Job No. 186449

October 29, 2021

Mike Rice
Paramount Homes
1905 Diamond Creek Drive
Colorado Springs, CO 80921

Re: Geologic Hazard Study
345 Earthsong Way
Site S-306(R), Crystal Park, Filing No. 2
El Paso County, Colorado

Dear Mr. Rice:

This report presents the findings of an evaluation performed by RMG – Rocky Mountain Group of the above-referenced site in El Paso County, Colorado. The purpose of our report is to evaluate the site conditions and present our opinions of the observed conditions on the proposed development with respect to the intended usage.

Revisions and modifications to the conclusions and recommendations presented in this report may be issued subsequently by RMG based upon additional observations made during grading and construction (which may indicate conditions that require re-evaluation of some of the criteria presented in this report) and/or upon receipt of review comments from El Paso County and/or any third-party reviewing agencies.

Qualifications of Preparers

This Geologic Hazard Study was prepared by a professional geologist as defined by Colorado Revised Statures section 34-1-201(3) and by a qualified geotechnical engineer as defined by policy statement 15, "Engineering in Designated Natural Hazards Areas" of the Colorado State Board of Registration for Professional Engineers and Professional Land Surveyors. (Ord. 96-74; Ord. 01-42)

The principle investigators for this study are Kelli Zigler, P.G. and Tony Munger, P.E. Ms. Zigler is a professional Geologist with over 20 years of experience in the geological and geotechnical engineering field. Ms. Zigler holds a Bachelor of Science in Geology from the University of Tulsa. Ms. Zigler has supervised and performed numerous geological and geotechnical field investigations in Colorado. Tony Munger is a licensed professional engineer with over 20 years

of experience in the construction engineering (residential) field. Mr. Munger and holds a Bachelor of Science in Architectural Engineering from the University of Wyoming.

Existing and Proposed Land Use

The site is to consist of an approximately 30,544 square foot parcel zoned as "PUD" Planned Unit Development per El Paso County zoning. The proposed land use is to create an approximately 0.70 acre single-family parcel known as Site S-306(R) within the Crystal Park subdivision.

Project Description

It is our understanding that the proposed development of this site is to consist of the construction of a single-family dwelling with an on-site wastewater treatment system and well. This geologic hazards study was performed to evaluate geologic conditions that may impact the proposed development and provide recommendations for mitigation and design for residential construction.

Site Evaluation Techniques

The information included in this report has been compiled from

1. Field reconnaissance
2. Geologic maps
3. Review of previous reports performed by RMG in the same subdivision
4. Available aerial photographs
5. Geologic research and analysis
6. Site development plans prepared by others

Geophysical investigations were not considered necessary for characterization of the site geology.

Previous Studies and Field Investigations

Reports of previous geotechnical engineering/geologic investigations specifically addressed to this site were available for our review and are listed below:

1. *Soils Report, Filing #2, Crystal Park Subdivision, 306 Earthsong Way, El Paso County, Colorado*, prepared by Geoquest, LLC, Job #21-0480, dated May 26, 2021.

Site Conditions

We performed a site visit for field reconnaissance on October 21, 2021. At the time of the field reconnaissance, the site consisted of vacant land under development and is generally located about 1.3 miles from Crystal Park entrance in El Paso County, Colorado. The driveway was cut in and cleared. The driveway leads to a narrow building site. The ground surface within the proposed building area was cleared of vegetation. The ground surface surrounding the building area consisted of scrub oak, tall grasses, weeds, moderate- to high-growth coniferous trees, aspens, and

boulders. Topographically, the slopes immediately above and below the footprint of the proposed residence ranged between 35 and 70 percent. Slopes across the remainder of the site were generally sloping down to the east and south. The site has generally good drainage in the form of surface sheet flow directed to the east and south. Surficial soil erosion was evidenced northwest of the proposed residence location along Crystal Park Road.

General Geology

Based upon mapping presented by the Colorado Geological Survey (CGS) ([1]Keller et al, 2003), the bedrock underlying the subject site is comprised of the Pikes Peak Granite, geologic map unit Ypp. Pikes Peak Granite is comprised of light gray to pink and reddish-brown, coarse-grained, porphyritic granite. The Pikes Peak Granite often produces grus (disaggregated loose masses of constituent minerals) when weathered. Grus can accumulate to thicknesses as much as 150 feet, and develop first along joints in the granite. Resistant outcrops typically are round and bouldery and may be seen in many road cuts in the area. The principal minerals composing the Pikes Peak Granite are perthitic microcline, quartz, biotite and plagioclase (oligoclase). The depth of weathering and thickness of grus in the area near the site is generally 20 to 100 feet thick on north-facing hillslopes and 10 to 13 feet thick on south-facing hillslopes.

