

AGENDA ITEM NO: 7-H-8

MEETING DATE: November 7, 2017

STAFF REPORT – COVER SHEET

SUBJECT: City of Chilliwack
OCP Pre-Consultation
Amendments to Eastern Hillside Plan and
Development Permit Area 2 Guidelines DATE: October 30, 2017

DEPARTMENT: Planning & Strategic Initiatives
OCP00031 PREPARED BY: Karen Stanton

1. SUMMARY OF ISSUE:

On April 4, 2017, Council received a staff report regarding continuing ground movement in the Marble Hill area, and directed staff under section 463 (2) of the Local Government Act to begin the preparation of bylaw amendments that, if adopted, would prohibit development within the affected area. As amendments to Official Community Plan Schedule D (Eastern Hillside Comprehensive Area Plan) and Development Permit Area 2 Guidelines (Hillside and Upland Areas) are proposed, Council is requested to consider pre-consultation with outside agencies in accordance with Section 475 of the Local Government Act. As a number of properties in the affected area are owned by the Crown, pre-consultation with the Ministry of Forestry Lands and Natural Resources is recommended.

2. RECOMMENDATION:

Recommendation that Council direct staff to consult with the Ministry of Forest Lands and Natural Resources on the proposed Official Community Plan amendment to amend the Eastern Hillside Area Plan and Development Permit Area 2 Guidelines.



David Blain
Director of Planning & Engineering

**3. CHIEF ADMINISTRATIVE OFFICER'S
RECOMMENDATION/COMMENTS:**

Supports recommendation.



Peter Monteith
Chief Administrative Officer

**STAFF REPORT ON
OCP PRE-CONSULTATION – OCP00031**

PREPARED BY: Karen Stanton DATE: October 30, 2017

POSITION: Manager, Long Range
Planning DEPARTMENT: Planning & Strategic Initiatives

1. DEFINITION OF ISSUE:

On April 4, 2017, Council received a staff report regarding continuing ground movement in the Marble Hill area, and directed staff under section 463 (2) of the Local Government Act to begin the preparation of bylaw amendments that, if adopted, would prohibit development within the affected area. As amendments to Official Community Plan Schedule D (Eastern Hillside Comprehensive Area Plan) and Development Permit Area 2 Guidelines (Hillside and Upland Areas) are proposed, Council is requested to consider pre-consultation with outside agencies in accordance with Section 475 of the Local Government Act. As a number of properties in the affected area are owned by the Crown, pre-consultation with the Ministry of Forestry Lands and Natural Resources is recommended.

2. FACTORS:

2.1 The geotechnical firm of Klohn Crippen Berger (KCB) has been analyzing the ground movement survey data for over a decade. Their most recent report from 2014 found ground movement in excess of two (2) metres in some locations. A subsequent report from 2016 recommended the following:

- (a) No development in the Ridge Crest rock fall hazard area (Areas A1 and A2)
- (b) Moratorium on further development in the Hinkley Creek suspect slide area Area B; and
- (c) No development in the earthflow area, Areas C1, C2, and C3

A map illustrating the location of these areas is included in Appendix 1 of this report.

2.2 On April 4, 2016, Council received a staff report (attached Appendix 2) regarding continuing ground movement in the Marble Hill area, and directed staff under section 463 (2) of the Local Government Act to begin the preparation of bylaw amendments that, if adopted, would prohibit development within the affected area.

2.2 The following amendments to the Official Community Plan are proposed:

- (a) Amendments to Development Permit Area 2 – Hillside and Upland Areas Guidelines, to require geotechnical reports for new development, to indicate that development will not be endangered, or that the measures have been taken to ensure that the development will not be endangered, by rock fall hazard, landslides, earthflow or other slope or foundational instability;

(b) Amendments to Official Community Plan Schedule D - Eastern Hillside Comprehensive Area Plan (Figure 2 Land Use Plan, Figure 4 Geotechnical Constraints, and Figure 5 Environmental Constraint Overlays and Development Cells to

- i. rename the Marble Hill "Subject to No Build Moratorium" area to "No Build Area" and expand it to reflect boundaries of the earthflow area, Areas C1, C2, and C3, where no new construction is permitted;
- ii. establish a new "Geologically Sensitive" area (to reflect Areas A1 and A2; and Hinkley Creek suspect landslide area, Area B, where new construction or tree clearing may occur only in accordance with approved development permits);
- iii. amend the Official Community Plan Schedule D - Eastern Hillside Comprehensive Area Plan Policy 5.27 by renaming "No Build Moratorium Zone" as "No Build Area" and replace the existing provisions for this area with the following:

Location: boundaries of the earthflow area, Areas C1, C2, and C3 as identified in geotechnical reports from the engineering firm of Kohn Crippen Berger dated August 3, 2016; and former Marble Hill Road (slide)

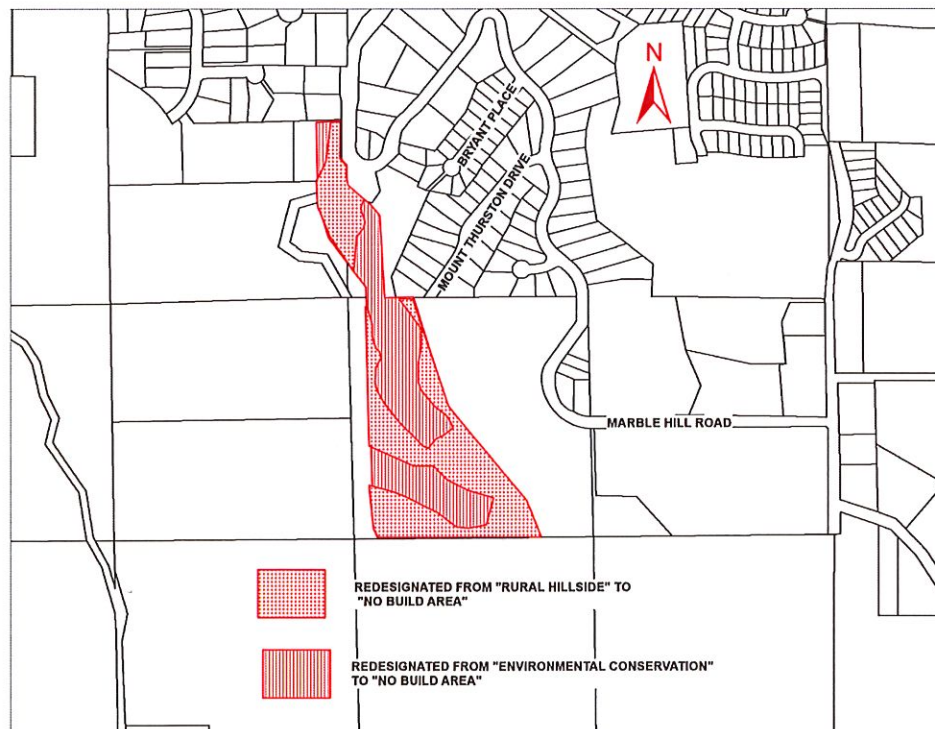
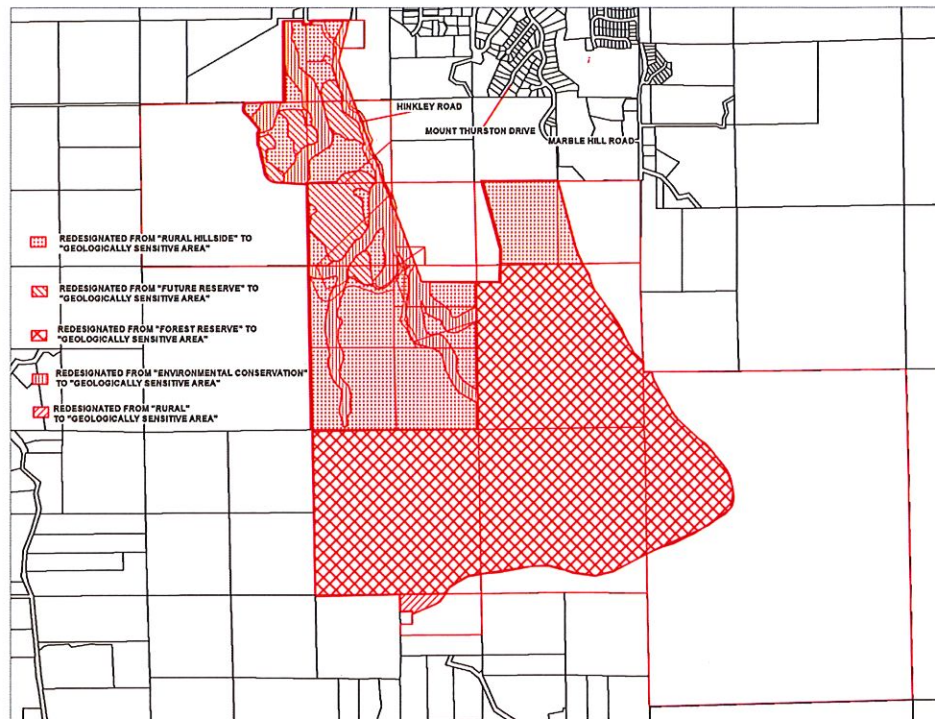
Appropriate uses: existing residential uses; no new construction or reconstruction of existing homes

- iv. amend the Official Community Plan Schedule D - Eastern Hillside Comprehensive Area Plan Policy 5.27 by adding the following provisions for the "Geologically Sensitive Area":

Location: boundaries of the Ridge Crest rockfall area, Areas A1 and A2; and Hinkley Creek suspect landslide area, Area B, as identified in geotechnical reports from the engineering firm of Kohn Crippen Berger, dated August 3, 2016

Appropriate uses: residential uses, in accordance with a development permit issued by Council; no tree cutting shall be permitted except in accordance with a development permit issued by Council.

