GeoStrata 14425 South Center Point Way, Bluffdale, Utah 84065
T: (801) 501-0583 ~ info@geostrata-llc.com

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: **Timothy J. Thompson, P.G., Principal Geologist**

Date: **December 2, 2020**

Subject: **Review of Supplemental Data Geologic Hazards Evaluation AJ Rock LLC Property 6695 South Wasatch Boulevard Cottonwood Heights, Utah (October 4, 2020)**

Review of Geologic Hazards Evaluation AJ Rock LLC Property 6695 South Wasatch Boulevard Cottonwood Heights, Utah (May 11, 2020)

Review of Surface Fault Rupture Hazard Evaluation AJ Rock LLC Property 6695 South Wasatch Boulevard Cottonwood Heights, Utah (October 8, 2018)

Introduction

At the request of Mr. Michael Johnson and Mr. Adam Ginsberg, GeoStrata reviewed the subject report for the AJ Rock Property completed by Western Geologic & Environmental LLC (Western Geologic) and dated October 4, 2020. The referenced October 4, 2020 Western Geologic report is a supplemental data report to their May 11, 2020 report and their October 8, 2018 report, also cited above. The Western Geologic May 11, 2020 geologic hazards evaluation report and was submitted to Cottonwood Heights City for 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. Our 10/18/2019 review was conducted on the Western Geologic October 8, 2018 report submitted to Cottonwood Heights City. Our 6/16/2020 review was conducted on the updated Western Geologic May 11, 2020 report submitted to Cottonwood Heights City. Our current review of the Western Geologic October 4, 2020 supplemental data report 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 geologic hazards 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 (10/18/2019)
The following are our review comments.

Review Comment 1 (10/18/2019)
Section 19.72.100 Geologic Hazards Reports of Cottonwood Heights City's SLEDS ordinance states:

"A. Upon a determination by the DRC of the scope of geologic or other hazard studies required by an applicant, the applicant, at its expense, shall provide the city with a site-specific report consistent with the requirements of this chapter that identifies all known or suspected geologic hazards on the site, whether originating on-site or offsite, and whether previously identified or previously unrecognized, that may affect the subject property. All reports shall include the original signature and wet stamp of the qualified professional geotechnical engineer or engineering geologist. Geologic hazards reports co-prepared by professional geologists and engineers must include the original signature and wet stamp of both professionals.

B. The scope of the development and the potential for hazards to exist on a sensitive lands property, as determined by the DRC in consultation with the city engineer and city geologist, shall govern which of the following studies must be completed in connection with a development application (the specific requirements for the performance of such studies are found in the appendices to this chapter):

1. Surface fault rupture hazard report (Appendix B). Surface fault rupture hazard reports shall contain all requirements described in Appendix B of this chapter, Minimum Standards for Surface Fault Rupture Hazard Studies. Surface fault rupture studies shall be conducted by a qualified engineering geologist.
2. Slope stability and landslide hazard reports (Appendix C). Slope stability and landslide hazard reports shall contain all requirements described in Appendix C of this chapter, Minimum Standards for Slope Stability Hazard Studies. Slope stability and landslide studies shall be conducted by a qualified engineering geologist, a qualified geotechnical engineer.
3. Liquefaction hazard reports (Appendix D). Liquefaction hazard reports shall contain all requirements described in Appendix D of this chapter, Minimum Standards for Liquefaction Hazard Studies. Liquefaction analyses shall be conducted by a qualified geotechnical engineer.
4. Debris flow hazard reports (Appendix E). Debris flow hazard reports shall contain all requirements described in Appendix E of this chapter, Minimum Standards for Debris Flow Hazard Studies. Debris flow hazard investigations shall be conducted by a qualified engineering geologist. Mitigation measures will generally require contributions from geotechnical engineers, hydrologists, or civil engineers.
5. Rockfall hazard reports (Appendix F). Rockfall hazard reports shall contain all requirements described in Appendix F of this chapter, Minimum Standards for Rock-Fall Hazard Studies. Rockfall studies shall be conducted by a qualified engineering geologist. Mitigation measures will generally require contributions from geotechnical and/or civil engineers.
6. Foundation excavation observation reports (Appendix H). Foundation excavation observation reports shall contain all requirements described in Appendix H of this chapter, Minimum Standards for Foundation Excavation Observation Reports. Foundation observation reports shall be conducted by a qualified geotechnical engineer or engineering geologist. A foundation excavation observation report is required as a condition to issuance of all building permits in sensitive lands areas."

The Purpose and Scope section of the October 8, 2018 Western Geologic Surface Fault Rupture Hazard Evaluation report states: *"...The purpose of our investigation was therefore to evaluate the hazard from surface faulting at the site. Other geologic hazards possibly present at the site were not evaluated and would be beyond the scope of this study..."*

GeoStrata recommends Cottonwood Heights City request that the applicant provide additional geologic hazards reports that assesses the potential for the occurrence of all other geologic hazards that could affect the site in accordance with Cottonwood Heights City's SLEDS ordinance (Title 19 Chapter 19.72 of the Cottonwood Heights City Municipal code).

Review Comment 2 (10/18/2019)

The Purpose and Scope section of the October 8, 2018 Western Geologic Surface Fault Rupture Hazard Evaluation report states: *"...This report has been prepared in general accordance with the Guidelines for Evaluating Surface Fault Rupture Hazards in Utah (Christenson and others, 2003) and generally meets requirements in Appendix B, Chapter 19-9, of the Cottonwood Heights City Geologic Hazards Ordinance (which follows Batatian, 2002), with the exception that no field reviews were conducted in 2009 given that trench excavation and logging were performed on weekends, with backfilling and restoration prior to each Monday, to accommodate active operations and need for unrestricted construction vehicle access. However, the exposures were digitally photographed to document subsurface conditions. The photos are not included herein, but are available upon request."*

Appendix B Section 2.3 Field Review of Cottonwood Heights City's SLEDS ordinance states:

> "A field review by the city's geologist is required during exploratory trenching. The applicant must provide a minimum of two business days' notice to schedule the field review with the city…"

A field review was not scheduled by the applicant and GeoStrata did not conduct a field review of the fault trenches excavated as a part of the October 8, 2018 Western Geologic Surface Fault Rupture Hazard Evaluation.

Appendix B Section 2.1 Scoping meeting of Cottonwood Heights City's SLEDS ordinance states:

> "A scoping meeting with the DRC shall be scheduled by the consultant geologist. At this meeting, the developer, the city and the consultant will evaluate the fault investigation approach. The consultant should bring a site plan to the meeting that shows the following information:
>
> (a) Proposed building locations (if known);
> (b) Expected fault location(s) and orientation;
> (c) Proposed trench locations, orientation, length, and depth (see Section 2.2, Fault Investigation Method);
> (d) Extent of impact to vegetation and trees; and
> (e) Method of controlling erosion and managing storm water.
>
> The investigative approach should allow for flexibility due to unexpected site conditions. The field findings may require modifications to the work plan."

It should be noted that a scoping meeting was not scheduled with the DRC by the consulting geologist as a part of the October 8, 2018 Western Geologic Surface Fault Rupture Hazard Evaluation.

Review Comment 3 (10/18/2019)
The Purpose and Scope section of the October 8, 2018 Western Geologic Surface Fault Rupture Hazard Evaluation report states: *"Salt Lake County hazard maps show the site is crossed by three northwest-trending faults and within the Surface Fault Rupture Special Study Area where trenching studies are required..."*

The Seismotectonic Setting section of the October 8, 2018 Western Geologic Surface Fault Rupture Hazard Evaluation report states: *"...Salt Lake County hazard mapping shows several traces of the WFZ trending northwestward across the site, which form a broad zone of en-echelon, down-to-the-west faulting over 1,000 feet wide..."*

GeoStrata recommends Cottonwood Heights City request that Western Geologic make additional reference to the maps provided in Appendix A and all other applicable sections of Cottonwood Heights City's SLEDS Ordinance (Title 19 Chapter 19.72 of the Cottonwood Heights City Municipal code).

