrastructure, Public, Commercial	Low	
High	Permanent Residents	< 10	< 10 ⁽⁴⁾	Significant loss or deterioration incl. Important habitat Restoration or compensation possible	Same as below	High economic losses to buildings, services, public transportation, commerce, infrastructure, etc.	< \$10M ⁽⁴⁾ Same as below	High (Low ⁴)	
Very High	Permanent Residents	< 100	< 100	Significant loss or deterioration incl. critical habitat Restoration or compensation impractical	Loss or deterioration of Nationally & Provincially important habitat & sites – High chance for restoration or compensation	Very high economic losses to important buildings, services, transportation, infrastructure, commerce etc. Or severe damage to residential areas	< \$100M Substantial Infrastructure, Public, Commercial	High (High ⁴)	
Extreme	Permanent Residents	> 100	> 100	Major loss or deterioration incl. critical habitat Restoration or compensation impossible	Loss or deterioration of Nationally & Provincially important habitat & sites – Low chance for restoration or compensation	Extremely high economic losses to critical buildings, services, transportation, infrastructure, commerce etc. Or destruction or severe damage to residential areas	> \$100M Very High Infrastructure, Public, Commercial, Residential	Very High	

¹ This table contains abridged descriptions of the dam failure consequences. Attachment 1 contains the full descriptions from BC Regulation 108/2011. In all cases the Regulation takes precedence over information contained in this table.

² Names for these categories in BC Reg. 44/2000 are "Environmental and Cultural Losses" and "Economic and Social Losses" respectively.

³ Conservative estimate of loss of life amongst population affected by the flood waters (may equal Population at Risk).

⁴ Sub-classifications of "High (Low)" and "High (High)" and associated thresholds were established by policy in 1998 for use in the BC Dam Safety Program risk-based assessment.

⁵ A temporary population (e.g. in recreational areas) could be quite large and a "sunny-day" failure could result in multiple fatalities.

APPENDIX I

Provincial Dam Safety – Dam Classification Correspondence



November 30, 2012

File: 76915-07/Comp Form

SCOTT PAMMINGER
CITY OF NANAIMO
PUBLIC WORKS YARD
2020 LABIEUX RD
NANAIMO BC V9T 6J9

Dear Dam Owner:

Re: 2012 Dam Inspection Compliance Form

Thank you for completing the 2011 Dam Inspection Compliance Form(s) for:

Dam File Number	Dam Name	Failure Consequence Rating
D720001-00	MIDDLE CHASE RIVER DAM	EXTREME
D720002-00	LOWER CHASE RIVER DAM	EXTREME
D720003-01	WESTWOOD LAKE DAM	HIGH
D720005-01	JUMP CREEK DAM	VERY HIGH
D720005-02	JUMP CREEK SADDLE DAM	HIGH
D720007-00	SOUTH FORK DAM	VERY HIGH
D720121-00	RESERVOIR 1 DAM	HIGH

Under the authority of the *Water Act* of British Columbia, Dam Safety Regulation, as an owner (or owner's representative) of a High, Very High or Extreme failure consequence classification dam in British Columbia, you are required to complete the attached annual dam inspection compliance form(s). Information from these forms helps determine individual compliance and the overall provincial level of dam owner compliance.

If you have more than one dam with a failure consequence classification of High, Very High or Extreme, you will find attached one form for each dam; please submit one for each structure. The completed form(s) **must be returned by January 28, 2013** by fax (250-952-6792), by mail using the pre-paid self-addressed return envelope, or by email (dam.safety@gov.bc.ca).

Page 1 of 2

Ministry of Forests, Lands and Natural Resource Operations Resource Stewardship Division	Water Management Branch Dam Safety Section	Mailing Address: PO Box 9340 Stn Prov Govt Victoria BC V8W 9M1 Telephone: 250-952-6790 Facsimile: 250-952-6792	Location: 3 rd Floor, 395 Waterfront Cres Victoria BC V8T 5K7 
--	---	--	---

You are also reminded that a Dam Safety Review, conducted by a qualified engineer, is required every 7 years for Extreme Consequence dams and every 10 years for High and Very High Consequence Dams. Those dam owners not in compliance with this requirement were recently sent letters and are required to comply before January 31, 2013. If you received a letter indicating that we do not have the required Dam Safety Review report, please ensure that you follow the instructions provided or you may be subject to escalating enforcement action.

Please also ensure you review the information on the reverse side of the enclosed *compliance form(s)* for an explanation of the eight questions on the form. A list of Dam Safety Officers and contact information is enclosed. If you have any questions, please contact your Dam Safety Officer or visit our web page at: www.env.gov.bc.ca/wsd/public_safety/dam_safety/.

If you are not the correct person to receive this compliance form, please return it with your comments so that we can determine who should receive the form.

Yours truly,



Glen Davidson, P.Eng.
Comptroller of Water Rights

Enclosures

pc: Dam Safety Officer(s):
MONTY MIEDREICH
JOHN BALDWIN



January 9, 2012

File: 76915-03/Dam Safety Regulation

CITY OF NANAIMO
ATTN: BILL SIMS, MANAGER
2020 LABIEUX RD
NANAIMO BC
V9T6J9

Dear Dam Owner:

**Re: Information for Dam Owners about the amended BC Dam Safety Regulation
(under OIC 108/2011)**

This letter is to inform you that the Dam Safety Regulation, 108/2011, under the *Water Act of British Columbia* has been amended. Our records indicate that you are the primary owner of the dam(s) noted below (for definition of primary owner, please refer to the second last paragraph of the letter).

