



**GEOTECHNICAL HAZARDS REPORT
DPA1 UPDATE – GIBSONS OFFICIAL
COMMUNITY PLAN
TOWN OF GIBSONS, BC**

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1.0 Introduction

The Town of Gibsons (the Town hereinafter) is located on the southeast portion of the Sunshine Coast with the north limit of the Town located approximately 3 kilometres to the south of the Langdale ferry terminal.

The Town of Gibsons had published a document titled Smart Plan – Gibsons Official Community Plan (Schedule A: “Town of Gibsons Official Community Plan Bylaw No. 985, 2005”) in March 2015. In the aforementioned document, the Town had established ten Development Permit Area (DPA) zones. In the aforementioned document, the Town provided guidelines and requirements for each DPA zone that were required to be addressed in the Development Permit Applications to the Town for proposed developments.

The guideline for DPA 1, which is related to the properties that would have a potential for geotechnical hazards, was prepared based on a study that was conducted by Thurber Engineering Ltd. (Thurber hereinafter) as summarized in their report titled “Town of Gibsons Official Community Plan Reconnaissance Study of Geotechnical Hazards and Biophysical Environmental”, dated October 22, 1991.

Due to the increase in development proposals over the last few years, and since the aforementioned document was prepared based on a study that was carried out in 1991, the Town retained RAM Engineering Ltd (RAM hereinafter) to review the current DPA 1 guideline with respect to current geotechnical hazards and to provide recommendations and updates, as required. It should be noted that the geohazards presented in this report mainly relate to slopes and that other geotechnical hazards such as liquefaction, settlement of the soils due to raising grades or lowering the groundwater table, etc. are not specifically addressed on a site-by-site basis in this study.

RAM subsequently retained Stirling Geoscience Ltd. (Stirling hereinafter) as part of this project to conduct the study and assessment of the geohazards for this project relating to creek and coastal flooding. The Stirling observations, conclusions and recommendations relating to these types of geohazards are presented in a standalone report, Town of Gibsons Development Permit Area 1 (Geotechnical Hazards) Update (Flood Hazard Component), Gibsons, BC, dated November 12, 2025; this report also addresses debris flows.

As part of this project, but addressed in a separate deliverable, the current guidelines for DPA2, which are related to environmentally sensitive areas, have been assessed and updated, as required, by Diamond Head Consulting. DPA9, which addresses and protects the Gibsons Aquifer, is not addressed herein, although artesian groundwater and the risk of aquifer breach is mentioned as a geotechnical-related hazard in Section 7.0.

It should be noted that the engineer who carried out the geotechnical hazard reconnaissances, Nima Tafazzoli, Ph.D., P.Eng., is no longer with RAM. However, the undersigned engineer has been involved in a review capacity with the project since inception.

2.0 Executive Summary

The context of this report is to review the areas within the Town with regard to geotechnical hazards, and to provide recommendations for updating the current DPA1 guideline based on the changes in professional practice since 1991.

RAM carried out a site reconnaissance of the areas with potential for geohazards, reviewed the available information, and identified the types of geotechnical hazards, and the areas and properties that would have a potential for geotechnical hazards related to slope hazard. As part of the aforementioned recommendations, there are properties with potential for geohazards that are now being included under the DPA1 guideline.

We also recommend that geohazards arising from seismic activity (e.g. slope stability under the design seismic loading event or liquefaction) be considered in design and construction of the new developments. The available information related to liquefaction and settlement geohazards is sparse, so these geohazards are only generally addressed herein.

RAM has provided recommendations in this report with respect to the updates that would be necessary to be implemented in the current DPA1 guideline. We have also provided recommendations with regard to requirements of the documents to be submitted by professionals. Further, RAM encourages the Town of Gibsons to maintain a hazard report file so that available literature regarding geohazards, including those unrelated to slopes and water courses, is available to Qualified Professionals providing engineering or geoscience services within their jurisdiction.

3.0 Reference Documents

3.1 Reports for Public and Private Projects

Several documents were provided to us by the Town for public and private projects. The information contained in these documents was reviewed as part of RAM's desktop study for this project. A list of the aforementioned documents is provided in Appendix 3, and a summary of the aforementioned information is provided for select reports in Appendix 4.

3.2 Air Photos

Hard copies of historical aerial photographs were obtained from the University of British Columbia's (UBC) Geographic Information Centre and which were reviewed for this project are listed below. These aerial photographs were reviewed in order to identify any historical geohazards, such as landslides, within the Town of Gibsons.

- Year 1947, Roll BC349, Photo Numbers 7 to 8 and 101 to 103;
- Year 1950, Roll BC1048, Photo Numbers 70 to 77, with the exception of 73;
- Year 1957, Roll BC2099, Photo Numbers 28 to 30 and 49 to 51;

- Year 1962, Roll BC5055, Photo Numbers 13 to 15;
- Year 1967, Roll BC4426, Photo Numbers 259 and 261;
- Year 1967, Roll BC4427, Photo Numbers 84 to 86;
- Year 1974, Roll BC5577, Photo Numbers 42 to 46;
- Year 1978, Roll 15BC78016, Photo Numbers 270 to 274;
- Year 1983, Roll 15BC83016, Photo Numbers 35 to 39 and 59 to 62;
- Year 1986, Roll 30BC86061, Photo Numbers 47 to 50;
- Year 1990, Roll 30BCB86061, Photo Numbers 47 to 50;
- Year 1994, Roll 30BCC94145, Photo Numbers 22, 24, 29 to 32, and 79 to 81;
- Year 1998, Roll 30BCB98007, Photo Numbers 238, 239, 255, and 256;
- Year 1998, Roll 30BCB98008, Photo Numbers 239 to 241; and
- Year 2005, Roll 30BCC05143, Photo Numbers 173 to 175 and 184 to 186.

4.0 Background Information

4.1 Town of Gibsons

The Town of Gibsons is located at the southwest side of Howe Sound. The Town's boundary is shown on Figure 1. The majority of the existing developments and residences in the Town are within the eastern half of the Town. Gibsons Harbour (Howe Sound) is located to the east of the Town's boundary. General topography within the Town slopes down from the west, where mountains are located, towards the east, where the harbour is located.

The two major creeks within the Town of Gibsons are Gibsons Creek (within the north portion of the Town) and Charman Creek (within the central portion of the Town), both of which flow from west to east and discharge into Howe Sound. The ravines of the aforementioned creeks are steep to very steep and are heavily forested with second growth.

Geotechnical hazards that have historically been identified within the Town comprise flood, landslide, rockfall, debris flood, debris torrent, and wave erosion (within the coastal areas).

4.2 LiDAR Data

For our review and preparation of this report, LiDAR data that was obtained in 2021 was provided to us by the Town. The 1 metre and 5 metre topographic contour lines were defined in the aforementioned LiDAR data.

4.3 Expected Surficial Geology

Based on the Geological Map of British Columbia, Geoscience Map 2009-1, published by the British Columbia Geological Survey, Ministry of Energy, Mines and Petroleum Resources, dated 2009, and the Surficial Geology and Sand and Gravel Deposits of Sunshine Coast, Powell River, and Campbell River Areas report, published by the Province of British Columbia, Ministry of Mines and Petroleum Resources, dated 1977, the surficial geology within the majority of the Town of Gibsons is expected to comprise from top to bottom:

- Capilano Sediments locally described as marine and glacio-marine deposits that comprise gravelly, sandy, stoney, clay and clay veneer, and Quaternary, described as unconsolidated glacial, fluvial, and alluvial deposits;
- Vashon Drift: locally described as glacio-fluvial deposits comprising gravel and sand, and ground moraine deposits comprising mainly till;
- Pre-Vashon Sediments: locally comprising gravel, sand and silt; and
- Bedrock: mostly bare rock with thin patches of overburden usually till or marine veneer.

The bedrock is exposed at some areas within the southeast portion of the Town (e.g. Bay Area / Georgia View) and rises steeply from the shoreline.

4.4 Thurber 1990 and 1991 Reports

Thurber carried out a site reconnaissance of the Elphinstone, West Howe Sound, and Town of Gibsons areas in 1990 and 1991. The potential geotechnical hazards in the aforementioned areas were identified to be:

- landslides and areas of wave erosion along the ocean-front slopes;
- landslides on the ravine slopes and creeks;
- rockfalls on bedrock shorelines;
- debris floods and debris torrents on the creeks; and
- potential flooding from the creeks and ocean.

The probabilities of hazard occurrences for different areas were categorized into three groups:

- less than 1:500 annually;
- between 1:150 to 1:500 annually; and
- and between 1:25 to 1:150 annually.

Thurber recommended that the crest of a slope should be determined with conservative field criteria such as the perceived location of ground fractures and other suspect features which may indicate an imminent landslide.

The ravine slopes of Gibsons and Charman Creeks were described as forested and locally steeper along the upper stream channels, which was inferred to indicate comparatively recent erosion.

No distinct landslides were observed during the site reconnaissance that was carried out by Thurber. Local trash dumping on the ravine slopes and along the lower creek courses was observed. Widespread soil creep and movement within shallow depths (e.g. 1 to 2 metres), along with bowed trees and small soil slumps, was noted.

The creek slopes were observed to be steepened due to stream erosion and inferred to promote future debris landslides during heavy rain. Thurber mentioned that, although the direct effects of landslides could be minimal due to the lack of habitation on ravine floors, a debris landslide could create a temporary dam along a creek. If a debris dam was then breached, there would be a potential for downstream destruction if rapid debris flows followed the creek beds and reached the developed areas.

It was noted that the Gibsons Creek culvert on Marine Drive was (then) adequately sized and therefore, there was a relatively high debris catchment capacity above the roadway; however, the capacity of Charman Creek may no longer be sufficient. It was noted by Thurber that most of the culverts along Charman Creek were undersized, with the upper ones more likely to become jammed with debris that could result in local overflow and possible channel shifts. A debris containment basin on Charman Creek near the Sewage Treatment Plant was recommended to be evaluated, and the culvert capacities were recommended to be reviewed by a hydraulic engineer.

Active landslides along Franklin Road and encompassing Gower Point Road were noted. Small debris slides and soil creep were observed in the backyards of the lots along Franklin Road and adjacent to Gower Point Road. Soil fill within the properties and trash fill on the slopes was observed. It was noted by Thurber that, for the aforementioned areas, horizontal setbacks in addition to shoreline setbacks may be required.

Two large areas north and south of Charman Creek were identified as being at high risk with respect to a flooding hazard. South of Charman Creek, the probability of flooding was noted to decrease southward (i.e. toward Goose Bird Creek).

Rock fall hazard was noted for the cliff slopes and loose rock areas in the Gospel Rock area.

It was recommended that the Town prohibit dumping of fill of any kind along ravine crests.

Below is a summary of recommendations by Thurber that were used in the current DPA1 guideline:

- 15 metres setbacks from the crests of all ravine or creek slopes with respect to potential landslides or creek erosion;
- 20 metres setbacks at the crests of the beach front slopes (Pine Street and undeveloped Gower Point Road) eastward from the ravine slopes. Setbacks to be reduced to 15 metres at the transition from beach-front to becoming proximate to ravine slopes;
- 15-metre setbacks from the crests of beach front slopes east of 6th Street. If the right-of-way limit is on flatter ground above the slope crest, the 15 metres setback or the distance to the right-of-way applied, whichever was greater;

- Minimum setbacks of 15 metres from the crests of ravine or creek-eroded slopes for septic fields, unless other criteria apply such as a 30 metres setback from water courses;
- 20 metres setbacks from the tops of beach-front slopes above the roadway portion of Ocean Beach Esplanade within the southwest portion of the Town;
- Elphinstone: minimum of 15 metres along creeks from each side of the creek high water, and no less than 1.5 metres above the creek high water (whichever is more restrictive);
- Minimum setbacks of 15 metres for buildings from a natural shoreline boundary were recommended;
- It was noted that the ocean shorelines may be impacted by storm-wave erosion, bluff erosion, landslides, and possible future sea level rise. A minimum 15-metre horizontal setback from the mean high tide level along all shorelines was recommended;
- In beach areas at the south end of Town, where the geohazards risk was identified to be high, 15 metres horizontal setback from the crest of the shoreline slope (including the 15 metres shoreline setback from the mean high tide line) was recommended. Zones of very low to medium risk would require the setback to be extended another 15 metres. A total of 30 metres setback was recommended to extend from the top of the shoreline slopes closest southward on bedrock-controlled shoreline slopes just south of the last house on Gower Point Road (i.e. No. 741). From here southward, the shoreline setback and a general rock fall hazard zone were recommended to apply;
- Hazard zones along headwater streams should be defined by 1.5 metres in elevation or 15 metres horizontal distance, whichever results in greater horizontal distance;
- The generalized limits of the recommended Development Permit Area within the Gospel Rock area are the tops of slopes greater than 2H:1V, a variable rockfall shadow zone at the bases of these slopes, and areas of loose rock; and
- The aforementioned setbacks were to apply unless lesser setbacks were approved by a Professional Engineer.

4.5 KWL Report

Kerr Wood Leidal was retained by the Sunshine Coast Regional District to conduct a geotechnical hazards assessment for West Howe Sound. Their site reconnaissance was carried out in late February 2013.

With regards to the oceanfront slopes, and in order to delineate a setback for slope hazards for oceanfront slopes, a future sea level reference level of 5 metres was used to set an initial 15 metres horizontal setback. From that point a 3 times horizontal setback was applied to the total slope height to determine the setback line. The 5 metres reference level and 15 metres setback were intended to address climate change and the effects of sea level rise.

Debris flow was identified as a geotechnical hazard for Gibsons Creek. The top of ravine was defined as the first significant break in a ravine slope where the break occurs such that the grade beyond the

break is flatter than 3:1 for a minimum distance of 15 metres measured perpendicularly from the break, and the break does not include a bench within the ravine that could be developed.

Slope thematic mapping was prepared by KWL for the subject areas, and recommendations for the DPAs were provided based on the slope angles and additional consideration of hazard mechanism.

It was noted that seismic slope stability analysis should apply to the design of foundations and engineered slopes in accordance with the APEGBC Legislated Guidelines for Landslide Risk Assessment and Residential Development guideline, published in 2008.

The following were recommended by KWL:

- Coastal Slopes: The landward-side boundary of the coastal slopes DPA is defined by a combination of a 15 metres horizontal buffer from the existing 5 metres contour that is a rough proxy for the future natural boundary), and a further horizontal offset of 3 times the slope height; and
- Ravines: A minimum 15 metres setback from ravine crests is required for all developments. For ravines that are deeper than 15 metres, the setback from the ravine crest is to be 30 metres. An engineering report by a qualified professional would be required to reduce the aforementioned setbacks.

5.0 Site Reconnaissance

Registered professionals, Nima Tafazzoli, Ph.D., P.Eng., and Jamie Stirling, P.Geo., from RAM and Stirling Geoscience, respectively, carried out a site reconnaissance from April 25th to 27th, 2023 in order to review the areas with potential for geohazards.

The following areas were visited as part of the site reconnaissance carried out by RAM and are reported herein:

- Slopes of ravines for Gibsons Creek and Charman Creek;
- The upper portions of slopes (e.g. crest) areas within some of the private properties in the sloping areas; and
- The properties located in close vicinity to the toe of the slope along Bayview Heights Road; and

It must be noted that only select properties were visited during our visit, depending on whether permission was received from the respective owners and the site reconnaissance schedule.

