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20 October 2025

Mission Ridge Expansion Master Planned Resort Draft EIS
Mike Kaputa, Chelan County Department of Natural Resources
411 Washington Street, Suite 201
Wenatchee, WA 98801

RE: Commentary on DEIS Section 4.1 "Earth" and Appendix B

Dear Mr. Kaputa:

I am writing to provide commentary on the "Earth" (Section 4.1) of the DEIS and Appendix B, which provide various supporting geotechnical reports. My comments are below.

GHOD Applicability

The existing Mission Ridge (MR) development, the proposed access road to Section 19, and proposed MPR exist, almost entirely, within steep landslide terrain consistent with all 7 examples for landslide hazard areas as defined in Chapter 11.86 of the Chelan County Code, which defines Chelan County's Geologic Hazards Overlay District (GHOD).

The County's GHOD is applicable to this proposal and the requirements of the Chelan County Code should be enforced. Given the complex geology and technical nature of the required evaluations, and the limited and inadequate geotechnical evaluations provided in this DEIS, there is inadequate data to assess the scope of this project as it relates to landslide hazard assessment and mitigation. The county should place the burden of proof upon the applicant to provide sufficient feasibility-level evaluations as to confirm the size and complexity of the geotechnical designs necessary to complete the project. Further, the County may find value in soliciting professional consultation to review of the submitted documents to confirm technical rigor in their site characterization, assessment of the hazards therein, and proposed mitigations. To do otherwise has, at best, the potential to allow development of a resort that has a significantly larger environmental impact than proposed; and at worst, activation of problematic landslides and conditions that endanger the public, the environment, and the County's reputation.

The upper Squilchuck Valley has a deep history of ancient and recent landslides:

The County's attention is drawn to multiple recent landslides have occurred within the upper Squilchuck basin in recent years, including the Whispering Ridge landslide, the 2006 and 2016 inbounds landslides documented in the Appendix B of the DEIS. An active landslide scarp with ongoing movement is noted in the DEIS to existing within the proposed development limits.

Landslides similar to the recent 2006 and 2016 events within the ski area have potential to occur elsewhere within the existing and proposed developments. Similar slides within the proposed MPR have the potential to cutoff the single point of access proposed by the developer; potentially injuring or stranding residents and guests. At present, the DEIS contains no assessment of the predilection of the sites surrounding the proposed MPR to similar events.

The area is fire prone, as noted in other sections. The dramatic increase in human presence in the area increases the likelihood that a fire will eventually occur. Accordingly, post-fire landsliding and debris flow potential represents a significant hazard. Such post-fire hydrology and landsliding is not addressed by the DEIS and poses a reasonable future condition in the event of wildfire within the upper Squilchuck basin. Such slides could very plausibly impact the single access route proposed for the MPR.

The proposed utility corridor is risky and has not been assessed

The proposed utility corridor roughly parallels Squilchuck Creek between Forest Ridge and the existing MR base areas. Given its length and location at the toe of steep slopes in the valley, the utility corridor is particularly vulnerable to disruption by landsliding and mass movements anywhere along this route. No detailed geologic or geotechnical assessment of the utility corridor is provided within the DEIS such as would allow a reasonable assessment of mitigation requirements or their feasibility with respect to providing reliable water, power, communications, and other services. Notably, the February 2020 GN Northern Geotechnical Report (DEIS Appendix B), which assessed the access road crossing of Squilchuck Creek noted the following:

"…based on the subsurface soil conditions and the geomorphology of this area, we suspect that Zone A [the road crossing of Squilchuck Creek] likely represents an earthflow (slope creep) that may potentially be active"

Downstream of this location, relatively low on the opposite slope, an active landslide scarp was identified near the proposed MPR maintenance building site as shown on Figure 4.1.1a. Continued movement of this, or other yet-to-be-observed landslide, can be reasonably expected to move into Squilchuck Creek, block its flow, and damage the utility

corridor. A quantitative analysis of landsliding adjacent to the creek and the corresponding thread to the utility corridor could not be found within the DEIS. No borings, test pits, geophysics, or other investigations has sought to characterize the utility corridor.

The DEIS main text states: “Construction of the Utility Corridor is within the ground and there would be no development on the areas of steep slopes.”

This statement appears to have been prepared without consultation with a geotechnical engineer. Simply installing utilities within the ground, particularly the earthflow and creeping soils identified by GN Northern (2020), is not a mitigation for landsliding. More likely it could be the opposite—particularly in a situation where creeping soils cause water line rupture that saturates soils, induces sliding, and leaves residents without water. This utility corridor should be assessed for stability before assuming that utilities can be installed there.

