

Dam Emergency Plan (DEP)

THULIN LAKE DAM

THULIN CREEK

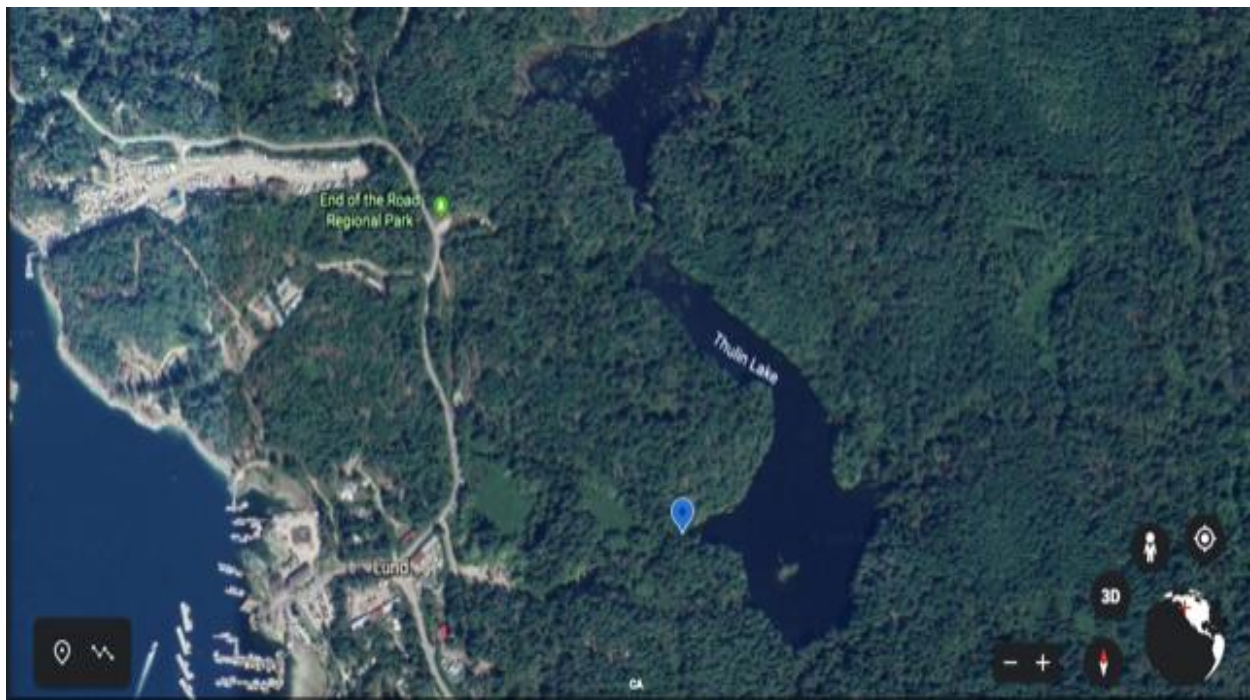
D420108-00

THULIN LAKE (UPPER) DAM

ALSO KNOWN AS LUND LAKE

D420106-00

LUND, BC



Dam Owner: Lund Waterworks District

Prepared By: Shelley Cherry & Courtney Robertson

Reviewed and Updated: 2024-02-05

Copy 1 of 7

DEP Revision #2

DEP Overview

The purpose of this Dam Emergency Plan (DEP) is to reduce the risk of human life loss and injury and minimize property damage during an unusual or emergency event at Thulin Lake and Thulin (Upper) Lake. This DEP has been prepared with the intent of meeting the requirements of the *Water Sustainability Act*, Dam Safety Regulation (Regulation). The dam owner and local, regional and provincial response agencies all play a role in responding to an emergency under the *Emergency Program Act*.

Notifications regarding an unusual or emergency event at the dams are based on the three emergency levels which are determined by the dam owner, Lund Waterworks District. The notification charts for each of the three emergency levels, located in *Appendix B-1*, must be reviewed, and if necessary, revised annually.

Section 9 (1) (a) (ii) of the Regulation requires the dam owner's DEP to include a record containing specific information on their dam to be used by local emergency authorities for their own local emergency plan; a plan mandated under the *Emergency Program Act*. Therefore, to fulfill this requirement, following approval by the Dam Safety Officer, the dam owner must provide *Sections 1 & 2* and *Appendix A (A-1, A-2 & A-3)* to relevant local emergency authorities. Subsequently, these sections are reviewed annually by the dam owner and, if required, updated and copies sent to the Dam Safety Officer and all local emergency authorities for that area.

2. Basic DEP Data

2.1 Dam Description

Dam Name:	Thulin Lake
Stream Name:	Thulin Creek
Consequence Classification:	High
Dam Type:	Concrete Gravity
Provincial Dam Number:	D420108-00
Height:	3.7 m
Storage Volume:	204,000 m ³
Drainage Area:	5.0 km ²
Spillway type:	Stoplog
Low Level Outlet:	Plastic (PVC) 6"
Coordinates (i.e. lat/long or UTM):	49° 58' 55" N 124° 45' 08" W
<i>Other description:</i>	

See Plan View of Dam, *Appendix C*.

2.2 Directions to Thulin Lake Dam

Vehicular access to the dam may be obtained by following Highway 101 into Lund, turning right onto Finn Bay Road and then the first right onto Emil Road. There is an unpaved access road located at the end of Emil Road. At 9730 Emil Road, the road forks. Vehicular access is to the left and secured by a locked gate. The Lund Waterworks District Staff as well as the Water Operator can provide access with a key. A sign at the dam crest provides local and provincial emergency numbers to call if any dam concerns are noted. The Lake may be accessed by a two or four-wheel drive (in winter conditions) vehicle. Alternative dam access at 9730 Emil Road offers a walking path to the left, secured by a heavy chain to prevent motorized access.

2.4 Dam Description

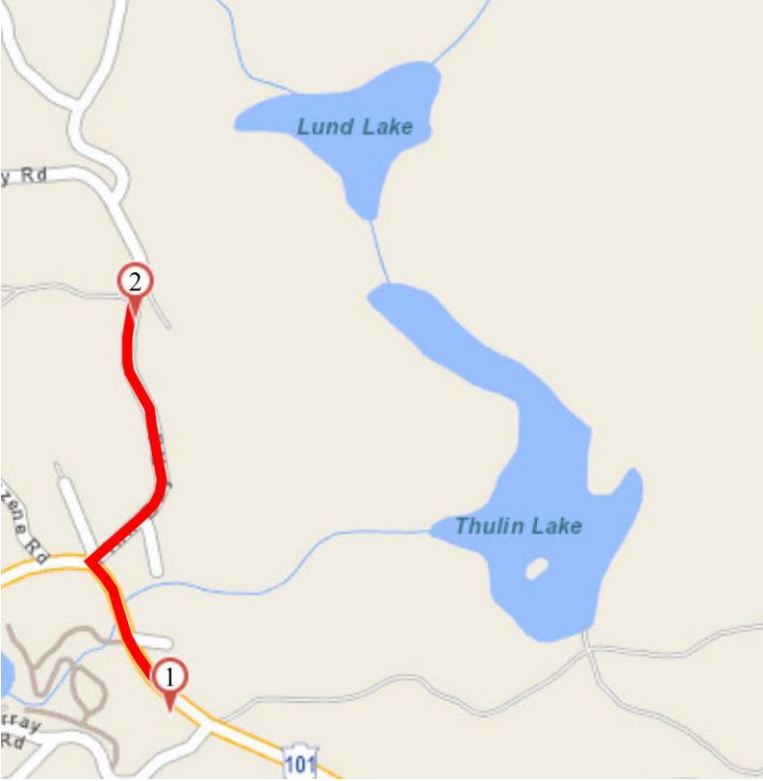
Dam Name:	Thulin (Upper) Lake aka Lund Lake
Stream Name:	Thulin Creek
Consequence Classification:	High
Dam Type:	Earthfilled
Provincial Dam Number:	D420106-00
Height:	2.4 Meters
Storage Volume:	44,900m ³
Drainage Area:	4.1km ²
Spillway type:	Stoplog
Low Level Outlet:	Plastic (PVC) 6"
Coordinates (i.e. lat/long or UTM):	49° 59' 11" N 124° 45' 12" W
<i>Other description:</i>	

See Plan View of Dam, *Appendix C*.