Observations as relate to creek and coastal flood risk are reported by Stirling Geoscience under separate cover.

Select photographs are attached in Appendix 1.

5.1 Slope Ravines of Gibsons Creek

The following is a summary of our observations during our site reconnaissance of the Gibsons Creek ravine from a geotechnical viewpoint:

- There is evidence of fill materials that have been placed on the slope (presumably fill that was placed on the slope during the time of development within the private properties). These areas were previously identified and are shown on the current DPA1 guideline Schedule C map. These slopes are generally moderately steep to steep with low coverage of vegetation and trees, in comparison to adjacent areas;
- A new area was located as one with a potential presence of fill on the east tributary to Gibsons Creek to the east of the property located at 674 Fairmont Road. Within the upper portion of the slope, broken trees and tree branches were observed on the slope that could be an indication of slope movements;
- Minor erosion of soils, especially at the toes of the slope breaks and at the toe of the slope adjacent to the creek was observed;
- A large landslide was observed along the west tributary of Gibsons Creek to the north of the property located at 637 Hicks Lane. The approximate length and height of the landslide were estimated to be 10 metres and 4.5 metres, respectively. The exposed soils on the landslide erosional feature were observed to comprise grey, dense / hard sand and silt;
- A landslide was observed along the east tributary of Gibsons Creek to the east of the property located at 674 Fairmont Road. The exposed soil on the landslide erosional feature appeared to be grey, dense, sand and/or hard silt;
- Fallen trees were observed at different areas within Gibsons Creek which could be a concern in the long term as these could create temporary dams, which could lead to debris flows;
- Garbage was observed to have been dumped along the toes of the slopes at the ravines and along the creek, which may be a concern in the long term as these could create temporary dams, which could lead to debris flows;
- A relatively large landslide was observed along the west slope of Gibsons Creek to the east of the property located at 832 Teralee Place. The approximate length and height of the landslide were estimated to be 12 metres and 3 metres, respectively. The exposed soils on the landslide erosional feature were observed to comprise grey, dense / hard sand and silt, with some gravel and occasional cobbles and boulders;
- Erosion of the lower portion of the slope ravine was observed along the west slope of the Gibsons Creek ravine to the east of the property located at 808 Mountainview Drive. The exposed soils on the slope cut appeared to be grey, dense/hard sand and/or silt;
- A landslide was observed along the west ravine slope, extending from the crest to the toe, located to the northeast of the property at 778 Creekside Crescent. The exposed soils on the landslide erosional feature appeared to be grey, dense hard sand and/or silt;

- Erosion of the lower portion of the slope ravine was observed west of Gibsons Creek to the east of the properties located at 788 and 792 Mountainview Drive. The exposed soils at the landslide scar appeared to be grey, sand and/or silt; and
- A landslide was observed along the west ravine slope, extending from the crest to the toe, located to the northeast of the property at 832 Teralee Place. The exposed soils at the landslide erosional feature appeared to be grey, dense / hard sand and/or silt.

5.2 Slope Ravines of Charman Creek

The following is a summary of our observations during our site reconnaissance of Charman Creek from a geotechnical viewpoint:

- Erosion of the surficial soils along the toes of the ravine slopes of Charman Creek within the east portion of the Town (e.g. Prowse Road) was observed. The exposed soils comprised brown, dense / hard sand and/or silt with gravel and cobbles;
- Jackstrawred trees were observed along the north bank of the creek within the lot located at 389 Stewart Road. The slope was covered with vegetation and trees; therefore, we were not able to observe if there were any signs of slope failure;
- Fallen trees were observed at different areas of the slope banks of Charman Creek, which could be a concern in the long term as they could create temporary dams which could lead to debris flows; and
- Erosion of the middle portion of the ravine slope was observed along the north slope of Charman Creek within the northwest portion of the lot located at 389 Stewart Road. The exposed soils on the landslide erosional feature appeared to be grey, dense / hard sand and/or silt.

5.3 Gower Point Road

We visited the properties located at 717, 719 and 723 Gower Point Road to review the slope conditions within the upper portions, to determine if signs of slope movement were evident within these properties. The slope spanning these properties was moderately steep to steep, and heavily vegetated. No obvious signs of slope movement (e.g. tension cracks or irregular settlement) were observed within the sloping backyards of the subject properties.

5.4 Bayview Heights Road

5.4.1 784 through 792

These properties are located within the upper portion of the ravine slopes of Charman Creek. During our visit to these sites, no obvious signs of slope movement (e.g. tension cracks or irregular settlement) were observed within the sloping backyards of the subject properties.

5.4.2 794 through 830

These properties are located within the toe area of a moderately steep to steep slope. Based on our conversations with two of the owners of these properties, they had observed multiple, relatively young trees falling down within the lower portion of the slope over the past few years. As part of our site reconnaissance, we reviewed the slope within the lower and middle portions. We did not see any obvious signs of slope movement or erosion of the soils along these properties, with the exception of the slope within the central portion generally located to the west of the property located at 800 Bayview Heights Road. At the aforementioned location, we observed minor erosion of the surficial soils. The maximum height and depth (e.g. undermined) of the eroded portion were approximately 0.9 metre and 0.6 metre, respectively.

5.5 Creekside Crescent

The properties located at 728, 732, 736, 752, 766 and 770 Creekside Crescent were visited during our site reconnaissance. Accumulation of debris and fill was observed behind the trees within the upper portions of the slope spanning these properties. No obvious signs of slope movement (e.g. tension cracks or irregular settlement) were observed within the sloping backyards of the subject properties.

5.6 Mountainview Drive

The properties located at 802, 808 and 812 Mountainview Drive were visited during our site reconnaissance. Accumulation of debris and some fill was observed behind the trees within the upper portion of the slope spanning these properties. Some pistol butted trees were observed within the upper portion of the slope. No obvious signs of slope movement (e.g. tension cracks or irregular settlement) were observed within the sloping backyards of these properties.

5.7 Teralee Place

The properties located at 832, 834, 838, 840, 842, 846, and 852 Teralee Place were visited during our site reconnaissance. Accumulation of debris and some fill was observed behind the trees within the upper portions of the slopes within these properties. Some pistol butted trees were observed within the upper portion of the slope. No obvious signs of slope movement (e.g. tension cracks or irregular settlement within the backyards) were observed.

5.8 Hillcrest Road

The properties located at 662 and 668 Hillcrest Road were visited during our site reconnaissance. Accumulation of debris and some fill was observed behind the trees within the upper portion of the slope spanning these properties. Some pistol-butted trees were observed within the upper portion of the slope. No obvious signs of slope movement (e.g. tension cracks or irregular settlement) were observed within the sloping backyards of these properties.

5.9 Franklin Road

We visited the upper portions of the slope to the south of the private properties on Franklin Road, via a few access roads connecting from Franklin Road to the crest of the slope spanning these properties. Based on our observations, it appears that the slope mainly comprises bedrock. Based on signage posted by the Town of Gibsons at one of the access roads, along with the reports provided from the Town to us (as noted in Section 3.6), it is our understanding that some slope failures have been observed within these areas, and that affected properties were being reviewed by Professionals at the time of our site reconnaissance. We have now had the opportunity to review several recently published reports, as listed in Appendix 3. Detailed comments are provided in Appendix 4. In general, the findings comprise the following:

- The lots face the waterfront, with foreshore slopes in the order of 8 to 14 metres tall;
- Subsurface soil identified mostly comprised sand and gravel over glacial till, over bedrock at approximately sea level, or slightly above in some instances;
- Some areas on the slope are noted to be intact and covered with vegetation, whereas others exhibited some erosion including evidence of sloughing;
- The main mechanism of slope deterioration was noted to be undermining by sea wave action and progressive failure of over-steepened locations;
- The pre-existing recommended setback of 30 metres from the slope crest was found to be generally conservative. Values in the order of 10 to 20 metres were recommended for site-specific conditions;
- Riprap revetments were recommended where prior failures were observed. These were installed and reviewed as-built in some cases;
- All of building lots were found to be well above a Flood Construction Level including for allowances for sea level rise and climate change; and
- For conventional at-grade buildings, the general conclusion was that no aquifer interference or disturbance is likely during construction.

5.10 Georgia Road at the Shoreline

Based on our observations of this area, the slope mainly comprises bedrock.

5.11 Gower Point Road at the South-Central Portion of the Study Area

We visited the properties located at 672 and 662 Gower Point Road. The properties within this area are located near the toe of a slope rising to the west. During our site visit, no obvious signs of slope failure were observed.

5.12 Inglis Road

We visited the properties located at 895 and 924-926 Inglis Road, and the ravine slopes in the property located at 933 Inglis Road. Additionally, Stirling Geoscience Ltd. provided us with observations and photographs regarding 915 Inglis Road.

5.12.1 933 Inglis Road

Fallen trees were observed at different areas within the creek which could be a concern in the long term as they could create temporary dams, which could lead to debris flows.

5.12.2 915 Inglis Road

A newly constructed road was observed on the east ravine slope on Charman Creek between the confluence of the East Tributary and Inglis Road. If this road has not been designed and constructed with involvement of a Qualified Professional it is possible that a failure of the fill prism could create temporary dams, which could lead to debris flows.

5.12.3 895 Inglis Road

Below is a summary of our observations of the ravine slopes within this property:

- Fallen trees were observed at different areas within the creek which could be a concern in the long term as they could create temporary dams, which could lead to debris flows; and
- Erosion of the surficial materials exposing near vertical, grey, natural soils (which appeared to comprise sand and silt), estimated to be up to 4 metres high in some areas, were observed.

5.13 Southeast of Bay Area / Georgia View

The ground surface within this area slopes up from all directions towards Allison Way. Within this area, some of the properties are located at the crests of the slopes, some of the properties are located within the mid-portions of the slopes, and some of the properties are located at the toes of the slopes. Based on our observations, the slopes within this area mainly comprise bedrock.

6.0 DPA1 Guideline

6.1 Slope Stability

For the purpose of communicating the comparative stability of a slope, a factor of safety may be determined for a given slope condition. A factor of safety is based on the ratio of resisting forces to driving forces, where the resisting forces help to stabilize a slope and the driving forces contribute to instability. A factor of safety greater than 1.0 would indicate that the slope is more likely to be stable, while a factor of safety less than 1.0 would indicate that the slope is likely to be unstable.

The Landslide Assessments in British Columbia guideline, Version 4.1, published by Engineers and Geoscientists BC (EGBC), dated March 1, 2023, indicates that currently there is no defined level of landslide safety that has been adopted within the Province of BC. However, some jurisdictions in BC have adopted a level of landslide safety that is deemed to be acceptable within that jurisdiction (e.g. District of North Vancouver, District of Squamish, Fraser Valley Regional District, etc.). It is our understanding that currently the Town of Gibsons does not have a defined level of landslide safety (e.g. Factor of Safety for slope stability). Therefore, Professional Engineers or Geoscientists assessing the landslide safety of properties within the Town are advised to refer to an acceptable level of safety based on their judgement. However, it is highly recommended by RAM that the Town of Gibsons adopt a level of safety that would be acceptable for the slopes within the Town so that all Professionals could refer to the same standard as this would leave less room for interpretation.

6.2 Definitions

In order to review and assess the applicability of recommendations provided in the Current DPA1, terms related to slopes must be defined. These terms are defined as below:

Adjacent means within a distance upslope from the mid-point of a slope equal to 2 times the slope height, and within a distance downslope from the mid-point equal to 3 times the slope height.

Crest is defined by the ground transition where the gradient of the adjacent upper surface is no steeper than average 18 degrees (1.0 vertical to 3.0 horizontal).

Toe is defined by the ground transition where the gradient of the adjacent lower surface is no steeper than average 18 degrees (1.0 vertical to 3.0 horizontal).

Preliminary Runout Zone can be defined as a line at 18 degrees to horizontal extending down from the crest of slope to determine the recommended horizontal setback distance as measured from the toe of slope. For new developments, the horizontal distance from the slope crest would be 3 times the height of the slope.

The definitions above are shown on Figure 3.

6.3 Current Recommendations in DPA1

The following is a summary of existing recommendations with regards to setbacks for the developments from the subject slopes from a geotechnical viewpoint:

- 15 horizontal metres back from the crests of ravine slopes of Gibson Creek, Charman Creek, and the two small ravines at the southwestern boundary of the Town;
- The areas that are within elevation differences of up to 1.5 metres from the headwaters of streams and/or within 15 metres horizontal distance from the headwaters of streams;
- 15 horizontal metres back from the ocean shoreline;
- Both 15 horizontal metres and 30 horizontal metres setbacks from the crest of the shoreline slope; and

- The existing lower Charman Creek stream channel and possible overflow areas, as well as the area within 15 horizontal metres of the stream channel and/or overflow areas.

6.4 Preliminary Assessment

As mentioned in Section 3.2, LiDAR data that were obtained in 2021 were provided to us by the Town of Gibsons. The 1 metre and 5 metre contour lines were defined in the aforementioned LiDAR data. Based on the aforementioned LiDAR data, a slope thematic map was prepared by RAM based on the slope gradients shown in Table 1. This slope thematic map is shown on Figure 1.

Our preliminary assessment of the recommendations provided in the current DPA1 comprised the following steps:

- Preparation of around 60 topographical profiles within the areas, of which seven are shown on Figures 4 to 7;
- Defining adjacent, crest, toe, and the Preliminary Runout Zone for each of the aforementioned profiles;
- Showing a horizontal setback distance of 15 metres from the crest;
- Showing a line rising at 1 vertical : 2 horizontal from the toe of the slope, as a general guidance for stability (under the static loading condition) of slopes comprising competent soils (e.g. compact to very dense / very stiff to hard) and finding the intersection of the aforementioned line with the ground surface;
- Comparing the setback distance of 15 metres from the crest of the slope, as recommended in the current DPA1 guideline, with the intersection of the line of 1V:2H from the toe of the slope;
- Indicating lands which are above these 1 V : 2 H lines, (shaded yellow) on a plan of the Town of Gibsons (Figure 2), to be included in the DPA1 area;
- Showing a Preliminary Runout Zone on pertinent topographic profiles, with this zone defined by lands falling under a line descending from the crest of a slope at 18 degrees from horizontal.
- Indicating lands which are below these 18-degree lines, (hatched red) on Figure 2, to be included in the DPA1 area. It should be noted that areas subject to this hazard which lie within a riparian area are not indicated on the subject plan.

It should also be noted that fill was observed to be present at the north termini of Glen Road, Seaview Road and McColl Lane at the crest of the west embankment of Gibsons Creek, near the east central portion of the Town. It was inferred that this fill continued down the embankment (hatched green on Figure 2) and, based on LiDAR topography, may also be present on adjacent private properties. Accordingly, the above-noted 1 V : 2 H line was varied to 1 Vertical : 3 Horizontal. Although this sensitivity analysis did result in some variation of the footprint of the recommended DPA1 area, it did not result in any additional properties being recommended for inclusion in the DPA1 area.

6.5 Findings

Based on the topographical profiles and the procedure described in Section 5.4, we conclude that the current minimum setback distance of 15 metres for a development from the crest of the slope is considered generally reasonable for the slopes within the Town of Gibsons. However, there are areas, specifically within the northeast portion of the Town, where a setback of greater than 15 metres may be required. A suitably qualified Professional Engineer or Geoscientist must independently verify the minimum setback from the crest that would be required for a proposed development, based on the site-specific slope geometry and subsurface soil and groundwater conditions. If a setback distance of less than 15 metres from the crest of the slope is proposed for a development, a suitably qualified Professional Engineer or Geoscientist must provide a reasonable rationale (e.g. based on the results of subsurface investigation, groundwater monitoring and slope stability analyses) to justify a lesser setback which will ensure the safety of the development and its residents.

