ENTECH
ENGINEERING, INC.

505 ELKTON DRIVE
COLORADO SPRINGS, CO 80907
PHONE (719) 531-5599
FAX (719) 531-5238

December 2, 2021
Revised March 2, 2022

Tuscany Homes
1825 Austin Bluffs Parkway, Suite 100
Colorado Springs, Colorado 80918

Attn: Stan Campbell

Re: Geologic Hazard Investigation
Tax Schedule No. 74080-00-074
570 Day Spring View
Site S-309 Addition to Crystal Park Subdivision No. 2
Manitou Springs, Colorado

Dear Mr. Campbell:

The report was revised in response to the site review conducted by the Colorado Geological Survey (CGS), January 18, 2022 (Reference 3). The CGS review letter is included in Appendix C.

As requested, personnel of Entech Engineering, Inc. have investigated the above-referenced site to evaluate the conditions with respect to geology and geologic hazards affecting development of the site. The site is located south of the intersection of Railroad Grade Road and Crystal Park Road and Crystal Park Road and Day Spring View in the western portion of El Paso County, Colorado. The approximate location of the site is shown on the Vicinity Map, Figure 1.

The site is located in a portion of the SW¼ of the SW¼ of Section 8, Township 14 South, Range 67 West, of the 6th Principal Meridian in Colorado Springs, Colorado. The topography of the site is moderately to steeply sloping to the east with the steeper slopes located along the driveway cuts on the site. Drainages were not observed on the site. Vegetation observed on site consisted of scrub oak and conifers with an understory/open areas of native grasses, weeds, yucca, and other wooded bushes. The approximate location of the site is shown on the USGS Map, Figure 2. Site photographs taken August 27, 2021 are included in Appendix A. The locations and directions of these photographs are indicated on the Site Plan/Test Boring Location Map, Figure 3.

The site is zoned as PUD (Planned Urban Development). The site does not lie within the Hillside Overlay (Reference 1). However, very steep slopes were encountered on this site. At the time of our site investigation the site was undeveloped with an existing driveway and a small area cleared for drilling access. The proposed project is to consist of the construction of a single-family residence on a 30,492-sqft lot. The structure is proposed in the northwestern portion of the lot. The Site Plan/Test Boring Location Map is presented in Figure 3.

The scope of this report will include a geologic analysis of the site utilizing published geologic data, subsurface soils information and site-specific mapping of major geologic features, and identification of geologic hazards with respect to proposed development with recommended mitigation techniques.

PREVIOUS INVESTIGTATIONS

A Subsurface Soil Investigation was performed by Entech Engineering, Inc., revised date December 2, 2021 (Reference 2, Appendix B). This investigation consisted of drilling two (2) test borings, on the site, and collecting a grab sample from one proposed boring locations. The test

boring locations are indicated on Figure 3. Test Borings Logs and Laboratory Test Results are included with the report in Appendix B. Information from this reports was used in evaluating the site.

GEOLOGIC CONDITIONS

The geology of the site was evaluated using a *Subsurface Soil Investigation* by Entech Engineering, Inc. dated September 14, 2021, (Reference 2), the *Geologic Map of the Manitou Springs Quadrangle* by Keller, *et al,* 2003 (Reference 4, Figure 4), the *Reconnaissance Geologic Map of Colorado Springs* by Scott and Wobus, 1973 (Reference 5), the *Geologic Map of Colorado Springs – Castle Rock Area* by Trimble and Machette, 1979 (Reference 6), and site-specific mapping of the site. The Geology Map prepared for the site is presented in Figure 5.

Approximately ½ mile to the northeast of the site is a major structural feature known as the Ute Pass Fault. This fault marks the boundary between the Great Plains Physiographic Province and the Southern Rocky Mountain Province. The site exists within the western portion of the structural feature known as the Ancestral Front Range Uplift. The bedrock in this area is igneous in nature, and typically Middle Proterozoic in age. One mappable unit was identified on this site which is described as follows:

Ypp **Pikes Peak Granite of Middle Proterozoic Age:** This material consists of coarse-grained red to brown biotite-hornblende granite associated with the Pikes Peak batholith. These rocks are formed in an intrusive igneous environment and are generally massive and homogeneous with frequent join planes and weathered to a coarse grained, granular material called grus.

The soils encountered in the test boring consisted of thin layer of silty sand overlying decomposed granite bedrock. The soils were encountered at medium dense to very dense states and moist to dry conditions. Bedrock was not encountered in the test borings, which were drilled to 20 feet below ground surface (bgs).

Groundwater was not encountered in the test borings which were drilled to 20 feet. Fluctuations in groundwater conditions may occur due to variations in rainfall or other factors not readily apparent at this time. Contractors should be cognizant of the potential for the occurrence of subsurface water features during construction.

ENGINEERING GEOLOGIC HAZARDS

The geologic hazards identified on this site include downslope creep and potentially unstable slopes which are indicated on the Geology/Engineering Geology Map, Figure 5. In accordance with the Geologic Hazards Ordinance of El Paso County, the following geologic hazards have been addressed:

Expansive Soils

The site is classified in an area of low swell potential according to *the Map of Potentially Swelling Soil and Rock in the Front Range Urban Corridor, Colorado* by Hart, 1974 (Reference 7). Expansive soils were not encountered in the test borings drilled on–site.

Loose or Collapsible Soils

Loose or collapsible soils were not encountered in the test borings. Any loose or collapsible soils encountered beneath the foundation or floor slab will require mitigation.

Mitigation:

Any loose or collapsible soils encountered beneath the foundation or floor slab should be overexcavated, moisture-conditioned and recompacted. The soils should be recompacted to 95 percent of the soils maximum Modified Proctor Dry Density ASTM D-1557 at ± 2 percent of optimum moisture content. The reconditioned soils on this site should be observed and tested to verify adequate compaction. Areas requiring recompaction should be determined during the excavation observation.

Artificial Fill

Artificial fill was not observed on the site.

Landslide Hazard and Slope Stability

No signs of slope failures or landslides were observed on the site. The site generally slopes moderately to steeply to the northeast and the site has been mapped with downslope creep and potentially unstable slope hazards. The majority of the site has been mapped as downslope creep and areas mapped as potentially unstable along portions of the driveway cut. These areas are further discussed in the following sections.

- *Downslope Creep and Potentially Unstable Slope Areas*

  The areas identified with this hazard include the majority of the site as shown on Figure 5. No signs of recent slope failures were observed on the site. In these areas of downslope creep, we would anticipate lateral and vertical movement of the near surface soils in the downslope direction. Additionally, areas along the driveway cut have been identified as potentially unstable slopes. The design of foundations in these areas should account for this additional pressure. A typical lateral pressure diagram is included in Figure 6. Additionally, the foundation should be designed to withstand pressures where steeper areas slope away from the foundation. These areas are acceptable as building sites with the following constraints on construction.

  Mitigation:

  Building is possible in these areas if the following engineering and construction mitigation steps are taken. This type of movement will increase lateral pressures against foundation walls on the uphill side of structures. The design of foundations in these areas should account for this additional pressure. A typical lateral pressure diagram is included in Figure No. 6. Additionally, the foundation should be designed to withstand pressures where steeper areas slope away from the foundation. Tie beams and buttresses are recommended to stiffen the foundation system. We recommend stepping the foundation down in the area of the moderate to steep slopes. Cuts should be avoided on the potentially unstable slope unless specifically analyzed for slope stability and held by engineer-designed retaining walls. This includes cuts made for landscaping and terracing. Proper control of drainage at both the surface and in the subsurface is important. Saturation of materials should be avoided that may create unstable conditions. Areas of ponded water should be avoided. Utility trenches and other subsurface features should not be permitted to become water traps which may promote saturation of

subsurface materials. Xeriscape landscaping is recommended to reduce the need for additional irrigation.

- *Slope Stability Analysis*
  Slope Stability Analyses were conducted utilizing the GSTABL7 computer program to evaluate the stability of the proposed structure. The sections analyzed (A-A' and B-B') are shown on the Slope Stability Section Map, Figure 7. Slope stability analysis results are included in Appendix D. The sections were analyzed for the existing and proposed conditions with an elevated water table. Soil strength values used for the program were as follows.

	Angle of Internal Friction (degrees)	Cohesion (psf)
Decomposed Granite	40	0

Soil strength values were assumed values based on similar soils in the area.

Factors of safety were calculated by the Modified Bishop Method for Circular Failure Surfaces. The slope profile was constructed with the soil types encountered in the test borings from the subsurface soil investigation and observations on the slopes above the test borings. Although groundwater was not encountered, groundwater levels were evaluated in accordance with levels that may be anticipated in the area and also for sensitivity analysis. Structural loads from the proposed home were used in the analysis.

Figure No.	Section	Analysis	Water Table	F.O.S	Description
D-1	A-A'	Existing (Circular)	High	0.8	Initiation and termination points of analysis modified to encompass existing slope. Circular failure surface analyzed.
D-2	A-A'	Proposed (Circular)	High	1.5	Initiation and termination points of analysis modified to encompass proposed building cut/pad. Circular failure surface analyzed. [1, 2, 3]
D-3	B-B'	Existing (Circular)	High	1.6	Initiation and termination points of analysis modified to encompass existing slope. Circular failure surface analyzed.
D-4	B-B'	Existing (Circular)	High	1.8	Initiation and termination points of analysis modified to encompass existing slope. Circular failure surface analyzed.
D-5	B-B'	Proposed (Circular)	High	1.6	Initiation and termination points of analysis modified to encompass proposed building cut/pad. Circular failure surface analyzed. [1, 2, 3]
D-6	B-B'	Proposed (Circular)	High	1.6	Initiation and termination points of analysis modified to encompass proposed building cut/pad. Circular failure surface analyzed. [1, 2, 3]

[1] – Proposed house with stiffened foundation.
[2] – Foundation on the eastern side of the structure immediately upgradient of slope must be embedded a minimum of 8' below existing grade.
[3] – 14' maximum allowable cut into existing slope.

Based on our drilling, the probability of groundwater up to the excavation level is considered low provided surface and subsurface drainage systems are maintained. A factor of safety of 1.5 is recommended for slopes with permanent structures. Slope stability analysis results are included in Appendix D

Erosion
The surficial soils on this site are prone to erosion without proper mitigation. Erosion control blankets are recommended to help re-establish vegetation in disturbed areas. The soils on the slopes and driveway are subject to future erosion and should be mitigated with adequate slope and erosion protection. A North American Green RollMax VMAX or equivalent erosion control product should be considered.

Debris Fans
Based on site observations, recent debris fans were not observed in the area.

Subsidence
Based on a review of a Subsidence Investigation Report for the Colorado Springs area by Dames and Moore, 1985 (Reference 9), the site is not undermined. The closest underground mines in the area are approximately 7 miles to the northeast and the area is not mapped within any potential subsidence zones.

Groundwater
Groundwater was not encountered in the test borings which were drilled to 20 feet. Shallow groundwater is not expected to affect shallow foundations on site, however, fluctuation in groundwater conditions may occur due to variations in rainfall and other factors not readily apparent at this time. Isolated sand layers within the variable soil profile, sometimes only a few feet in thickness and width, can carry water in the subsurface. Builders should be cognizant of the potential for the occurrence of such subsurface water features during construction on-site.

Floodplain and Drainage Areas
The site does not lie within any floodplains according to the FIRM Map, No. 08041CO708G (Reference 10, Figure 7). Any site grading considered should be modified to direct surface flows around the structures or roads and carried off-site so as to not produce any areas of ponded water. Drainage studies are beyond the scope of this report.

Faults
The closest known fault is the Ute Pass Fault, located approximately ½ mile to the northeast of the site. Several faults associated with the Ute Pass Fault exist in the area, but no faults are mapped on the site itself. Previously, Colorado was mapped entirely within Seismic Zone 1, a very low seismic risk. Additionally, the Uniform Building code (UBC), 1997 currently places this area in Seismic Risk Zone 1. According to a report by the Colorado Geological Survey by Robert M. Kirkman and William P. Rogers, Bulletin 43 (1981) (Reference 11), this area should be

designed for Zone 2 due to more recent data on the potential for movement in this area, and any resultant earthquakes.

Rockfall Hazard

Areas on the site have been identified as having potential rockfall hazards. In these areas, granite outcrops which have the potential and boulders are exposed and produce boulder and cobble size talus are located upslope of the proposed structure. Based on site observations it appears the majority of the potential source areas are stable in their present condition with only smaller 3 to 4-inch sized loose rocks observed on the slope and do not pose a significant rockfall hazard. No recent dislodged rocks were observed in the proposed building area or upslope of the proposed building area. Due to the potential for the smaller 3 to 4-inch sized rocks to become dislodged windows are not recommended on the upslope side of the structure within 4-feet of exterior grade.