- (c) Re-designation of affected properties to "No Build Area" and "Geologically Sensitive Area" as follows:



- 2.4 Zoning amendments are also proposed to accompany the Official Community Plan amendments, amending the RSV1 (Limited Use Reserve) Zone to include two new sub areas, “geologically sensitive area-Hinkley Road Area” and “geologically restricted area” to align with the “Geologically Sensitive area” and “No Build Area” OCP designations respectively, and to clarify permitted uses and conditions for each of these areas.
- 2.5 The anticipated date for introduction of the bylaws is November 21, 2017.
- 2.6 As other provincial agencies and First Nations were consulted prior to adoption of the Eastern Hillside Comprehensive Area Plan and Official Community Plan 2040, and the proposed amendments do not represent an increase in land use intensity, no other referrals are recommended.

3. **RECOMMENDATION & SUBSTANTIATION:**

Recommendation:

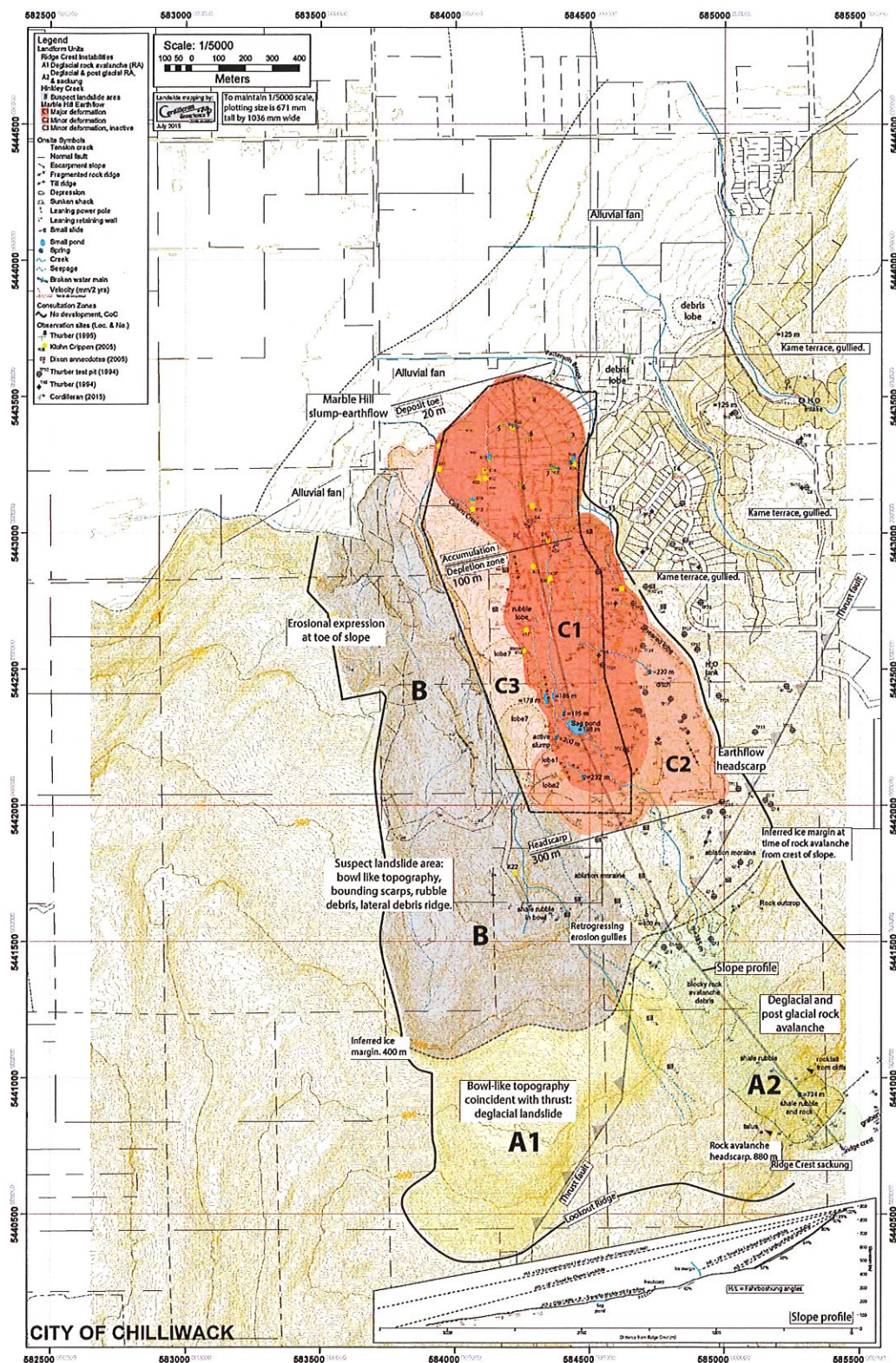
Recommendation that Council direct staff to consult with the Ministry of Forest Lands and Natural Resources on the proposed Official Community Plan amendment to amend the Eastern Hillside Area Plan and Development Permit Area 2 Guidelines.

Substantiation:

As the proposed OCP amendment affects Crown land, it is proposed that this report be referred to the Ministry of Forest Lands and Natural Resources.

Appendix 1:

Cordilleran Geoscience terrain map,
Marble Hill Landslide Mapping Project, Eastern Hillside
As referenced in letter from Klohn Crippen Berger, August 3, 2016



Appendix 2:

Staff Report dated April 4, 2017

AGENDA ITEM NO: 7-B-2

MEETING DATE: April 4, 2017

STAFF REPORT – COVER SHEET

SUBJECT: Marble Hill Development Moratorium Area DATE: March 15, 2017

DÉPARTMENT: Engineering PREPARED BY: R.E.G Sanderson

1. SUMMARY OF ISSUE:

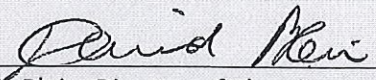
In 2004 Chilliwack City Council put in place a Development Moratorium in the Marble Hill area, since 2004 considerable ground movement monitoring work has been completed. This ground movement data, as well as ground truthing has resulted in a geo-technical recommendation to enlarge the Development moratorium area.

2. RECOMMENDATION:

Recommendation that Council direct staff under section 463(2) of the *Local Government Act* to begin the preparation of a zoning amendment bylaw and ancillary draft policies that will have the effect, if adopted, of prohibiting development of any building or structure on land located:

- a) in the Ridge Crest rockfall hazard area, Areas A1 and A2;
 - b) in Hinkley Creek suspect landslide area, Area B; and
 - c) in the earthflow area, Areas C1, C2 and C3;
- as shown on the map contained within the Staff Report dated March 15, 2017.

and further, that the City expand its GPS Monitoring Program to cover the entire mapped earthflow area.


D. A. Blain, Director of Planning and Engineering

3. CHIEF ADMINISTRATIVE OFFICER'S RECOMMENDATION/COMMENTS:

Supports recommendation.


Peter Monteith, CAO

STAFF REPORT ON

MARBLE HILL DEVELOPMENT MORATORIUM AREA

PREPARED BY: Rod Sanderson DATE: March 15, 2107
POSITION: Deputy Director of Engineering DEPARTMENT: Engineering

1. DEFINITION OF ISSUE:

In 2004 Chilliwack City Council put in place a development moratorium in the Marble Hill area, since 2004 considerable ground movement monitoring work has been completed. This ground movement data, as well as ground truthing has resulted in a geo-technical recommendation to enlarge the development moratorium area.

2. BACKGROUND:

- 2.1 The moratorium area was created in response to geotechnical instability that resulted in residential property settlement and home damage. So severe was the settlement in two cases that the homes were demolished on safety grounds.
- 2.2 The geotechnical instability is caused by a land slide mass consisting mostly of broken shale that settles and shifts in response to the penetration of ground water.
- 2.3 The original moratorium or potential movement area was created based on the best information available at that time. Since then, we have expanded the data gathering area to confirm presence or absence of movement.