Review Comment 4 (10/18/2019)
Section 19.72.100 Geologic Hazards Reports of Cottonwood Heights City's SLEDS ordinance states:

"C. In addition to the requirements of the aforementioned reports, all geologic hazards reports shall include the following:

1. A 1:24,000-scale geologic map, with references, showing the general surface geology (landslides, alluvial fans, etc), bedrock geology where exposed, bedding attitudes, faults, and other geologic structural features;
2. A detailed site map of the subject area, at a scale equal to or more detailed than one inch equals 200 feet, showing the locations of subsurface investigations and site-specific geologic mapping performed as part of the geologic investigation, including boundaries and features related to any geologic hazards, topography, and drainage. The site map must show the location and boundaries of the property, geologic hazards, delineation of any recommended setback distances from hazards, and recommended locations for structures. Buildable and non-buildable areas shall be clearly identified;
3. Trench logs, when applicable, prepared in the field and presented in the geologic hazard report at a scale equal to or more detailed than one inch equals five feet;
4. Boring logs, when applicable, prepared with standard geologic nomenclature;
5. Listing of aerial photographs used and other supporting information, as applicable;
6. Conclusions, clearly supported by adequate data included in the report, that summarize the characteristics of the geologic hazards, and that address the potential effects of the geologic conditions and geologic hazards on the proposed development and its occupants, particularly in terms of risk and potential damage;
7. Specific recommendations for additional or more detailed studies, as may be required to understand or quantify a geologic hazard;
8. An evaluation of whether or not mitigation measures are required, including an evaluation of multiple mitigation options;
9. Specific recommendations for avoidance or mitigation of the effects of the hazards, consistent with the purposes set forth in this chapter, including design or performance criteria for engineered mitigation measures and all supporting calculations, analyses, modeling or other methods, and assumptions. Final design plans and specifications for engineered mitigation must be signed and stamped by a qualified geotechnical, civil and/or structural engineer, as

appropriate;

10. All data upon which recommendations and conclusions are based shall be clearly stated in the report;
11. A statement shall be provided regarding the suitability of the proposed development from a geologic hazard perspective; and
12. Identification of all utilities that serve the proposed development, including design and specifications of flexible expansion joints for utility lines that cross any fault line(s).

D. When a submitted report does not contain adequate data to support its findings, additional or more detailed studies shall be required to explain or quantify a particular geologic hazard or to describe how mitigation measures recommended in the report are appropriate and adequate."

The Subsurface Evaluation section of the October 8, 2018 Western Geologic Surface Fault Rupture Hazard Evaluation report states: *"…Figure 4 is a site plan at a scale of 1:1,200 (1 inch equals 100 feet) showing the site boundary (heavy black line), current development plan, locations for the trenches conducted for our study (in heavy blue lines), and exposed faults in the trenches (shown by small black lines, with bar and ball on the downthrown side). Faults displaying more than 4 inches (0.3 feet) of displacement in the trench exposures have been correlated across the site based on trend, displacement sense and air photo evidence (discussed above). The faults are labeled for reference purposes with "F" where west dipping and "AF" where east dipping, and are further numbered (west to east) F1 through F9 or AF1 and AF2 (Figure 4)… All of the trenches at the site, except for T-5, exposed one or more faults that displace the Lake Bonneville stratigraphic sequence. No evidence for faulting was observed in T-5. Major faults showing more than 4 feet of displacement were observed in trenches T-3, T-6, T-7, and T-8, corresponding to three main, west-dipping, en-echelon traces (from west to east): (1) a trace formed by F1 and F2 on the west side of the project, which appears to converge northward; (2) fault F7 in the central part of the project; and (3) faults F8 and F9 in the eastern part of the project, which also converge northward (Figure 4). The faults correspond to visible west-facing escarpments on Figure 3A that form a series of steps from west to east across the site. The faulting pattern shown on Salt Lake County hazard maps is similar. Minor faults with between 0.3 and 4.0 feet of displacement were observed in T-2, T-4, and T-7, corresponding to faults F2 through F6. These faults converge northward with F1 and F7 (Figure 3A). Two antithetic faults were also exposed in the trenches: (1) AF1 on the west side of the project in the westernmost escarpment on Figure 4, and (2) AF2 on the east side, which forms a graben bounded by fourth major west-dipping fault to the east on Figure 3A. …"*

GeoStrata recommends Cottonwood Heights City request that Western Geologic provide the additional information for all identified active faults as required in Appendix A and all other applicable sections of Cottonwood Heights City's SLEDS Ordinance (Title 19 Chapter 19.72 of the Cottonwood Heights City Municipal code). Specific attention should be paid to Items 7, 11, and 12 shown above. We also recommend that Cottonwood Heights city request that the referenced publications in the October 8, 2018 Western Geologic Surface Fault Rupture Hazard Evaluation report be reviewed by the consultant and that all updated or more recent maps and reference documents be considered by the Consultant.

In addition, additional information is likewise required based on Items 1, 2, 5, 6, and 10 shown above. Any differences noted by the consultant between the references cited in the October 8, 2018 Western Geologic report and more updated or current maps and reference documents should be addressed by the consultant and changes should be incorporated into their report and recommendations as deemed necessary.

Review Comment 5 (10/18/2019)
The Subsurface Evaluation section of the October 8, 2018 Western Geologic Surface Fault Rupture Hazard Evaluation report states: *"…Faults displaying more than 4 inches (0.3 feet) of displacement in the trench exposures have been correlated across the site based on trend, displacement sense and air photo evidence (discussed above)... Small displacement faults with less than 0.3 feet of displacement were observed in T-1, T-2, and T-4."*

The Conclusions and Recommendations section of the October 8, 2018 Western Geologic Surface Fault Rupture Hazard Evaluation report states: *"…Trenches T-2, T-4, and T-7 also exposed several lesser faults. Table 1 is a compilation of fault data from the trenches at the site, and shows the log station of each trenched fault, fault trends, and dip angles. Small displacement faults showing less than 0.3 feet of displacement are not shown... Several small-displacement faults (less than 4 inches of displacement) were also observed in the trenches at the site. Such faults may be present in other unexplored areas. Although Christenson and others (2003) do not categorically exempt small-displacement faults from the setback guidelines, it is standard practice to exclude these faults from setbacks as they generally pose a lower life safety risk. Although these faults are common and related features of fault-zone deformation, we note that such deformation could cause structural damage that requires costly repairs or which may render a building unusable..."*

Appendix B Section 2.5 Small-displacement-faults of Cottonwood Heights City's SLEDS ordinance states:

"(a) Small-displacement faults are not categorically exempt from setback requirements. Some faults having less than 4 inches (100 mm) of displacement ("*small displacement faults*") may be exempt from setback requirements.

(b) Specific structural risk-reduction options such as foundation reinforcement may be acceptable for some small-displacement faults in lieu of setbacks. Structural options must minimize structural damage.

(c) Fault studies must still identify faults and fault displacements (both net vertical displacements and horizontal extension across the fault or fault zone), and consider the possibility that future displacement amounts may exceed past amounts. If structural risk-reduction measures are proposed for small displacement faults, the following criteria must be addressed:

(i) Reasonable geologic data indicating that future surface displacement along the particular fault will not exceed 4 inches.

(ii) Specific structural mitigation to minimize structural damage.

(iii) A structural engineer must provide appropriate designs and the city shall review the designs."

GeoStrata recommends Cottonwood Heights City request that Western Geologic provide the additional information for the referenced small displacement faults as required in Appendix A and all other applicable sections of Cottonwood Heights City's SLEDS Ordinance (Title 19 Chapter 19.72 of the Cottonwood Heights City Municipal code).