Mitigation: We recommend stabilization by removal of smaller loose rocks, often referred to as scaling. Any scaling should be performed under existing conditions prior to any earthwork that would remove exiting vegetation and change soil characteristics that could alter where the rocks roll. Temporary barriers should be used to protect existing buildings during scaling operations. Periodic monitoring will be necessary to determine areas where erosion over time has destabilized other rocks and stabilized rocks. Any larger rocks observed overtime that need stabilized. This will likely involve the use of Portland cement grout placed at the base of unstable rocks to prevent dislodgement. Additional observations should be made to determine what rocks should be stabilized prior to construction. A well-defined swale should be created to direct surface flows and debris around the structure. Surface debris and runoff should be intercepted with a well-defined swale and directed around the structure.

Dipping Bedrock

The bedrock underlying the site is the Pikes Peak Granite. According to the map of *Areas Susceptible to Differential Heave in Expansive, Steeply Dipping Bedrock* by Himmelreich and Noe in 1999 (Reference 12, Figure 8), the site does not lie within the area mapped with steeply dipping bedrock (>30°). Bedrock was not encountered in the test borings which were drilled to 20 feet.

Radon

Radon levels for the area have been reported by the Colorado Geologic Survey in the open file, Report No. 91-4 (Reference 13). Average Radon levels for the 80829-zip code are 6.75 pCi/l have been measured in the area. The following is a table of radon levels in this area:

0 < 4 pCi/l	50.00%
4 < 10 pCi/l	0.00%
10 < 20 pCi/l	50.00%
> 20 pCi/l	0.00%

Mitigation:

The potential for high radon levels is present for the site. Build-up of radon gas can usually be mitigated by providing increased ventilation of basement and crawlspace and sealing joints. Specific requirements for mitigation should be based on site specific testing.

RELEVANCE OF GEOLOGIC CONDITIONS TO DEVELOPMENT

The proposed development is to consist of construction of a new residence and associated site improvements. Shallow foundations bearing on medium dense to very dense decomposed granite are anticipated for the structure on the site. It is our opinion that the existing geologic and engineering geologic conditions will have some constraints on the proposed development and construction. The most significant problems affecting development will be that associated with the downslope creep and potentially unstable slope areas. These problems can be satisfactorily mitigated through proper engineering design and construction practices or avoidance.

The upper silty, gravelly sand soils are typically at medium dense states and the decomposed granite is typically at medium dense to very dense states. Foundations anticipated for this site, include shallow foundations. The medium dense to very dense soils should provide adequate support for the proposed structure. Any loose soils encountered beneath the foundation or floor slabs should be overexcavated, moisture-conditioned and recompacted. The soils should be recompacted to 95 percent of the soils maximum Modified Proctor Dry Density ASTM D-1557 at ± 2 percent of optimum moisture content. Any reconditioned soils on this site should be observed and tested to verify adequate compaction.

Moderate to steep slopes exist across the site. Areas of downslope creep and potentially unstable slopes have been shown on the Geology/Engineering Geology Map Figure 5. Areas identified as downslope creep are located across the site and the potentially unstable slopes are located along the existing driveway cut. In these areas, we would anticipate lateral and vertical movement of the near surface soils in the downslope direction. The foundation should be designed to account for these additional pressures. Tie-beams and buttresses are recommended to stiffen the foundation system. We recommend stepping the foundation down in the area of the moderate to steep slopes. Specific recommendations should be made when the site plan and foundation design are completed. Cuts should be avoided on the potentially unstable slopes unless analyzed for slope stability. This includes cuts made for terracing and landscaping.

Slope Stability Analyses were conducted utilizing the GSTABL7 computer program to evaluate the stability of the proposed structure. The sections analyzed (A-A' and B-B') are shown on the Slope Stability Section Map, Figure 7. Slope stability analysis results are included in Appendix D. The sections were analyzed for the existing and proposed conditions with an elevated water table. Factors of safety of 0.8 to 1.8 were obtained for the existing conditions and proposed conditions. The existing slope factor of safety of 0.8 will be retained by the proposed structured with a stiffened foundation. The results are summarized in the table in the Slope Stability Section of this report. The proposed house will need a stiffened foundation, the foundation on the eastern side of the structure immediately upgradient of slope must be embedded a minimum of 8' below existing grade. A 14' maximum allowable cut into existing slope.

The surficial soils on this site are prone to erosion without proper mitigation. Erosion control blankets are recommended to help re-establish vegetation in disturbed areas. The soils on the slopes and driveway are subject to future erosion and should be mitigated with adequate slope and erosion protection. A North American Green RollMax VMAX or equivalent erosion control product should be considered.

Areas on the site have been identified as having potential rockfall hazards. In these areas, granite outcrops which have the potential and boulders are exposed and produce boulder and cobble size talus are located upslope of the proposed structure. Based on site observations it appears the majority of the potential source areas are stable in their present condition with only smaller 3 to 4-inch sized loose rocks observed on the slope and do not pose a significant rockfall hazard. No recent dislodged rocks were observed in the proposed building area or upslope of the proposed building area. Due to the potential for the smaller 3 to 4-inch sized rocks to become dislodged windows are not recommended on the upslope side of the structure within 4-feet of exterior grade. We recommend stabilization by removal of smaller loose rocks, often referred to as scaling. Any scaling should be performed under existing conditions prior to any earthwork that would remove exiting vegetation and change soil characteristics that could alter where the rocks roll. Periodic monitoring will be necessary to determine areas where erosion over time has destabilized other rocks. Larger rocks observed overtime that require stabilization, can be stabilized with the use of Portland cement grout placed at the base of unstable rocks to prevent dislodgement. Additional observations should be made to determine what rocks should be stabilized or removed prior to construction. A well-defined swale should be created to direct surface flows and debris around the structure. Surface debris and runoff should be intercepted with a well-defined swale and directed around the structure.

In summary, development of the site can be achieved if the items mentioned above are mitigated. These items can be mitigated through proper design, construction practices or avoidance.

CLOSURE

It should be pointed out that because of the nature of data obtained by random sampling of such variable nonhomogeneous materials as soil and rock, it is important that we be informed of any differences observed between surface and subsurface conditions encountered in construction and those assumed in the body of this report. Construction and design personnel should be made familiar with the contents of this report. Additional evaluation of the site may be recommended after the house plans and location is determined.

This report has been prepared for Tuscany Homes, for application to the proposed project in accordance with generally accepted geologic, soil and engineering practices. No other warranty expresses or implied is made.

Tuscany Homes
Geologic Hazard Investigation
Tax Schedule No. 74080-00-074
570 Day Spring View
Site S-309 Addition to Crystal Park Subdivision No. 2
Manitou Springs, Colorado

We trust that this report has provided you with all the information that you required. Should you require additional information, please do not hesitate to contact us.

Respectfully Submitted,

ENTECH ENGINEERING, INC.

Logan L. Langford, P.G.
Geologist

Reviewed by:

Joseph C. Goode, Jr., P.E.
President

COLORADO LICENSED
JOSEPH COLLIN GOODE JR
23725
3/2/22
PROFESSIONAL ENGINEER

LLL/jhr

Encl.
Entech Job No. 211933
AAprojects/2021/211933 Geohaz

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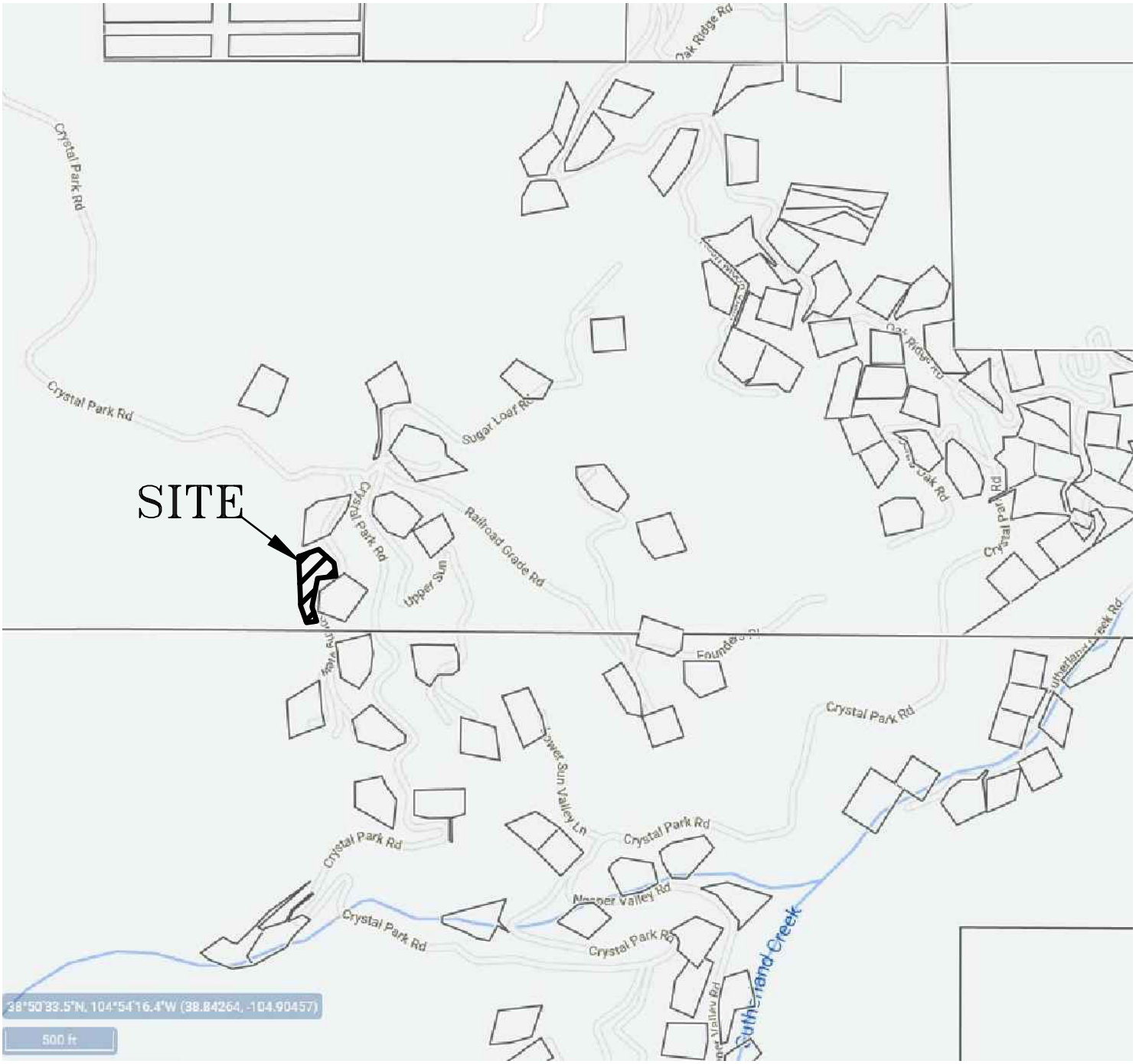
FIGURES