Construction on and near steep slopes may increase landslide risk, the risk is not quantified, and no viable mitigation is proposed.

The text of the DEIS acknowledges the risk of construction and its potential to increase landslide risk, but does not provide viable solutions that allow the reader to understand how the hazard will be mitigated, if such mitigation is possible, or what would be the environmental impacts of these mitigations. For example, the text states the following:

The DEIS main text states that “Although for the construction that would occur in the bedrock and talus slope it is anticipated that the distribution of the rock would be used to mitigate areas that are more sensitive to slope movement elsewhere at the site.” (DEIS pp 4-10)

While difficult to interpret, this statement suggests an opinion that the developer will be able to stabilize slopes by simply redistributing excess rock material (excavation spoil and talus) around the site to mitigate landslide hazards. This statement is inconsistent with the recommendations of the geotechnical reports provided in Appendix B which note the need for additional field investigation, analysis, and design. The concept to place rockfill buttresses at the toe of steep slopes to improve their stability is valid, in concept, however the very tall and steep slopes of the project cannot be reasonably buttressed. This is because there is no reasonable configuration of buttress construction that could support the proposed roadways and developments. For example, to buttress the proposed access road, which crosses a uniform slope steeper than 40%, it would be necessary to construct a slope buttress on the order of 400 feet in height, and which would bury Squilchuck creek. This is not a reasonable solution and it presents unacceptable environmental impact that is not addressed in the DEIS.

The DEIS seems to acknowledge the hazard exists, but suggests that it can delay assessing the landslide hazard until "project design"

On pp 4-11, the DEIS states the following:

"Due to the risks and uncertainties associated with landslides in and near the Project Area, as well as the size, complexity, and dynamics of the many elements of the Proposed Project (e.g., structures, transportation, utilities, increased population, etc.), Chelan County has determined that a significant adverse impact does exist. This impact may be partially mitigated through additional requirements for geotechnical studies, engineered design, and long-term monitoring."

While this is true, and a regurgitation of GHOD requirements, it suggests that performing further studies and engineering designs will address the landslide hazard. This is naïve to the realities of design and does not address the method of mitigation, its aerial extent, size, environmental impact, level of disturbance, or cost. It is inappropriate to leave these questions unanswered in the DEIS, and it is appropriate for the applicant to complete a feasibility level evaluation be required for the utility corridor, access road, and MPR developments.

The DEIS does not indicate how the access road will cross the active earthflow at the Squilchuck creek crossing

Page 15 of the February 2020 GN Northern Report (DEIS Appendix B) notes that the area of the [Squilchuck] creek crossing may be characterized as a potentially active earthflow (slope creep).

Further, GN Northern states: "Options for the design of the creek crossing structure have not been prepared as of the date of this report. … The borings completed at this location (B-9 & B-10) did not reveal a competent bearing stratum within a depth of 50 feet BGS. Design of a permanent creek crossing structure at this location that will ultimately be used for public access to the expansion area will require additional geotechnical exploration and evaluation/analysis to assess potential slope creep concerns and develop appropriate recommendation for remediation and structure design support."

By these comments alone, the concept for a creek crossing in this area is incomplete. Mitigation of more than 50 feet of creeping active earthflow soils is a major undertaking and likely to have significant environmental impacts that have not been addressed in this DEIS.

The Soils within Squilchuck Creek are likely susceptible to liquefaction and lateral spreading, but they have not been evaluated; groundwater conditions have not been characterized

The DEIS further states that the new Squilchuck creek crossing structure should consider NEHRP Site Class "E," based on an incomplete assessment (field investigatinos extended to a depth of on 50% of the depth required for seismic site characterization as defined by the National Earthquake Hazard Reduction Program (NEHRP). The limited findings of the borings suggest soft, saturated, actively-creeping soil deposits. These are textbook conditions for liquefaction susceptibility and lateral spreading, however, these significant seismic hazards have not been addressed by this report, and no viable concept for a public roadway crossing of Squilchuck Creek is presented. No analysis of liquefaction susceptibility has been presented in the DEIS. Inconsistent with the 2020 GN Northern report, page 4-12 of the main text notes that liquefaction was notecompleted and that the likelihood of liquefaction is low due to the presence of bedrock and depth to groundwater. This rationale is not consistent with the findings of borings B-9 and B-10 which noted wet soils at depths of 4.5 feet.

Despite the know severity of the landslide hazard, and the complex post-landslide topography numerous sag ponds, springs, and intermittent wetlands; no groundwater monitoring instrumentation has been installed to date. Instead, the DEIS relies on the interpreted finding of a single well drilled near the existing lodge to make broad statements about groundwater as being greater than 50 feet deep across the site. This represents a dangerous mischaracterization of site conditions.