3. FACTORS:

- 3.1 The original 2004 Development Moratorium map is attached in Appendix A and includes Panorama Drive, Allison Place, Ridgeview Street and Ridgeview Place.
- 3.2 The geotechnical firm of the Klohn Crippen Berger (KCB) has been analyzing the ground movement survey data for over a decade. Their most recent report from 2014 found ground movement in excess of two (2) metres in some locations. The July 2014 report is attached in Appendix B.
- 3.3 In response to the decade of movement data results, KCB recommended we conduct a review of the existing moratorium area map and update as required. That moratorium area map review is now complete and the summary of the report is attached in Appendix C, dated August 3, 2016. In addition to the new mapping resource, the August 3rd report makes 4 key recommendations repeated here for convenience:

With reference to the attached Cordilleran Geoscience terrain map, we have the following recommendations (the areas are shown on the last page of the report):

- a) No development in the Ridge Crest rockfall hazard area Areas A1 and A2 noted;
 - b) Moratorium on further development in Hinkley Creek suspect landslide area, Area B; and
 - c) No development in the earthflow area, Areas C1, C2 and C3;
- as shown on the map contained within the Staff Report dated September 28, 2016. And further, that the City expands its GPS monitoring program to cover the whole mapped earthflow area.

3.4 Areas A1 and A2 are inaccessible so there will be no impact on development.

Area C1 is the existing moratorium area. Due to their proximity to C1, any development application in areas C2 and C3 are already subject to rigorous geotechnical investigation. The proposed moratorium area will formalize that process.

Area B includes some existing homes along Hinkley and Development Cell 13 in the Eastern Hillside Comprehensive Area Plan (identified as future reserve). Extension of the moratorium to this area will affect the development potential of the property but based on the information received it would be prudent for the City to require extensive geotechnical evaluation before any development application in the area is considered. Extending the hub monitoring network will provide background information for both the City and a development applicant.

3.5 To assist property owners and the public in interpretation of the new map, our GIS Department simplified the KCB updated map boundary. This new simplified map is attached in Appendix D.

3.6 The no development recommendation refers to rezoning and subdivision. If a property owner within the original or proposed moratorium area wishes to build a home or structure, there is a geotechnical investigation methodology prescribed by the City to determine if movement or landslide shale is present on the property. The extent of the work required will depend on the proposal. The geotechnical work required will depend on the location, and may include but not be limited to, GPS hub installation and long term monitoring, subsurface material investigation by drilling and subsurface water table investigation by piezometer tube installation.

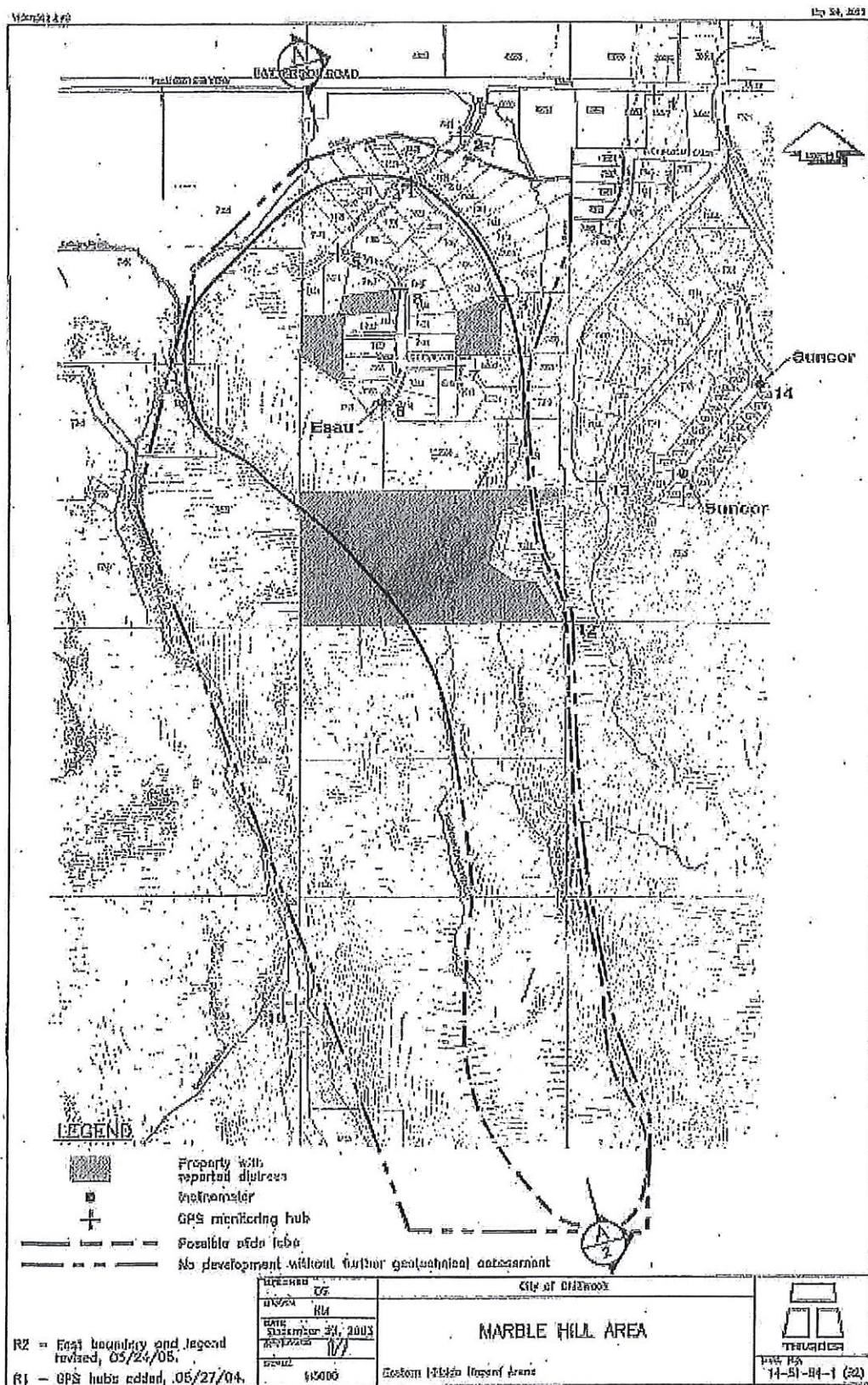
4. RECOMMENDATION & SUBSTANTIATION:

Recommendation that Council direct staff under section 463(2) of the *Local Government Act* to begin the preparation of a zoning amendment bylaw and ancillary draft policies that will have the effect, if adopted, of prohibiting development of any building or structure on land located:

- a) in the Ridge Crest rockfall hazard area, Areas A1 and A2 noted;
 - b) in Hinkley Creek suspect landslide area, Area B; and
 - c) in the earthflow area, Areas C1, C2 and C3;
- as shown on the map contained within the Staff Report dated March 15, 2017.

and further, that the City expand its GPS Monitoring Program to cover the entire mapped earthflow area.

APPENDIX A



APPENDIX B



July 14, 2014

City of Chilliwack
8550 Young Road
Chilliwack, British Columbia
V2P 8A4

Mr. Rod Sanderson, A.Sc.T.
Manager of Transportation and Drainage

Dear Mr. Sanderson:

Panorama/Ridgeview Subdivision
2012-2013 Ground Movement Data Review

We have reviewed the 2012-2013 ground surface movement monitoring data provided by the City of Chilliwack for the Marble Hill area that includes the Panorama/Ridgeview Subdivision in Chilliwack, BC. This letter summarizes the movement monitoring history and our interpretation of the data trends, as well as recommendations for further monitoring and data analysis.

1 MONITORING HISTORY

The enclosed Figure A shows a site plan with locations of the hubs that are being monitored in the Marble Hill area. Ground surface movement monitoring started in 2004. Since 2011, Underhill Geomatics Ltd. has taken readings at approximately three to four monthly intervals, using either GPS (Global Positioning System) technique or total station survey where tree cover obstructed satellite signals. The hubs were installed at different times and monitored by various firms as described below:

- Hubs 2 to 14, located mostly in the Panorama/Ridgeview Subdivision, were established in February 2004 by Thurber Engineering and McElhanney Consulting Services, and monitored by McElhanney during 2004-2005, by the City during 2007-2008, by various surveying firms during 2009, and finally by Underhill since 2010.
- Hubs 20 to 94, located at 7109 Marble Hill Road (Park property), were installed by Thurber and McElhanney between December 2005 and April 2007 and monitored by McElhanney until December 2007, then by Underhill since 2010.
- Hubs 100 to 150, 161 and 162, located throughout the Marble Hill area, were installed by Wedler Engineering in August 2009, and monitored by Wedler Engineering, Tunbridge & Tunbridge, and McElhanney during 2009, and finally by Underhill since 2010.
- Hubs 15 and 18, located in the adjacent east subdivision, were monitored by Underhill since 2010.

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City of Chilliwack
Panorama/Ridgeview Subdivision

2012-2013 Ground Movement Data Review

- Hubs 151 to 160, and 163, also located mostly in the adjacent east subdivisions, were installed and monitored by Underhill since March 2011.
- New Hubs 1101 to 1112 and 2016, referred to as Fortis Monuments in Fig. A and located mostly in lot 49936 at the northeast end of Ridgeview Place, were installed and monitored by Underhill since July 2013.

