CTL | THOMPSON INCORPORATED

November 14, 2022

The Garrett Companies
1051 Greenwood Springs Boulevard, Suite 101
Greenwood, IN 46143

Attention: Karl Stout

Subject: Geologic Hazard Evaluation
Citizen on Constitution
El Paso County, Colorado
CTL|T Project No. CS19460-105

This letter presents our response to the Colorado Geological Survey (CGS) second review dated November 2, 2022. While we agree with some of the observations and recommendations made by CGS, we present the following discussion with specific items from the CGS letter and our responses. CTL|Thompson, Inc. (CTL|T) prepared a Geologic Hazard Evaluation for the proposed multi-family development at Constitution Avenue and Marksheffel Road in Colorado Springs, Colorado (CTL|T Project No. CS19460-105, dated May 27, 2022). We have been provided the review comments from the Colorado Geological Survey (CGS), whom El Paso County contracts with for the review of Geologic Hazards Evaluations. The CGS review comments were prepared by Jonathan R. Lovekin, P.G., Senior Engineering Geologist and are dated November 2, 2022. The following are a summary of the CGS review comments and our responses.

CGS Comment:

Prior to approval of the site development plan, CGS recommends that the criteria used by the engineer to estimate differential movement at the site be sent to CGS for review. This may include the rationale for the estimate but must be of sufficient detail (i.e., calculations, methodology, etc.) for others to be able to reach the same conclusion as the engineer on the amount of differential movement expected at the site. If calculations of heave from expansive material and settlement of the fill are comingled to estimate ultimate differential movement, this shall be clearly indicated in the criteria to be reviewed.

CTL|T Response:

Engineers use multiple methods to analyze potential settlements. These engineering solutions to estimate settlement have been developed through semiempirical statistical approaches based on the study of field and laboratory testing and historic performance of foundations in the field. The methodologies rely on the engineer's interpretation of the data to input appropriate parameters into the appropriate equations.

The following methodologies were considered for our estimate of settlement and differential movement: Harr (1966); Mitchell and Gardner (1975); Schmertmann (1970); Meyerhof (1956) and (1965); Terzaghi and Peck (1967); Bowles (1977); and Burland and Burbidge (1985). These methods are discussed in the Fundamentals of Geotechnical Engineering by Braja M. Das (4th ed.) and Soil Mechanics in Engineering Practice by Terzaghi, Peck, and Mesri (3rd ed.), amongst other sources.

The experience of the geologist or geotechnical engineer must be used to provide a judgement of the appropriate parameters to use. Appendix C C.2.2.C Site Evaluation Techniques of the El Paso County Engineering Criteria Manual states, "The most appropriate site evaluation techniques shall be determined by the geologist/geotechnical engineer based on site conditions and the activities being proposed for the site."

The judgement of the engineer is the true variable in the methods. This variation can lead to differing results from one firm to another, and even between engineers practicing at the same firm. These variations will be due to selection of input parameters and determination on what method is most appropriate. The expectation that "others" will come to the same conclusion as another engineer is not a reasonable expectation, nor does it define the standard of care relating to the practice of engineering.

The Land Development Code of El Paso County and the El Paso County Engineering Criteria Manual do not include requirements for the disclosure of engineering calculations for geotechnical design, including laboratory test results, bearing capacity, or settlement calculations. Review of these calculations amounts to nothing more that checking the math in well vetted spreadsheets.

This site is generally non-expansive; however, heave was considered for the expansive materials encountered at the site. Various parameters were evaluated to determine appropriate inputs for the design of post tensioned slabs-on-grade and provide the structural engineers with geotechnical criteria for their design. The two main criteria include differential movement of the slab edge and the distance of edge moisture variation that the movement occurs. They are provided for both "edge lift" and "center lift" (edge settlement). These parameters help the structural engineer design the slab to be sufficiently stiff to control differential foundation deflection.

While the structural design of a post tensioned slab helps to mitigate differential soil movements, it should be reiterated that CTL|T has not provided an option to build at the site without either further investigation to determine the fill is reasonably consistent with our soil borings, or that other mitigation methods be employed.