2.5 Directions to Thulin (Upper) Lake Dam

Vehicular access to the dam may be obtained by following Highway 101 into Lund, turning right onto Finn Bay Road, turn right onto an unpaved road just before the gazebo property at 9840 Finn Bay Road, Lund, BC. Thulin (Upper) Lake Dam is approximately 500m along this road. The Lund Waterworks District Staff as well as the Water Operator can provide access with a key. A sign at the dam crest provides local and provincial emergency numbers to call if any dam concerns are noted. The Lake may be accessed by a two or four-wheel drive (in winter conditions) vehicle. Alternative dam access at 9730 Emil Road offers a walking path to the left, secured by a heavy chain to prevent motorized access.

2.6 Access Map to Thulin (Upper) Lake Dam



3. General Roles and Responsibilities

The following are the basic emergency planning and response roles and responsibilities for the five key agencies involved when a level 2 or 3 emergency occurs. For more detailed information regarding emergency planning, preparedness, response and recovery refer to the document, *British Columbia Emergency Management System (BCEMS) 2016*.

3.1 Dam Owner

- As soon as an emergency event is observed or reported, immediately determine the emergency level (see Guidance for Determining the Emergency Level, *Appendix D*).
 - Level 1: unusual event, slowly developing
 - Level 2: potential dam failure situation, rapidly developing
 - Level 3: dam failure appears imminent or is in progress
- Immediately notify the personnel in the order shown on the Notification Chart (Appendix B-1) for the appropriate emergency level. This includes “persons in the immediate vicinity of the dam to be evacuated”, Appendix A-3.
- Undertake appropriate remedial actions during Level 2. Remedial actions may be recommended by the Dam Owners Technical Representative or required by the Dam Safety Officer.
- Provide updates of the situation to the local emergency authority to assist them in making timely and accurate decisions regarding warnings and evacuations.
- Provide leadership to assure the DEP is reviewed and updated annually and copies of the revised DEP are distributed to all who received copies of the original DEP including the records for the local emergency authorities. Undertake DEP exercises as appropriate.

3.2 Local Emergency Authorities

Local emergency authorities support and coordinate the overall emergency response activities within its geographical or functional jurisdiction.

- Serve as the primary contact responsible for coordination of all emergency actions for potentially affected communities.
- When a Level 2 situation occurs:
 - Prepare emergency response personnel for possible evacuations that may be needed if a Level 3 situation occurs.
 - Consider drafting a State of Local Emergency in preparation for Level 3.
 - Provide resources as necessary to the dam owners.
- When a Level 3 situation occurs:

- Initiate warnings and order evacuation of people at risk downstream of the dam.
- Declare a State of Local Emergency if required.
- Direct local emergency response services (may include local law enforcement) to carry out the evacuation of people and close roads within the evacuation area (see Evacuation Area Map, Appendix A-2).
- Provide resources as necessary to the dam owners.
- Decide when to terminate the emergency.
- Participate in review, updates and exercises of the DEP.

3.3 Emergency Management BC (EMBC)

Emergency Management BC (EMBC) is the lead agency in the provincial government for all emergency management activities. EMBC works with local governments, First Nations, federal departments, industry, non-government organizations and volunteers to support the emergency management phases of mitigation/ prevention, preparedness, response and recovery. EMBC has its headquarters, the Provincial Emergency Co-ordination Centre (PECC) and the 24/7 Emergency Call Centre (ECC) in Victoria. Six Provincial Regional Emergency Operations Centres (PREOCs) are located in Terrace, Prince George, Kamloops, Nelson, Surrey and Victoria (co-located with the PECC).

- When a Level 2 or Level 3 situation occurs, provide support as requested or required. For example:
 - Assist local emergency authority when notified of the activation of local emergency plans with issuance of an emergency task number.
 - Propagate the emergency information to other relevant stakeholders.
 - Support the communication needs of local emergency authority.
 - Declare a Provincial State of Emergency if required.
- Participate in exercises of the DEP.

3.4 Dam Owner's Technical Representatives

- Undertake an engineering assessment of the safety hazard at the dam.
- Assist the dam owner to determine the emergency level, if time permits.
- Advise the dam owner of remedial actions to take if Level 2 event occurs, as required.

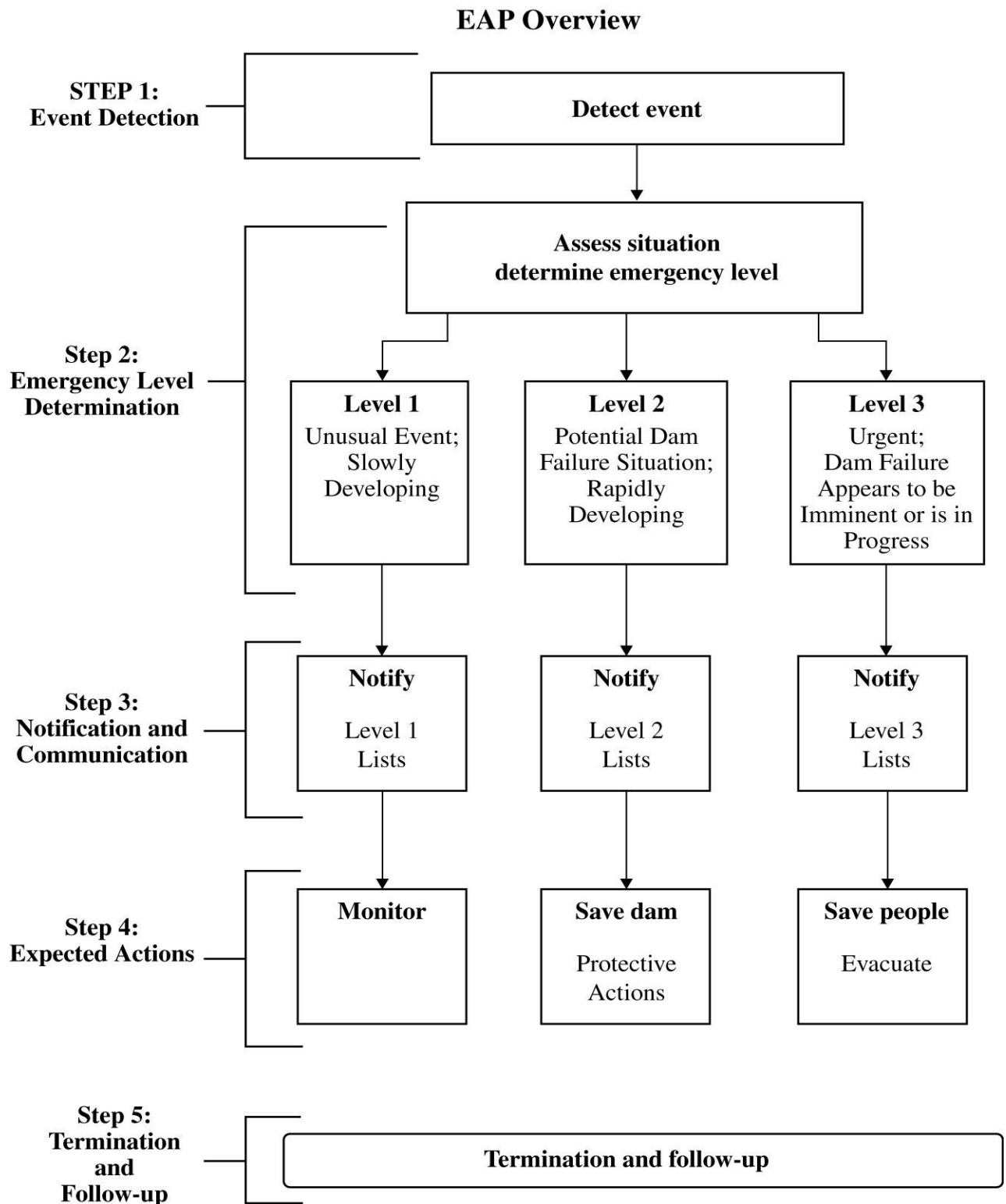
3.5 Ministry of Forests, Lands and Natural Resource Operations