This letter has been sent to owners of dams classified as "Low" and "Significant" under Schedule 1 of the amended Dam Safety Regulation. Please be advised that Dam Consequence Classification names under Schedule 1 of the amended Dam Safety Regulation have been changed. "Low" classification dams were previously named "Very Low" and "Significant" classification dams were previously named "Low". This revision is a change of name only; please see the enclosed information sheet on dam classification. The new classification(s) of your dam(s) are noted in the table below.

Dam Name	Dam File Number	2011 Consequence Class
MCGARRIGLE CREEK DAM	720147	LOW
WESTWOOD LAKE SADDLE DAM	720003	SIGNIFICANT
UPPER CHASE RIVER	720122	SIGNIFICANT

Please read the enclosed information carefully and familiarize yourself with any applicable changes to your responsibilities, if any:

- A copy of the amended Dam Safety Regulation (108/2011),
- "Application of the Dam Safety Regulation", an Information Sheet on the amended regulation,

Page 1 of 2

Ministry of Forests, Lands & Natural Resource Operations Resource Stewardship Division	Water Management Branch Dam Safety Section	Mailing Address: PO Box 9340 Stn Prov Govt Victoria BC V8W 9M1 Telephone: 250-952-6790 Facsimile: 250-952-6792	Location: 3 rd Floor, 395 Waterfront Cres Victoria BC V8T 5K7 
--	---	--	---

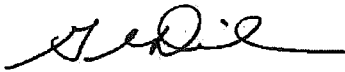
- "Dam Signage Requirements"; Information Sheet for dams on or partially on Crown Land (if applicable),
- "Dam Failure Consequence Classification Conversion Guideline", Information Sheet.

New Signage Requirement: Please note that as of November 30, 2011 all owners of dams (except those of Low Classification) that are located on or partially on Crown Land must install information signs as per Section 3, subsections (5), (6) and (7) of the Dam Safety Regulation. Additional information regarding the signs is in the enclosed document "Dam Signage Requirements".

In some instances there is more than one person who holds a water licence to store water in the reservoir behind the dam. This letter is being sent to the person that we have on record as the holder of the largest water storage licence, or, the person who has been identified as the representative of other water storage licence holders. This person is identified as the primary owner. To determine who the other water storage licencees are (if any), you may use the following weblink (or contact the Dam Safety Officer in your region): http://a100.gov.bc.ca/pub/wtrwhse/water_licences.input.

If you have any questions please contact your Dam Safety Officer, or send an email to dam.safety@gov.bc.ca or visit the BC Dam Safety web page (www.env.gov.bc.ca/wsd/public_safety/dam_safety/). A list of Dam Safety Officers and contact information is available on the website.

Yours truly,



Glen Davidson, P.Eng.
Comptroller of Water Rights

Enclosures (4)



August 12, 2011

File: 76915-03/Dam Safety Regulation

Scott Pamminger Water Resources Technologist
City of Nanaimo
Public Works Yard
2020 Labieux Rd
Nanaimo BC V9T 6J9

Dear Dam Owner:

Re: June 9, 2011 Dam Safety Regulation Amendment – Information for Dam Owners

This registered letter is to inform you that the Dam Safety Regulation, 108/2011, under the *Water Act of British Columbia* has been amended. Our records indicate that you are the owner of the dam(s) noted below. Please be advised that Dam Consequence Classifications under Schedule 1 of the amended Dam Safety Regulation are being revised. The old classification(s) and new classification(s) of the dam(s) are noted in the table below. Please read the enclosed information carefully and take note of the requirements for dam owners. Dam owner requirements are based on the dam classification.

Dam Name	Dam File Number	2000 Con. Class.	2011 Con. Class.
MIDDLE CHASE RIVER DAM	D720001-00	High	Very High
LOWER CHASE RIVER DAM	D720002-00	High	Very High
WESTWOOD LAKE DAM	D720003-01	High	High
JUMP CREEK DAM	D720005-01	High	Very High
SOUTH FORK DAM	D720007-00	High	Very High
RESERVOIR 1 DAM	D720121-00	High	High

Please find enclosed the following documents:

- A copy of the amended Dam Safety Regulation (108/2011),
- “Application of the Dam Safety Regulation”, an Information Sheet on the amended regulation,
- “Dam Signage Requirements”; Information Sheet for dams on, or partially on Crown Land;
- “Dam Failure Consequence Classification Conversion Guideline”, Information Sheet.

Page 1 of 2

Ministry of Forests, Lands & Natural Resource Operations Resource Stewardship Division	Water Management Branch Dam Safety Section	Mailing Address: PO Box 9340 Stn Prov Govt Victoria BC V8W 9M1 Telephone: 250-952-6790 Facsimile: 250-952-6792	Location: 3rd Floor, 395 Waterfront Cres Victoria BC V8T 5K7 
--	---	--	---

New Signage Requirement: Please note that as of November 30, 2011 all owners of dams (except Low Classification) that are located on or partially on Crown Land must install information signs as per OIC 237/2011. Information on the location, size, height, type and wording required for these signs is in the enclosed document "Dam Signage Requirements" and OIC 237/2011.

In some instances there is more than one person who holds a water licence to store water in the reservoir behind the dam. This letter is being sent to the person that we have on record as the holder of the largest water storage licence, or, the person who has been identified as the representative of other water storage licence holders. A letter advising of the amended regulation will be sent to the other water storage licence holders in due course.

If you have any questions please contact your Dam Safety Officer, or send an email to dam.safety@gov.bc.ca or visit the BC Dam Safety web page (www.env.gov.bc.ca/wsd/public_safety/dam_safety/). A list of Dam Safety Officers and contact information is available on the website.

Yours truly,

A handwritten signature in black ink, appearing to read 'G. Davidson', written over a horizontal line.

Glen Davidson, P.Eng.
Comptroller of Water Rights

Enclosures