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505 ELKTON DRIVE
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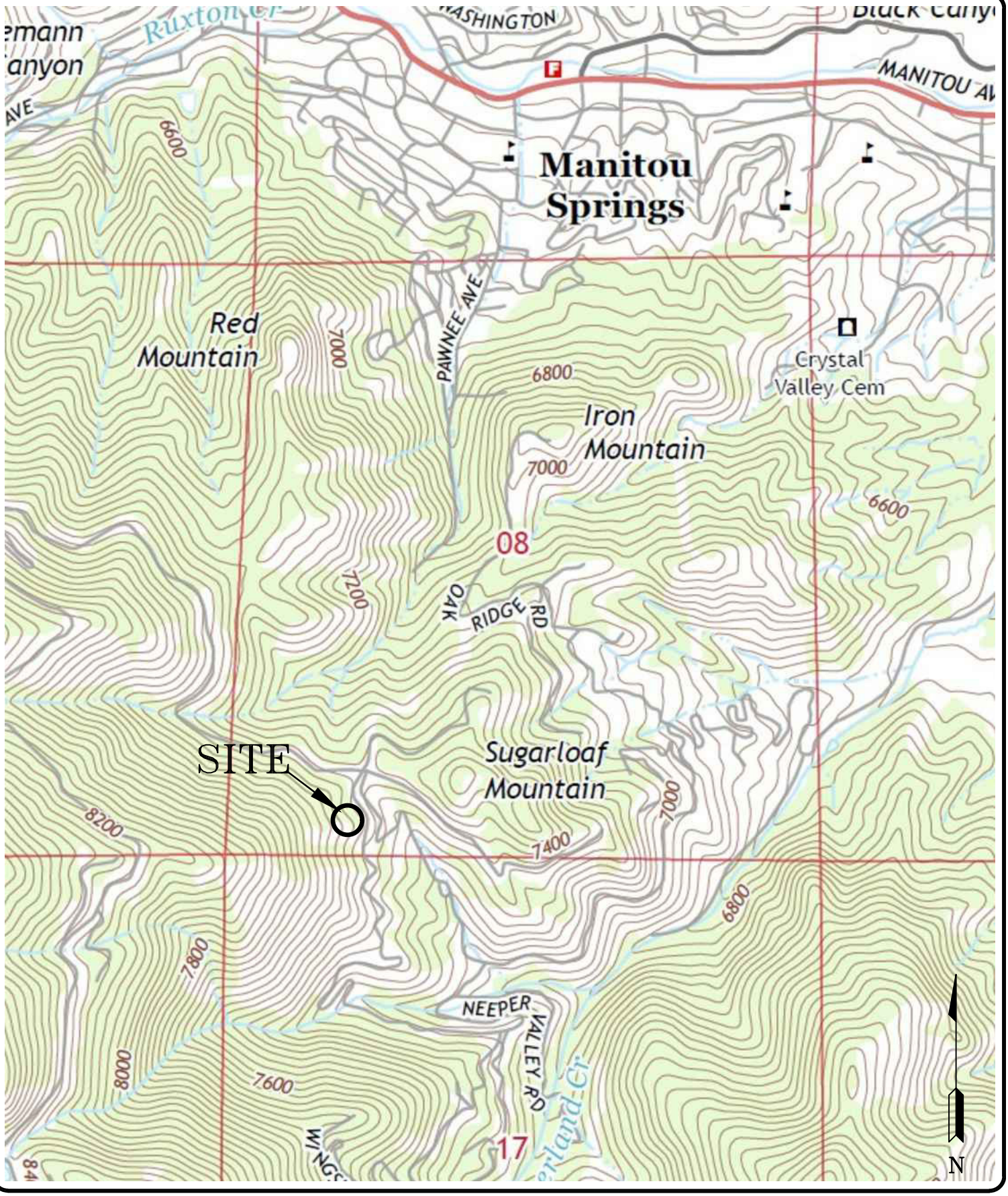
VICINITY MAP
570 DAY SPRING VIEW SITE S-309
ADDITION TO CRYSTAL PARK SUBDIVISION NO.2
EL PASO COUNTY, CO.
FOR: TUSCANY HOMES

DRAWN:	DATE:	CHECKED:	DATE:
JHR	11/10/21	LLL	

JOB NO.: 211933

FIG NO.: 1



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USGS MAP
570 DAY SPRING VIEW SITE S-309
ADDITION TO CRYSTAL PARK SUBDIVISION NO.2
EL PASO COUNTY, CO.
FOR: TUSCANY HOMES

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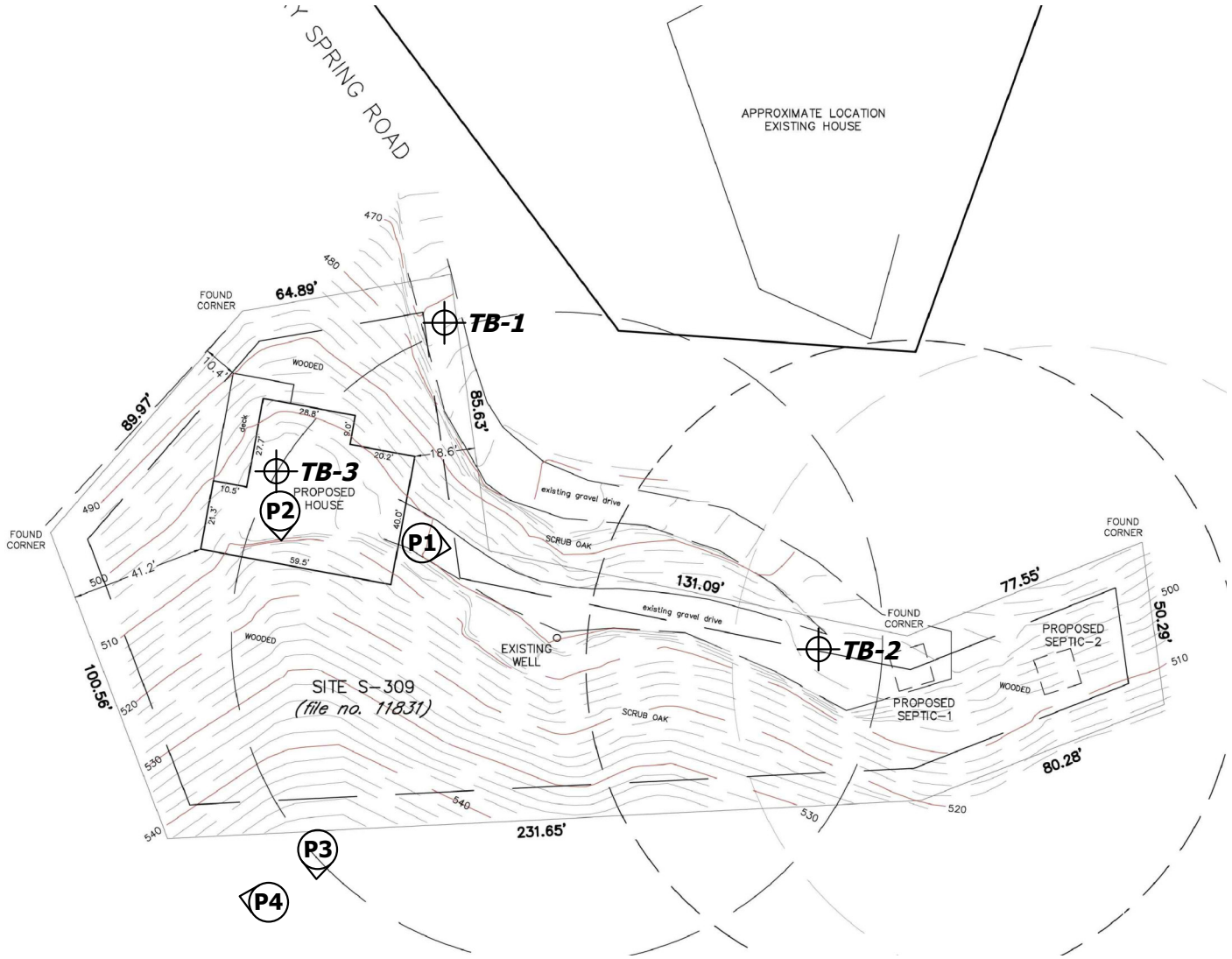
JOB NO.: 211933

FIG NO.: 2



Legend :

- *Approximate Test Boring Location*

P2 - *Approximate Photograph Location*

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SITE PLAN/TEST BORING LOCATION MAP
570 DAY SPRING VIEW SITE S-309
ADDITION TO CRYSTAL PARK SUBDIVISION NO.2
EL PASO COUNTY, CO.
FOR: TUSCANY HOMES

DRAWN:	DATE:	CHECKED:	DATE:
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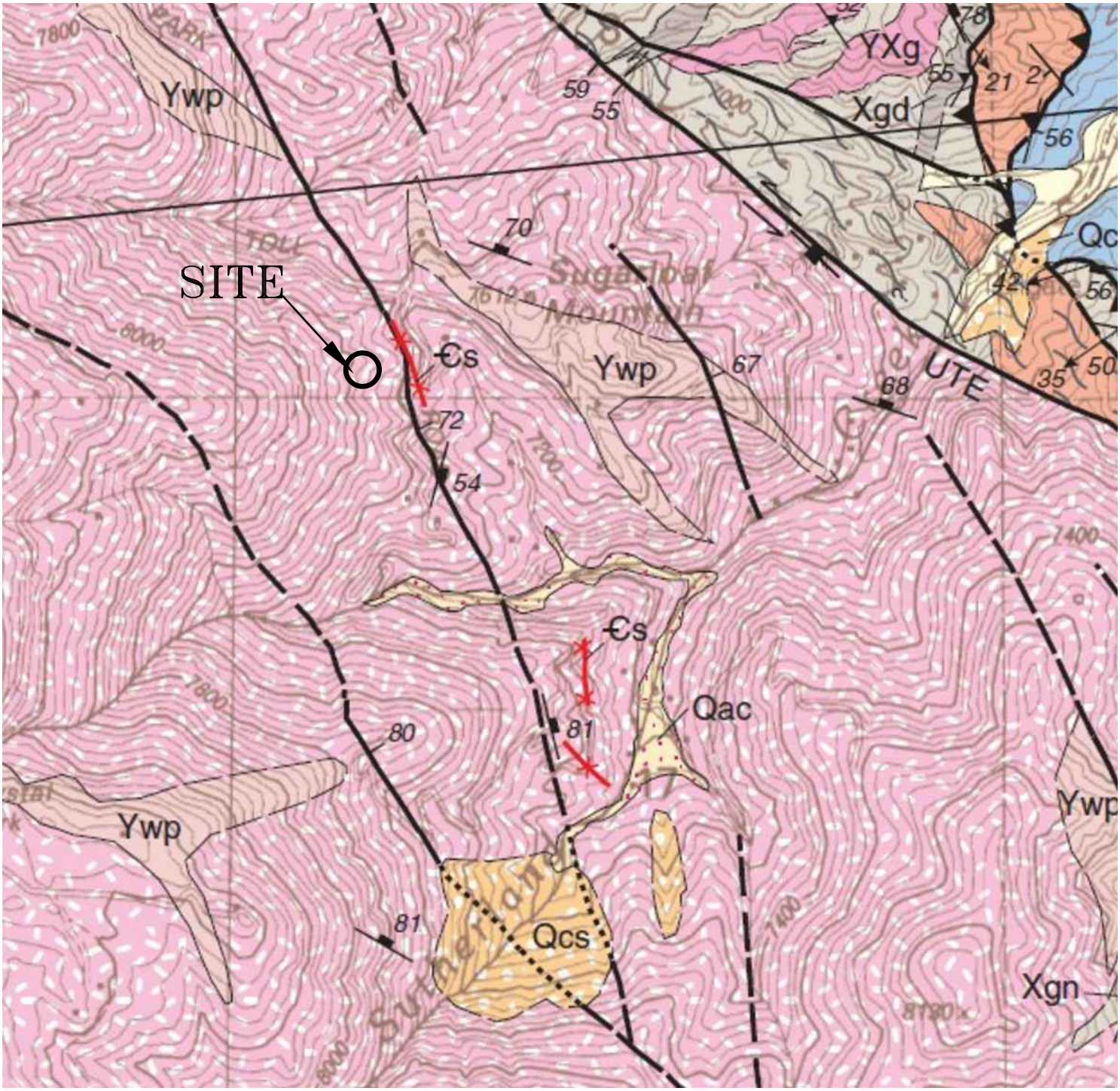
JOB NO.: 211933

FIG NO.: 3



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MANITOU SPRINGS QUADRANGLE GEOLOGIC MAP
570 DAY SPRING VIEW SITE S-309
ADDITION TO CRYSTAL PARK SUBDIVISION NO.2
EL PASO COUNTY, CO.
FOR: TUSCANY HOMES