With this recommendation, all the properties that are currently within the DPA1 guideline would remain under this guideline, and additional lots within the northeast and mid-central areas of the Town would need to be included in the areas with potential geotechnical hazards.

It is our understanding that there are no recommendations in the current DPA1 guideline with regards to the setbacks of developments from the toes of the slopes with respect to landslide runout zones. Based on our review of the areas with steep slopes within the Town, we envisage that the properties located on Bayview Heights Road and within the southeast portion of Bay Area / Georgia View are located within a Preliminary Runout Zone. Therefore, these properties must be added to the areas of DPA1 as having a potential for geotechnical hazards.

The areas that are recommended to be considered for the updated DPA1 are shown on Figure 2.

7.0 Seismic and Other Considerations

The Town of Gibsons is in a location which is vulnerable to earthquakes. The current National Building Code (2020) and the new BC Building Code (2024) require that developments be designed for a seismic event with a 2% probability of exceedance in 50 years, which corresponds to a return period of 2,475 years. Therefore, seismic events must be considered in the design of proposed developments and also in slope hazard assessments. The recommendations provided in the guideline “Landslide Assessments in British Columbia”, Version 4.1, published by EGBC, dated March 1, 2023 (or current version of same), must be considered by professionals carrying out slope hazard assessments.

Liquefaction is the loss of shear strength due to an increase in pore water pressure due to cyclic loading during earthquakes. This condition can occur in loose, saturated, granular deposits during an earthquake of sufficient magnitude. Some surficial soils within Salish and Capilano Sediments underlying the Town of Gibsons could be susceptible to liquefaction during an earthquake of sufficient magnitude. The recommendations provided in the Canadian Foundation Engineering Manual, 6th Edition (2023, or current version of same), published by the Canadian Geotechnical Society regarding liquefaction and other seismically induced responses of soft / loose soils must be considered by the professionals for

areas with a potential for this type of related geohazards and corresponding recommendations must be provided for design and construction of proposed developments.

Artesian groundwater conditions are another geotechnical hazard present within the Town of Gibsons; this is addressed in their DPA9.

Finally, although not documented as yet in the Town of Gibsons, sink holes are a geotechnical hazard which have been encountered in other areas of the Sunshine Coast. Qualified Professionals should remain vigilant for existing conditions, proposed subsurface investigation programs and/or proposed site regrading plans which promote local or widespread high hydraulic gradients and/or internal erosion.

8.0 Recommendations

Based on our observations during our site reconnaissance, our review of the LiDAR data, our experience with similar types of geohazards, and our experience with similar expected surficial geology and subsurface soils, we recommend the following be incorporated into the update for the DPA1:

- A suitably qualified Professional Engineer or Geoscientist must independently verify if the minimum setback of 15 metres from the crest of the slopes would be acceptable for the areas that are within the DPA1 geohazards zone;
- Based on the site-specific slope geometry and subsurface soil and groundwater conditions, determined as a result of suitable investigation (e.g. as per the recommendations of the Geotechnical Engineering Services for Building Projects by EGBC or Canadian Foundation Engineering Manual by CGS), if a setback distance of less than 15 metres from the crest of a slope is proposed for a development, a suitably qualified Professional Engineer or Geoscientist must provide a reasonable rationale to justify the safety of the development and its future residents;
- There are properties adjacent to the crest of a slope which have potential geotechnical hazards that are recommended to be added to the DPA1 areas;
- There are properties that are adjacent to the toe of a slope and within the preliminary runoff zone that are recommended to be added to the DPA1 areas. We recommend that properties located on Bayview Heights Road and within the southeast portion of Bay Area / Georgia View, as shown on Figure 2, be included in the DPA1 zones;
- Recommendations provided in the latest edition of the EGBC professional practice guideline titled “Geotechnical Engineering Services for Building Projects”, must be followed by the Professional Engineer or Geoscientist for any proposed development. It is noted that this guideline requires that the latest Canadian Foundation Engineering Manual, published by the Canadian Geotechnical Society must be followed or a rationale be provided by the Professional Engineer or Geoscientist as to why it is not. Accordingly, a site reconnaissance, subsurface investigation (including monitoring of groundwater via piezometers), and slope stability and/or runoff modelling is expected to be standard practice to support engineering conclusions and

recommendations. This guideline also requires that the results of a subsurface investigation be reconciled with the results of the literature review;

- Recommendations provided in the latest edition of the EGBC professional practice guideline titled “Landslide Assessments in British Columbia”, must be considered by the Professional Engineer or Geoscientist in their review of properties with respect to their potential for geohazards;
- We recommend that a checklist for slope hazard assessment reports be prepared and included in the DPA1. This checklist would contain the items that need to be addressed by the Professional Engineer or Geoscientist and could be attached to their slope hazard assessment reports. A sample of this checklist that was developed by RAM, that was implemented by the City of Coquitlam, is attached to this report. We would be pleased to prepare a similar checklist for the Town of Gibsons, if required;
- We recommend that the current definitions of geohazards as ‘high’ and ‘low’ be changed to the type of geohazards that could be expected within different areas of the Town (e.g. slope hazard, flooding hazard, debris flow hazard, etc.); and
- We recommend that assessing the potential for liquefaction and/or other seismically-induced responses of soft / loose ground be included in the DPA1 checklist such that the professional would be required to provide comments as to whether the subject site is susceptible to this type of geohazard, and that the results of their assessment be considered in their preparation of design and construction recommendations for new developments.

Furthermore, given the scarcity of information regarding surficial geology that is publicly available, and in order to grow the body of geotechnical knowledge within the cohort of engineers and geoscientists providing services on the Sunshine Coast and advance their state of practice, we recommend that the Town of Gibsons maintain a geotechnical / hazard report file which is made available to Qualified Professionals.

Finally, in order to ensure that the risk of debris flows is maintained as low, we recommend that the Town of Gibsons conduct reconnaissances of creek channels within its jurisdiction at a standard frequency of not less than every 2 years and not more than every 5 years. Should debris, including treefall, be observed within areas subject to water flow, or at risk of becoming so, maintenance to remove this should be carried out.



9.0 Closure

This report has been prepared for the sole use of our client and other consultants for this project, as described. Any use or reproduction of this report for other than the stated intended purpose is prohibited without the written permission of RAM Engineering Ltd.

We are pleased to be of assistance to you on this project and we trust that our comments and recommendations are both helpful and sufficient for your current purposes. If you would like further details or require clarification of the above, please do not hesitate to call.

For:
RAM ENGINEERING LTD.

Karen Savage, P.Eng., FEC
Principal Geotechnical Engineer

Engineers and Geoscientists BC Permit to Practice Number: 1002292



Appendix 1

SELECT PHOTOGRAPHS



Photo 1: April 26, 2023. Looking south (upslope) at the southwest ravine slope of Gibsons Creek just upstream of Marine Drive. The slope area lacking trees and dominated by English Ivy is identified in the DPA 1 Schedule C as “Adverse Fill Area”.



Photo 2: April 26, 2023. Looking south (upslope) at the southwest slope of the Gibsons Creek ravine just upslope of Marine Drive at the “Adverse Fill Area”. Garbage was observed under the English Ivy.



Photo 3: April 26, 2023. Looking upstream on a tributary of Gibsons Creek located near Gibsons Way. A slope failure occurred on the left (north) bank slope of the tributary. The failure is 44 m long and 8 m high.



Photo 4: April 26, 2023. Looking north at the slope failure on the left (north) bank of the Gibsons Creek tributary near Gibsons Way showing a recently uprooted tree from the crest of the failure.



Photo 5: April 26, 2023. Looking north at the slope failure on the left (north) bank of the tributary on Gibsons Creek near Gibsons Way.



Photo 6: April 26, 2023. Looking downstream at the slope failure on the left (north) bank slope of the Gibsons Creek tributary near Gibsons Way.



Photo 7: April 26, 2023. Looking upstream on the Gibsons Creek tributary near Gibsons Way at the upstream end of the slope failure on the left (north) bank slope.



Photo 8: April 26, 2023. Looking upstream on the Gibsons Creek tributary near Gibsons Way at the upstream end of the slope failure on the left (north) bank slope.



Photo 9: April 26, 2023. Looking south (upslope) at the southwest ravine slope of Gibsons Creek adjacent to the Hillcrest Road area. The area on the slope void of trees suggests an old, disturbed area either by intentional clearing or a slope failure.



Photo 10: April 26, 2023. Looking west (upslope) on the southwest slope of the Gibsons Creek ravine where clearing of ravine slope crest has occurred in the Tricklebrook Way area. Fallen trees have been left on slope.



Photo 11: April 26, 2023. Looking west (upslope) at the west ravine slope of Gibsons Creek in the Creekside Crescent area showing a disturbed portion of the slope.



Photo 12: April 26, 2023. Looking upstream on Gibsons Creek where lawn chairs have been set up along the creek near Mountainview Drive. Note the oversteepened exposed slope above the chairs.



Photo 13: April 26, 2023. Looking north from Charman Creek at the north ravine slope just upstream of Stewart Road at the site of “Adverse Fill Area” as identified in the DPA 1 Schedule C.



Photo 14: April 26, 2023. Looking upstream on Charman Creek 300 m upstream of Gower Point Road showing the left (north) bank ravine slope dominated by a young deciduous forest with an established understory. This forest area is unique to the rest of the ravine suggesting this slope may have been cleared.



Photo 15: April 26, 2023. Looking upslope (south) on a wide gully on the right bank of Charman Creek north of Shaw Road. The lack of mature forest in this gully suggests it may have been intentionally cleared or it's the location of a slope failure.



Photo 16: April 26, 2023. Looking upslope (north) at a slope failure near the crest of the north ravine slope south of Shaw Road adjacent to Inglis Trail.



Photo 17: April 26, 2023. Looking upslope (north) at a slope failure near the crest of the north ravine slope south of Shaw Road adjacent to Inglis Trail. Note the large root bulb that has been mobilized.



Photo 18: April 26, 2023. Looking west across a deep and narrow eroded gully on the north ravine slope south of Shaw Road adjacent to Inglis Trail.



Photo 19: April 26, 2023. Looking upslope (north) at the crest of the north ravine slope adjacent to Inglis Trail at a channel draining ditches for the trail. Flow from this channel caused the eroded gully in the previous photo.



Photo 20: April 26, 2023. Looking north along the Inglis Trail south of Shaw Road showing the culvert and ditch runoff from the trail that drains to the channel down the slope shown in the previous photo. The ditch extends north to Shaw Road.

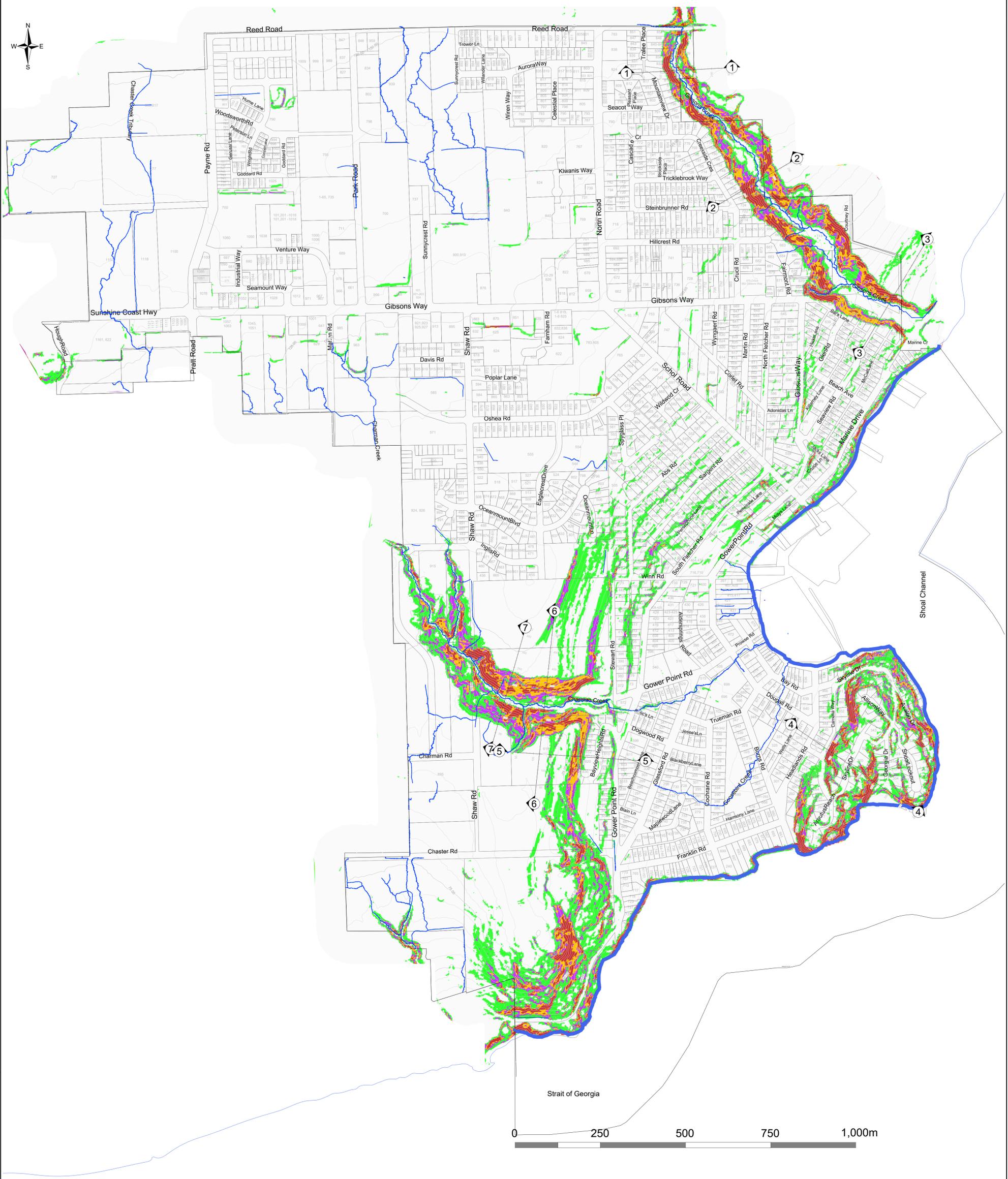


Photo 21: April 26, 2023. Looking east (upslope) at a newly constructed road on the east ravine slope on Charman Creek between the confluence with the East Tributary and Inglis Road.



