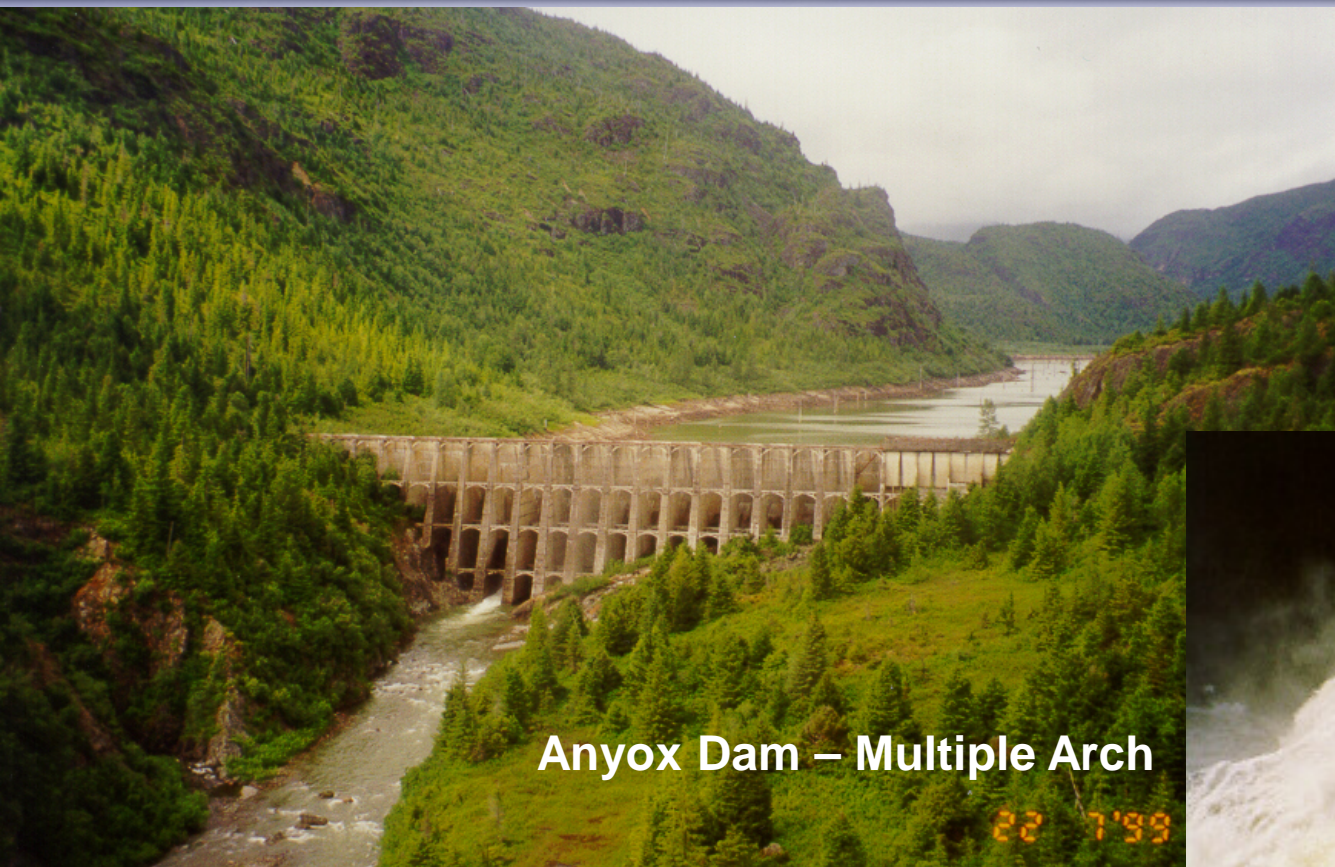




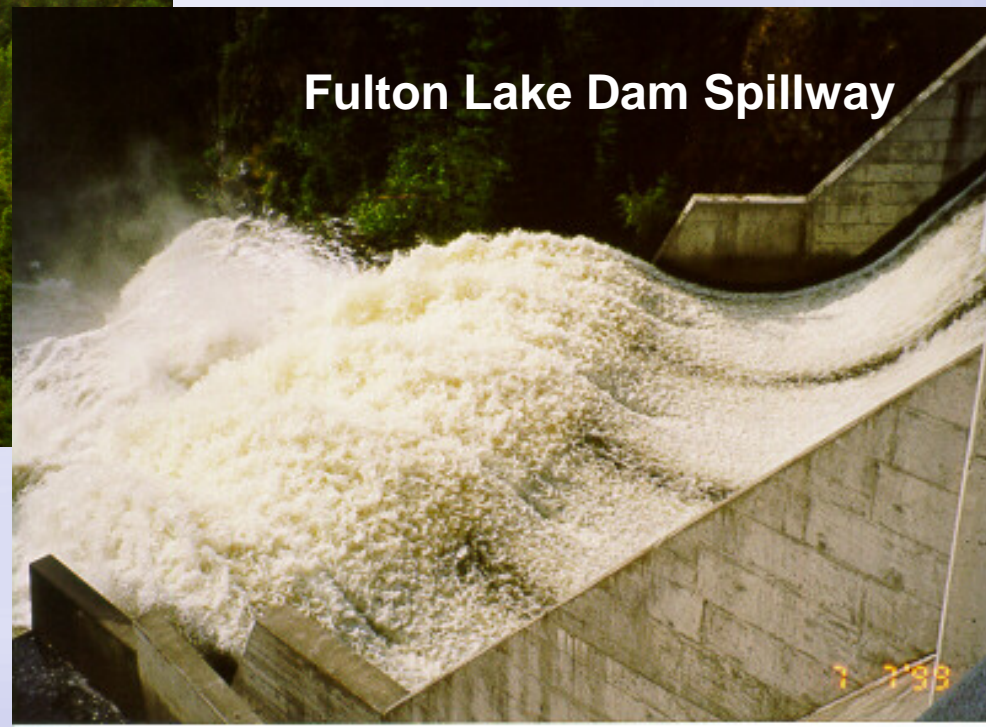
# Ministry of **Forests, Lands and Natural Resource Operations**