Review Comment 6 (10/18/2019)
The Conclusions and Recommendations section of the October 8, 2018 Western Geologic Surface Fault Rupture Hazard Evaluation report states: *"…To reduce the risk from active surface faulting at the Project, we recommend the following:*

- *Fault Setbacks and Unexplored Areas – No structures intended for human occupancy should be located in the setback zones shaded in red on Figure 4. It is generally accepted practice to allow streets, driveways, yards, and other non-occupied, non-attached structures to be constructed within these areas. No habitable structures should also be located in the unexplored area shaded in gray on Figure 4 without additional subsurface exploration to evaluate if active faults are present.*
- *Excavation Inspection – This report does not reflect subsurface variations that may occur laterally away from an exploration trench. Such variations may occur that could become evident during construction. Thus, it is important that we observe subsurface materials exposed in future excavations (should any below-grade excavations be conducted) to take advantage of opportunities to recognize differing conditions that could affect the performance of a planned structure.*
- *Final Grading and Development Plan Review – The setback distances on Table 1 and Figure 4 assume an 8-foot footing depth from existing grade. However, dipping surfaces may require cuts to create level building pads and require deeper footing depths than assumed. We should therefore review the final grading and development plan to ensure proposed structures will not be in any setback zones. Based on discussions with Tom Henriod of Rockworth Companies, the northeast corner of the apartment building will have a footing depth of 24 feet below existing grade, whereas the remaining building corners will have footing depths of less than 8 feet. Given the fault characteristics from the nearest trench (T-6, Figure 4 and Table 1), a 24-foot footing depth (instead of 8 feet) would increase the setback for fault F9 by 8.7 feet in the area of the northeast building corner. However, the structure is more than 19 feet west of the current setback zone on Figure 4 and thus would still be outside this wider setback.*
- *Excavation Backfill Considerations – The trenches may be in areas where a structure could subsequently be placed. However, backfill may not have been replaced the excavations in compacted layers. The fill could settle with time and upon saturation. Should structures be located in an excavated area, no footings or structure should be founded over the excavation unless the backfill has been removed and replaced with structural fill, if the fill is to support a structure.*
- *Availability of Report – The report should be made available to architects, building contractors, and in the event of a future property sale, real estate agents and potential buyers. This report should be referenced for information on technical data only as interpreted from observations and not as a warranty of conditions throughout the site. The report should be submitted in its entirety, or referenced appropriately, as part of any document submittal to a government agency responsible for planning decisions or provide herein. Although this report and the data herein are the property of the client, the report format is the intellectual property of Western Geologic & Environmental LLC and should not be copied, used, or modified without express permission of the authors."*

GeoStrata concurs with the recommendations provided by Western Geologic in their October 8, 2018 report and recommends that Cottonwood Heights City request that the applicant comply with all recommendations presented by the consultant in their report.

Review Discussion (6/16/2020)

Section 2.0 Purpose and Scope of the May 11, 2020 Western Geologic Geologic Hazards Evaluation report states: *"The purpose and scope of this investigation is to identify and interpret surficial geologic conditions at the site to identify potential risk from geologic hazards to the Project. This investigation is intended to: (1) provide preliminary geologic information and assessment of geologic conditions at the*

site; (2) identify potential geologic hazards that may be present and qualitatively assess their risk to the intended site use; and (3) provide recommendations for additional site- and hazard-specific studies or mitigation measures, as may be needed based on our findings. Such recommendations could require further multi-disciplinary evaluations, and/or may need design criteria that are beyond our professional scope. Our investigation was conducted concurrently with a geotechnical engineering study performed at the Project by Gordon Geotechnical.

Maps included in Appendix A of the Cottonwood Heights City's Sensitive Lands Evaluation & Development Standards (SLEDS; Cottonwood Heights City Municipal Code Title 19, Chapter 19.72) show the property is located in Surface Fault Rupture Study Area (Map 1), a "High" Slope Stability Hazard Area (Map 2), a "Very Low" Liquefaction Hazard Area (Map 3), a "Low" Debris Flow Hazard Area (Map 4), and a "Moderate" Rock Fall Hazard Area (Map 5). Appendix A, Map 10, provides a surficial geologic map based on U.S. Geological Survey Map I-2106 (Personius and Scott, 1992), which is incorporated into Personius and Scott (2009)."

Section 2.1 Methodology of the May 11, 2020 Western Geologic Geologic Hazards Evaluation report states: *"The engineering geology section of this report has been prepared in accordance with Bowman and Lund (2016), current generally accepted professional engineering geologic principles and practice in Utah, and the Cottonwood Heights City SLEDS. However, we do not include discussion of radon hazard potential, as recommended in Bowman and Lund (2016), because radon gas poses an environmental health hazard and indoor levels are heavily influenced by several post-construction, non-geologic factors. The hazard from radon should be evaluated by long-term testing following construction."*

Section 5.0 Geologic Hazards of the May 11, 2020 Western Geologic Geologic Hazards Evaluation report states: *"Assessment of potential geologic hazards and the resulting risks imposed is critical in determining the suitability of the site for development. Table 1 below shows a summary of the geologic hazards reviewed at the site, as well as a relative (qualitative) assessment of risk to the Project for each hazard…"*

Table 1. *Geologic hazards summary.*

Hazard	H	M	L
Earthquake Ground Shaking	X		
Surface Fault Rupture	X		
Liquefaction and Lateral-spread Ground Failure		X	
Tectonic Deformation	X		
Seismic Seiche and Storm Surge			X
Stream Flooding			X
Shallow Groundwater		X	
Landslides and Slope Failures		X	
Debris Flows and Floods			X
Rock Fall			X
Problem Soil and Rock			X

The following are our review comments.

Review Comment 1 (6/16/2020)
In GeoStrata's Review Comment 1 (10/18/2019), we recommend that Cottonwood Heights City request that the applicant provide additional geologic hazards reports that assess the potential for the occurrence of all other geologic hazards that could affect the site in accordance with Cottonwood Heights City's SLEDS ordinance (Title 19 Chapter 19.72 of the Cottonwood Heights City Municipal code).

Based on the data and discussion presented by Western Geologic in their May 11, 2020 Geologic Hazards Evaluation report, we consider this comment addressed.

Review Comment 2 (6/16/2020)
In GeoStrata's Review Comment 2 (10/18/2019), we state that a field review was not scheduled by the applicant and GeoStrata did not conduct a field review of the fault trenches excavated as a part of the October 8, 2018 Western Geologic Surface Fault Rupture Hazard Evaluation. We also state that a scoping meeting was not scheduled with the DRC by the consulting geologist as a part of the October 8, 2018 Western Geologic Surface Fault Rupture Hazard Evaluation.

Section 4.3 Subsurface Investigation of Western Geologic's May 11, 2020 Geologic Hazards Evaluation report states: *"Eight trenches were excavated and logged at the Project in 2009 and one trench was excavated and logged in 2020 to evaluate subsurface geologic conditions and assess the potential hazard from surface faulting. The 2009 investigation was conducted prior to formalization of the current Cottonwood Heights City SLEDS, based on an estimated timeline provided by Tim Thompson of GeoStrata. No work plan was prepared for the 2009 investigation, and no Project scoping or field reviews were conducted. A work plan dated March 2, 2020 was prepared for the 2020 investigation that was approved by Tim Thompson of GeoStrata on March 17, 2020. A field review for trench T-9 was conducted with Mr. Thompson on March 27, 2020."*

Based on the data and discussion presented by Western Geologic in their May 11, 2020 Geologic Hazards Evaluation report, we consider this comment addressed.

Review Comment 3 (6/16/2020)
In GeoStrata's Review Comment 3 (10/18/2019), we recommend that Cottonwood Heights City request that Western Geologic make additional reference to the maps provided in Appendix A and all other applicable sections of Cottonwood Heights City's SLEDS Ordinance (Title 19 Chapter 19.72 of the Cottonwood Heights City Municipal code).

Based on the data and discussion presented by Western Geologic in their May 11, 2020 Geologic Hazards Evaluation report, we consider this comment addressed.

Review Comment 4 (6/16/2020)
In GeoStrata's Review Comment 4 (10/18/2019), we recommend that Cottonwood Heights City request that Western Geologic provide the additional information for all identified active faults as required in Appendix A and all other applicable sections of Cottonwood Heights City's SLEDS Ordinance (Title 19 Chapter 19.72 of the Cottonwood Heights City Municipal code). Specific attention should be paid to Items 7, 11, and 12 listed in Section 19.72.100 Geologic Hazards Reports of Cottonwood Heights City's SLEDS ordinance:

7. Specific recommendations for additional or more detailed studies, as may be required to understand or quantify a geologic hazard;
11. A statement shall be provided regarding the suitability of the proposed development from a geologic hazard perspective; and
12. Identification of all utilities that serve the proposed development, including design and specifications of flexible expansion joints for utility lines that cross any fault line(s).

Based on the data and discussion presented by Western Geologic in their May 11, 2020 Geologic Hazards Evaluation report, we consider this comment addressed. Some detailed discussion of these items may be presented in our current comments addressing Western Geologic's assessment of individual geologic hazards presented in their May 11, 2020 Geologic Hazards Evaluation report which can be found in comments 7 through 18 later this memorandum.