Appendix 2

FIGURES



Legend

- Town boundary
- Watercourse
- Coastline

Slope Legend

Number	Slope	Angle	Color
1	0% - 30%	0° - 17°	
2	30% - 50%	17° - 27°	
3	50% - 60%	27° - 31°	
4	60% - 70%	31° - 35°	
5	> 70%	> 35°	

References
 - Town of Gibsons, Address Map drawing dated June 2019.
 - Town of Gibsons, Schedule C-Geotechnical Hazards drawing dated August 2014.
 - Town of Gibsons, LIDAR files, received on January 27, 2023

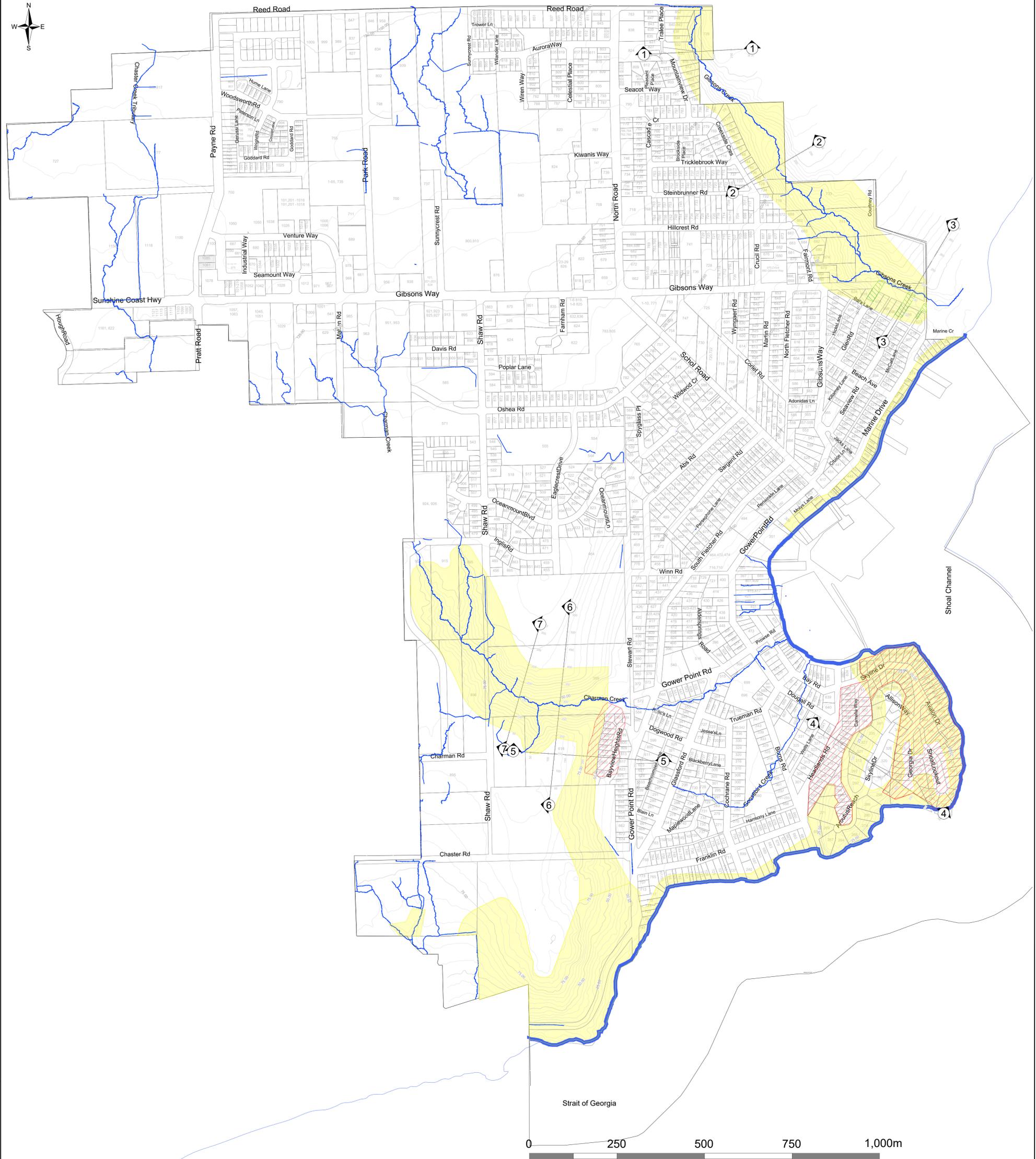


TOWN OF GIBSONS
 474 S. Fletcher ST, Box 340, Gibsons, BC

DEVELOPMENT PERMIT
 AREA UPDATE
 Gibsons, BC

DEVELOPMENT PERMIT
 AREA 1 (DPA1)
 Slope Thematic Plan

Drawn by: HN, Des by: NT, Ck by: KS
 Scale: 1:5000, File no: 122-5203
 Rev no: B, Rev date: 2025-09-25
 Figure: 1



Legend

-  Town boundary
-  Watercourse
-  Coastline
-  Known area of fill

Geotechnical Hazards

-  Slope hazard due to proximity to crest
-  Slope hazard due to proximity to toe

References:
 - Town of Gibsons, Address Map drawing dated June 2019.
 - Town of Gibsons, Schedule C-Geotechnical Hazards drawing dated August 2014.
 - Town of Gibsons, LIDAR files, received on January 27, 2023.

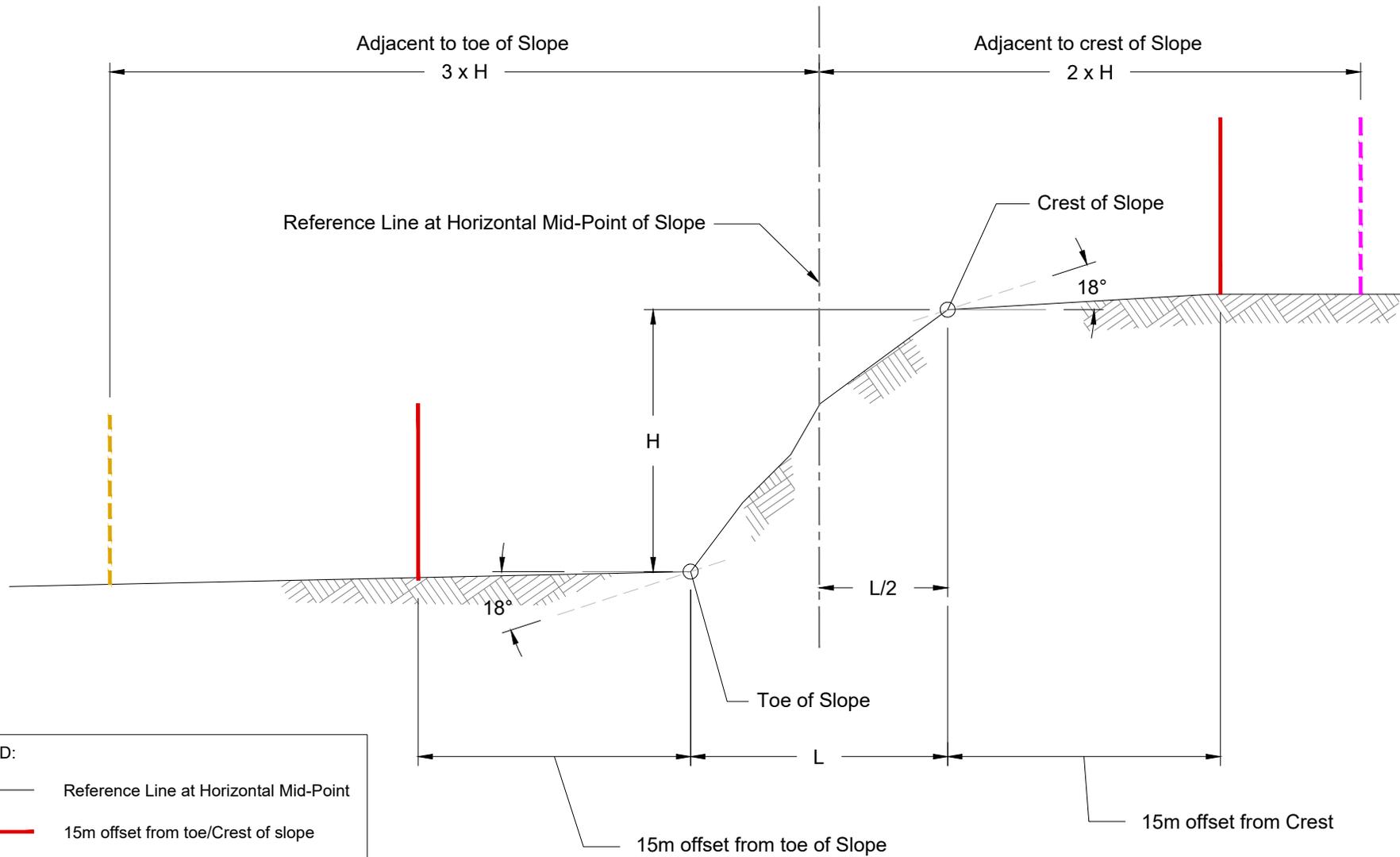


TOWN OF GIBSONS
 474 S. Fletcher ST, Box 340, Gibsons, BC

DEVELOPMENT PERMIT
 AREA UPDATE
 Gibsons, BC

DEVELOPMENT PERMIT
 AREA 1 (DPA1)
 Slope Hazard Plan

Drawn by:	HN	Des by:	NT	Chk by:	KS
Scale:	1:5000	File no:	122-5203		
Rev no:	B	Rev date:	2025-09-25		
Figure:					



LEGEND:

	Reference Line at Horizontal Mid-Point
	15m offset from toe/Crest of slope
	Adjacent to crest of Slope
	Adjacent to toe of Slope
	Crest/Toe of slope

TOWN OF GIBSONS
 474 S. Fletcher ST, Box 340, Gibsons, BC

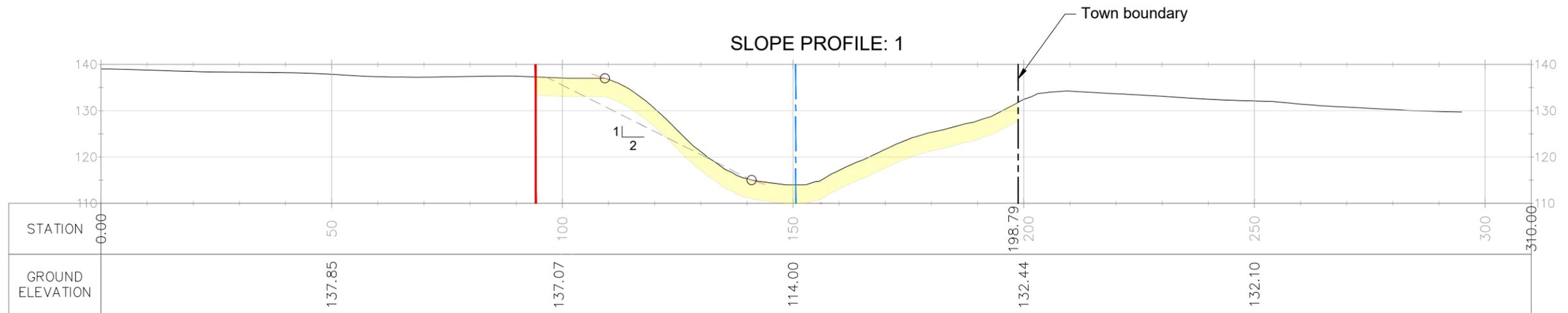
DEVELOPMENT PERMIT AREA UPDATE
 Gibsons, BC

**SCHEMATIC SLOPE AND DEFINITIONS
 WITH REGARDS TO SLOPES**

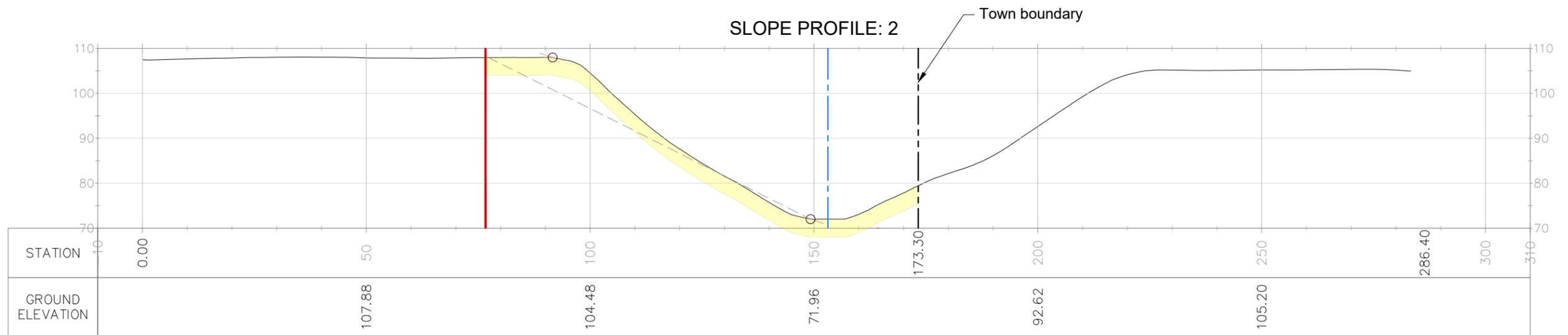
		YOUR PROJECT. OUR PASSION.	
Drw by: HN	Des by: NT	Chk by: KS	Rev no: B
Scale: NTS	File no: 122-5203	Rev Date (YYYY-MM-DD): 2025-09-25	3

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Scale check: 1 inch = 10mm



0 10m 20m
Slope Profile 1
Scale: 1:1000



0 10m 20m
Slope Profile 2
Scale: 1:1000

LEGEND:		Geotechnical Hazards	
	Approx. watercourse centreline		Slope hazard due to proximity to crest
	15m offset from crest of slope		Slope hazard due to runoff
	Assumed crest/toe of slope		
*Not applicable within riparian areas as no development permitted			

TOWN OF GIBSONS
474 S. Fletcher ST, Box 340, Gibsons, BC

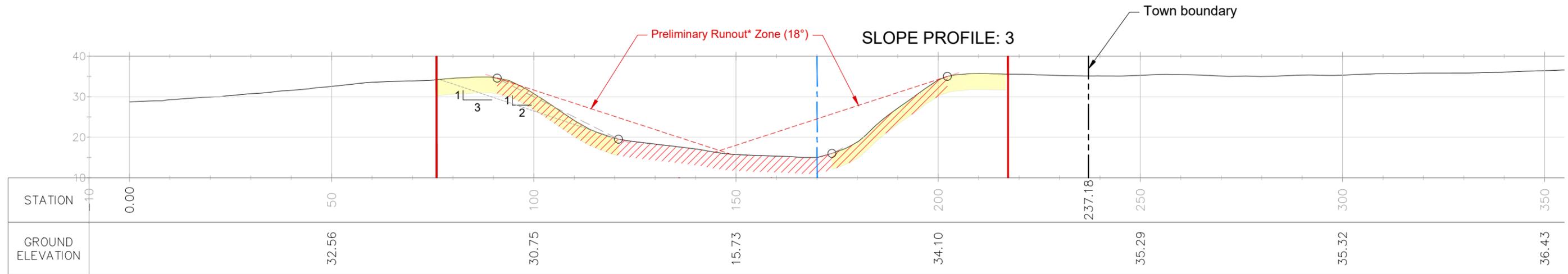
DEVELOPMENT PERMIT AREA UPDATE
Gibsons, BC

