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Project DRF070312

Re: Initial comments on the North Alouette River flooding on March 11 and 12, 2007 that damaged your nursery and other facilities.

At your request, issues related to a damaging flood which occurred on March 11 and 12, 2007 in Maple Ridge, B.C. were reviewed.

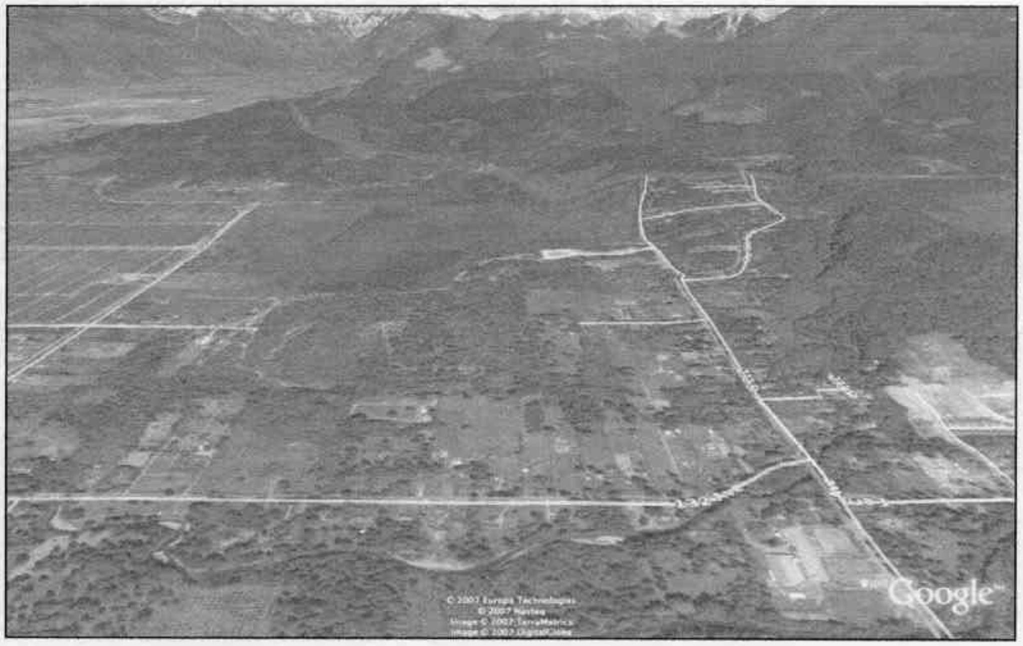

Figure 1: Looking north over the area in Maple Ridge affected by flooding, showing the approximate path of the water that flowed out of the North Alouette River starting at a private bridge on the east side of 232nd Street near 132nd Avenue, and then west in a new channel north of and approximately parallel to 132nd Avenue in Maple Ridge, B.C.

With respect to this matter, the following comments are made. Note that these are preliminary comments based on an initial field visit and review of the available data, and may need to be revised as more and better information is compiled.

1. The flooding occurred during a period of intense precipitation that lasted from about 13:00 (1 pm), Saturday, March 10, 2007 until about 01:00 (1 am), Monday, March 12, 2007 (36 hours), including a particularly intense period of precipitation between 08:00 (8 am) on March 11 and 21:00 (9 pm) on March 11 (13 hours) during which a total of 113 mm (4.4 inches) of rain fell; this is shown on the following graph, which is derived from raw B.C. Hydro data collected at the Alouette Dam, 8.5 km northeast of the flooded area.