## Dam Safety in B.C. New Dam Emergency Plan



**Anyox Dam – Multiple Arch**



**Fulton Lake Dam Spillway**

# Provincial Dam Safety Program

## Who is Involved? Responsible?

- 💧 Downstream Inhabitants
- 💧 Dam Owner
- 💧 Regulator
- 💧 Provincial Emergency Program
- 💧 Local Government



# Provincial Dam Safety Program

## Who is Involved? Responsible?

- 💧 Downstream Inhabitants
- 💧 Dam Owner
- 💧 Regulator
- 💧 Provincial Emergency Program
- 💧 Local Government

# Dam Safety Perspective

DO YOU REMEMBER THE  
LAST TIME YOU HEARD  
ABOUT A DAM FAILURE IN  
BRITISH COLUMBIA?





**Polar Mill Pond Dam - March 27, 2015**



# Testalinden Dam, near Oliver, BC

June 13, 2010

- 
- Dam Height 3.3 m
  - Storage Capacity 22,000 m<sup>3</sup>
  - Reservoir Surface Area 1.6 ha





# Manley Creek Dam on Vancouver Island - February 2008







# Cannon Creek Dam Failure

## Near Quesnel

### May 1995

DRAGON MOUNTAIN RANCH  
AFTER THE FAILURE



CANNON CREEK DAM  
AFTER THE FAILURE



# Dam Safety Perspective

DO YOU REMEMBER THE  
LAST TIME YOU HEARD  
ABOUT A DAM FAILURE IN  
THE UNITED STATES?



FRIDAY OCT. 9, 2015

MOST POPULAR

LOCAL

ENTERTAINMENT

SPORTS

POLITICS

OPINION

GREAT READS

PLACE AN AD



Nation

# South Carolina residents rush to higher ground as 14 dams fail

## Thursday, October 4, 2015



Floodwaters rush over a dam on Forest Lake in Columbia, S.C., on Oct. 4, 2015. (Chuck Burton / Associated Press)



ADVERTISEMENT

### In Case You Missed It



**UCLA students protest after partygoers wear blackface at 'Kanye'-themed frat party**

7:50 AM



# Meadow Lake Dam – Sept 2013, Colorado



- ❖ One of 5 dams on river.
- ❖ Spillway Design = 1:50 Year Flood.
- ❖ “Low Hazard” Classification.





# Santa Clara Flood, UTAH

## Sept 11, 2012

Laub Lake Dam



Flooded neighborhood in Santa Clara, Utah. The dam breached after heavy rain, sending a deluge of water into downtown.





## Kaloko Dam, Kauai, March 14, 2006



- 6 killed in one family
- 2 houses & major road
- 5 kilometre path of destruction to the sea





A contemporary illustration of the broken South Fork Dam from Harper's Weekly.

## South Fork Dam Failure

Johnstown Flood May 1889

2,209 fatalities



The people standing on the rooftops in this striking image are likely sightseers who have come to see the flood destruction.



Cleanup workers among the debris near downtown.

# FAILURE MODE VIDEO - 1

OVERTOPPING



# Provincial Dam Safety Program

## Who is Involved? Responsible?

- 💧 Downstream Inhabitants
- 💧 Dam Owner
- 💧 Regulator
- 💧 Provincial Emergency Program
- 💧 Local Government



# Provincial Dam Safety Program

## Dam Safety Regulation

BC Reg. 44/2000 Repealed  
Including the Nov 2011 Amendment

Revised Dam Safety Regulation  
February 2016

# British Columbia Dam Safety Regulation

## Consequence Classifications

|             |     |
|-------------|-----|
| Extreme     | 38  |
| Very High   | 63  |
| High        | 253 |
| Significant | 569 |
| Low         | 686 |

Total Active Dams in BC, Jan 2016 = 1,501\*

\* Not including applications, under construction or rehabilitation, drained or breached.



# British Columbia Dam Safety Regulation

## Surveillance, Inspections & Tests Section 18

- Formal Inspections annually – all classifications
- Surveillance Inspections – Weekly/Monthly
- Mechanical, Electrical & Communications – Test Gates & Comms Annually

# British Columbia Dam Safety Regulation

## Operation, Maintenance & Surveillance Manual - Section 8

- OMS Manuals required for all but Low Consequence Dams
- Review and revise OMS Manual 7 to 10 Years
- Submit OMS manual to the DSO for acceptance



# British Columbia Dam Safety Regulation

## Dam Emergency Plan<sup>\*</sup> Section 9

- ♦ DEP required for all but Low Consequence Dams
- ♦ Submit DEP to the DSO for acceptance
- ♦ Forward a portion of the DEP to the Local Emergency Authority for their LEP

<sup>\*</sup> Previously called “Emergency Preparedness Plan”



# EMERGENCY PLANNING



# British Columbia Dam Safety Regulation

## Record Identifying Emergency Contact – Section 10

An Owner of a Low Consequence Dam must identify a Contact Person, record the Contact Information and send it to:

