

**To: Mr. Michael Johnson
Director of Community and Economic Development
City of Cottonwood Heights**

**Mr. Adam Ginsberg
Staff Engineer
Public Works, City of Cottonwood Heights**



From: Daniel J. Brown, P.E., Senior Geotechnical Engineer

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Date: January 20, 2021

Subject: Review of Report Geotechnical Study and Slope Stability Analysis Proposed Wasatch Rock Development, 6695 South Wasatch Boulevard Cottonwood Heights, Utah (Gordon Geotechnical, May 13, 2020, Job No. 528-005-20)

Review of Response Letter, Review of Geotechnical Study and Slope Stability Analysis, Proposed Wasatch Rock Development, 6695 South Wasatch Boulevard, Cottonwood Heights, Utah (Gordon Geotechnical, July 9, 2020, Job No. 528-005-20)

Review of Report Final Slope Stability Analysis, Proposed Wasatch Rock Development 6695 South Wasatch Boulevard, Cottonwood Heights, Utah (Gordon Geotechnical, October 7, 2020, Job No. 528-006-20)

Review of Response Letter 3-rev1, Review of Geotechnical Study and Slope Stability Analysis, Proposed Wasatch Rock Development, 6695 South Wasatch Boulevard, Cottonwood Heights, Utah (Gordon Geotechnical, December 16, 2020, Job No. 528-006-20)

Introduction

At the request of Mr. Michael Johnson and Mr. Adam Ginsberg, GeoStrata reviewed the most recent Gordon Geotechnical Engineering, Inc. (Gordon Geotechnical) (G²) review response dated December 16, 2020 which was prepared for the Proposed Wasatch Rock Development located at 6695 South Wasatch Boulevard in Cottonwood Heights, Utah. The Proposed Wasatch Rock Development is planned to consist of a proposed mixed-use development currently planned to include a hotel, a large apartment building, a condominium tower, a senior living center, three mixed-use pads, various ancillary parking areas, three retail pads and re-alignment of Wasatch Boulevard along the western boundary of the subject site.

The December 16, 2020 Gordon Geotechnical review response was completed in response to a GeoStrata review memorandum dated November 3, 2020. The November 3, 2020 GeoStrata review memorandum was prepared as part of our review of the Gordon Geotechnical October 7, 2020 report titled "Report Final Slope Stability Analysis Proposed Wasatch Rock Development 6695 Wasatch Boulevard Cottonwood Heights, Utah". Our review of the above referenced consultant's documents was conducted

on behalf of Cottonwood Heights City to assist the city in protecting public health, safety, and welfare, and to reduce risks to future property owners. The purposes of our review are to assess whether or not the report adequately addresses the geotechnical and slope stability concerns associated with the project consistent with reasonable standards of practice and in accordance with Cottonwood Heights City's Sensitive Lands Evaluation & Development Standards (SLEDS) (Title 19 Chapter 19.72 of the Cottonwood Heights City Municipal code). The objectives to be achieved by the designation of a sensitive lands district include, without limitation, the following:

A. The protection of the public from natural hazards, such as landslide, rockfall, debris flow, earthquake ground rupture, liquefaction, shallow ground water, snow melt/storm water runoff and erosion.

Review Discussion

Section 1.3, Objectives and Scope, of the October 7, 2020 Gordon Geotechnical report states:

“The objectives and scope of our study were planned in discussions between Mr. Josh Cowley of Rockworth Companies and Mr. Patrick Emery of G².”

In general, the objectives of this study were to:

- 1. Further define and evaluate the general subsurface soil and groundwater conditions across the site.*
- 2. Provide updated slope stability recommendations to be utilized in the design and construction of the proposed facilities.”*

Section 1.5, Professional Statements, of the October 7, 2020 Gordon Geotechnical report states:

“Supporting data upon which our recommendations are based are presented in subsequent sections of this report. Recommendations presented herein are governed by the physical properties of the soils encountered in the exploration borings, test pits, and trenches, measured and projected groundwater conditions, and the layout and design data discussed in Section 2., Proposed Construction, of this report. If subsurface conditions other than those described in this report are encountered and/or if design and layout changes are implemented, G2 must be informed so that our recommendations can be reviewed and amended, if necessary.