In GeoStrata's Review Comment 4 (10/18/2019), we recommend that Cottonwood Heights city request that the referenced publications in the October 8, 2018 Western Geologic Surface Fault Rupture Hazard Evaluation report be reviewed by the consultant and that all updated or more recent maps and reference documents be considered by the consultant. Specific attention should be paid to Items 1, 2, 5, 6, and 10 listed in Section 19.72.100 Geologic Hazards Reports of Cottonwood Heights City's SLEDS ordinance:

1. A 1:24,000-scale geologic map, with references, showing the general surface geology (landslides, alluvial fans, etc), bedrock geology where exposed, bedding attitudes, faults, and other geologic structural features;
2. A detailed site map of the subject area, at a scale equal to or more detailed than one inch equals 200 feet, showing the locations of subsurface investigations and site-specific geologic mapping performed as part of the geologic investigation, including boundaries and features related to any geologic hazards, topography, and drainage. The site map must show the location and boundaries of the property, geologic hazards, delineation of any recommended setback distances from hazards, and recommended locations for structures. Buildable and non-buildable areas shall be clearly identified;
5. Listing of aerial photographs used and other supporting information, as applicable;
6. Conclusions, clearly supported by adequate data included in the report, that summarize the characteristics of the geologic hazards, and that address the potential effects of the geologic conditions and geologic hazards on the proposed development and its occupants, particularly in terms of risk and potential damage;
10. All data upon which recommendations and conclusions are based shall be clearly stated in the report;

Based on the data and discussion presented by Western Geologic in their May 11, 2020 Geologic Hazards Evaluation report, we consider this comment addressed with the exception of Item 2 listed above. A detailed site map of the subject area, at a scale equal to or more detailed than one inch equals 200 feet, showing the site-specific geologic mapping performed as part of the geologic investigation was not included in the report. We recommend that that Cottonwood Heights City request that Western Geologic prepare an updated Figure 4 that includes their site-specific geologic mapping that meets the requirements of Item 2. Some detailed discussion of these items may be presented in our current comments addressing Western Geologic's assessment of individual geologic hazards presented in their

May 11, 2020 Geologic Hazards Evaluation report which can be found in comments 7 through 18 later this memorandum.

In GeoStrata's Review Comment 4 (10/18/2019), we recommend that any differences noted by the consultant between the references cited in the October 8, 2018 Western Geologic report and more updated or current maps and reference documents should be addressed by the consultant and changes should be incorporated into their report and recommendations as deemed necessary.

Based on the data and discussion presented by Western Geologic in their May 11, 2020 Geologic Hazards Evaluation report, we consider this comment addressed.

Review Comment 5 (6/16/2020)
In GeoStrata's Review Comment 5 (10/18/2019), we recommend that Cottonwood Heights City request that Western Geologic provide the additional information for the referenced small displacement faults as required in Appendix A and all other applicable sections of Cottonwood Heights City's SLEDS Ordinance (Title 19 Chapter 19.72 of the Cottonwood Heights City Municipal code).

Section 5.2 Subsurface Fault Rupture of Western Geologic's May 11, 2020 Geologic Hazards Evaluation report states: *"Small displacement faults (< 0.3 feet of offset) are not listed on Table 3A, but two such faults were observed in trench T-1 underlying Pad E (Figures 4 and 5A). These faults show no evidence for Holocene reactivation that would suggest a future larger displacement is likely. We believe the faults pose a low life-safety risk, but recommend the structure be designed to withstand up to 0.3 feet of vertical offset to reduce the risk of costly repairs. Utility lines that cross faults should also be engineered to withstand expected displacements and/or have design features to ensure life safety."*

Section 6.0 Conclusions and Recommendations, *Surface Fault Rupture Hazards* of Western Geologic's May 11, 2020 Geologic Hazards Evaluation report states: *"... The structure on Pad E, which overlies two small displacement faults observed in trench T-1 (Figures 4 and 5A), should be designed to withstand up to 0.3 feet of vertical offset. Utility lines that cross faults should also be engineered to withstand expected displacements and/or have design features to ensure life safety."*

Section 6.0 Conclusions and Recommendations, *Excavation Inspection* of Western Geologic's May 11, 2020 Geologic Hazards Evaluation report states: *"This report does not reflect subsurface variations that may occur laterally away from an exploration trench. Such variations may occur that could become evident during construction. Thus, it is important that we observe subsurface materials exposed in future excavations to take advantage of opportunities to recognize differing conditions that could affect the performance of a planned structure."*

We concur with the recommendations provided by Western Geologic to address the issue of small displacement faults across the subject site. These recommendations include: 1) Structure be designed to withstand up to 0.3 feet of vertical offset to reduce the risk of costly repairs. 2) Utility lines that cross faults should also be engineered to withstand expected displacements and/or have design features to ensure life safety. 3) The structure on Pad E, which overlies two small displacement faults observed in trench T-1 (Figures 4 and 5A), should be designed to withstand up to 0.3 feet of vertical offset. 4) The project professional geologist should observe subsurface materials exposed in future excavations to take advantage of opportunities to recognize differing conditions that could affect the performance of a

planned structure.

We recommend that Cottonwood Heights City require the applicant to comply with these Western Geologic recommendations. We recommend that Cottonwood Heights City require that the project professional geologist assess where utility lines cross active faults so that the utilities can be engineered to withstand expected displacements and/or have design features to ensure life safety and observe subsurface materials exposed in future excavations to take advantage of opportunities to recognize differing conditions that could affect the performance of a planned structure.

Based on the data and discussion presented by Western Geologic in their May 11, 2020 Geologic Hazards Evaluation report, we consider this comment addressed.

Review Comment 6 (6/16/2020)
In GeoStrata's Review Comment 6 (10/18/2019), we concurred with the recommendations provided by Western Geologic in their October 8, 2018 report and recommend that Cottonwood Heights City request that the applicant comply with all recommendations presented by the consultant in their report. This comment needed no response by Western Geologic.

Review Comments Regarding Western Geologic's May 11, 2020 Geologic Hazards Report (6/16/2020)

Review Comment 7 (6/16/2020)
Section 4.3 Subsurface Investigation of Western Geologic's May 11, 2020 Geologic Hazards Evaluation report states: *"…Subsurface exploration was limited to accessible areas not mantled by large gravel piles, such as along roads, and further restricted by the easement for the aqueduct crossing the site. No exploration was conducted in steep areas of the eastern part of the Project (east of the steep escarpments from gravel mining) and no long continuous trench exposures were feasible…*

Section 4.4 Cross Sections of Western Geologic's May 11, 2020 Geologic Hazards Evaluation report states: *"…Units and contacts should be considered approximate and inferred, and variations should be expected at depth and laterally. We caution that some portions of the cross sections have limited or no subsurface data.*

No groundwater was encountered in Gordon Geotechnical boring B-3 or any of the trenches at the site, except for in the base of the old tank excavation in trench T-2 (Figure 6C, stations 155 feet to about 190 feet). Groundwater in trench T-2 was at a depth of about 13 feet below the ground surface (bgs), and was encountered at a depth of 22.5 feet bgs in boring B-1 and at a depth of 29 feet bgs in boring B-2 (Figure 4). Based on this, groundwater deepens between trench T-2 and boring B-2 from 13 to 29 feet deep, and deepens to more than 100 feet between borings B-2 and B-3. These data suggest a southwestward flow direction. Inferred groundwater levels are shown on the cross sections."

Based on the data and discussion presented by Western Geologic in their May 11, 2020 Geologic Hazards Evaluation report regarding the preparation of the geologic cross sections, it is our opinion that due to the site constraints faced by Western Geologic during their fieldwork, the geologic cross sections are preliminary in nature with little or no substantiating subsurface data in some areas. It is our opinion that more subsurface data is needed by Western Geologic to allow them to prepare geologic cross

sections that are substantiated with sufficient subsurface data. The geologic cross sections presented by Western Geologic in their May 11, 2020 Geologic Hazards Evaluation report were utilized by the project geotechnical engineer in their slope stability modeling. Only three cross sections were prepared for the site. Western Geologic cautions that variations should be expected at depth within and laterally from their geologic cross sections. We recommend that Cottonwood Heights City consider the slope stability modeling based on the Western Geologic May 11, 2020 geologic cross sections to be preliminary in nature and the city should require the consultant to prepare updated geologic cross sections that are substantiated with sufficient subsurface data when the site conditions allow such data to be collected. When updated geologic cross sections are prepared that are substantiated with sufficient subsurface data, we recommend that the city require the geotechnical consultant to utilize these updated geologic cross sections for finalized detailed slope stability modeling across the subject site.