DRAWN:	DATE:	CHECKED:	DATE:
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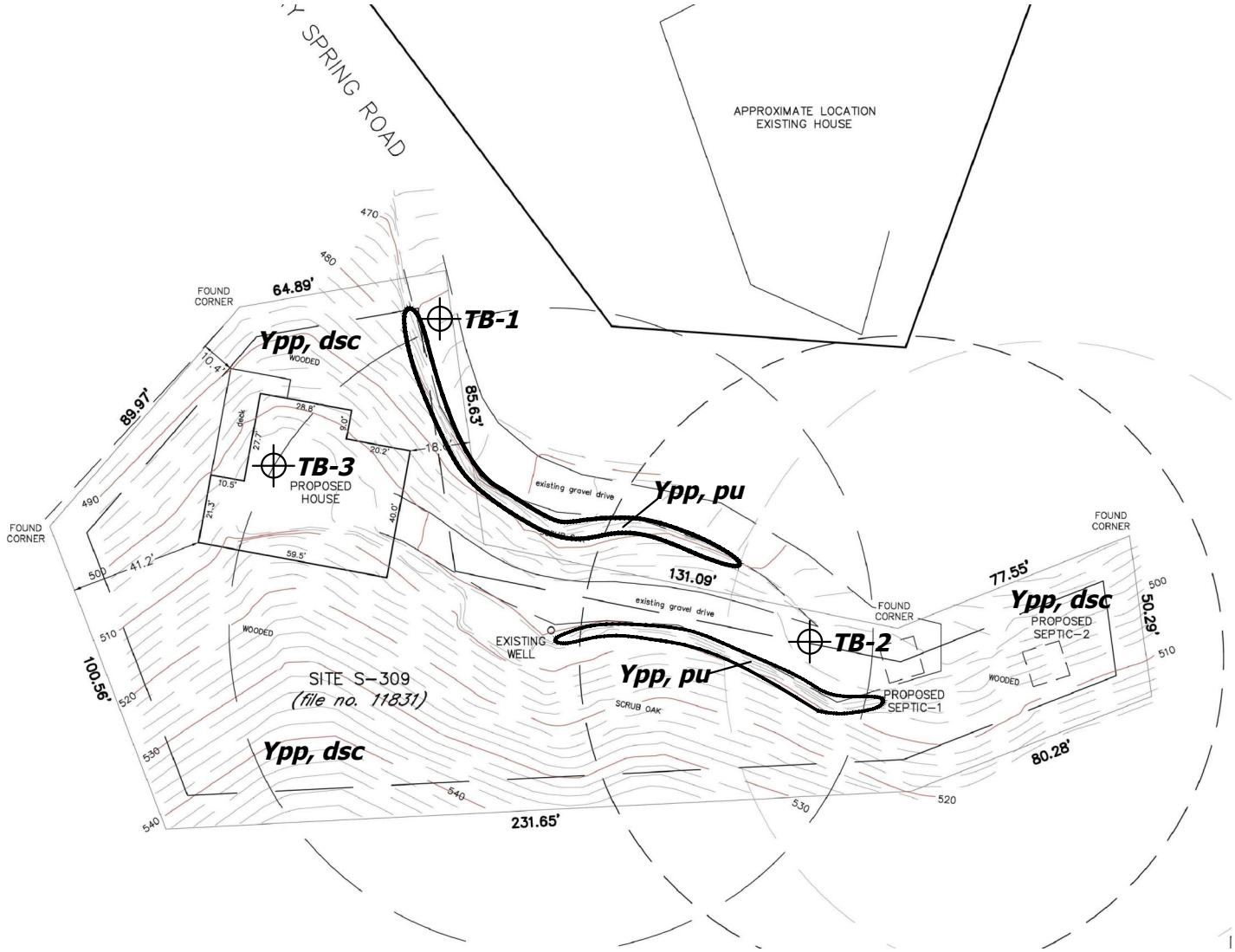
JOB NO.: 211933

FIG NO.: 4



Legend :

Ypp - Pikes Peak Granite of Middle Proterozoic:
biotite-hornblende granite associated with Pikes Peak batholith. Intrusive igneous rock and decomposed residual soils.

dsc - downslope creep area
pu - potentially unstable slope
⊕ - Test Boring Location

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GEOLOGY/ENGINEERING GEOLOGY MAP
570 DAY SPRING VIEW SITE S-309
ADDITION TO CRYSTAL PARK SUBDIVISION NO.2
EL PASO COUNTY, CO.
FOR: TUSCANY HOMES

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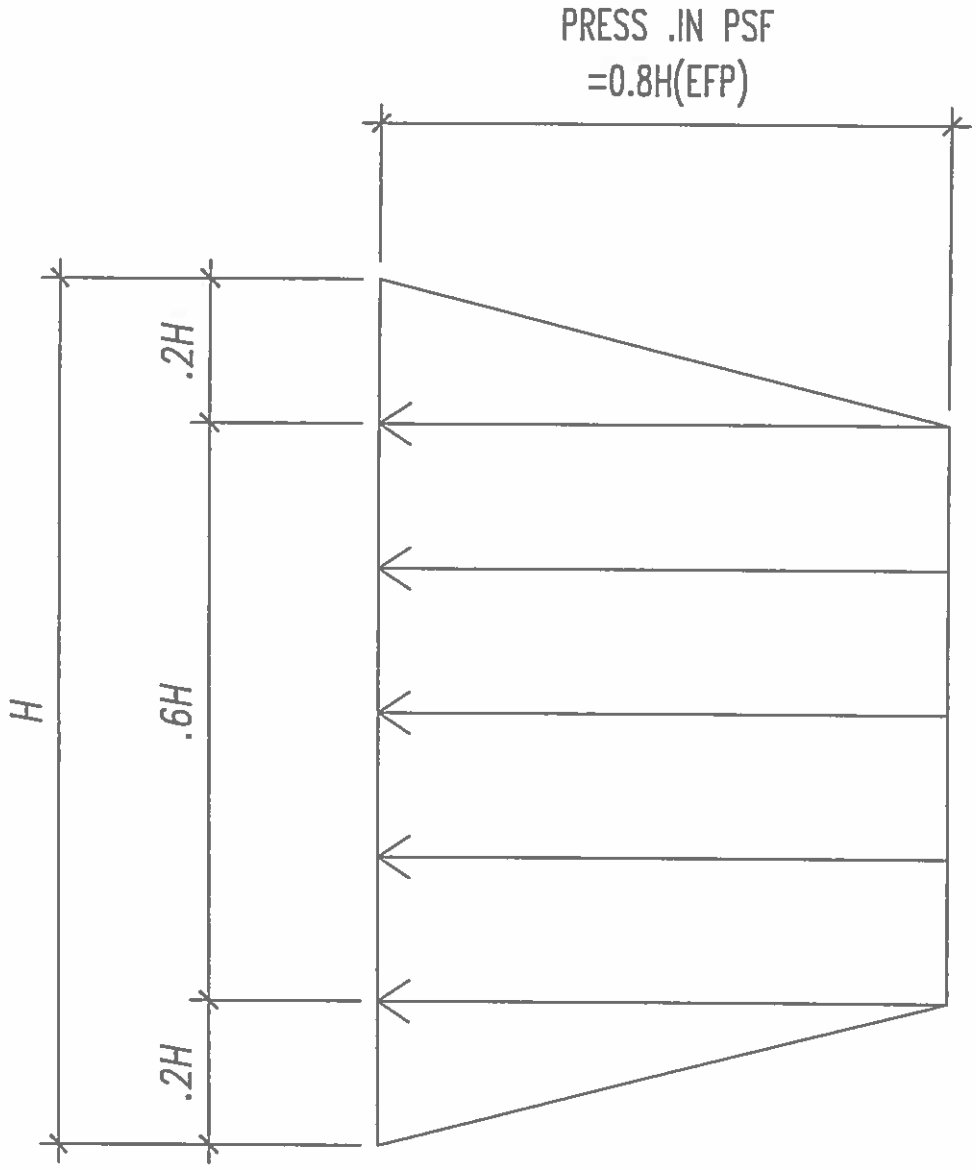
JOB NO.: 211933

FIG NO.: 5



PRESSURE DISTRIBUTION

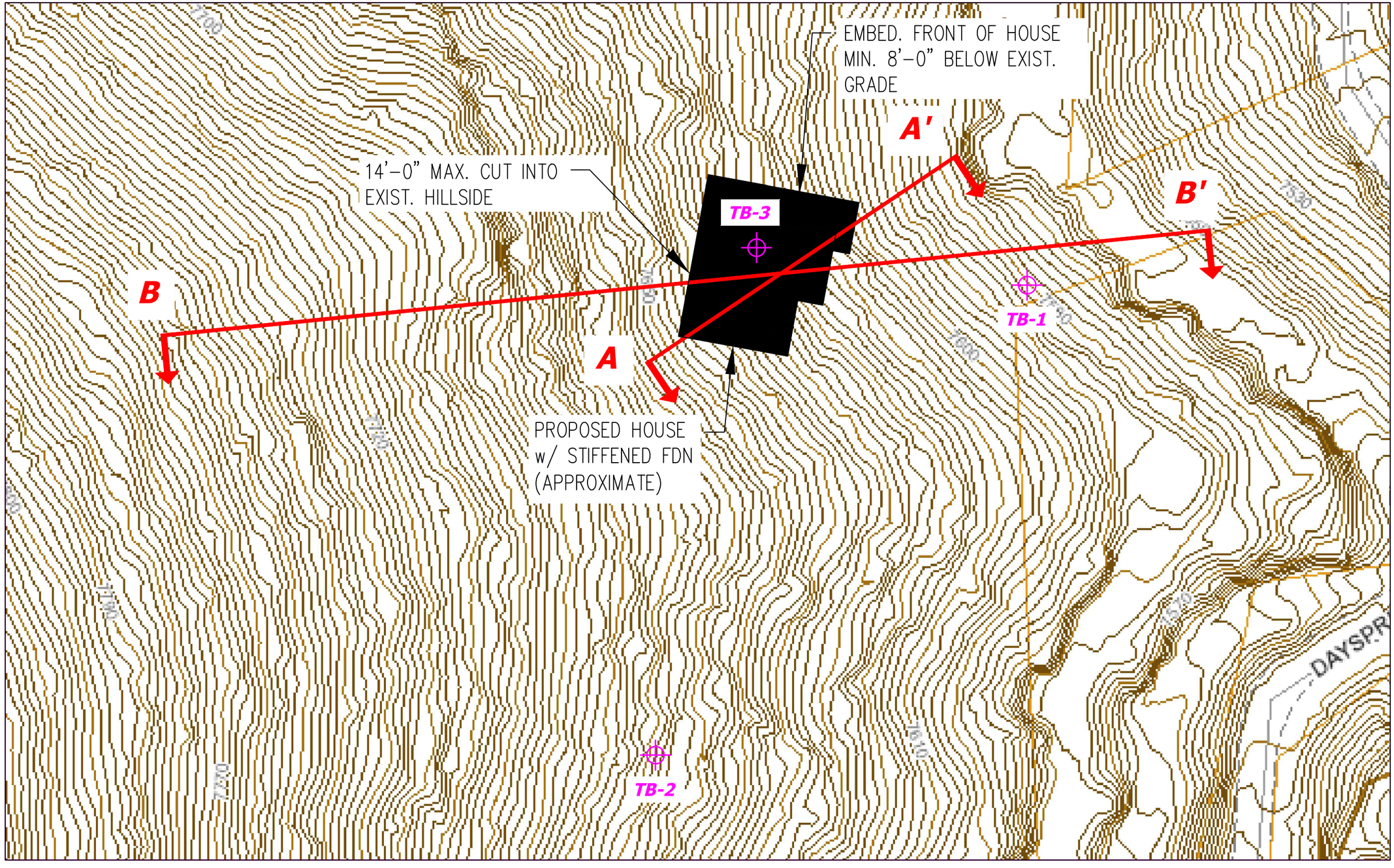
ENTECH
ENGINEERING, INC.
505 ELKTON DRIVE
COLORADO SPRINGS, CO. 80907 (719) 531-5599

LATERAL PRESSURE DISTRIBUTION
AREA WITH CREEP

DRAWN BY:	DATE DRAWN:		
R. MCBRIDE	03/13/13		

JOB NO.: 211933

FIG. NO.: 6e



SLOPE STABILITY SECTION

TB- approximate test boring location and number

NOTE: THIS SHEET CONTAINS COLORED LINEWORK & MUST BE PRINTED IN COLOR TO UNDERSTAND.

REVISIONS	BY:

ENTECH ENGINEERING, INC.
505 ELKTON DRIVE
COLORADO SPRINGS, CO. 80907
(719) 531-5599

SLOPE SECTION MAP
570 DAY SPRING VIEW
MANITOU SPRINGS, CO
FOR: TUSCANY HOMES

DRAWN BY:	AMN
DESIGNED BY:	AMN
CHECKED BY:	
DATE:	02/22/22
SCALE:	AS SHOWN
JOB NO.:	211933
FIGURE NO.:	7

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FEMA FLOODPLAIN MAP
570 DAY SPRING VIEW SITE S-309
ADDITION TO CRYSTAL PARK SUBDIVISION NO.2
EL PASO COUNTY, CO.
FOR: TUSCANY HOMES

DRAWN:	DATE:	CHECKED:	DATE:
JHR	11/18/21	LLL	

JOB NO.: 211933

FIG NO.: 8

APPENDIX A: Site Photographs

1

Looking east along the driveway in the western portion of the site.

January 31, 2022

2

Looking south upslope the proposed building area.

January 31, 2022

Job No. 211933

3

Looking towards granite outcrop upslope of the proposed building area.

January 31, 2022

4

Looking west towards outcrop upslope and southwest of the proposed building area.

January 31, 2022

Job No. 211933

APPENDIX B: Subsurface Soil Investigation
Dated September 14, 2021, Entech Job No. 211933

September 14, 2021
Revised December 2, 2021

ENTECH
ENGINEERING, INC.