Our professional services have been performed, our findings developed, and our recommendations prepared in accordance with generally accepted engineering principles and practices in this area at this time.”

The following review comments have been provided after review of our June 17, 2020 review of the May 13, 2020 Gordon Geotechnical report, response comments from the Gordon Geotechnical July 9, 2020 review response letter, our November 3, 2020 review comments based on our review of the Gordon Geotechnical July 9, 2020 review response letter and the October 7, 2020 Gordon Geotechnical final slope stability analysis report, and our current review comments based on our review of the Gordon Geotechnical December 16, 2020 review response letter No. 3-rev1.

June 17, 2020 Review Comment 1

Section 2, Proposed Construction, of the May 13, 2020 Gordon Geotechnical report states:

“Development plans for the site have changed since the previous geotechnical reports for the site. Development at the site is complicated by the existence of several fault lines and a buried aqueduct which render significant portions of the site as “un-buildable” for habitable structures. These fault lines and buried aqueduct have been considered from the onset when designing the latest development plans. The proposed structures have been strategically located in the “buildable” areas defined in the surface fault rupture hazard report.

Currently, a hotel, an apartment, condominium, senior living center, three mixed-use pads, and three retail pads are planned for the site. Additionally, Wasatch Boulevard along the western boundary of the site will be re-aligned to bi-sect the site in a generally north-south direction.”

GeoStrata understands that a geologic hazards study has been completed for the site concurrently with this geotechnical study, which includes a surface fault rupture hazard assessment. GeoStrata recommends that Cottonwood Heights City request that the GeoStrata review comments regarding the surface fault rupture hazard be addressed prior to approving final buildable areas for the proposed development.

July 9, 2020 Gordon Geotechnical Response to Review Comment 1

“A geologic hazard evaluation and surface fault rupture hazard evaluation was performed by Mr. Bill Black of Western Geologic (G2 sub consultant). Comments regarding the surface fault rupture hazard will be addressed in a separate letter by Western Geologic.”

November 3, 2020 Review Comment 1

An update to portions of the geologic hazards study has been completed with the October 7, 2020 Gordon Geotechnical report. GeoStrata is currently completing a separate review of the updated geologic hazards study. Any deficiencies with the geologic hazards’ evaluation (if present) will be noted in our current geologic hazards review letter. Any comments pertaining the updated geologic hazards evaluation must be addressed prior to approving final buildable areas for the proposed development.

Current Comment 1

The GeoStrata November 3, 2020 Review Comment 1 was not addressed by Gordon Geotechnical in their December 16, 2020 review response. GeoStrata recommends that Cottonwood Heights City request that the consultant provide a response to this review comment.

June 17, 2020 Review Comment 2

Section 2, Proposed Construction, of the May 13, 2020 Gordon Geotechnical report states:

“Maximum column and wall loads for the condominium structure are anticipated to be very large, on the order of 1,000 to 1,500 kips and 15 to 30 kips per lineal foot, respectively. Detailed structural loads will be needed to finalize geotechnical recommendations for this structure.”

Following approval of buildable areas and final subdivision of lots for the subject property, GeoStrata

recommends that Cottonwood Heights City request that a design level geotechnical assessment be performed for each of the proposed buildings, which incorporates detailed structural loads. This is especially critical for the proposed condominium structure.

July 9, 2020 Gordon Geotechnical Response to Review Comment 2

“G² is planning to provide a detailed geotechnical assessment for each proposed building with recommendations tailored to the structural loads when foundation plans or loading details become available.”

November 3, 2020 Review Comment 2

GeoStrata recommends that the City require that a detailed geotechnical assessment be provided for each proposed building with recommendations tailored to the structural loads when foundation plans or loading details become available.

Current Comment 2

The GeoStrata November 3, 2020 Review Comment 2 was not addressed by Gordon Geotechnical in their December 16, 2020 review response. GeoStrata recommends that Cottonwood Heights City request that the consultant provide a response to this review comment.

June 17, 2020 Review Comment 3

Section 2, Proposed Construction, of the May 13, 2020 Gordon Geotechnical report states:

“Final site grading will require cuts up to 30 feet in the northern portions of the site and fills on the order of 5 to 10 feet in the southwest portion of the site. Fills up to 35 feet in height are planned for the eastern portion of the site and will buttress the existing gravel pit cut slope. Final site grading slopes are generally not anticipated to not exceed 50 percent or 2.0:1.0 (H:V) with localized areas of up to 56 percent or 1.8:1.0 (H:V).”

