

NOTICE OF MEETING
HILLSIDE REVIEW BOARD
CITY OF ST. GEORGE
WASHINGTON COUNTY, UTAH

Public Notice

Notice is hereby given that the Hillside Review Board of the City of St. George, Washington County, Utah, will hold meetings at the referenced site on **Wednesday, February 28, 2024**, commencing on-site at approximately 8:30 a.m.

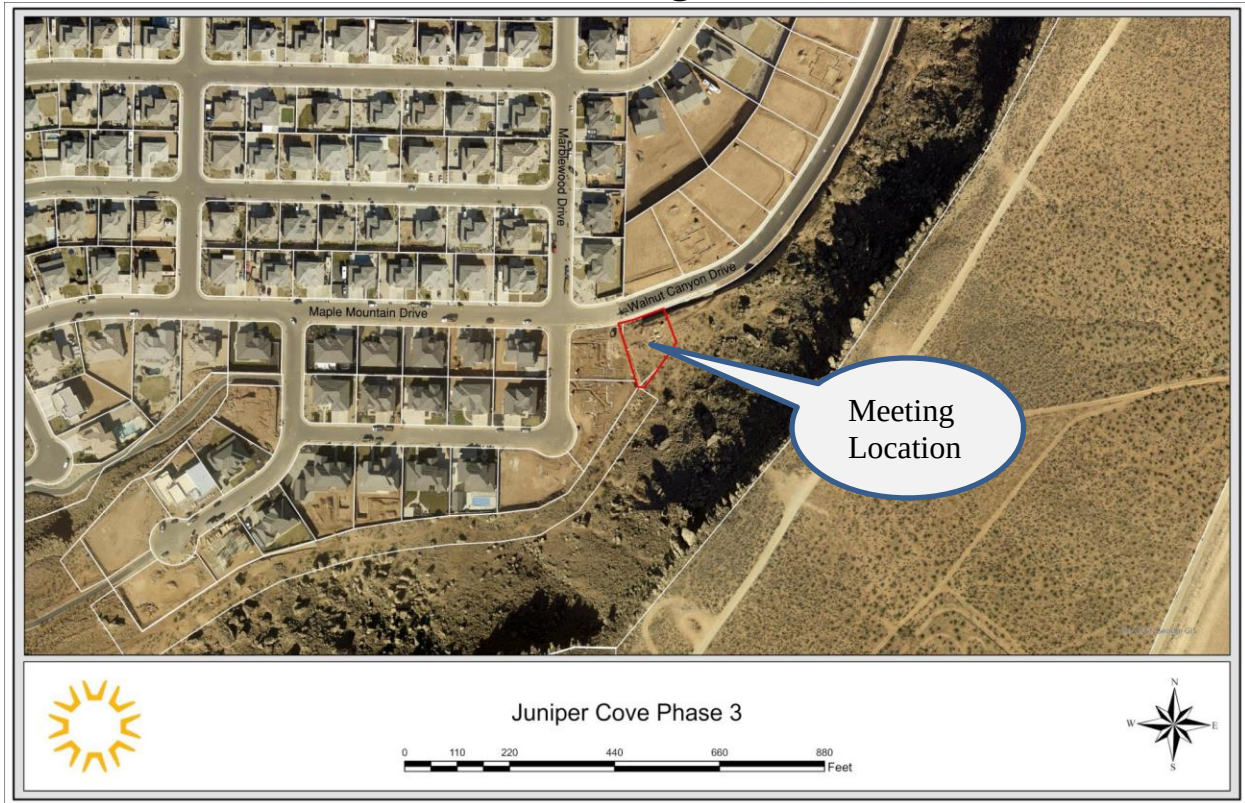
The estimated site times are in bold. The agenda for the meeting is as follows:

1. Consider a request for a hillside development permit in the hillside overlay zone and in areas exceeding 20% slope and rockfall study area for a potential single-family lot located at approximately just east of the Marblewood Drive/Walnut Canyon Drive Intersection (see map below). The property is approximately 0.26 acres. **Meeting time is approximately 8:30 am, on Walnut Canyon Drive just east of Marblewood Drive.**
2. Consider a request for a hillside development permit in the hillside overlay zone and in areas exceeding 20% slope and in a rockfall study zone for a potential hotel at approximately 300 South 1470 East (see map below). The property is approximately 2.17 acres. **Meeting time is approximately 9:00 am, on 1470 East at approximately 300 South.**
3. Approval of the meeting minutes from January 24, 2024, meeting.

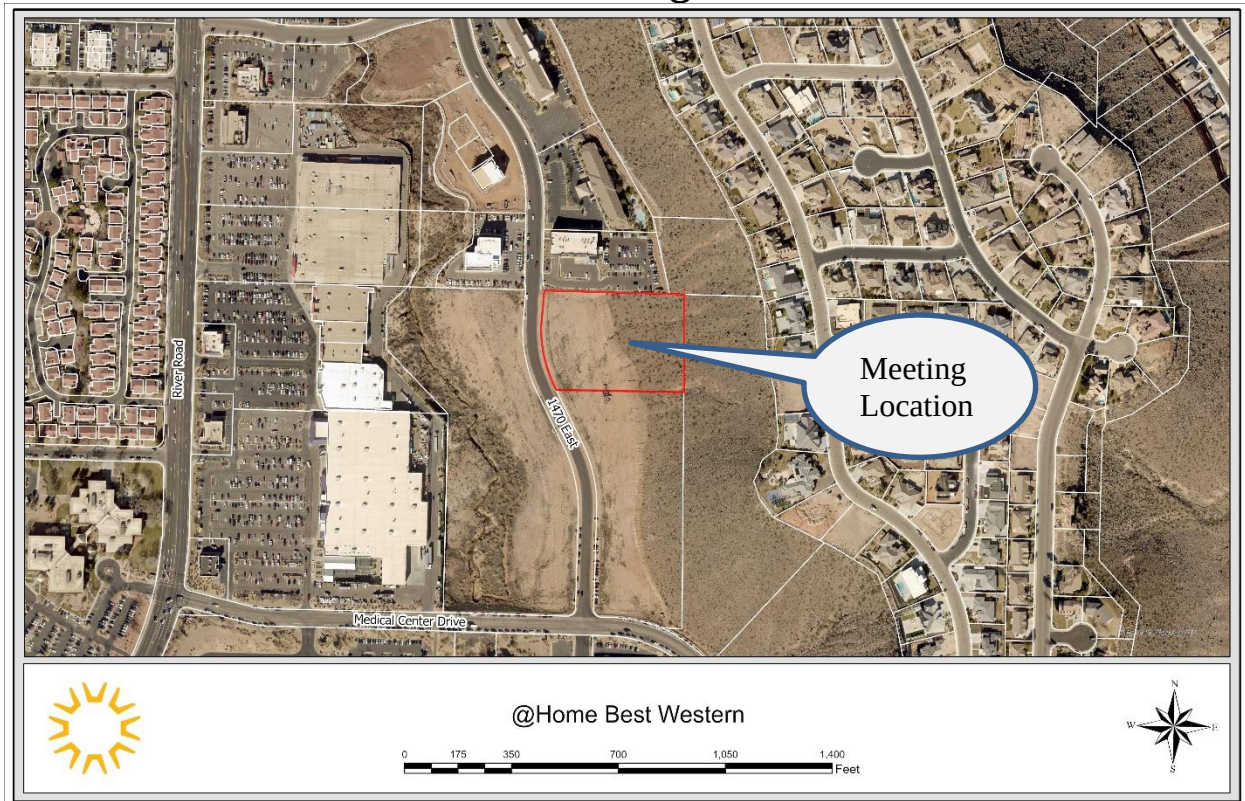
Brenda Hatch
Planner II – CDBG and Housing

Reasonable Accommodation: The City of St. George will make efforts to provide reasonable accommodations to disabled members of the public in accessing City programs. Please contact the City Human Resources Office at (435) 627-4674 at least 24 hours in advance if you have special needs.

Item #1 Meeting Location

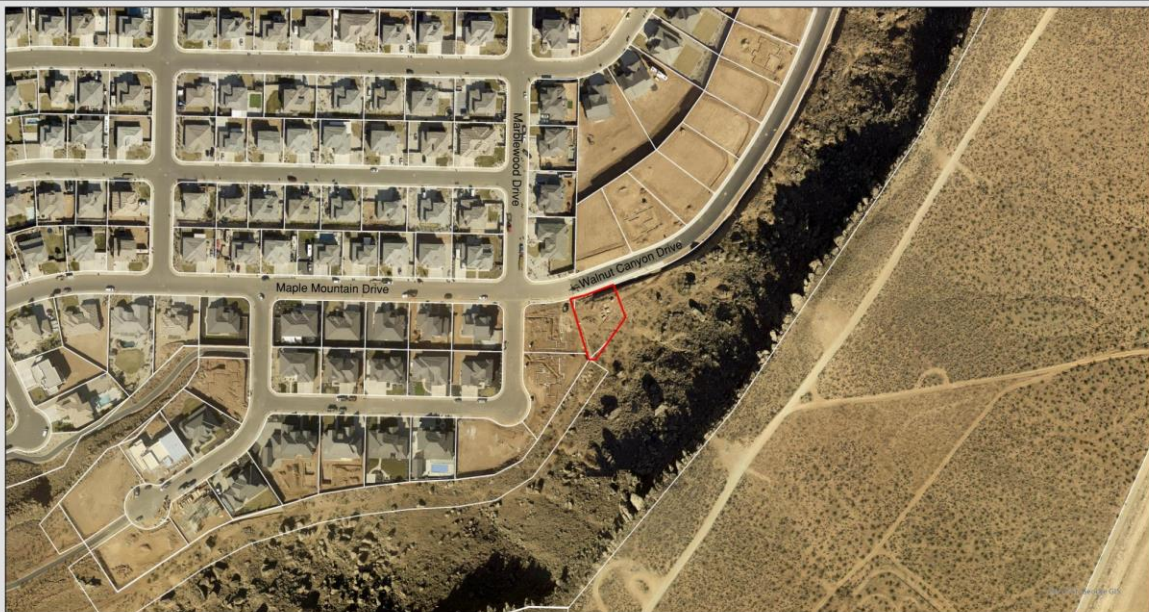


Item #2 Meeting Location



HILLSIDE REVIEW BOARD AGENDA REPORT: 02/28/2024

Juniper Cove Phase 3 Hillside Development Permit (Case No. 2024-HS-003)		
Request:	A Hillside Development Permit to allow disturbance of areas in the 20-30%, 30-40% and 40% and above slope areas and review possible construction in a rockfall hazard overlay area.	
Applicant:	DSG Engineering	
Representative:	Mike Terry	
Location:	Just east of the Marblewood Drive/Walnut Canyon Drive Intersection	
General Plan:	MDR (Medium Density Residential)	
Existing Zoning:	PD-R (Planned Development Residential)	
Surrounding Zoning:	North	R-1-8 (Single Family Residential, 8,000 ft² lots)
	South	R-1-8 (Single Family Residential, 8,000 ft² lots)
	East	R-1-8 (Single Family Residential, 8,000 ft² lots)
	West	R-1-8 (Single Family Residential, 8,000 ft² lots)
Land Area:	Approximately 11,366 ft² (0.26 acres)	



Juniper Cove Phase 3

0 110 220 440 660 880 Feet



BACKGROUND

In October of 2020, Phase one of Juniper Cove was recorded creating the adjacent lot to the west of the subject property. At the time, lot 15 was the only lot created on the south side of Walnut Canyon Drive. As the property owner has analyzed the property further, they feel they could likely create an additional lot before the property gets rockier to the north-east. There is a small outcropping of rock that is in the 20-30% slope category requiring a review by the Hillside Review Board. Additionally, the property falls within the rockfall study zone requiring a study to be conducted on the property. The applicant has supplied a slope analysis and a rockfall study that was produced in 2018.

APPLICABLE ORDINANCE(S) *(Selected portions)*

10-13A-1: Density and Disturbance Standards

- A. The hillside development overlay zone (HDOZ) limits development densities and provides specific development incentives to transfer underlying zone densities from hillsides (sending areas) to less steep slopes or more safe development areas (receiving areas), within a development.
- B. For those portions of a proposed development with natural slopes twenty percent (20%) or less, development density follows the density and development standards in the underlying zone.
- C. For those portions of a proposed development with natural slopes from twenty-one percent (21%) to thirty percent (30%), development activity shall not disturb more than thirty percent (30%) of the parcel within this slope category.
- D. For those portions of a proposed development with natural slopes from thirty-one percent (31%) to forty percent (40%), development activity shall not disturb more than five percent (5%) of the area within this slope category.
- E. A proposed development may not disturb slopes in excess of forty percent (40%).

10-13A-2: Slope and Slope Areas Determined

- A. Slope shall be determined for each significant portion of development parcel.
- B. *Procedure:* The applicant shall map the location of the natural slope by using the following procedure:
 - 1. *Preparation of Contour Maps:* The applicant shall submit an accurate, current contour map, prepared and certified by a licensed professional engineer or surveyor, which shows all land contours at intervals no greater than five feet (5'), drawn at a one inch equals one hundred feet (1" = 100') scale maximum.

2. *Verification through Field Surveys:* The city engineer or designee may require the applicant to submit a field survey to verify the accuracy of the contour map.

C. *Determination of Slope Areas:* Using the contour map, natural slopes shall be calculated using points identified as natural slopes of twenty percent (20%), thirty percent (30%), and forty percent (40%), and shall be located on the contour map and connected by a continuous line. That area bounded by said lines and intersecting property lines shall be used for determining project density. Small washes or outcrops, which have slopes distinctly different from surrounding property, and are not part of the contiguous topography, may be excluded from the slope determination.

10-13B-2: Development in Geologic Hazard Areas

A. *Geologic Hazard Areas (UGS 1 – 4: subsections A1 through A4 of this section):* For any development in the city with a geologic hazard listed below, applicant shall submit a report prepared by a qualified, licensed geologist specializing in engineering geology, or a licensed civil engineer, trained and experienced in the practice of geotechnical engineering. Development in the geologic hazard overlay for high category rockfall areas shall be reviewed by the hillside review board.

1. Surface fault rupture and earthquake: well-defined Holocene, and well-defined fault areas, red and purple lines/categories (extending five hundred feet (500') on the downthrown side and two hundred fifty feet (250') on the upthrown side of each red/purple fault line).
2. Liquefaction: Very High category.
3. Landslide: Very High category.
4. Rockfall: High category.

B. *General Requirements for Development in a Geologic Hazard Area:*

1. Submit a site-specific report prepared by a qualified, licensed geologist specializing in engineering geology, or a licensed civil engineer, trained and experienced in the practice of geotechnical engineering with the following minimum requirements:
 - a. Identify all geologic hazard areas (UGS 1 – 4: subsections A1 through A4 of this section);
 - b. Identify any other geologic hazards, not listed above (UGS 1 – 4: subsections A1 through A4 of this section), which present an unacceptable risk to development;
 - c. Demonstrate which areas of the development are suitable for the proposed use;
 - d. Recommend specific measures necessary to make the land suitable for the proposed use;
 - e. Recommend the optimal placement of all structures, roadways, utilities, trails and infrastructure in relation to the geologic hazard area;
 - f. Slope stability analysis: conclusions and recommendations concerning the effects of material removal, introduction of water, both on and off site, including, where applicable, on mesa tops, seismic activity, and erosion on slope stability;

g. Foundation investigation: conclusions and recommendations concerning the effects of soil conditions on foundation and structural stability, including bearing capacity, sheer strength, and shrink/swell potential of soils;

h. Spring location: the location and yield of springs and seeps which shall be shown on the site plan;

i. Structural features: structural features including any geological limitations;

j. Surface hazards: existence of surface hazards including potential for rockfalls and toppling failures to cliffs, slopes and overhangs above the subject property; and

k. Effect of geologic conditions: conclusions and recommendations regarding the effect of geologic conditions on the proposed development, together with recommendations identifying the means proposed to minimize any hazard to life or property, or adverse impact on the natural environment.

2. The city shall review the applicant's report. If the applicant's report is deemed adequate by the city engineer or designee, development may proceed if the report recommendations are followed. If the report is deemed incomplete or inadequate by the city engineer or designee, the development application shall be denied. If denied, the applicant may request an independent review, and the city engineer or designee may order a review by independent, qualified professionals. The professionals selected by the city shall review and prepare written findings and comments on the applicant's report. The cost of the independent, qualified professionals shall be paid to the city by applicant. Applicant may develop if the independent review and written findings and comments are implemented, in addition to any nonconflicting recommendations in the initial report of applicant. The city engineer or designee is the land use authority for the decision. The reports shall be specifically identified on the plat and available to all owners and interested parties.

3. All development shall be outside the geologic hazard areas in subsections A1 through A4 of this section, unless:

a. The city has accepted applicant's report, prepared by a qualified, licensed geologist specializing in engineering geology or a licensed professional engineer trained and practicing in the field of geotechnical engineering, and it recommends development, and shows hazards can be adequately mitigated for the proposed land use;

b. If the city has not accepted applicant's report, the applicant also adopts and implements the independent review and writing findings and comments, in addition to any nonconflicting recommendations in applicant's report;

c. All report recommendations, and HDOZ permit conditions (when required), are adopted by the city and are conditions of development.

4. Hold the city harmless from all claims resulting from any damage related to development within a geologic hazard area by executing a "geologic hazard disclaimer of liability and agreement" and by placing a "notice of hazard" on the final plat.

5. The applicant may appeal a decision in accordance with chapter 3 of this title.

C. *Compliance*: No structure or land shall be constructed, located, extended, converted or altered without full compliance with the terms of this chapter and other applicable regulations.

D. *Abrogation and Greater Restrictions*: This chapter is not intended to repeal, abrogate or impair any existing easement, covenant or deed restriction; however, where this chapter and another ordinance, easement, covenant or deed restriction conflict or overlap, the more stringent restriction shall prevail.

E. *Interpretation*: In the interpretation and application of this chapter, all provisions are minimum requirements in addition to applicable provisions of this title.

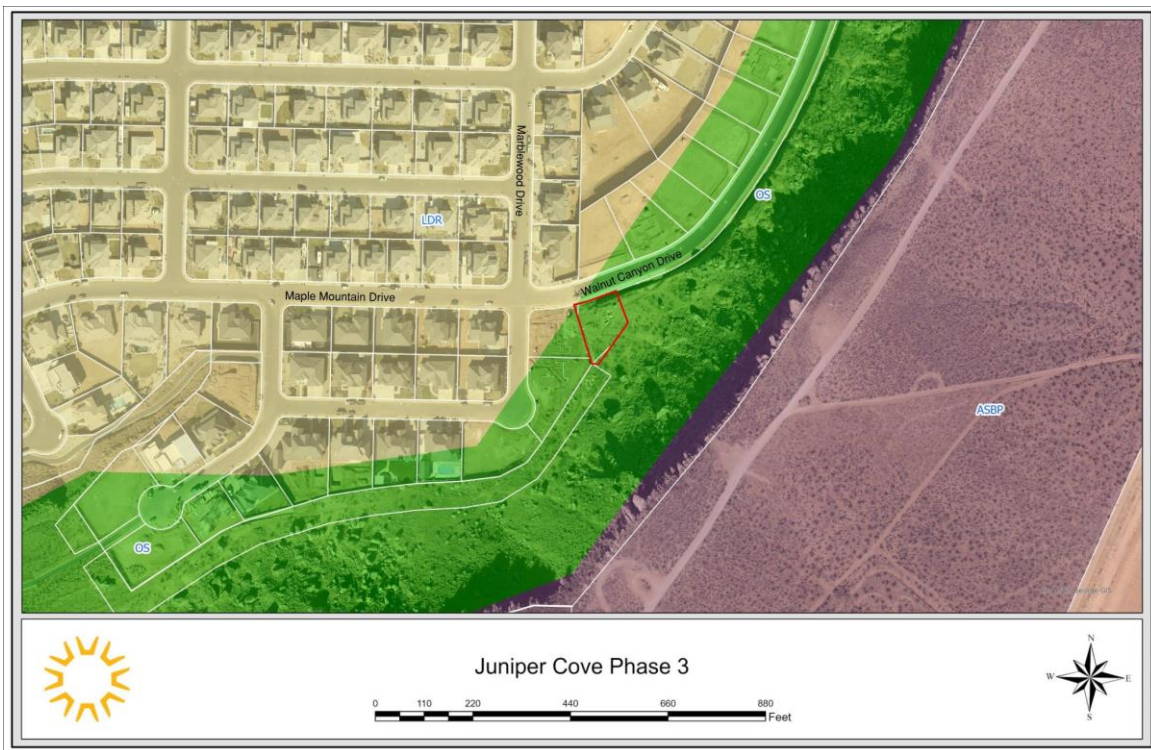
EXHIBITS PROVIDED

1. Exhibit A – Hillside Slope Map
“Exhibit A” in the packet shows the location of the new road extension.
2. Exhibit B – Rockfall Study
“Exhibit B” in the packet is a study conducted by AGECEC, dated May 8, 2018 for the Teakwood Subdivision.
3. Exhibit C – Legal Description
Exhibit C is a legal description of the property.

RECOMMENDATION

Section 10-13A-8(B)(1) of the “Hillside Review Board Powers and Duties” states that the Hillside Board can make recommendations to “adopt, modify or reject a proposal” to the Planning Commission (PC).