SLOPE PROFILES
1 & 2

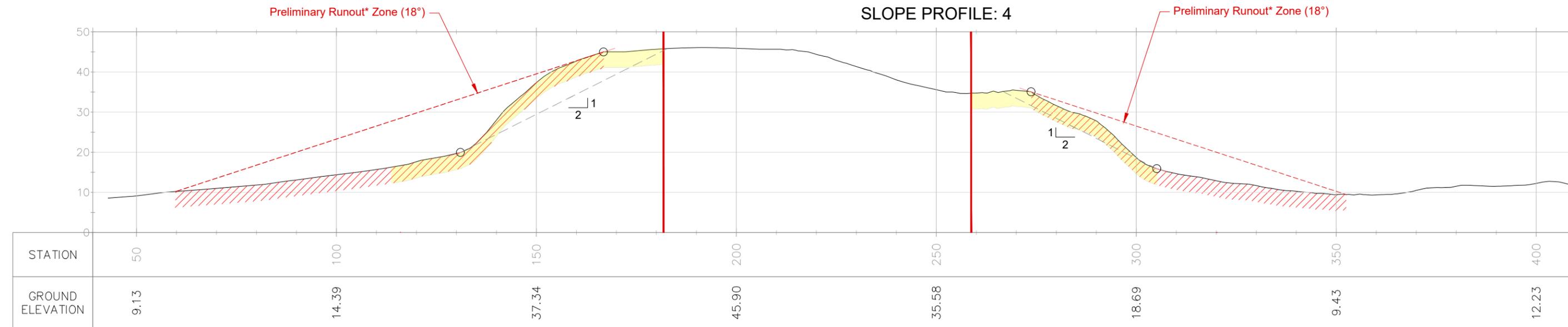
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HN	NT	KS	B	4
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AS SHOWN	122-5203	2025-09-25		

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Scale check: 1 inch = 10mm



0 10m 20m
Slope Profile 3
Scale: 1:1000



0 10m 20m
Slope Profile 4
Scale: 1:1000

LEGEND:		Geotechnical Hazards	
	Approx. watercourse centreline		Slope hazard due to proximity to crest
	15m offset from crest of slope		Slope hazard due to runout
	Assumed crest/toe of slope		
*Not applicable within riparian areas as no development permitted			

TOWN OF GIBSONS
474 S. Fletcher ST, Box 340, Gibsons, BC

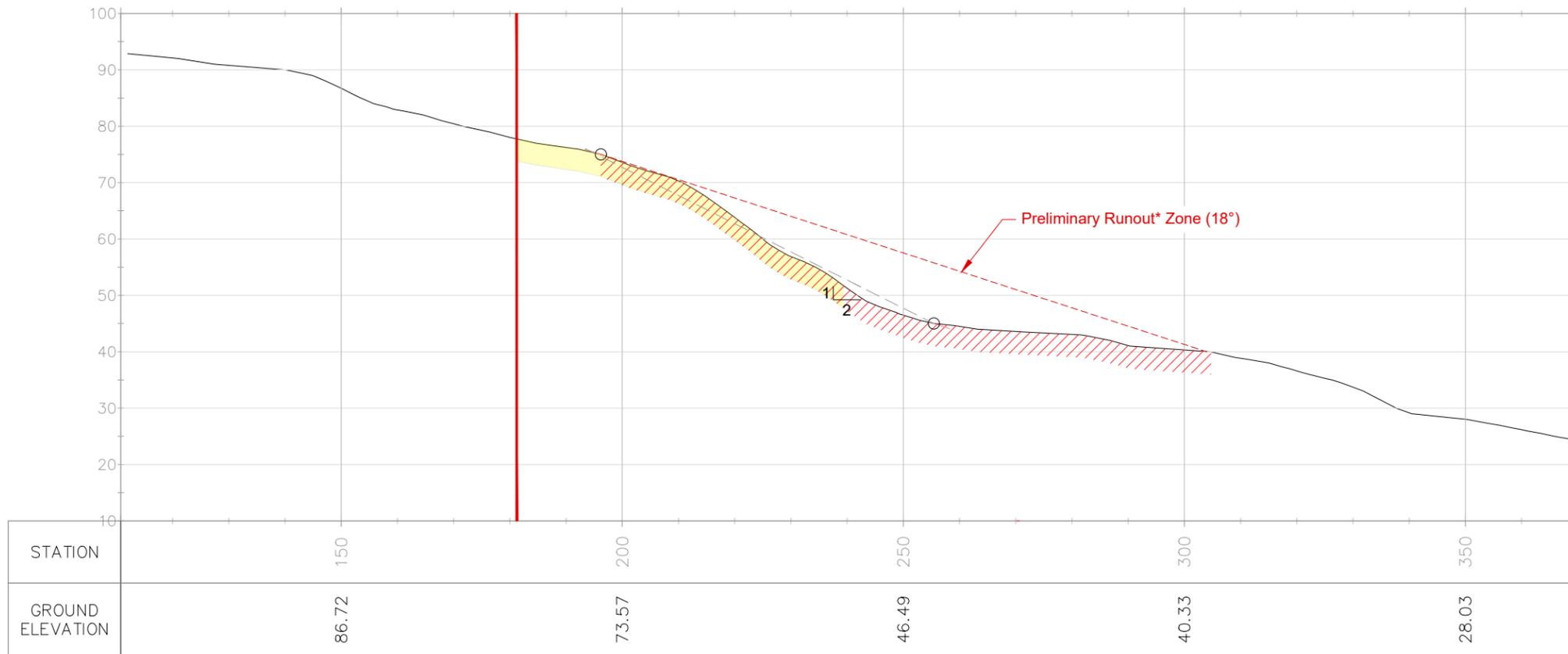
DEVELOPMENT PERMIT AREA UPDATE
Gibsons, BC

SLOPE PROFILES
3 & 4

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Scale: AS SHOWN	File no: 122-5203	Rev date (YYYY-MM-DD): 2025-09-25		

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SLOPE PROFILE: 5



0 10m 20m
Slope Profile 5
 Scale: 1:1000

LEGEND:

	Approx. watercourse centreline	Geotechnical Hazards
	15m offset from crest of slope	
	Assumed crest/toe of slope	

**Not applicable within riparian areas as no development permitted*

TOWN OF GIBSONS
 474 S. Fletcher ST, Box 340, Gibsons, BC

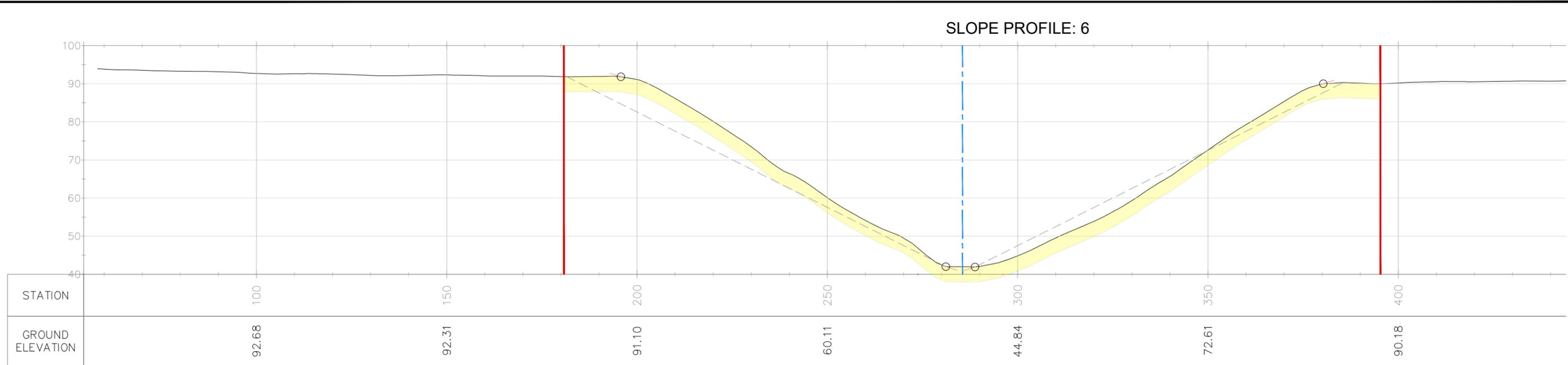
DEVELOPMENT PERMIT AREA UPDATE
 Gibsons, BC

SLOPE PROFILES
 5

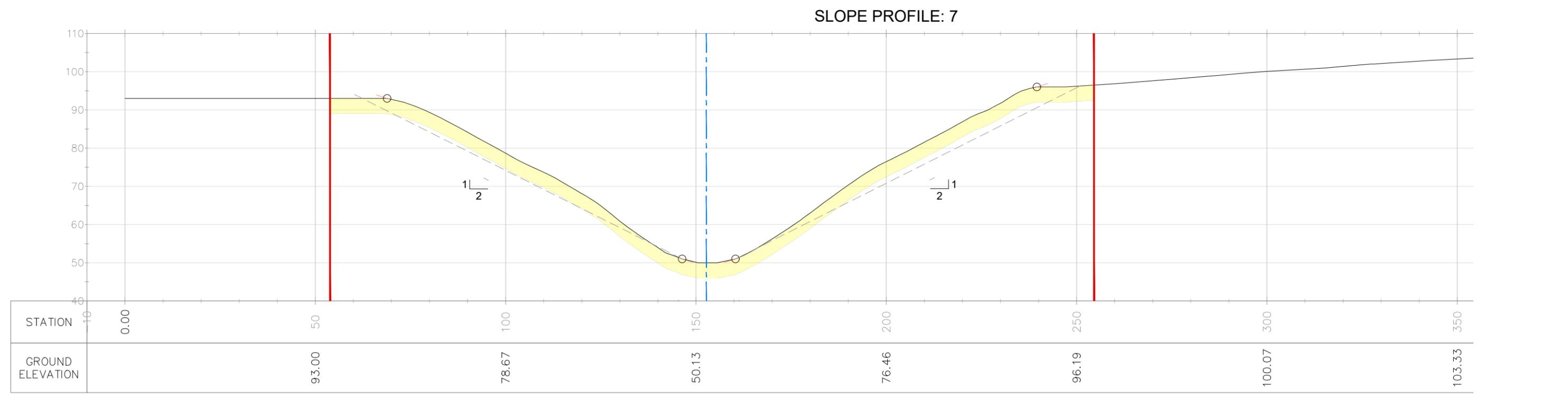
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Scale check: 1 inch = 10mm



0 10m 20m
Slope Profile 6
 Scale: 1:1000



0 10m 20m
Slope Profile 7
 Scale: 1:1000

LEGEND:

<ul style="list-style-type: none"> --- Approx. watercourse centreline --- 15m offset from crest of slope ○ Assumed crest/toe of slope 	<p>Geotechnical Hazards</p> <ul style="list-style-type: none"> Slope hazard due to proximity to crest Slope hazard due to runoff
---	---

*Not applicable within riparian areas as no development permitted

TOWN OF GIBSONS
 474 S. Fletcher ST, Box 340, Gibsons, BC

DEVELOPMENT PERMIT AREA UPDATE
 Gibsons, BC

SLOPE PROFILES
 6 & 7

YOUR PROJECT.
OUR PASSION.

Drw by:	Des by:	Chk by:	Rev no:	Figure:
HN	NT	KS	B	7
Scale: AS SHOWN		File no: 122-5203	Rev date (YYYY-MM-DD): 2025-09-25	



Appendix 3

REFERENCE DOCUMENTS

A1.1 Reports for Public Projects and Publicly Available Information

The following documents were either provided to us by the Town as part of the public projects, or found available publicly, and were read and interpreted by RAM for this study. Information from select documents is summarized in this report.

- Surficial Geology and Sand and Gravel Deposits of Sunshine Coast, Powell River, and Campbell River Areas report, published by the Province of British Columbia, Ministry of Mines and Petroleum Resources, dated 1977;
- Reconnaissance Study of Geotechnical Hazards Elphinstone and West Howe Sound Official Community Plans, Report to Sunshine Coast Regional District, prepared by Thurber Engineering Ltd., dated July 25, 1990;
- Town of Gibsons Official Community Plan Reconnaissance Study of Geotechnical Hazards and Biophysical Environmental, prepared by Thurber Engineering Ltd., dated October 22, 1991;
- Recommended Changes to Elphinstone Community Plan Maps, prepared by Thurber Engineering Ltd., dated September 17, 1992;
- Preliminary Review of Gospel Rock Neighbourhood Rezoning, prepared by Thurber Engineering Ltd., dated November 23, 1994;
- Gospel Rock Rezoning Application Geotechnical Comments, prepared by Thurber Engineering Ltd., dated September 14, 1995;
- Town of Gibsons Watercourse Classification, prepared by Whitehead Environmental Consultants Ltd., dated July 21, 2005;
- Geological Map of British Columbia, Geoscience Map 2009-1, published by the British Columbia Geological Survey, Ministry of Energy, Mines, and Petroleum Resources, dated 2009;
- Gospel Rock Neighbourhood Plan Area: Ecosystem – and Wildlife Area Use classification, prepared by Paul van Poppelen, dated October 31, 2009;
- Town of Gibsons Foreshore Condition Assessment, Final Report, prepared by Kerr Wood Leidal, dated December 5, 2014;
- Smart Plan – Gibsons Official Community Plan (Schedule A: “Town of Gibsons Official Community Plan Bylaw No. 985, 2005”), dated March 2015;
- Gibsons Foreshore and Seawalk Improvements, Conceptual Design Report (revised Final), prepared by Kerr Wood Leidal, dated October 2017;
- 2018 Integrated Stormwater (Rainwater) Management Plan Update, prepared by Urban Systems, dated November 2018;
- Managing Natural Assets to Increase Coastal Resilience, Town of Gibsons, BC, Pilot Study, prepared by David Suzuki Foundation and Making Nature Count, dated June 2021;

- Geotechnical Engineering Services for Building Projects, Version 2.1, published by Engineering and Geoscientists BC (EGBC), dated September 22, 2021;
- Habitat/Condition Assessment of Charman Creek, Gibsons, BC, an Urbanized Stream, prepared by FSCI Biological Consultants, dated November 30, 2021;
- Canadian Foundation Engineering Manual (CFEM), 5th Edition, published by the Canadian Geotechnical Society in 2023.

A1.2 Reports for Private Projects

The following reports were provided to the Town as part of the private projects, and were read, interpreted, and considered by RAM for this study / assessment.