GeoStrata recommends that Cottonwood Heights City request that the project geotechnical engineer review final site grading plans to assess whether the final grading plan conforms to the slope stability analysis and recommendations presented in the May 13, 2020 Gordon geotechnical report or whether additional slope stability analysis is needed for the subject development.

July 9, 2020 Gordon Geotechnical Response to Review Comment 3

“G² can review final site grading plans for conformance with the slope stability recommendations provided as final site grading plans become available.”

November 3, 2020 Comment 3

Section 6, Conclusions, of the October 7, 2020 Gordon Geotechnical report states:

“The slope at Section C-C’ is the steepest with an average grade of approximately 53 percent. The stability analysis indicates that compacted bank-run sand and gravel fill material will be required for slopes that exceed 50 percent or 2:1 (H:V).”

Cottonwood Height Code of Ordinances, Title 19, Chapter 19.72, Section 19.72.40, Development Standards and Controls, Subsection F, Cut and Fill Slopes states:

Cut and fill slopes shall comply with the following unless otherwise recommended in an approved soils and geology report:

1. *Cut and fill slopes shall not exceed 12 feet.*
2. *Cut and fill slopes shall not exceed a slope ratio of 2:1 except as follows:*
 - (a) *No slopes shall be cut steeper than the bedding plane, fracture, fault or joint in any formation where the cut slope will lie on the dip of the strike line of the fracture, bedding plane, fault or joint.*
 - (b) *No slopes shall be cut in an existing landslide, mud flow or other form of naturally unstable slope.*
 - (c) *If the material of a slope is of such composition and character as to be unstable under the anticipated maximum moisture conditions, the slope angle shall be reduced to a stable value or increased through retention using a method approved by the city engineer and certified as to its stability by a professional soils engineer.*
3. *Fill slopes shall not be constructed on natural slopes steeper than 2:1.*
4. *Roadway cut and fill slopes located outside the dedicated public right-of-way shall be within recorded easements providing for slope protection and preservation. The easements shall be in a form acceptable to the city.*

GeoStrata recommends that Cottonwood Heights City request that the project geotechnical engineer review final site grading plans to assess whether the final grading plan conforms to the final accepted slope stability analysis and recommendations or whether additional slope stability analysis is needed for the subject development.

Current Comment 3

The GeoStrata November 3, 2020 Review Comment 3 was not addressed by Gordon Geotechnical in their December 16, 2020 review response. GeoStrata recommends that Cottonwood Heights City request that the consultant provide a response to this review comment.

June 17, 2020 Review Comment 4

Section 5.1, Summary of Findings, of the May 13, 2020 Gordon Geotechnical report states:

“The condominium structure at Section A-A’ incorporates a deep cut for below-grade parking. A structural element must extend a minimum of 15 feet below the bottom of footings to assure an adequate factor of safety. This may consist of deep foundations, soil improvement, or a permanent shoring solution such as soil nails.”

GeoStrata recommends that Cottonwood Heights City request that internal, external, and global stability of the permanent shoring and/or retaining wall to be constructed on the uphill side of the proposed condominium structure be evaluated prior to approval for construction. This evaluation will likely be completed during final design of this structure.

July 9, 2020 Gordon Geotechnical Response to Review Comment 4

“Internal, external, and global stability analyses will be performed in conjunction with the final design of the condominium structure and required shoring design. Shoring designs are typically provided by the specialty contractors performing the work.”

November 3, 2020 Review Comment 4

In the October 7, 2020 Gordon Geotechnical report, cross-section A-A' was updated based on additional subsurface data obtained from new boreholes. Section 6, Conclusions, of the October 7, 2020 Gordon Geotechnical report states:

“The condominium structure at Section A-A’ incorporates a deep cut for below-grade parking. A structural element must extend a minimum of 5 feet below the bottom of footings on the cut side to assure an adequate factor of safety. This may consist of deep foundations, soil improvement, or a permanent shoring solution such as soil nails. A depth of 5 feet is shallower than previously recommended in the May 13, 2020 report. This is due to the lack of groundwater encountered to depths of 81 feet at boring locations B-9 and B-10. The projected groundwater is deeper in the updated slope stability models resulting in more favorable slope stability conditions.”