- the Dam Safety Officer
- the Local Emergency Authority

# British Columbia Dam Safety Regulation

## Dam Safety Review – Section 20

- Every 7 to 10 years for E, VH & H dams
- P. Eng. “qualifications & experience in dam safety analysis”

### CDA Definition:

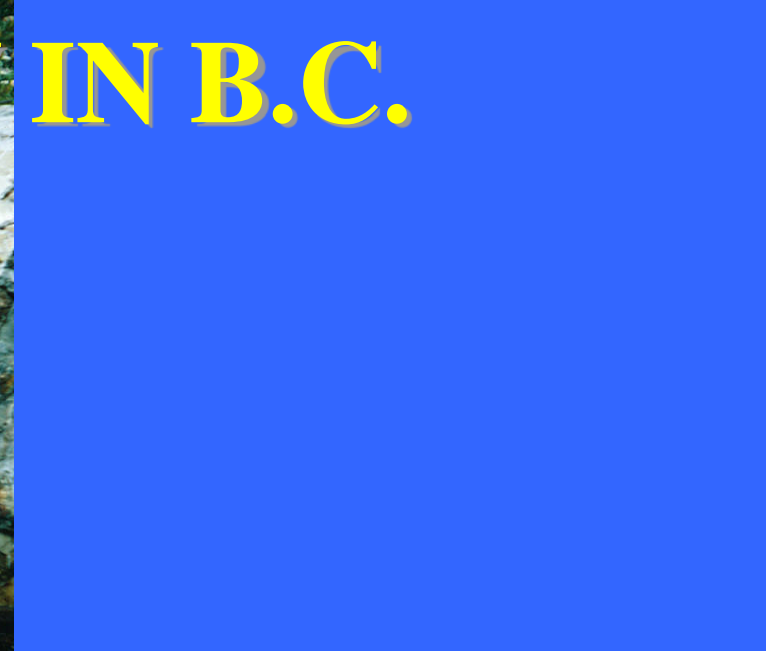
“Comprehensive formal review carried out at regular intervals to determine whether an existing dam is safe, and if it is not safe, to determine required safety improvements”