- MFLNRO is the ministry responsible for the provincial government “Dam Emergency Response Plan (DERP)” under the Emergency Program Act. The BC Dam Safety Program administers the DERP and has an active role in all levels.
- The DSO is the first point of contact in MFLNRO for Level 1, and, is required to inform EMBC if a dam is considered to be at Level 1. EMBC may contact the local emergency authority at their discretion.
- The DSO may have an active role in Levels 2 and 3. The DSO may advise the dam owner of the emergency level determination.
- The DSO may advise the dam owner of remedial actions to take if Level 2 event occurs.

- Support EMBC, local emergency authorities, and other agencies. The DSO may be called on to be the Subject Matter Expert at an emergency response center.
- The Dam Safety Officer (DSO) is responsible for reviewing and accepting the DEP.

4. Five-Step DEP Process

4.1 DEP Overview



4.2 Five Steps

Step 1 - Event Detection

This step describes the detection of an unusual or emergency event and provides information to assist the dam owner in determining the appropriate emergency level for the event.

Unusual or emergency events may be detected by:

- Observations at or near the dam, by dam owner, government personnel (local, Provincial, or Federal), landowners, visitors to the dam, or the public
- Dam safety review, formal inspection or site surveillance
- Evaluation of instrumentation data
- Earthquakes felt or reported in the vicinity of the dam
- Forewarning of conditions that may cause an unusual event or emergency event at the dam (for example, a severe weather or flash flood forecast)

Step 2 - Emergency Level Determination

After an unusual or emergency event is detected or reported, the dam owner or his alternate is responsible for classifying the event into one of the following three emergency levels (*See table Guidance for Determining the Emergency Level (Appendix D) for guidance in evaluating specific events to determine if they are unusual or emergency situations*):

Emergency Level 1 - *Non-emergency, unusual event, slowly developing*:

This situation is not normal and has not yet threatened the operation or structural integrity of the dam, but possibly could if it continues to develop (corresponds to Section 15 - *Potential safety hazard* of the Dam Safety Regulation, *Water Sustainability Act*). A dam safety engineer or technical expert should be contacted to investigate the situation and recommend actions to take. The condition of the dam should be closely monitored, especially during storm events, to detect any development of a potential or imminent dam failure situation. The Local Emergency Authority should be informed if it is determined that the issue may possibly develop into a worse condition that may require emergency actions.

Emergency Level 2 - *Potential dam failure situation, rapidly developing*:

This situation may eventually lead to dam failure and flash flooding downstream, but there is not an immediate threat of dam failure (corresponds to Section 14 – *Hazardous conditions* of the Dam Safety Regulation, *Water Sustainability Act*). A dam safety engineer or technical expert should be contacted to investigate the situation, if time permits, and recommend actions to take. The dam owner should closely monitor the condition of the dam, modify the operation of the dam if needed, and undertake other appropriate hazard response activities. The dam owner should periodically update the status of the situation to

appropriate emergency response authorities. If the dam condition worsens and failure becomes imminent, evacuation procedures must be implemented under Level 3.

Emergency Level 2 is also applicable when flow through the spillway has caused or is expected to cause flooding of downstream areas and people near the stream channel could be endangered. The dam owner may need to refer to flood release operations as outlined in the Operation, Maintenance and Surveillance manual.

Persons in the immediate vicinity of the dam, local emergency authorities, EMBC and the dam safety officer should be on alert to initiate evacuations or road closures if the flooding increases or the level 2 emergency escalates.

Emergency Level 3 - Urgent; dam failure appears imminent or is in progress:

This is an extremely urgent situation where a dam failure is occurring or obviously is about to occur and cannot be prevented. This situation is also applicable when flow through the spillway is causing downstream flooding and creates a hazardous condition that places persons in danger. The following persons must be contacted immediately so persons in imminent danger can be evacuated from the endangered area, roads can be closed as needed and other emergency response activities can be undertaken (see Evacuation Area Map, Appendix A-2); the persons in the immediate vicinity of the dam, Emergency Management BC, Local Emergency Authority and the Dam Safety Officer (Regulation, Section 14, *Hazardous conditions*).

See Examples of Emergency Situations (Appendix F).

Step 3 - Notification and Communication

Notification

After the emergency level has been determined, the people on the Notification Chart (Appendix B-1) for the appropriate emergency level shall be notified immediately.

Communication

The Dam Emergency Situation Report (Appendix F) may be used as a guide for the information that should be communicated with the various emergency personnel.

Emergency Level 1 - Non-emergency, unusual event, slowly developing:

The dam owner should contact their Technical Expert and must notify the Dam Safety Officer to describe the situation, and request technical assistance on next steps to take.

Emergency Level 2 - Potential dam failure situation, rapidly developing:

The dam owner should contact their Technical Expert if time permits but must notify the following of this emergency situation (see Regulation, Section 14, *Hazardous conditions*); Emergency Management BC, Local Emergency Authority, Persons in the Immediate Vicinity of the Dam (Appendix A-3) and the Dam Safety Officer.

The following message may be used to help describe the emergency situation to the Local Emergency Authority:

“This is Identify yourself; name, position.

We have an emergency condition at Thulin Lake Dam, located 1 kilometer northeast of Lund Harbour, BC. Or Thulin (Upper) Lake Dam, located 1.5 Kilometers northeast of Lund Harbour

We have activated the Dam Emergency Plan for this dam and are currently under Level 2.

We are implementing predetermined actions to respond to a rapidly developing situation that could result in dam failure.

Please be prepared to evacuate the area along low-lying portions of Thulin Creek.

Reference the evacuation map in your copy of the Dam Emergency Plan.

We will advise you when the situation is resolved or if the situation gets worse.

I can be contacted at the following number – emergency contact phone number. If you cannot reach me, please call the following alternative number alternate phone number.”

Emergency Level 3 - Urgent; dam failure appears imminent or is in progress:

The following actions should be taken:

1. Contact all Persons in the Immediate Vicinity of the Dam (*Appendix A-3*) to advise them to vacate the endangered area and call the Local Emergency Authorities. Be sure to say, “This is an emergency.” The Local Emergency Authority will implement their mandated emergency plan and begin the evacuation.

The following message may be used to help describe the emergency situation:

“This is an emergency. This is Identify yourself; name, position.

Thulin Lake Dam, located 1 kilometer northeast of Lund Harbour, BC is failing. The downstream area must be evacuated immediately. Repeat, Thulin Lake Dam is failing; evacuate the area along low-lying portions of Thulin Creek.

We have activated the Dam Emergency Plan for this dam and are currently under Level 3. Reference the evacuation map in your copy of the Dam Emergency Plan.

I can be contacted at the following number emergency contact phone number. If you cannot reach me, please call the following alternative number alternate phone number.”