Review Comment 8 (6/16/2020)
Section 5.1 Earthquake Ground Shaking of Western Geologic's May 11, 2020 Geologic Hazards Evaluation report states: *"…We note that IBC 2018 provisions require calculation of the spectral acceleration value (SM1), seismic design value (SD1), and site coefficient (Fv) differently from IBC 2015. In municipalities where IBC 2018 has been adopted, the Project engineer or architect should determine these seismic values in accordance with ASCE 7-16 Section 11.4.8 guidelines."*

Based on the data and discussion presented by Western Geologic in their May 11, 2020 Geologic Hazards Evaluation report, we consider Earthquake Ground Shaking addressed.

Review Comment 9 (6/16/2020)
Section 4.3 Subsurface Investigation of Western Geologic's May 11, 2020 Geologic Hazards Evaluation report states: *"…Trench excavation and logging in 2009 was performed on weekends to facilitate backfilling and restoration and allow for unrestricted construction vehicle access prior to active operations each following Monday. Subsurface exploration was limited to accessible areas not mantled by large gravel piles, such as along roads, and further restricted by the easement for the aqueduct crossing the site. No exploration was conducted in steep areas of the eastern part of the Project (east of the steep escarpments from gravel mining) and no long continuous trench exposures were feasible… Deep fill materials were encountered in places that complicated excavation and logging, such as from active and inactive utility lines, old pit excavations, backfilled settling ponds, and past grading activities. Although native sediments were exposed, excavation in some areas could not extend deep enough to expose correlative stratigraphy across exposed faults… Surveyed elevations for significant faults are tagged in blue on Figure 4 to show the highest point of the fault in the trench exposure. Fault elevation is shown because the site has been and will be subject to significant surface modification, which may change the fault location depending on dip direction, angle, and amount of surface material removed. The trenches generally provide good overlapping coverage given a presumed overall fault trend of about N15°W… A lineament is on the 1938 air photo that suggests this fault (F10, Figure 4) trends to the southeast and then bends eastward to converge with F9. No trenching could be conducted to confirm the fault location southeast of trench T-9 due to the aqueduct easement.*

Section 5.2 Surface Fault Rupture of Western Geologic's May 11, 2020 Geologic Hazards Evaluation report states: *"…Faults displaying 0.3 feet or more of displacement in the trench exposures are correlated across the site on Figure 4 (bold red dashed lines) based on trend, displacement sense and air photo evidence (Section 4.2)… Small displacement faults (less than 0.3 feet) are noted where they*

were encountered in a trench, but are not correlated. With the exception of trench T-1, all of the small displacement faults were observed in existing fault zones with larger displacements… Given the above, the risk from surface faulting is high at the site. Based on our current understanding that surface fault rupture and deformation tend to follow past patterns, we recommend a non-buildable (setback) zone around the projected traces of the fault crossing the site as shown on Figure 4… Small displacement faults (< 0.3 feet of offset) are not listed on Table 3A, but two such faults were observed in trench T-1 underlying Pad E (Figures 4 and 5A). These faults show no evidence for Holocene reactivation that would suggest a future larger displacement is likely. We believe the faults pose a low life-safety risk, but recommend the structure be designed to withstand up to 0.3 feet of vertical offset to reduce the risk of costly repairs. Utility lines that cross faults should also be engineered to withstand expected displacements and/or have design features to ensure life safety… The setback distances on Tables 3A-B and Figure 4 are calculated assuming an 8-foot footing depth from existing grade. However, the Project may require cuts to create level building pads that would have deeper footing depths than we assume. We therefore show a safety factor on Tables 3A and 3B that should be added to the calculated setback distance (S, Table 3A) per 1-foot difference between the surveyed fault elevation (or existing grade) and proposed grade elevation where the difference exceeds 6 feet (assuming footings are 2 feet below grade, for a total depth of 8 feet). The distance between the fault and nearest portion of the structure should be more than the sum. The minimum setback is 20 feet. This safety factor only applies to the downthrown fault sides. For upthrown fault sides, cuts would shift a fault and the corresponding UFS setback horizontally in the direction of dip, i.e. westward for west-dipping faults and eastward for east-dipping faults… We recommend not modifying the defined setback areas on Figure 4 to avoid complexity and because development plans may change. Instead, the Project civil engineer should review the above on a case-by-case basis to ensure that structures are at a safe distance in areas where significant cuts are planned. This may be shown as a table on the grading plan. It is our understanding that minor adjustments will be made with regard to the condominium and Pad E structures on Figure 4. The most-recent grading plan should be submitted at the time our report and the geotechnical engineering report are submitted to Cottonwood Heights City. Though plans may change (and may differ from the base provided on Figure 4), CAD fault and setback delineations on Figure 4 have been confirmed to accurately coincide with those of the Project civil engineer."

Based on the data and discussion presented by Western Geologic in their May 11, 2020 Geologic Hazards Evaluation report regarding their subsurface investigation and surface fault rupture hazard assessment, it is our opinion that due to the site constraints faced by Western Geologic during their fieldwork, the surface fault rupture hazard assessment presented in their May 11, 2020 Geologic Hazards Evaluation report is considered preliminary in nature. Western Geologic states that their subsurface exploration was limited to accessible areas of the subject site not mantled by large gravel piles, such as along roads, and further restricted by the easement for the aqueduct crossing the site and that no exploration was conducted in steep areas of the eastern part of the Project (east of the steep escarpments from gravel mining) and no long continuous trench exposures were feasible. They also state that the ground surface elevation for significant faults were surveyed and tagged in blue on Figure 4 in their May 11, 2020 report because the site has been and will be subject to significant surface modification, which may change the ground surface intersection locations of faults depending on dip direction, angle, and amount of surface material removed. They also state that a lineament on the 1938 air photo was used to map fault F10 (Figure 4) trending to the southeast and then bending eastward to converge with F9, however no trenching could be conducted to confirm the fault location southeast of trench T-9 due to the aqueduct easement. Western Geologic recommends the Project civil engineer should review the fault

setbacks presented on Figure 4 on a case-by-case basis to ensure that structures are setback a safe distance from active faults in areas where significant cuts are planned. Western Geologic also states that it is their understanding that minor adjustments will be made with regard to the condominium and Pad E structures on Figure 4. They recommend that the most-recent grading plan be submitted to Cottonwood Heights City at the time their report and the geotechnical engineering report are submitted to the city, but they state that the site plans may change and may differ from the base provided on Figure 4. GeoStrata recommends that Cottonwood Heights City require the applicant to allow Western Geologic to review the final design site plans and make any necessary comments on the grading plan and adjustments to their recommended fault setbacks. We further recommend that Cottonwood Heights City require the applicant to allow Western Geologic to perform to final surface fault rupture hazard assessment of each proposed structure on a case-by-case basis to assess each proposed buildable area for active faults and make any necessary modifications to their surface fault rupture hazard mitigation recommendations. We recommend that Western Geologic perform the final surface fault rupture hazard assessment of each proposed structure once final grading plans and design plans have been prepared and prior to final approval of the development plans by Cottonwood Heights City.

Review Comment 10 (6/16/2020)
Section 5.3 Liquefaction of Western Geologic's May 11, 2020 Geologic Hazards Evaluation report states: *"...Based on the above, we rate the existing risk from liquefaction as moderate. We conservatively recommend that the hazard from liquefaction be considered and discussed in the Project geotechnical engineering evaluation. Future liquefaction from a large-magnitude earthquake on the Salt Lake City section of the WFZ, if it occurs, could similarly manifest as lateral spreading given the site slopes."*

Based on the data and discussion presented by Western Geologic in their May 11, 2020 Geologic Hazards Evaluation report, we consider Liquefaction addressed.