2 DATA PLOTS AND TRENDS

The attached Figures 1 to 5 summarize the measured cumulative hub movements to the north (downslope) plotted against time for all available monitoring data. The GPS data are grouped and plotted as follows:

- Fig. 1 (a) – Panorama/Ridgeview Subdivision – 2004 Hubs
- Fig. 1 (b) – Panorama/Ridgeview Subdivision – 2009 Hubs
- Fig. 2 (a) – 7360/7365 Properties South of Ridgeview Street – 2009 Hubs
- Fig. 2 (b) – 7255 Marble Hill Road (Dixon Property) – 2009 Hubs
- Fig. 3 (a) – 7105 Marble Hill Road (Park Property) – 2005-2007 Hubs
- Fig. 3 (b) – 7105 Marble Hill Road (Park Property) – 2009 Hubs
- Fig. 4 (a) – 7195 Marble Hill Road (Rempel Property) – 2009 Hubs
- Fig. 4 (b) – Adjacent East Subdivisions – 2010-2011 Hubs
- Fig. 5 – New Fortis Monuments – 2013 Hubs

Note that not all hubs shown on the same graph were started at the same time, and some hubs were not regularly surveyed during the entire period shown on the graph. The erratic readings obtained in 2009 were due to different surveying equipment and techniques used by three different companies that performed the surveys in 2009. The subsequent 2010 to present readings, all surveyed by one company, were relatively more consistent. However, the September 2011 and December 2011 surveys also contained some erratic readings.

Figure B shows the horizontal movement vectors (magnitude and direction) of the hubs for the two year period from March 2012 to February 2014. Figure C shows the corresponding vertical movement vectors, also for the same two-year period. Figure D presents the north trending movement rates of the hubs, as well as inferred contours of movement rates. The movement rates (mm per month) shown are averages over the last five years of readings.

The ground surface movement data indicate the following trends:

1. Ground surface movements to the north are continuing at relatively constant, but different, rates in the Marble Hill area that includes the Panorama/Ridgeview Subdivision.

City of Chilliwack
Panorama/Ridgeview Subdivision

2012-2013 Ground Movement Data Review

2. The highest horizontal movements continue to occur at 7105 Marble Hill Road (Park property) and 7255 Marble Hill Road (Dixon property), with rates of up to 26 mm per month.
3. At the Panorama/Ridgeview Subdivision, movement rates are 1 to 10 mm per month, and have been consistent over the last ten years.
4. The 2011 hubs installed mostly in the east subdivisions have not indicated any reliable movement trends.
5. Very limited readings from the new 2013 Fortis hubs installed at the lot on the northeast end of Ridgeview Place suggest north movements of up to 8 mm per month and settlement of up to 5 mm per month. Future readings will provide more definitive trends at this lot.

3 RECOMMENDATIONS

We recommend that the current hub monitoring survey program, with reading frequency at three-month intervals, should continue. The monitoring data should be forwarded to Klohn Crippen Berger for review as they become available.

Assuming the current constant rates of movement trends continue and if the City would like to reduce the frequency of readings, we recommend:

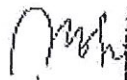
- Selected hubs with relatively large movement rates and representative of various zones across the Marble Hill area be surveyed at four-month intervals, and
- All other hubs be surveyed at least annually.

The existing piezometers and TDR cables in the Subdivision and Dixon property were last read more than five years ago, in January 2008. We recommend that the conditions of these instruments be assessed, and any available data be downloaded. The data from these instruments can provide valuable information in detecting changes in groundwater levels and movements below ground surface that would be useful in interpreting the surface movement data at the site.

We trust this meets your requirements. Please contact us if you have any questions.

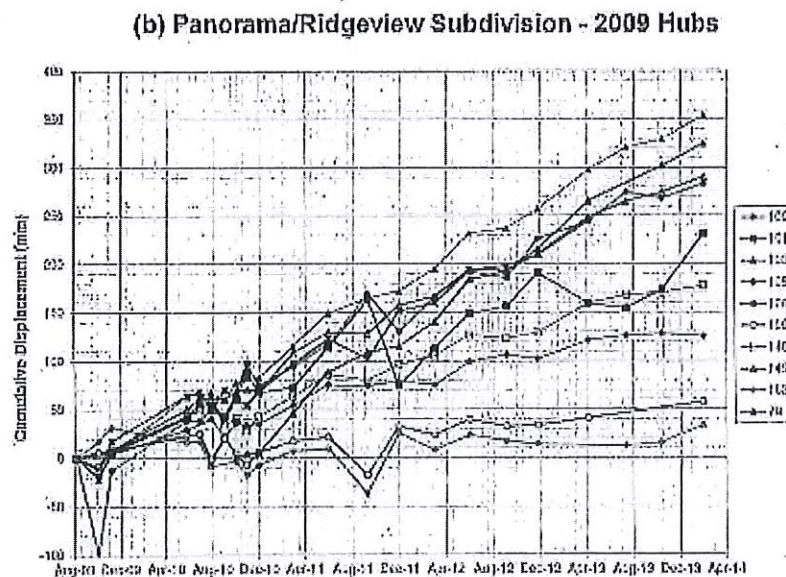
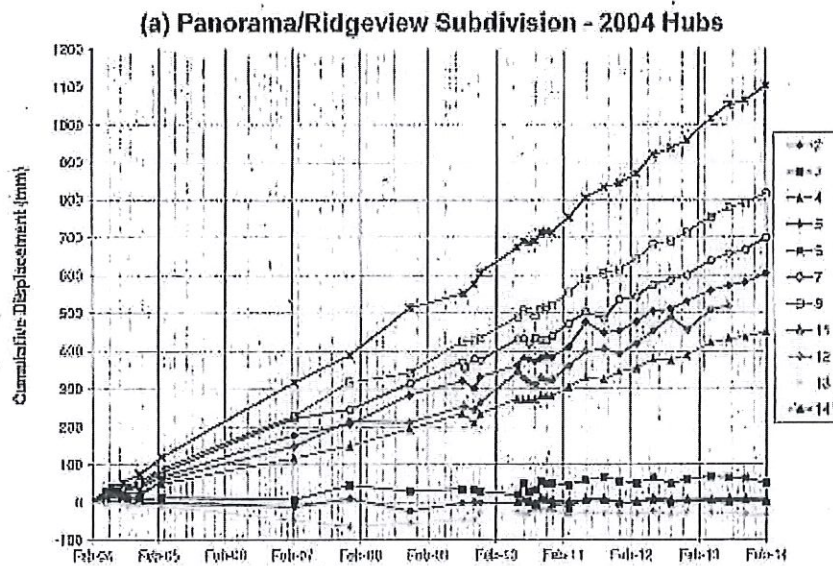
Yours truly,

KLOHN CRIPPEN BERGER LTD.


Alex Sy, Ph.D., P.Eng.
Project Manager



Encls. Figures 1 to 5 - Ground surface north movements vs. time plots
Figures A to D - Site plans showing movement vectors and rates



AS AN INITIAL PRESENTATION TO CURRENTS, THE PUBLIC AND CULTURE, ALL THE OFFICIAL DRAWINGS ARE SUBMITTED FOR THE COMPETITIVE ANALYSIS OF THE CLIENT. THE OFFICIAL PROJECT AND ALL THE MATERIAL FOR THE ANALYSIS OF THE CLIENT, INCLUDING THE OFFICIAL PROJECT, ARE SUBMITTED TO THE CLIENT FOR THE ANALYSIS OF THE CLIENT. THE OFFICIAL PROJECT AND ALL THE MATERIAL FOR THE ANALYSIS OF THE CLIENT, INCLUDING THE OFFICIAL PROJECT, ARE SUBMITTED TO THE CLIENT FOR THE ANALYSIS OF THE CLIENT.