CGS Comment:

A disclosure statement should be added to the final plat stating that this site is underlain by undocumented fill, that the total differential movement at this site may exceed the engineer's estimates, and that it is unknown when in the future differential movement of the undocumented fill will occur.

CTL|T Response:

As discussed in our previous response letter three different approaches to mitigating of the undocumented fill were provided for this site. A plat note stating that the "site is underlain by undocumented fill" as CGS suggests, will describe a situation that will no longer be applicable for the site once remediation is complete.

Further, the plat note CGS suggests states "the total differential movement at this site may exceed the engineer's estimates, and that it is unknown when in the future differential movement of the undocumented fill will occur". This statement assumes that significant differential movement will occur. CTL|T does not provide recommendations that we believe pose a high risk of damaging, post-construction movement. CTL|T has identified the undocumented fill hazard as part of our investigation and includes that observation as part of the Geologic Hazard Evaluation for this site. The Colorado Geological Survey is overstepping by commenting on engineering design considerations.

Section 8.4.9.F Geology and Soils Standards and Reports, Effect of Approval of the El Paso County Engineering Criteria Manual states "The resolution of an issue may be in the form of modification of the development design to mitigate the constraints and hazards, placement of notes on the preliminary plan and final plat to advise buyers of the constraints and hazards, restrictions on construction within a lot or within the subdivision, or a determination that the constraint or hazard may be mitigated by specialized engineering or construction techniques and identification of the entity responsible for such mitigation." We have provided specialized engineering and construction techniques to mitigate the constraint (undocumented fill). We believe that the suggested plat note is unnecessary, and the information intended to be conveyed by such a note has been included in our report, which is already referenced on the plat.

CGS Comment:

Since Plat Note #11 discusses geologic hazards identified at the site, we recommend that the professional who prepared the geologic hazard report provide this notes content for the plat.

CTL|T Response:

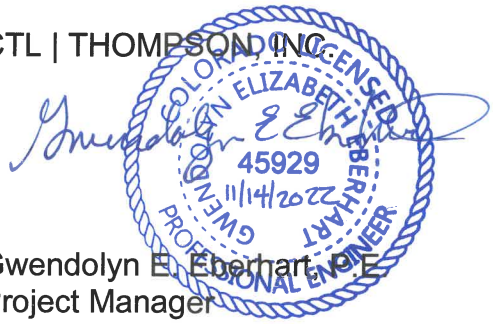
We suggest Plat Note #11 read: "Geologic Hazard Note: Per the Geotechnical Investigation Report prepared by CTL|Thompson, Inc., dated November 16, 2022, (CTL|T Project No. CS19460-125) and the Geologic Hazards Evaluation dated May 27, 2022 (CTL|T Project No. CS19460-105) - No geologic hazards were identified at this site that CTL|Thompson believes preclude development of the project as planned. Undocumented fill material and expansive soils were identified at the site and may pose engineering constraints to development. CTL|Thompson believes these conditions can be mitigated with engineering design and construction methods commonly employed in this area. Geologic Hazards and mitigation alternatives are discussed in the Geotechnical Investigation Report and the Geologic Hazards Evaluation."

We believe this note accurately identifies the potential hazards and provides sufficient notice to potential buyers or design professions about the conditions at the site. As noted above mitigation or further evaluation of the fill at the site will cause the CGS recommended language to be inaccurate.

If we can be of further service in discussing the contents of this letter, please call.

Sincerely,

CTL | THOMPSON, INC.



Gwendolyn E. Eberhart, P.E.
Project Manager

Coauthored by:

Timothy A. Mitchell, P.E.
Division Manager

GE:TAM:tam

Via Email: AWhite@TheGarrettCo.com; Karl@TheGarrettCo.com

Andrew White

From: Jonathan Lovekin <jlovekin@mines.edu>
Sent: Thursday, December 1, 2022 5:25 PM
To: Karl Stout; kariparsons@elpasoco.com; Amy Crandall; JustinKilgore@elpasoco.com; Mitchell, Timothy
Cc: Andrew White
Subject: RE: [External] Sample Settlement Calculations

Kari,

CTL has provided calculations and the methodology used to determine the settlement potential of the undocumented fill. CGS appreciates the additional information, as this satisfies the request from our review of this application. CGS has no further objection to the approval of the development plan and final plat.