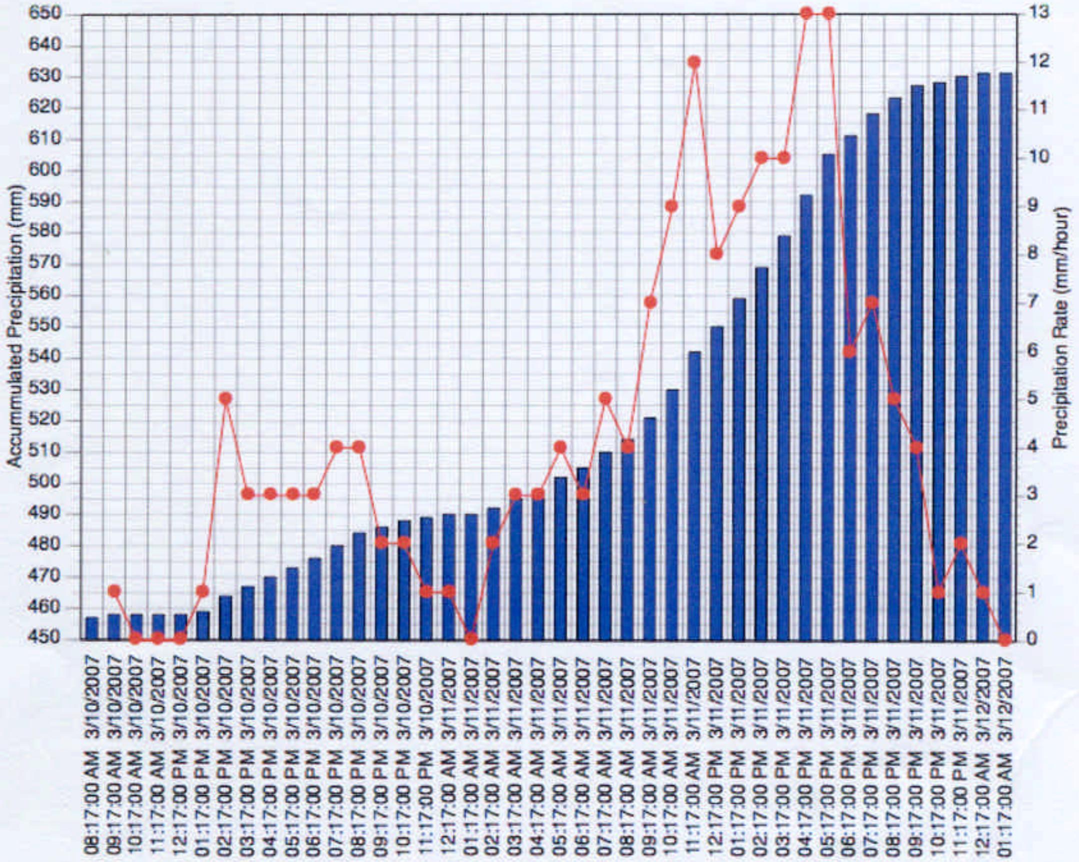

Figure 2: Precipitation data from the B.C. Hydro Hydromet station (ALU) at Alouette Dam, about 8.5 km northeast of the area of flooding. The red line shows the rate of precipitation.

2. Not only did a lot of rain (a total of 173 mm or almost 7 inches) fall over the 36 hours, but the intensity at times was very high at 13 mm (0.5 inch) per hour.

3. During the storm, temperatures also rose from about 6.8°C to a high of about 12.9°C. This is significant because it caused freezing levels to rise to over 2000 metres, prompting a considerable amount of snow to melt, which would have added to the precipitation-induced runoff.

4. The precipitation was brought in by a particularly intense southwesterly flow of relatively warm and moist air that originated in the Pacific Ocean near Hawaii; this is sometimes referred to as a "Pineapple Express" rainstorm.