NOTES:

1. Positive displacements to the north.
2. For Hub 79, available readings from October 2010 are plotted.

TO BE READ WITH KLOHN CRIPTEMBERGER REPORT DATED JUL 2014



Klohn Crippen Berger

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PANORAMA / RICKVIEW SUBDIVISION
CHILLIWACK, BC

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GROUND SURFACE NORTH MOVEMENTS VERSUS TIME
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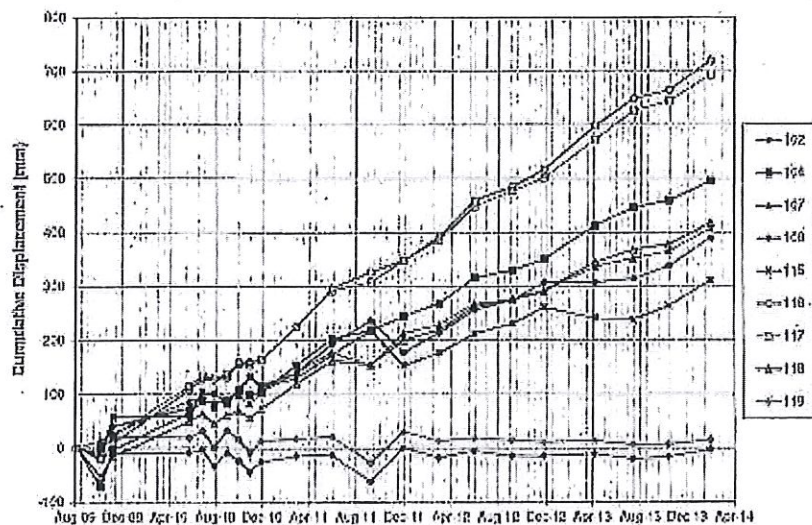
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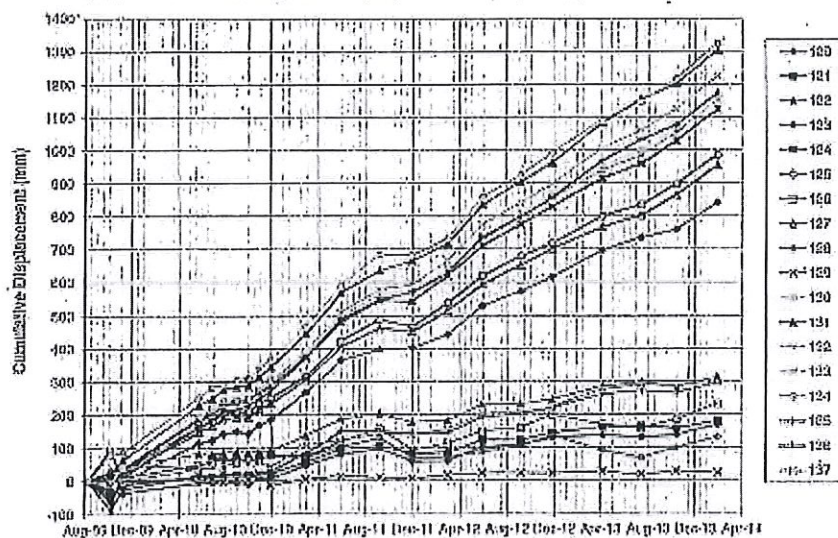
FIGURE 1

10-2-2

(a) 7360/7365 Properties South of Ridgeview Street - 2009 Hubs



(b) 7255 Marble Hill Road (Dixon Property) - 2009 Hubs



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NOTES:
Positive displacements to the north

TO BE READ WITH THE GROUND SURFACE REPORT DATED JUL 2014



CITY OF CHILLIWACK

PANORAMA / RIDGEVIEW SUBDIVISION
CHILLIWACK, BC

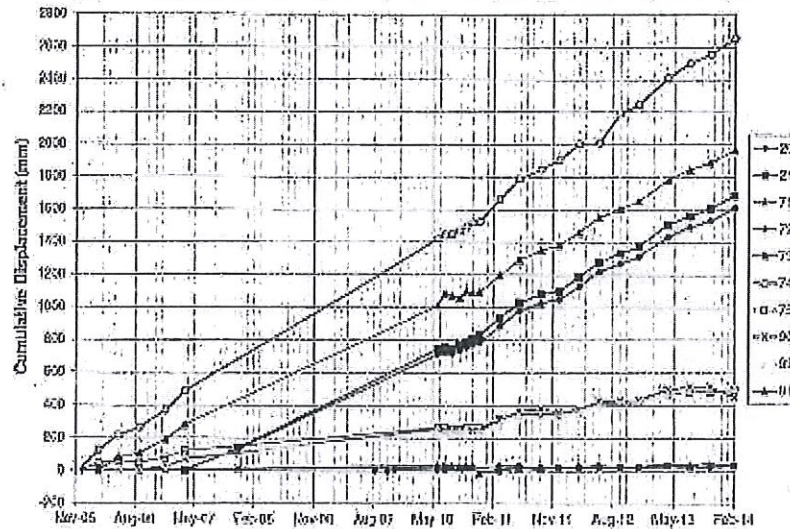
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SET 2 OF 5

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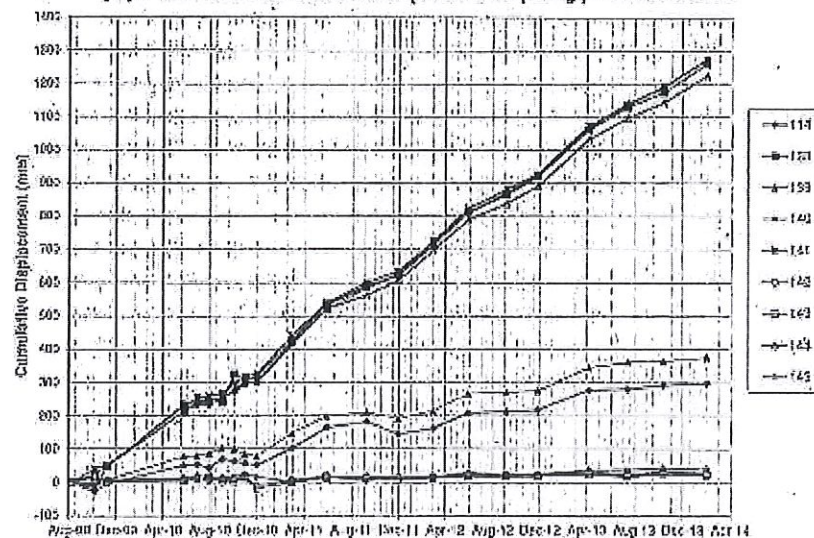
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FIGURE 2

(a) 7105 Marble Hill Road (Park Property) 2005-2007 Hubs




(b) 7105 Marble Hill Road (Park Property) - 2009 Hubs



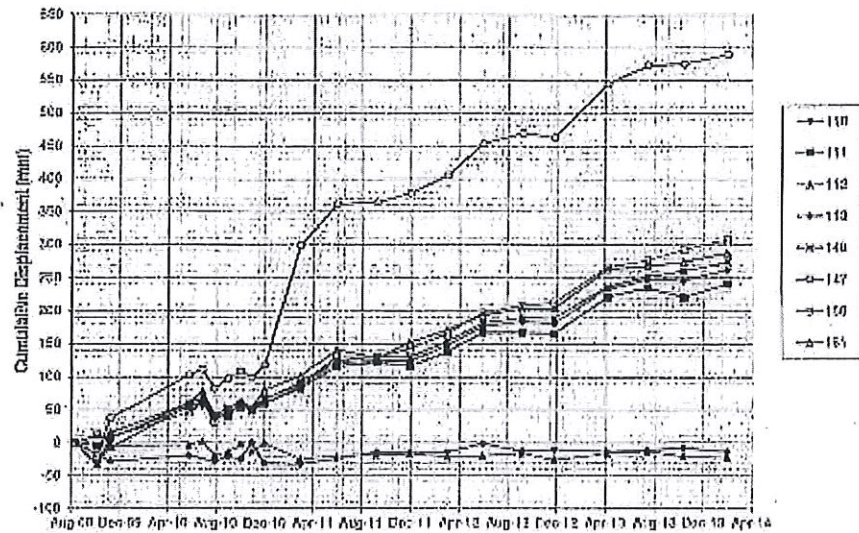
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NOTE:
Positive displacement is to the north.

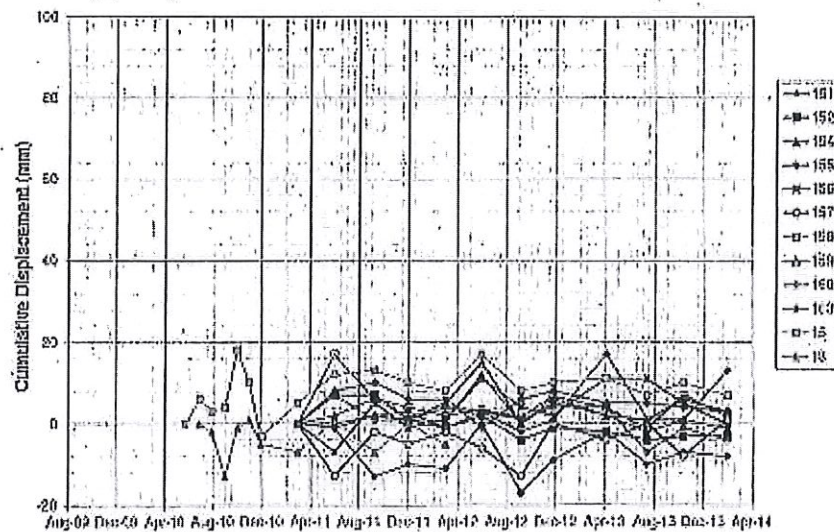
TO BE READ WITH KLOHN CRIPPEN BERGER REPORT DATED JUL 2014