General Plan – OS – Open Space



Zoning – PD-R (Planned Development Residential)

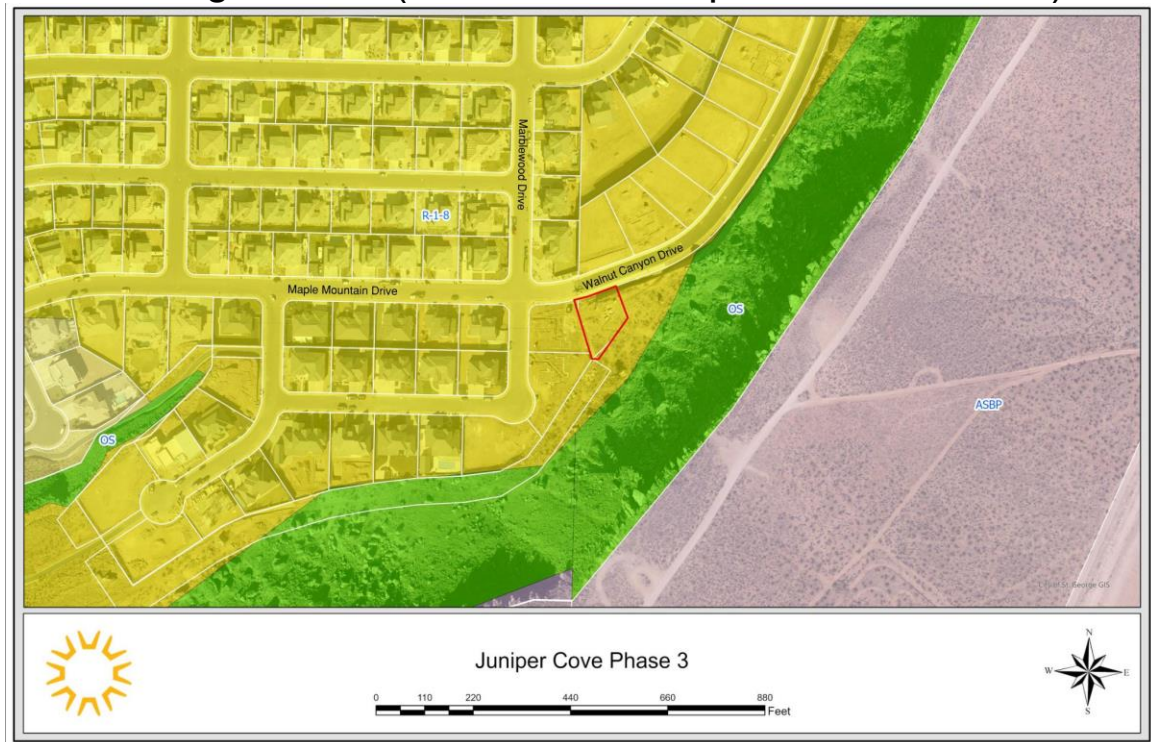
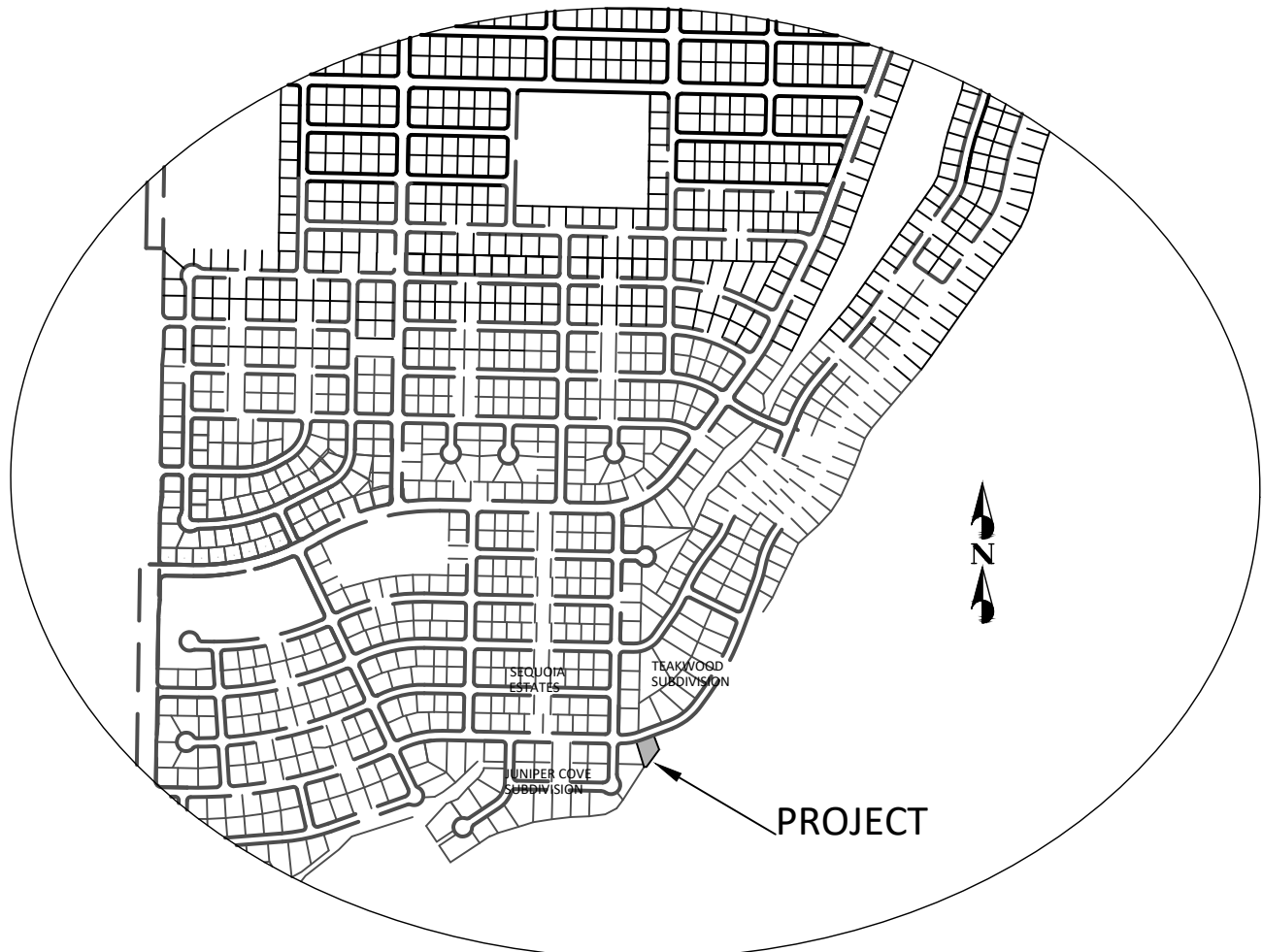


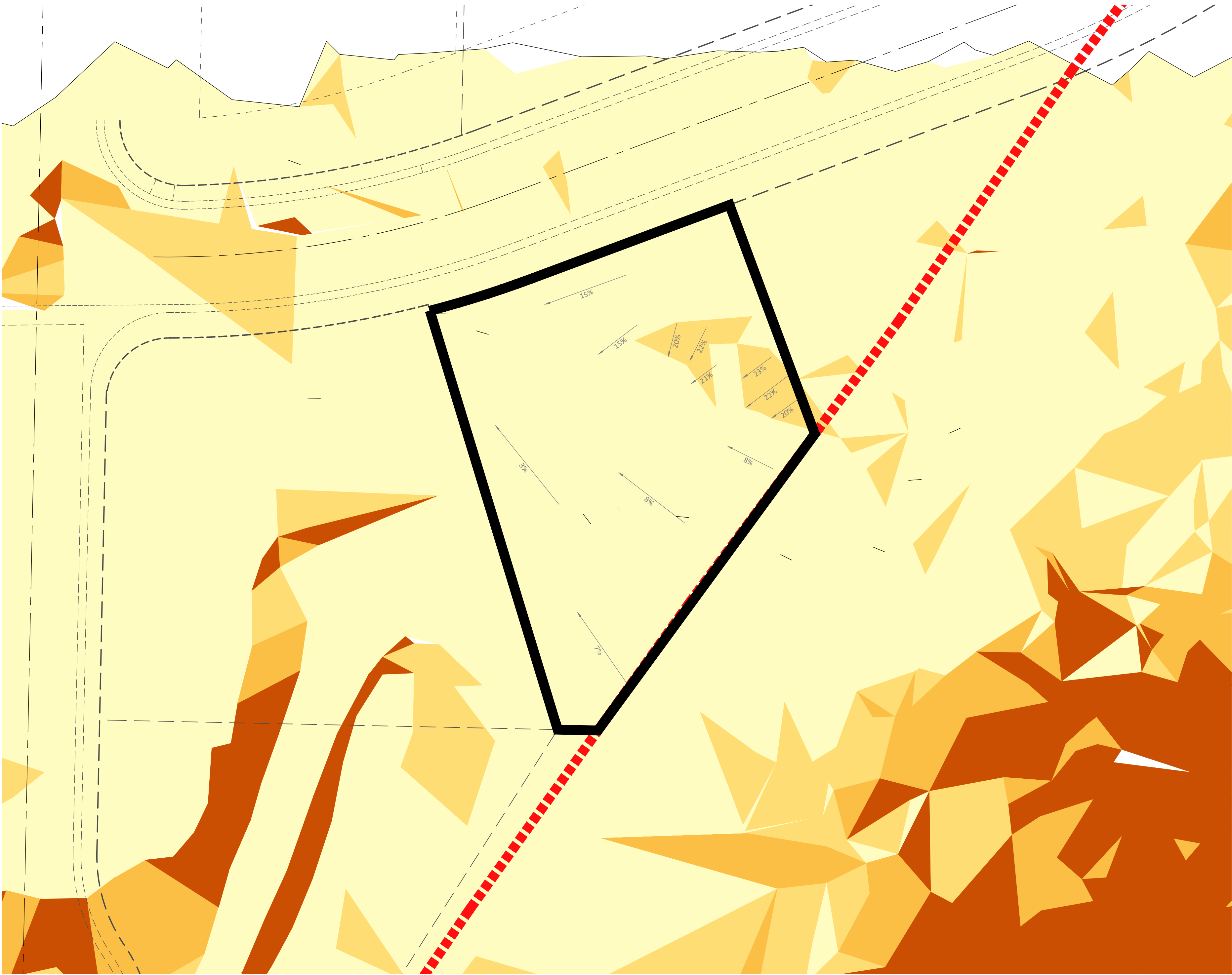
EXHIBIT A
Hillside Slope Map

HILLSIDE ANALYSIS
FOR
JUNIPER COVE
PHASES 3

LOCATED IN THE NORTHWEST QUARTER OF SECTION 14, TOWNSHIP
43 SOUTH, RANGE 15 WEST, S.L.B.&M.



St. George
Vicinity Map



OWNER/DEVELOPER

QUALITY DEV LLC
113 EAST 200 NORTH STE. #2
ST. GEORGE, UTAH 84770

CONTACT

MIKE TERRY, EIT
(435) 628-2121

LEGEND:

- SUBDIVISION BOUNDARY
- STREET CENTERLINE
- ROAD RIGHT OF WAY LINE
- EXISTING ROAD RIGHT OF WAY LINE
- PROPOSED PROPERTY LINE
- EXISTING PROPERTY LINE
- EXISTING CURB & GUTTER
- ROCK FALL LINE BY AGECE

SLOPE ANALYSIS LEGEND	
	0-20% SLOPE
	20-30% SLOPE
	30-40% SLOPE
	40-100% SLOPE



PROJECT NAME:

JUNIPER COVE
PHASE 3
LOCATED IN ST. GEORGE, UTAH
HILLSIDE ANALYSIS

DSG ENGINEERING, INC
LAND PLANNERS, LAND SURVEYORS, CIVIL ENGINEERS
113 EAST 200 NORTH STE. #2
St. George, UT 84770
Office (435) 628-2121

DATE :

NOV 2023

PM :

RT

DRAWN BY :

MT

DESIGNED BY :

MT

CHECKED BY :

RT

PROJECT NO. :

23-028

SCALE :

20

SHEET NUMBER :

P-1

1 OF 01 TOTAL

EXHIBIT B
Rockfall Study



May 8, 2018

Development Solutions
120 East St. George Blvd. #300
St George, Utah 84770

Attention: Steve Kamlowsky

Subject: Geologic-hazard Study
Teakwood Subdivision
Marblewood and Crimson Ridge Drives
St George, Utah
Project No. 2180172

Gentlemen:

Applied Geotechnical Engineering Consultants, Inc. (AGEC) was requested to perform a geologic-hazards study for the proposed Teakwood Subdivision located below the airport bluff at Marblewood and Crimson Ridge Drives in St. George, Utah (see Figure 1).

PROPOSED CONSTRUCTION

We understand the area is planned for single-family residences. The approximate area planned for development is shown on Figure 1.

GEOLOGY

The geology for the area was mapped by Hayden and Willis (2011) to consist of the upper unit of the Triassic-age Moenkopi Formation. This unit consists of interbedded siltstone and sandstone. The Triassic-age Shnabkaib Member of the Moenkopi underlies this unit and consists predominantly of siltstone. The Shinarump Conglomerate Member of the Chinle Formation overlies the Moenkopi Formation and makes up the rock near the top of the bluff southeast of the site, the source of the rockfall for the southeast portion of the property. The bedrock exposed on the property is that of the Moenkopi Formation. The bedrock in the area dips down toward the southeast at approximately 11 to 15 degrees.

GEOLOGIC-HAZARD EVALUATION

Low-sun-angle aerial photographs from 1960 and aerial photographs from 1938 were reviewed along with site reconnaissance to determine what potential geologic hazards may affect the proposed development. Rockfall is the geologic hazard that may affect

development in the area. Faulting, liquefaction, landslide and debris flow are not considered potential hazards at this site.

A. Rockfall Hazard

Source boulders for rockfall hazard originate from the Shinarump Conglomerate Member of the Chinle Formation, which forms cliffs at the top of the hill southeast of the property. Reconnaissance of the rockfall source area finds that there are numerous rock outcrops that could potentially dislodge from the cliffs above the site. These blocks of bedrock are similar to or larger in size to the boulders along the slopes and base of the hill. It appears that the boulders originating from the cliffs typically break into smaller particles as they roll down the slope.

Rockfall hazard is typically limited to a zone between the rockfall-originating cliff and a limit line based on a shadow angle of 22 degrees in this area. The shadow angle is the angle from horizontal formed from the base of the originating cliff to the farthest rockfall rock. Cross sections are presented on Figures 3 through 6 showing the shadow angle with respect to the selected rockfall-limit line as an example for the proposed development. The rockfall-limit line is adjusted some to account for current rock source, a selected buffer zone and observed conditions at the site.

The approximate rockfall-hazard zone is presented on Figure 2. The extent of the rockfall hazard was determined based on guidelines presented by Bowman and Lund (2016). The rockfall-hazard zone shown is intended to capture most of the potential rockfall-runout area but there may be a potential for rockfall hazard to extend beyond this zone.

Modifying grades toward the bottom of the rockfall-hazard zone can affect the extent of the area of concern. Generally, lowering grade will increase the hazard area and raising grade will decrease the hazard area. Installing berms, rock fences or other rock barriers can be used to decrease the hazard area.

B. Other Geologic Hazards

Fault hazard was evaluated based on review of aerial photographs and geologic maps for the area, and site reconnaissance. There is no evidence of fault-related features on or near the site.

Liquefaction and associated lateral spread are not considered hazards at the site because bedrock underlies the site. Bedrock is not considered susceptible to liquefaction.

Review of the aerial photographs and geology show no evidence of landslides on or near the site. Landslide is not considered a hazard at the site. Slope stability of cut and fill slopes would be addressed in the geotechnical report for the project.

Debris flow is not considered a hazard at the site due to the lack of a source for debris flow. A drainage with a drainage area of about 25 acres or more is needed to develop debris flows (VanDine, 1984). There are no such drainages up gradient of the site.

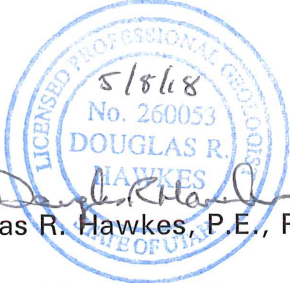
LIMITATIONS

This letter has been prepared in accordance with generally accepted geologic engineering practices in the area for the use of the client. The conclusions and recommendations included in the letter are based on conditions observed during our field study and the topographic information provided. If conditions are significantly different from those described in this letter, we should be notified to reevaluate the recommendations given. There may be rockfall hazard beyond the rockfall zone shown on Figure 2 and this hazard should be disclosed to potential home buyers.

If you have questions or if we can be of further service, please call.

Sincerely,

APPLIED GEOTECHNICAL ENGINEERING CONSULTANTS, INC.


Douglas R. Hawkes, P.E., P.G.

Reviewed by JEN, P.E.

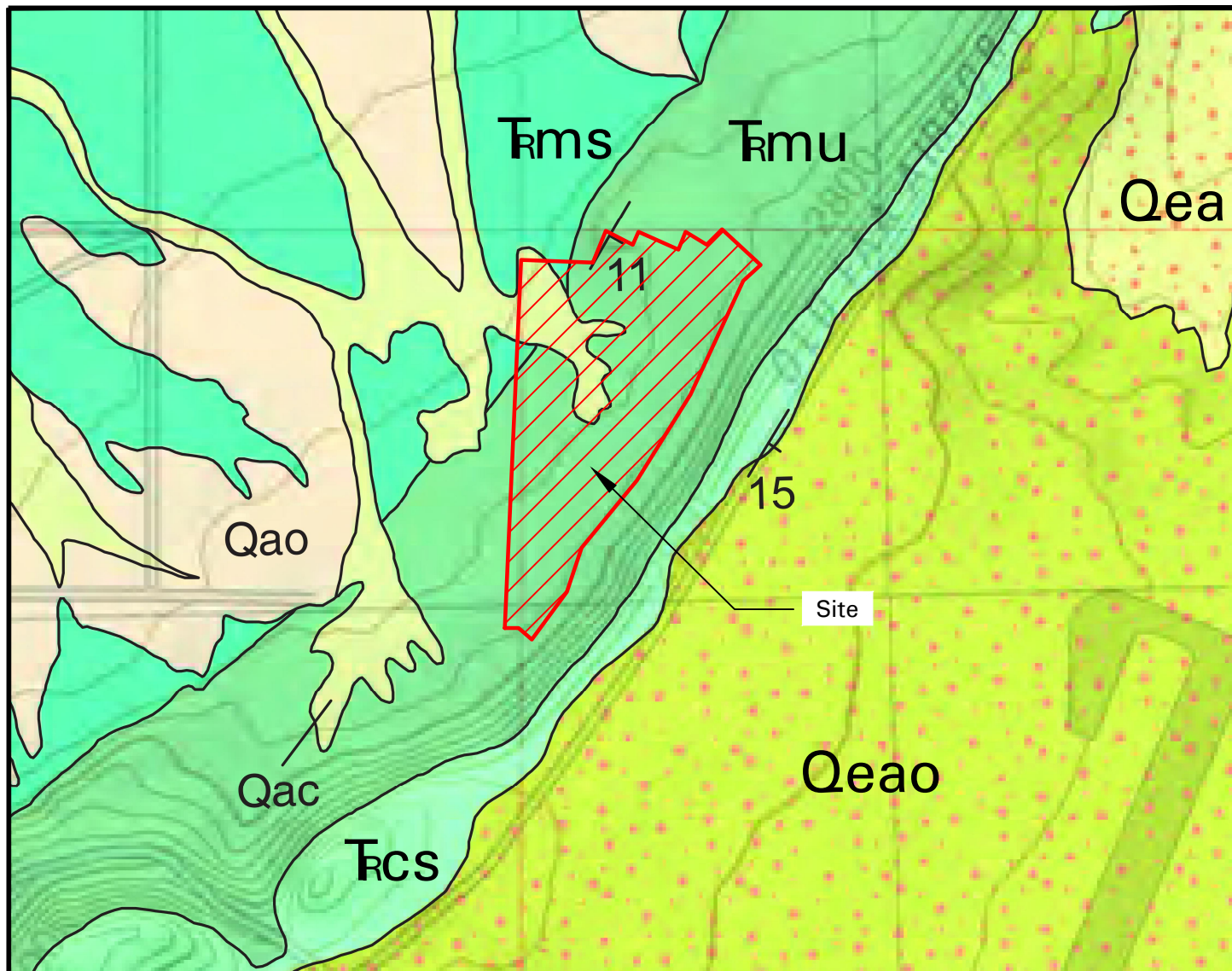
Enclosures

Reference:

Hayden, J.M. and Willis, G.C. 2011; Geologic map of the St George quadrangle, Washington County, Utah, Utah Geological Survey Map 251DM.

Lund, W.R., Knudsen, T.R., Vice, G.S. and Shaw, L.M., 2008; Geologic hazards and adverse construction conditions, St. George-Hurricane Metropolitan Area, Washington County, Utah, Utah Geological Survey Special Study 127.

VanDine, D.F., 1984; Debris flow and debris torrents in the Southern Canadian Cordillera, 8th Canadian Geotechnical Colloquium, at the 37th Canadian Geotechnical Conference, Toronto.