2. Notify Emergency Management BC and the Dam Safety Officer of this emergency situation (see Regulation, Section 14, *Hazardous conditions*).
3. Do whatever is necessary to bring people in imminent danger (anyone on the dam, downstream from the dam, boating on the reservoir, or evacuees) to safety.
4. Keep in frequent contact with the Local Emergency Authorities and to keep them up-to-date on the condition of the dam. They can help handle the emergency.
5. If all means of communication are lost: (1) try to find out why, (2) try to get to another radio or telephone that works, or (3) get someone else to try to re-establish communications. If these means fail, handle the immediate problems as best as you can, and periodically try to re-establish contact with Local Emergency Authorities.

The following message may be used as a guide for the Local Emergency Authorities to communicate the status of the emergency with the public:

*Attention: This is an emergency message from the **Local Emergency Authority**. Listen carefully. Your life may depend on immediate action.*

*Thulin Lake Dam, located 1 kilometer northeast of Lund Harbour, BC is failing.
Repeat. **Thulin Lake Dam**, located 1 kilometers northeast of Lund Harbour, BC is failing.*

If you are in or near this area, proceed immediately to high ground away from the valley. Do not travel on Highway 101, south of Lund, BC or return to your home to recover your possessions. You cannot outrun or drive away from the flood wave. Proceed immediately to high ground away from the valley.

Repeat message.

Step 4 - Expected Actions

If the dam owner becomes aware of an unusual or emergency event at their dam, they should immediately determine the emergency level and the following actions should be taken. If time permits, the dam owner's Technical Expert should be contacted for technical consultation.

Emergency Level 1 - Non-emergency, Unusual event, slowly developing:

- A. The dam owner should inspect the dam; at a minimum, inspect the full length of the upstream slope, crest, downstream toe, and downstream slope. Also, check the reservoir area, abutments, and downstream channel for signs of changing conditions. **If increased seepage, erosion, cracking, or settlement is observed, immediately report the observed conditions to their Technical Expert; refer to the table Guidance for Determining the Emergency Level (Appendix D) for guidance in determining the appropriate event level for the new condition and recommended actions.**
- B. The dam owner must notify the Dam Safety Officer and prepare a plan, through their Technical Expert, that sets out any actions required to rectify this potential safety hazard (see Dam Safety Regulation, Section 15, *Potential Safety hazard*).

- C. Record all contacts that were made on the Notification Chart (Appendix B-1). Record all information, observations, and actions taken. Note the time of changing conditions. Document the situation with photographs and video, if possible.

Emergency Level 2 - Potential dam failure situation, rapidly developing:

- A. The dam owner should contact their Technical Expert, if time permits, to report the situation and request technical staff to investigate the situation and recommend corrective actions.
- B. The dam owner must contact EMBC, the Local Emergency Authorities and Persons in the Immediate Vicinity of the Dam to inform them that the DEP has been activated and if current conditions get worse an emergency situation may require evacuation. Preparations should be made for possible road closures and evacuations.
- C. Provide updates to the Persons in the Immediate Vicinity of the Dam and Local Emergency Authorities to assist them in making timely decisions concerning the need for warnings, road closures, and evacuations.
- D. If time permits, the dam owner should inspect the dam. At a minimum, inspect the full length of the upstream slope, crest, downstream toe, and downstream slope. Also, check the reservoir area, abutments, and downstream channel for signs of changing conditions. **If piping, increased seepage, erosion, cracking, or settlement are observed, immediately report the observed conditions to the Technical Expert; refer to the table Guidance for Determining the Emergency Level (Appendix D) for guidance in determining the appropriate event level for the new condition and recommended actions.**
- E. Record all contacts that were made on the Notification Chart (Appendix B-1). Record all information, observations, and actions taken. Note the time of changing conditions. Document the situation with photographs and video, if possible.
- F. If time permits, follow the Emergency Remedial Actions for Level 2 Conditions (Appendix E) as appropriate.

Emergency Level 3 - Urgent; dam failure appears imminent or is in progress:

- A. The dam owner shall immediately advise the Local Emergency Authorities of the urgent condition of the dam and request that they lead the efforts to evacuate persons in the endangered area, carry out warnings and close roads (see Evacuation Area Map, Appendix A-2) to safeguard persons in imminent danger. The dam owner shall also immediately advise Persons in the Immediate Vicinity of the Dam (Appendix A-3) to vacate the endangered area.
- B. The dam owner shall immediately contact others shown on the Notification Chart (Appendix B-1).
- C. The dam owner shall maintain continuous communication and provide the Local Emergency Authorities with updates of the situation to assist them in making timely decisions concerning warnings and evacuations.
- D. The dam owner should record all contacts that were made to Persons in the Immediate Vicinity of the Dam and record all information, observations, and actions and note the time of changing conditions. Document the situation with photographs and video, if possible.

- E. Advise people monitoring the dam to follow safe procedures. Everyone should stay away from any of the failing structures or slopes and out of the potential breach inundation areas.

Step 5 - Termination

Whenever the DEP has been activated, an emergency level has been declared, all DEP actions have been completed, and the emergency is over, the DEP operations must eventually be terminated and follow-up procedures completed.

Termination responsibilities

The Local Emergency Authority is responsible for terminating DEP operations and relaying this decision to the dam owner. It is then the responsibility of each person to notify the same group of contacts that were notified during the original event notification process to inform those people that the event has been terminated.

Prior to termination of a Level 3 event that has not resulted in an actual dam failure, the dam owner's Technical Expert or the Dam Safety Officer will inspect the dam or require the inspection of the dam to determine whether any damage has occurred that could potentially result in loss of life, injury, or property damage. If it is determined those conditions do not pose a threat to people or property, the Local Emergency Authority will be advised to terminate DEP operations as described above.

The dam owner shall ensure that a final Dam Emergency Situation Report (*Appendix F*) is completed, and document the emergency event and all actions that were taken. The dam owner shall distribute copies of the completed report to the Dam Safety Officer.

5. DEP Maintenance

5.1 Annual Review of DEP

Update the emergency contact information in the DEP at least once a year as per the Regulation, Schedule 2. The DEP should be revised if any of the contacts have changed. The DEP annual review will include the following:

- Verifying that all of the contact information in Emergency Contacts for the Dam (*Appendix A-1*), Evacuation Area Map (*Appendix A-2*) and Persons in the Immediate Vicinity of the Dam to be Evacuated (*Appendix A-3*) is current.
- Verifying that all contact information in Notification Chart (*Appendix B-1*), Emergency Services Contacts and Other Agencies (*Appendix B-2*) and Emergency Response Resources (*Appendix B-3*), is current.

5.2 Revisions

Update the DEP document at least every 10 years for significant and high failure consequence classification dams and every 7 years for very high and extreme failure consequence classification dams as per Schedule 2 of the Regulation. The DEP document held by the dam owner is the master document. When revisions occur, the dam owner will provide the revised pages and an updated revision summary page to all the DEP document holders. The document holders are responsible for revising any outdated copy of the respective document(s) whenever revisions are received. Outdated pages shall be immediately destroyed to avoid any confusion with the revisions.

5.3 Exercises

The province along with the Canadian Dam Association recommends DEP training for all dam personnel and testing the DEP through internal exercises and periodic review and/or exercise of the DEP. Periodic exercise may consist of a simple review by the dam owner(s) and key dam owner personnel (i.e. emergency, principal, alternate contacts the dam owner's technical experts) or a more thorough exercise that could include external organizations such as the local emergency authorities (who may want to include emergency responders), persons in the immediate vicinity of the dam, the Dam Safety Officer, EMBC and others with responsibilities listed in the DEP. Other organizations that may be involved with an unusual or emergency event at the dam may also be encouraged to participate. It is recommended that before the tabletop exercise begins, meeting participants visit the dam to familiarize themselves with the dam site.