Further, GN Northern notes that the eastern portion of the roadway alignment has not been investigated and recommends additional geotechnical evaluations and studies.

The geotechnical reports prepared to support the DEIS have expired and do not meet county criteria:

The GHOD requires that "Geologic site hazards and geotechnical reports, when completed in accordance with this chapter, shall be valid for a period of five years."

The most recent geotechnical report included in the Appendix B of the DEIS (February 2020 report by GN Northern) states the following: "this Report is subject to review and shall not be relied upon after a period of one (1) year from the issued date of the Report."

Global slope stability analyses have errors and are incomplete:

Appendix V of the February 2020 GN Northern Geotechnical report provides the results of slope stability evaluations for the proposed access road for 4 analysis sections (A thru D). Existing and proposed slope cross sections are provided, including a seismic (pseudostatic) analysis case. Notably absent are:

(1) evaluations of the eastern end of the road,

(2) evaluations anywhere within the proposed MPR development,
(3) evaluations of the roadway crossing of Squilchuck creek, and
(4) the slopes above the utility corridor.

Review of the work submitted indicates that the analyses performed address only a portion of the project. Moreover, they are incomplete with respect to the GHOD's explicit requirement to provide a quantitative analysis of slope stability.

There are multiple technical concerns with the manner in which these analyses were performed and documented, as well as the language used to portray these results in the main body of the report (Section 4.1). A detailed complete review appears impossible given the brief summary data submitted, but inferences can be made from the limit equilibrium slope stability analysis outputs presented in Appendix V of the 2020 GN Northern report (Appendix B of the DEIS):

- The subsurface profiles shown in the cross sections are not adequately characterized via subsurface investigations. Each section is represented by a single shallow boring which is then assumed to be representative of the entire slope. This is a tremendous amount of extrapolation.
- The cross sections do not consider the entire height of the slope, rather they consider an approximately 250 foot tall portion of a slope that in actuality is more than 1500 feet in height based upon topography presented in the DEIS. This does not adequately capture the complete driving forces associated with very tall and steep slopes, nor does it capture the potential for true global stability failure surfaces.
- It is apparent from the software outputs that the SLIDE software search routine has been limited by adjustment of the "slope limits" and does not evaluate the true global stability of the proposed roadway for several of the sections. Rather, the search routine only considers the slope above the road, and not the roadway itself, nor the slope below. Many prudent analysis cases appear to be missing, even for the sections that were analyzed.
- For Section D, the proposed retaining wall section is shown to have a factor of safety of 0.76 under static conditions, which represents failure. This is significantly less than the minimum factor of safety of 1.5 typically used for design of retaining walls. GN Northern concludes that a different approach will be necessary to provide a stable roadway here. Table 3 of the 2020 GN Northern Report shows (red text) that for 3 of the 4 cross sections analyzed fail to meet minimum stability criteria.

While the analysis results are reasonably caveated in the limitations section of the GN Northern Report, the main text of the DEIS provides an unrealistic interpretation that the

landslide hazard and slope stability can be reasonably managed through further detailed analysis during the design phase.

In Appendix B, GN Northern states:

“the stability of the existing native slopes typically falls below recommended minimum factors of safety for both static and seismic conditions” (page 10 of the February 2020 report)

Despite the obvious shortcomings of the evaluation methodologies, the analyses do not conclude stability for 3 of the 4 proposed roadway sections. The feasibility of the proposed roadway cross sections has not been demonstrated at this level of DEIS, and the scope of an engineered solution to develop a public roadway in this terrain has not been presented for review. The extents of excavation, fill placement, site clearing, temporary access roads, tie back anchors, drilled piers, or other significant and invasive slope stabilization measures likely to be required in this difficult terrain is unknown at this time, and their corresponding impact on the surrounding environment cannot be reasonably be reviewed for compliance with the GHOD or other criterion.

Recognizing the preliminary nature of this development, the industry-standard approach for a global stability analysis would require a parametric analysis of key variables (e.g. material strength, groundwater levels, material thicknesses) and configurations to develop an understanding of controlling mechanisms for the slope. This should be supported with additional geotechnical data, subsurface investigations, groundwater monitoring, and other means.

Closure

I’d like to thank the County for the opportunity to review this document. I hope that these comments provide some clarity on some of the technical issues associated with the landslide and slope stability hazard. The submitted work is incomplete and does not support the assertions made by the applicant, nor does it align with the established criteria in the Chelan County Code (GHOD, Chapter 11.86). Please do not hesitate to contact me with questions or for clarifications.

Sincerely,

Mark D. Kacmarcik