GeoStrata recommends that Cottonwood Heights City request that internal, external, and global stability of the permanent shoring and/or retaining wall to be constructed on the uphill side of the proposed condominium structure be evaluated prior to approval for construction. This evaluation will likely be completed during final design of this structure and should include an assessment of temporary cut and/or shoring during construction.

In addition, GeoStrata recommends that Cottonwood Heights City request that the constructability of the required cuts for this structure be investigated for feasibility. It is likely that additional geotechnical recommendations will be required for this portion of the project in order to decrease the potential for collapse of larger cuts within the unconsolidated granular sediments.

December 16, 2020 Gordon Geotechnical Response to Review Comment 4

G² Response to Current Review Comment 4

Our slope stability analysis indicates that a shoring system will be required to maintain excavation sidewall stability and global stability of the large cuts associated with the condominium structure. There is most likely not sufficient space on the site to open cut this excavation. We recommend that the structural element requirement be considered as part of the shoring or footing design since it would likely be installed by drilling/shoring contractors.

Based on our understanding of the subsurface conditions and experience with deep below grade construction, a top-down cut with a shoring system such as soldier pile and lagging, tieback, or soil nail walls are feasible for this project. G² works with several shoring contractors in Salt Lake City with extensive experience installing permanent and temporary showing walls.

Temporary or permanent shoring systems are typically designed by the contractor performing the work. The shoring system design requires a significant amount of engineering and therefore is typically not performed until the building construction plans have been finalized. Minor changes to the building layout or footing elevations would require a complete re-design of the shoring/deep foundation system.

G² must review the shoring design to ensure that it conforms to the recommendations in our geotechnical study and slope stability analysis.

Current Comment 4

We concur with the recommendations provided by Gordon Geotechnical in their December 16, 2020 response to review comment 4 and we recommend that Cottonwood Heights City require the applicant to comply with these Gordon Geotechnical recommendations.

Based on the discussion presented by Gordon Geotechnical in their December 16, 2020 response to review comment 4, we consider this comment addressed.

June 17, 2020 Review Comment 5

Section 5.2.2, Geometry, of the May 13, 2020 Gordon Geotechnical report states:

“The geometry for the slope stability models was developed from the geologic cross-sections provided with the concurrent Geologic Hazards Evaluation report. Topography was obtained from 2013 lidar data with 0.5-meter resolution. Three cross-sections (A-A’, B-B’, and C-C’) for slope stability analysis were selected based on the locations of the proposed developments and the most adverse topographic and geologic conditions.”

Based on our review of the slope stability results presented in Appendix D and review of the Western Geologic prepared geologic cross sections, the slope stability cross sections closely match the Western Geologic cross sections. If any changes to the geologic cross sections are made based on comments from our review of the Western Geologic geologic hazards study, any updated information, or otherwise, GeoStrata recommends that Cottonwood Heights City request that slope stability cross sections likewise be updated.

July 9, 2020 Gordon Geotechnical Response to Review Comment 5

“G²’s slope stability cross-sections are based on the cross-sections provided by Western Geologic in conjunction with the Geologic Hazard Evaluation report for the project. G2 can update slope stability cross-sections as needed if changes are made in response to the review of the Geologic Hazard Evaluation report.”

November 3, 2020 Review Comment 5

Section 5.1.2, Geometry, of the October 7, 2020 Gordon Geotechnical report states:

“The geometry for the slope stability models was developed from the geologic cross-sections provided with the concurrent Geologic Hazards Evaluation report. Topography was obtained from 2013 lidar data with 0.5-meter resolution. Four cross-sections (A-A’, B-B’, C-C’, and D-D’) for slope stability analysis were selected based on the locations of the proposed developments and the most adverse topographic and geologic conditions.”

Based on our review of the slope stability results presented in Appendix D of the October 7, 2020 report and review of the Western Geologic prepared geologic cross sections presented in Appendix A of the October 7, 2020 report, the updated slope stability cross sections closely match the updated Western Geologic cross sections. If any changes to the geologic cross sections are made based on comments from our review of the Western Geologic geologic hazards study, any updated information, or otherwise, GeoStrata recommends that Cottonwood Heights City request that slope stability cross sections likewise

be updated.