Review Comment 11 (6/16/2020)
Section 5.4 Seismic Seiche and Storm Surge of Western Geologic's May 11, 2020 Geologic Hazards Evaluation report states: *"...Given the above, the Project is in an area at a high risk from tectonic deformation. Tectonic deformation is not typically a life-safety issue but can tilt building pads and alter sewer and water flow gradients, which may require expensive subsequent repairs. The owner and all future owners should understand and be willing to accept the risk. We recommend that the hazard from tectonic deformation be disclosed in all future real estate transactions."*

Based on the data and discussion presented by Western Geologic in their May 11, 2020 Geologic Hazards Evaluation report, we consider Seismic Seiche and Storm Surge addressed.

Review Comment 12 (6/16/2020)
Section 5.5 Tectonic Deformation of Western Geologic's May 11, 2020 Geologic Hazards Evaluation report states: *"...Given the elevation of the subject property and distance from large bodies of water, we rate the risk from seismic seiches as low."*

Based on the data and discussion presented by Western Geologic in their May 11, 2020 Geologic Hazards Evaluation report, we consider Tectonic Deformation addressed.

Review Comment 13 (6/16/2020)
Section 5.6 Stream Flooding of Western Geologic's May 11, 2020 Geologic Hazards Evaluation report states: *"…No active drainages were observed crossing the Project and Federal Emergency Management Agency flood insurance rate mapping (Map Number 49035C0318G, effective 09/25/2009) classifies the Project in "Zone X - Area of Minimal Flood Hazard". Given the above, we rate the risk from stream flooding as low. Care should be taken that proper surface drainage is maintained."*

Based on the data and discussion presented by Western Geologic in their May 11, 2020 Geologic Hazards Evaluation report, we consider Stream Flooding addressed.

Review Comment 14 (6/16/2020)
Section 5.7 Shallow Groundwater of Western Geologic's May 11, 2020 Geologic Hazards Evaluation report states: *"As discussed* [in] *Section 4.4 above, groundwater deepens between trench T-2 and Gordon Geotechnical boring B-2 from 13 to 29 feet deep (Figure 4), and deepens to more than 100 feet between borings B-2 and B-3. Given this, the western half of the site has a moderate risk from shallow groundwater. Foundation and site subsurface drainage concerns should be considered and discussed in the Project geotechnical engineering evaluation. Care should be taken that proper subsurface drainage is maintained."*

Based on the data and discussion presented by Western Geologic in their May 11, 2020 Geologic Hazards Evaluation report, we consider Shallow Groundwater addressed.

Review Comment 15 (6/16/2020)
Section 5.7 Landslides and Slope Failures of Western Geologic's May 11, 2020 Geologic Hazards Evaluation report states: *"…No landslides are mapped or evident at the Project on Figure 2, but trench T-6 exposed evidence for a relict landslide that incorporated surficial debris and likely occurred prior to or contemporaneous with the Bonneville transgression… Given the above and the steep slopes at the site associated with prior gravel mining operations, as profiled on Figures 14 through 16, we rate the risk from landslides and slope instability as moderate. We conservatively recommend that slope stability be evaluated by the Project geotechnical engineer based on site-specific soil conditions and the data provided in this report. Recommendations should be provided to reduce the landslide hazard risk if factors of safety are determined to be unsuitable. Water, steep man-made cuts, and non-engineered fill materials are often major contributors to slope instability. Care should therefore also be taken to maintain proper site drainage, that site grading does not destabilize slopes at the site without prior geotechnical analysis and grading plans, and that water from man-made sources is minimized in potentially unstable slope areas."*

Based on the data and discussion presented by Western Geologic in their May 11, 2020 Geologic Hazards Evaluation report, we consider Landslides and Slope Failures addressed.

Review Comment 16 (6/16/2020)
Section 5.7 Debris Flows of Western Geologic's May 11, 2020 Geologic Hazards Evaluation report states: *"…The site is not in a mapped active alluvial fan, and no evidence for debris-flow channels, levees, or other debris-flow features was observed at the site on air photos or during our reconnaissance. Given the above, we rate the risk as low."*

Based on the data and discussion presented by Western Geologic in their May 11, 2020 Geologic Hazards Evaluation report, we consider Debris Flows addressed.

Review Comment 17 (6/16/2020)
Section 5.7 Rock Fall of Western Geologic's May 11, 2020 Geologic Hazards Evaluation report states: *"No significant bedrock outcrops are at the site or in adjacent higher slopes that could present a source area for rock fall clasts, and no boulders likely from rock falls were observed at the site. Based on the above, we rate the hazard from rock falls as low."*

Based on the data and discussion presented by Western Geologic in their May 11, 2020 Geologic Hazards Evaluation report, we consider Rock Fall addressed.

Review Comment 18 (6/16/2020)
Section 5.7 Problem Soil and Rock of Western Geologic's May 11, 2020 Geologic Hazards Evaluation report states: *"Surficial soils that contain certain clays can swell or collapse when wet. Soil conditions and specific recommendations for site grading, subgrade preparation, and footing and foundation design should be provided in the Project geotechnical engineering evaluation."*

Based on the data and discussion presented by Western Geologic in their May 11, 2020 Geologic Hazards Evaluation report, we consider Problem Soil and Rock addressed.

Review Comment 19 (6/16/2020)
The Conclusions and Recommendations section of Western Geologic's May 11, 2020 Geologic Hazards Evaluation report states: *"Earthquake ground shaking, surface fault rupture, and tectonic deformation are identified as posing a high relative risk to the proposed development. Liquefaction and lateral-spread ground failure, shallow groundwater, and landslides and slope failures are identified as posing a moderate risk. The following recommendations are provided with regard to the geologic characterizations in this report:*

- *Seismic Design – All habitable structures developed at the property should be constructed to current adopted seismic building codes to reduce the risk of damage, injury, or loss of life from earthquake ground shaking. The Project geotechnical engineer should confirm the ground-shaking hazard and provide appropriate seismic design parameters as needed. We note that earthquake ground shaking is a common hazard for all Wasatch Front areas and, although ground shaking and surface faulting are related earthquake hazards, they pose distinctly different risks.*
- *Geotechnical Evaluation – A design-level geotechnical engineering study should be conducted prior to construction to assess soil foundation conditions, assess the risk from shallow groundwater and liquefaction (and provide recommendations as needed), and evaluate slope stability. The stability evaluation should be based on geologic characterizations in this report and site-specific geotechnical data, and provide recommendations for reducing the risk of landsliding if the factors of safety are deemed unsuitable.*
- *Site Modifications and Drainage – No unplanned cuts should be made in the slopes at the site without prior geotechnical analyses, and proper surface and subsurface drainage should be maintained.*
- *Surface Fault Rupture Hazards – No structures intended for human occupancy should be located*

in the setback zones shaded in light red on Figure 4. It is generally accepted practice to allow streets, driveways, yards, and other non-occupied, non-attached structures to be constructed within these areas. No habitable structures should also be located in the unexplored area shaded in light green on Figure 4 without additional subsurface exploration to evaluate if active faults are present. The structure on Pad E, which overlies two small displacement faults observed in trench T-1 (Figures 4 and 5A), should be designed to withstand up to 0.3 feet of vertical offset. Utility lines that cross faults should also be engineered to withstand expected displacements and/or have design features to ensure life safety.

- *Grading and Development Plan Review – Significant cuts could change fault locations and setback zone calculations. A safety factor and an upthrown fault side modifier are therefore provided in Section 5.2 to assist review of the grading and development plan by the Project civil engineer in areas where there such cuts may be planned. Care should be taken in these areas to ensure that proposed structures remain at a safe distance. Results of this review may be shown as a table on the grading plan. The most-recent grading plan should be included with our report and the geotechnical engineering report when the reports are submitted to Cottonwood Heights City. We have confirmed our fault and setback delineations on Figure 4 accurately coincide with CAD data of the Project civil engineer.*
- *Excavation Backfill Considerations – The trenches may be in areas where a structure could subsequently be placed. However, backfill may not have been replaced in the excavations in compacted layers. The fill could settle with time and upon saturation. Should structures be located in an excavated area, no footings or structure should be founded over the excavation unless the backfill has been removed and replaced with structural fill.*
- *Excavation Inspection – This report does not reflect subsurface variations that may occur laterally away from an exploration trench. Such variations may occur that could become evident during construction. Thus, it is important that we observe subsurface materials exposed in future excavations to take advantage of opportunities to recognize differing conditions that could affect the performance of a planned structure.*
- *Hazard Disclosures and Report Availability – All hazards identified as posing a high risk at the site should be disclosed to future buyers so that they may understand and be willing to accept any potential developmental challenges and/or risks posed by these hazards. This report should be made available to architects, building contractors, and in the event of a future property sale, real estate agents and potential buyers. The report should be referenced for information on technical data only as interpreted from observations and not as a warranty of conditions throughout the site. The report should be submitted in its entirety, or referenced appropriately, as part of any document submittal to a government agency responsible for planning decisions or geologic review. Incomplete submittals void the professional seals and signatures we provide herein. Although this report and the data herein are the property of the client, the report format is the intellectual property of Western Geologic and should not be copied, used, or modified without express permission of the authors".*

GeoStrata concurs with the recommendations provided by Western Geologic in their May 11, 2020 Geologic Hazards Evaluation report and recommends that Cottonwood Heights City request that the applicant comply with all recommendations presented by the consultant in their report.