In our opinion, Friday's meeting is no longer needed.

Thank you,

Jonathan R. Lovekin, P.G.
Senior Engineering Geologist
Colorado Geological Survey at the Colorado School of Mines
1801 Moly Road, Golden, CO 80401
303.384.2654

From: Karl Stout <Karl@TheGarrettCo.com>
Sent: Thursday, December 1, 2022 1:33 PM
To: kariparsons@elpasoco.com; Jonathan Lovekin <jlovekin@mines.edu>; Amy Crandall <acrandall@mines.edu>; JustinKilgore@elpasoco.com; Mitchell, Timothy <TMitchell@CTLThompson.com>
Cc: Andrew White <awhite@thegarrettco.com>
Subject: [External] Sample Settlement Calculations

Hello,

In preparation for tomorrow's discussion regarding the Citizen on Constitution Multifamily project, please see CTL-Thompson's summary of their methods utilized to calculate differential settlement, along with supplementary calculations. We are hoping you have a chance to review these items before tomorrow's meeting so we can have a productive discussion. We can upload these responses to the County EDARP portal whenever requested.

Thank you.

Andrew White
Civil Engineering Manager, The Garrett Companies
o: 317.497.8275

m: 317.354.6813

RELENTLESSLY PURSUING EXCELLENCE

From: Mitchell, Timothy <TMitchell@CTLThompson.com>
Sent: Wednesday, November 30, 2022 4:57 PM
To: Andrew White <awhite@thegarrettco.com>; Karl Stout <Karl@TheGarrettCo.com>; Eberhart, Gwendolyn <geberhart@ctlthompson.com>
Subject: Sample Settlement Calculations

Please see the attached sample calculations. The method shown, was chosen for the simplicity in showing the calculations. Other methods were also used, as previously noted, to provide context for our judgement in determining appropriate recommendations; however, these are not as simple to show, and I judge this method to be suitable to provide a reasonable assessment of settlements for this project site. Other methods will give different settlement amounts.

These calculations show the "worst case" N value of 8 blows per foot and a high N value of 50 blows per foot. Blow counts are on the logs and the sampler type has been taken into account for the calculations. In practice, the method shown is generally taken as N/4 = Allowable Bearing Capacity (ksf) for up to 1 inch of settlement. I have also shown the second calculation for footing widths greater than 4 feet, although this does not start to show much significance until the footings are larger. Typically, due to simplicity, we do this calculation in our head for sand sites as we count blows in the field, look at the field logs, and as we evaluate the site during the design process. If N/4 is higher than the allowable pressure, then the settlement is calculated as less than 1-inch. I did not show each of the calculations, Gwen and I, have run in our heads.

We apply engineering judgment to the blow counts, because one single blow count does not necessarily reflect the soils through the depth of influence both vertically or horizontally. Additionally, the variations shown in the calculations, from the two scenarios run, reflect differentials over a wide spacing on the site. They also do not indicate how much of the settlement occurs during construction, as loads are applied. The calculations also show a much higher degree of accuracy than is applied to recommendations. **These reasons are why the settlement calculations are used as a basis for judgement and are not typically provided outright. It is highly likely someone will take the values out of context and not consider the overall site, subsurface conditions, and the proposed construction type, because they do not apply the same judgement as the engineer evaluating the site weighing the responsibility of providing the sealed design recommendations.**

As previously stated, the PT Slab design also helps to mitigate differential soil movements. The design adjusts the stiffness based on expected differential movements (which are more than expected due to settlement). This is different methodology than design of separate shallow foundation elements.

As stated, the existing fill does not need to be mitigated due to the calculated settlements. The requested additional investigation is to verify conditions in our boring logs are consistent within the building footprint. This is best done during the construction process when the area is more open and can be better assessed. This same process would be done whether existing fills were identified early in the site evaluation or during construction.

Lastly, in full disclosure, I recalled one time I have been asked for my settlement calculations. It was from another geotechnical consultant, working for us (previous employer) on a related portion of the Virginia State Capital Renovation, back in 2004. This involved a 35-40 foot cut for a below-grade structure with heavy loads, adjacent to the historic capital building. They had tight tolerances due to the building type and age. An interesting, in-depth project for an engineer with only 8 years of experience.