Current Comment 5

The GeoStrata November 3, 2020 Review Comment 5 was not addressed by Gordon Geotechnical in their December 16, 2020 review response. GeoStrata recommends that Cottonwood Heights City request that the consultant provide a response to this review comment.

June 17, 2020 Review Comment 6

Section 5.2.3, Soil Strength, of the May 13, 2020 Gordon Geotechnical report states:

“The soil parameters were selected for analysis based upon direct shear test results performed on undisturbed and laboratory recompacted samples. Strength parameters for the more coarse-grained granular soils were selected based upon our experience with similar soils in the area. These coarse-grained sand and gravel soils are projected to exhibit relatively high strengths based on their performance history in gravel pit cut slopes which have been known to stand near vertical for extended periods of time. The cohesive characteristic of these granular soils may be explained by a slight cementation and interlocking of particles. Parameters of concrete washout are estimated as a hybrid between high strength soil and low-grade concrete.”

Slope cross section B-B' includes a large area of 'Inferred Extents of Concrete Washout'. As the extents of this material are unknown, GeoStrata recommends that Cottonwood Heights City request that reduced strength parameters be applied to this soil unit. In our opinion, the reduced strength parameters for the 'Concrete Washout' material should be similar to the 'Site Grading Fill' soil strength parameters in order to account for the unknown extents and soil strengths of the materials.

July 9, 2020 Gordon Geotechnical Response to Review Comment 6

“G² has performed an updated slope stability analysis for Cross-Section B-B' considering reduced strength parameters to account for the unknown extents of the concrete washout material. The results of the stability analysis indicate that the slope stability recommendations provided are still valid. Graphical results of the updated slope stability analysis are included with Appendix A of this letter.”

November 3, 2020 Review Comment 6

In both the July 9, 2020 Gordon Geotechnical response letter and in the October 7, 2020 Gordon Geotechnical report, strength parameters of the 'Concrete Washout' were updated to match the strength parameters of the 'Site Grading Fill' as requested in our June 17, 2020 review letter. This portion of the comment may be considered addressed.

However, in Section 6.0 "Conclusions" of the October 7, 2020 G² report, it states "Section B-B' indicates that concrete washout material may remain in place provided that any loose or raveling material is removed and the concrete washout is competent."

GeoStrata recommends that Cottonwood Heights City request clarification concerning how the competency of this material is to be assessed, and when such assessments would need to be completed or that the concrete washout material be considered undocumented fill which will require removal, replacement, and compaction to rebuild the slope to satisfactory conditions.

December 16, 2020 Gordon Geotechnical Response to Review Comment 6

G² Response to Current Review Comment 6

The concrete washout material was found to be relatively competent and intact during G²'s field investigation and testing. Our updated slope stability analysis with reduced strength parameters indicated that the concrete washout material can be left in place and maintain global stability of proposed fill slopes. However, some loose blocks and raveling material was observed in the current gravel pit cut slope face near the location of Cross-Section B-B' and is anticipated to be encountered during site grading. The competency of this material will be assessed during initial earthwork site preparation for mass grading. Any loose or raveling material encountered on the slope face during preparation for placement of site grading fill slopes will be considered unsuitable and must be completely removed. G² can observe the site preparation and assess the competency of these materials as needed.

Current Comment 6

We concur with the recommendations provided by Gordon Geotechnical in their December 16, 2020 response to review comment 6 and we recommend that Cottonwood Heights City require the applicant to comply with these Gordon Geotechnical recommendations.

Based on the discussion presented by Gordon Geotechnical in their December 16, 2020 response to review comment 6, we consider this comment addressed.

June 17, 2020 Review Comment 7

Section 5.2.4, Analysis Results, of the May 13, 2020 Gordon Geotechnical report lists recommendations for site grading.

GeoStrata recommends that Cottonwood Heights City request that the applicant include these recommendations and detail drawings for benching of fill slopes into the existing slope with the final grading plan.

July 9, 2020 Gordon Geotechnical Response to Review Comment 7

"G² can assist in providing a detail drawing for benching of the fill slopes into the existing slopes as final site grading plans are developed."