A tabletop exercise usually involves a facilitator presenting a scenario of an unusual or emergency event at the dam. The scenario should be developed prior to the exercise. Once the scenario has been presented, the participants will discuss the responses and actions that they would take to address and resolve the scenario. The facilitator controls the discussion, ensuring realistic responses and developing the scenario throughout the exercise.

After the tabletop exercise, the five-step DEP response process should be reviewed and discussed. Any recommendations for improvements should be documented.

6. Record of Holders of Control Copies of this DEP

Copies of the DEP should be provided to appropriate Dam Owner personnel and outside agencies and updates provided as the original is updated.

Copy Number	Entity or Organization	Person receiving copy	Whole DEP or Part ¹
1	Lund Waterworks District - Receiver	Frances Ladret	Whole
2	Lund Waterworks District – Water Operator	Courtney Robertson	Whole
3	Lund Waterworks District – Administrator	Shelley Cherry	Whole
4	Province of BC – Dam Safety Officer/Engineer	Binod Acharya	Whole
5	qathet Regional District – Catastrophic Emergencies	Ria Curtis	Part
6	qathet Regional District - Emergency Notification System	Ryan Thoms	Part
7	Vancouver Coastal Health – Certified Environmental Health Officer	Jack Davidson	Part

¹ Sections 1, 2 & 4.1 and Appendix A (A-1, A-2 & A-3) only

7. Record of Revisions and Updates Made to DEP

Revision Number	Date	Revisions made	By whom	Provided to Holders of Control Copies
1	2022-07-07	Updated contacts and DEP holders	Shelley Cherry	1 through 7
2	2024-02-05	Update contacts, DEP holders and include Thulin (Upper) Lake Dam.	Shelley Cherry	1 through 7

Appendix A

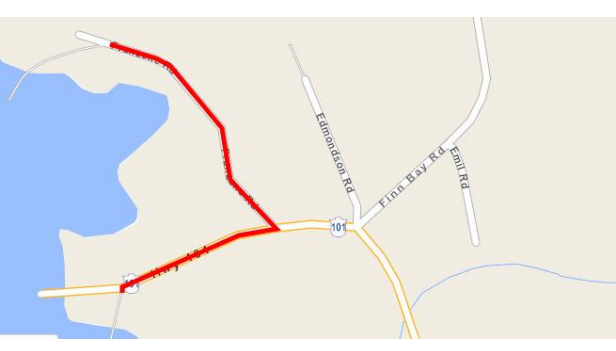
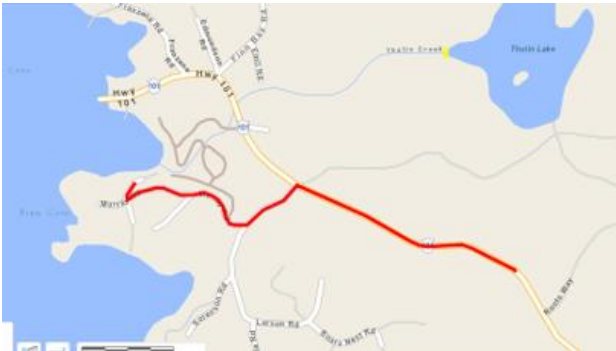
(Appendix A to be forwarded to local emergency authorities)

1. Appendix A-1 – Emergency Contacts for Dam
2. Appendix A-2 – Evacuation Area Map
3. Appendix A-3 – Persons in the Immediate Vicinity of the Dam to be Evacuated

Appendix A-1 Emergency Contacts for the Thulin Lake Dam

Dam Owner:	Lund Waterworks District
Emergency Dam Contact:	Courtney Robertson – Water Operator
Business Name:	Lund Waterworks District
Address	1724 Highway 101, Lund, BC V0N 2G0
Business Phone	604-414-0230
Cell Phone:	604-483-1410
Fax:	
Email:	courtney.robertson808@gmail.com
Other:	
Principal Dam Contact:	Shelley Cherry - Administrator
Business Phone:	
Cell Phone:	604-935-9555
Email:	lundwaterdistrict@gmail.com
Other:	
Alternate Dam Contact	Frances Ladret - Receiver
Business Phone:	
Cell Phone:	604-223-4671
Email:	francesladret@gmail.com
Other:	

Appendix A-2 Evacuation Area Map



Appendix A-3 Persons in the Immediate Vicinity of the Thulin Lake Dam to be Evacuated

(Note: if your dam has a consequence of failure classification of low or significant, by definition you will most likely not have person's that would be considered in the endangered zone and therefore this list would not be required in your DEP.)

A major flood caused by a sudden uncontrolled release of water from the dam is estimated to inundate areas surrounding Thulin Creek and 4 properties located in the immediate vicinity of the dam. 'Persons in the immediate vicinity of the dam' means persons located immediately downstream and adjacent to the dam where available warning time is very limited (where local emergency authorities could not be expected to respond in time). The persons, including residents and/or property and business owners (marked on the evacuation map) that will need to be on notice to evacuate at Level 2 or to be evacuated at level 3 are listed below.

Persons (including residents and/or property & business owners)	Address	Phone numbers	Distance from dam (m)
Tla' Amin Resources	9730 Emil Road, Lund	604-414-0474	240 Meters
Sun Lund RV Park Ed & Julia Levy	1496 Murray Road, Lund	604-483-9220	1 Kilometer
Cindy & Sonny Wong	1530 Scotch Place, Lund	604-414.9430	550 Meters
Lund Marine Ltd. DBA: Lund Auto & Outboard Blake Rice or Drew Jewra	1520 Highway 101, Lund	604-483-4612	270 Meters