The surficial deposits observed during our site visit consisted primarily of decomposed granite and gravel rock fragments of the Pikes Peak Granite. Pikes Peak Granite is the most abundant of the intrusive rock types that can be found across the Manitou Springs Quadrangle area. Evidence of natural rockfall or debris flow deposits was not observed in the vicinity of the building site.

The site is located in the vicinity of the Ute Pass Fault zone (to the east). The Ute Pass Fault is located approximately one mile to the east of the site. According to information presented by the CGS ([2]Kirkham et al, 2004-2007), several earthquakes have occurred in the vicinity of the Ute Pass Fault near Colorado Springs and Woodland Park. The earthquakes, with magnitudes in the range of 3.0 to 3.9, occurred approximately from 1962 to 2007.

Subsurface Materials

Based on the review of the Geoquest *Soils Report* referenced above, two test borings were performed on April 29, 2021. The test borings encountered decomposed granite (classified as silty sand-SM) extending to the 15-foot termination depth of the test borings. Groundwater was not discussed in the referenced report.

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[1] Keller, John W., Siddoway, Christine, Morgan, Matthew L., Route, Erik E., Grizzell, Matthew T., Sacerdoti, Raffaello, and Stevenson, Adair, 2003 ***Geologic Map of the Manitou Springs Quadrangle, El Paso and Teller Counties, Colorado,*** Colorado Geological Survey, Open File Map 03-19.

[2] Kirkham, R. M., Rogers, W. P., Powell, L., Morgan, M. L., Matthews, V., and Pattyn, G. R., 2004-2007, ***Colorado Earthquake Map Server.*** Colorado Geological Survey Bulletin 52b.

http://geosurvey.state.co.us/Default.aspx?tabid=270

BEARING OF GEOLOGIC FACTORS UPON PROPOSED DEVELOPMENT

General Geologic Conditions

Based upon our evaluation of the geologic conditions, it is our professional opinion that the proposed residential development is feasible. The geologic hazards identified are not considered unusual for mountainous regions of Colorado. Mitigation of geologic hazards is most effectively accomplished by avoidance. However, where avoidance is not a practical or acceptable alternative, geologic hazards should be mitigated by implementing appropriate planning, engineering, and local construction practices.

Potentially Unstable Slopes

Unstable slopes or apparent signs of ongoing slope movement were not observed on the property. Visible evidence of slope movement was not observed on the site. Coniferous trees and native vegetation local to the area showed no obvious signs of slope movement (such as "pistol-butting", scarps, etc.).

Based on Google Earth Pro aerial imagery, it appears that the gravel road for Earthsong Way was constructed around 2004. The driveway cut for the current project is a continuation of the grading done for the initial road. The cut slope along the driveway ranges from approximately 4 feet to 9 feet in height. The driveway for the site has been cut in, leading down to the footprint of the proposed residence. A reconnaissance of the site revealed that the cuts into the slope above the driveway are about 1:1.

Areas exposed by the cut slopes created by the grading of the driveway revealed root systems that are holding the soil in place beneath the surface layer. Low plants on these slopes provide ground cover from wind and the taller, moderate- to high-growth trees should reduce the force of precipitation before it hits the ground.

Raveling, a process of the detachment of soil particles or rock fragments from slopes, has resulted in an accumulation of decomposed granite and gravel fragments at the bottom of the cut slopes. Evidence of raveling can be seen in Appendix A, Site Visit Photos. However, the raveling encountered on the site was relatively limited to the areas exposed to surficial weathering. The more recently exposed areas (the driveway, the proposed building "pad", and the wastewater treatment area) were found to be relatively intact bedrock.

Due to the nature of the bedrock encountered at the site and the heavily vegetated slopes above and below the immediate area surrounding the site, the potential for relatively rapid downslope movement at the site is considered to be low. It is also our opinion that the risk of landslide activity on this lot is no greater than the risk on surrounding lots within the same development. The risk of destabilization of localized slopes above or below the home is a permanent risk, and one that may be adversely affected by factors outside the control of the owner or resident of the subject

property. The mitigation recommendations presented herein for the proposed residence are not intended to resist lateral ground movements related to landslides.

Downslope Creep

Downslope creep, which is the slow downslope movement of superficial soil and rock materials, is common to the area. The structural design of the residence should consider its placement on the hillside and the additional surcharge pressures that could be generated by downslope creep and by retaining upslope materials.

It is also recommended that the foundation be designed with additional rigidity to help reduce the effect of potential lateral movement of subsurface soils. This may include (but is not limited to) the use of tie beams, counterforts, and added reinforcing to help the foundation move as a unit. This approach should reduce potential cracking and damage resulting from differential movement within the foundation system and super structure.