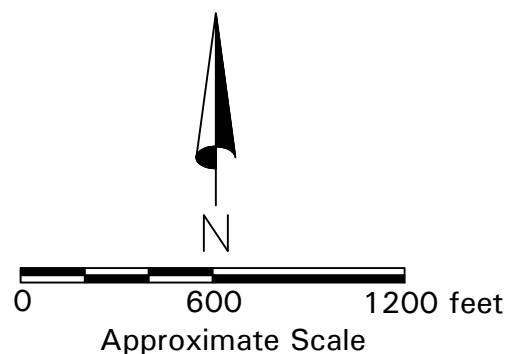
EXPLANATION OF SYMBOLS AND GEOLOGIC UNITS IN AREA OF
PROPOSED DEVELOPMENT

From Hayden and Willis (2011)

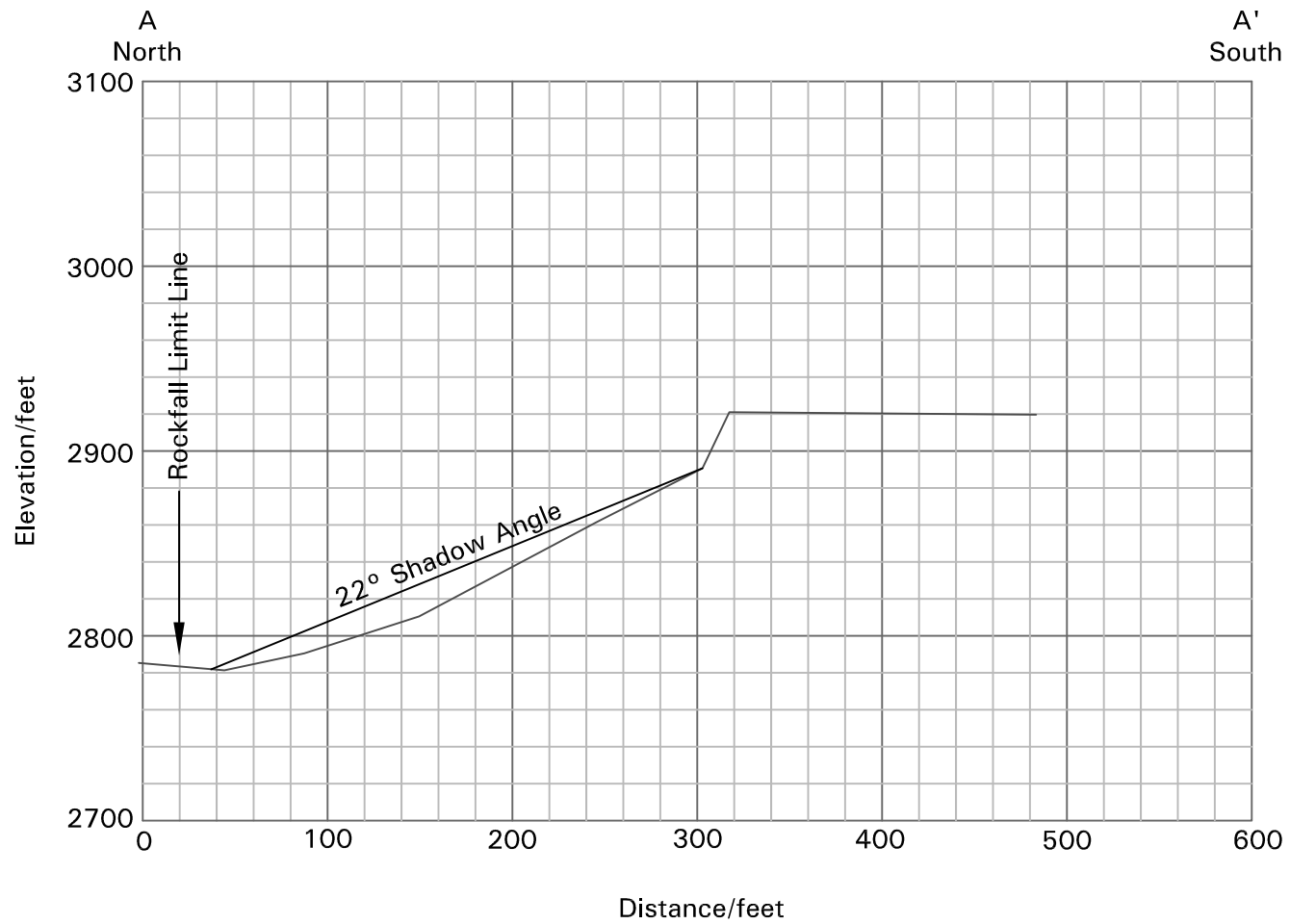
- Qao - Older alluvial deposits (Holocene to middle Pleistocene).
- Qac - Mixed alluvial and colluvial deposits (Holocene to upper Pleistocene).
- Tcs - Triassic Shinarump Conglomerate Member of the Chinle Formation - sandstone and conglomerate.
- Tmu - Triassic upper red member of the Moenkopi Formation - interbedded sandstone and siltstone.
- Tms - Triassic Shnabkaib Member of the Moenkopi Formation - siltstone.

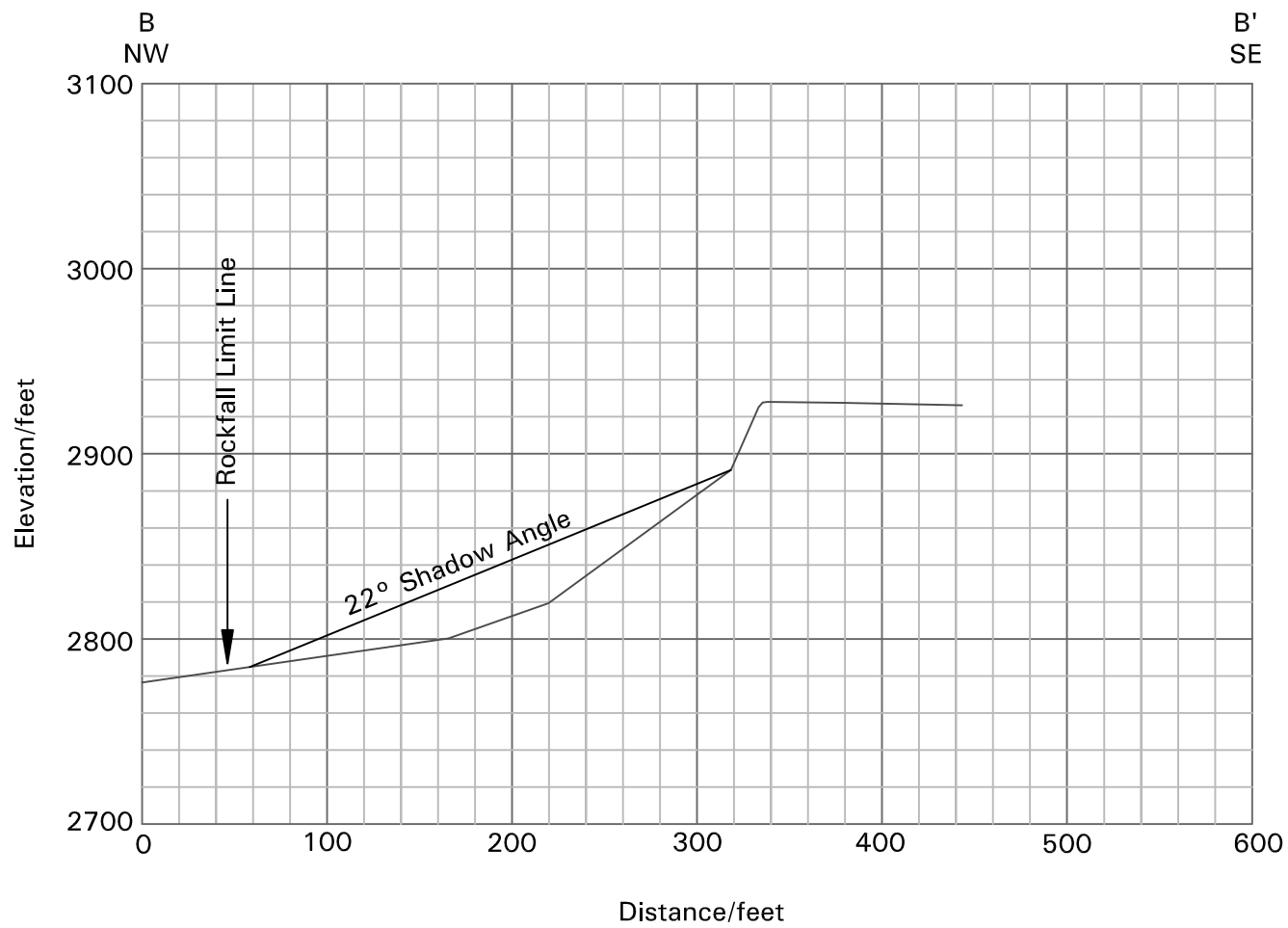
— Contact between geologic units.

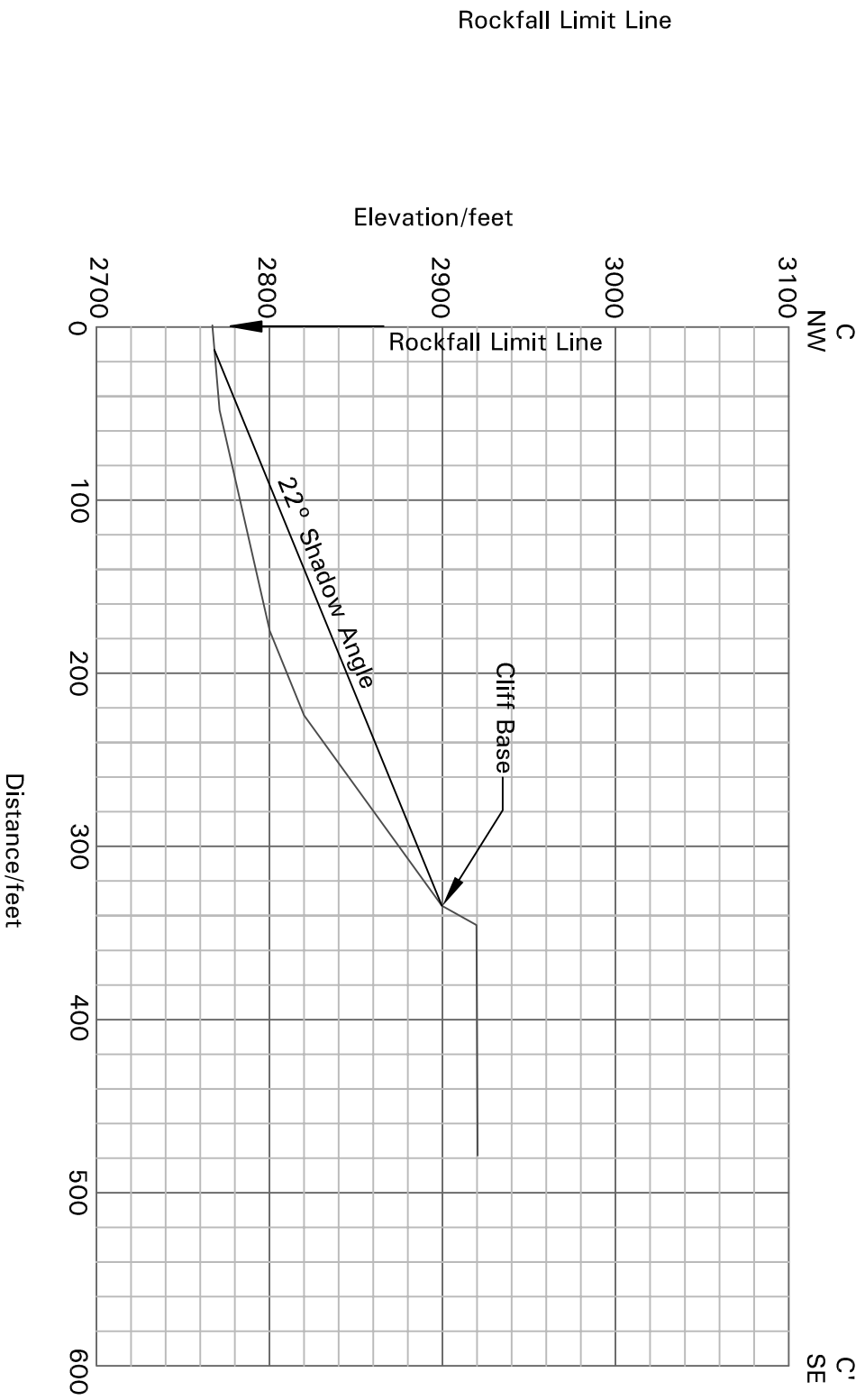
15
— Strike and dip of bedding.



TEAKWOOD SUBDIVISION
MARBLEWOOD AND CRIMSON RIDGE DRIVES
ST. GEORGE, UTAH







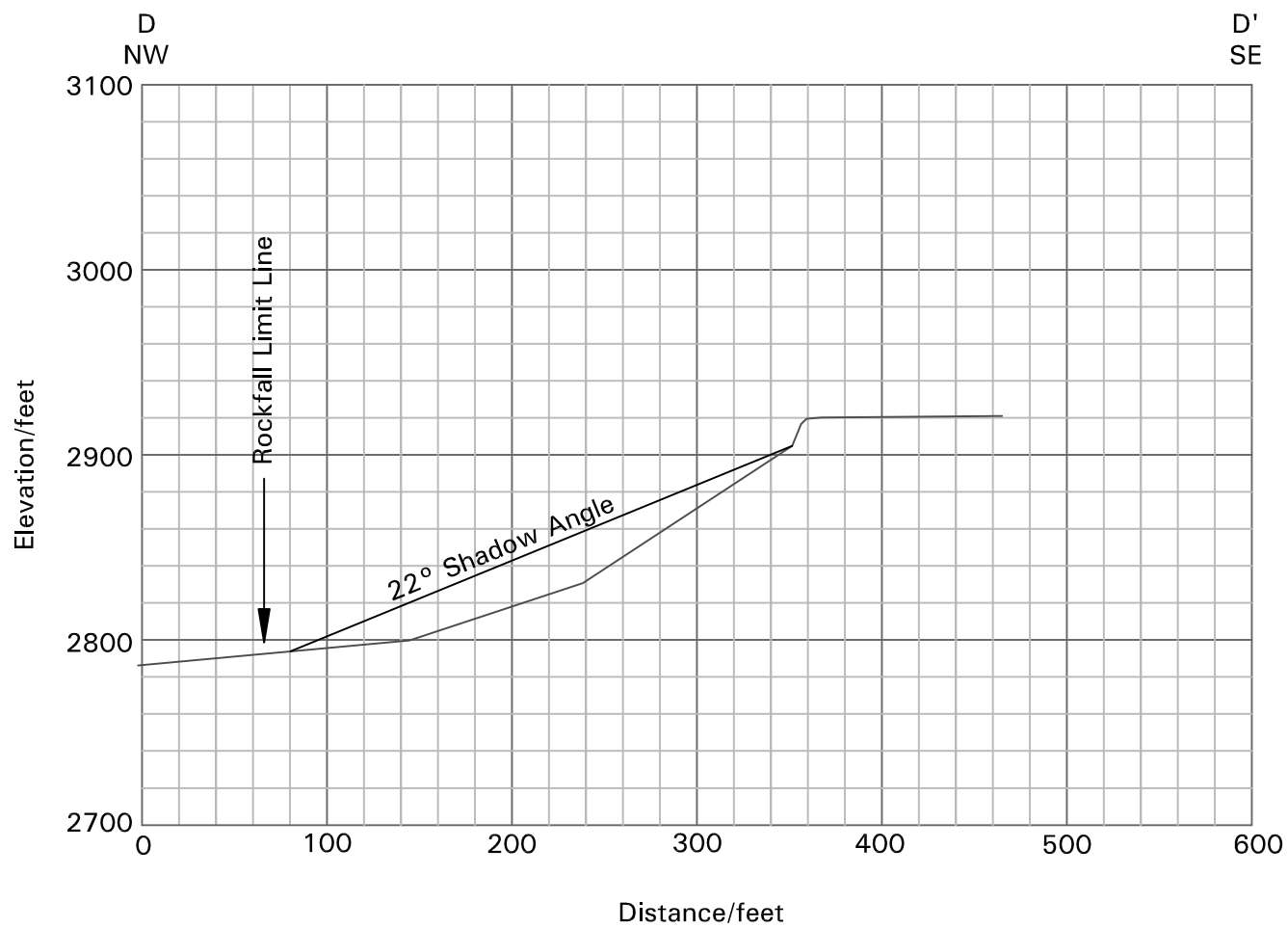


EXHIBIT C
Legal Description

JUNIPER COVE – PHASE 3 FINAL PLAT BOUNDARY

BEGINNING AT A POINT ON THE EASTERLY BOUNDARY OF THE JUNIPER COVE – PHASE 2 SUBDIVISION, AS RECORDED AND ON FILE WITH THE WASHINGTON COUNTY RECORDER'S OFFICE, SAID POINT BEING SOUTH 01°10'03" WEST ALONG THE SECTION LINE, A DISTANCE OF 1386.618 FEET, AND SOUTH 88°49'57" EAST 34.127 FEET FROM THE NORTHEAST CORNER OF SECTION 15, TOWNSHIP 43 SOUTH, RANGE 15 WEST, SALT LAKE BASE AND MERIDIAN AND RUNNING THENCE NORTH 16°57'54" WEST ALONG SAID SUBDIVISION BOUNDARY AND THE EASTERLY BOUNDARY OF THE JUNIPER COVE – PHASE 1 SUBDIVISION, AS RECORDED AND ON FILE WITH THE WASHINGTON COUNTY RECORDER'S OFFICE, A DISTANCE OF 140.020 FEET TO THE SOUTHERLY BOUNDARY OF THE TEAKWOOD – PHASE 3&4 SUBDIVISION, AS RECORDED AND ON FILE WITH THE WASHINGTON COUNTY RECORDER'S OFFICE; THENCE ALONG SAID SOUTHERLY BOUNDARY THE FOLLOWING (2) TWO COURSES: (1) NORTH 75°55'46" EAST 33.352 FEET; AND (2) NORTH 69°34'25" EAST 66.845 FEET; THENCE SOUTH 20°25'35" EAST 77.020 FEET; THENCE SOUTH 36°36'24" WEST 65.543 FEET; THENCE SOUTH 45°56'38" WEST 58.348 FEET TO THE POINT OF BEGINNING.

CONTAINS 11,366 SQ. FT. (0.261 ACRES)

HILLSIDE REVIEW BOARD AGENDA REPORT: 02/28/2024

@Home Best Western Hillside Development Permit (Case No. HD24-000001)		
Request:	A Hillside Development Permit to allow disturbance of areas in the 20-30%, 30-40% and 40% and above slope areas and review possible construction in a rockfall hazard overlay area.	
Applicant:	Nick Ence	
Representative:	Rhett Beazer	
Location:	Approximately 300 South and 1470 East (See map)	
General Plan:	COM (Commercial)	
Existing Zoning:	PD-C (Planned Development Commercial)	
Surrounding Zoning:	North	PD-C (Planned Development Commercial)
	South	PD-C (Planned Development Commercial)
	East	OS (Open Space)
	West	PD-C (Planned Development Commercial)
Land Area:	Approximately 94,647 ft ² (2.17 acres)	



BACKGROUND

In 2011, the southern extension of 1470 East was constructed making the connection between the existing 1470 East termination and Medical Center Drive. This opened the land along that corridor available to develop. The city hasn't seen any development along that stretch of road yet until now. The applicant for this hillside permit is requesting to build on slope that exceeds 20% and area that is in a rockfall study zone. The application is for a proposed hotel. Specifics like room numbers, height of the building, etc. are not yet known but, will be forthcoming with a PD (Planned Development) amendment.

The Hillside Review Board must weigh in and make a recommendation to Planning Commission and City Council on all applications in hillside overlay areas.

APPLICABLE ORDINANCE(S) (Selected portions)

10-13A-1: Density and Disturbance Standards

- A. The hillside development overlay zone (HDOZ) limits development densities and provides specific development incentives to transfer underlying zone densities from hillsides (sending areas) to less steep slopes or more safe development areas (receiving areas), within a development.
- B. For those portions of a proposed development with natural slopes twenty percent (20%) or less, development density follows the density and development standards in the underlying zone.
- C. For those portions of a proposed development with natural slopes from twenty-one percent (21%) to thirty percent (30%), development activity shall not disturb more than thirty percent (30%) of the parcel within this slope category.
- D. For those portions of a proposed development with natural slopes from thirty-one percent (31%) to forty percent (40%), development activity shall not disturb more than five percent (5%) of the area within this slope category.
- E. A proposed development may not disturb slopes in excess of forty percent (40%).

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- B. *Procedure:* The applicant shall map the location of the natural slope by using the following procedure:
 - 1. *Preparation of Contour Maps:* The applicant shall submit an accurate, current contour map, prepared and certified by a licensed professional engineer or surveyor, which shows all land contours at intervals no

greater than five feet (5'), drawn at a one inch equals one hundred feet (1" = 100') scale maximum.

2. *Verification through Field Surveys:* The city engineer or designee may require the applicant to submit a field survey to verify the accuracy of the contour map.

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2. Liquefaction: Very High category.
3. Landslide: Very High category.
4. Rockfall: High category.

B. *General Requirements for Development in a Geologic Hazard Area:*

1. Submit a site-specific report prepared by a qualified, licensed geologist specializing in engineering geology, or a licensed civil engineer, trained and experienced in the practice of geotechnical engineering with the following minimum requirements:
 - a. Identify all geologic hazard areas (UGS 1 – 4: subsections A1 through A4 of this section);
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 - c. Demonstrate which areas of the development are suitable for the proposed use;
 - d. Recommend specific measures necessary to make the land suitable for the proposed use;
 - e. Recommend the optimal placement of all structures, roadways, utilities, trails and infrastructure in relation to the geologic hazard area;

- f. Slope stability analysis: conclusions and recommendations concerning the effects of material removal, introduction of water, both on and off site, including, where applicable, on mesa tops, seismic activity, and erosion on slope stability;
- g. Foundation investigation: conclusions and recommendations concerning the effects of soil conditions on foundation and structural stability, including bearing capacity, sheer strength, and shrink/swell potential of soils;
- h. Spring location: the location and yield of springs and seeps which shall be shown on the site plan;
- i. Structural features: structural features including any geological limitations;
- j. Surface hazards: existence of surface hazards including potential for rockfalls and toppling failures to cliffs, slopes and overhangs above the subject property; and
- k. Effect of geologic conditions: conclusions and recommendations regarding the effect of geologic conditions on the proposed development, together with recommendations identifying the means proposed to minimize any hazard to life or property, or adverse impact on the natural environment.

2. The city shall review the applicant's report. If the applicant's report is deemed adequate by the city engineer or designee, development may proceed if the report recommendations are followed. If the report is deemed incomplete or inadequate by the city engineer or designee, the development application shall be denied. If denied, the applicant may request an independent review, and the city engineer or designee may order a review by independent, qualified professionals. The professionals selected by the city shall review and prepare written findings and comments on the applicant's report. The cost of the independent, qualified professionals shall be paid to the city by applicant. Applicant may develop if the independent review and written findings and comments are implemented, in addition to any nonconflicting recommendations in the initial report of applicant. The city engineer or designee is the land use authority for the decision. The reports shall be specifically identified on the plat and available to all owners and interested parties.

3. All development shall be outside the geologic hazard areas in subsections A1 through A4 of this section, unless:

- a. The city has accepted applicant's report, prepared by a qualified, licensed geologist specializing in engineering geology or a licensed professional engineer trained and practicing in the field of geotechnical engineering, and it recommends development, and shows hazards can be adequately mitigated for the proposed land use;
- b. If the city has not accepted applicant's report, the applicant also adopts and implements the independent review and writing findings and comments, in addition to any nonconflicting recommendations in applicant's report;
- c. All report recommendations, and HDOZ permit conditions (when required), are adopted by the city and are conditions of development.

4. Hold the city harmless from all claims resulting from any damage related to development within a geologic hazard area by executing a "geologic hazard disclaimer of liability and agreement" and by placing a "notice of hazard" on the final plat.

5. The applicant may appeal a decision in accordance with chapter 3 of this title.

C. *Compliance*: No structure or land shall be constructed, located, extended, converted or altered without full compliance with the terms of this chapter and other applicable regulations.

D. *Abrogation and Greater Restrictions*: This chapter is not intended to repeal, abrogate or impair any existing easement, covenant or deed restriction; however, where this chapter and another ordinance, easement, covenant or deed restriction conflict or overlap, the more stringent restriction shall prevail.