505 ELKTON DRIVE
COLORADO SPRINGS, CO 80907
PHONE (719) 531-5599
FAX (719) 531-5238

Tuscany Homes
1825 Austin Bluffs Parkway, Suite 100
Colorado Springs, Colorado 80918

Attn: Stan Campbell

Re: Subsurface Soil Investigation
570 Dayspring View
Site S-309, Crystal Park Filing No. 2
Manitou Springs, Colorado

Dear Mr. Campbell:

Personnel of Entech Engineering, Inc. have drilled two shallow test borings at the site referenced above. A grab sample was obtained in the location of Test Boring No. 1 due to inaccessibility of the drill rig. Specific findings for the site are presented in this letter.

Soil Classification:

Soil types observed in the test borings drilled on this site were found to consist of a thin layer of silty sand overlying decomposed granite bedrock.

Allowable Bearing Capacity:

An allowable bearing pressure of 2600 psf is recommended for imported structural fill or properly broken-down decomposed granite used as structural fill. An equivalent hydrostatic fluid pressure (in the active state) of 45 pcf is recommended for this site.

Soil Moisture Conditions:

Dry.

Expansion Potential:

Low.

Fill:

None.

Special Considerations:

The Ute Pass Fault is mapped southwest of the site according to the *Geologic Map of the Cascade Quadrangle, El Paso County, Colorado* by M.L. Morgan, C.S. Siddoway, P.D. Rowley, J. Temple, J.W. Keller, B.H. Archuleta, and J.W. Himmelrich Jr., distributed by the Colorado Geological Survey in 2003 (Open-File Report 03-18).

Due to the very dense nature of the bedrock, track mounted equipment will likely be required for the excavation. To provide a uniform pad of similar bearing soils the foundation should bear on a minimum 2-foot layer of granular structural fill. Fill placed below the foundation components

should be compacted to a minimum of 95% of its maximum Modified Proctor Dry Density, ASTM D-1557 at moisture content within 2 percent of optimum. The extent and final depth of overexcavation should be determined at the time of the open excavation observation. Site materials may be acceptable for use as structural fill pending approval by Entech.

The steep slopes on the lot may require deep cuts during construction. Slope excavation should be benched to minimize potential slope instability conditions. The foundation design should include provisions for higher lateral forces due to the sloping conditions. Stepping the foundation into the slope will be required.

Due to the moderate to steep slopes at this site, foundation stiffeners such as tie-beams, buttresses or additional reinforcement may be required. The need for stiffeners should be determined when final grading and construction plans are available.

Foundation Type:

A spread footing (16")/stemwall foundation system in conjunction with over excavation is anticipated for this site. Point load bearing pads should be sized for the allowable bearing capacity given. **This does not constitute a foundation design.** Qualified personnel should verify that building loads do not exceed the bearing value given in this letter. The bottoms of exterior foundations should be located at least 30 inches below finished grade for frost protection.

Foundation Configuration Remarks:

The configuration of the foundation system is critical to its performance. The position of foundation windows, jogs, steps and the relative elevation of adjacent and opposite walls determine foundation performance. Improper placement of the above can result in differential and lateral foundation movement. In addition, foundation walls over 4 feet in height should not span over 30 feet in length without specific design.

Reinforcing:

Reinforcing should be designed to permit foundation walls to span a minimum of 10 feet under the design load. Foundation walls should be designed to resist an equivalent fluid pressure (in the active state) of 45 pcf. Highly expansive soils should not be used as backfill material.

Floor Slabs:

Floor slabs-on-grade, if any, should be separated from structural portions of the building and allowed to float freely. Interior partitions must be constructed in such a manner that they do not transmit floor slab movement to the roof or overlying floor. Backfill placed below floor slabs should be compacted to a minimum of 95% of its maximum Modified Proctor Dry Density, ASTM D-1557.

Drainage and Grading:

The ground surface must be sloped away from the building to provide positive drainage away from the foundation. We recommend an equivalent slope of 6 inches in the first 10 feet (5%) surrounding the structure, where possible, or as required to quickly remove surface water. Where a 5% slope cannot be achieved practically, such as around patios, at inside foundation corners, and between a building and nearby sidewalk, we believe it is desirable to establish as much slope as possible and to avoid irrigation in the area. Roof downspouts should discharge beyond the limits of backfill. We recommend providing splash blocks and downspout extensions to discharge runoff beyond the limits of backfill.

Owners should maintain the surface grading and drainage installed by the builder to assure water is not directed toward the foundations and does not pond near the structure. Landscaping should be carefully designed to minimize irrigation adjacent to the foundation. We do not recommend use of impervious plastic membranes below landscaped areas near foundations; geotextile fabrics can control weed growth while allowing evaporation. Plants used close to foundations should be limited to those with low moisture requirements; irrigated grass should not be located within 5 feet of the foundation. Sprinklers should not discharge water within 5 feet of foundations. Irrigation should be limited to the minimum amount sufficient to maintain vegetation. Application of more water will increase the potential for slab and/or foundation movements.

Subdrain:

A subsurface perimeter drain should be placed around useable space below grade and is recommended around the entire structure if expansive soils are encountered in the foundation excavation. A typical drain detail is attached.

Backfill:

Backfill should be compacted to 95% of its maximum Modified Proctor Dry Density, ASTM D-1557. Backfill must be compacted by mechanical means. No water flooding techniques of any type should be used in the compaction of backfill on this site. Expansive soils are not to be used as foundation backfill.

Concrete:

Type II cement is recommended for all concrete on this site. Concrete should not be placed on frozen or wet ground. Care should be taken to prevent the accumulation and ponding of water in the excavations prior to the placement of concrete. If standing water is present in any excavation, it should be removed by installing sumps and pumping the water away from the building area. If concrete is placed during periods of cold temperatures, the concrete must be kept from freezing. This may require covering the concrete with insulated blankets and heating to prohibit freezing.

Tuscany Homes
Subsurface Soil Investigation-Revised
570 Day Spring View
Site S-309, Crystal Park Filing No. 2
Manitou Springs, Colorado

Remarks:

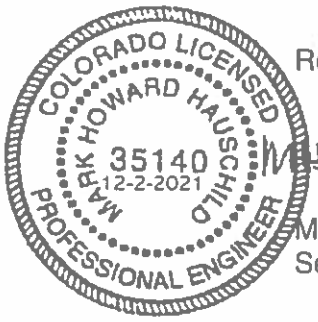
The recommendations provided in this letter are based upon the observed soil parameters, anticipated foundation loads, and accepted engineering procedures. The recommendations are intended to minimize differential movement resulting from the heaving of expansive soils or resulting from settlement induced by the application of building loads. It must be recognized that the foundation may undergo movement. In addition, concrete floor slabs may experience movement; therefore, adherence to those recommendations which would isolate floor slabs from columns, walls, partitions or other structural components is extremely important, if damage to the superstructure is to be minimized. Owners should be apprised of the soil conditions and advised to maintain good practice in the future with regard to surface and subsurface drainage, framing of partitions above floor slabs, drywall and finish work above floor slabs, etc.

We trust this has provided you with the information you required. If you have any questions or need additional information, please do not hesitate to contact us.

Respectfully Submitted,

ENTECH ENGINEERING, INC.

Stuart Wood
Geologist



Reviewed by:

Mark H. Hauschild, P.E.
Senior Engineer

BWV/bs

Encl.

Entech Job No. 211933
AApProject/2021/211933 ssi

TEST BORING NO. 2
DATE DRILLED 8/27/2021
Job # 211933

REMARKS

DRY TO 17', 8/27/21

DECOMPOSED GRANITE, FINE TO COARSE GRAINED, RED BROWN, DRY

AUGER REFUSAL AT 17'

* - BULK SAMPLE TAKEN

Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type
			*	1.1	
5			*	1.0	
10			*	1.4	
15			*	1.2	
20					

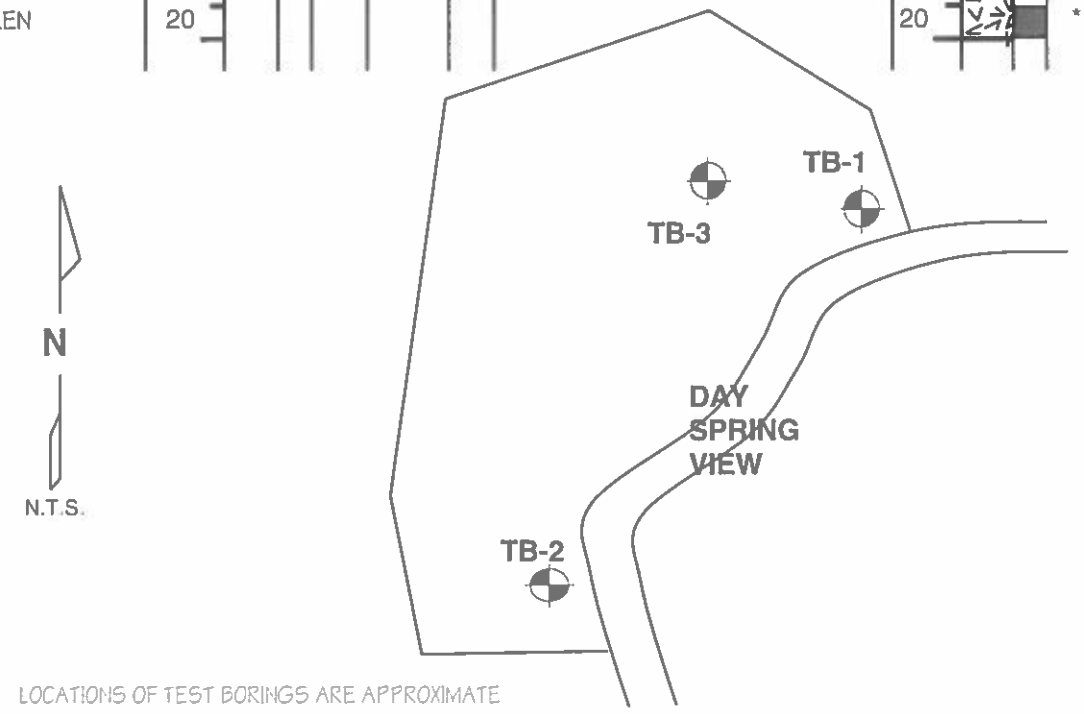
TEST BORING NO. 3
DATE DRILLED 8/27/2021
CLIENT TUSCANY HOMES
LOCATION 570 DAY SPRING VIEW

REMARKS

DRY TO 20', 8/27/21

DECOMPOSED GRANITE, FINE TO COARSE GRAINED, RED BROWN, DRY

Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type
			*	1.3	
5			*	1.8	
10			*		
15			*	1.4	
20			*	2.2	



LOCATIONS OF TEST BORINGS ARE APPROXIMATE

ENTECH
ENGINEERING, INC.
505 ELKTON DRIVE
COLORADO SPRINGS, COLORADO 80907

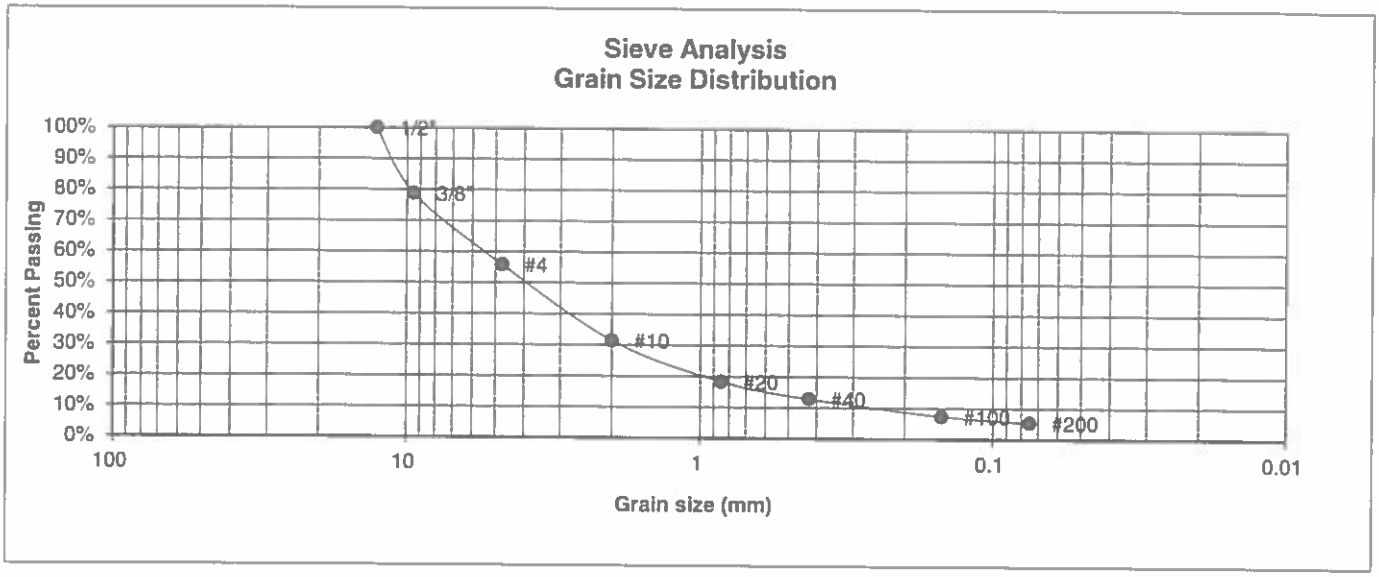
TEST BORING LOG

DRAWN:	DATE:	CHECKED:	DATE:
		DS	9/17/21

JOB NO.: 211933

FIG NO.: 1

BORING NO.	TB-1	UNIFIED CLASSIFICATION	SM-SW	TEST BY	BL
DEPTH(ft)	GRAB	AASHTO CLASSIFICATION		JOB NO.	211933
CLIENT	TUSCANY HOMES				
PROJECT	570 DAY SPRING VIEW				