Rockfall

The subject site does have a steep slope to the north (uphill) of the proposed build area above the cut for the driveway. The slope to the south (downhill) of the proposed home is also steep. The slope to the north does have large boulders, but it is our understanding that they are to be removed during the construction phase of the site development. Once the proposed mitigation has been implemented, the subject property is not considered to be prone to rockfall.

Debris Flows and Debris Fans

Terrain features consistent in the formation of debris flows and debris fans are not present in the vicinity of the property.

Seismicity

The Pikes Peak Regional Building Code, 2017 Edition, indicates maximum considered earthquake spectral response accelerations of 0.185g for a short period (S_s) and 0.059g for a 1-second period (S_1). Based on the results of our experience with similar subsurface conditions, we recommend the site be classified as Site Class B, with average shear wave velocities ranging from 2,500 to 5,000 feet per second for the materials in the upper 100 feet.

Specific recommendations should be provided by the Geotechnical Engineer of Record during the design phase of the project.

Surface Drainage and Erosion

The permeability of the decomposed granite at the site is generally considered to be high. Surface runoff could also be rapid and the potential for rapid erosion of unvegetated slopes could be high. Long-term slopes should not be steeper than 3:1 (horizontal:vertical) in both cut and fill areas. Revegetation of any disturbed areas should be performed as soon as possible with

revegetation/erosion mats placed as required. Excavation cuts and soil disturbance should be kept to a minimum. Proper surface drainage, as recommended in the soils report referenced above, should be provided and maintained by the Homeowner.

Radioactivity/Radon Gas

Based upon a Map of Radon Zones by the Colorado Department of Public Health and Environment (CDPHE) (Ref. 11), two zones of radon potential are indicated in Colorado, Zone 1 - High Radon Potential (probable indoor radon average >4 pCi/L) and Zone 2 -Moderate Radon Potential (probable indoor radon average 2-4 pCi/L). El Paso County is located within Zone 1.

Potential radon hazards are best mitigated at the building design and construction phases. Providing increased ventilation of basements, crawlspaces, creating slightly positive pressures within structures, and sealing of joints and cracks in the foundations and below-grade walls can help mitigate radon hazards.

Closing

This report has been prepared for the exclusive purpose of providing geologic hazards information and recommendations for development described in this report. RMG should be retained to review the final construction documents prior to construction to verify our findings, conclusions and recommendations have been appropriately implemented.

This report has been prepared for the exclusive use by the Client for application as an aid in the design and construction of the proposed development in accordance with generally accepted geotechnical and geological engineering practices. The analyses and recommendations in this report are based in part upon data obtained from site observations and the information presented in referenced reports. The nature and extent of variations may not become evident until construction. If variations then become evident, RMG should be retained to review the recommendations presented in this report considering the varied condition, and either verify or modify them in writing.

Our professional services were performed using that degree of care and skill ordinarily exercised, under similar circumstances, by geotechnical engineers practicing in this or similar localities. RMG does not warrant the work of regulatory agencies or other third parties supplying information which may have been used during the preparation of this report. No warranty, express or implied, is made by the preparation of this report. Third parties reviewing this report should draw their own conclusions regarding site conditions and specific construction techniques to be used on this project.

The scope of services for this project does not include, either specifically or by implication, environmental assessment of the site or identification of contaminated or hazardous materials or conditions. Development of recommendations for the mitigation of environmentally related conditions, including but not limited to biological or toxicological issues, are beyond the scope of this report. If the Client desires investigation into the potential for such contamination or conditions, other studies should be undertaken. If we can be of further assistance in discussing the

contents of this report or analysis of the proposed development, from a geotechnical engineering point-of-view, please feel free to contact us.