Current Review Discussion
The October 4, 2020 Western Geologic Supplemental Data Geologic Hazards Evaluation report states: *"Western Geologic & Environmental, LLC prepared a geologic hazards evaluation report for the subject site dated May 11, 2020 (Western Geologic, 2020). This letter provides supplemental information with regard the site to address review comments provided in GeoStrata (2020) and additional subsurface information obtained by Gordon Geotechnical in August and September 2020...This letter is not a stand-alone document and should be included as a supplement to our prior report. No changes to the recommendations provided in Western Geologic (2020; Section 6.0) appear needed at this time…"*

The following are our review comments.

Current Review Comment 1
Based on the data and discussion presented by Western Geologic in their May 11, 2020 Geologic Hazards Evaluation report, we consider this comment addressed.

Current Review Comment 2
Based on the data and discussion presented by Western Geologic in their May 11, 2020 Geologic Hazards Evaluation report, we consider this comment addressed.

Current Review Comment 3
Based on the data and discussion presented by Western Geologic in their May 11, 2020 Geologic Hazards Evaluation report, we consider this comment addressed.

Current Review Comment 4
The October 4, 2020 Western Geologic Supplemental Data Geologic Hazards Evaluation report states: *"GeoStrata (2020; current review comment 4) recommends that a site-specific geologic map for the site be provided. As indicated on the revised Figure 4, we consider the entire site to be underlain by man-made fill overlying lacustrine gravel and sand deposited during the transgressive stage of Lake Bonneville, including cobbles, and lesser silt and clay. The native sediments have a mixed depositional provenance and have been mapped as separate, differing units by McKean (2018) and Personius and Scott (1992, 2009). However, these sediments are similar in composition and have been consistently observed throughout the site. We do not consider their provenance to be a significant detail from the perspective of the Cottonwood Heights City's Sensitive Lands Evaluation & Development Standards (SLEDS; Cottonwood Heights City Municipal Code Title 19, Chapter 19.72)."*

Based on the data and discussion presented by Western Geologic in their May 11, 2020 Geologic Hazards Evaluation report and their October 4, 2020 Supplemental Data Geologic Hazards Evaluation report, we consider this comment addressed.

Current Review Comment 5
We concur with the recommendations provided by Western Geologic in their May 11, 2020 Geologic Hazards Evaluation report to address the issue of small displacement faults across the subject site. These recommendations include: 1) Structure be designed to withstand up to 0.3 feet of vertical offset to reduce the risk of costly repairs. 2) Utility lines that cross faults should also be engineered to withstand expected displacements and/or have design features to ensure life safety. 3) The structure on Pad E, which overlies two small displacement faults observed in trench T-1 (Figures 4 and 5A), should be designed to

withstand up to 0.3 feet of vertical offset. 4) The project professional geologist should observe subsurface materials exposed in future excavations to take advantage of opportunities to recognize differing conditions that could affect the performance of a planned structure.

We recommend that Cottonwood Heights City require the applicant to comply with these Western Geologic recommendations. We recommend that Cottonwood Heights City require that the project professional geologist assess where utility lines cross active faults so that the utilities can be engineered to withstand expected displacements and/or have design features to ensure life safety and observe subsurface materials exposed in future excavations to take advantage of opportunities to recognize differing conditions that could affect the performance of a planned structure.

Based on the data and discussion presented by Western Geologic in their May 11, 2020 Geologic Hazards Evaluation report, we consider this comment addressed.

Current Review Comment 6

In GeoStrata's Review Comment 6 (10/18/2019), we concurred with the recommendations provided by Western Geologic in their October 8, 2018 report and recommend that Cottonwood Heights City request that the applicant comply with all recommendations presented by the consultant in their report. This comment needed no response by Western Geologic.

Current Review Comment 7

Section 4.3 Subsurface Investigation of Western Geologic's May 11, 2020 Geologic Hazards Evaluation report states: *"...Figure 4 provides a site plan at scale of 1 inch equals 100 feet (1:1,200) showing locations of the subsurface exploration we conducted at the site, as well as locations of ten (10) Gordon Geotechnical borings, site boundaries, proposed development, and faults and setback zones (as defined in Western Geologic, 2020). Borings B-4 through B-10 are the new borings conducted in August and September 2020. Based on additional subsurface data from these borings, we have revised Figures 14 through 16 from Western Geologic (2020) and included one additional geologic cross section (D-D', Figure 17). Cross Section A-A' is based on the stratigraphic sequence in trenches T-5, T-6, and T-9 and subsurface data from borings B-9 and B-10. Cross Section B-B' is based on the stratigraphic sequence in trenches T-5 and T-6, as well as data from borings B-3, B-4, and B-5. Cross section C-C' is based on the stratigraphic sequence in trenches T-6, T-7, and T-8, as well as data from borings B-2 and B-7. Cross section D-D' is at a scale of 1-inch equals 50 feet, and is based on the stratigraphic sequence in trenches T-5 and T-6, as well as data from borings B-4 and B-8. Cross sections B-B' and D-D' show a pre-Lake Bonneville landslide that was encountered in trench T-6 and at depth in borings B-5 and B-6. The inferred extent of the concealed landslide deposit is shown on Figure 4 based on a lack of evidence for it in the remaining explorations. Inferred groundwater levels are based on static groundwater depths measured in the borings by Gordon Geotechnical in September 2020. The topographic profiles are based on geoprocessed 2013 LIDAR data. The LIDAR data provide a snapshot of topographic conditions at the time it was acquired; past, present, and future topographic conditions may vary. We believe the attached cross sections provide a conservative basis for slope stability analyses by Gordon Geotechnical and are adequate based on available data. However, units and contacts should be considered approximate and inferred. Some variation should be expected that cannot be anticipated..."*

Based on the data and discussion presented by Western Geologic in their May 11, 2020 Geologic Hazards Evaluation report and their October 4, 2020 Supplemental Data Geologic Hazards Evaluation

report, we consider this comment addressed.

The four geologic cross sections presented by Western Geologic in their October 4, 2020 Supplemental Data Geologic Hazards Evaluation report were utilized by the project geotechnical engineer (Gordon Geotechnical Engineering) in their slope stability modeling presented in their October 7, 2020 report titled "Final Slope Stability Analysis Proposed Wasatch Rock Development 6695 Wasatch Boulevard Cottonwood Heights, Utah".

Current Review Comment 8
Based on the data and discussion presented by Western Geologic in their May 11, 2020 Geologic Hazards Evaluation report, we consider Earthquake Ground Shaking addressed.

Current Review Comment 9
Based on the data and discussion presented by Western Geologic in their May 11, 2020 Geologic Hazards Evaluation report regarding their subsurface investigation and surface fault rupture hazard assessment, it is our opinion that due to the site constraints faced by Western Geologic during their fieldwork, the surface fault rupture hazard assessment presented in their May 11, 2020 Geologic Hazards Evaluation report is considered preliminary in nature. Western Geologic states that their subsurface exploration was limited to accessible areas of the subject site not mantled by large gravel piles, such as along roads, and further restricted by the easement for the aqueduct crossing the site and that no exploration was conducted in steep areas of the eastern part of the Project (east of the steep escarpments from gravel mining) and no long continuous trench exposures were feasible. They also state that the ground surface elevation for significant faults were surveyed and tagged in blue on Figure 4 in their May 11, 2020 report because the site has been and will be subject to significant surface modification, which may change the ground surface intersection locations of faults depending on dip direction, angle, and amount of surface material removed. They also state that a lineament observed on the 1938 air photo was used to map fault F10 (Figure 4) trending to the southeast and then bending eastward to converge with F9, however no trenching could be conducted to confirm the fault location southeast of trench T-9 due to the aqueduct easement.