U.S. Sieve #	Percent Finer
3"	
1 1/2"	
3/4"	
1/2"	100.0%
3/8"	78.8%
4	55.8%
10	31.4%
20	18.2%
40	12.8%
100	7.4%
200	5.3%

Atterberg Limits
Plastic Limit
Liquid Limit
Plastic Index

Swell
Moisture at start
Moisture at finish
Moisture increase
Initial dry density (pcf)
Swell (psf)

ENTECH ENGINEERING, INC.
505 ELKTON DRIVE
COLORADO SPRINGS, COLORADO 80907

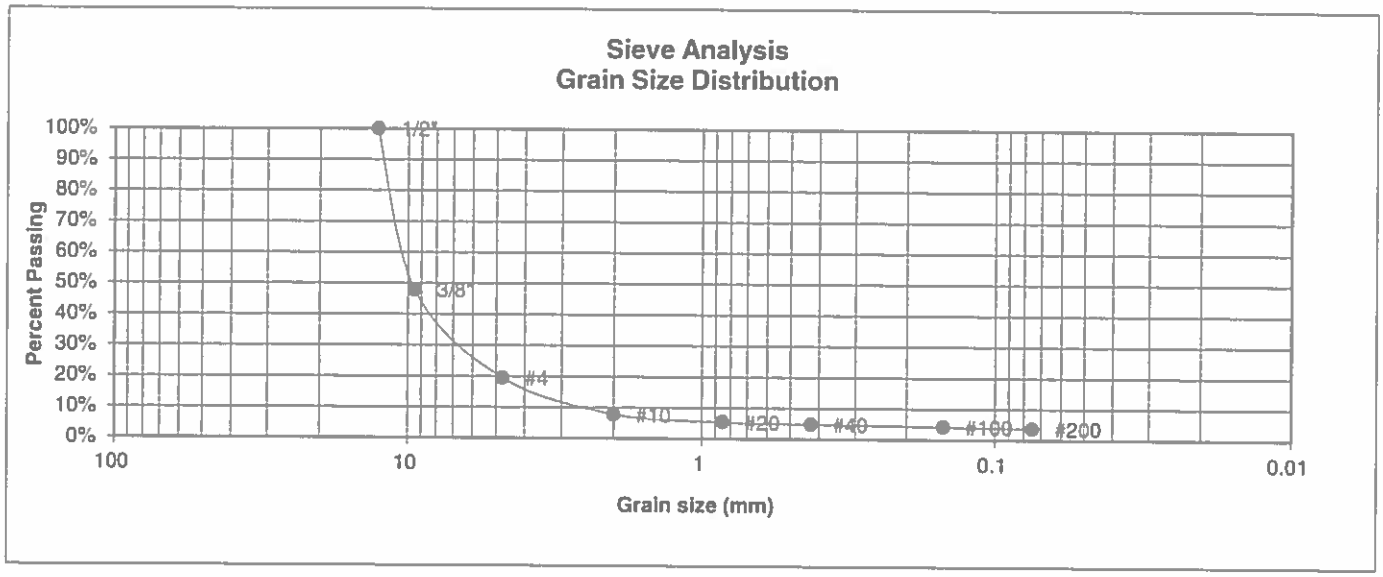
LABORATORY TEST RESULTS

DRAWN:	DATE:	CHECKED:	DATE:
		DS	9/17/21

JOB NO.: 211933

FIG NO.: 2

BORING NO.	2	UNIFIED CLASSIFICATION	GW	TEST BY	BL
DEPTH(ft)	5	AASHTO CLASSIFICATION		JOB NO.	211933
CLIENT	TUSCANY HOMES				
PROJECT	570 DAY SPRING VIEW				



U.S. Sieve #	Percent Finer
3"	
1 1/2"	
3/4"	
1/2"	100.0%
3/8"	47.9%
4	19.5%
10	7.8%
20	5.4%
40	4.9%
100	4.2%
200	3.7%

Atterberg Limits
Plastic Limit
Liquid Limit
Plastic Index

Swell
Moisture at start
Moisture at finish
Moisture increase
Initial dry density (pcf)
Swell (psf)

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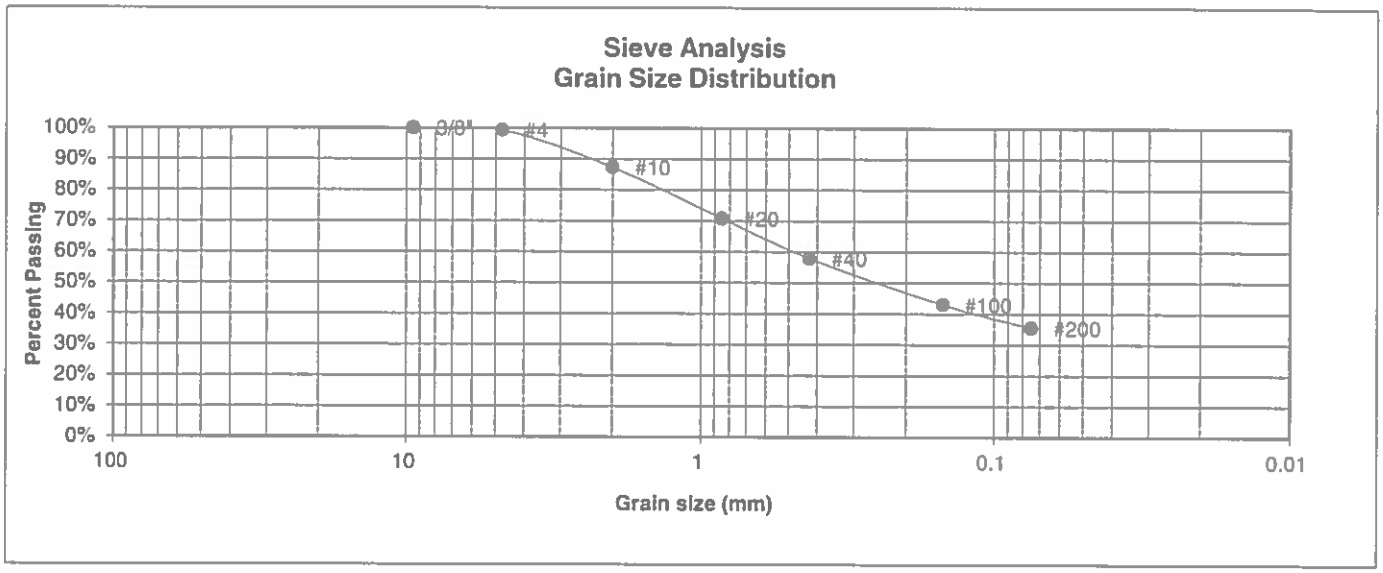
LABORATORY TEST RESULTS

DRAWN	DATE	CHECKED	DATE
		DS	9/17/21

JOB NO. 211933

FIG NO. 3

BORING NO.	3	UNIFIED CLASSIFICATION	SM	TEST BY	BL
DEPTH(ft)	10	AASHTO CLASSIFICATION		JOB NO.	211933
CLIENT	TUSCANY HOMES				
PROJECT	570 DAY SPRING VIEW				



U.S. Sieve #	Percent Finer
3"	
1 1/2"	
3/4"	
1/2"	
3/8"	100.0%
4	99.2%
10	87.3%
20	70.8%
40	57.9%
100	43.0%
200	35.5%

Atterberg Limits
Plastic Limit
Liquid Limit
Plastic Index

Swell
Moisture at start
Moisture at finish
Moisture increase
Initial dry density (pcf)
Swell (psf)

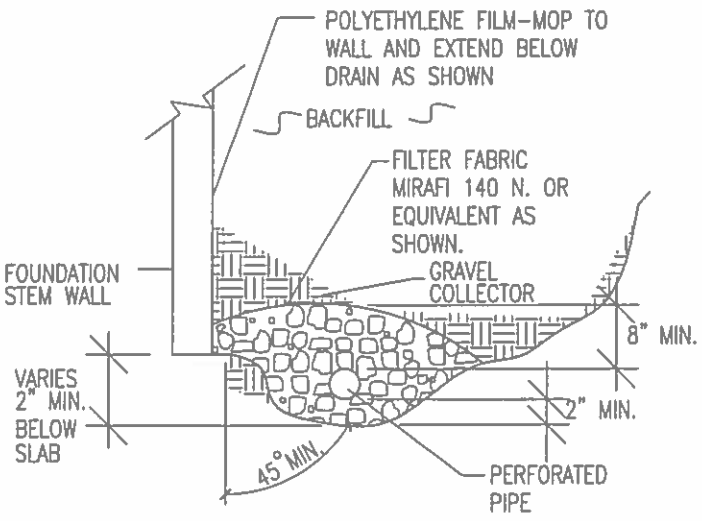
ENTECH
ENGINEERING, INC.
505 ELKTON DRIVE
COLORADO SPRINGS, COLORADO 80907

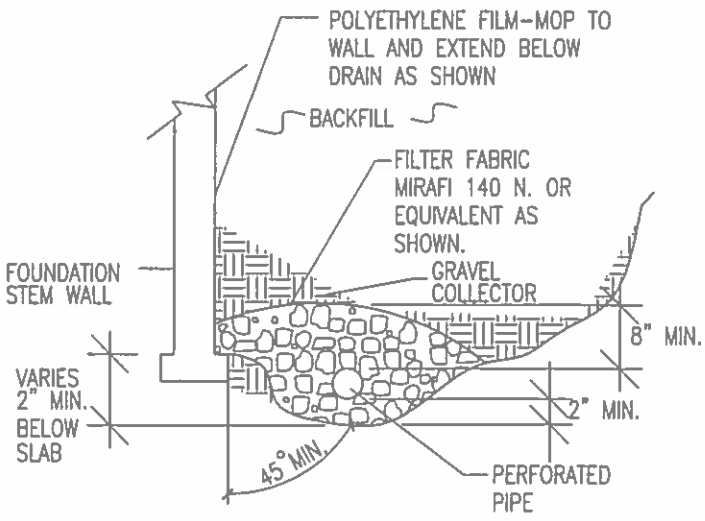
LABORATORY TEST RESULTS

DRAWN:	DATE:	CHECKED:	DATE:
		DS	9/17/21

JOB NO.: 211933

FIG NO.: 4





NOTES:

-GRAVEL SIZE IS RELATED TO DIAMETER OF PIPE PERFORATIONS-85% GRAVEL GREATER THAN 2x PERFORATION DIAMETER.

-PIPE DIAMETER DEPENDS UPON EXPECTED SEEPAGE. 4-INCH DIAMETER IS MOST OFTEN USED.

-ALL PIPE SHALL BE PERFORATED PLASTIC. THE DISCHARGE PORTION OF THE PIPE SHOULD BE NON-PERFORATED PIPE.

-FLEXIBLE PIPE MAY BE USED UP TO 8 FEET IN DEPTH, IF SUCH PIPE IS DESIGNED TO WITHSTAND THE PRESSURES. RIGID PLASTIC PIPE WOULD OTHERWISE BE REQUIRED.

-MINIMUM GRADE FOR DRAIN PIPE TO BE 1% OR 3 INCHES OF FALL IN 25 FEET.

-DRAIN TO BE PROVIDED WITH A FREE GRAVITY OUTFALL, IF POSSIBLE. A SUMP AND PUMP MAY BE USED IF GRAVITY OUT FALL IS NOT AVAILABLE.