# DESIGN REVIEW IN B.C.



GRAYSTOKE DAM, KELOWNA - ORIGINAL SPILLWAY



NEW SPILLWAY



# British Columbia Dam Safety Regulation

## Alteration of a Dam\* – Section 12 & 13

### Skins Lake Spillway Rehabilitation

1. Must be authorized by a Water Licence or Order
2. Does not apply to emergencies or maintenance



\*Also includes Improvement or Replacement



# **SKINS LAKE SPILLWAY PLUNGE POOL - CONSTRUCTION COMPLETED -**



**SPRING 2003**

# British Columbia Dam Safety Regulation

## Section 14 Hazardous Conditions

- Operate under DEP
- Contact: EMBC, DSO, Local Authorities
- Modify Operation

WAC BENNETT DAM

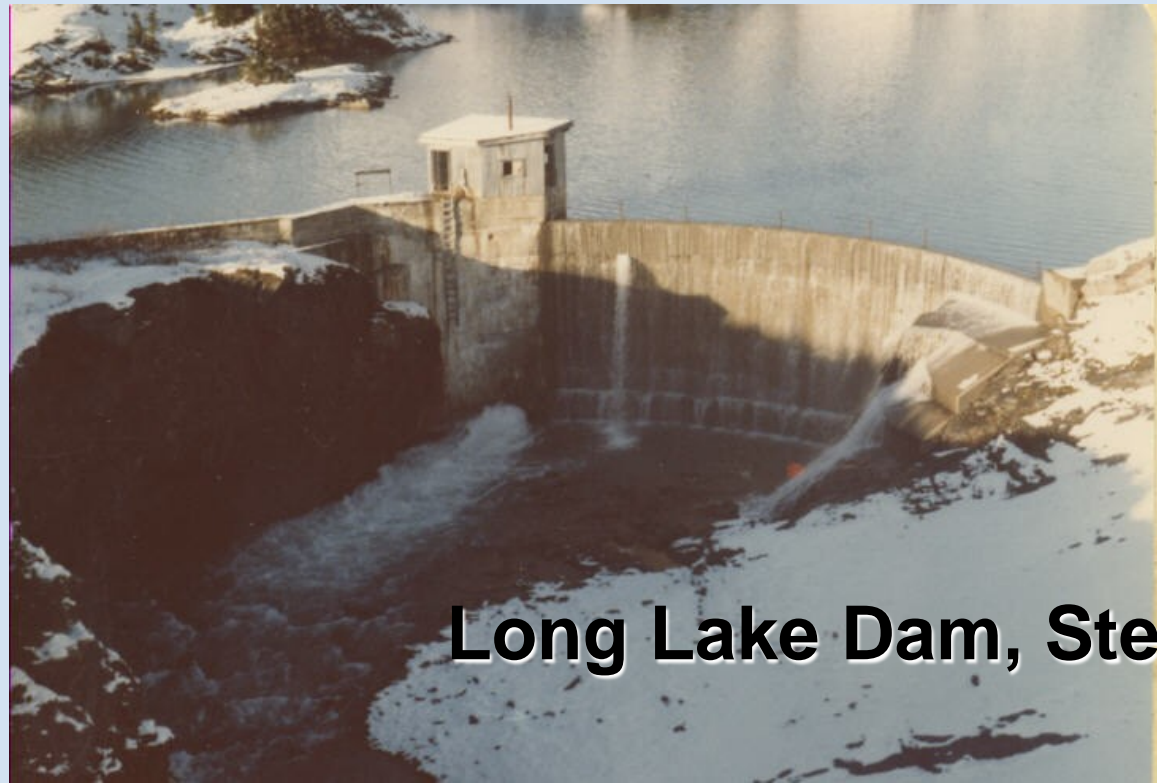
Sinkhole 5:00 pm June 17, 1996





# British Columbia Dam Safety Regulation

## Removing, Decommissioning, Deactivating or Stopping Operation Section 17



Long Lake Dam, Stewart, BC



# Long Lake Dam Removal, September 28, 1980







First Blast - Long Lake Dam Removal, September 29, 1980



# Reservoir Draining - Long Lake Dam Removal, September 30, 1980







Second Blast - Long Lake Dam Removal, September 30, 1980



## Third Hole - Long Lake Dam Removal, October 1, 1980







# Final Removal - Long Lake Dam, October 2, 1980







# Long Lake Dam Reconstructed – 2012-2013





# British Columbia Dam Safety Regulation

## Signage for Dams Section 11

- Purpose: Passers-by will know who to contact
- Not for dams on Private property
- Not for Low Consequence Dams



# FAILURE MODE VIDEO - 2

PIPING





# Provincial Dam Safety Program

## Who is Involved? Responsible?

- 💧 Downstream Inhabitants
- 💧 Dam Owner
- 💧 Regulator
- 💧 Emergency Management BC
- 💧 Local Government

# Provincial Dam Safety Program

## Dam Safety Officers Responsibilities

- Dam Owner Compliance - 4 Pillars
  - I. Education & Awareness - BCWWA





# Inspection & Maintenance of Dams One Day Workshop



# Provincial Dam Safety Program

- Dam Owner Compliance - 4 Pillars
  - I. Education & Awareness - BCWWA
  - II. Dam Registry



# Provincial Dam Safety Program

- Dam Owner Compliance - 4 Pillars
  - I. Education & Awareness - BCWWA
  - II. Dam Registry
    - I. 5 consequence classifications – E, VH, H, S & L
    - II. Total number of dams in the registry 1,500
    - III. Most of these dams are displayed in **iMapBC**
    - IV. Public view has 13 attributes - not consequence
    - V. Internal view has all attributes visible

# Google Earth – Dam & Downstream Area



## Dam Close-up



# Provincial Dam Safety Program

- Dam Owner Compliance - 4 Pillars
  - I. Education & Awareness - BCWWA
  - II. Dam Registry
  - III. Compliance Mail-Out

# Compliance Form for Dam Owners

- **Has your 2011 Formal Inspection been completed?**  
Yes ☐ No ☐
- **Have any Dam Safety Concerns been identified?**  
Yes ☐ No ☐ *If yes to #2.....*
- **Has a plan been prepared for the safety concern(s)?**  
Yes ☐ No ☐ N/A
- **Did you undertake *regular* Site Surveillance?**  
Yes ☐ No ☐



# Provincial Dam Safety Program

- Dam Owner Compliance - 4 Pillars
  - I. Education & Awareness - BCWWA
  - II. Dam Registry
  - III. Compliance Mail-Out
  - IV. Dam Auditing
    - I. Not an Inspection – Compliance with D S Reg
    - II. High Consequence Dams every 5 Years
    - III. Significant Consequence Dams every 10 Years

# Provincial Dam Safety Program

- Dam Owner Compliance - 4 Pillars
  - I. Education & Awareness - BCWWA
  - II. Dam Registry
  - III. Compliance Mail-Out
  - IV. Dam Auditing
- Plans Review & Approval



# Plan Submission Guidelines



## Plan Submission Requirements for the Construction and Rehabilitation of Dams



# Provincial Dam Safety Program

- Dam Owner Compliance - 4 Pillars
  - I. Education & Awareness - BCWWA
  - II. Dam Registry
  - III. Compliance Mail-Out
  - IV. Dam Auditing
- Plans Review & Approval
- Headquarters & Regional Offices



# Provincial Dam Safety Program

- Dam Owner Compliance - 4 Pillars
  - I. Education & Awareness - BCWWA
  - II. Dam Registry
  - III. Compliance Mail-Out
  - IV. Dam Auditing
- Plans Review & Approval
- Headquarters & Regional Offices
- Emergency Planning & Response (DERP)

# BC Dam Emergency Response Plan

## BRITISH COLUMBIA DAM EMERGENCY RESPONSE PLAN



Ministry of Forests, Lands and Natural Resource Operations  
Water Management Branch  
Dam Safety Section



