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November 28, 2006

Shane Sorensen
Alpine City Engineer
20 North Main
Alpine, Utah 84004

Reference: Review of "Geotechnical and geological investigation, Canyon Brooks PUD residential development, Fort Canyon area, Alpine, Utah," IGES, Inc. report of October 19, 2006.

Dear Mr. Sorensen:

In response to your request, we reviewed the geologic aspects of the October 19, 2006, report from IGES, Inc. (IGES, 2006), regarding the proposed Canyon Brook subdivision in the Fort Canyon area of Alpine City. The report is a follow-up to a preliminary geologic hazards assessment of December 2, 2005, by IGES Ingenieros, LLC (IGES, 2005), which we reviewed in our letter of January 11, 2006. The purpose of this review is to assess whether IGES (2006) adequately addressed potential geologic hazards that could affect the proposed development.

IGES has addressed most of our concerns regarding geologic aspects of the development. We recommend that:

- IGES define and map (at a site scale) active channels and sources of alluvial-fan floodwater and sediment for each lot to define where protection is needed and aid in the design of protective measures, in accordance with guidelines in Giraud (2005).

- IGES work closely with the design engineer to provide appropriate geologic parameters, such as a range of alluvial-fan deposit thicknesses, to determine flow depths for the engineering design of alluvial-fan-flood and debris-flow risk-reduction measures.

- The design civil engineer for the subdivision review the adequacy of the stream-flood zone and along with geologists, assess the possibility for channel migration and bank erosion discussed in IGES (2006). Also, if Alpine City participates in the Federal Emergency Management Agency

(FEMA) National Flood Insurance Program (NFIP), the provisions of the NFIP should be met.

- Following the recommendation made in IGES (2005), building-foundation excavations be observed as a prudent precautionary measure for faults mapped nearby by Biek (2005).

- Similar to recommendations made in IGES (2005, 2006), and as stated in our January 11 letter, the effect of landslides on the proposed development be considered if construction is planned on or near steep slopes.

- Geotechnical-engineering aspects of the report regarding earthwork and foundations be reviewed by a qualified engineer.

The preliminary IGES (2005) report identified stream flooding, alluvial-fan flooding, and debris flows as potential geologic hazards at the site, and also recommended the consideration of fault and landslide hazards. Subsequently, IGES (2006) investigated the potential alluvial-fan flooding and debris-flow hazards by excavating seven test pits at the site, which exposed dominantly silty and sandy distal-alluvial-fan deposits. IGES (2006) used this information to characterize the debris-flow hazard as low and the alluvial-fan flooding hazard as moderate, and recommended engineered grading plans and diversion structures to reduce the alluvial-fan-flooding risk. However, the area is geologically complex, with each lot located on a different and sometimes multiple, coalescing alluvial fans. Thus, we recommend that IGES define and map (at a site scale) active source channels for the alluvial fans to determine where grading and diversion structures are needed and work with design engineers to determine design parameters for protective structures, in accordance with guidelines in Giraud (2005). Also, care must be taken to ensure that measures taken at one lot do not increase the hazard at another lot.

Additionally, IGES (2006) suggested that the alluvial-fan deposits were deposited in "layers less than 1 foot [30 cm] thick;" however, with the exception of test pit 5, IGES did not include individual deposit thicknesses on their test-pit logs to support their conclusion regarding layer thicknesses, which are critical to design. Thus, we also recommend that IGES work closely with the design engineer to provide appropriately prudent geologic parameters, such as a likely range of alluvial-fan deposit thicknesses to determine flow depths, for the engineering design of grading plans and alluvial-fan-flood and debris-flow diversion structures.

Stream-flooding hazards, including the possibility of lateral stream-channel migration, exist at the site due to the potential for flooding along Fort Canyon Creek (IGES, 2005, 2006). IGES (2005, 2006) cited a 100-foot-wide stream-flood zone determined by Alpine City, and recommended that the design civil engineer for the subdivision review the adequacy of the stream-flood zone and the possibility of channel migration, and we concur. We recommend that geologists participate in

the assessment of the potential for channel migration and bank erosion. Also, if Alpine City participates in the Federal Emergency Management Agency (FEMA) National Flood Insurance Program (NFIP), the provisions of the NFIP should be met.

Biek (2005) shows faults that trend toward, but are not mapped within, the subdivision site. Although these faults show no evidence for Quaternary movement, IGES (2005) considered them to be a potential hazard and recommended that building-foundation excavations be observed for faults. However, this recommendation was not repeated in IGES (2006). As stated in our January 11 letter, we believe the recommendation made in IGES (2005) to observe the excavations is a prudent precautionary measure.

IGES (2005) recommended the evaluation of potential landslide hazards at the site. Although Biek (2005) does not show existing landslide deposits in the area and IGES (2006) did not observe any evidence for landsliding in the field, IGES (2006) recommended the consideration of "the effect that the proposed development might have on slope stability." We concur, and as stated in our January 11 letter, recommend that the effect of landslides on the proposed development be considered if construction is planned on or near steep slopes.

In addition to the specific geologic-hazards recommendations given above, we also recommend that:

- The existence of the IGES (2005, 2006) reports, our January 11 letter, this review, and any future geotechnical and/or geologic-hazard reports and reviews be disclosed to potential buyers.

- The developer submit to Alpine City written documentation from the geotechnical consultant indicating that their recommendations were followed.

Conclusions and recommendations in this letter are based on data presented in IGES (2005, 2006). The Department of Natural Resources, Utah Geological Survey (UGS), provides no warranty that the data in IGES (2005, 2006) are correct or accurate, and has not done an independent site evaluation. Recommendations in this review are provided to aid Alpine City in reducing risks from geologic hazards, but the Utah Geological Survey makes no warranty, expressed or implied, and shall not be liable for any direct, special, incidental, or consequential damages with respect to claims by users of this review.

Please contact me (christopherduross@utah.gov; 801-537-3348) or Gary Christenson (garychristenson@utah.gov; 801-537-3304) if you have any questions.

Sincerely,

Christopher B. DuRoss

Gary E. Christenson

Attachment

Attachment - References

Biek, B.F., 2005, Geologic map of the Lehi quadrangle and part of the Timpanogos Cave quadrangle, Salt Lake and Utah Counties, Utah: Utah Geological Survey Map 210, scale 1:24,000, 2 pl.

Giraud, R.E., 2005, Guidelines for the geologic evaluation of debris-flow hazards on alluvial fans in Utah: Utah Geological Survey Miscellaneous Publication 05-6, 16 p.

IGES Ingenieros, LLC, 2005, Preliminary geologic hazards assessment, Canyon Brook PUD, Alpine, Utah: Bluffdale, Utah, unpublished consultant's report, variously paginated.

IGES, Inc., 2006, Geotechnical and geologic investigation, Canyon Brooks PUD residential development, Fort Canyon area, Alpine, Utah: Bluffdale, Utah, unpublished consultant's report, variously paginated.