E. *Interpretation*: In the interpretation and application of this chapter, all provisions are minimum requirements in addition to applicable provisions of this title.

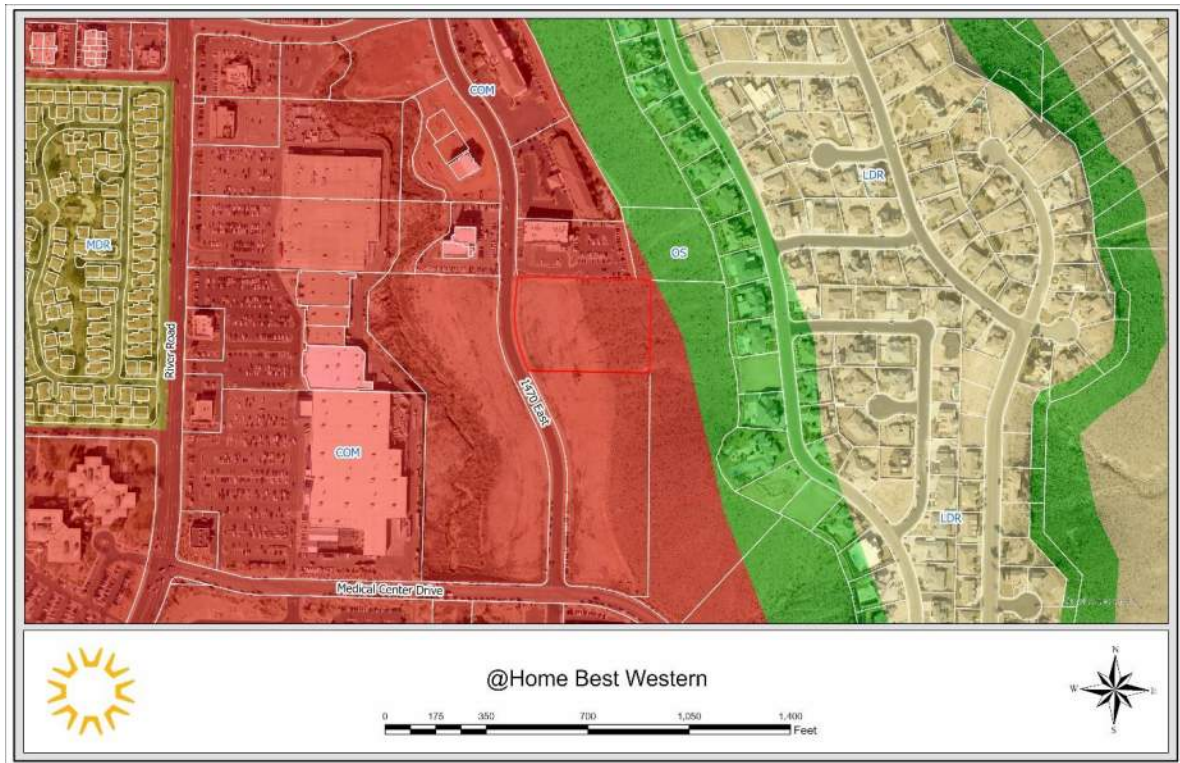
EXHIBITS PROVIDED

1. Exhibit A – Hillside Slope Map
“Exhibit A” in the packet shows the location of the new road extension.
2. Exhibit B – Site Plan
This is the proposed site plan for the site.
3. Exhibit C – Landscape & Vegetation Plan
4. Exhibit D – Street Design
Cross sections of the proposed streets
5. Exhibit E – Earth moving Plan
“Exhibit B” in the packet is the earth moving plan.
6. Exhibit F – Geotechnical Engineering Report (**Rockfall Study is included at the end of this report**)
Exhibit C is a geotechnical report and rockfall study.
7. Exhibit G – Drainage Control Plan
This is a letter from Alpha Engineering which describes the plan for controlling drainage

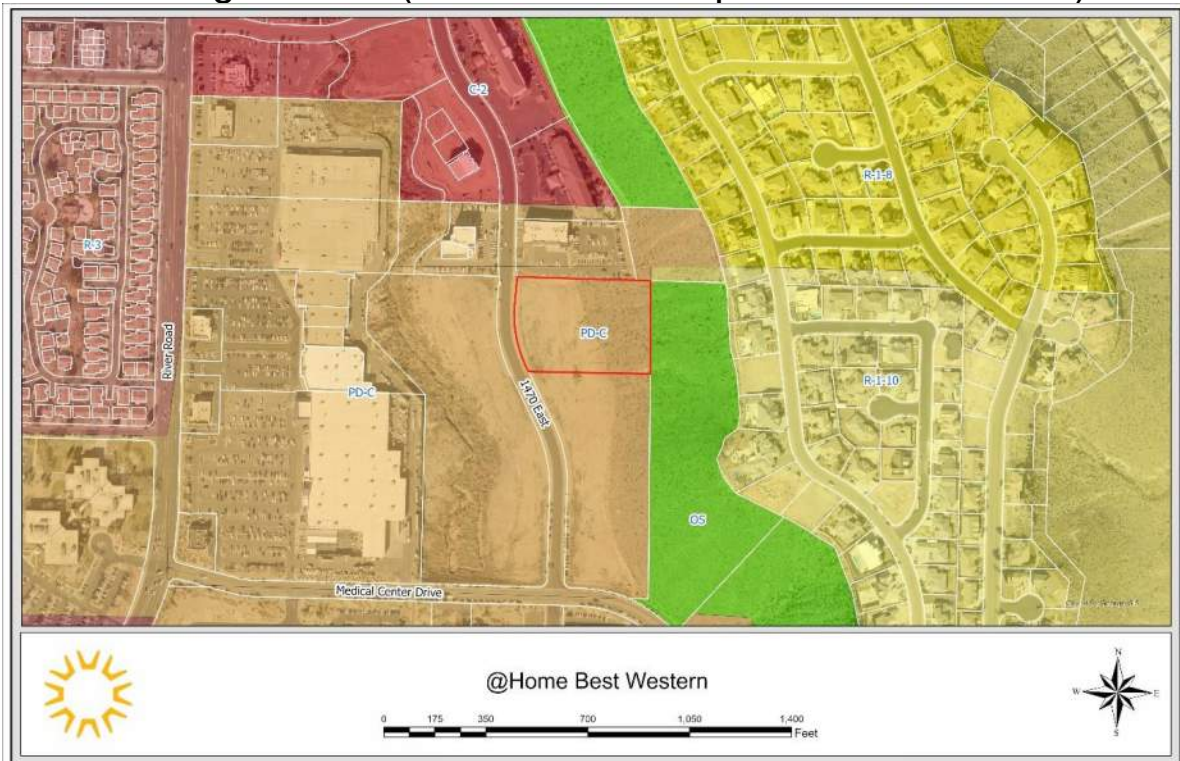
RECOMMENDATION

Section 10-13A-8(B)(1) of the “Hillside Review Board Powers and Duties” states that the Hillside Board can make recommendations to “adopt, modify or reject a proposal” to the Planning Commission (PC).

General Plan – COM – Commercial



Zoning – PD-C (Planned Development Commercial)



HS HD24-000001
@Home Best Western

EXHIBIT A
Hillside Slope Map

[illegible]

PRELIMINARY
NOT FOR CONSTRUCTION

ALPHA
ENGINEERING

43 South 100 East, Suite 100 • St. George, Utah 84770
T: 435.628.6500 • F: 435.628.6535 • alphaengineering.com

SLOPE ANALYSIS

**@HOME BEST WESTERN
ST. GEORGE, UTAH**

PROJECT #	2043-01
NAME	RKB
DATE	FEBRUARY 6, 2024
SCALE	AS NOTED
SHEET	1 1 OF 1
FILE	2043-01 Hillside.dwg

HS HD24-000001
@Home Best Western

EXHIBIT B

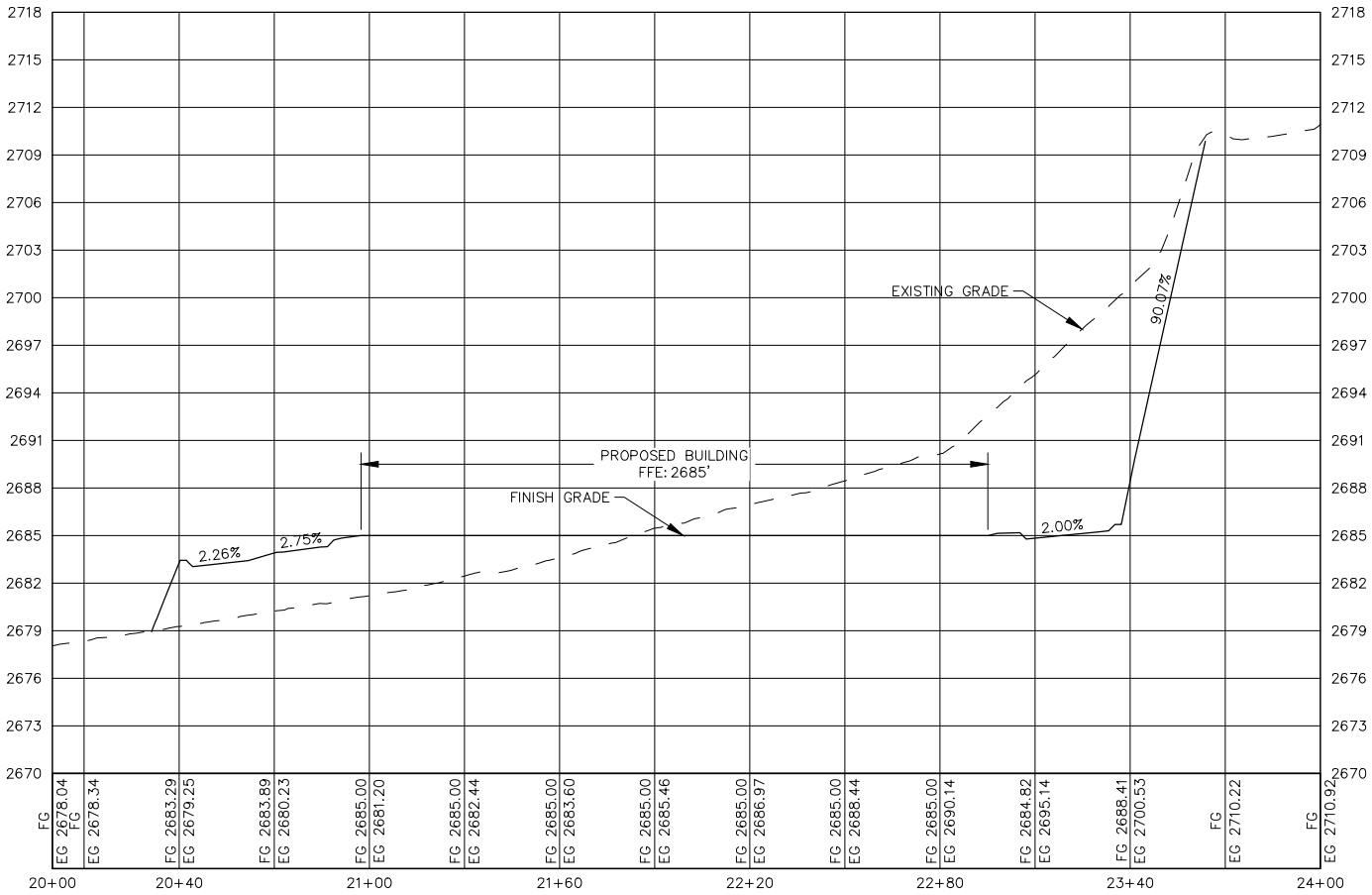
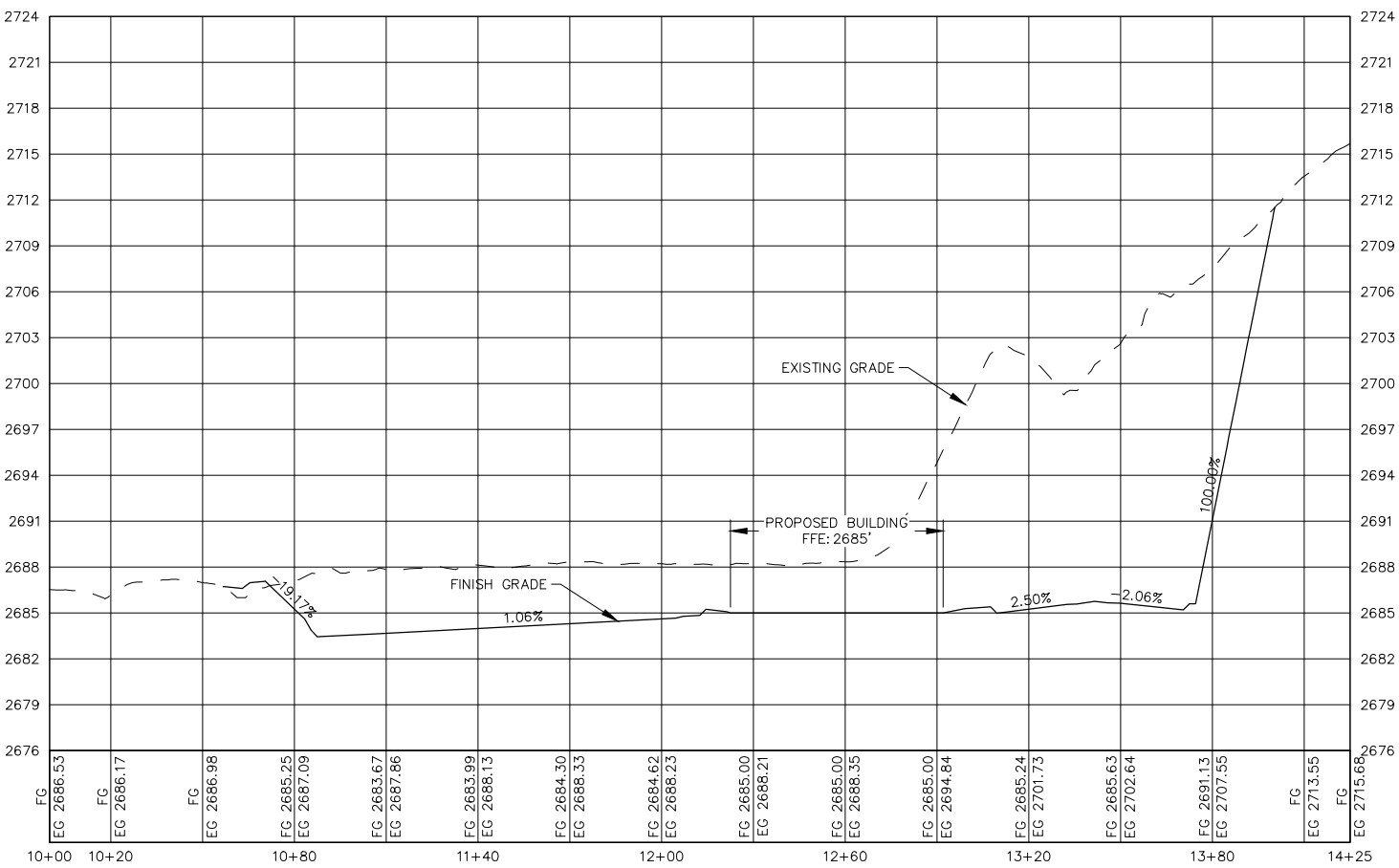
Site Plan

[illegible]

SITE PLAN

@HOME BEST WESTERN
ST. GEORGE, UTAH

PROJECT #	2043-01
NAME	RKB
DATE	FEBRUARY 7, 2024
SCALE	AS NOTED
SHEET	1
FILE	2043-01 Hillside.dwg



NO.	DATE	BY	DESCRIPTION

REVISIONS

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**ALPHA**
ENGINEERING

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CROSS SECTIONS

@ HOME BEST WESTERN
ST. GEORGE, UTAH

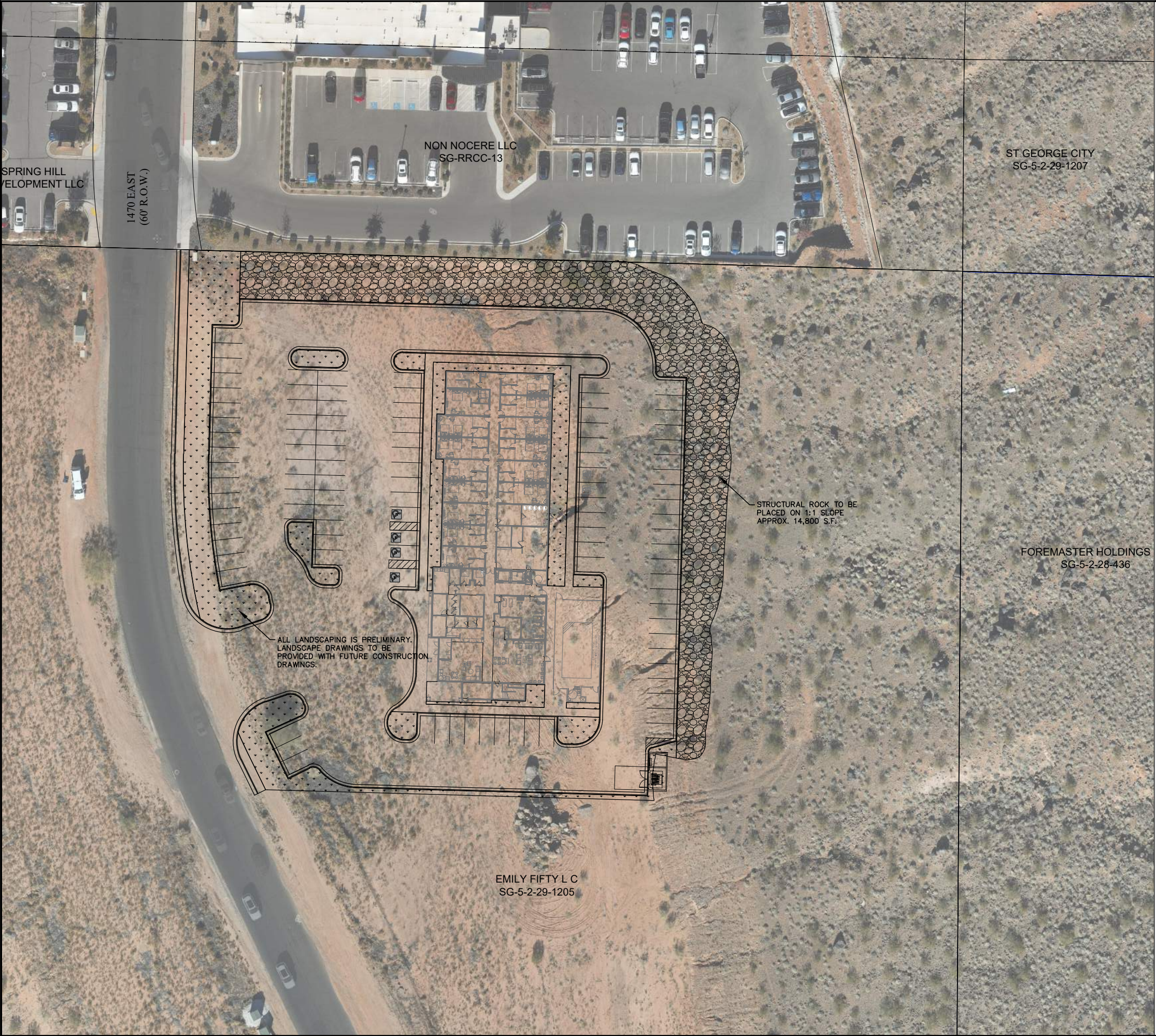
PROJECT #	2043-01
NAME	RKB
DATE	FEBRUARY 7, 2024
SCALE	AS NOTED
SHEET	2
FILE	2043-01 Hillside.dwg

HS HD24-000001
@Home Best Western

EXHIBIT C

Landscape & Vegetation Plan

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SPRING HILL
VELOPMENT LLC

1470 EAST
(60' R.O.W.)

NON NOCERE LLC
SG-RRCC-13

ST GEORGE CITY
SG-5-2-29-1207

FOREMASTER HOLDINGS
SG-5-2-28-436

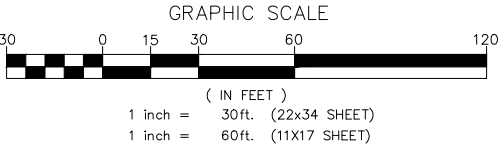
EMILY FIFTY L C
SG-5-2-29-1205

ALL LANDSCAPING IS PRELIMINARY.
LANDSCAPE DRAWINGS TO BE
PROVIDED WITH FUTURE CONSTRUCTION
DRAWINGS.

STRUCTURAL ROCK TO BE
PLACED ON 1:1 SLOPE
APPROX. 14,800 S.F.

LANDSCAPE NOTES

1. DISTURBED SLOPES TO BE LINED WITH ROCK FOR STRUCTURAL PURPOSES.
2. IRRIGATION WILL NOT BE PLACED ON THE DISTURBED 1:1 SLOPES.
3. LANDSCAPE & IRRIGATION PLANS WILL BE PROVIDED WITH FUTURE CONSTRUCTION DRAWINGS. ALL LANDSCAPING AND IRRIGATION WILL CONFORM TO ST. GEORGE CITY STANDARDS AND REQUIREMENTS.