Cordially,

RMG – Rocky Mountain Group

Kelli Zigler

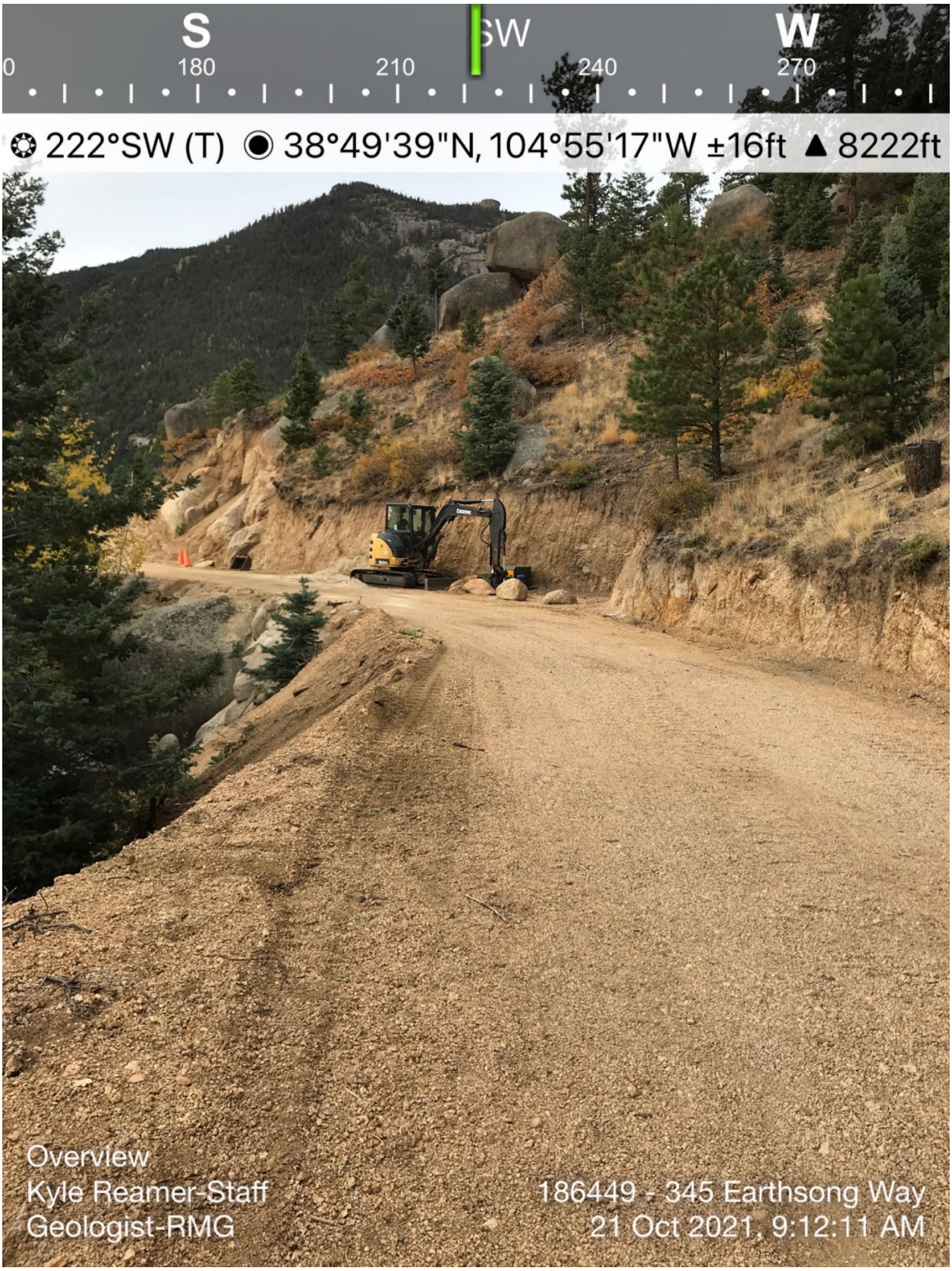
Kelli Zigler
Project Geologist

Reviewed by,

RMG – Rocky Mountain Group