- Geotechnical Assessment of Lot 4, Block 33 Plan 13381, D. L. 685 (733 Gower Point Road), prepared by Rock Group Consulting Engineers, dated April 26, 1996;
- Geotechnical Investigation For Lot 13 Cochrane Road, Gibsons, BC, prepared by Peter Peart Geotechnical Ltd., dated January 26, 1998;
- Geotechnical Assessment, Lots C, D, and E, DL 685 Dougall Road, Gibsons, BC, prepared by GeoTacTics Engineering Ltd., dated May 26, 2004;
- Geotechnical Assessment of Phase 2 Area, Shaw and Inglis Roads Subdivision, Gibsons, BC, prepared by GeoTacTics Engineering Ltd., dated November 20, 2004;
- Geotechnical Assessment, 670 Fairmont Road, Gibsons, BC, prepared by GeoTacTics Engineering Ltd., dated July 2, 2006;
- Proposed Development of Lot 48, shoal Lookout, Gibsons, Geotechnical Assessment Report, prepared by GeoTacTics Media Engineering, dated January 25, 2008;
- Geotechnical Assessment, 310 Glassford Road, Gibsons, BC, prepared by GeoTacTics Media Engineering, dated April 22, 2008;
- Review of Sanitary Sewer Line Replacement at Fairmont road, Gibsons, BC, prepared by GeoTacTics Media Engineering Ltd., dated May 27, 2008;
- Riparian: Proposal tree removal at West Bank of Charman Creek, Marina Place, Dougall Road, Gibsons, prepared by Langdale Field and equipment Services, dated March 23, 2009;
- Arboricultural Review, Smitty's Oyster House Restaurant, Gibsons, BC, prepared by Landwise Consultants Inc., dated July 14, 2009;
- Geotechnical Assessment, Proposed House Addition at 668 Bay Road, Gibsons, BC, prepared by GeoTacTics Media Engineering Ltd., dated October 1, 2012;
- Memorandum 1 – Proposed Subdivision, Development Permit Areas 1 and 9 Review – Geotechnical Hazards and Gibsons Aquifer, 396 Aldersprings Road, Gibsons, BC, prepared by Arya Engineering Inc., dated December 9, 2012;



- Geotechnical/Environmental Appraisal at 719 Gower Point Road, Gibsons, BC, prepared by GeoTacTics Media Engineering Ltd., dated February 8, 2013;
- Geotechnical Site Report, Geotechnical Site Observations – Foreshore Hazard Assessment at 745, 749, and 755 Franklin Road, Gibsons, BC, prepared by Lewkowich Engineering Associates Ltd, dated June 29, 2015;
- Memorandum for Site Reconnaissance – Slope Clearing Recommendations, 546 Marine Drive, Gibsons, BC, prepared by Western Geotechnical Consultants Ltd., dated January 14, 2016;
- Geotechnical Assessment, Lot 4 Glassford Road (308), Gibsons, BC, prepared by Western Geotechnical Consultants Ltd, dated June 28, 2016;
- Geotechnical Assessment at Lot 17 Inglis Road, Gibsons, BC, prepared by Western Geotechnical Consultants Ltd., dated July 27, 2016;
- Geotechnical Assessment, Proposed Single Family Residence at 651 Bay Road, Gibsons, BC, prepared by Lewkowich Engineering Associates Ltd, dated October 7, 2016;
- Geotechnical Assessment, Lot 14 and 15 Bals Lane (596 Bals), Gibsons, BC, prepared by Western Geotechnical Consultants Ltd., dated November 28, 2016;
- Geotechnical Assessment, 623 Gower Point Road, Gibsons, BC, prepared by Western Geotechnical Consultants Ltd., dated February 21, 2017;
- Geotechnical Assessment, Proposed Single Family Residence at 792 (Lot 11) Bayview Heights, Gibsons, BC, prepared by Lewkowich Engineering Associates Ltd, dated March 23, 2017;
- 681 Dougall Road, Development Permit Area #1, prepared by Sunco Civil Consulting Ltd., dated November 23, 2017;
- Geotechnical Assessment: Proposed Demolition and Residential Development, 340 Cochrane Road, Gibsons, BC, prepared by Arya Engineering Inc., dated September 5, 2018;
- Memorandum, Development Permit Area 9 Review, 505 Gower Point Road, Gibsons, BC, prepared by Arya Engineering Inc., dated September 18, 2018;
- Geotechnical Site Report, Geotechnical Site Observations – Foreshore Hazard Assessment at 741 Franklin Road, Gibsons, BC, prepared by Lewkowich Engineering Associates Ltd, dated November 19, 2018;
- Geotechnical Site Review – Slope Works at 755 Franklin Road, Gibsons, BC, prepared by Lewkowich Engineering Associates Ltd, dated November 22, 2018;
- Geotechnical Assessment, Deck Renovation at 554 Marine Drive, Gibsons, BC, prepared by Western Geotechnical Consultants Ltd., dated December 11, 2018;
- Preliminary Geotechnical Assessment, Proposed Residential Development – Gospel Rock Village, Block 7 DL 842 Group 1 NWD Plan 6755, Gibsons, BC, prepared by Kontur Geotechnical Consultants, dated December 27, 2018;



- Geotechnical Exploration and Report, Proposed Residential Development – Gospel Rock Village, Block 7 DL 842 Group 1 NWD Plan 6755, Gibsons, BC, prepared by Kontur Geotechnical Consultants, dated January 31, 2019;
- Geotechnical Addendum Letter, Proposed Residential Development – Gospel Rock Village, Block 7 DL 842 Group 1 NWD Plan 6755, Gibsons, BC, prepared by Kontur Geotechnical Consultants, dated September 18, 2019;
- Geotechnical Report, Proposed Single Family Residence at 689 Franklin Road, Gibsons, BC, prepared by Davies Geotechnical Inc., dated December 6, 2019;
- Geotechnical Addendum Letter 02, Building Setbacks for Proposed Residential Development – Gospel Rock Village, Block 7 DL 842 Group 1 NWD Plan 6755, Gibsons, BC, prepared by Kontur Geotechnical Consultants, dated February 5, 2020;
- Geotechnical Addendum Letter 03, Rock Slope and Foundation Stabilization Measures – Gospel Rock Village, Block 7 DL 842 Group 1 NWD Plan 6755, Gibsons, BC, prepared by Kontur Geotechnical Consultants, dated April 8, 2020;
- Slope Stability Assessment, Pebbles Beach Front Properties at Burns Road Park and 661, 665, and 667 Franklin Road, Gibsons, BC, prepared by Thurber Engineering Ltd., dated July 24, 2020;
- Geotechnical Assessment Report for Proposed Landscape Retaining Walls, 466 Marine Drive, Gibsons, BC, prepared by Ground Up Geotechnical, dated September 23, 2020;
- Geotechnical Report – Rev. 1, Proposed Single Family Residence, 336 Cochrane Road, Gibsons, BC, prepared by Davies Geotechnical Inc., dated February 2, 2021;
- Geotechnical Review Letter, Proposed Sunroom Addition at 652 Bay Road, Gibsons, BC, prepared by Kontur Geotechnical Consultants, dated May 27, 2021;
- Geotechnical Hazard Assessment, Foundation Repair to an Existing Single-Family Residence, 476 Marine Drive, Gibsons, BC, prepared by Lewkowich Engineering Associates Ltd., dated June 25, 2021;
- Environmental Assessment for Proposed Development, 528 Marine Drive, Gibsons, BC, prepared by Keystone Environmental, dated October 2021;
- Coastal Flood Hazard Assessment for 528 Marine Dr., Gibsons, BC, Draft Report Rev. 2, prepared by Northwest Hydraulic consultants, dated October 26, 2021;
- Slope Enhancement (foreshore Assessment and Slope Erosion Review) at 761 Franklin road, Gibsons, BC, prepared by Lewkowich Engineering Associates Ltd, dated November 5, 2021;
- Memorandum 1 – development Permit Area (DPA) Review – Gibsons Aquifer and Geotechnical Hazard at 731 Franklin Road, Gibsons, BC, prepared by Arya Engineering Inc., dated April 12, 2022;
- Initial Site Reconnaissance and Slope Hazard Assessment and Slope Stability Analysis, 456-458 Marine Drive, Gibsons, BC, prepared by GES Geotech Inc., dated June 26, 2022;



- DPA9 application Review for an Environmental Site Investigation at 528 Marine Drive, Gibsons, BC, prepared by Waterline Resources Inc., dated August 17, 2022.
- Geotechnical Hazard Assessment – 679 Franklin Road, Gibsons BC, prepared by Boundary Consulting Services Ltd, dated December 6, 2024;
- Geotechnical Report. Proposed Single Family Residence. 689 Franklin Road, Gibsons BC, prepared by Davies Geotechnical Inc, dated December 6, 2019;
- Geotechnical Assessment. Proposed Slope Stabilizations. 721 Franklin Road, Gibsons BC, prepared by Arya Engineering Inc. dated July 23, 2025;
- Geotechnical Assessment. 725 and 727 Franklin Road, Gibsons BC, prepared by Western Geotechnical Consultants Ltd, dated October 26, 2016;
- Geotechnical Site Observations – Foreshore Revetment Installation As-built. 741 Franklin Road, Gibsons, BC, prepared by Lewkowich Engineering Associates Ltd, dated April 26, 2019;
- Geotechnical Site Observations – Foreshore Hazard Assessment. 745, 749, 755 Franklin Road, Gibsons BC, prepared by Lewkowich Engineering Associates Ltd, dated June 29, 2015;
- Geotechnical Site Review – Slope Works. 755 Franklin Road, Gibsons, BC, prepared by Lewkowich Engineering Associates Ltd,, dated Novembre 22, 2018; and
- Geotechnical Assessment. Proposed Single Family Residence. 761 Franklin Road, Gibsons BC, prepared by Lewkowich Engineering Associates Ltd, dated March 27, 2019. Appendix 1

Appendix 4

SUMMARIES OF SELECT REFERENCE DOCUMENTS PROVIDED BY THE TOWN

The documents below were provided to us by the Town for public and private projects. The information contained in these documents was reviewed as part of RAM's desktop study for this project; however, the information provided in the documents below was not used directly as part of this project.

A2.1 280 Cochrane Road, Gibsons, BC

A geotechnical inspection was carried out by Peter Peart Geotechnical Ltd. on January 23, 1998 and a geotechnical investigation report was published on January 26, 1998, presumably for a proposed house. The lot is located within the southeast portion of the Town of Gibsons and was described as relatively flat with a gentle slope down to the east. Two test pits were excavated as part of the site visit, each to a depth of 3 metres below the site grades. The groundwater was encountered at a depth of 0.6 metre below the site grade. The subsurface soils at the locations of the test pits were found to comprise 0.6 metre of fill, underlain by medium dense, grey, fine to medium-grained sand. At a depth of approximately 0.5 to 1.5 metres below site grade, the aforementioned sand layer was underlain by grey, very dense (hard?) and cohesive, clayey silt with trace sand, pebbles and cobbles.

A.2.2 298 Shoal Lookout, Gibsons, BC

GeoTacTics Media Engineering carried out a site assessment of the subject site on June 20, 2007 and published a geotechnical assessment report on July 2, 2007 for a proposed house. The subject site is located within the southeast portion of the Town of Gibsons, situated within the DPA1 permit zone (e.g. geotechnical hazards), and was noted to be underlain by bedrock that was exposed at the surface beneath a thin soil cover. The bedrock was described generally to have fracture spacing of up to several metres in places. It was concluded that although some dislodgement of rock fragments had occurred at the base of the shoreline bluff, the exposed bedrock was considered stable. It was noted that there were no geotechnical or hydrological issues that would have precluded construction of the proposed house.

A.2.3 308 Glassford, Gibsons, BC

Western Geotechnical published a geotechnical assessment report dated June 28, 2016 for a proposed house. The subject site is located within the southeast portion of the Town of Gibsons and situated within the DPA1 permit zone (e.g. geotechnical hazards). They carried out a site reconnaissance at the subject site on May 26, 2016, and a subsurface investigation comprising excavation of two test pits to a depth of 1.5 metres each. The subsurface soils were described as an approximately 0.6 metre thick layer of topsoil, underlain by an approximately 0.5 metre thick layer of sand and gravel, which in turn was underlain by an approximately 0.3 metre thick layer of medium dense silty sand. No bedrock was encountered at the locations of the test pits. A Dynamic Cone Penetration Test (DCPT) was advanced

within the area of the proposed development, with blow counts of more than 50 encountered at a depth of approximately 1.5 metres. Groundwater was encountered at a depth of approximately 1.2 metres below the site grade. Geotechnical recommendations for construction of the proposed house were provided in the report.

A.2.4 310 Glassford, Gibsons, BC

GeoTacTics Media Engineering carried out a site assessment of the subject lot on March 28, 2008 and published a geotechnical assessment report dated April 22, 2008 for the proposed subdivision and/or re-development of the property. The subject site is located within the southeast portion of the Town of Gibsons, situated within the DPA1 permit zone (e.g. geotechnical hazards), and was noted to be relatively flat. The subsurface soils at the site were described as a thin layer comprising a mixture of sand and gravels with roots, organics, and wood waste, underlain by glacio-marine sediments. It was noted that there were no geotechnical or hydrological issues that would have prevented the subdivision and re-development of the subject property.

A.2.5 336 Cochrane Road, Gibsons, BC

Davies Geotechnical published a geotechnical report dated February 2, 2021 for a proposed single-family house at the subject site. A site reconnaissance was carried out on September 25, 2020. The subject site is located between Charman Creek and Goosebird Creek (at the southeast portion of the Town of Gibsons), which is identified as an area within the DPA1 permit zone (e.g. geotechnical hazards). The site is slightly sloping down towards the east. The subsurface soils were envisaged to comprised a thin layer of fill, underlain by dense, till-like soils. It was concluded that flooding of the site due to Goosebird Creek would be possible; however the risk of flood hazard due to peak discharge from the 1:200 year storm was low. The subject site was also located within the DPA9 zone (e.g. confined aquifer) area. The report concluded that construction of the proposed single-family house with excavations of up to 1.5 metres below the site grades would not have negative impact on the Gibsons Aquifer.

A.2.6 340 Cochrane Road, Gibsons, BC

Arya Engineering published a geotechnical assessment report dated September 5, 2018 for a proposed single-family house at the subject site. The subject site is located within the southeast portion of the Town of Gibsons. The subject site is located in close proximity to Charman Creek; therefore, the site is within the area of DPA1 for the Town of Gibsons. A site reconnaissance was carried out on August 21, 2018, that included manual probing to evaluate geotechnical conditions at the site. Two test pits were excavated at the site to a depth of approximately 1.5 metres each. Based on the results of the test pit excavation, the subsurface soils consisted of granular soils with trace fines (e.g. Capilano Sediments) that were underlain by glacial till. Bedrock was not observed at the locations of the test pits. It was noted in the above-mentioned report that no subsurface indications of historic flooding were observed and that the flood hazard for the site was considered to be low.

A.2.7 396 Aldersprings Road, Gibsons, BC

Arya Engineering published a memorandum dated December 9, 2021 for a proposed subdivision of the subject site. The subject site is located within the southeast portion of the Town of Gibsons and within the DP1 permit zone (e.g. low geotechnical hazard – flooding) due to its close proximity to Charman Creek. A site reconnaissance was carried out on September 7, 2021. A peak flow volume of 12.87 m³/s was estimated during a 1:100 year flood event and it was concluded that the current culvert was not sufficiently sized to accommodate for the subject flood.

A.2.8 458 Marine Drive, Gibsons, BC

GES Geotech Inc. published a geotechnical report dated June 26, 2022 as part of a slope hazard assessment and slope stability analysis for the subject site. The subject site is located within the central east portion of the Town of Gibsons and is situated within the DPA1 permit zone (e.g. geotechnical hazards). GES carried out a site reconnaissance on May 26, 2022 indicating that the subsurface soils comprised mainly of medium dense glacial till deposits. The results of the slope stability analysis indicated that the factors of safety for the existing slope under the static and seismic loading conditions are 1.5 and greater than 1.0, respectively.

A.2.9 466 Marine Drive, Gibsons, BC

Ground Up Geotechnical published a geotechnical assessment report dated September 23, 2022 for proposed landscape retaining walls at the subject site. The subject site is located within the central east portion of the Town of Gibsons and is situated within the DPA1 permit zone (e.g. geotechnical hazards). The retaining walls were proposed in order to improve the usability of the steep slopes at the site, as part of renovations to the existing house at the site. The focus of the assessment was the lower segment of the slope, extending up from the waterfront to the existing house. It was concluded the proposed retaining walls could be accommodated without adversely affecting the stability of the existing slope at the subject site.