ENTECH ENGINEERING, INC.
505 ELKTON DRIVE
COLORADO SPRINGS, CO. 80907 (719) 531-5599

PERIMETER DRAIN DETAIL

DRAWN:	DATE:	DESIGNED:	CHECKED:
			DS

JOB NO.: 211933
FIG NO.: 5

APPENDIX C: Colorado Geological Survey Review Letter dated January 18, 2022, CGS Unique No. EP-22-0053

EP-22-0053 Cueller Residence (Crystal Park Site S-309)

S½ SW¼ SW¼ Section 8, T14S, R67W, 6th Meridian

38.8398, -104.9201
…

The applicant proposes a single-family residence at 570 Dayspring View in the Crystal Park development. With this referral, we received the Site Plan (Tuscany Homes, October 26, 2020), Elevation Plans (Tuscany Homes, October 26, 2020), and Subsurface Soil Investigation (Entech Engineering, Inc., stamped December 2, 2021). The Entech soils report did not address the geologic hazards associated with the site. Per County code, a soil and geology report is required that identifies geologic hazards and provides appropriate mitigation measures.

CGS offers the following comments and recommendations during the planning and development of this site.

Geologic Hazard Disclosure Statement. CGS recommends that Entech or another qualified geotechnical engineer evaluate the geologic hazards and constraints required by county code and provide appropriate recommendations and mitigation measures. We suggest the geologic hazards and constraints be included in the preliminary/site plan.

Site Geology. The site is underlain at variable depths by relatively loose material (commonly known as "Grus" or "Colluvium") weathered from the underlying Pikes Peak Granite. Pikes Peak Granite is typically not problematic from a geotechnical or foundation performance perspective. However, the rock is fractured and weathered, sometimes extensively. Both of these rock quality characteristics can impact slope stability and erosion potential. Additionally, Grus is weaker than the bedrock and can be highly variable in depth.

Rockfall. Directly upslope from the site is mapped as containing a rockfall hazard. The risk of rockfall was first recognized and mapped at this site in the geologic hazard mapping conducted for El Paso County in the 1970s according to House Bill 1041 concerning geologic hazards in Colorado. Even a low probability rockfall can have significant risk to permanent structures even after many decades without previous rockfall resulting in significant property damage and fatalities.

As previously stated, the bedrock at the site is the Pikes Peak Granite, forming outcrops directly upslope (to the west). The existing rocks and boulders are likely to be disturbed during construction activities and/or freeze/thaw, resulting in an increased potential for a rockfall hazard. It may be prudent to remove such rocks during construction. **CGS recommends the county require the risk for rockfall hazards to be evaluated prior to construction**. The appropriate mitigation measures should be noted on the project plans.

Steep Slopes and Construction-Related Slope Instability. Available LiDAR show slopes exceeding 30 percent upslope and downslope from the proposed residence. There are risks associated with construction on steep slopes, such as are present at this site. While mapped landslides are not present, there are risks associated with construction on these steep slopes where erosion is also a significant constraint. Presently stable slopes may become unstable as a result of reduced soil strengths if,

1) Modifications are made through the excavation of cuts, the addition of fills, and loading due to structures,

2) Significant moisture is added to the slope through residential irrigation (including infiltration from septic fields) and ample precipitation or snowmelt,
3) The existing drainage pattern is altered through grading, introducing water to previously drier areas.

To further reduce potential hazards associated with erosion, construction-related slope instability, shallow failures such as creep and slumping, and increased runoff, the following should be implemented in the design and construction:

- A qualified geotechnical professional should determine maximum allowable, unretained temporary, and permanent cut/fill heights and slope angles.
- All planned cuts exceeding four feet in height **should be evaluated for slope stability** using proposed slope geometry and considering all foundation and proposed cuts that will affect the slope.
- Driveway retaining walls, building foundations, and upslope walls that will function as retaining walls must be designed by a qualified geotechnical or civil engineer and must include adequate behind-wall drainage.
- The structure should be designed with as much rigidity as possible due to the potential of downslope creep. CGS agrees with Entech on page 2, "*Due to the moderate to steep slopes at this site, foundation stiffeners such as tie-beams, buttresses or additional reinforcement may be required*."
- The existing vegetative cover should be left intact to the extent possible, and every effort should be made to restore native vegetation within disturbed areas as quickly as possible. Irrigation beyond the bare minimum required to reestablish native vegetation should not be permitted.

Surface Drainage and Erosion. The onsite soil and colluvium ("Grus") are highly susceptible to erosion. Concentrated, developed flows can cause serious and damaging erosion and rapidly erode the surface material down to hard rock. Site drainage should be designed and constructed to prevent concentrated flows from being developed within the site. Proper maintenance and erosion protection of the slope face within the subject property is critical to the long-term structural integrity of the proposed structure.

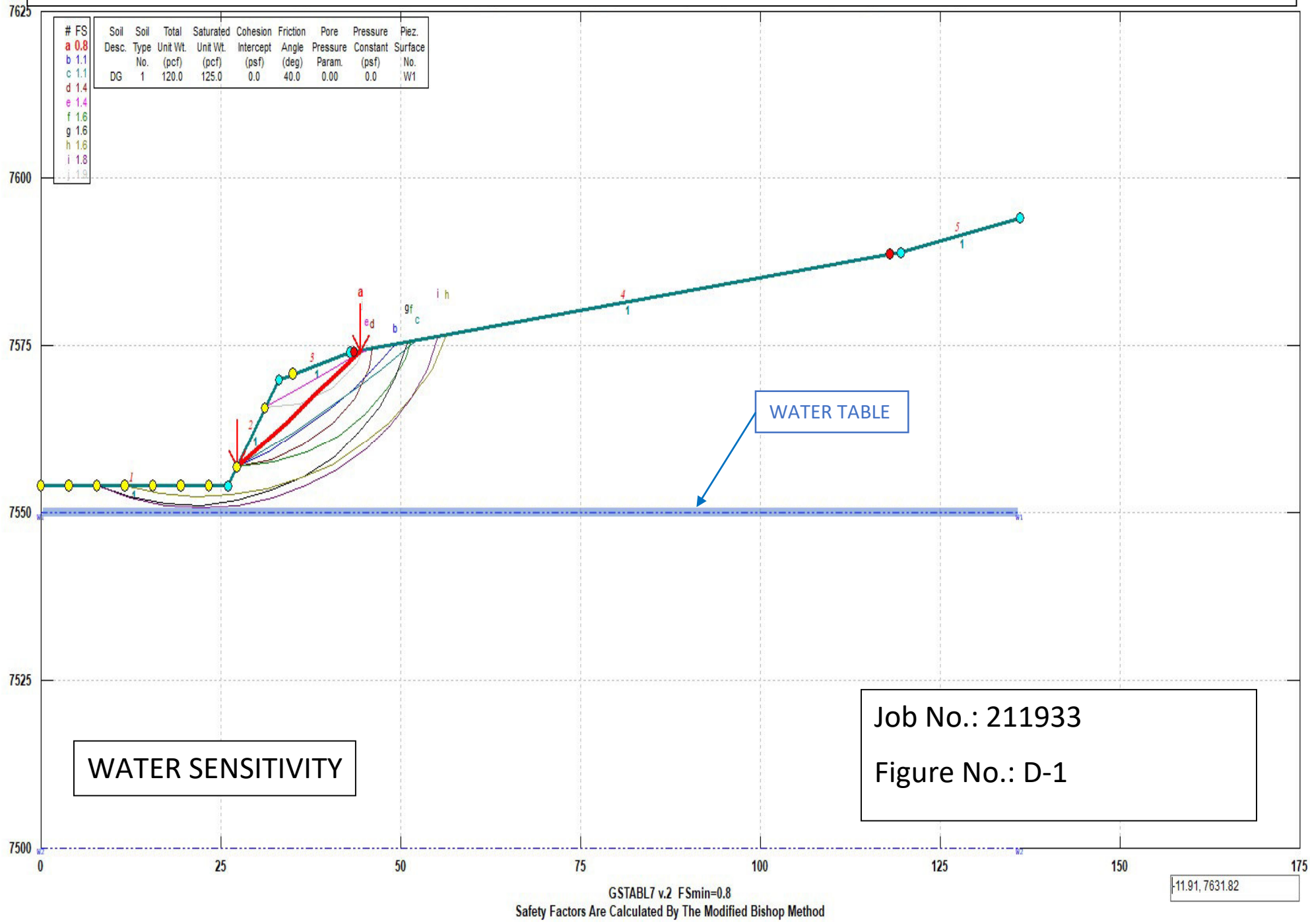
In summary, CGS recommends that Entech or another qualified geotechnical engineer evaluate the geologic hazards and constraints as required by county code and provide appropriate recommendations and mitigation measures. At a minimum, we recommend:

1. The geologic hazards and constraints are evaluated as required by county code, and appropriate recommendations and mitigation measures are provided.
2. A geologic hazard disclosure statement is included in the preliminary/site plan.
3. The county requires the risk for a rockfall hazard to be evaluated prior to construction and a mitigation plan established to reduce the potential risk.
4. The geotechnical engineer provides maximum allowable, unretained temporary, and permanent cut/fill heights and slope angles.
5. All planned cuts exceeding four feet in height are evaluated for slope stability using proposed slope geometry and considering all foundation and proposed cuts that will affect the slope.

Submitted 1/18/2022 by Amy Crandall, Engineering Geologist, Colorado Geological Survey (303-384-2632 or acrandall@mines.edu)