# FAILURE MODE VIDEO - 3

SLOPE FAILURE



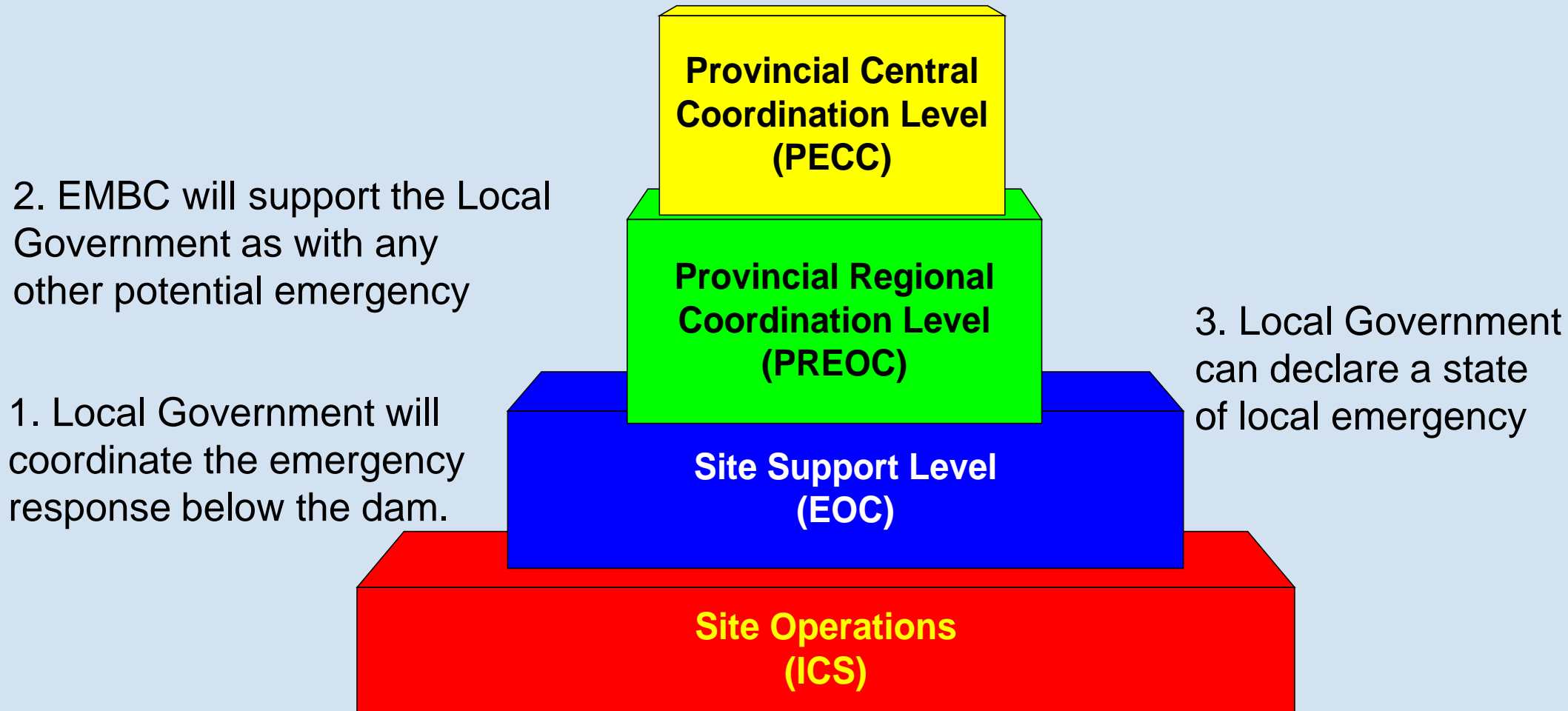
# Provincial Dam Safety Program

## Who is Involved? Responsible?

- 💧 Downstream Inhabitants
- 💧 Dam Owner
- 💧 Regulator
- 💧 Emergency Management BC
- 💧 Local Government



# Provincial Emergency Response Structure



# The EMBC All-Hazard Plan

PROVINCE OF BRITISH COLUMBIA

## The All-Hazard Plan

---

EMERGENCY MANAGEMENT BRITISH COLUMBIA

4/11/2012



# The EMBC All-Hazard Plan

## The All-Hazard Plan – EMBC

- Outlines response framework for emergencies and disasters requiring activation of EMBC EOCs to coordinate provincial integrated response.
- Basis for response to all types of hazards in BC.

# The EMBC All-Hazard Plan

## The All-Hazard Plan – Provincial

- ◆ Provincial ministries develop hazard specific emergency response plans under the Emergency Program Management Regulation.
  - ◆ Hazardous Spills (General) – Environment
  - ◆ Highway Avalanches – MOTI
  - ◆ Dam Failure – MFLNRO
  - ◆ Tailings Dam Failures – MEM



# The EMBC All-Hazard Plan

## The All-Hazard Plan – Local Authorities

- Have primary responsibility for emergency planning, response and recovery within their jurisdictions
- Establish an emergency management organization.....