A.2.10 476 Marine Drive, Gibsons, BC

Lewkowich Engineering Associated published a geotechnical hazard assessment report dated June 25, 2021 for the proposed foundation repair of an existing single-family house. The subject site is located within the central east portion of the Town of Gibsons and is situated within the DPA1 permit zone (e.g. geotechnical hazards). A site reconnaissance was conducted on September 4, 2020, followed by a supplemental field review on June 4, 2021. A subsurface investigation was not carried out for this project. Minor soil exposures observed at the site and the subsurface soils were categorized as coarse-grained sand and gravel with some cobbles, inferred to be compact to dense. It was noted that no signs of potential global / full slope height instability were observed on the slope; however, surficial soil creep could be expected. As part of the foundation repair, it was recommended that the foundations be lowered to a depth of minimum 1.2 metres below the existing site grades. It was noted that since the entire property is on a slope, the minimum setbacks for steep slopes as indicated in the DPA1 could not have been achieved.

A.2.11 668 Bay Road, Gibsons, BC

GeoTacTics Media Engineering published a geotechnical assessment report dated October 1, 2012 for a proposed house addition at the subject site. The subject site is located within the east central portion of the Town of Gibsons, situated between the Charman Creek and Goosebird Creek and is part of the DPA1 (e.g. geotechnical hazards) zone as identified by the Town of Gibsons. The site was described as relatively flat. The main geotechnical issue related to the re-development of the subject site was identified to be the setbacks from the natural boundary of the sea and the Flood Construction Level (FCL). A site reconnaissance was conducted on September 21, 2012. No subsurface investigation was carried out as part of this project. Localized soil exposures along the surface of the property were observed. Based on the excavations carried out for new footings to a depth of approximately 0.5 metre below the site grade, the subgrade soils consisted of brown silty sand and gravel. The report concluded that the probability of occurrence of naturally occurring and catastrophic debris flow, debris flood, avulsion, and flooding at the subject site was low. However, the probability of occurrence of these events could be increased by blockages of the creeks in combination of high-water levels during periods of intense, heavy rainfall, and extreme high tides. It was noted that the existing building satisfies the geotechnical setback of 15 metres from the natural boundary of the sea, and that the finished floor level of the proposed house addition meets the criteria of 1.5 metres above the high-water level for flood protection.

A.2.12 528 Marine Drive, Gibsons, BC

Northwest Hydraulic Consultants published a coastal flood hazard assessment report dated October 26, 2021 for the subject site. The subject site is located within the central east portion of the Town of Gibsons. The proposed development at the subject site comprised a 3-storey townhouse complex. Since the site was located within the DPA1 (e.g. geotechnical hazards) permit area, the flood construction level for the proposed development was assessed and recommendations were provided intended to ensure that the proposed development would be safe for construction and that it would meet the criteria established by the Town of Gibsons.

A.2.13 554 Marine Drive, Gibsons, BC

Western Geotechnical Consultants published a geotechnical assessment report dated December 11, 2018 for a deck renovation at the subject site. The subject site is located within the central east portion of the Town of Gibsons and is situated within the DPA1 permit zone (e.g. geotechnical hazards). A site reconnaissance was conducted on November 29, 2018, including a hand-auger advanced to a depth of 1.1 metres below the site grades. A layer of compact gravelly sand was observed at a depth of 1.0 metre below the site grades. Recommendations for the geotechnical and geohazard components of the project were provided in the report.

A.2.14 596 Bals Lane, Gibsons, BC

Western Geotechnical Consultants published a geotechnical assessment report dated November 28, 2016 for two proposed single-family houses. The subject site is located within the central east portion of the Town of Gibsons and within the DPA1 permit zone (e.g. geotechnical hazards). A site

reconnaissance was conducted on November 15, 2016. Based on Western Geotechnical's knowledge of the area, hand probing, and visual observations during the site reconnaissance, suitable bearing materials for foundation (e.g. sand) were estimated to be at depths ranging from 0.6 to 1.4 metres below the site grades. The aforementioned sand layer was expected to be underlain by till-like materials. The report concluded that the site did not present substantial geotechnical evidence for susceptibility to geotechnical hazards. Slope stability analysis was carried out and recommendations for the proposed development was provided in the report.

A.2.15 636 Gower Point Road, Gibsons, BC

Western Geotechnical Consultants published a geotechnical assessment report dated February 21, 2017 for a proposed carriage house and two-level garage. The subject site is located within the southeast portion of the Town of Gibsons and is situated within the DPA1 permit zone (e.g. geotechnical hazards) zone. A subsurface investigation was carried out, comprising excavation of two test pits to a maximum depth of 1.5 metres below the site grades. Fill materials were observed within the test pits to depths ranging from 1.0 to 1.5 metres below the site grades; there were underlain by sand and gravel with organic residuals. The report concluded that there were no reasonably conceivable geotechnical issues that would impede successful development on the subject site.

A.2.16 651 Bay Road, Gibsons, BC

Lewkowich Engineering Associated published a geotechnical assessment report dated October 7, 2016 for the construction of a residential building. The subject site is located within the southeast portion of the Town of Gibsons and is situated within the DPA1 (e.g. geotechnical hazards). Lewkowich Engineering Associated used the information provided in the geotechnical report that was previously prepared by Western Geotechnical Consultants for the subject site, including the descriptions for soils encountered in 3 test pits that had been excavated within the site. The subsurface soils within the test pits were found to comprise an approximately 1.5 metres thick layer of fill, underlain by stiff silt. Geotechnical recommendations along with a flood construction level of 3.91 metres was provided for this project.

A.2.17 652 Bay Road, Gibsons, BC

Kontur Geotechnical Consultants published a geotechnical review letter dated May 27, 2021 for the proposed sunroom addition to the existing porch area of the house at this address. The subject site is located within the southeast portion of the Town of Gibsons and also is situated within the DPA1 zone (e.g. geotechnical hazard - flood). The site was described as being relatively flat and no steep slope was located within the immediate vicinity of the subject site. The report concluded that the site may be subject to inundation of floodwater from the sea or Goosebird Creek; however, significant debris flow or debris flood hazards that may be associated with Goosebird Creek were not anticipated to influence the site due to the flatness and distance of the site from the potential source area. The report indicated that the existing floor elevation and the proposed renovation will meet the Town of Gibsons FCL guidelines for Goosebird Creek but will not meet the FCL guidelines for the sea.

A.2.18 657 and 685 Dougall Road, Gibsons, BC

GeoTicTacs Engineering published a geotechnical assessment report dated May 26, 2004 for construction of 1 to 2-level cottages at the sites. The subject sites are located within the southeast portion of the Town of Gibsons and also are situated within the DPA1 permit zone (e.g. geotechnical hazards - flood). A site reconnaissance was conducted on May 19, 2004. Two test pits were carried out at the site indicating the presence of an approximately 0.45 to 0.75 metre thick layer of fill, underlain by an approximately 0.75 metre thick layer of silty sand and gravel, which in turn was underlain by dense sand with lenses of silt. No evidence of instability or anomalous erosion was observed on the properties or along the Goosebird creek north and south of the properties. It was concluded that except for extreme flood conditions, flooding due to storms would have a very low probability of extending beyond the setback strips along the creek channel. It was confirmed that the setbacks that are proposed for the proposed cottages are considered safe for intended use.

A.2.19 661, 665, and 667 Franklin Road and Burns Road Park, Gibsons, BC

Thurber Engineering published a slope stability assessment report dated July 24, 2020 for the subject lots. The subject site is located within the southeast portion of the Town of Gibsons and also is situated within the DPA1 permit zone (e.g. geotechnical hazards). The subject lots slope down steeply to the beach where the toe of the slope is protected by a Lock-Block retaining wall. It was reported that a landslide had occurred around January 30, 2020 which had impacted the slopes on 661 and 665 Franklin Road. The report indicated that four of the blocks in the top row were tipped backwards, possibly due to the late December 2019 storm events. The Lock Block wall was constructed in 1999 to protect the toe of the slope from wave attack and erosion. Site reconnaissances were conducted on April 21 and June 22, 2020. Granular fill was exposed in the scarp at 661 Franklin and the toe of the landslide could not be discerned due to the dense vegetation. It was recommended that the slumped materials be removed, and the permanent slope be graded to 1.1H:1V or flatter relative to the existing break in the slope and the toe of the retaining wall. Further recommendations were provided regarding the work and reinstatement of the Lock Block wall to its previous condition.

A.2.20 670 Fairmont Road, Gibsons, BC

GeoTicTacs Engineering published a geotechnical assessment report dated July 2, 2006 to assess potential impact on the stability of the slope from removal of five trees at the subject site. The subject site is located within the central east portion of the Town of Gibsons and also is situated within the DPA1 permit zone (e.g. geotechnical hazards). The subject trees were located near the top of the north bank of an eastward-draining storm runoff gully, which was a tributary to Gibsons Creek. The report concluded that removal of the trees had not worsened the erosion potential of the slope of the tributary gully. The root mats were remained in place and the ground cover had not been disturbed.

A.2.21 689 Franklin Road, Gibsons, BC

Davies Geotechnical published a geotechnical report dated December 6, 2019 for a proposed single-family house at the subject site. The subject site is located within the southeast portion of the Town of Gibsons and also is situated within the DPA1 permit zone (e.g. geotechnical hazards). A site

reconnaissance was conducted on November 1, 2019 which included completion of a hand-dug test pit through the face of the slope. The subsurface soils at the site were described to consist of approximately 8 metres of dense silty sand to sandy silt, underlain by bedrock. The slope was found to be steep and heavily vegetated, and no evidence of slides or erosion was found during the site reconnaissance. A slope stability analysis was carried out with respect to the proposed single-family house. The aforementioned report provided recommendations for the geotechnical hazards, including the flood construction level for the site.

A.2.22 719 Gower Point Road, Gibsons, BC

GeoTacTics Media Engineering published a geotechnical/environmental appraisal report dated February 8, 2013, providing the client with geotechnical and environmental information for purchase and development of the site. The subject site is located within the southeast portion of the Town of Gibsons and is situated within the DPA1 permit zone (e.g. geotechnical hazards). A site reconnaissance was conducted on February 4, 2013. No evident concerns from geotechnical or geohazard viewpoints were observed during the aforementioned site reconnaissance.

A.2.23 731 Franklin Road, Gibsons, BC

Arya Engineering published a memo dated April 12, 2022 for a proposed walkway and boulder stacked rock landscaping walls at the subject site. The subject site is located within the southeast portion of the Town of Gibsons and also is situated within the DPA1 permit zone (e.g. geotechnical hazards). Slope stability analysis was carried out as part of the landslide hazard analysis for the southern slope at the site, and recommendations were provided in the report.

A.2.24 733 Gower Point Road, Gibsons, BC

The B+L Rock Group Ltd. published a geotechnical assessment on April 26, 1996, assessing the subject site and potential reconstruction of a house within the property. The subject site is located within the southeast portion of the Town of Gibsons and also is situated within the DPA1 permit zone (e.g. geotechnical hazards). A site reconnaissance was conducted on April 24, 1996 including excavation of a test pit. The subsurface soils encountered at the location of the test pit consisted of an approximately 0.5 metre thick layer of topsoil, underlain by an approximately 0.8 metre thick layer of till-like, dense cobbles, gravel, sand and clay. The aforementioned till-like soil was underlain by very dense sand with some silt for a thickness of approximately 0.8 metre. Some undercutting of the slope at the shoreline by wave erosion was observed during the site reconnaissance and the bedrock was exposed. Therefore, it was concluded that further wave erosion would not have an impact on the stability of the present structure, and that further erosion of the slope could be controlled with erosion control works which would be carried out below the property line. A vertical scarp face, approximately 2 to 3 metres high, was observed on the property which was an evidence of past slope instability. However, it was concluded that the aforementioned slope instability did not pose a threat to then existing structure that was located about 9 metres from the crest of the slope. Slope stability analysis was also carried out for the slope as part of this project.

A.2.25 745, 749, and 755 Franklin Road, Gibsons, BC

Lewkowich Engineering Associates published a geotechnical site observations report dated June 29, 2015 to assess the foreshore conditions at the aforementioned properties. The subject sites are located within the southeast portion of the Town of Gibsons and also situated within the DPA1 permit zone (e.g. geotechnical hazards). A site reconnaissance was carried out on May 15, 2015. During the site reconnaissance a high bank foreshore of approximately 8 metres high with a relatively flat intertidal zone facing the open water was observed. The property owners had noted that previous storms had caused a significant change to the shore bank by removing a significant amount of topsoil, grasses, small trees, and low-lying vegetation, and that this had impacted the underlying soils of the steep bank which has little to no protection from high tides and storm surges. It was concluded that the foreshore erosion had undermined the surficial soils on the property and that foreshore protection must be constructed by placing Rip Rap (a matrix of igneous boulders and infill gravels).

A.2.26 741 Franklin Road, Gibsons, BC

Lewkowich Engineering Associates published a geotechnical site observations report dated November 19, 2018 to assess the foreshore conditions below the subject site. The subject site is located within the southeast portion of the Town of Gibsons and is situated within the DPA1 permit zone (e.g. geotechnical hazards). A site reconnaissance was carried out on September 13, 2018. Similar observations and conclusions to the ones at 745, 749, and 755 Franklin Road were made for this project.

A.2.27 761 Franklin Road, Gibsons, BC

Lewkowich Engineering Associates published a geotechnical site observations report dated November 5, 2021 to assess the foreshore slope below the subject site. The subject site is located within the southeast portion of the Town of Gibsons and is situated within the DPA1 permit zone (e.g. geotechnical hazards). A site reconnaissance was carried out and revealed a 10.5 metres steep slope with an overall gradient of 30 degrees with a steeper 45 degree portion near the crest. Surficial slope movement was evident, and erosion was likely caused by stormwater runoff, resulting in a shallow slump of over-saturated soils. It was noted that the slope remained in a globally stable condition. It was recommended that a robust slope revetment, such as armour rock infilled with gravel, be constructed at the toe of the slope to improve the surficial stability.

A.2.28 792 Bayview Heights Road, Gibsons, BC

Lewkowich Engineering Associates published a geotechnical assessment report dated March 23, 2017, providing recommendations for the proposed single-family house at the subject site. The subject site is located within the southwest portion of the Town of Gibsons and is situated within the DPA1 permit zone (e.g. geotechnical hazards). It appears that no site reconnaissance was carried out as part of preparation of this report and the review was done based on the similar works in the area. The site was considered suitable for construction of a single-family house.

A.2.29 Oceanmount Boulevard / Shaw Road / Inglis Road, Gibsons, BC

GeoTacTics Engineering published a geotechnical assessment report dated March November 20, 2004 for subdivision and development of the areas of Shaw Road, Inglis Road and Oceanmount Boulevard. The subject area is located within the central west portion of the Town of Gibsons and also is situated within the DPA1 permit zone (e.g. geotechnical hazards). A site reconnaissance was carried out on July 12, 2004. The established 15 metres setback from the top of the slope of the ravines were recommended as part of this subdivision. It was noted that the average rate of retreat of the crest of the gully was estimated to be 5 to 10 mm per year.