 Klohn Crippen Berger	PROJECT: PANORAMA RIDGEVIEW SUBDIVISION CHILLIWACK, BC			
	TITLE: GROUND SURFACE NORTH MOVEMENTS VERSUS TIME SET 3 OF 5			
CLIENT: CITY OF CHILLIWACK	DATE OF ISSUE: JUL 2014 APPROVAL: AB	PROJECT NO: PC0177A04	DRAWING NO: FIGURE 3	SCALE:

(a) 7195 Marble Hill Road (Rempel Property) - 2009 Hubs




(b) Adjacent East Subdivisions - 2010-2011 Hubs



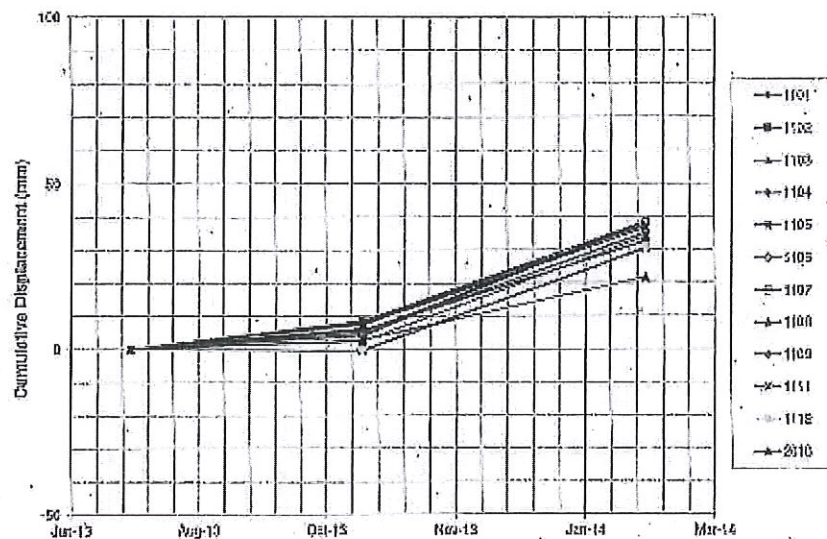
ANNUAL PROTECTION TO OUR CLIENT THE FLYING CROWNS INC. REPORTS AND DRAWINGS ARE SUBMITTED FOR THE CONFIDENTIAL INFORMATION OF OUR CLIENT FOR A SPECIFIC PROJECT AND AUTHORIZATION FOR USE AND/OR REPRODUCTION OF DATA, STATEMENTS, CONCLUSIONS OR RECOMMENDATIONS FROM THIS REPORT AND DRAWINGS IS RESERVED WITHOUT OUR WRITTEN APPROVAL.

NOTES:
Positive displacements to the north

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 Klohn Crippen Berger	PROJECT: PANORAMA / RIDGEVIEW SUBDIVISION CHILLIWACK, BC			
	TITLE: GROUND SURFACE NORTH MOVEMENTS VERSUS TIME SET 4 OF 6			
CLIENT: CITY OF CHILLIWACK	PROJECT NO: JUL 2014	PROJECT NO: PG0177A04	TITLE: FIGURE 4	DATE:
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New Fortis Monuments - 2013 Hubs



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NOTES:
Positive displacements to the north