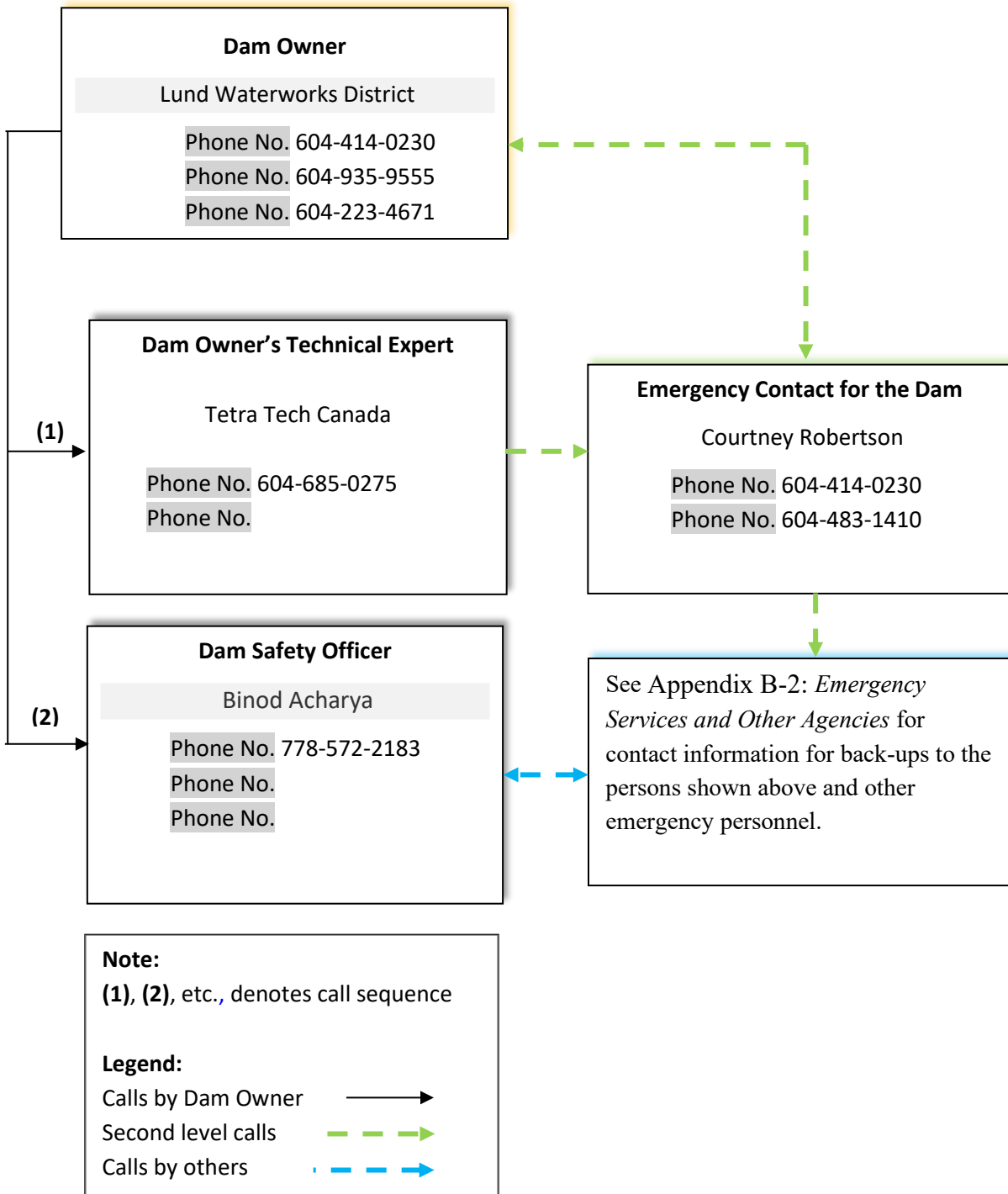
Appendix B

- 1. Appendix B-1 – Notification Charts**
- 2. Appendix B-2 – Emergency Services Contacts and other Agencies**
- 3. Appendix B-3 – Emergency Response Resources**

Appendix B-1 Notification Charts

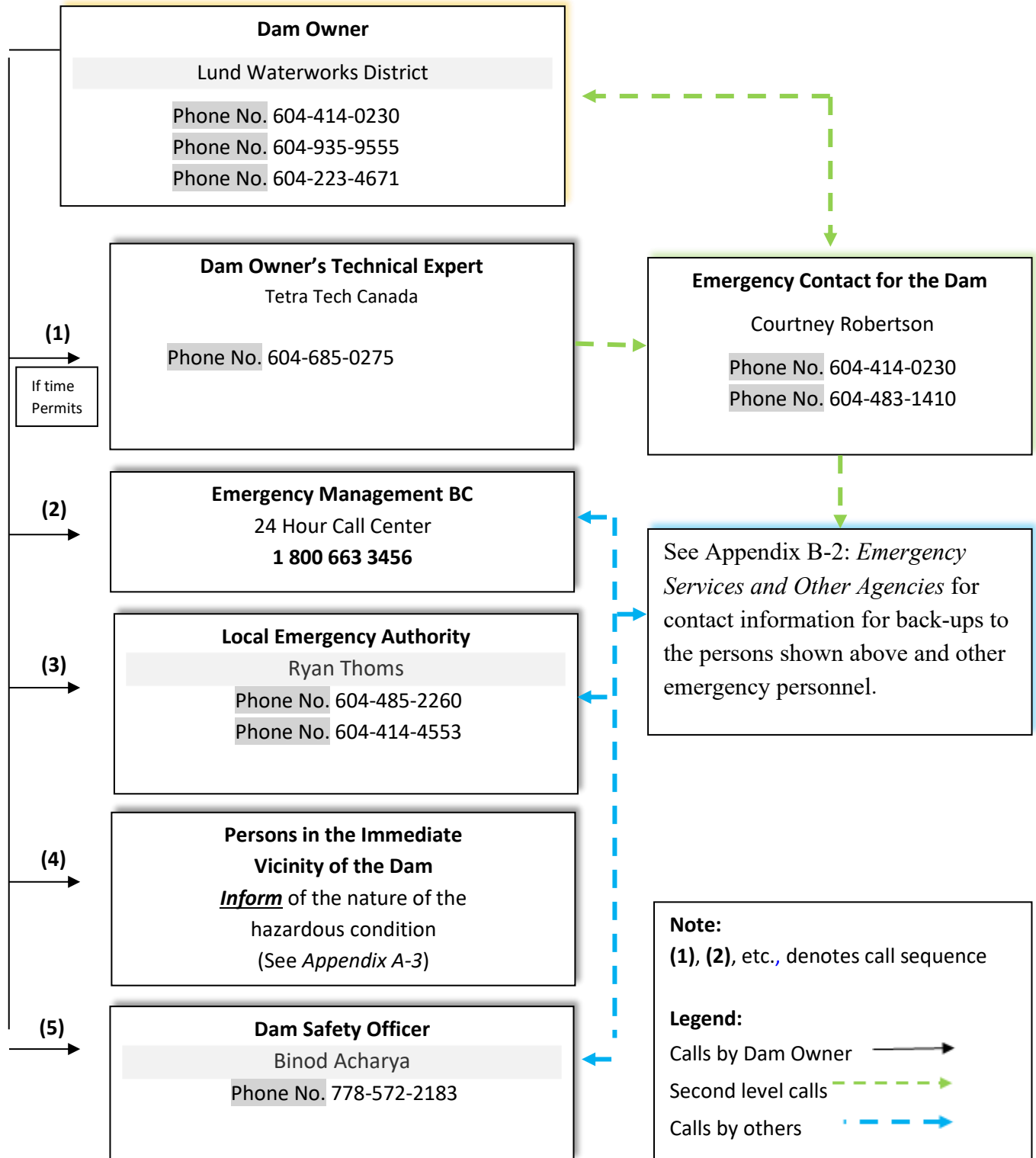
Emergency Level 1 Notifications

Non-emergency unusual event; slowly developing



Emergency Level 2 Notifications

Emergency event, potential dam failure situation; rapidly developing



Appendix B-2 Emergency Services Contacts and Other Agencies

Agency / Organization	Principal contact	Address	Office telephone number	Alternate telephone numbers
Dam Owner's Technical Expert (alternative)				
RCMP or Police		7070 Barnet Street Powell River, BC	604-485-6255	911
Local Search and Rescue		6791 Drake Street Powell River, BC	604-483-9931	
Ministry of Transportation and Infrastructure	Rino Parise	6953 Alberni Street Powell River, BC	604-485-3610	
EMBC Regional Manager	Ryan Thoms	202-4675 Marine Ave Powell River, BC	604-485-2260	
Env. Canada Weather				
GSC Pacific Earthquakes		9860 W Saanich Rd Saanich, BC	250-363-6500	
River Forecast Center		Box 9340 Stn Prov Govt Victoria, BC		
BC Hydro			1 888 769 3766	1 800 224 9376
Other Agency or Organization				
Other Agency or Organization				

other possible notifications depending on what is downstream of the dam: railway, power utilities, gas or oil pipelines, parks agencies.

Appendix B-3 Emergency Response Resources

Locally available equipment, personnel, and materials.