COLORADO REGISTERED
ANTHONY P. MUNGER
10/29/21
39818
PROFESSIONAL ENGINEER

Tony Munger, P.E.
Geotechnical Project Manager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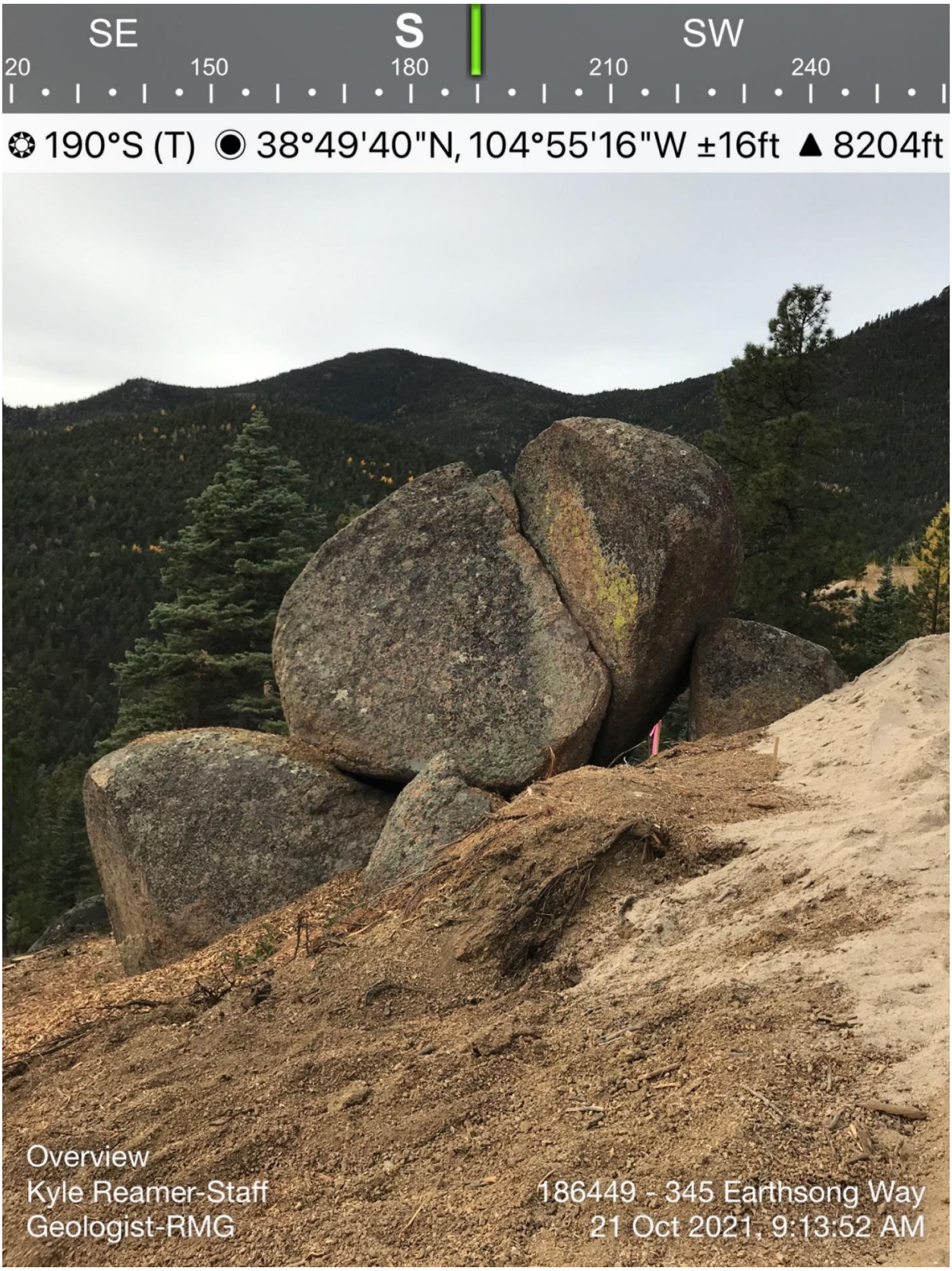
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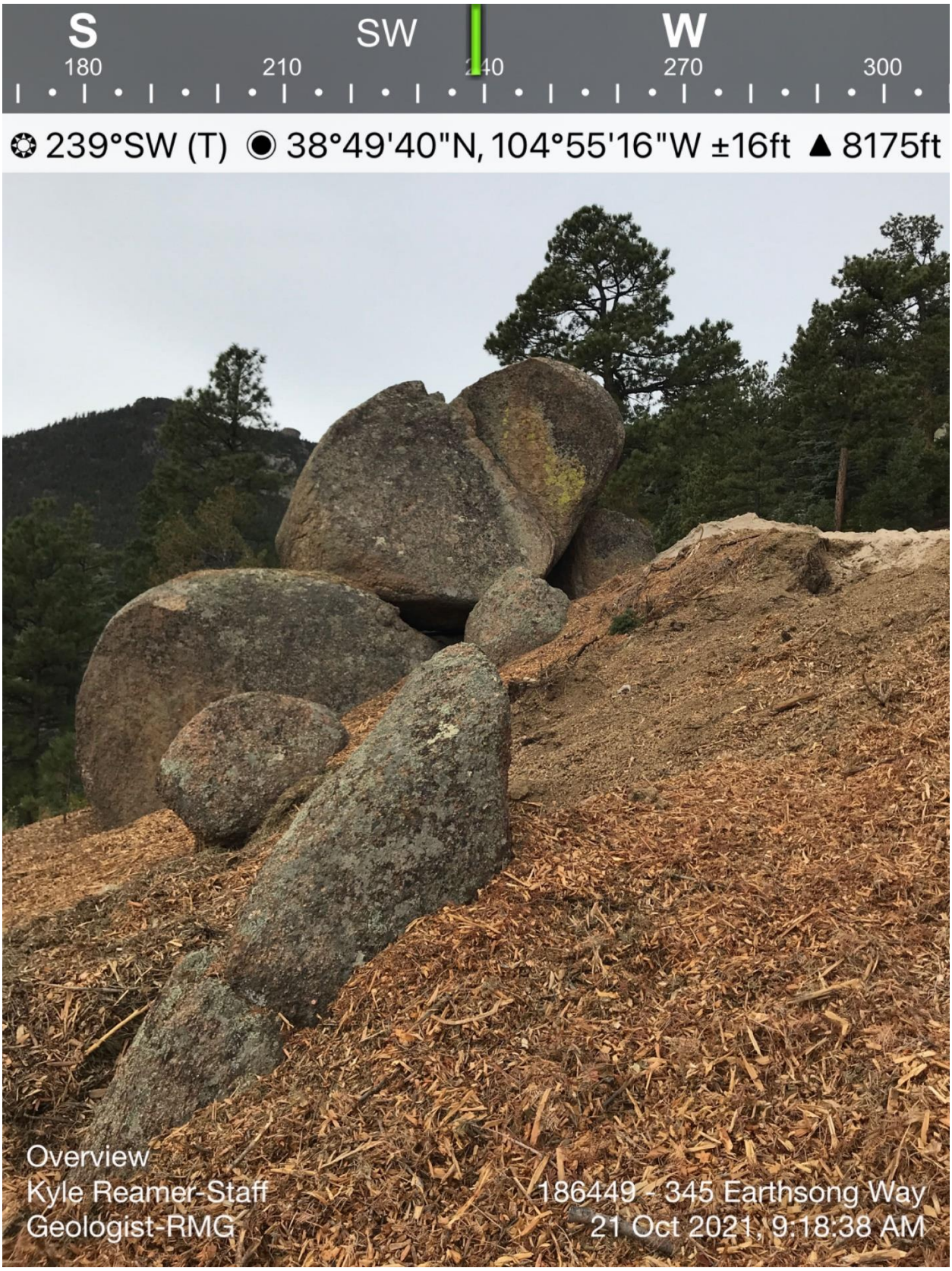
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