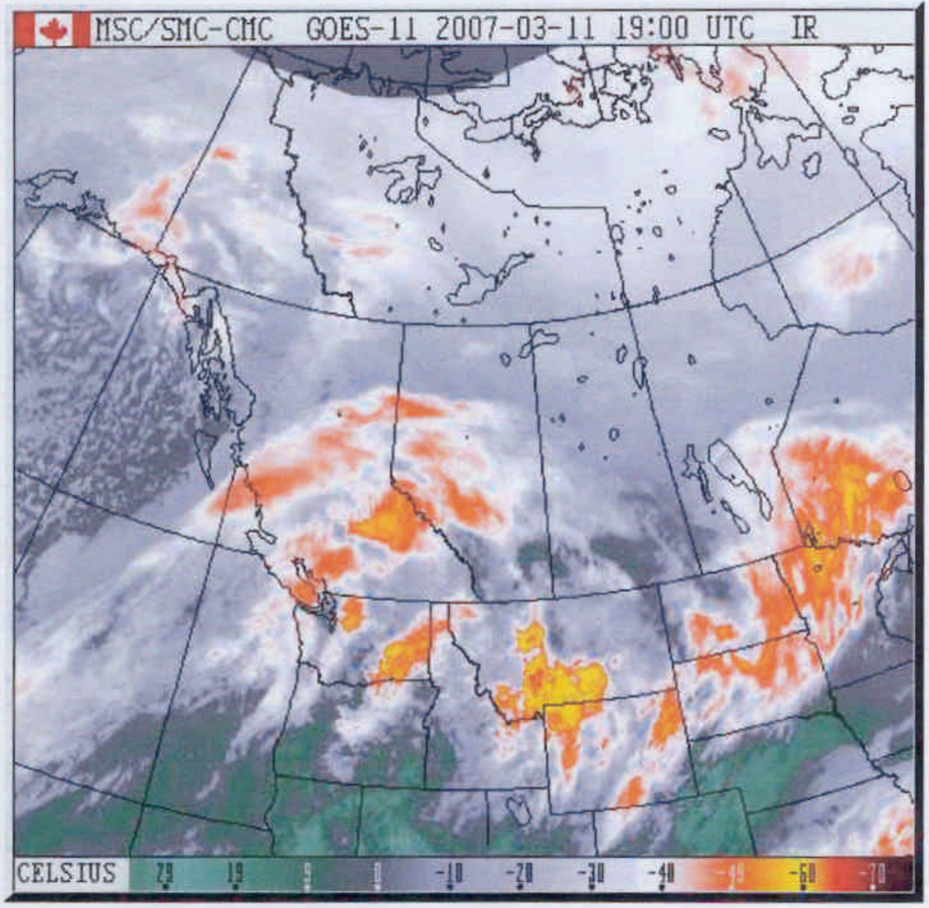

Figure 3: Environment Canada satellite image taken during the height of the storm at about 12:00 pm (noon), Sunday, March 11, 2007.

5. A traverse of a portion of the lower North Alouette River and interviews with local residents suggests that the flooding was caused by high water flows that first caused bank erosion to occur about 450 metres upstream from the bridge across the North Alouette River near the intersection of 232nd Street and 132nd Avenue. This bank erosion caused several large trees and sediment to topple into the water.

6. Just east of the intersection of Birch Street and 233rd Street, at about N49.24571°, W122.57689° (NAD 83 datum), the water and debris carried by the North Alouette river piled up against an old log bridge and caused it to wash out. Based on the position of the remaining log crib abutments, the bridge had wood stringers that were about 18 metres long, and the bottom of the bridge (soffit) was located about 2.8 metres above the bottom of the river channel. Based on measurements of the channel at this point, the cross-sectional area under the bridge would have been about 48 square metres. However, two large concrete blocks from an earlier bridge are also present in the channel at this point, and would reduce the overall hydraulic capacity somewhat.

Figure 4: Aerial image of the area where flooding initiated, showing various features and the approximate path of flood waters- they continued for several hundred more metres to the west.

7. The bridge stringers in Bridge 1 appear to have been cabled together and were most likely carried in one large mass down the river for about 300 metres until they encountered a second private bridge located on private land about 100 m upstream from 232nd Street. This bridge is about 25 metres across, but has a mid-stream pier and two spans.