The dam owner has the following resources that can be utilized in the event of an emergency:

NONE

Other locally available resources may include:

Heavy equipment service and rental	Sand and gravel supply	Ready-mix concrete supply
Ecoterra Developers Ltd. 8559 Craig Road Powell River, BC 604-483-9560	Ecoterra Developers Ltd. 8559 Craig Road Powell River, BC 604-483-9560	Adams Concrete 7095 Duncan Street Powell River, BC 604-485-6888
ATV Rental	Boat Rental	Helicopter
Ecoterra Developers Ltd. 8559 Craig Road Powell River, BC 604-483-9560	Lund Water Taxi 1431 Highway 101 Lund, BC 604-483-9749	Oceanview Helicopters Ltd. 7390 Empress Way Powell River, BC 604-485-7135
Pumps	Diving contractor	Sand bags
Ecoterra Developers Ltd. 8559 Craig Road Powell River, BC 604-483-9560	Powell River Divers 7318 Alberni Street Powell River, BC 604-485-4526	Ecoterra Developers Ltd. 8559 Craig Road Powell River, BC 604-483-9560

Appendix C Plan View of Thulin Lake Dam



Appendix C Plan View of Thulin (Upper) Lake Dam



Appendix D Guidance for Determining the Emergency Level

Event	Situation	Emergency level*
Earth spillway flow	Reservoir water surface elevation at spillway crest or spillway is flowing with no active erosion	1
	Spillway flowing with active gully erosion	2
	Spillway flow that could result in flooding of people downstream if the reservoir level continues to rise	2
	Spillway flowing with an advancing headcut that is threatening the control section	3
	Spillway flow that is flooding people downstream	3
Embankment overtopping	Reservoir level is 1 foot below the top of the dam	2
	Water from the reservoir is flowing over the top of the dam	3
Seepage	New seepage areas in or near the dam	1
	New seepage areas with cloudy discharge or increasing flow rate	2
	Seepage with discharge greater than 10 gallons per minute	3
Sinkholes	Observation of new sinkhole in reservoir area or on embankment	2
	Rapidly enlarging sinkhole	3
Embankment cracking	New cracks in the embankment greater than ¼-inch wide without seepage	1
	Cracks in the embankment with seepage	2
Embankment movement	Visual movement/slippage of the embankment slope	1
	Sudden or rapidly proceeding slides of the embankment slopes	3
Instruments	Instrumentation readings beyond predetermined values	1
Earthquake	Measurable earthquake felt or reported on or within 50 kilometers of the dam	1
	Earthquake resulting in visible damage to the dam or appurtenances	2
	Earthquake resulting in uncontrolled release of water from the dam	3
Security threat	Verified bomb threat that, if carried out, could result in damage to the dam	2
	Detonated bomb that has resulted in damage to the dam or appurtenances	3

Sabotage/ vandalism	Damage to dam or appurtenance with no impacts to dam function	1
	Modification to the dam or appurtenances that could adversely impact the functioning of the dam	1
	Damage to dam or appurtenances that has resulted in seepage flow	2
	Damage to dam or appurtenances that has resulted in uncontrolled water release	3

- * Level 1: Nonemergency unusual event, slowly developing
- * Level 2: Potential dam failure situation, rapidly developing
- * Level 3: Urgent; dam failure appears imminent or is in progress

Appendix E Emergency Remedial Actions for Level 2 Conditions

If time permits, the following emergency remedial actions should be considered for Level 2 conditions. Immediate implementation of these remedial actions may delay, moderate, or prevent the failure of the dam. Several of the listed adverse or unusual conditions may be apparent at the dam at the same time, requiring implementation of several modes of remedial actions. Close monitoring of the dam must be maintained to confirm the success of any remedial action taken at the dam. Time permitting, any remedial action should be developed through consultation with the Dam Owner's Technical Expert. See Emergency Response Resources (*Appendix B-3*) for sources of equipment and materials to assist with remedial actions.

Embankment overtopping

1. If the water level in the reservoir is no longer rising, place sandbags along the low areas of the top of the dam to control wave action, reduce the likelihood of flow concentration during minor overtopping, and to safely direct more water through the spillway.
2. Cover the weak areas of the top of the dam and downstream slope with riprap, sandbags, plastic sheets, or other materials to provide erosion-resistant protection.

Seepage and sinkholes

1. Open the low level outlet gate to lower the reservoir level as rapidly as possible to a level that stops or decreases the seepage to a non-erosive velocity. If the gate is damaged or blocked, pumping or siphoning may be required.

Continue lowering the water level until the seepage stops.

2. If the entrance to the seepage origination point is observed in the reservoir (possible whirlpool) and is accessible, attempt to reduce the flow by plugging the entrance with readily available materials such as hay bales, bentonite, soil or rockfill, or plastic sheeting.
3. Cover the seepage exit area(s) with several feet of sand/gravel to hold fine-grained embankment or foundation materials in place. Alternatively, construct sandbag or other types of ring dikes around seepage exit areas to retain a pool of water, providing backpressure and reducing the erosive nature of the seepage.
4. Prevent vehicles and equipment from driving between the seepage exit points and the embankment to avoid potential loss from the collapse of an underground void.

Embankment movement

1. Open outlet(s) and lower the reservoir to a safe level at a rate commensurate with the urgency and severity of the condition of the slide or slump. If the gate is damaged or blocked, pumping or siphoning may be required.
2. Repair settlement of the crest by placing sandbags or earth and rockfill materials in the damaged area to restore freeboard.
3. Stabilize slides by placing a soil or rockfill buttress against the toe of the slide.

Earthquake

1. Immediately conduct a general overall visual inspection of the dam.
2. Perform a field survey to determine if there has been any settlement and movement of the dam embankment, spillway, and low-level outlet works.
3. Drain the reservoir, if required.

Appendix F Dam Emergency Situation Report

To be completed by the owner at regular intervals during the emergency.

Dam Name: dam name

Provincial Dam Number: dam file number

Dam location: _____

Date: _____ Time: _____ Situation Report #: _____

Weather conditions: _____

General description of emergency situation:

Area(s) of dam affected:

Extent of dam damage: _____

Possible cause(s): _____

Effect on dam's operation: _____

Initial reservoir elevation: _____ Time: _____

Maximum reservoir elevation: _____ Time: _____

Final reservoir elevation: _____ Time: _____

Description of area flooded downstream/damages/injuries/loss of life: _____

Other data and comments:

Observer's name and telephone number: _____

Report prepared by: _____ Date: _____

Appendix G Examples of Emergency Situations

The following are examples of conditions that usually constitute an emergency situation that may occur at a dam. Adverse or unusual conditions that can cause the failure of a dam are typically related to aging or design and construction oversights. Extreme weather events that exceed the original designed conditions can cause significant flow through the spillway or overtopping of the embankment. However, accidental or intentional damage to the dam may also result in emergency conditions. The conditions have been grouped to identify the most likely emergency-level condition. The groupings are provided as guidance only. Not all emergency conditions may be listed, and the dam operator is urged to use conservative judgment in determining whether a specific condition should be defined as an emergency situation at the dam.

Pre-existing conditions on this dam: There has been a small seepage area near the downstream toe on the north side of the release channel. This was first noticed in the 1990s, but has not changed since that time.

Earth Spillway Flows

Level 2—Potential dam failure situation; rapidly developing:

1. Significant erosion or headcutting of the spillway is occurring, but the rate does not appear to threaten an imminent breach of the spillway crest that would result in an uncontrolled release of the reservoir.
2. Flow through the earth spillway is or is expected to cause flooding that could threaten people, homes, and/or roads downstream from the dam.

Level 3—Urgent; dam failure appears imminent or is in progress:

1. Significant erosion or headcutting of the spillway is occurring at a rapid rate, and a breach of the control section appears imminent.
2. Flow through the earth spillway is causing flooding that is threatening people, homes, and/or roads downstream from the dam.