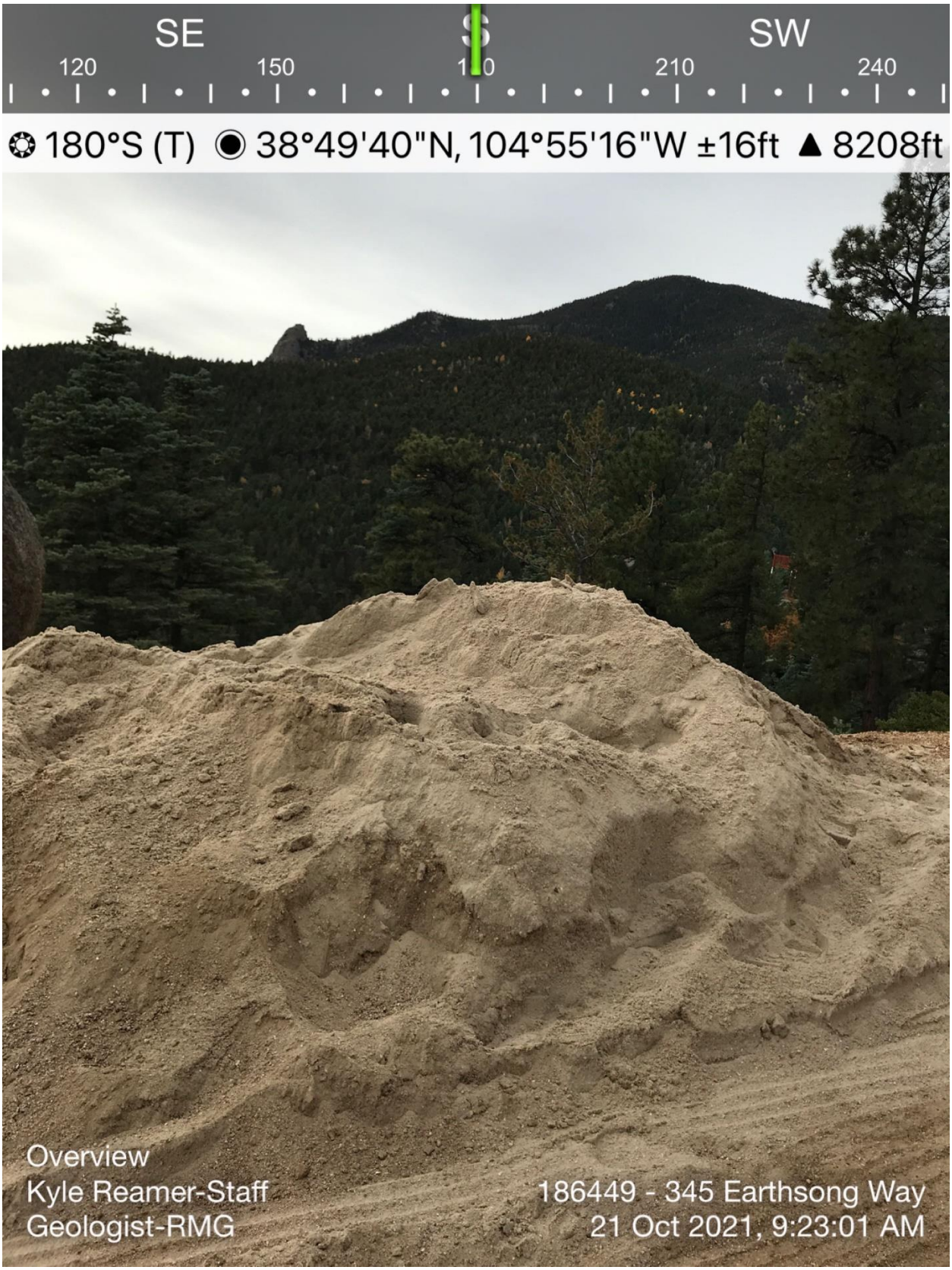
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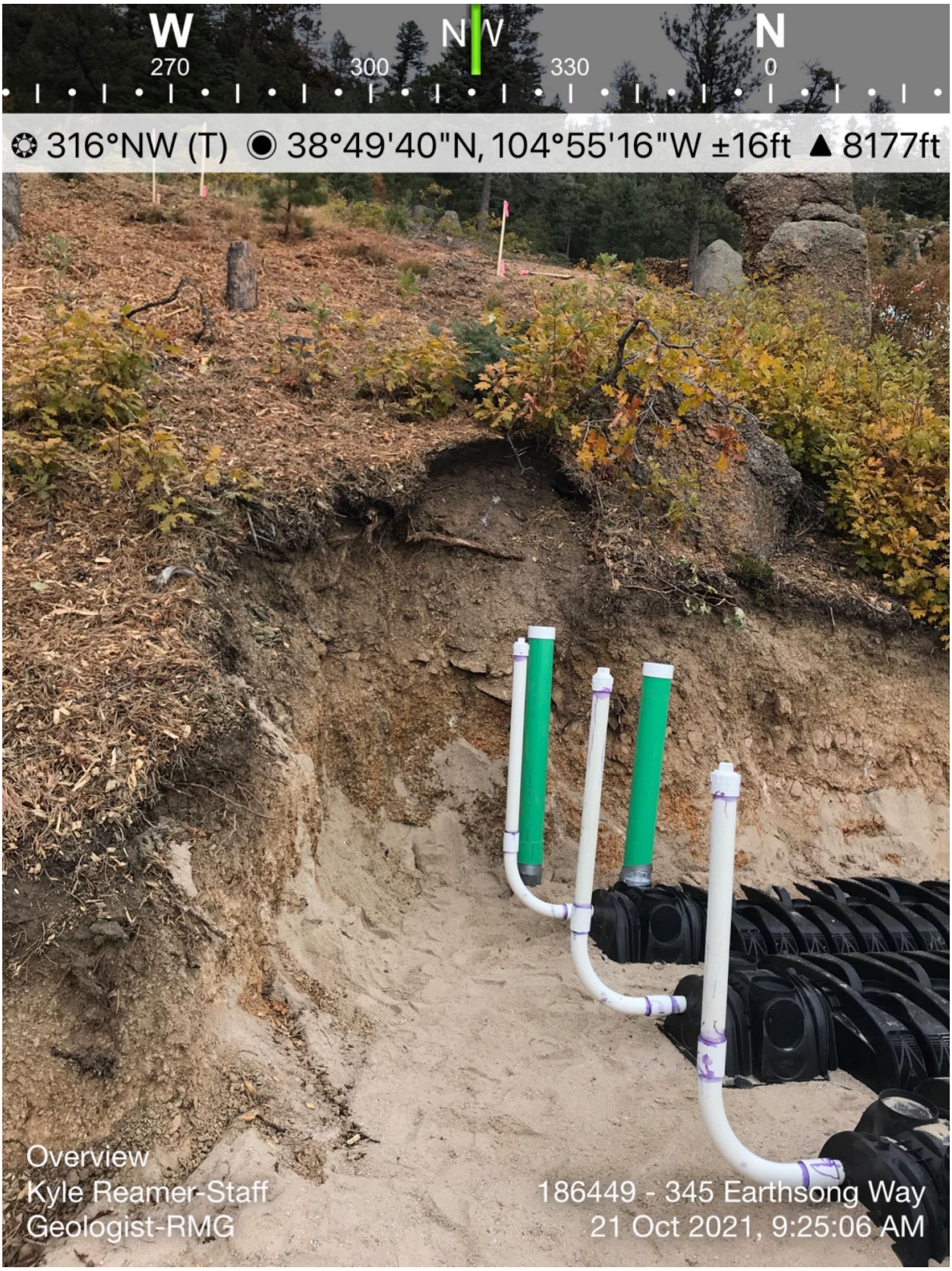
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