APPENDIX D: Slope Stability Analysis

TUSCANY HOMES – 211933– A-A - EXISTING



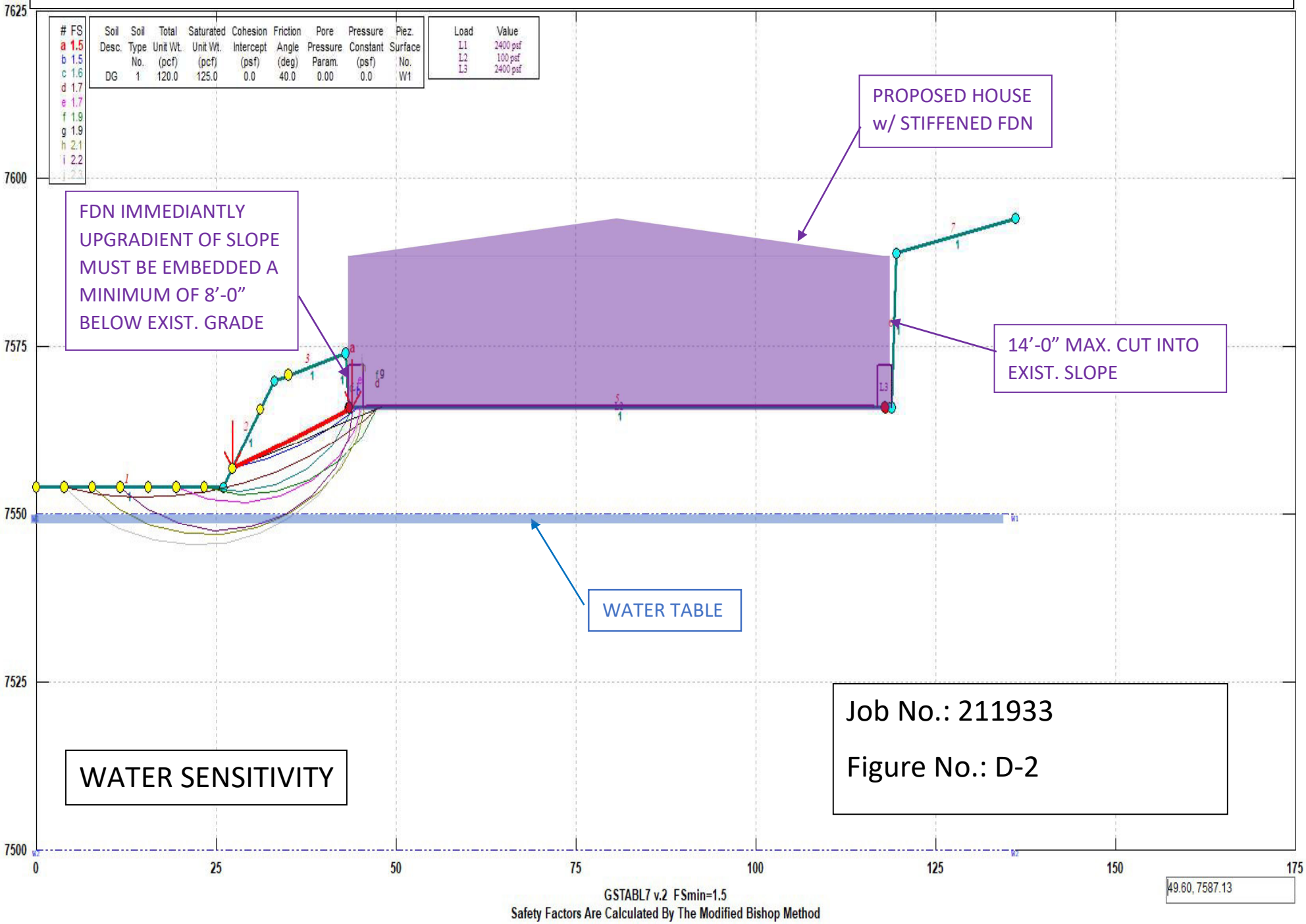
WATER SENSITIVITY

Job No.: 211933

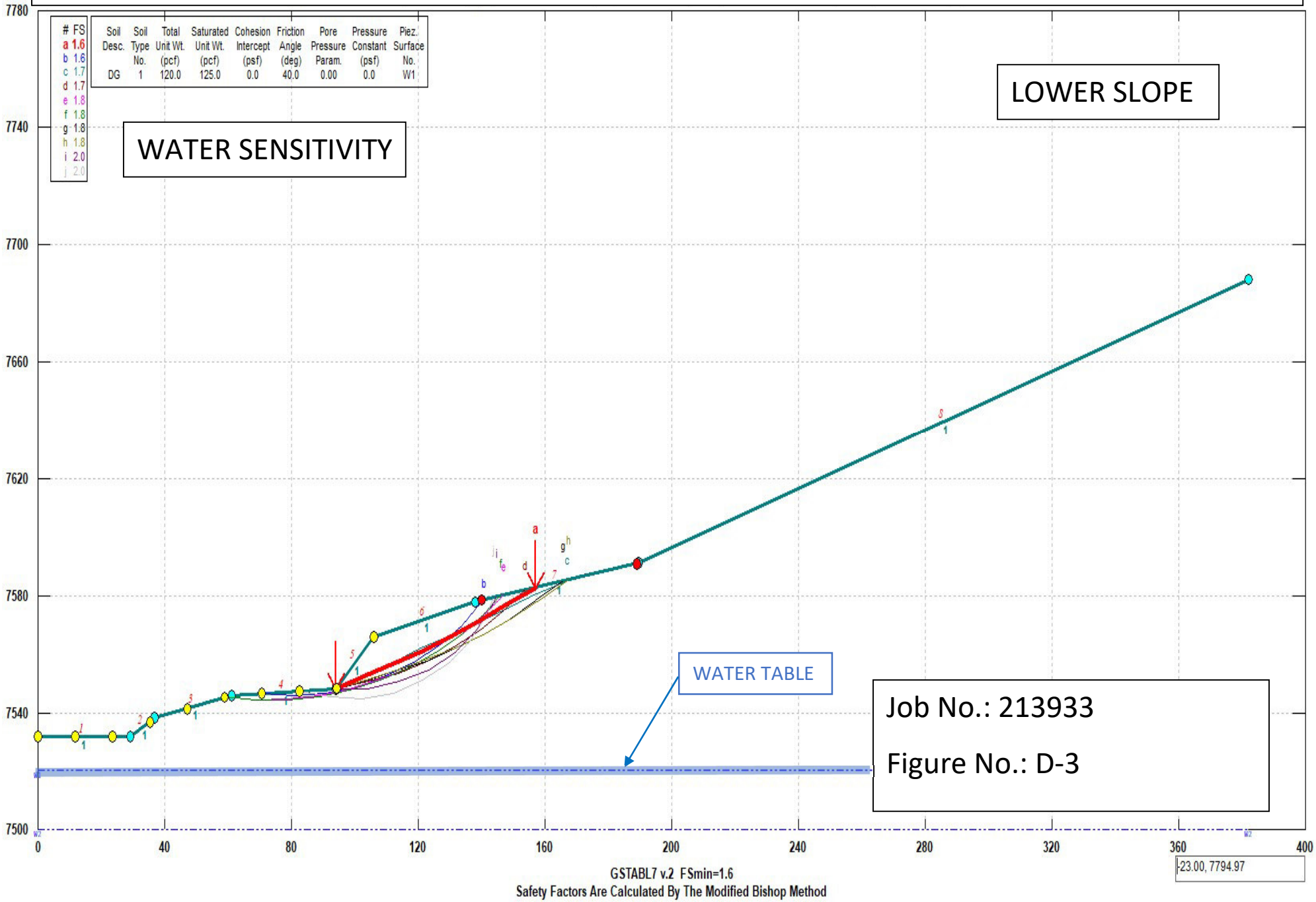
Figure No.: D-1

GSTABL7 v.2 FSmin=0.8
Safety Factors Are Calculated By The Modified Bishop Method

TUSCANY HOMES – 211933– A-A - PROPOSED



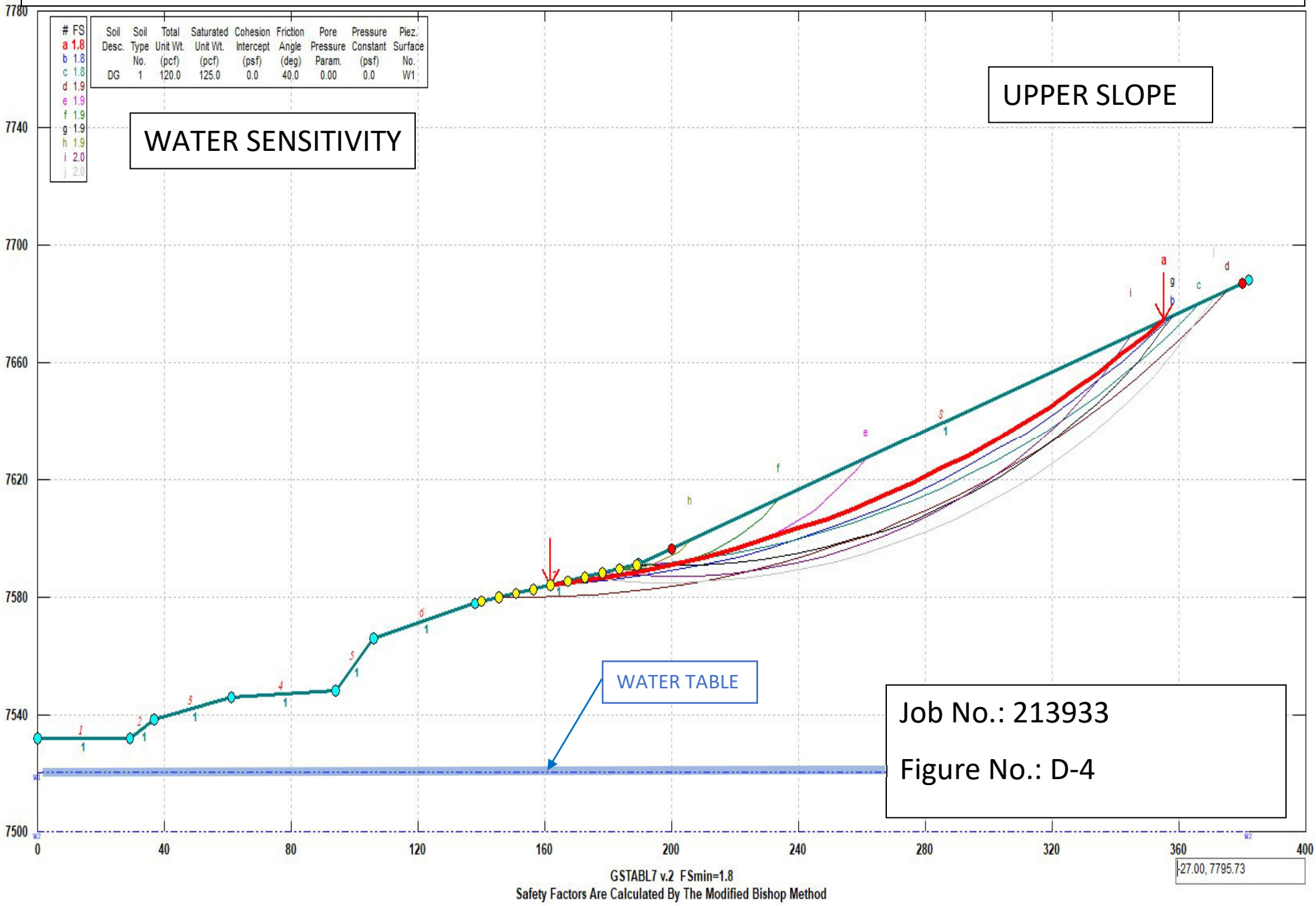
TUSCANY HOMES – 211933– B-B - EXISTING



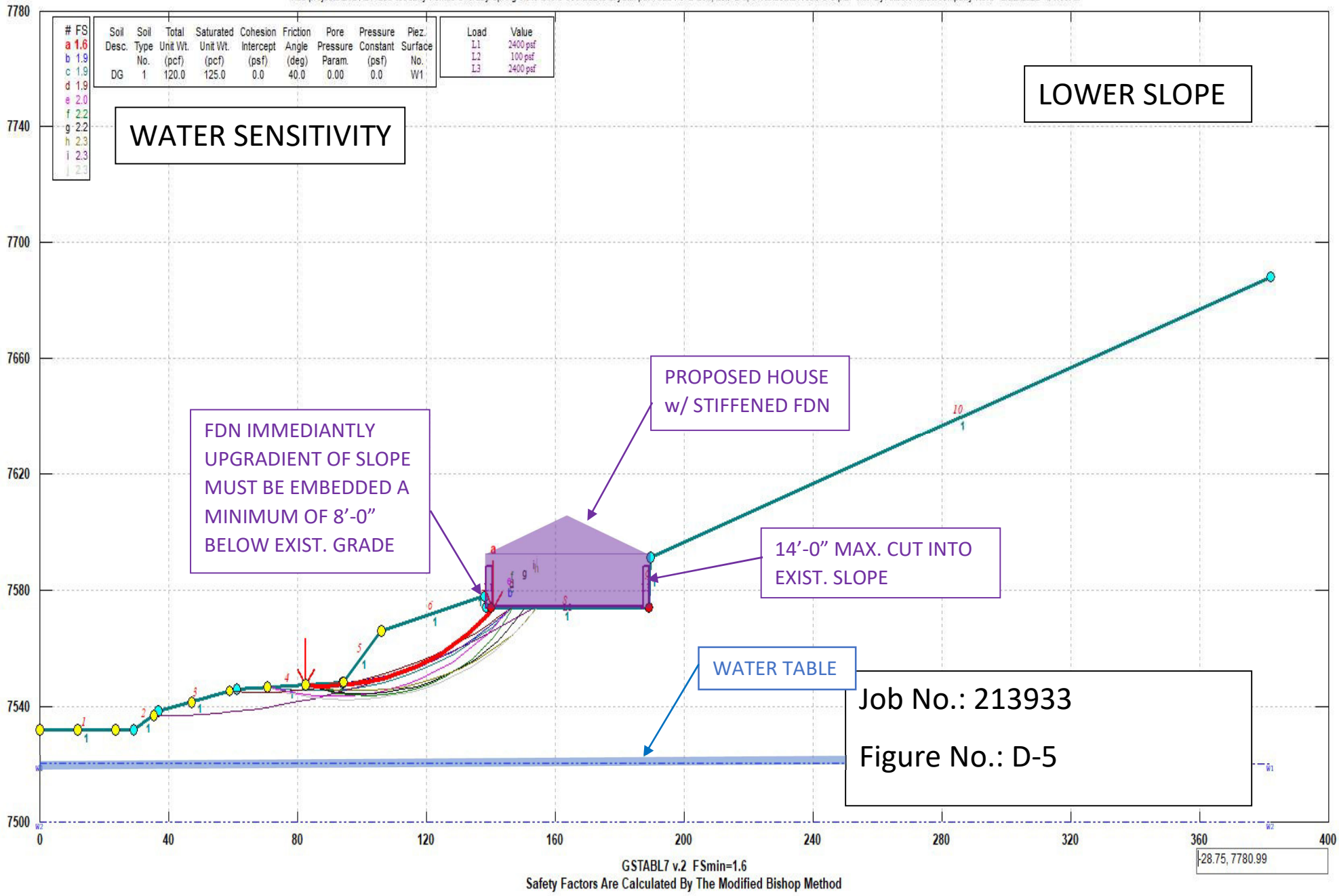
Job No.: 213933

Figure No.: D-3

TUSCANY HOMES – 211933– B-B - EXISTING



TUSCANY HOMES – 211933– B-B - PROPOSED



TUSCANY HOMES – 211933– B-B - PROPOSED