November 3, 2020 Review Comment 7

Section 6, Conclusions, of the October 7, 2020 Gordon Geotechnical report lists recommendations for site grading.

GeoStrata recommends that Cottonwood Heights City request that the applicant include these recommendations and detail drawings for benching of fill slopes into the existing slope with the final grading plan.

Current Comment 7

Section 6, Conclusions, of the October 7, 2020 Gordon Geotechnical report lists recommendations for site grading. In GeoStrata's November 3, 2020 Review Comment 7, we recommended that Cottonwood Heights City request that the applicant include these recommendations and detail drawings for benching of fill slopes into the existing slope with the final grading plan. This comment needed no response by Gordon Geotechnical.

June 17, 2020 Review Comment 8

Cottonwood Height Code of Ordinances, Title 19, Chapter 19.72, Appendix C, Section 3.0, Submittals, Subsection (c) states:

“The results of any slope stability analyses must be submitted with pertinent backup documentation (i.e., calculations, computer output, etc.). Printouts of input data, output data (if requested), and graphical plots must be submitted for each computer-aided slope stability analysis.”

GeoStrata recommends that Cottonwood Heights City request that printouts of input/output data for the near-surface and global slope stability analysis calculations be provided as required by the Cottonwood Heights Code of Ordinances.

July 9, 2020 Gordon Geotechnical Response to Review Comment 8

“Data printouts and calculations for the near-surface and global stability analysis calculations are provided with Appendix B of this letter.”

November 3, 2020 Review Comment 8

Printouts of input/output data for near-surface and global slope stability analysis have been included in the July 9, 2020 Gordon Geotechnical response letter and in the October 7, 2020 Gordon Geotechnical report. This comment may be considered addressed.

June 17, 2020 Review Comment 9

Section 5.3.1, Site Preparation, of the May 13, 2020 Gordon Geotechnical report states:

“Preparation of the site must consist of the removal of all non-engineered fills, loose surficial soils, topsoil, debris, and other deleterious materials from beneath an area extending at least five feet beyond the perimeter of the proposed building, rigid pavement, and exterior flatwork areas.

The non-engineered fills may remain in flexible pavement areas as long as they are properly prepared. Proper preparation will consist of scarifying and moisture conditioning the upper eight inches and recompacting to the requirements of structural fill. However, it should be noted that compaction of fine-grained soils (if encountered) as structural site grading fill will be very difficult, if not impossible, during wet and cold periods of the year. As an option for proper preparation and recompaction, the upper eight inches of the non-engineered fills may be removed and replaced with granular subbase over proofrolled subgrade. Even with proper preparation, flexible pavements established on non-engineered fills may experience some longterm movements. If the possibility of these movements is not acceptable, these non-engineered fills must be completely removed.”

GeoStrata recommends that Cottonwood Heights City request that the recommendation to not fully

remove non-engineered fills from beneath flexible pavements be modified to only include private parking and driveway areas. All city roads will require all undocumented or non-engineered fills be fully removed beneath pavements.

July 9, 2020 Gordon Geotechnical Response to Review Comment 9

G2 recommends that the Cottonwood Heights City requirements for City roads be followed. City roads must be established upon structural site grading fill extending to suitable natural soils. The recommendations provided for flexible pavement site preparation in our May 13, 2020 report are still valid for all private parking and roadway areas.

November 3, 2020 Review Comment 9

This comment may be considered addressed.

June 17, 2020 Review Comment 10

Section 5.4.2, Reinforced Continuous Mat, of the May 13, 2020 Gordon Geotechnical report states:

“We request that a bearing pressure distribution plan be provided to our office for review, when available.”

As part of final design of the proposed structures and as recommended in Review Comment 2, GeoStrata recommends that Cottonwood Heights City request that a design level geotechnical assessment be performed for each of the proposed buildings, which incorporates detailed structural loads. As part of preparation of these reports, a review of planned building foundations and foundation loads should be completed by the geotechnical engineer.

July 9, 2020 Gordon Geotechnical Response to Review Comment 10

“G² can provide a detailed geotechnical assessment for each proposed building, including the condominium structure, when final foundation loading details become available.”