LANDSCAPE & VEGETATION
PLAN

@ HOME BEST WESTERN
ST. GEORGE, UTAH

NO. DATE BY DESCRIPTION

REVISIONS

PRELIMINARY
NOT FOR CONSTRUCTION



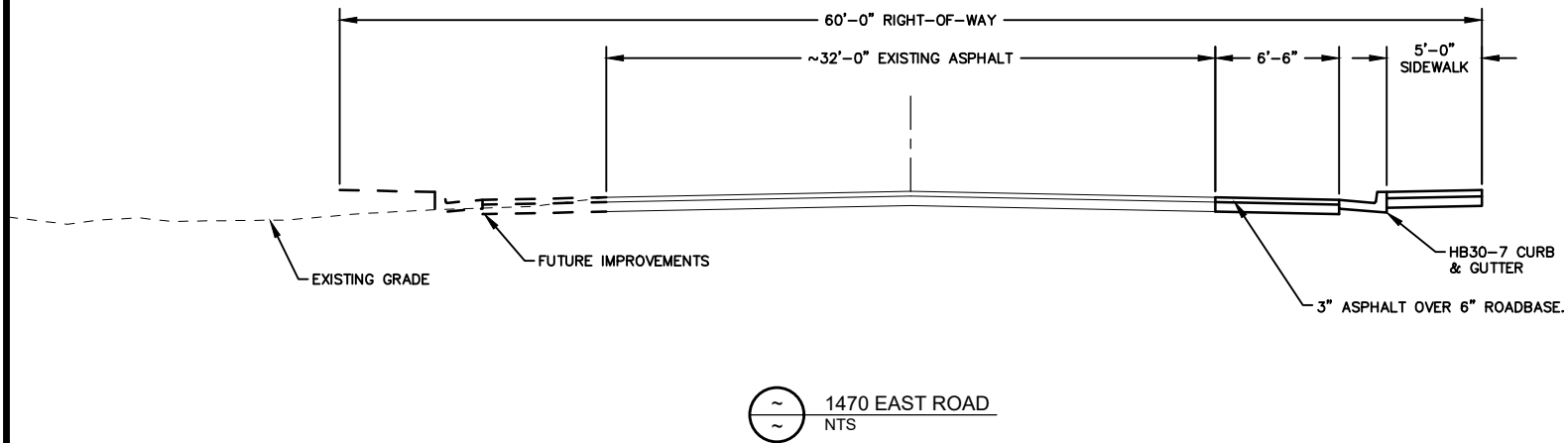
43 South 100 East, Suite 100 • St. George, Utah 84770
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HS HD24-000001
@Home Best Western

EXHIBIT D

Street Design

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STREET DESIGN - @ HOME BEST WESTERN

RKB

ST. GEORGE, UTAH



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EXHBIT E

Earth Moving Plan



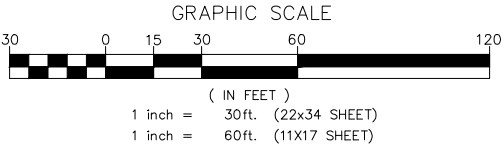
EARTH MOVING NOTES

- SUITABLE EXISTING MATERIAL WILL BE USED FOR FILL ON-SITE.
- EXCESS AND UNSUITABLE MATERIAL WILL BE REMOVED FROM THE SITE.
- ANTICIPATED OPERATIONS MAY INCLUDE:
 - CAT D-6 DOZERS
 - CAT 980 SIZE LOADERS
 - CAT 345 SIZE EXCAVATORS

ANTICIPATED SCHEDULE:
BEGIN GRADING BY: OCTOBER 1, 2024
FINISH GRADING BY: DECEMBER 31, 2024
FINISH ROCK STACKING BY: JANUARY 31, 2025

TERRAIN DESCRIPTION

THE EAST PORTION ADJACENT TO 1470 EAST HAS BEEN ROUGH GRADED FOR FUTURE DEVELOPMENT. TOPOGRAPHY EXTENDS UPWARD ROUGHLY 200 FEET FROM THE PROPOSED BUILDING ELEVATION OVER ROUGHLY 400 FEET HORIZONTALLY, GIVING AN AVERAGE GRADE OF 2 HORIZONTAL TO 1 VERTICAL. THE GRADE IS NOT CONSISTENT AND STEEPENS SIGNIFICANTLY TOWARDS THE TOP WITH LOCALIZED GRADES APPROACHING 1H:1V AND IS CAPPED WITH COLUMNAR BASALT. VEGETATION ON SITE IS SPARSE WITH SOME DESERT SHRUBS AND GRASSES PRESENT. THE MAJORITY OF THE GROUND SURFACE IN THE DEVELOPMENT AREA IS BARE EARTH AND ROCK FIELDS.



NO.	DATE	BY	DESCRIPTION

REVISIONS

PRELIMINARY
NOT FOR CONSTRUCTION

**ALPHA**
ENGINEERING

43 South 100 East, Suite 100 • St George, Utah 84770
T: 435.628.6500 • F: 435.628.6553 • alphaengineering.com

TITLE		EARTH MOVING PLAN	
PROJECT		BEST WESTERN @ HOME ST. GEORGE, UTAH	
PROJECT #	2043-01	NAME	RKB
DATE	FEBRUARY 7, 2024	SCALE	AS NOTED
SHEET	1	1 OF 1	
FILE	2043-01 Hillside.dwg		

HS HD24-000001
@Home Best Western

EXHIBIT F

Geotechnical Report (Rockfall Study)

GEOTECHNICAL ENGINEERING REPORT

Prepared for:

Home Hospitality Group

Attn: Nick Ence

107 South 1470 East Suite #302

St. George, Utah 84790

February 6, 2024

(Edited: February 7, 2024)

@Home Best Western



Prepared by:



795 EAST FACTORY DRIVE
ST. GEORGE, UT 84790

Landmark Project No: 240016



February 6, 2024 (Edited: February 7, 2024)

Home Hospitality Group
Nick Ence
107 South 1470 East, Suite 302
St. George, Utah 84790

Subject: Geotechnical Engineering Report
@Home Best Western
St. George, Utah
Landmark Project No.: 240016

Mr. Nick Ence,

Landmark Testing and Engineering (Landmark) has completed a Geotechnical Engineering Report for the proposed hotel development located at approximately 335 South 1470 East in St. George, Utah. The geotechnical recommendations, including foundation design, pavement design, slope stability analysis, and rockfall analysis, along with our field and laboratory data are presented in this report. This work has been done in general accordance with Landmark proposal YP4756 dated December 1, 2023 and your subsequent authorization of the work.

The field investigation consisted of eight test pits excavated to a maximum depth of 15 feet below ground surface (bgs) and one trench to 8 feet bgs. Additionally, Landmark performed one refraction microtremor (ReMi) array proximate to the proposed structure, and rockfall and slope stability reconnaissance.

Conventional spread footings bearing on structural fill are recommended for structural support of the proposed structures. Over-excavation and recompaction, as detailed in Section 6.0 of this report, will be required. The existing soils, free from organics and other debris are suitable for use as structural fill.

To reduce the risk to life and property against potential rockfall hazards, we also recommend the construction of a rockfall protection method. We have provided parameters and analysis assuming an earthen berm will be constructed along the eastern property line above the top of the proposed 1 horizontal to 1 vertical (1H:1V) to be cut in that area.

Landmark has great interest in providing materials testing and special inspection services during the construction phase of this project. If you advise us of the appropriate time to discuss these engineering services, we will be pleased to meet with you at your convenience.

Please feel free to contact our office at (435) 986-0566 if you have any questions.

Sincerely,

LANDMARK TESTING AND ENGINEERING

Steven Wells, P.E.
Geotechnical Manager

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FIGURE A-2:	Site Map
FIGURE A-3:	Critical Cross Section S-S'
FIGURES A-4 through A-11:	Test Pit Logs
FIGURE A-12:	Trench Profile
FIGURE A-13:	Unified Soil Classification System

APPENDIX B – Laboratory Test Results

TABLE B-1:	Summary of Laboratory Test Results
FIGURE B-1:	Consolidation Curve
FIGURE B-2:	Modified Proctor Curve
FIGURE B-3:	CBR Curve
FIGURES B-4 and B-5:	Soil Classification Reports
FIGURE B-6:	Water-Soluble Sulfate Report

APPENDIX C – Shear Wave Velocity Analysis

FIGURE C-1:	Shear Wave Velocity Report (2 Pages)
FIGURE C-2:	ASCE Hazard Tool Seismic Output (3 Pages)

APPENDIX D – Slope Stability Analysis

FIGURE D-1:	Slope Stability Profiles for Static and Seismic
FIGURE D-2:	Slide2 – Slope Stability Report (35 Pages)

APPENDIX E – Rockfall Study

FIGURE E-1:	RocFall2 - Rock Endpoint Distribution
FIGURE E-2:	RocFall2 – Round Rock Paths
FIGURE E-3:	RocFall2 – Rock Paths with Berm
FIGURE E-4:	Typical Berm Detail
FIGURE E-5:	RocFall2 – Rockfall Report

1.0 INTRODUCTION

This report presents the results of Landmark Testing & Engineering's geotechnical investigation and analysis for the proposed @Home Best Western development in St. George, Utah. Figure A-1 is a Vicinity Map showing the project location relative to surrounding features. Figure A-2 is a Site Map showing the proposed project layout and the approximate locations of the test pits completed for this investigation. Figure A-3 shows the critical cross section line used for slope stability and rockfall analysis.

This investigation was completed to assist in developing opinions and recommendations concerning site earthwork and foundation design.

2.0 PROPOSED CONSTRUCTION

A preliminary site layout and grading plan has been provided to us and reviewed in preparation of this Geotechnical Engineering Report. We understand that development of the 2.27-acre project site will include construction of a three- to four-story hotel, associated asphalt paved parking and driveways, and dumpster pad. It is anticipated that the east side of the property will be cut as much as 30 feet down to the parking lot elevation. The south end of the development area will be filled roughly 10 feet to meet the proposed design grades.

Building loads are expected to be on the order of 3,500 to 4,500 pounds per linear foot along strip footings, with point loads on pad footings up to 100 kips. Traffic loads are anticipated to be equivalent to residential average daily traffic with heavy use drive aisles providing access to the garbage enclosure.

Any significant changes to the anticipated development should be reviewed by Landmark to evaluate the continued applicability of the recommendations contained in this report.

3.0 SITE SETTING

3.1 SURFACE CONDITIONS

The project is located at approximately 335 South 1470 East on Parcel SG-5-2-29-1205. The entire lot is roughly 21 acres, with the proposed development being in the northernmost 2.27 acres. This lot is immediately South of the Mesa Medical Center located at 295 South 1470 East. The southern majority of the property has been rough graded for future development, and the property has frontage onto 1470 East to the west. Historical imagery shows that the western portion of the lot has been roughly graded around 2013.

Foremaster Ridge extends upward immediately east of the property. Topography extends upward roughly 200 feet from the proposed building elevation over roughly 400 feet horizontally giving an average grade of 2 horizontal to 1 vertical (2H:1V). The grade is not consistent and steepens significantly towards the top with localized grades approaching 1H:1V and is capped with columnar basalt, which is a known source for rock fall. Storm water has cut channels into the slope, and the landscape is scattered with rocks ranging from 10 feet to 2 feet.

Vegetation on site is sparse with some desert shrubs and grasses present. The majority of the ground surface in the development area is bare earth and rock fields.

3.2 GEOLOGIC SETTING

According to the Utah Geological Survey,¹ the project site is mapped as located on:

Qmt: Talus (Holocene to upper Pleistocene)

Poorly sorted, angular boulders and finer-grained interstitial sediment deposited principally by rock fall on and at the base of steep slopes; typically grades downslope into colluvial deposits and may include colluvial deposits where impractical to differentiate the two; also includes alluvial deposits in the bottom of washes, and, in the Smith Mesa quadrangle, locally includes small landslide deposits along the outcrop belt of the Petrified Forest Member of the Chinle Formation; generally less than 30 feet (9 m) thick.

This colluvial Talus layer is likely underlain by:

Jks: Springdale Sandstone Member of Kayenta Formation (Lower Jurassic)

Medium- to thick-bedded, fine- to medium-grained sandstone with planar and low-angle cross-stratification, and minor, thin, discontinuous lenses of intraformational conglomerate and thin interbeds of moderate-reddish-brown or greenish-gray mudstone and siltstone; contains locally abundant petrified and carbonized fossil plants.

Materials encountered during the subsurface exploration of the property coincide with geologic mapping by the UGS.

3.3 GEOLOGIC HAZARDS

The St. George basin lies within the physiographical transitional zone between the Colorado Plateau to the east and the Basin and Range Province to the west. Southwestern Utah is located on a structural block proximate to the southern segment of the Intermountain Seismic belt, which is characterized by high-angle normal faults that tend to step down to the west. The Hurricane fault with an offset of 6,000 to 8,000 feet forms the eastern edge of the transition zone. The Grand Wash-Reef Reservoir-Gunlock fault system with displacement of about 1,500 to 3,000 feet forms the western edge.

Fault Rupture

The trace of the Washington Fault Zone is located approximately 3 miles east of the site with the Hurricane Fault roughly 13 miles to the east. The Utah Geologic Survey indicates that these faults displace late Quaternary sediments and are considered active. Strong ground motion associated with movement along these, or other faults associated with the Intermountain Seismic Belt is possible, however, the potential for surface fault rupture is considered low.

Although the potential for surface rupture caused by activity from either of these faults is low, there is potential for strong ground motion at the site due to possible fault rupture at these or other localized faulting zones. These ground motions are considered by the ASCE 7-16 seismic design parameters given in Section 3.4. Shear wave velocity analysis was performed to assist in seismic classification of the site as outlined in Section 3.4.

¹ Utah Geological Survey (UGS), Interactive Geologic Map Portal, Accessed February 5, 2024

Liquefaction

Liquefaction is the sudden loss of shear strength in the soil due to the build-up of excess pore water pressure.² This can occur when the soil is subjected to intense shaking such as during a seismic event. The soils that are most susceptible to liquefaction are loose, saturated sandy soils with a low fines content (material passing the #200 sieve).

According to the Utah Geological Survey,³ the soils in the project area are mapped as being low liquefaction-susceptibility zone. Soils encountered in the test pits are Silty Sands with minor Clayey Sands. Groundwater was not encountered in our test pits during our investigation and therefore liquefaction potential may be considered low. A liquefaction study is beyond the scope of this report.

Slope Stability

Global slope stability is a concern when a native or constructed slope is steep enough that the resisting forces in the soil may be overcome by the mobilization forces acting downward on a section of soil. Different soil types and slope geometry can greatly impact the stability of a given slope grade. In general, a soil slope of 2H:1V is considered stable and does not require additional analysis.

The preliminary grading plan shows that in order to establish the desired parking lot and building grades for the development, a slope of 1H:1V will need to be cut in the eastern portion of the project. Beyond the proposed cut, the slope continues upward in a relatively steep manner. Slope stability analysis has been performed as described in Section 4.3 and Section 5.1.

Rockfall

The proposed development is shown on the UGS geologic hazards map as being located within a high rockfall hazard area. The project area and the slope further east exhibit signs of rockfall including the presence of geologically young basalt which has become detached from the Lava Ridge Lava Flow source which is present east of the property as shown in Figure A-3. Landmark has performed rockfall analysis as outlined in Section 4.3 and 5.2

Expansive soils

The site is shown on the UGS geologic hazards map as being partially located in a low expansive soil hazard area. Expansive soils are clays and claystone which change volume due to moisture content changes. Expansive soils were not encountered in our test pits.

It is possible for expansive soil to be present in areas beyond our exploration locations. As such, excavating contractors should be vigilant in observation of soil conditions. If highly plastic soils which are unusual in color are found on site, Landmark should be contacted for further evaluation and recommendations.

Collapsible Soils

-
- 2 Coduto, Donald P. (1999), *Geotechnical Engineering: Principles and Practices*, Prentice Hall, Upper Saddle River, NJ
 - 3 St. George-Hurricane Metropolitan Area Geologic-Hazard Study, Knudsen, Tyler R., Utah Geologic Survey Special Study 127.

The site is shown on the UGS geologic hazards map as being located in Type 2 Collapsible Soil hazard area. Collapsible soils are considered to have considerable strength when in a dry, natural state, but significantly settle due to hydro compaction, reduction of air space when the soil is wetted. Soils encountered on site exhibited signs of collapsibility which were confirmed by laboratory testing.

Collapsible soils pose significant hazard to the development. For recommendations related to collapsible soils, refer to Section 6.0.

3.4 SEISMICITY

Seismicity at the site was determined using ASCE Hazard Tool from ASCEhazardtool.org website. Consideration should be given to the risk category of the building. It is assumed in this report that the building is risk category II as determined by International Building Code (IBC) Table 1604.5. It is possible that risk category III is more appropriate, depending on the intended use and capacity of the structure. If this is the case, applicable design considerations should be followed.

A Shear Wave Velocity Study was conducted on the project site as shown on the site map in Figure A-2. Landmark determined the average shear wave velocity of the upper 100 ft ($V_{s,100}$) of the site soil profile on the project according to the refraction microtremor method (ReMi). The ReMi data showed that the $V_{s,100}$ of the site soils is 1,756 ft/sec, which classifies the site as “C.” The ReMi data is included as Figure C-1. This correlates well with soils encountered in the test pits. Bedrock was found in the ReMi data, although it is difficult to define as the near surface rock is heavily weathered in places. There are significant strength increases seen at roughly 8 feet and 16 feet bgs, with another increase at roughly 36 feet bgs as shown in Figure C-1.

The following values are presented to assist with seismic design:

- Latitude = 37.102952° North, Longitude = 113.551219° West
- $V_s = 1,756$ ft./sec.
- Site Class = C – Very Dense Soil and Soft Rock, based on ASCE 7 as referenced in 2021 IBC

Period (sec)	S_a (g)	Site Class
0.2	$S_s = 0.521$	B/C
1.0	$S_1 = 0.169$	B/C
0.2	$S_{DS} = 0.448$	C
1.0	$S_{D1} = 0.169$	C

The complete ASCE Hazard Tool output is attached as Figure C-2.

4.0 INVESTIGATION

4.1 FIELD INVESTIGATION

To investigate the subsurface conditions, 8 test pits and a trench were excavated to a maximum depth of 15 feet. Test pits were excavated using a CAT 336F mid-sized trackhoe with a 4-foot

toothed bucket. Depending on subsurface conditions, bag or block samples of soil were obtained from the test pit excavations. Test pit and trench designations and approximate locations are shown on Figure A-2.

Landmark geologist Michael Meyers supervised the excavation. A log of the subsurface conditions was prepared, samples were collected and sealed for transport, and relevant site photographs were taken. Groundwater was not encountered in the test pits at the time of investigation.

Soil conditions were variable across the property. Near surface soils especially up on the slope along the eastern portion of the development area consisted of silty sand to lean clay with various amounts of fines and gravels as well as basalt boulders in some locations. Underlying these colluvial deposits at various depths, materials transitioned to mudstone or sandstone which was difficult to excavate, and in many cases, the test pits were terminated due to refusal.

Complete test pit logs are presented on Figures A-4 through A-11 with the trench profile as Figure A-12. A key to the soil classifications used on the logs is presented as Figure A-13.

4.2 LABORATORY TESTING

Soil samples from the test pits were taken to our St. George, Utah laboratory for testing. Tests performed on the samples included:

- Moisture content and unit weight for density determination
- Sieve analysis and Atterberg Limits for soil classification
- One-Dimension Consolidation for earthwork design
- Modified Proctor for construction testing
- California Bearing Ratio (CBR) for pavement section design
- Soluble Sulfate Content for concrete mix design selection

A sample from TP-4 at 12 feet bgs was tested for soil classification. The sample had a moisture content of 3.7 percent. Atterberg Limit testing showed that the sample had a liquid limit of 20 with a plasticity index of 4 indicating low plasticity. Mechanical sieve analysis showed that the sample was 11 percent gravel, 47 percent sand, and 42 percent silt and clay. According to the USCS, this soil is classified as Silty Clayey Sand (SC-SM).

Another sample from TP-5 at 3 feet bgs was tested for soil classification. The sample had a moisture content of 3.7 percent. Atterberg Limit testing showed that the sample was non-plastic. Mechanical sieve analysis showed that the sample was 19 percent gravel, 58 percent sand, and 32 percent silt and clay. According to the USCS, this soil is classified as Silty Sand with Gravel (SM).

A sample taken from TP-6 at 2 feet bgs was tested for consolidation. The sample had a density of 89.4 pcf with a moisture content of 4.4 percent. This sample collapsed 4.1 percent under a 1.5 ksf load in a saturated condition. This is considered highly collapsible. For recommendations related to collapsible soil see Section 6.

A sample taken from TP-7 at 1.5 feet bgs was tested for water soluble sulfate content. The sample tested had 1.89 percent soluble sulfate which is considered highly corrosive according to the American Concrete Institute (ACI) Section 318. For recommendations related to corrosive soils, refer to Section 12.0.

A bulk sample taken from TP-2 was tested for maximum dry density, optimum moisture, and CBR.

According to modified Proctor testing, the sample has a maximum dry density of 123.2 at an optimum moisture of 10.2 percent with a CBR of 38.

The results of the laboratory tests are shown on the test pit logs as well as on the attached Summary of Laboratory Test Results on Table B-1. Individual test results are also included in Appendix B.

4.3 *ROCKFALL AND SLOPE STABILITY RECONNAISSANCE*

To determine the rockfall and slope stability hazard present on the site, a Landmark engineer visited the property to document the surface conditions of the slopes, their characteristic roughness, approximate grade, and the typical boulder size. The general direction of the slope, and the likely path if rockfall or slope failure were to occur.

The basalt cap of Foremaster Ridge is considered the main source of rockfall in the area. The parking lot is roughly 430 horizontal feet west of the rock source and the structure is approximately 500 feet west. Critically, the proposed 1H:1V cut slope is roughly 390 horizontal feet from the rock source. The area between the proposed structure and the top of the slope is mapped by UGS as talus deposits.

In general, the topography of the slope steepens towards the top, with grades near the bottom of 3H:1V and steepening to nearly 1H:1V at the top. The rock source zone is nearly vertical with severely fractured columnar basalt from the Lava Ridge lava flow being exposed. The topography of the slope is moderately hummocky as is common in areas of colluvial activity. Stormwater has scoured out canals and channels of various sizes trending generally parallel to the grade of the slope.

The slope is lightly vegetated with desert shrubs and grasses. Boulders of various sizes and shapes are scattered across the slope and into the development area. There is evidence of a significant rockfall event that occurred relatively recently above the proposed development, the separated rock segment was very large and blocky.

As previously mentioned, the proposed development includes cutting a 1H:1V slope at the toe of the existing grade. This increases the potential acceleration zone of potential rockfall and may be a detriment to the global stability of the natural slope. As such, Landmark has performed analysis of the global slope stability and rockfall analysis as outlined in Section 5.0. Recommendations for site grading and earthwork pertaining to this analysis are given in Section 6.0.

5.0 ANALYSIS AND CONCLUSIONS

Our field and laboratory tests results indicate that near surface soils on site consist of colluvial silty sand which is intermixed with gravel, cobbles, and boulders especially along the western portion of the project area. These sands are underlain by mudstone and sandstone which was difficult to excavate with the mid-sized trackhoe used for the exploration. Several of the test pits reached refusal as shallow as 7 feet bgs.