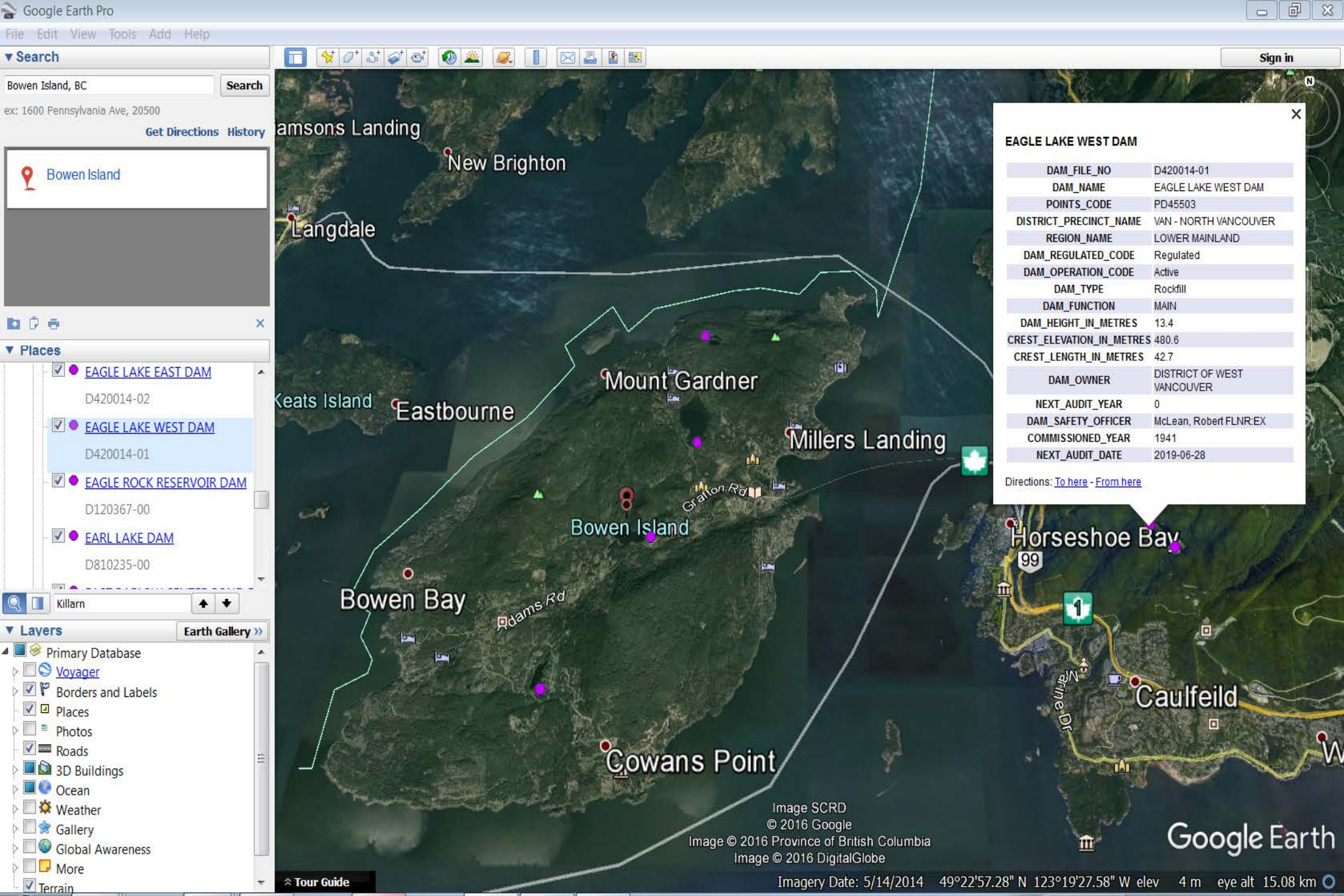
# The EMBC All-Hazard Plan

## The All-Hazard Plan – Local Authorities (continued)

- ◆ Develop emergency plans for response and recovery based on:
  - ◆ “The potential emergencies and disasters that could affect all or any part of the jurisdictional area for which the local authority has responsibility”. Local Authority Emergency Management Regulation.

**HOW?** Google Earth – [Dam Safety Web Link](#)





| EAGLE LAKE WEST DAM       |                            |
|---------------------------|----------------------------|
| DAM_FILE_NO               | D420014-01                 |
| DAM_NAME                  | EAGLE LAKE WEST DAM        |
| POINTS_CODE               | PD45503                    |
| DISTRICT_PRECINCT_NAME    | VAN - NORTH VANCOUVER      |
| REGION_NAME               | LOWER MAINLAND             |
| DAM_REGULATED_CODE        | Regulated                  |
| DAM_OPERATION_CODE        | Active                     |
| DAM_TYPE                  | Rockfill                   |
| DAM_FUNCTION              | MAIN                       |
| DAM_HEIGHT_IN_METRES      | 13.4                       |
| CREST_ELEVATION_IN_METRES | 480.6                      |
| CREST_LENGTH_IN_METRES    | 42.7                       |
| DAM_OWNER                 | DISTRICT OF WEST VANCOUVER |
| NEXT_AUDIT_YEAR           | 0                          |
| DAM_SAFETY_OFFICER        | McLean, Robert FLNR:EX     |
| COMMISSIONED_YEAR         | 1941                       |
| NEXT_AUDIT_DATE           | 2019-06-28                 |

# Dam Owner - Dam Emergency Plan

## Development of DEPs for Dam Owners

- 1984 Guideline for O&M Manual – EPP in Section 4
- 1998 Inspection Manual – 2 page EPP template
- 2000 – 1<sup>st</sup> Dam Safety Regulation – High Con. Dams
- 2007 CDA Guidelines:
  - Internal ERP
  - External EPP
- Continued.....



# Dam Owner - Dam Emergency Plan

## Development of DEPs for Dam Owners

- ♦ 2016 BC Dam Safety Regulations revised
- ♦ Section 9 (1) , Dam Owners must prepare:
  - i. a record describing actions to be taken by the dam owner.....
  - ii. a record containing information for the use of the local emergency authorities for the purpose of preparing local emergency plans under the *Emergency Program Act*.

# New Guide and Template for DEP

## 2016 DEP Guideline for Dam Owners

- ♦ July 2016 Guide and Template available on line
- ♦ Based on 2 existing Guidelines:
  - ♦ 2007 CDA Guidelines
  - ♦ ASDSO - EAP Resource Center: Simple and low cost tools for preparing Emergency Action Plans



# New Guide and Template for DEP

## 2016 DEP Template for Dam Owners

1. DEP Overview – purpose and Reg. requirements
2. Basic DEP Data – inc. dam plan and access map
3. Roles and Responsibilities – All Parties
4. Five Step DEP Process
5. DEP Maintenance, 6. Copy Holders, 7. Record Rev.
6. Appendix A
7. Appendix B
8. Appendix C to G