November 3, 2020 Review Comment 10

As part of final design of the proposed structures and as recommended in Review Comment 2, GeoStrata recommends that Cottonwood Heights City request that a design level geotechnical assessment be performed for each of the proposed buildings, which incorporates detailed structural loads. As part of preparation of these reports, a review of planned building foundations and foundation loads should be completed by the geotechnical engineer.

Current Review Comment 10

In GeoStrata’s November 3, 2020 Review Comment 7, we recommended that Cottonwood Heights City request that a design level geotechnical assessment be performed for each of the proposed buildings, which incorporates detailed structural loads. As part of preparation of these reports, a review of planned building foundations and foundation loads should be completed by the geotechnical engineer. This comment needed no response by Gordon Geotechnical.

June 17, 2020 Review Comment 11

Cottonwood Height Code of Ordinances, Title 19, Chapter 19.72, Appendix D, Section 7.0, Submittals, Subsection (c) states:

“The results of any liquefaction analyses must be submitted with pertinent backup documentation (i.e., calculations, computer output, etc.). Printouts of input data, output data (on request), and graphical plots must be submitted for each computer aided liquefaction analysis. In addition, input data files, recorded on diskettes, CDs, or other electronic media, may be requested to facilitate the city’s review.”

GeoStrata recommends that Cottonwood Heights City request that printouts of input/output data for liquefaction hazard analysis calculations be provided as required by the Cottonwood Heights Code of Ordinances.

July 9, 2020 Gordon Geotechnical Response to Review Comment 11

“Data printouts for the liquefaction analysis are provided with Appendix C of this letter.”

November 3, 2020 Review Comment 11

Printouts of input/output data for liquefactions hazard analysis were provided in the July 9, 2020 Gordon Geotechnical response letter. This comment may be considered addressed.

November 3, 2020 Review Comment 12

Section 5.1.3, Soil Strength, of the October 7, 2020 Gordon Geotechnical report states:

“The soil parameters were selected for analysis based upon direct shear test results performed on undisturbed and laboratory recompacted samples. Strength parameters for the more coarse-grained granular soils were selected based upon our experience with similar soils in the area. These coarse-grained sand and gravel soils are projected to exhibit relatively high strengths based on their performance history in gravel pit cut slopes which have been known to stand near-vertical for extended periods of time. The cohesive characteristic and friction angle of these granular soils may be explained by a slight cementation and interlocking of particles. Strength parameters of concrete washout are estimated as being equal to that of site grading fill.

The table on the following page summarizes the soil strength values utilized for static and seismic conditions.”

Soil Type	Soil Parameter	Parameter Units
Lacustrine Sand and Gravel	Cohesion	200 (psf)
	Friction Angle	36
	Unit Weight	120 (pcf)
Laminated Silty Fine Sand Beds, Poorly Graded Sand Beds, Lacustrine Sand	Cohesion	0 (psf)
	Friction Angle	33
	Unit Weight	120 (pcf)
Lacustrine Fines	Cohesion	150 (psf)
	Friction Angle	27
	Unit Weight	120 (pcf)
Site Grading Fill (Compacted Washout Fines)	Cohesion	350 (psf)
	Friction Angle	33
	Unit Weight	120 (pcf)
Site Grading Fill (Compacted Sand and Gravel)	Cohesion	250 (psf)
	Friction Angle	38
	Unit Weight	120 (pcf)
Concrete Washout	Cohesion	350 (psf)
	Friction Angle	33
	Unit Weight	130 (pcf)
Pre-Lake Bonneville Landslide Deposits	Cohesion	0 (psf)
	Friction Angle	21
	Unit Weight	120 (pcf)
Pre-Lake Bonneville Alluvial Fan Deposits	Cohesion	200 (psf)
	Friction Angle	36
	Unit Weight	120 (pcf)

The table above lists soil strength parameters utilized in the slope stability assessment for the proposed development. GeoStrata recommends that Cottonwood Heights City request that the consultant add a column to this table to list the source of each of these soil strength parameters, i.e. sample location, depth, etc.