8. The floating mass of woody debris containing the remains of Bridge 1, plus some additional woody debris, were caught up against the center pier of Bridge 2 and blocked much of the river right side of the channel. This greatly reduced the hydraulic capacity of the structure, causing water to back up and flow over the banks upstream on both sides of the bridge.

Figure 5: Bridge 2 and the mass of woody debris pushing up against its upstream side.

9. Most of the water flowed over the river right (north) bank, and then formed a new channel that caused water to flow in a westerly direction through yards, across 232nd Street, and then through numerous houses and yards in the area north of 132nd Avenue. This caused a considerable amount of damage to houses, farm and nursery buildings, yards, roads and other infrastructure, as well as depositing a considerable amount of sediment over these areas. The left bank abutment of Bridge 2 itself has been severely undermined and is not safe for vehicle passage, especially emergency vehicle access.

Comment and Conclusions:

1. The flooding and damage appear to have been caused by a number of factors including heavy precipitation, warming that caused snow melt, and then a high water flow in the North Alouette River that caused banks to erode and trees to topple.

2. The water and debris moved downstream and could not pass under an old wooden bridge that constricts the channel east of the end of Birch Street. Old concrete blocks under this bridge added to the problem of reduced channel capacity and interfered with the passage of debris.

3. Eventually, the water pushing up against the old wood bridge (Bridge 1) destroyed it, and allowed the woody debris to be carried downstream, where it was then caught up against the center pier of a second bridge (Bridge 2). This second blockage then caused water to back up and rise, and spill over the right bank, and from there, flow for hundreds of metres parallel to 132nd Street through homes, farm buildings, roads and yards where it did a considerable amount of damage before eventually flowing back into its natural channel.

Recommendations:

1. To ensure that there are no remaining unstable banks or trees that could topple and block the channel and cause additional problems, or present a safety issue, the entire channel of the North Alouette River should be assessed using aerial and ground observations.

2. Woody debris up against the private bridge about 100 metres upstream on the North Alouette River from the corner of 132nd Avenue and 232nd Street should be removed as soon as possible in order to re-establish adequate channel capacity and reduce the possibility of future flooding. The design and capacity of this bridge should be checked to ensure that it is adequately able to convey flood flows, as well as pass woody debris and sediment, and, if not, to determine what design modifications may be necessary to minimize downstream impacts during future floods.

3. The old concrete abutments that partially block the North Alouette River channel east of Birch Street should be removed in order to increase hydraulic capacity and reduce the possibility of future blockages.

4. The British Columbia Ministry of Environment's flood hydrologists should be engaged to analyze this flooding event and determine its return frequency, and also to re-define the expected Q200 flood flow (the flow of water expected to occur on average every 200 years). Once this is done, all bridges across the North Alouette River, as well as the channel itself, should be checked to ensure that they have adequate capacity to pass expected water flows, any woody debris, and also are able to deal with any channel aggradation (sediment build-up).

5. Bank protection and diking systems along the North Alouette River should be checked to ensure that they are able to help convey flood flows and minimize damage during high water events. Part of this should also involve an analysis of flood routing to see where water would flow during a high water event, especially if blockages occur, and whether dikes or other protection might help reduce the possibility of future flooding.

6. Fisheries and Oceans Canada and the British Columbia Ministry of the Environment should be consulted to ensure that any repairs or modifications to flood protection systems are properly permitted and consistent with prudent fish habitat management.

An Understanding:

The conclusions of this report are based on the currently available data and may need to be modified if additional information becomes available. It must be stressed that terrain analysis, hazard assessment and the evaluation of slope and hydrologic hazards is an inexact science and that any development in mountainous terrain is subject to some degree of geologic or hydrologic risk. This means that the absolute safety or stability of any proposed development cannot be guaranteed and that users of this report must accept a certain degree of risk if they carry out such development plans. If questions remain, additional specialist advice or a second opinion should be obtained.

Yours truly,

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