TO BE READ WITH KLOHN CRIPPEN BERGER REPORT DATED JUL 2014



Klohn Crippen Berger

CITY OF CHILLIWACK

PANORAMA / RIDGEVIEW SUBDIVISION
CHILLIWACK, BC

GROUND SURFACE NORTH MOVEMENTS VERSUS TIME
SET 5 OF 5

DATE OF ISSUE
JUL 2014

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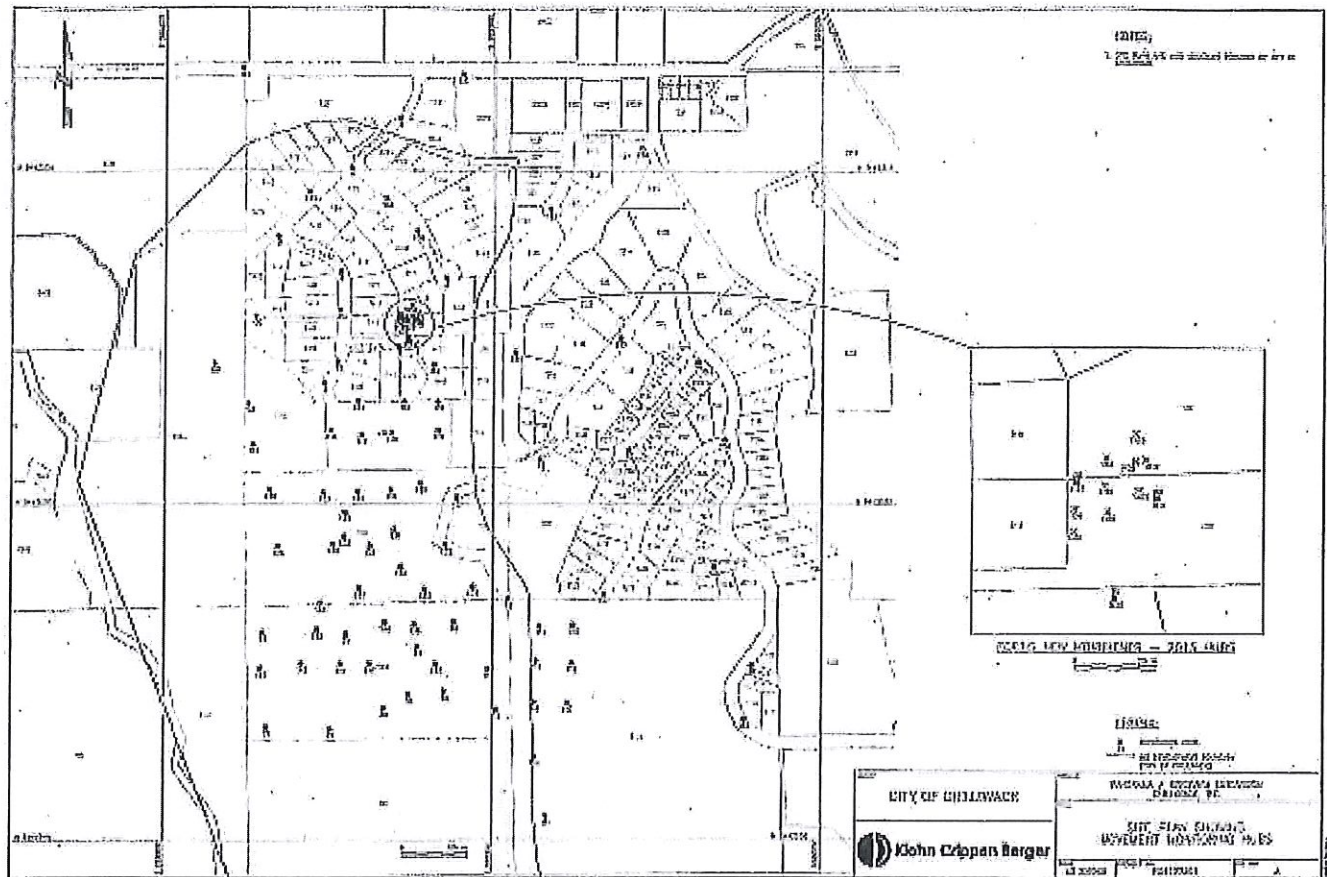
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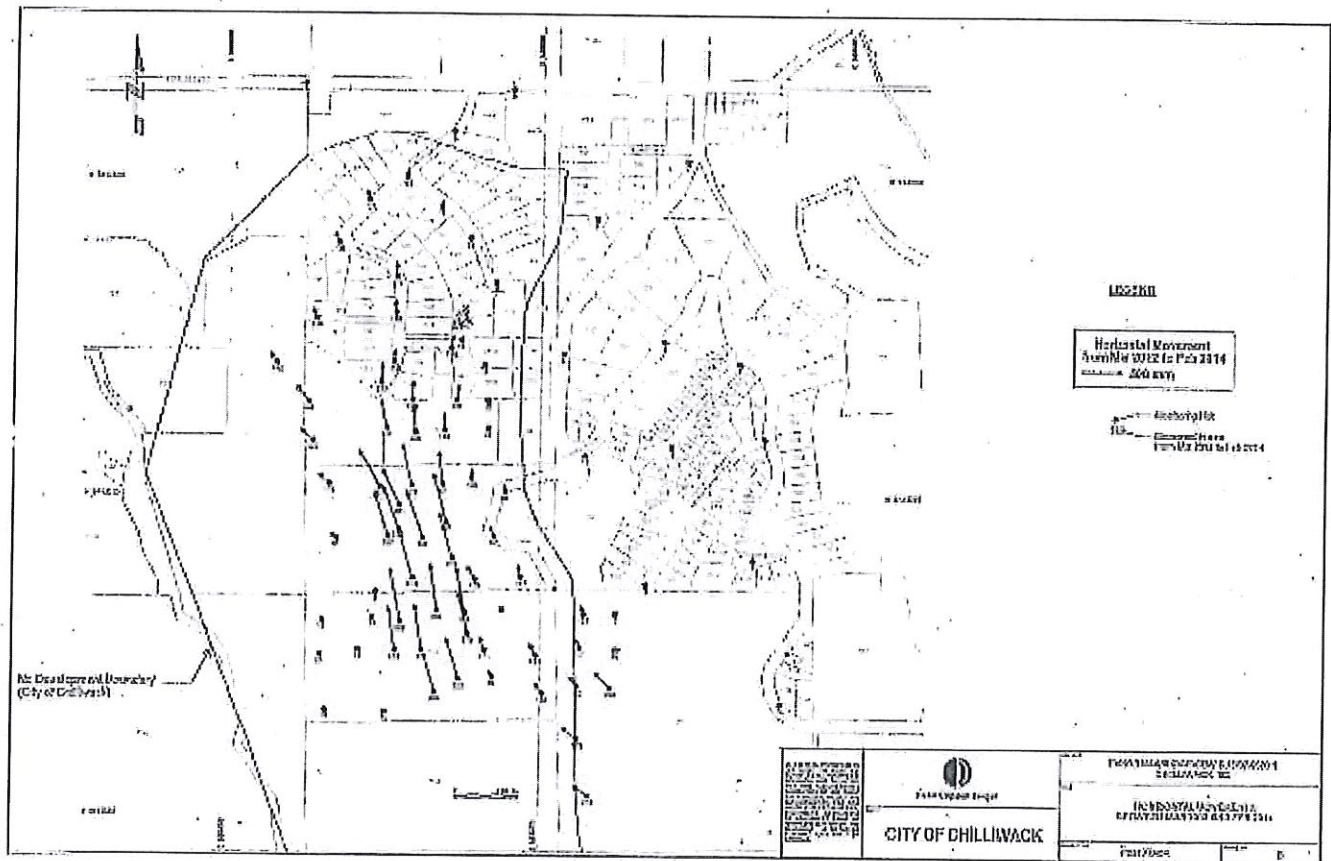
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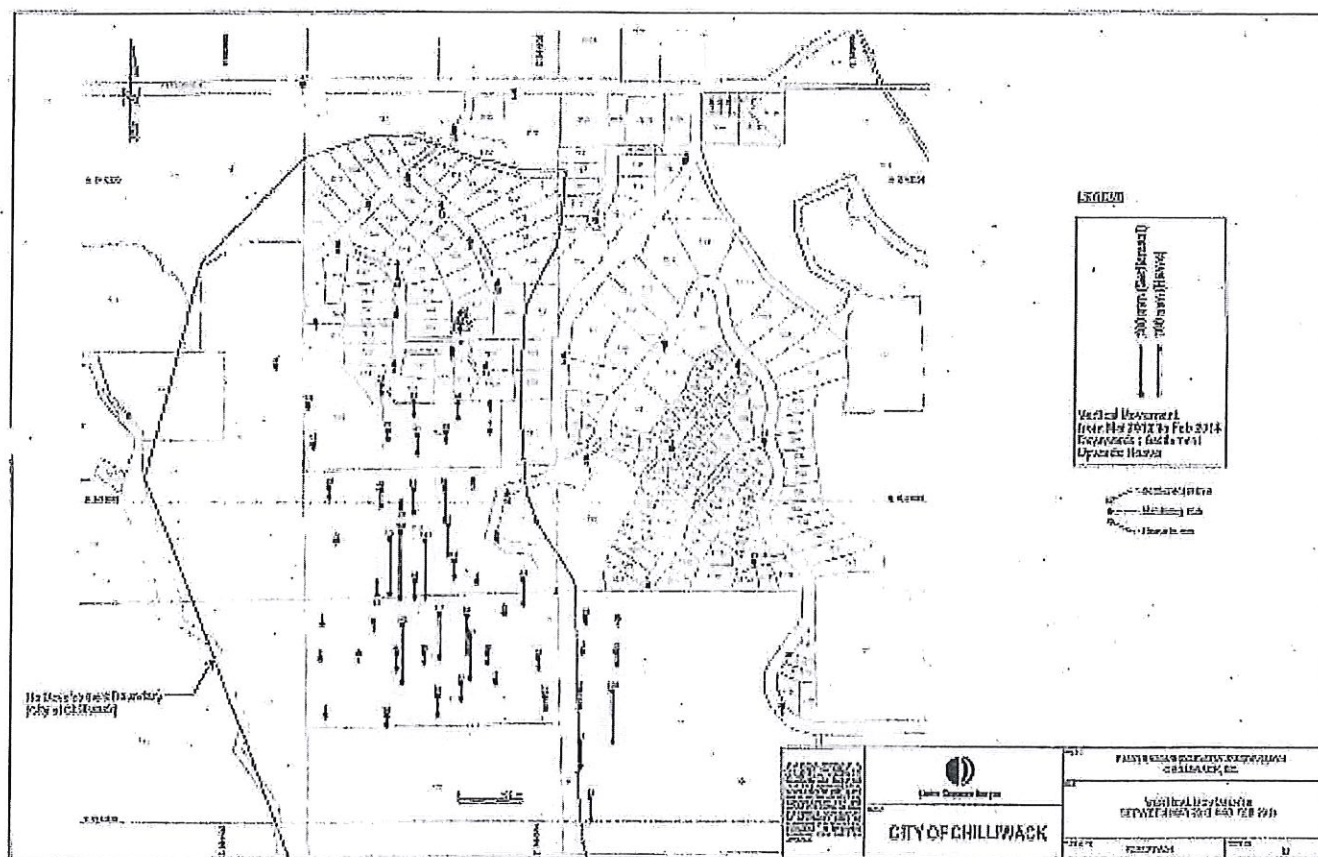
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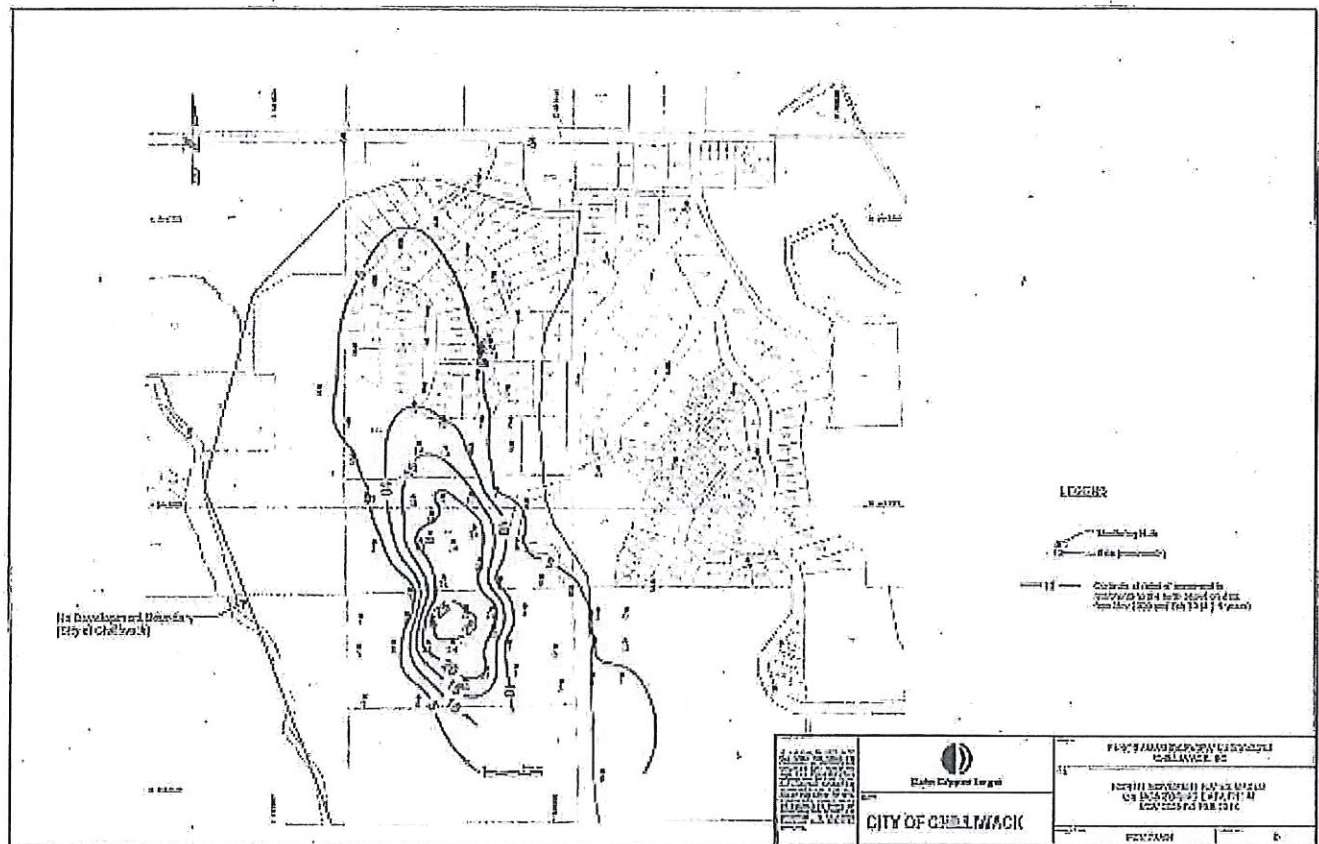
FIGURE 5

DATE









APPENDIX C



August 3, 2016

City of Chilliwack
8550 Young Road
Chilliwack, British Columbia
V2P 8A4

Mr. Rod Sanderson, A.Sc.T.
Deputy Director of Engineering

Dear Mr. Sanderson:

**Panorama Subdivision - Marble Hill, Chilliwack, BC
Updated Landslide Map**

This letter presents the results of a study to update the existing landslide map in the Panorama Subdivision-Marble Hill area in Chilliwack, BC. The City requested this study to extend and update their current No-Development zoning map because of the discovery of shale-derived landslide material in a borehole conducted by Thurber Engineering in November 2014 at 6650 Hinkley Road, which lies outside the City's current No-Development boundaries, as shown on the attached plan.