A.2.30 955 Inglis Road, Gibsons, BC

Western Geotechnical Consultants published a geotechnical assessment report dated July 27, 2016 for the proposed single-family house at the subject site. The subject area is located within the central west portion of the Town of Gibsons and is situated within the DPA1 permit zone (e.g. geotechnical hazards). A site reconnaissance was conducted on June 13, 2016 and a subsurface investigation, comprising excavation of two test pits to a maximum depth of 1.8 metres below the site grades, was carried out on June 20, 2016. The subsurface soils comprise a thin layer of podzol, underlain by firm clayey silt or stiff glacial till. Refusal depth for manual probing the ground was encountered at depths ranging from 0.3 to 0.6 metre below the site grades. The site was assessed for geotechnical hazards (e.g. debris flow, landslides, rock fall, etc.). No evidence of previous geotechnical hazards at the site was observed. Slope stability analysis was carried out as part of localized landslide assessment. Recommendations regarding potential geotechnical hazards were provided in this report.

A.2.31 Gospel Rock Village, Chaster Road, Gibsons, BC

Kontur Geotechnical Consultants published geotechnical assessment reports dated December 27, 2018, January 31, 2019, and September 19, 2019, providing recommendations for the proposed subdivision and development of the subject area. The subject area is located within the southwest portion of the Town of Gibsons and is situated within the DPA1 permit zone (e.g. geotechnical hazards). A site reconnaissance was conducted on November 24, 2018. The project site is situated primarily along the top of a wide, bedrock-controlled ridge. As part of subsurface investigation, 21 test pits were excavated to depths ranging from 1.2 to 3.0 metres below the site grades. Surficial soil materials comprising, topsoil, fill, compact / firm, sand to sandy silt, and stiff to hard clayey silt to silty clay were encountered at the locations of the test pits, that were underlain by till-like sandy silt to silty sand, which in turn was underlain by bedrock. Ground seepage was observed at depths ranging from 0.6 to 1.2 metres below the site grades. Review of historical photographs of the area that date back to 1947 indicated various logging activities and construction of residential properties adjacent to and within the project site. The report noted that the slope below the project site may be subject to rock falls, topples, or localized slides. Recommendations with regards to geotechnical hazards (e.g. setbacks from the crest of the slopes), rock slope stabilization, and/or foundation stabilization were provided in this report.

A2. 31. 679 Franklin Road, Gibsons BC

Boundary Consulting Services Ltd published a geohazard assessment report dated December 6, 2024, providing a summary of the desktop study, limited scope of site investigation and quantitative, as well as qualitative geohazard analysis. The assessment was done to support the existing building renovation. A test pit and a DCPT test encountered Sand with some silt and trace gravel soils to the depths of 1.23 mbgs. Qualitative geohazard assessment found Moderate hazard from Localized Landslide, as well as Low hazard from both Oceanic Flood and Aquifer Hazard. Quantitative assessment was then performed for these 3 hazard types. Landslide hazard has been found to be within tolerance limits. The existing building was found to be above FCL. General recommendations for foundations, excavations and retaining walls were provided.

A2. 32. 689 Franklin Road, Gibsons BC.

Davies Geotechnical Inc published a geotechnical report dated December 6, 2019. The study comprised desktop review and site walkthrough. Subsurface conditions were found to comprise dense silty fine sand (Capilano sediments) over bedrock with minimal groundwater seepage. The property was found to be stable, with no evidence of erosion or slides. Slope stability analysis was conducted. A 9-metre setback from the slope crest was recommended as a result to ensure stability against seismic and erosional risks, both under current and projected sea-level conditions. The report confirms the site is safe for development using standard shallow foundations, provided stormwater is directed away from slopes, vegetation is maintained, and no added loading occurs near the slope crest. Flood and aquifer contamination risks were found to be minimal, and the property lies outside critical wellhead protection areas. Foundation, floor slab and drainage recommendations are also provided.

A2. 33. 721 Franklin Road, Gibsons BC,

Arya Engineering Ltd published a geotechnical assessment report dated July 23, 2025, in support of proposed slope stabilization works. Assessment comprised site reconnaissance, review of background data and slope stability analysis. The proposed stabilization with pipe piles, tieback anchors and shotcrete was reviewed. Subsurface conditions were assumed based on surficial observations and geology mapping available for the area. It was found that the installation of a recommended stabilization system is expected to increase the stability of the slope.

A2. 34. 725 and 727 Franklin Road, Gibsons, BC.

Western Geotechnical Consultants Ltd published a geotechnical assessment report dated October 26, 2016. The report was done to support the demolition of an existing building, as well as construction of a new proposed dwelling. A site investigation comprised excavation of two test pits as well as a drilling program. Subsurface conditions were found to comprise sand over glacial till within 3.5 mbgs. A slope stability analysis was conducted and concluded that a 10-m setback from the slope crest will satisfy the safety factors required. In addition, the potential for slope erosion from the wave action of 4m over the following 100 year-period was estimated. Recommendations for site preparation, drainage, shallow foundations, retaining walls and excavations were provided.

A2.35. 741 Franklin Road, Gibsons, BC,

Lewkowich Engineering Associates Ltd published a geotechnical memo dated April 26, 2019 on geotechnical site observations regarding a foreshore revetment installation. The revetment was reviewed as have been installed per the previously issued design drawings – 2-3m wide, 1-2m tall, made of 900 t 1500mm rockfill. It is concluded that the installation will provide protection from increased tidal levels and storm frequency due to the predicted effects of climate change.

A2.36. 745, 749, 755 Franklin Road, Gibsons, BC.

Lewkowich Engineering Associates Ltd published a geotechnical site observations memo dated June 29, 2015, outlining foreshore hazard assessment. The work was performed in support of the foreshore revetment installation. Recommendations for revetment for those similar outlined in item A2.35 above.

A2.37. 761 Franklin Road, Gibsons, BC

Lewkowich Engineering Associates Ltd published a geotechnical assessment dated March 27, 2019. The purpose of the study was to support the development of a new residential building. The study comprised a site visit and visual assessment of the property. The subsurface conditions were inferred from adjacent project sites and were determined as topsoil, overlying sand with gravel, overlying firm moist silt layer. Aquifer protection aspects are discussed. It is found that the proposed excavation is unlikely to cause any aquifer disturbance or uncontrolled water release. In terms of landslide hazard, it is noted that applicable existing DPA-1 setback is set to 30m. The proposed development is expected to encroach into this setback by 2.69m. The slope analysis is performed to confirm this is safe from a landslide perspective. General recommendations, such as foundation, dewatering, fill and excavations are also included.



Appendix 5

SLOPE HAZARD ASSESSMENT REPORTS CHECKLISTS (REF CITY OF COQUITLAM)

Checklist A - Preliminary Slope Hazard Assessment Reports

A **Preliminary Slope Hazard Assessment Report** should include, but not be limited to, the following items, where applicable:

- Prepared by a qualified **Professional Engineer** or **Professional Geoscientist** who is registered with the **Engineers and Geoscientists of British Columbia**
- Provides background and site information (typically obtained from available literature) regarding:
 - site location (civic address and/or legal description) and surrounding land / developments;
 - local surficial and/or bedrock geology (e.g. published Geological Survey of Canada map);
 - documented surface and/or ground water conditions (e.g. creeks, seepage, water table, etc.);
 - current site conditions (e.g. topography, existing development, underground services, retaining walls, etc.);
 - previous site development and/or historical land use (e.g. fill placed to raise grades, former ground improvement / stabilization works, buried ravine, buried tanks, abandoned infrastructure, etc.);
 - the proposed development (e.g. building footprint, proposed site grades, retaining walls, etc.)
- Topographic survey that:
 - is prepared by a registered **British Columbia Land Surveyor**;
 - was completed within a reasonable time period prior to the report date to ensure accurate data reflecting current site conditions;
 - encompasses the **Property** or proposed development area;
 - extends beyond the crest and toe of slope areas;
 - provides slope contours at 1 metre interval;
 - shows the footprint of structures that may be affected by a slope hazard;
- A site reconnaissance has:
 - been carried out on, and if required, beyond the **Property**:
 - within a reasonable time period (e.g. 1 year) prior to the report date that ensures the site conditions, observations, and report contents are still representative of current site conditions;
 - that includes a traverse of the sloping terrain;
 - OR
 - has not been carried out and justification or rationale is provided for why not.
- Provides description(s) and/or data:
 - to define the site, slope geometry, and/or relevant terrain feature (i.e. slope angles, slope heights, benches, terraces, ravines, gullies, retaining walls, etc.);
 - of the weather condition during the site reconnaissance;
 - that identifies
 - there are no indicator signs of any potential or existing slope instability or slope hazard on the Property or that may affect the Property;
 - OR
 - there are indicator signs of potential or existing slope instability or slope hazard;
 - the type of identified slope hazard (e.g. landslide, rockfall, debris flow, soil creep, etc.);
 - location of identified slope instability or slope hazard;
 - the estimated location, extent, and/or size of the identified slope instability or slope hazard

- Evaluates the slope instability or slope hazard with consideration of:
 - the current site and slope conditions;
 - the proposed development and expected changes in site conditions;
 - surface water impacts (e.g. slope erosion, misdirected water flow, creek avulsion, scour, etc.);
 - ground water impacts (e.g. lowering water table, intercepting seepage, artesian flow, etc.);
 - potential impacts to downslope and/or adjacent structures or properties;
 - climate change

- Provides a conclusion that there is
 - no identified slope instability or slope hazard that may adversely impact the site/proposed development or be initiated from the site to impact surrounding areas;OR
 - an identified slope instability or slope hazard, and
 - provides recommendations to address the slope instability or slope hazard, and/or
 - recommends a **Detailed Slope Hazard Assessment** be carried out.

- Includes a **Landslide Assessment Assurance Statement** (Appendix D from the EGBC Landslide Assessment Guidelines) that is completed, signed, sealed and dated by the **Qualified Professional**.

Where a **Preliminary Slope Hazard Assessment** report will support a **Building Permit Application** for either a new house, retaining wall, pool, outbuilding or building addition, geotechnical design and construction recommendations should be provided.

Checklist B - Detailed Slope Hazard Assessment Report

A **Detailed Slope Hazard Assessment Report** should include, but not be limited to, the following items, where applicable:

- Prepared by a qualified **Professional Engineer** or **Professional Geoscientist** who is registered with the **Engineers and Geoscientists of British Columbia**
- Provides background and site information (typically obtained from available literature) regarding:
 - site location (civic address and/or legal description) and surrounding land / developments;
 - local surficial and/or bedrock geology (e.g. published Geological Survey of Canada map);
 - documented surface and/or ground water conditions (e.g. creeks, seepage, water table, etc.);
 - current site conditions (e.g. topography, existing development, underground services, retaining walls, etc.);
 - previous site development and/or historical land use (e.g. fill placed to raise grades, former ground improvement / stabilization works, buried ravine, buried tanks, abandoned infrastructure, etc.);
 - the proposed development (e.g. building footprint, proposed site grades, retaining walls, etc.)
- Topographic survey that:
 - is prepared by a registered **British Columbia Land Surveyor**;
 - was completed within a reasonable time period prior to the report date to ensure accurate data reflecting current site conditions;
 - encompasses the Property or proposed development area;
 - extends beyond the crest and toe of slope areas;
 - provides slope contours at 1 metre interval;
 - shows the footprint of structures that may be affected by a slope hazard;
- A site reconnaissance has:
 - been carried out on, and if required, beyond the **Property**:
 - within a reasonable time period (e.g. 1 year) prior to the report date that ensures the site conditions, observations, and report contents are still representative of current site conditions;
 - that includes a ground traverse at a detailed level of intensity to allow characterization and delineation of existing and/or potential slope hazard area(s);
 - OR
 - not been carried out and justification or rationale is provided for why not.
- Field work (site investigation) has been carried out to characterize the local soil stratigraphy and/or bedrock condition by:
 - assessing local soil exposures and/or bedrock outcrops (including rock joint mapping, when applicable);
 - advancing test holes (e.g. test pits, auger drill holes, Standard Penetration Test soundings, etc.);
 - installing one or more ground water monitoring well(s) (e.g. standpipe piezometer);
 - measurement of local ground water level(s)

- Provides description(s) and/or data:
 - to define the site, slope geometry, and/or relevant terrain feature (i.e. slope angles, slope heights, benches, terraces, ravines, gullies, retaining walls, etc.);
 - of the weather condition during the site reconnaissance;
 - that identifies:
 - there are no indicator signs of any potential or existing slope instability or slope hazard on the Property or that may affect the Property;
 - OR
 - there are indicator signs of potential or existing slope instability or slope hazard;
 - the type of identified slope hazard (e.g. landslide, rockfall, debris flow, soil creep, etc.);
 - location of identified slope instability or slope hazard;
 - the estimated location, extent, and/or size of the identified slope instability or slope hazard

- Evaluates the slope instability or slope hazard with consideration of:
 - the current site and slope conditions;
 - the proposed development and expected changes in site conditions;
 - surface water impacts (e.g. slope erosion, misdirected water flow, creek avulsion, scour, etc.);
 - ground water impacts (e.g. lowering water table, intercepting seepage, artesian flow, etc.);
 - potential impacts to downslope and/or adjacent structures or properties;
 - climate change

- Engineering analysis that:
 - includes one or more sections depicting the slope model geometry, stratigraphy (including weathered zones, if applicable), and ground water table;
 - presents the method of analysis and any assumptions (e.g. sub-horizontal stratigraphy) including rationale for the assumptions;
 - lists the input parameters (e.g. soil types, thicknesses, friction angles, cohesion values, and unit weights);
 - considers ground water conditions including seasonal variability;
 - determines the Factor of Safety against global slope failure under static conditions for current and proposed site conditions including minimum Factor of Safety at the proposed building footprint;
 - determines the **Factor of Safety** against global slope failure under design seismic conditions for the proposed site conditions including predicted seismic slope displacement at the proposed building footprint;
 - estimates a likelihood or probability of occurrence of a landslide, if a risk analysis is implemented;
 - estimates the landslide runout distance or potential downslope impact area of a slope hazard.

- Provides discussions or conclusions regarding:
 - the results of the field work and engineering analysis (including results of sensitivity analyses);
 - the slope hazard type, extent, and potential impact to the subject property and/or adjacent land / developments;
 - the level of landslide / slope hazard “safety” (i.e. based on slope stability **Factor of Safety**, quantitative risk analysis, or **Frequency-Number of Fatality** plot); and
 - a comparison of the analysis / investigation results to the required level of landslide / slope hazard “safety” indicating that

- there is no identified slope instability or slope hazard that may adversely impact the site / proposed development and/or be initiated from the site to impact surrounding areas, and
 - no specific slope maintenance work is required; OR
 - slope maintenance work is required with recommendations provided;
- OR
- there is an identified slope instability or slope hazard that may adversely impact the site / proposed development and/or be initiated from the site to impact surrounding areas, and recommendations are provided to
 - improve the slope stability or slope hazard to satisfy “safety” requirements; OR
 - implement an **As Low As Reasonably Practicable** (ALARP) strategy;
- OR
- the required level of “safety” is not practicable to achieve at the site or for the proposed development (*supporting rationale for this extreme case is to be provided in the report*).

- Includes a **Landslide Assessment Assurance Statement** (Appendix D from the EGBC Landslide Assessment Guidelines) that is completed, signed, sealed, and dated by the **Qualified Professional**.
- Potential adoption of an **As Low As Reasonably Practicable** (ALARP) strategy regarding development at the **Property** is to be discussed with the **Building Official** and which is expected to be subject to an independent peer review.
- Building Official** recommends an independent **Peer Review**.

Where a **Detailed Slope Hazard Assessment** report will support a **Building Permit Application** for either a new house, retaining wall, pool, outbuilding, or building addition, geotechnical design and construction recommendations should be provided.