Geologist-RMG
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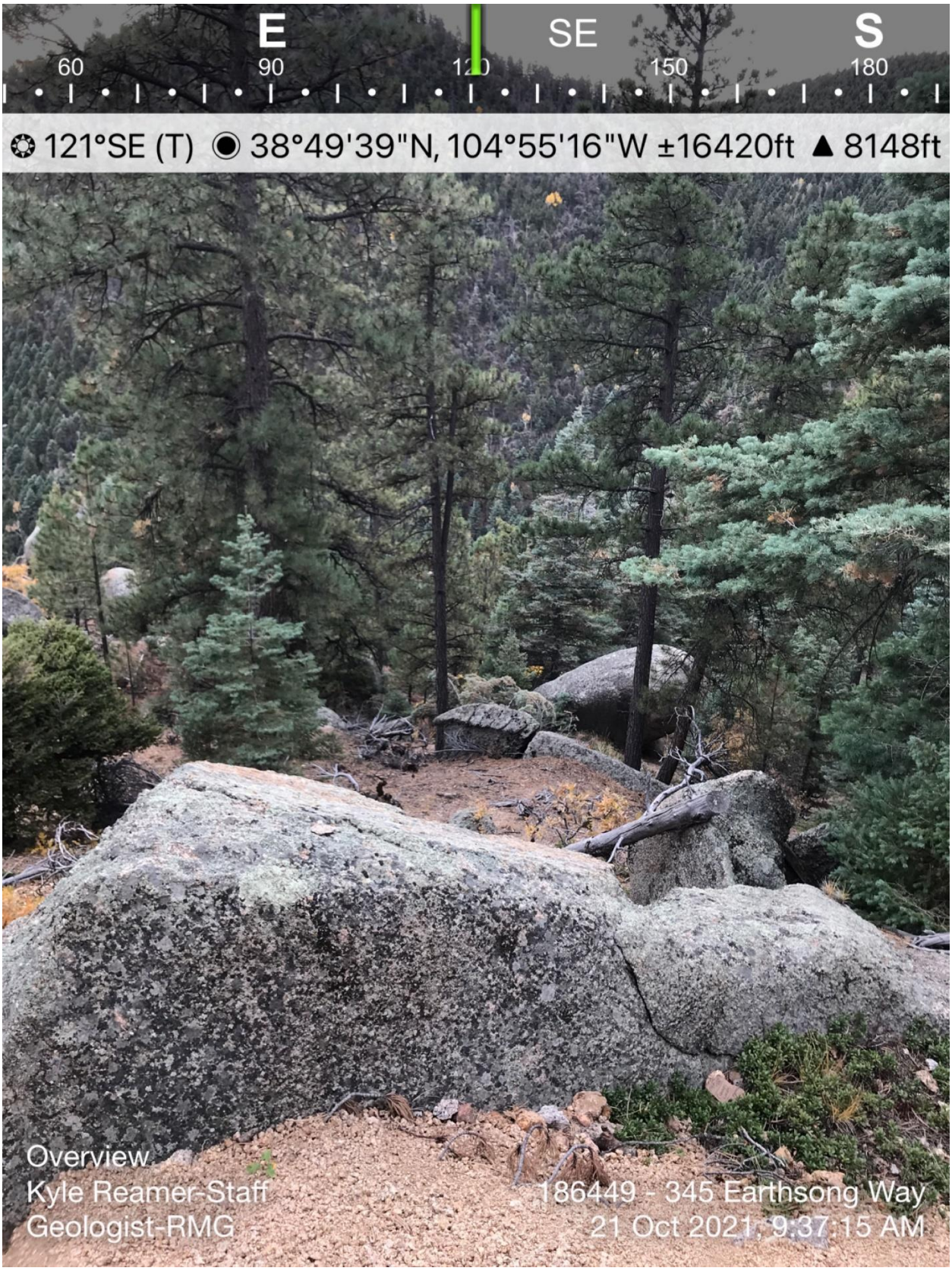
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