# New Guide and Template for DEP

## 2016 DEP Template for Dam Owners

1. [DEP Overview – purpose and Reg. requirements](#)
2. [Basic DEP Data – inc. dam plan and access map](#)
3. Roles and Responsibilities – All Parties
4. [Five Step DEP Process \(4.1 only\)](#)
5. DEP Maintenance, 6. Copy Holders, 7. Record Rev.
6. [Appendix A](#)
7. Appendix B
8. Appendix C to G

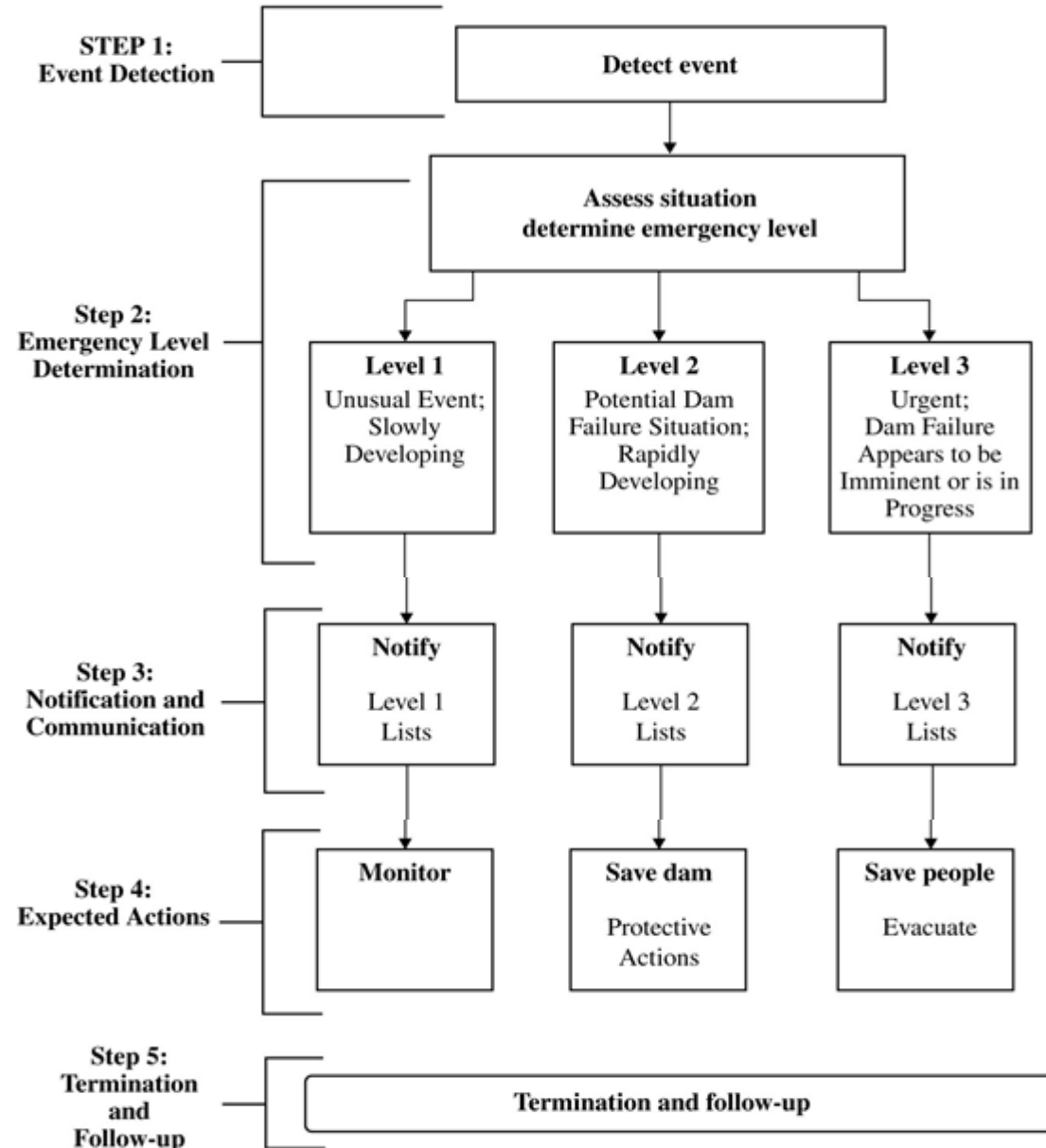


# New Guide and Template for DEP

## 2016 DEP Template for Dam Owners

1. DEP Overview – purpose and Reg. requirements
2. Basic DEP Data – inc. dam plan and access map
3. Roles and Responsibilities – All Parties
4. Five Step DEP Process (4.1 only)
5. DEP Maintenance, 6. Copy Holders, 7. Record Rev.
6. Appendix A
7. Appendix B
8. Appendix C to G