Western Geologic recommends the Project civil engineer should review the fault setbacks presented on Figure 4 on a case-by-case basis to ensure that structures are setback a safe distance from active faults in areas where significant cuts are planned. Western Geologic also states that it is their understanding that minor adjustments will be made with regard to the condominium and Pad E structures on Figure 4. They recommend that the most-recent grading plan be submitted to Cottonwood Heights City at the time their report and the geotechnical engineering report are submitted to the city, but they state that the site plans may change and may differ from the base provided on Figure 4. GeoStrata recommends that Cottonwood Heights City require the applicant to allow Western Geologic to review the final design site plans and make any necessary comments on the grading plan and adjustments to their recommended fault setbacks. We further recommend that Cottonwood Heights City require the applicant to allow Western Geologic to perform a final surface fault rupture hazard assessment of each proposed structure on a case-by-case basis to assess each proposed buildable area for active faults and make any necessary modifications to their surface fault rupture hazard mitigation recommendations. We recommend that Western Geologic perform the final surface fault rupture hazard assessment of each proposed structure once final grading plans and design plans have been prepared and prior to final approval of the development plans by Cottonwood Heights City.

It should be noted that the setback areas as shown on Figure 4 are delineated around the mapped locations of the surface rupture faults as shown on Figure 4. In Bowman and Lund (2016) Chapter 3 Guidelines for Evaluating Surface-Fault-Rupture Hazards in Utah, under the section heading Fault Mapping, subsection heading Trench Number and Location (page 44) it states: *"...Trenches should be oriented perpendicular, or as close to perpendicular as possible, to the trend of the mapped fault trace at or near the site, and be of adequate length to intercept faults projecting toward proposed or existing structures and potential setback areas...."*

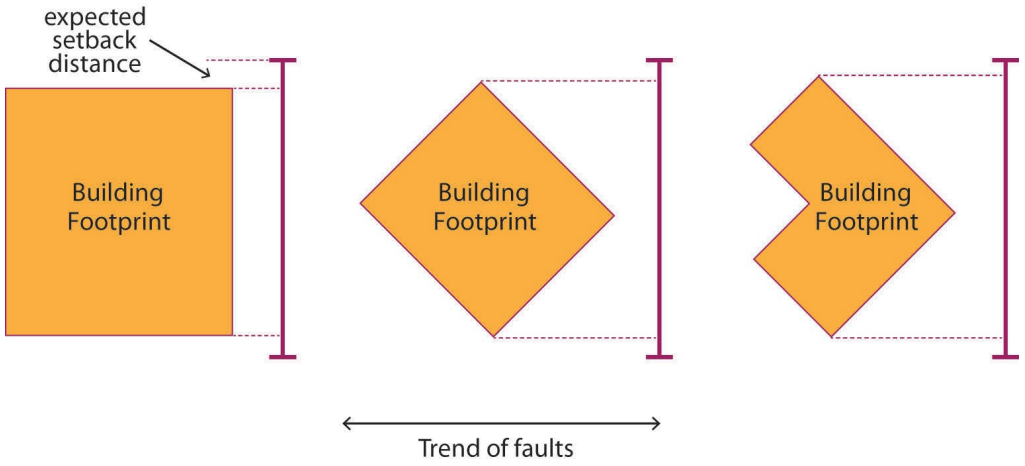

Figure 15. *Fault trench length and orientation to investigate a building footprint. Trenching must extend beyond the footprint of at least the expected setback distance for the IBC Building Risk Category class (from Christenson and others, 2003).*

Based on the recommended practice as described by Bowman and Lund (2016), trenching must extend beyond the proposed footprint of planned structures at least the distance of the expected or calculated setback distance. This means that the setback areas as shown on Western Geologic's Figure 4 should extend in from the ends of the trenches into the trench the distance of the calculated setback distance. The boundaries of the setback areas and buildable area as shown on Western Geologic's Figure 4 should be determined considering the UGS recommendation that trenching must extend beyond the footprint of each proposed structure a distance of at least the expected setback distance for the IBC Building Risk Category class (from Christenson and others, 2003) as shown above on the Bowman and Lund (2016) Figure 15. Setback areas and buildable areas for each proposed structure should be established in accordance with the method described by Bowman and Lund (2016) as part of the final surface fault rupture hazard assessment of each proposed structure. We recommend that the Cottonwood Heights City require Western Geologic to delineate surface fault rupture setback areas and buildable areas for the subject site on an updated Figure 4 in accordance with the method described by Bowman and Lund (2016).

Current Review Comment 10

Based on the data and discussion presented by Western Geologic in their May 11, 2020 Geologic Hazards Evaluation report, we consider Liquefaction addressed.

Current Review Comment 11

Based on the data and discussion presented by Western Geologic in their May 11, 2020 Geologic Hazards Evaluation report, we consider Seismic Seiche and Storm Surge addressed.

Current Review Comment 12
Based on the data and discussion presented by Western Geologic in their May 11, 2020 Geologic Hazards Evaluation report, we consider Tectonic Deformation addressed.

Current Review Comment 13
Based on the data and discussion presented by Western Geologic in their May 11, 2020 Geologic Hazards Evaluation report, we consider Stream Flooding addressed.

Current Review Comment 14
Based on the data and discussion presented by Western Geologic in their May 11, 2020 Geologic Hazards Evaluation report, we consider Shallow Groundwater addressed.

Current Review Comment 15
Based on the data and discussion presented by Western Geologic in their May 11, 2020 Geologic Hazards Evaluation report, we consider Landslides and Slope Failures addressed.

Current Review Comment 16
Based on the data and discussion presented by Western Geologic in their May 11, 2020 Geologic Hazards Evaluation report, we consider Debris Flows addressed.

Current Review Comment 17
Based on the data and discussion presented by Western Geologic in their May 11, 2020 Geologic Hazards Evaluation report, we consider Rock Fall addressed.

Current Review Comment 18
Based on the data and discussion presented by Western Geologic in their May 11, 2020 Geologic Hazards Evaluation report, we consider Problem Soil and Rock addressed.

Current Review Comment 19
GeoStrata concurs with the recommendations provided by Western Geologic in their May 11, 2020 Geologic Hazards Evaluation report and recommends that Cottonwood Heights City request that the applicant comply with all recommendations presented by the consultant in their report.

Closure

This letter is issued in response to the consultants' assessments of the above referenced site. Comments and recommendations in this review letter are based on data presented by the Consultants. GeoStrata has not performed an independent site assessment. GeoStrata has relied on the Consultant's logs, cross sections, and reports in performing its services. Consequently, it does not represent or warrant that the Consultant's logs, cross sections, and reports contain accurate data or proper recommendations. Recommendations and Comments presented in this review letter are provided to Cottonwood Heights City to aid them in making decisions to reduce potential risks from geologic and geotechnical hazards. GeoStrata makes no warranty; either expressed or implied and shall not be liable for any direct, special, incidental, or consequential damages with respect to claims by users of this review.

All services performed by GeoStrata for this review were provided for the exclusive use and benefit of Cottonwood Heights City. No other person or entity is entitled to rely on GeoStrata's services or use the information contained in this letter without the express written consent of GeoStrata.

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

References

Western Geologic & Environmental LLC, 2018, Surface Fault Rupture Hazard Evaluation AJ Rock LLC Property 6695 South Wasatch Boulevard Cottonwood Heights, Utah, dated October 8, 2018.

Western Geologic & Environmental LLC, 2020, Review of Geologic Hazards Evaluation AJ Rock LLC Property 6695 South Wasatch Boulevard Cottonwood Heights, Utah, dated May 11, 2020.

Western Geologic & Environmental LLC, 2020, Review of Supplemental Data Geologic Hazards Evaluation AJ Rock LLC Property 6695 South Wasatch Boulevard Cottonwood Heights, Utah, dated October 4, 2020.