Near surface sands exhibited signs of collapsibility in the field. In addition, a consolidation test performed on a sample from TP-6 collapsed 4 percent under 1.5 ksf loading under saturated condition which is highly collapsible. Therefore, we recommend that loose soils beneath footings and floor slabs of the hotel structure be excavated prior to construction. General recommendations for the earthwork and the foundation system are outlined in Sections 6.0 and 7.0 of the report.

Slope stability and rockfall analysis was performed along a critical cross section S – S' shown on Figure A-3. This section was selected as the most critical due to it being the tallest section of the 1H:1V cut as well as due to the steepness of the natural slope above the proposed cut. The selection of this critical cross section is based on the preliminary grading plan provided to Landmark. Should the grading plan change, Landmark should be contacted to evaluate the continued efficacy of the design.

5.1 SLOPE STABILITY ANALYSIS

Slope stability analysis is the quantitative and qualitative analysis of the condition of a man-made or natural slope. In the case of this project, the slope analyzed is both the man-made cut as well as the natural slope above the proposed cut.

To perform the analysis, appropriate soil properties, slope geometry and other conditions were established. Calculations were then performed to ensure that resisting forces are sufficiently greater than the forces tending to cause a slope to fail.⁴ Ultimately, a factor of safety (FS) is determined by comparing the resisting forces to the sliding forces along a potential failure surface.

To assist with analysis, RocScience Slide2 software was used to perform the calculations. Both the static and seismic conditions for the geometry and condition as shown in Figures D-1 and D-2 were analyzed using a variety of methods. For the conditions analyzed, the slope, cut at a 1H:1V as shown in the preliminary grading plan is stable for the static and seismic condition.

This assumes that the lower 20 feet of the cut will be comprised of competent sandstone material and the remaining soil consists of sandy colluvial material as encountered in TP-1. The slope stability output provided by RocScience is attached as Figure D-2. This report contains assumptions and limitations used in the analysis.

Landmark should be called on site to assess the soil conditions as the slope is being cut. Should soil conditions encountered during construction vary somewhat from the conditions found during the investigation, Landmark should perform further analysis of the “as-built” condition.

5.2 ROCKFALL ANALYSIS

A two-dimensional model of the natural slope, and then the design critical cross section S-S' was modeled in the Colorado Rock-Fall Simulation Program (CRSP) as well as in RocScience Rocfall2 software to evaluate the potential runout zone below the rock source. Firstly, analysis was done on the natural slope to verify the parameters of the model. Modeling of various rock shapes and sizes in Rocfall2 show relatively similar distribution as found in the field.

Based on the geometry provided in the preliminary grading plan, a variety of rock shapes and sizes were simulated in Rocfall2 and CRSP. Across several iterations, roughly 5 to 10 percent of the rocks analyzed reached the 1H:1V cut slope and then accelerated into the parking lot. Some rocks approached the proposed hotel site as shown in Figures E-1 and E-2.

4 Duncan, M.J. et al (2014), *Soil Strength and Slope Stability Second Edition*, Wiley Publishing, Pg. 81-101

Rockfall Recommendations

Based on our site evaluation and rockfall simulations, it appears that there is a risk of rockfall reaching the parking lot area, and a slight risk of falling rocks reaching the proposed structure footprint.

To reduce the risk of rockfall and damage to property and life, mitigation measures are recommended. We reviewed several mitigation options including concrete barriers, catchment fences, and an earth fill catch berm. The least invasive mitigation measure is the construction of a catch berm along the eastern property line of the lot. This berm should extend across the entirety of the proposed 1H:1V cut slope. A proposed berm detail is included in Figure E-4. Rockfall2 simulations indicate that the berm would be successful at reducing the risk of rocks reaching the cut slope and accelerating into the parking area. Concrete barriers and catchment fences would need to be designed for the potential rockfall energy.

6.0 SITE GRADING AND EARTHWORK

6.1 GENERAL GRADING

Site preparation should initially consist of grubbing and removal of vegetation. Grubbing is expected to be minimal, as most of the development area is bare earth.

The preliminary grading plan shows that the development area will be cut some 30 feet from the existing grades in the north and western portions of the site and roughly 10 feet of fill in the south and eastern portions of the site.

Near surface soils consisted of silty sand to lean clay with gravel, cobbles, and boulders intermixed. These soils exhibited high potential for collapse under loaded, saturated conditions.

Building Pad

In the area of the hotel building pad, we recommend that at least 4 feet of material be over-excavated from the existing ground surface. This excavation should extend 5 feet horizontally beyond the building envelope in all directions. Consideration should be given to over-excavating hardscaped areas around the perimeter of the building as well. If at any point sandstone bedrock is reached, the over-excavation may be considered complete at that point.

Once the over-excavation is complete, the bottom of the excavation should be scarified, moisture conditioned to within 2 percent of the optimum moisture, and recompact to 90% of maximum dry density as determined by ASTM D1557 Modified Proctor testing. If the bottom of the excavation is into bedrock, scarification is not required.

Following over-excavation, a Landmark engineer or geologist should observe the excavation to document the depth of the excavation and determine if subsurface conditions match those found in our filed investigation. Alterations to our recommendations may be required if substantially different conditions are encountered.

Once the over-excavation is complete, the contractor may begin placing structural fill as outlined in Section 6.2. On site soils which are free of over-sized material exceeding 6 inches may be used as structural fill on site. Shrinkage of the on-site soils should be expected on the order of 25 percent volume reduction. Imported material may be required to establish desired grades. Foundations

should be established on a minimum of 1 foot of structural fill, and not established directly on bedrock to limit the potential for differential settlement.

Landmark does not determine the location of the over-excavation or the location of the structures to be constructed. The builder is responsible to ensure that the building footprint is entirely within the over-excavated and recompacted building pad.

Pavement Area

Based on observation of the preliminary grading plan provided to Landmark, much of the portions of the project to be paved will be in areas of mass grading. The parking lot in the northeast will be significantly cut below existing grade, and the parking lot to the southwest will be on fill. In areas where the grading transitions from cut to fill, the contractor should ensure that at least 1 foot of structurally placed fill material is installed under pavement areas, curbs, and sidewalk to reduce the risk of settlement due to collapsible soils.

Catchment Berm

To reduce the risk of damage to life and property from rockfall hazard, Landmark recommends that a catchment berm be constructed along the top of the 1H:1V cut slope proposed along the eastern portion of the property. A typical detail for this berm is provided as Figure E-4. This berm should be constructed such that the total height of the berm is at least 5 feet high relative to the uppermost existing grade. This berm should be setback at least 5 feet from the top of the cut slope. The core of the berm should be constructed out of onsite sandy soils which have been compacted to 95% of ASTM D-1557. There should be roughly 3 feet of loose screened fill placed on the uphill side of the berm.

This berm should extend roughly the entire length of the cut slope. Modifications to this design maybe made in the field by a Landmark engineer should grading of the site warrant such a change.

6.2 FILL PLACEMENT AND COMPACTION

All fill to be placed for support of footings and slabs-on-grade should be considered structural fill. On-site soils with over-sized material removed are suitable for use as structural fill. However, we recommend that the floor slabs and footings be established on at least 12 inches of aggregate base course material or imported granular fill.

Imported, granular fill, if required, should be well-graded, non-expansive, and free of organics and all deleterious materials. Soils used for imported, granular fill should meet the following specifications and preferably would classify as gravel.

GRADATION	PERCENT PASSING
6- inch	100
3-inch	80-100
No. 200 sieve	10-25
ATTERBERG LIMITS	
Liquid Limit	30 or less

Plasticity Index	9 or less
------------------	-----------

Material not meeting the above requirements may be suitable for use as structural fill at the discretion of the geotechnical engineer. Samples of structural fill should be submitted for testing prior to transporting to the site.

Any on-site soils used as structural fill or imported, granular fill should be compacted to the following specifications.

FILL PLACEMENT AND COMPACTION	
Maximum lift thickness	8-inch (loose)
Minimum compaction	95% ASTM D-1557
Compacted Moisture Content	within 2% of optimum

Compaction of structural fill should be completed with equipment suitable for the conditions encountered in the field such that compaction requirements are met, including those areas that may be inaccessible to large rolling compactors. All structural fill should be evenly spread on a horizontal plane in eight-inch loose lifts. Each eight-inch lift of structural fill material placed at the site should be tested for compliance with the required relative compaction and moisture content prior to proceeding with additional lifts.

6.3 LIGHTLY LOADED ELEMENTS

Exterior concrete slabs on grade (sidewalks, curbs, gutters, and misc.) should be established on a minimum of 12-inches of structurally placed soils with a maximum particle size of 6-inches. Sidewalks adjacent to public right of ways will need to be underlain by approved road base as per City of St. George Standards.

Structural fill, including road base, should be compacted to a minimum of 95 percent of the maximum dry density as determined by ASTM D-1557.

6.4 CUT AND FILL SLOPES

It is recommended that permanent cut or fill slopes in silty sand soil be maintained at a slope of two horizontal to one vertical (2H:1V) or flatter unless structurally retained. The 1H:1V slope has been analyzed and is stable as shown in Section 5.0. The majority of the exposed cut face should be into competent sandstone material with less than 10 vertical feet of colluvium making up the slope.

Steeply cut slopes are subject to erosion and degradation over time. Consideration should be given to drainage and erosion control methods to limit the amount of maintenance required.

Grading of both cut and fill slopes should be such that surface water is directed away from the slopes and not concentrated on slopes or in unprotected channels. Construction procedures should ensure adequate compaction of slope faces. All excavations should conform to OSHA standards.

7.0 FOUNDATION & CONSTRUCTION CONSIDERATIONS

The proposed structures may be supported on conventional spread or continuous footings established on a minimum of 12 inches of aggregate base course or imported granular fill

overlaying structurally places silty sand. Foundation excavations should be visually observed and tested by qualified personnel prior to placement of reinforcing steel or concrete. Additional foundation recommendations are subsequently presented.

DESCRIPTION	VALUE
Foundation Type	Continuous or spread footings
Bearing Material	Aggregate Base Course or Granular Fill
Allowable Bearing Capacity	3,000 psf on Aggregate Base Course 2,800 psf on Granular Fill
Minimum embedment depth below finished grade	12 inches (for frost and confinement)
Minimum footing width	12 inches (continuous) for single-story 18-inches for two stories 24-inches (isolated spread)
Total estimated settlement	1-inch
Total differential settlement	less than 3/4 inch

The allowable bearing capacity is based upon dead load plus long-term live load. A one-third increase in allowable bearing capacity for short duration loads such as wind or seismic loads is permitted with the alternative load combinations given in Section 1605.3.2 of the IBC.

8.0 FLOOR SLABS

It is recommended that concrete floor slabs be constructed on a pad that has been prepared as previously indicated. A minimum of 4-inches of relatively free-draining material should be used beneath the slab in order to help distribute floor loads, break the rise of capillary water, and aid in the concrete curing process. Alternatively, 6 inches of road base may be used in place of the free draining-material. The thickness of the free-draining material may be included in the 12-inches of granular, structural fill.

Concrete slabs should be designed using rebar reinforcement and frequent crack control joints to help control normal shrinkage and stress cracking. Concrete placement and curing should meet ACI⁵ requirements including following hot or cold weather placement recommendations, when appropriate. If a moisture-sensitive floor covering will be installed, we recommend that a vapor barrier be installed beneath the concrete slab. The moisture sensitivity of floor finishes, anticipated project conditions, and the potential effects of slab curling and cracking should be considered in determining if the barrier should be placed directly beneath the slab or beneath the free-draining gravel (see ACI 302.IR-96 for more information regarding vapor barrier location). If the vapor barrier is installed directly beneath the slab, measures should be taken to minimize excessive slab curl such as reduced joint spacing and use of a low shrinkage (low water-cement ratio) mix.

9.0 LATERAL EARTH PRESSURES

Lateral loads imposed on footings may be resisted by the development of passive earth pressures against the sides of footings and friction between the base of the footing and the supporting soils. Lateral earth pressure values are presented in the following table.

Case Evaluated	Soil Type	Value
Active	Structurally placed Silty Sand	38 psf/ft
		56 psf/ft (with seismic)
At-Rest	Structurally placed Silty Sand	59 psf/ft
Passive	Structurally placed Silty Sand	407 psf/ft
		357 psf/ft (with seismic)
Seismic Coefficient	IBC 1610.1.1	0.179
Coefficient of friction $\tan(\phi*0.6)$ where $\phi = 32^\circ$	Structurally placed Silty Sand	0.35

The lateral earth pressures presented do not include any safety factors except where the friction angle (ϕ) used to determine the coefficient of friction has been multiplied by 0.6 to account for smooth contact conditions. The pressures also assume horizontal backfill and that the backfill is in a drained condition with no build-up of hydrostatic pressure. The additional effects of sloping backfill, surcharge, structural loads and groundwater conditions should be included in calculating lateral earth pressures. Backfill should be placed in accordance with the requirements of structural fill except that backfill in landscape and areas that will not be subject to structural loadings may be reduced to 90 percent of the maximum dry density as determined by ASTM D-1557.

10.0 PAVEMENT DESIGN RECOMMENDATIONS

10.1 ASPHALT PAVEMENT

Design of the pavement sections are based on the procedures outlined in the 1993 Guidelines for Design of Pavement Structures by the American Association of State Highway and Transportation Officials (AASHTO). A Traffic Index of 5.5 was used for design of the parking areas and typical use drive aisles planned for the development. A heavy use section should be considered along the path to the garbage enclosure and any loading areas. A CBR value of 10 was used based on the soil encountered in our investigation and laboratory testing performed.

For pavement design, the following design parameters have been assumed:

<u>Pavement Design Life</u>	20 years
<u>Subgrade CBR</u>	10
<u>Structural Layer Coefficients</u>	Asphalt = 0.42 Road Base = 0.12

Based on design parameters, the following pavement sections are provided.

Location	Asphalt Thickness (inches)	Base Course (inches)	Scarified and Compacted Subgrade (inches)
Typical Use (T.I = 5.5)	2.5	6	12
Heavy Use (T.I = 7.0)	3.5	8	12

Recompacted on-site soils should be compacted to a minimum of 95 percent of the maximum dry density as determined by ASTM D-1557 and base course soils should be compacted to a minimum of 95 percent of the maximum dry density (ASTM D-1557). Asphalt should be compacted to at least 96 percent of the Marshall maximum density. Asphaltic concrete and base should be tested prior to site delivery and during placement for conformance with project specifications.

10.2 CONCRETE PAVEMENT

We anticipate that a concrete pad may be installed by the dumpster or other areas with heavy truck traffic. Procedures outlined in the Portland Cement Association's guide "Thickness Design for Concrete Highway and Street Pavements" were utilized for concrete pavement design.

The following design parameters were used:

- Average daily truck traffic = 0.5 (Axle -load category 1)
- Subgrade-subbase support = moderate (based on site soils)
- Concrete modulus of rupture = 600 psi (with fiber reinforcement)

Based on input parameters, a minimum of 5.5 inches of concrete and 6 inches of base over a properly prepared subgrade will be adequate. The design recommendations are based on the following assumptions:

Subgrade soils should be compacted to a minimum of 95 percent of the maximum dry density (ASTM D-1557). Concrete and base coarse materials and construction should meet the City of St. George specifications.

As a rough guide, the joint spacing in feet for plain concrete pavement should not generally exceed twice the slab thickness in inches. Thus, for a 5.5-inch-thick slab, joint spacing would be on the order of 11.0 feet as a maximum. Also, as a general guideline, the ratio of slab width to length should not exceed 1.25.

Joint depth should be 1/4 of the slab thickness and continuous across the slab. If sawn joints are used, the joints should be sawn as soon as possible following concrete set.

11.0 MOISTURE CONTROL

This soils report provides recommendations for site preparation and foundation design. Inadequate surface drainage or failure to control moisture will result in excessive differential movement of slabs, walkways, porches, or patios and structural damage, regardless of the site preparation. The following moisture control measures are recommended:

- (1) Once the finish floor elevation has been established, the site grades should be constructed and maintained to drain surface and roof runoff away from the building

- foundation at a slope of five percent for at least ten feet beyond the structure. The ground surface should be graded to drain away from the building in all directions. Water should not be allowed to pond adjacent to foundations or on-site.
- (2) Grass should not be placed within 5 feet of the foundation. Grass, if planted, should have a minimum slope of 5% away from the foundation.
 - (3) Xeriscape (landscaping that eliminates the need for supplemental irrigation of plants) is recommended within 10 feet of the building foundation. Bubblers, although more efficient than sprinkler irrigation, still have a significant potential of introducing excessive water into the ground and saturating foundation soils. Bubblers are not recommended in the 10 feet buffer zone area. As an alternative, sealed bottom planter boxes may be used.
 - (4) Inadequate compaction of utility trench backfill provides a conduit for water migration. All utility trenches within the building footprint and extending 5 feet beyond the footprint should be backfilled with structural fill similar to that approved for the foundations. Backfill adjacent to structures should be compacted to at least 90 percent of the maximum dry density as determined by ASTM D-1557 and the minimum slope requirements should be followed. Backfill beneath structures should be compacted to at least 95 percent of the maximum dry density.
 - (5) Grading should be such that surface water is directed away from all cut and fill slopes and collected only in channels protected against erosion. Water should not be allowed to pond on-site.
 - (6) Unless roof runoff falls on impervious surfaces such as asphalt or concrete that are sloped away from the building for a distance of 10 feet, roof runoff should be collected and discharged well outside of the foundation backfill limits.

It should be emphasized that final grading and landscaping generally occurs after construction of the structure and observation of these features is outside of normal geotechnical inspection and observation. The owner/contractor is responsible to ensure that these surface drainage and moisture control recommendations are followed throughout the life of the structure.

12.0 SOIL CORROSIVITY

Soils from the project site were tested for water-soluble sulfates content. The percent of water-soluble sulfates in the sample tested was 1.89 percent which is considered highly corrosive according to ACI 318. We recommend that concrete mixes used on the project be designed in accordance with ACI 318 Table 19.3.1.1 for Sulfate Exposure Class S2. We recommend that buried pipes be plastic (PVC or HDPE) instead of metal, where possible.

13.0 FOUNDATION REVIEW AND TESTING

This report has been prepared to assist in project design and construction. Variations from the conditions portrayed in the exploratory investigations may occur which are sometimes sufficient to require modifications to the design. In order to incorporate recommendations provided into actual field conditions and to confirm that the project specifications are implemented, we recommend that observation and testing be performed during construction to monitor over-excavation, grading, and preparation of soils upon which foundations elements or structural loads may be established.

14.0 LIMITATIONS

The exploratory data presented in this report were collected to provide geotechnical design recommendations for this project and subsurface site descriptions represent conditions observed at the time and at the locations explored. The investigations may not be indicative of subsurface conditions beyond the investigation location and conditions may change with passage of time. If subsurface conditions are encountered that are significantly different than those reported herein, Landmark should be contacted immediately for the continued applicability of the recommendations. In the event changes to the project are made that differ from those presented in this report, Landmark should be made aware of the changes. Landmark will provide written verification that the recommendations and conclusions remain valid or that modifications are required.

This report has been prepared to assist in project design and construction. We respectfully request the opportunity to review the final design drawings and specifications in order to determine whether the assumptions and recommendations presented herein are applicable to the anticipated designs.

This report is not intended to be used as the sole bid document. Any information concerning the environmental conditions of the site is beyond the scope of this geotechnical study. This geotechnical report has been prepared to meet the specific needs of our client and may not be appropriate to satisfy the needs of other users.

Site conditions and standards of practice change, therefore, we should be notified to review and update the report and its recommendations if construction is not commenced within 3 years of the date it was issued.

We appreciate this opportunity to be of service.