Tim

Timothy A. Mitchell, P.E.
Principal Engineer | Division Manager
Colorado Springs and Pueblo
CTL|Thompson, Inc.
5170 Mark Dabling Boulevard
Colorado Springs, Colorado 80918
Office: 719-528-8300
tmitchell@ctlthompson.com | www.ctlt.com
Licensed States: CO, UT, VA

Confidential Notice: This is a confidential communication. If you received it in error, please notify the sender of the delivery error by replying to this message and then delete it from your system.

Information contained herein may not be complete or accurate. Stamped and signed engineering documents, including those signed digitally, take precedence over preliminary data and electronic communications. CTL¦Thompson will not be liable for the completeness, correctness or readability of electronic data. The electronic data should be checked by the addressee against stamped and signed documents.

SUBJECT: CITIZEN ON CONSTITUTION
SAMPLE SETTLEMENT
CALCULATIONS

CTL|THOMPSON

PROJECT NO.: CS19460-125 DATE: 11/30/22

BY: TAM PAGE 1 OF 1

MEYERHOF (1965)

S = SETTLEMENT IN INCHES
q = SOIL STRESS IN KIPS/SQUARE FOOT
B = FOOTING WIDTH IN FEET
N = UNCORRECTED BLOW COUNTS

$S = 4q/N \quad (B \le 4)$

$S = \frac{6q}{N}\left[\frac{B}{(B+1)}\right]^2 \quad (B > 4)$

q = 2000 PSF = 2KSF

GENERALLY $q = \frac{N}{4}$ FOR S = 1"

N VARIES FROM ABOUT 8 TO 50 IN THE FILL, PER BORING LOGS IN REPORT.

B = RIB WIDTH + 6 · SLAB THICKNESS (EDGE)

= 12" + 6 · 4" = 36" = 3'

$\therefore S = \frac{4q}{N}$ $\quad N=8 \Rightarrow S = \frac{4\cdot 2}{8} = \frac{8}{8} = \boxed{1"}$

$N=50 \Rightarrow S = \frac{4\cdot 2}{50} = \frac{8}{50} = \boxed{0.16"}$

B = RIBWIDTH + 16 · SLAB THICKNESS (INTERIOR)

= 12" + 16 · 4" = 76" = 6.33' ⇒ USE 6.5'

$\therefore S = \frac{6q}{N}\left[\frac{B}{(B+1)}\right]^2$ $\quad N=8 \Rightarrow \frac{6\cdot 2}{8}\left[\frac{6.5}{6.5+1}\right]^2 = \frac{12}{8}\cdot[0.87]^2 = 1.5\cdot 0.76 = \boxed{1.14"}$

$N=50 \Rightarrow \frac{6\cdot 2}{50}\left[\frac{6.5}{6.5+1}\right]^2 = \frac{12}{50}[0.76] = 0.24\cdot 0.76 = \boxed{0.18"}$

N=8 REPRESENTS WORST, SINGLE BLOW COUNT. INCREASING TO 9.12 RESULTS IN ALL SETTLEMENTS ≤1". BASED ON JUDGEMENT OF OVERALL BLOW COUNTS, SETTLEMENTS ARE LESS THAN 1" TOTAL AND LESS THAN 0.5" DIFFERENTIAL FOR BUILDING PURPOSES. ∴ NO MITIGATION IS REQUIRED DUE TO CALCULATED SETTLEMENTS.
EXPANSIVE SOILS ARE ADDRESSED VIA THE PT SLAB DESIGN PARAMETERS THAT ACCOUNT FOR DIFFERENTIAL MOVEMENTS OF 1.44" OVER 4.7' (EDGE LIFT) AND -0.98" OVER 9.0' (CENTER LIFT), WHICH MEET OR EXCEED TOTAL, CALCULATED DIFFERENTIAL SETTLEMENT.

SAMPLE CALCULATIONS ONLY. SEE REPORT FOR RECOMMENDED DESIGN VALUES AND RECOMMENDATIONS