While responding to this comment, it is recommended that the Consultant note Section 3.0 (a) *Submittals* of Title 19.72 of the Cottonwood Heights City Code, which states; “*Submittals for review shall include boring logs; geologic cross sections; trench and test pit logs; laboratory data (particularly shear strength test results, including individual stress-deformation plots from direct shear tests); discussions pertaining to how idealized subsurface conditions and shear strength parameters used for analyses were developed; analytical results, and summaries of the slope stability and conclusions regarding slope stability.* Section 6.0 (a) of the Cottonwood City Code states; “*Adequate evaluation of slope stability for a given site requires thorough and comprehensive geologic and geotechnical engineering studies. These studies are a crucial component in the evaluation of slope stability. Geologic mapping and subsurface exploration are normal parts of field investigation. Samples of earth materials are routinely obtained during subsurface exploration for geotechnical testing in the laboratory to determine the shear strength*

and other pertinent engineering properties.

It should be noted that all soil strength parameters need to be based either on laboratory testing completed on representative samples of the soils being investigated, or on correlations between other laboratory or field investigation parameters (such as SPT blow counts). Soil strength parameters based on “experience with similar soils in the area” are not considered to represent appropriate sources of soil strength parameters.

December 16, 2020 Gordon Geotechnical Response to Review Comment 12

G² Response to Current Review Comment 12

A column has been added to our strength parameters table indicating the source of the strength parameters for each material.

The table is presented below:

Soil Type	Soil Parameter	Parameter Units	Source of Strength Parameters
Lacustrine Sand and Gravel	Cohesion	200 (psf)	SPT blow count data (using Peck, Hansen, and Thornburn 1953 correlation), partial gradation tests, and direct shear on a representative remolded sample of lacustrine sand and gravel from adjacent gravel pit, "Sample C". The friction angle and cohesion were conservatively lowered from the test result on the laboratory compacted sample.
	Friction Angle	36	
	Unit Weight	120 (pcf)	
Laminated Silty Fine Sand Beds, Poorly Graded Sand Beds, Lacustrine Sand	Cohesion	0 (psf)	Minimum of: <u>Direct Shear: B-3 at 75'</u> Direct Shear: B-2 at 40' Direct Shear: B-4 at 5'
	Friction Angle	33	
	Unit Weight	120 (pcf)	

Soil Type	Soil Parameter	Parameter Units	Source of Strength Parameters
Lacustrine Fines	Cohesion	150 (psf)	Direct Shear: B-2 at 35'
	Friction Angle	27	
	Unit Weight	120 (pcf)	
Site Grading Fill (Compacted Washout Fines)	Cohesion	350 (psf)	Compaction and Direct Shear: representative sample of fill source from adjacent washout fines piles, TP-5
	Friction Angle	33	
	Unit Weight	120 (pcf)	
Site Grading Fill (Compacted Sand and Gravel)	Cohesion	250 (psf)	Compaction and Direct Shear: representative sample of granular fill source from adjacent gravel pit. "Sample C". Cohesion conservatively lowered.
	Friction Angle	38	
	Unit Weight	120 (pcf)	
Concrete Washout	Cohesion	350 (psf)	Field investigation and SPT testing (Boring B-1), strength of low-grade concrete, conservative comparison to compacted site grading fill from direct shear on TP-5 washout fines.
	Friction Angle	33	
	Unit Weight	130 (pcf)	
Pre-Lake Bonneville Landslide Deposits	Cohesion	0 (psf)	Residual Ring Shear: B-6 at 30' and Stark correlation with clay fraction and liquid limit of B-5 at 30' and B-5 at 32.5'. The laboratory test result was determined to be more representative due to interpreted age of the deposit and re-bonding of the clay minerals with time. Correlations were considered for comparison.
	Friction Angle	21	
	Unit Weight	120 (pcf)	
Pre-Lake Bonneville Alluvial Fan Deposits	Cohesion	200 (psf)	Blow count data (B-6 at 40') and conservative comparison to Lacustrine sand and gravel. Comparison is conservative because the interpreted age is much older than lacustrine sand and gravel
	Friction Angle	36	
	Unit Weight	120 (pcf)	

Current Review Comment 12

Based on the data and discussion presented by Gordon Geotechnical in their December 16, 2020 response to review comment 12, we consider this comment addressed.

Closure

This review letter is issued in response to the consultant's assessment of the above referenced site. Comments and recommendations in this review letter are based on data presented by the Consultant. GeoStrata has not performed an independent site assessment. GeoStrata has relied on the Consultant's

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If there are any questions concerning the contents of this review, please feel free to contact our office at (801) 501-0583.