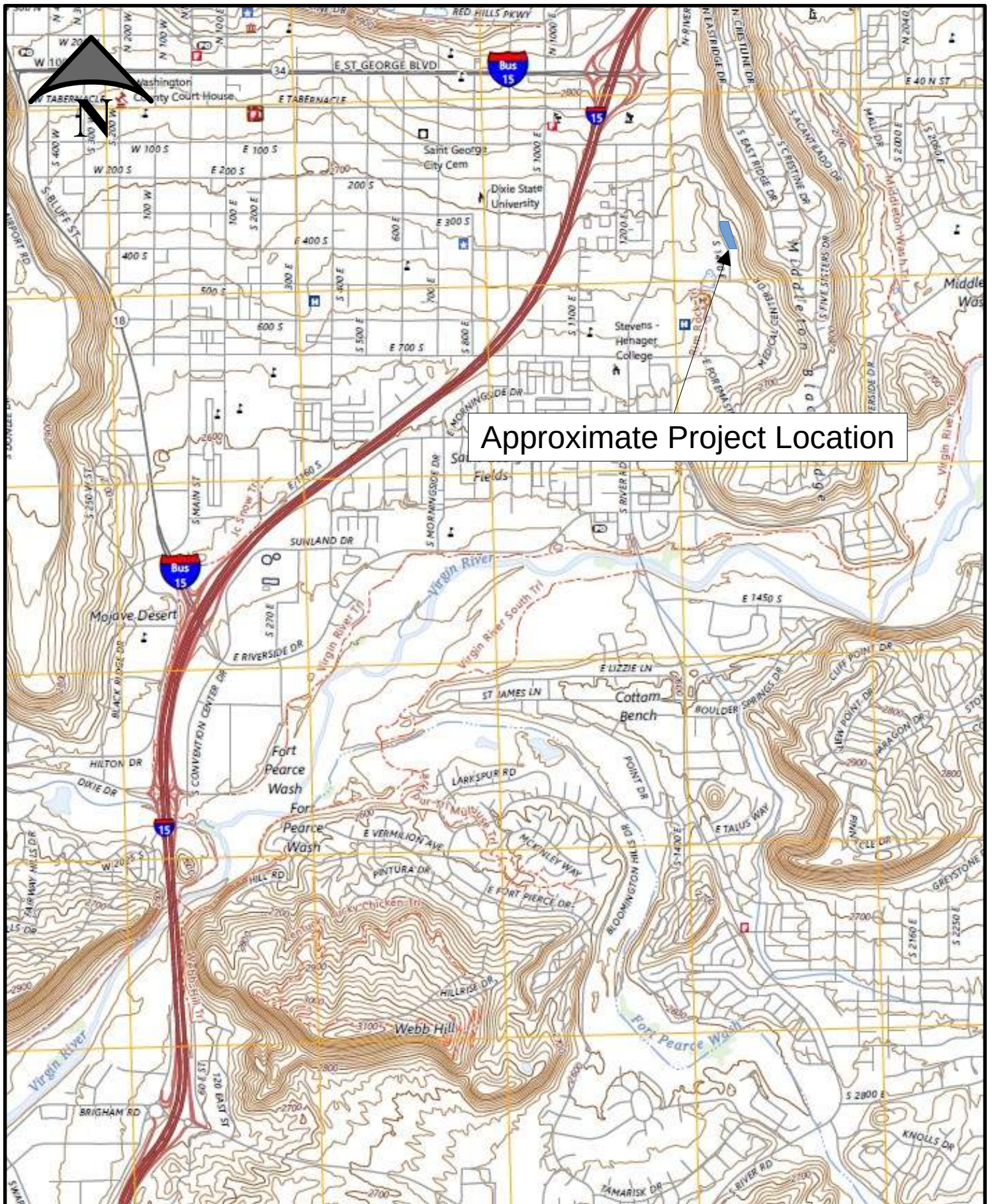
LANDMARK TESTING & ENGINEERING



Chad S. Hardman, P.E.
Professional Engineer



Reviewed By:
John M. Anderson, P.E.
Project Engineer

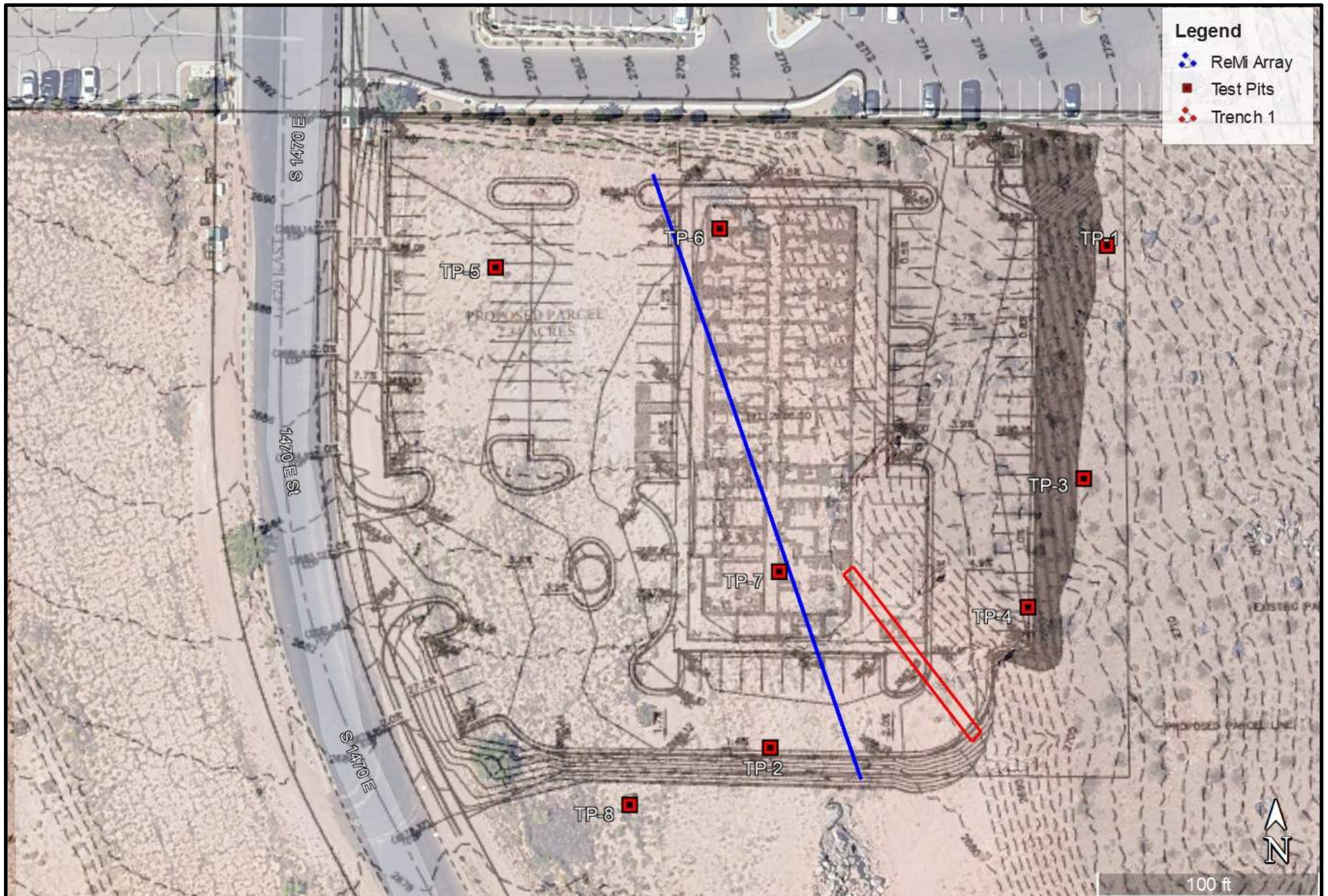


Approximate Project Location



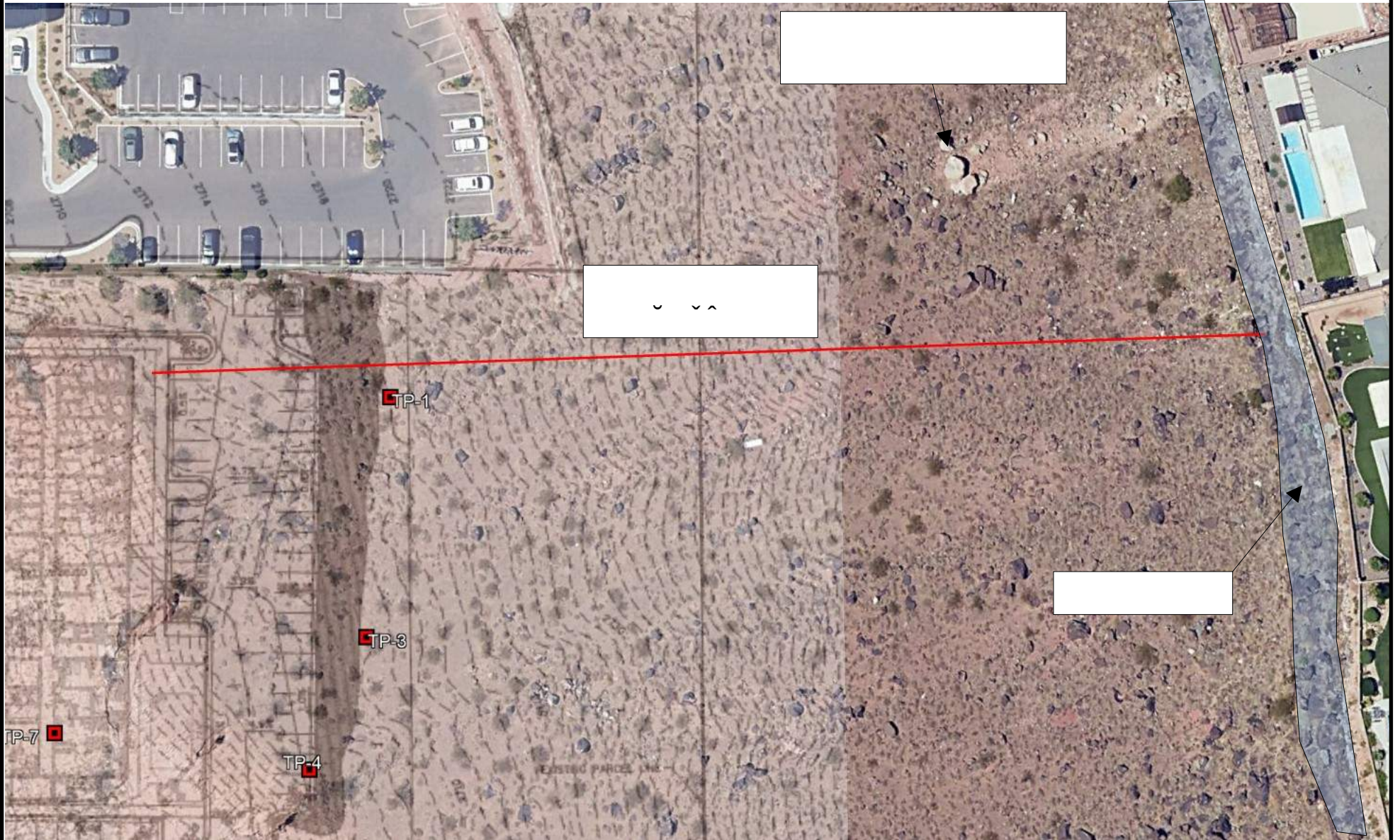
Vicinity Map
Landmark Project No 240016

Figure A-1



Site Plan
Landmark Project No 240016

Figure A-2



TEST PIT NUMBER TP-1

DATE: 2024-01-23
LOGGED BY: Micheal Meyers
REVIEWED BY: Chad Hardman
NOTES:
EXCAVATOR: Quality Excavation
EQUIPMENT: CAT 336F
LATITUDE/LONGITUDE: 37.10027 -113.55046
GROUNDWATER: feet below surface

Depth (ft)	Soil Symbol	Samples	Lithologic Description	Sample Dry Density (pcf)	Moisture (%)	Atterberg Limits		Gravel (%)	Sand (%)	Fines (%)	Consolidation	Modified Proctor Max. Dry Density (pcf)	Optimum Moisture (%)	Water-Soluble Sulfate (%)	CBR
						LL (%)	PI (%)								
Ground Surface															
0		BG	NATIVE: Silty SAND (SM) Medium dense to dense, wet, reddish brown												
1			Slightly moist, scattered gravel cobbles and boulders, fine roots down to 2 feet, brown to reddish brown												
2			Dense, slightly moist, abundant gravel cobble and boulders, carbonate cementation weak to moderate, pinkish brown and white												
3															
4		BG	Dense, slightly moist, abundant gravel cobbles and boulders, reddish brown to black												
5															
6															
7															
8															
9															
10															
11															
12	Sandstone Weathered to firm, dry to slightly moist, pinkish, springdale member														
13		TP-1 Terminated at 15'													
14															
15															
16															
17															
18															
19															
20															



PROJECT NAME: Hilton Home 2
Project Location: St. George, Utah
Project No.: 240016
Client: Home Hospitality Group

TEST PIT NUMBER TP-2

DATE: 2024-01-23

EXCAVATOR: Quality Excavation

LOGGED BY: Micheal Meyers

EQUIPMENT: CAT 336F

REVIEWED BY: Chad Hardman

LATITUDE/LONGITUDE: 37.10208 -113.55098

NOTES:

GROUNDWATER: feet below surface

Depth (ft)	Soil Symbol	Samples	Lithologic Description	Sample Dry Density (pcf)	Moisture (%)	Atterberg Limits		Gravel (%)	Sand (%)	Fines (%)	Consolidation	Modified Proctor Max. Dry Density (pcf)	Optimum Moisture (%)	Water-Soluble Sulfate (%)	CBR
						LL (%)	PI (%)								
Ground Surface															
0			NATIVE: Silty SAND (SM) Medium dense, slightly moist to moist, brown												
1			Slightly moist, brown to reddish brown												
2		B	Silty Clayey SAND (SC-SM) Medium stiff/dense, slightly moist, brown to reddish brown									123.2	10.2		38.3
3															
4															
5															
6			Sandstone Weathered to firm, dry to slightly moist, pinkish, springdale member												
7															
8															
9															
10			TP-2 Terminated at 8' Practical Refusal on Sandstone Bedrock												
11															
12															
13															
14															
15															
16															
17															
18															
19															
20															



PROJECT NAME: Hilton Home 2

Project Location: St. George, Utah

Project No.: 240016

Client: Home Hospitality Group

Figure A-5

TEST PIT NUMBER TP-3

DATE: 2024-01-23
 LOGGED BY: Micheal Meyers
 REVIEWED BY: Chad Hardman
 NOTES: _____

EXCAVATOR: Quality Excavation
 EQUIPMENT: CAT 336F
 LATITUDE/LONGITUDE: 37.10241 -113.5505
 GROUNDWATER: _____ feet below surface

Depth (ft)	Soil Symbol	Samples	Lithologic Description	Sample Dry Density (pcf)	Moisture (%)	Atterberg Limits		Gravel (%)	Sand (%)	Fines (%)	Consolidation	Modified Proctor Max. Dry Density (pcf)	Optimum Moisture (%)	Water-Soluble Sulfate (%)	CBR
						LL (%)	PI (%)								
Ground Surface															
0			NATIVE: Silty SAND (SM) Medium dense, moist, brown												
1			Slightly moist, fine roots down to 2.5 feet, gravel, brown to reddish brown												
2			Lean CLAY (CL) Medium stiff, slightly moist, weakly cemented carbonates, gravel cobbles and rare boulders, brown and light pink,												
3															
4			Silty SAND with Gravel (SM) Dense, slightly moist, fine to medium grained sand with gravel cobbles and boulders, brown to reddish brown, basalt boulders												
5															
6															
7															
8															
9															
10															
11			Mudstone Stiff, slightly moist, purple												
12			Sandstone Weathered to firm, slightly moist, pink												
13			TP-3 Terminated at 12' Practical Refusal on Sandstone Bedrock												
14															
15															
16															
17															
18															
19															
20															

RSLog / Landmark Test Pit - With Lab Results - NO ELEVATIONS / landmark-testing-and-engineering / admin / February 05, 2024 11:45 AM



PROJECT NAME: Hilton Home 2

Project Location: St. George, Utah

Project No.: 240016

Client: Home Hospitality Group

Figure A-6

TEST PIT NUMBER TP-4

DATE: 2024-01-23

EXCAVATOR: Quality Excavation

LOGGED BY: Micheal Meyers

EQUIPMENT: CAT 336F

REVIEWED BY: Chad Hardman

LATITUDE/LONGITUDE: 37.10225 -113.55058

NOTES:

GROUNDWATER: feet below surface

Depth (ft)	Soil Symbol	Samples	Lithologic Description	Sample Dry Density (pcf)	Moisture (%)	Atterberg Limits		Gravel (%)	Sand (%)	Fines (%)	Consolidation	Modified Proctor Max. Dry Density (pcf)	Optimum Moisture (%)	Water-Soluble Sulfate (%)	CBR
						LL (%)	PI (%)								
Ground Surface															
0			NATIVE: Silty SAND (SM) Medium dense, moist to wet, brown												
1			Slightly moist, with gravel and cobbles, fine roots down to 4 feet, brown to reddish brown												
2		BG	Lean CLAY (CL) Medium stiff, slightly moist, with gravel and cobble, pinholes down to at least 5 feet, weakly cemented carbonate pockets, brown to white												
3															
4															
5															
6		BLK													
7			Silty SAND (SM) Medium dense, slightly moist, with gravel and cobbles, brown to reddish brown												
8															
9		BG	Basalt boulders												
10															
11															
12															
13		BLK	Sandstone Weathered to firm, dry to slightly moist, pink, springdale member												
14															
15															
16			TP-4 Terminated at 15'												
17															
18															
19															
20															



PROJECT NAME: Hilton Home 2

Project Location: St. George, Utah

Project No.: 240016

Client: Home Hospitality Group

TEST PIT NUMBER TP-5

DATE: 2024-01-23

EXCAVATOR: Quality Excavation

LOGGED BY: Micheal Meyers

EQUIPMENT: CAT 336F

REVIEWED BY: Chad Hardman

LATITUDE/LONGITUDE: 37.10268 -113.5514

NOTES:

GROUNDWATER: feet below surface

Depth (ft)	Soil Symbol	Samples	Lithologic Description	Sample Dry Density (pcf)	Moisture (%)	Atterberg Limits		Gravel (%)	Sand (%)	Fines (%)	Consolidation	Modified Proctor Max. Dry Density (pcf)	Optimum Moisture (%)	Water-Soluble Sulfate (%)	CBR
						LL (%)	PI (%)								
Ground Surface															
0		BLK	NATIVE: Silty SAND (SM) Medium dense to dense, dry to slightly moist, yellow and white, pink sandstone, springdale member		5.3	0	0	19	58						
1															
2															
3		BG	Silty SAND (SM) Dense, slightly moist, pink to light purple, sandstone springdale member												
4															
5															
6			Dense, slightly moist, light purple, sandstone sprindale member												
7															
8															
9			TP-5 Terminated at 7' Practical Refusal on Sandstone Bedrock												
10															
11															
12															
13															
14															
15															
16															
17															
18															
19															
20															



PROJECT NAME: Hilton Home 2

Project Location: St. George, Utah

Project No.: 240016

Client: Home Hospitality Group

TEST PIT NUMBER TP-6

DATE: 2024-01-23
 EXCAVATOR: Quality Excavation
 LOGGED BY: Micheal Meyers
 EQUIPMENT: CAT 336F
 REVIEWED BY: Chad Hardman
 LATITUDE/LONGITUDE: 37.10272 -113.55106
 NOTES: _____
 GROUNDWATER: _____ feet below surface

Depth (ft)	Soil Symbol	Samples	Lithologic Description	Sample Dry Density (pcf)	Moisture (%)	Atterberg Limits		Gravel (%)	Sand (%)	Fines (%)	Consolidation	Modified Proctor Max. Dry Density (pcf)	Optimum Moisture (%)	Water-Soluble Sulfate (%)	CBR
						LL (%)	PI (%)								
0			Ground Surface												
1			NATIVE: Silty SAND (SM) Medium dense, slightly moist, some gravel cobbles and weathered sandstone, brown to reddish brown												
2		M		89.4	4.4						4.1% C @ 1540				
3															
4															
5															
6		BLK	Sandstone Weathered to firm, dry to slightly moist, light pink to white, springdale member												
7			TP-6 Terminated at 7' Practical Refusal on Sandstone Bedrock												
8															
9															
10															
11															
12															
13															
14															
15															
16															
17															
18															
19															
20															

RSLog / Landmark Test Pit - With Lab Results - NO ELEVATIONS / landmark-testing-and-engineering / admin / February 05, 2024 11:45 AM



PROJECT NAME: Hilton Home 2

Project Location: St. George, Utah

Project No.: 240016

Client: Home Hospitality Group

Figure A-9

TEST PIT NUMBER TP-7

DATE: 2024-01-23

EXCAVATOR: Quality Excavation

LOGGED BY: Micheal Meyers

EQUIPMENT: CAT 336F

REVIEWED BY: Chad Hardman

LATITUDE/LONGITUDE: 37.10229 -113.55096

NOTES:

GROUNDWATER: feet below surface

Depth (ft)	Soil Symbol	Samples	Lithologic Description	Sample Dry Density (pcf)	Moisture (%)	Atterberg Limits		Gravel (%)	Sand (%)	Fines (%)	Consolidation	Modified Proctor Max. Dry Density (pcf)	Optimum Moisture (%)	Water-Soluble Sulfate (%)	CBR
						LL (%)	PI (%)								
Ground Surface															
0		BLK	NATIVE: Silty SAND (SM) Medium dense, slightly moist, interbedded silts and clays, abundant pinholes in fines down to 5 feet, minor basalt boulders 5 feet wide, reddish brown to grey to dark purple											1.89	
1															
2															
3															
4															
5		BG	Sandstone Firm, dry to slightly moist, light pink and purple												
6															
7															
8															
9															
10			TP-7 Terminated at 8.5' Practical Refusal on Bedrock												
11															
12															
13															
14															
15															
16															
17															
18															
19															
20															

RSLog / Landmark Test Pit - With Lab Results - NO ELEVATIONS / landmark-testing-and-engineering / admin / February 05, 2024 11:45 AM



PROJECT NAME: Hilton Home 2

Project Location: St. George, Utah

Project No.: 240016

Client: Home Hospitality Group

Figure A-10

TEST PIT NUMBER TP-8

DATE: 2024-01-23

EXCAVATOR: Quality Excavation

LOGGED BY: Micheal Meyers

EQUIPMENT: CAT 336F

REVIEWED BY: Chad Hardman

LATITUDE/LONGITUDE: 37.10201 -113.5512

NOTES:

GROUNDWATER: feet below surface

Depth (ft)	Soil Symbol	Samples	Lithologic Description	Sample Dry Density (pcf)	Moisture (%)	Atterberg Limits		Gravel (%)	Sand (%)	Fines (%)	Consolidation	Modified Proctor Max. Dry Density (pcf)	Optimum Moisture (%)	Water-Soluble Sulfate (%)	CBR
						LL (%)	PI (%)								
Ground Surface															
0			NATIVE: Silty SAND with Gravel (SM)												
			Medium dense, moist, brown												
1			Slightly moist, fine roots down to 2 feet, brown to reddish brown												
2			Sandstone												
3			Weathered to firm, dry to slightly moist, light pink, springdale member												
4			Weathered to firm, dry to slightly moist, purple												
5		BG													
6															
7															
8															
9															
10			TP-8 Terminated at 9' Practical Refusal on Bedrock												
11															
12															
13															
14															
15															
16															
17															
18															
19															
20															