1 SCOPE OF MAPPING STUDY

We engaged Mr. Pierre Friele, MSc, P.Geo., Senior Geoscientist of Cordilleran Geoscience in Squamish, BC, to do the mapping work. The scope of work is as follows:

1. Background Information review;
2. Interpretation of 2 m contour Lidar base map to delineate likely extent of landslide mass;
3. Field mapping to identify possible evidence of the landslide activity; and
4. Preparation of terrain map with updated extent of landslide mass and report documenting the study.

2 RESULTS

The results of this study are presented in the attached report prepared by Mr. Friele titled "Marble Hill Landslide Mapping Project, Eastern Hillslides, Chilliwack, BC" dated November 27, 2015, with an accompanying terrain map. In the map, Mr. Friele identified three distinct geomorphic areas (or landform units) as follows:

160803L Chilliwack Mapping Study.docx
P29177A05

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City of Chilliwack
Panorama Subdivision-Marble Hill, Chilliwack, BC

Updated Landslide Map

1. Ridge crest sackung and potential rockfall hazard area, which encompasses the generally steep sloping area below Lookout Ridge (labelled A1 and A2 on the map);
2. Hinkley Creek suspect landslide area, generally to the west of Hinkley Road (labelled B on map); and
3. Marble Hill earthflow, which is subdivided into (1) Major Deformation Area that includes the Panorama-Ridgeview subdivision (labelled C1 on map), (2) Minor Deformation Area (C2 on map), and (3) Minor/Inactive Area (C3 on map).

3 LIMITATIONS OF THIS STUDY

Please note the following limitations on the results of this study:

- The terrain map prepared by Cordilleran Geoscience is based primarily on Lidar map interpretation of ground surface expressions, field observations of possible evidence of landslide activity, available geotechnical reports, and existing movement monitoring data in the subdivision area;
- Landform unit or zone boundaries shown on the map are estimates only;
- No confirmatory subsurface drilling investigation was carried out for this study;
- Mechanism of ground movements in the Panorama-Ridgeview subdivision is not fully understood; and
- It is not possible to predict if ground movement will occur in future on a landslide mass that is currently not moving.

4 RECOMMENDATIONS

With reference to the attached Cordilleran Geoscience terrain map, we have the following recommendations:

1. No development in the ridge crest rockfall hazard area immediately downslope of Lookout Ridge, including Areas A1 and A2 noted on the map, most of which is underlain by steep slopes (> 30%). We recommend the City engages a Qualified Professional as suggested in the Cordilleran Geoscience report to review rockfall hazard and potential for a large magnitude rock slide that could potentially impact existing development downslope.
2. Moratorium on further development in Hinkley Creek suspect landslide area (Area B on map). New GPS hubs should be installed and monitored to evaluate ground movements, if any. We also recommend that City considers doing a few Sonic core drill holes to investigate the presence or absence of landslide mass in this area.
3. No development in the earthflow area (Areas C1, C2 and C3 on map), most of which is already within the City's No-Development Zone that includes the Panorama-Ridgeview subdivision.

City of Chilliwack
Panorama Subdivision-Marble Hill, Chilliwack, BC

Updated Landslide Map

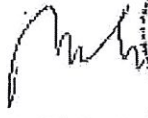
We recommend the City expands its GPS monitoring program to cover the whole mapped earthflow area.

4. We recommend the City compiles available geotechnical information and creates a geotechnical database of existing and future drill holes in Eastern Hillsides.

We trust this letter meets your requirements. Please call if you have any questions.

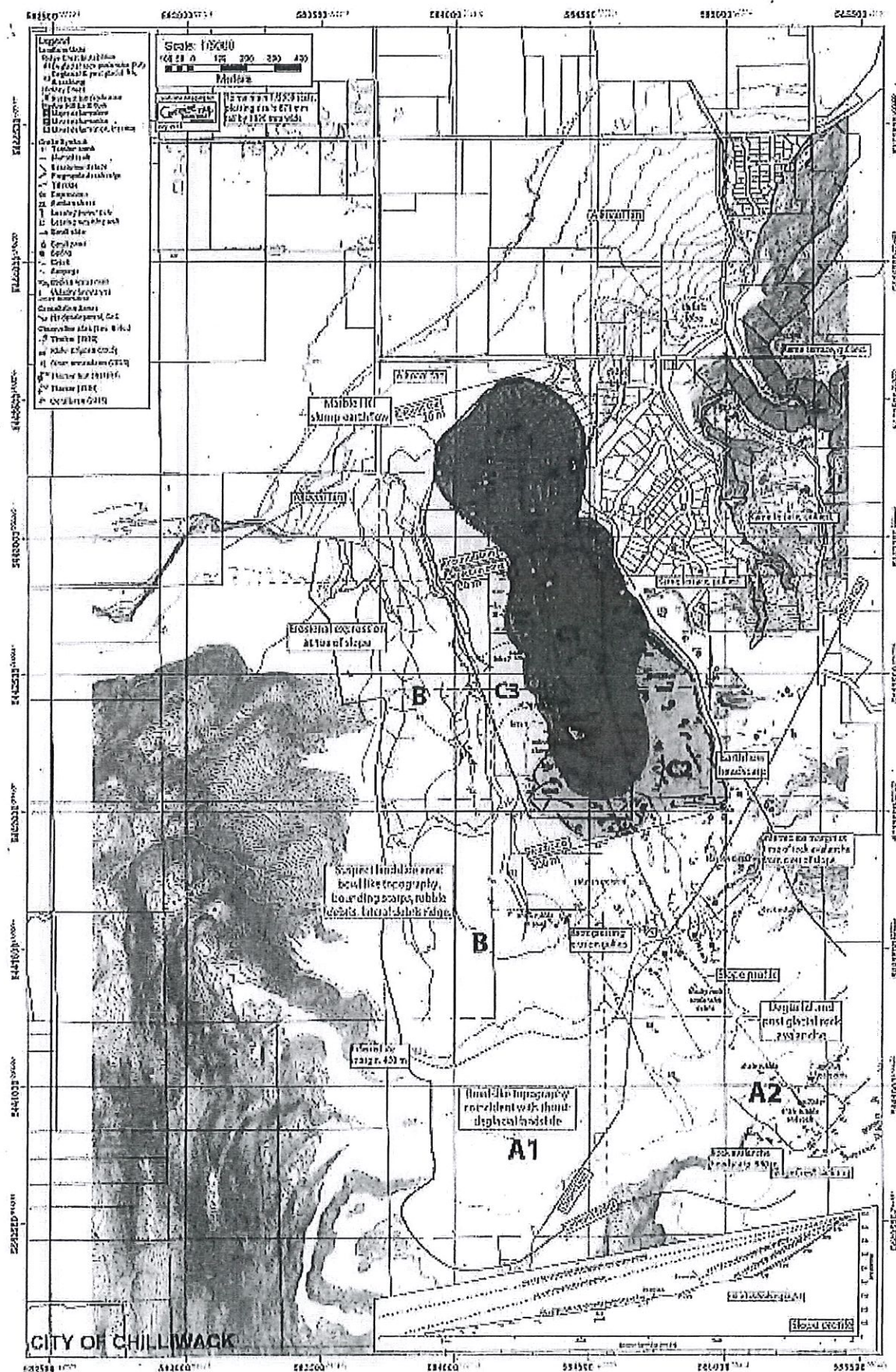
Yours truly,

KLOHN CRIPPEN BERGER LTD.


Alex Sy, Ph.D., P.Eng.
Project Manager



Encls: Plan showing City's No-Development Zone,
Cordilleran Geoscience Report "Marble Hill Landslide Mapping Project" November 27, 2015



APPENDIX D