Embankment Overtopping

Level 2—Potential dam failure situation; rapidly developing:

1. The reservoir level is within 1 foot from the top of the dam.

Level 3—Urgent; dam failure appears imminent or is in progress:

1. The reservoir level has exceeded the top of the dam, and flow is occurring over the embankment.

Seepage and Sinkholes

Level 2—Potential dam failure situation; rapidly developing:

1. Cloudy seepage or soil deposits are observed at seepage exit points or from internal drain outlet pipes.
2. New or increased areas of wet or muddy soils are present on the downstream slope, abutment, and/or foundation of the dam, and there is an easily detectable and unusual increase in volume of downstream seepage.
3. Significant new or enlarging sinkhole(s) near the dam or settlement of the dam is observed.
4. Reservoir level is falling without apparent cause.
5. The following known dam defects are or will soon be inundated by a rise in the reservoir:
 - Sinkhole(s) located on the upstream slope, crest, abutment, and/or foundation of the dam;
or
 - Transverse cracks extending through the dam, abutments, or foundation.

Level 3—Urgent; dam failure appears imminent or is in progress:

1. Rapidly increasing cloudy seepage or soil deposits at seepage exit points to the extent that failure appears imminent or is in progress.
2. Rapid increase in volume of downstream seepage to the extent that failure appears imminent or is in progress.
3. Water flowing out of holes in the downstream slope, abutment, and/or foundation of the dam to the extent that failure appears imminent or is in progress.
4. Whirlpools or other evidence exists indicating that the reservoir is draining rapidly through the dam or foundation.
5. Rapidly enlarging sinkhole(s) are forming on the dam or abutments to the extent that failure appears imminent or is in progress.
6. Rapidly increasing flow through crack(s) eroding materials to the extent that failure appears imminent or is in progress.

Embankment Movement and Cracking

Level 2—Potential dam failure situation; rapidly developing:

1. Settlement of the crest, slopes, abutments and/or foundation of the dam that may eventually result in breaching of the dam.
2. Significant increase in length, width, or offset of cracks in the crest, slopes, abutments, and/or foundation of the dam that may eventually result in breaching of the dam.

Level 3—Urgent; dam failure appears imminent or is in progress:

1. Sudden or rapidly proceeding slides, settlement, or cracking of the embankment crest, slopes, abutments, and/or foundation, and breaching of the dam appears imminent or is in progress.

Glossary of Terms

Abutment	That part of the valley side against which the dam is constructed. The left and right abutments of dams are defined with the observer looking downstream from the dam.
Acre-foot	A unit of volumetric measure that would cover 1 acre to a depth of 1 foot. One acre-foot is equal to 1,234 cubic meters.
Berm	A nearly horizontal step (bench) in the upstream or downstream sloping face of the dam.
Boil	A disruption of the soil surface due to water discharging from below the surface. Eroded soil may be deposited in the form of a ring (miniature volcano) around the disruption.
Breach	An opening through the dam that allows draining of the reservoir. A controlled breach is an intentionally constructed opening. An uncontrolled breach is an unintended failure of the dam.
Conduit	A closed channel (round pipe or rectangular box) that conveys water through, around, or under the dam.
Control section	A usually level segment in the profile of an open channel spillway above which water in the reservoir discharges through the spillway.
Cross section	A slice through the dam showing elevation vertically and direction of natural water flow horizontally from left to right. Also, a slice through a spillway showing elevation vertically and left and right sides of the spillway looking downstream.
Dam	A barrier constructed for the purpose of enabling the storage or diversion of water diverted from a stream or an aquifer, or both and other works that are incidental to or necessary for the barrier.
Dam failure	An uncontrolled release of all or part of the water impounded by the dam, whether or not caused by a collapse of the dam.
Dam Owner Representative	The person(s) with responsibility for the operation and maintenance of dam.

Drain	A water collection system of sand and gravel and typically pipes along the downstream portion of the dam to collect seepage and convey it to a safe outlet. The drains can be located in the toe, foundation or drainage blanket.
Drainage area (watershed)	The geographic area on which rainfall flows into the dam.
Drawdown	The lowering or releasing of the water level in a reservoir over time or the volume lowered or released over a particular period of time.
Emergency	A condition that develops unexpectedly, endangers the structural integrity of the dam and/or downstream human life and property, and requires immediate action.
Dam Emergency Plan	A formal document identifying potential emergency conditions that may occur at the dam and specifying preplanned actions to minimize potential failure of the dam or minimize failure consequences including loss of life, property damage, and environmental impacts. (<i>BC Dam Safety Reg.</i> , Section 9)
Evacuation map	A map showing the geographic area downstream of a dam that should be evacuated if it is threatened to be flooded by a breach of the dam or other large discharge.
Filter	The layers of sand and gravel in a drain that allow seepage through an embankment to discharge into the drain without eroding the embankment soil.
Freeboard	Vertical distance between a stated water level in the reservoir and the top of dam.
Gate	A general term for any mechanical device to control the flow of water in intakes, outlet works and over controlled spillways.
Groin	The area along the intersection of the face of a dam and the abutment.
Consequence classification	A system that categorizes dams (extreme, very high, high, significant, or low) according to the degree of their potential to create adverse incremental consequences such as loss of life, property damage, or environmental impacts of a failure or mis-operation of a dam.
Height of dam	The vertical distance between the crest of the dam and the lowest point at the downstream toe, which usually occurs in the bed of the outlet channel.

Hydrograph	A graphical representation of either the flow rate or flow depth at a specific point above or below the dam over time for a specific flood occurrence. It can include inflow, outflow or a breach flow.
Incident Commander	The highest predetermined official available at the scene of an emergency situation.
Instrumentation	An arrangement of devices installed into or near dams that provide measurements to evaluate the structural behavior and other performance parameters of the dam and appurtenant structures.
Inundation area or map	The geographic area downstream of the dam that would be flooded by a breach of the dam or other large discharge.
Low-Level Outlet	A conduit through a dam to allow for controlled release of the reservoir contents. Also see “Outlet Works”
Notification	To immediately inform appropriate individuals, organizations, or agencies about a potentially emergency situation so they can initiate appropriate actions.
Outlet works	An appurtenant structure that provides for controlled passage of normal water flows through the dam. Combination of intake structure, gates, conduits, tunnels, flow controls and energy dissipation devices to allow the release of water from the dam,
Persons in the immediate vicinity of the dam:	Considered the persons located immediately downstream and adjacent to the dam where available warning time is very limited (where local emergency authorities could not be expected to respond in time).
Piping	The progressive destruction of an embankment or embankment foundation by internal erosion of the soil by seepage flows.
Probable Maximum Precipitation (PMP) and Prob. Max. Flood (PMF):	The theoretically greatest precipitation (PMP) or resulting flood (PMF) that is meteorologically feasible for a given duration over a specific drainage area or at a particular geographical location.
Reservoir	The body of water impounded or potentially impounded by the dam.
Riprap	A layer of large rock, precast blocks, bags of cement, or other suitable material, generally placed on an embankment or along a watercourse as protection against wave action, erosion, or scour.

Risk	A measure of the likelihood and severity of an adverse consequence.
Seepage	The natural movement of water through the embankment, foundation, or abutments of the dam.
Slide	The movement of a mass of earth down a slope on the embankment or abutment of the dam.
Spillway (main)	The appurtenant structure that provides the controlled conveyance of excess water through, over, or around the dam.
Spillway (emergency)	An additional spillway, which usually has a crest elevation somewhat higher than the main spillway, designed to activate during extreme flood events to avoid overtopping the dam.
Spillway capacity	The maximum discharge the spillway can safely convey with the reservoir at the maximum design elevation.
Spillway crest	The lowest level at which reservoir water can flow over or into the spillway.
Tailwater	The body of water immediately downstream of the embankment at a specific point in time.
Toe of dam	The junction of the upstream or downstream face of an embankment with the ground surface.
Top of dam (crest of dam)	The elevation of the uppermost surface of an embankment which can safely impound water behind the dam.