# FIVE STEP DEP Process Section 4





# New Guide and Template for DEP

## 2016 DEP Template – Appendix A

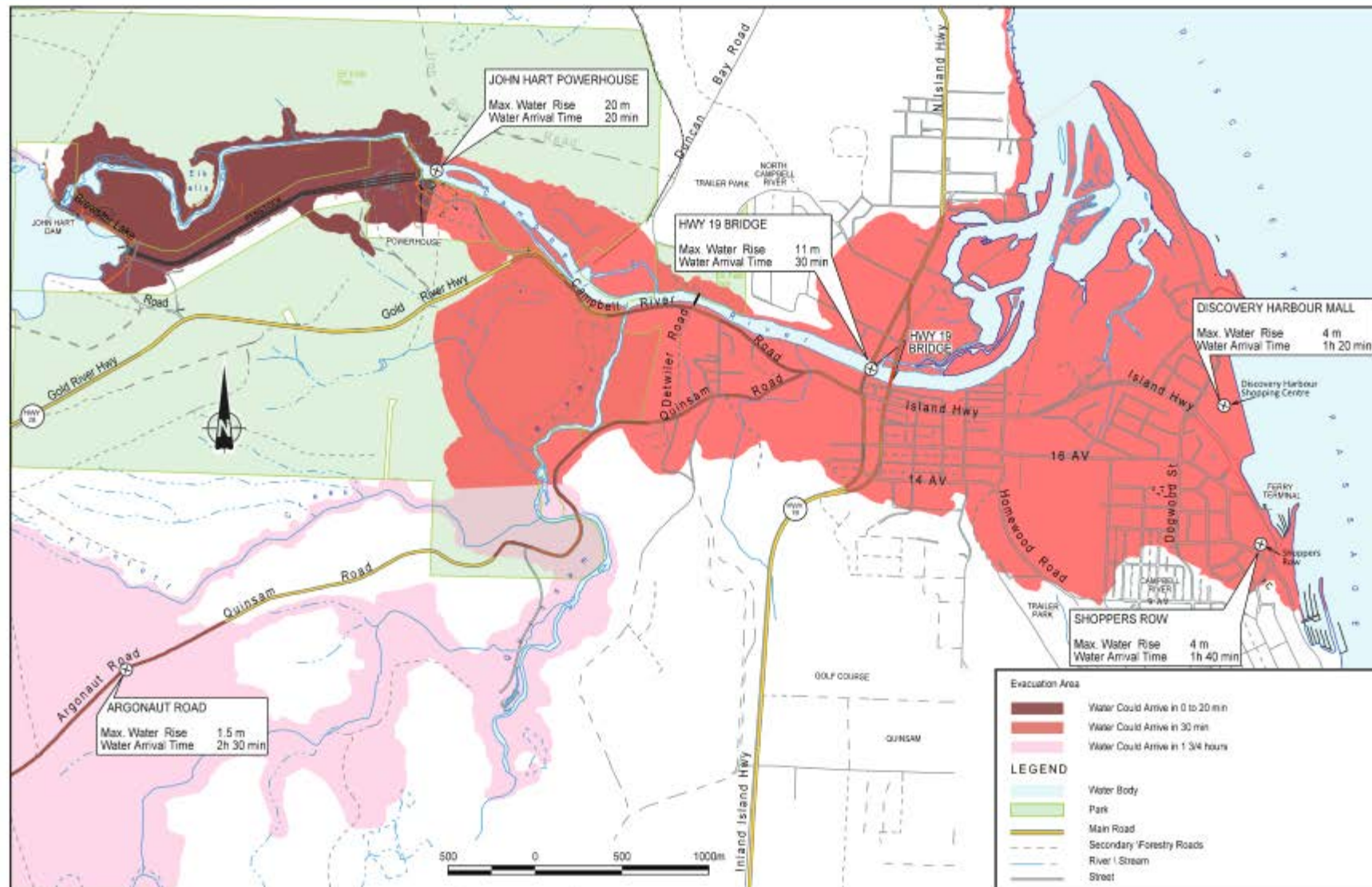
- ◆ Appendix A-1 – Emergency Contacts for Dam
- ◆ **Appendix A-2 – Evacuation Area Map**

# DAM





# CAMPBELL RIVER EARTHQUAKE EVACUATION MAP



Note: The flood areas show the worst case scenario of the John Hart or Strathcona dams failing. Also indicated, in either situation, is the fastest time of potential water arrival.



# New Guide and Template for DEP

## 2016 DEP Template – Appendix A

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

CDA Guidelines definition: “persons located immediately downstream and adjacent to the dam where available warning time is very limited and where local emergency authorities could not be expected to respond in time.

# New Guide and Template for DEP

## 2016 DEP Template – Appendix B

- ◆ **Appendix B-1 – Notification Charts – 3 levels**
- ◆ Appendix B-2 – Emergency Services Contacts
- ◆ Appendix B-3 – Emergency Response Resources

# New Guide and Template for DEP

## B-1 Notifications – Level 1, Monitor

### Dam Owner Contacts:

1. Dam Owner's Technical Expert
2. Dam Safety Officer



# New Guide and Template for DEP

## B-1 Notifications - Level 2, Save Dam

### Dam Owner Contacts:

1. Dam Owner's Technical Expert
2. EMBC
3. Local Emergency Authority
4. Persons in Immediate Danger
5. Dam Safety Officer

Appendix B-2:  
Other  
Emergency  
Services

# New Guide and Template for DEP

## B-1 Notifications – Level 3, Save People

### Dam Owner Contacts:

1. Local Emergency Authority
2. Persons in Immediate Vicinity
3. EMBC
4. Dam Safety Officer
5. Dam Owner's Technical Expert

Appendix B-2:  
Other  
Emergency  
Services

# New Guide and Template for DEP

## SUMMARY

### 2016 DEP Template for Dam Owners

1. DEP Overview – purpose and Reg. requirements
2. Basic DEP Data – inc. dam plan and access map
3. Roles and Responsibilities – All Parties
4. Five Step DEP Process (4.1 only)
5. DEP Maintenance, 6. Copy Holders, 7. Record Rev.
6. Appendix A
7. Appendix B
8. Appendix C to G



# SG Report on Testalinden Dam Failure, July 2010

## Recommendation 12:

*The Dam Safety Program should work with EMBC to ensure that dam owners are working directly with local government officials in tying together their emergency preparedness and response plans.*

**THE END - QUESTIONS?**

# Provincial Dam Safety Program

THE END

QUESTIONS?