PROJECT NAME: Hilton Home 2

Project Location: St. George, Utah

Project No.: 240016

Client: Home Hospitality Group

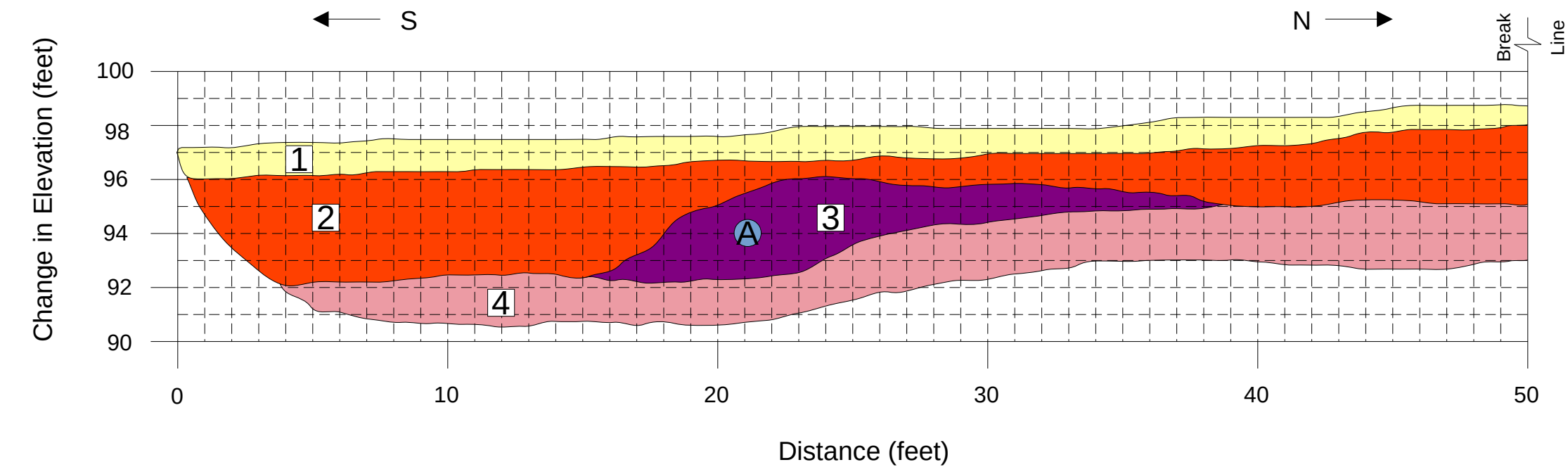
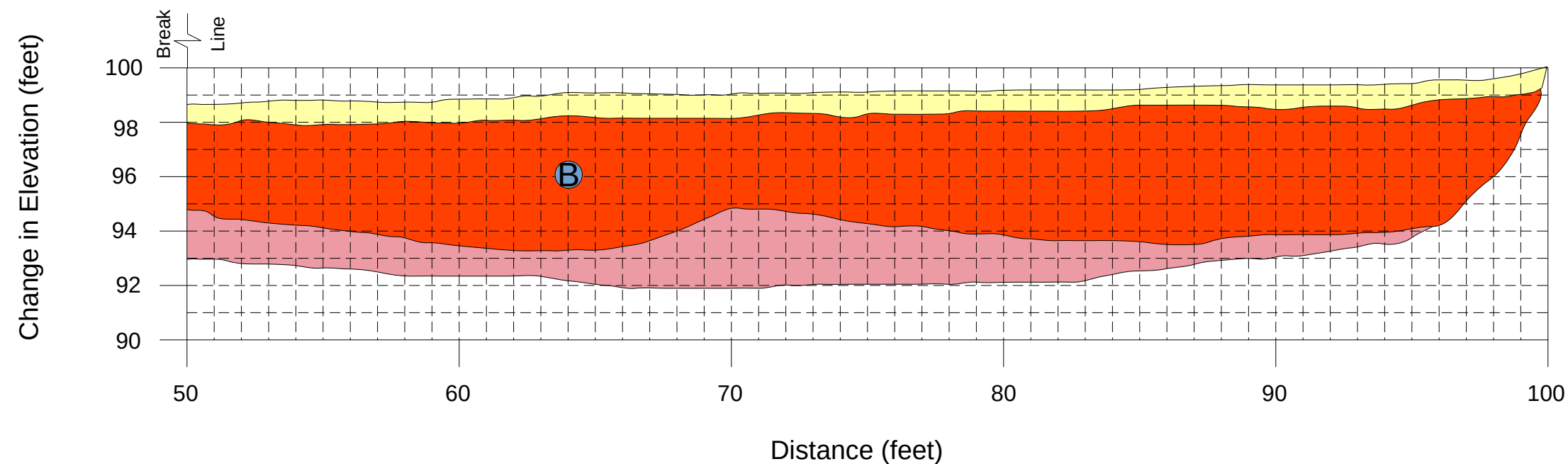


Image 1: Photograph of trench wall from approximately 0+15 to 0+25.



- Soil Types**
1. Fill: Silty Sand (SM), medium dense, slightly moist, fine to medium grained sand, brown to red brown
 2. Native: Silty Sand (SM), medium dense, slightly moist, fine to medium grained, brown to red brown
 3. Lean Clay (CL), medium stiff, slightly moist, fine to medium grained, purple and gray
 4. Sandstone, weathered to firm, dry to slightly moist, fine to medium grained, light pink and white

- Sample Locations**
- A. 0+21 at 3.5 ft
 - B. 0+64 at 3.0 ft



Trench 1
Landmark Project No 240016

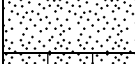
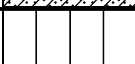
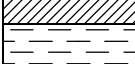
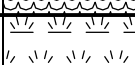
Figure A-12

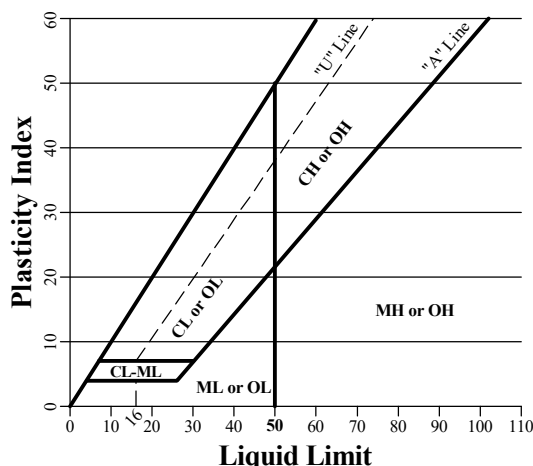
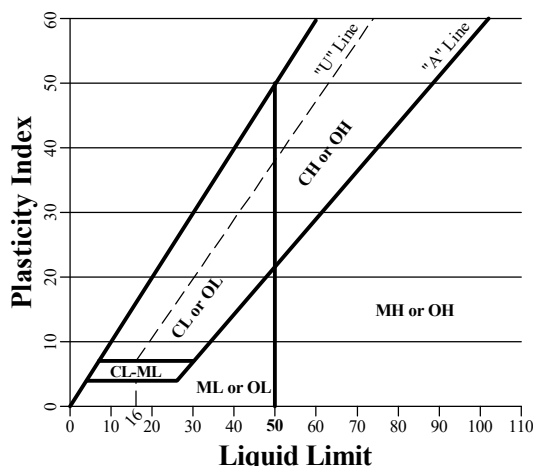
UNIFIED SOIL CLASSIFICATION SYSTEM

MAJOR DIVISIONS

SYMBOLS

TYPICAL NAMES

COARSE-GRAINED SOILS (More than 50% of soil Retained on No. 200 sieve size)	GRAVELS More than 1/2 of coarse fraction > No.4 sieve size		GW	Well graded gravels or gravel-sand mixtures little or no fines.
			GP	Poorly graded gravels or gravel-sand mixtures little or no fines.
			GM	Silty gravels, gravel-sand-silt mixtures
			GC	Clayey gravels, gravel-sand-clay mixtures
	SANDS More than 1/2 of coarse fraction < No.4 sieve size		SW	Well graded sands or gravelly sand mixtures little or no fines.
			SP	Poorly graded sands or gravelly sand mixtures little or no fines.
			SM	Silty sands, sand-silt mixtures
			SC	Clayey sands, sand-clay mixtures
FINE-GRAINED SOILS (Less than 50% of soil Retained on No. 200 sieve size)	SILTS & CLAYS Liquid Limit < 50		ML	Inorganic silts and very fine sands, rock flour, silty fine sands or clayey silts with slight plasticity
			CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays.
			OL	Organic silts and organic silty clays of low plasticity
	SILTS & CLAYS Liquid Limit > 50		MH	Inorganic silts, micaceous or diatomaceous fine sand or silty soils, elastic silts
			CH	Inorganic clays of high plasticity, fat clays
			OH	Organic clays of medium to high plasticity, organic silty clays, organic silts
	HIGHLY ORGANIC SOILS		PT	Peat and other highly organic soils

GRAIN SIZE CHART			SAMPLES	PLASTICITY CURVE
CLASSIFICATION	Range of Grain Size			
	U.S. Standard Sieve Size	Grain Size in Millimeters		
BOULDERS	Above 12"	Above 305		
COBBLES	12" to 3"	305 to 76.2		
GRAVEL	3" to No. 4	76.2 to 4.76		
	Coarse 3" to 3/4"	76.2 to 19.1		
Fine 3/4" to No. 4	19.1 to 4.76			
SAND	No. 4 to No. 200		4.76 to 0.074	
	Coarse No. 4 to No. 10		4.76 to 2.00	
	Medium No. 10 to No. 40		2.00 to 0.42	
	Fine No. 40 to No. 200	0.420 to 0.074		
SILT & CLAY	Below No. 200	Below 0.074		
				
				



Landmark Testing & Engineering
795 Factory Drive
St. George, UT 84790
Telephone: 435-986-0566
Website: www.landmarktesting.com

Figure A-13



2/2/2024

St George, UT 84790

Project #: 240016

Location: St. George, Utah

[illegible]

TABLE B-1



CONSOLIDATION REPORT

Client: Home Hospitality Group
107 S 1470 E, Ste 302
St George, UT 84790

Date of Report: 2/1/2024

Reviewed By: Z. Girsberger

Lab#: 24SG0570

Project: Hilton Home 2

Project #: 240016

Location: St George

Sampled By: M. Meyers

Date: 1/23/2024

Type of Sample: SM

Tested By: J. Bracken

Date: 1/26/2023

Location of Sample: Test Pit 6 at 2

Authorized By: Client

Date: 1/23/2024

COLLAPSE/SWELL CURVE

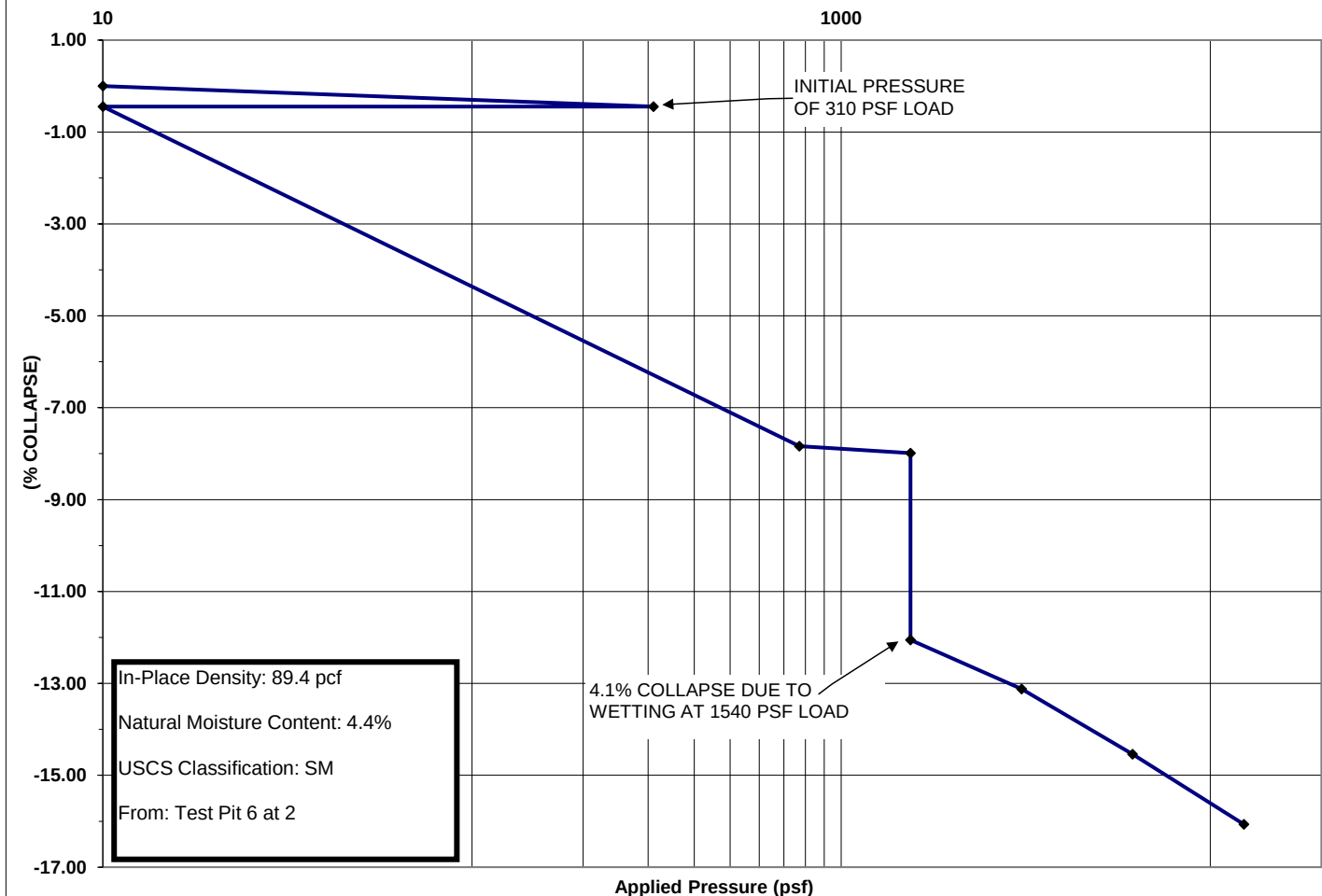


Figure B-1



PROCTOR REPORT

Client: Home Hospitality Group
107 S 1470 E, Ste 302
St George, UT 84790

Date of Report: 1/29/2024

Reviewed By: Z. Girsberger

Lab#: 24SG0572

Project: Hilton Home 2

Project #: 240016

Location: St George

Sampled By: M. Meyers

Date: 1/23/2024

Type of Sample: Red Brown Silty Sand with Sandstone Gravel

Tested By: J. Wells

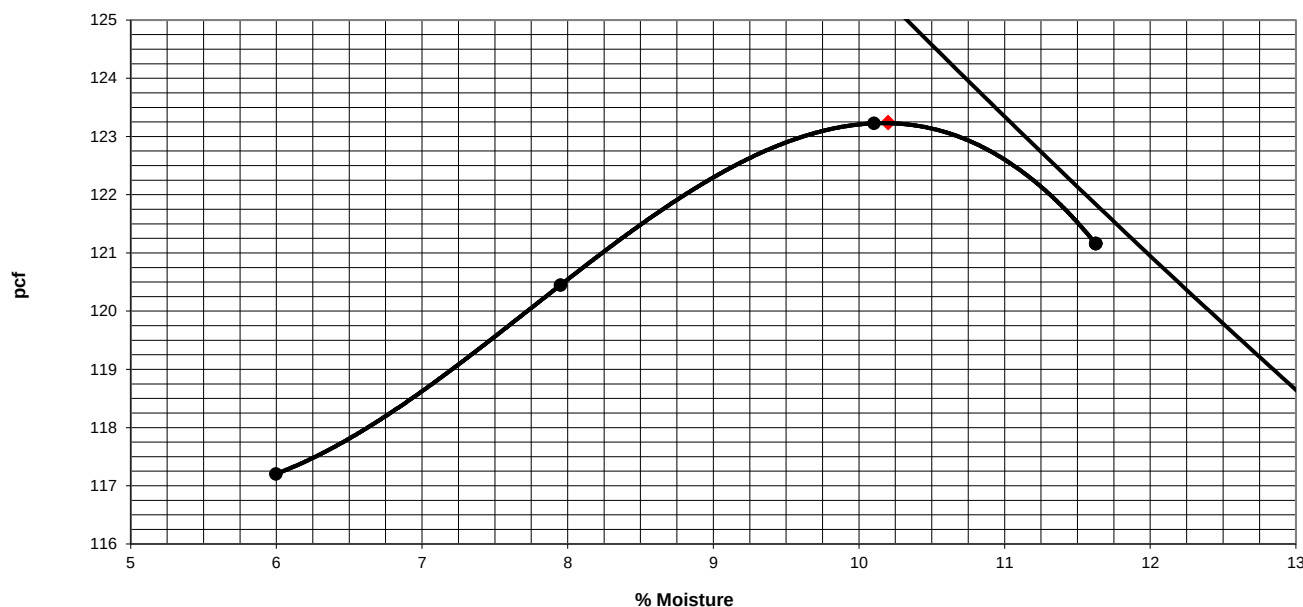
Date: 1/29/2024

Location of Sample: Test Pit 2 at Bulk

Authorized By: Client

Date: 1/23/2024

Moisture Density Relationship



Proctor Data

Hammer Weight:	10 pounds
Hammer Drop:	18 inches
Number of Layers:	5 layers
Blows per Layer:	56 blows
Mold Size (cu. Ft.):	0.075
% Oversized:	2.0
Oversize Sp. G.:	N/A
ZAV Sp. G.:	2.53
Test Performed on Material Passing:	3/4 in. Sieve

Point	1	2	3	4	5	6
% Moisture	6.0	7.9	10.1	11.6		
Dry Density	117.2	120.4	123.2	121.2		

Test Results

Maximum Dry Density, Lbs/ft ³	123.2
Optimum Moisture, %	10.2
Test Standard	ASTM D 1557
Method	Method C

Figure B-2



CALIFORNIA BEARING RATIO

Client: Home Hospitality Group
107 S 1470 E, Ste 302
St George, UT 84790

Date of Report: 2/2/2024

Reviewed By: Z. Girsberger

Lab#: 24SG0572

Project: Hilton Home 2

Project #: 240016

Location: St George

Sampled By: M. Meyers

Date: 1/23/2024

Type of Sample: Red Brown Silty Sand with Sandstone Gravel

Tested By: J. Wells

Date: 1/29/2024

Location of Sample: Test Pit 2 at Bulk

Authorized By: Client

Date: 1/23/2024

SOIL DATA

Max. Dry Density:	123.2	<
Optimum Moisture:	10.2	<
Test Standard	ASTM D 1557	
% +3/4" Replaced	2.0	<

CBR RESULTS

0.10 in. penetration:	36.2
0.20 in. penetration:	38.3

SPECIFICATION

0.20 in penetration:	
----------------------	--

CALIFORNIA BEARING RATIO, ASTM D 1883

MOLDED		SOAKED	
% Moisture Before:	9.1	Average % Moisture:	11.8
% Moisture After:	9.1	Top 1" % Moisture:	11.8
Dry Density:	123.0	Dry Density:	121.6
% of Max. Density:	99.9	% of Max. Density:	98.7
# Blows / Lift:	56 / 5	Percent Swell:	0.5
Surcharge, lbs:	10	Linearity Correction:	0.008

Penetration Curve

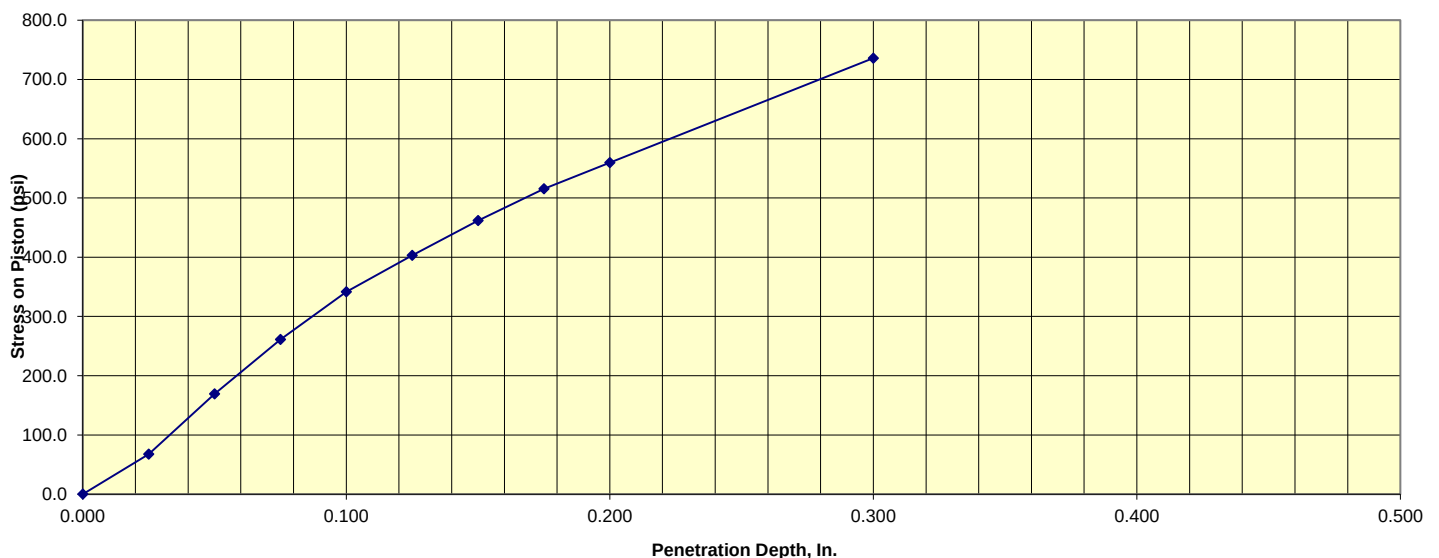


Figure B-3



SOIL CLASSIFICATION REPORT

Client: Home Hospitality Group
107 S 1470 E, Ste 302
St George, UT 84790

Date of Report: 2/1/2024

Reviewed By: Z. Girsberger

Lab#: 24SG0568

Project: Hilton Home 2

Project #: 240016

Location: St George

Sampled By: M. Meyers

Date: 1/23/2024

Type of Sample: Brown Silty, Clayey Sand

Tested By: A. Pay

Date: 1/31/2024

Location of Sample: Test Pit 4 at 12.0

Authorized By: Client

Date: 1/23/2024

Sieve Analysis , ASTM C136 and C117

Sieve Size	% Passing Cumulative	Specification
150 mm 6"		
75 mm 3"		
50 mm 2"		
37.5 mm 1-1/2"	100	
25 mm 1"	99	
19 mm 3/4"	95	
12.5 mm 1/2"	94	
9.5 mm 3/8"	92	
4.75 mm #4	89	
2.00 mm #10	86	
1.18 mm #16	85	
425 µm #40	83	
300 µm #50	82	
75 µm #200	42.2	

Test	Result	Specification	Test Standard
Natural Moisture Content, %	3.7		ASTM D 2216
Liquid Limit	20		ASTM D 4318
Plasticity Index	4		ASTM D 4318
Unified Classification System	SC-SM		ASTM D 2487
AASHTO Classification System	A-4(0)		AASHTO M145

% Cobble > 3"	% Gravel < 3" - #4	% Sand < #4 - #200	% Silt-Clay < #200
0.0	11.0	46.8	42.2

Diameter D ₆₀	Diameter D ₃₀	Diameter D ₁₀	Coefficient of Uniformity, C _u	Coefficient of Concavity, C _c

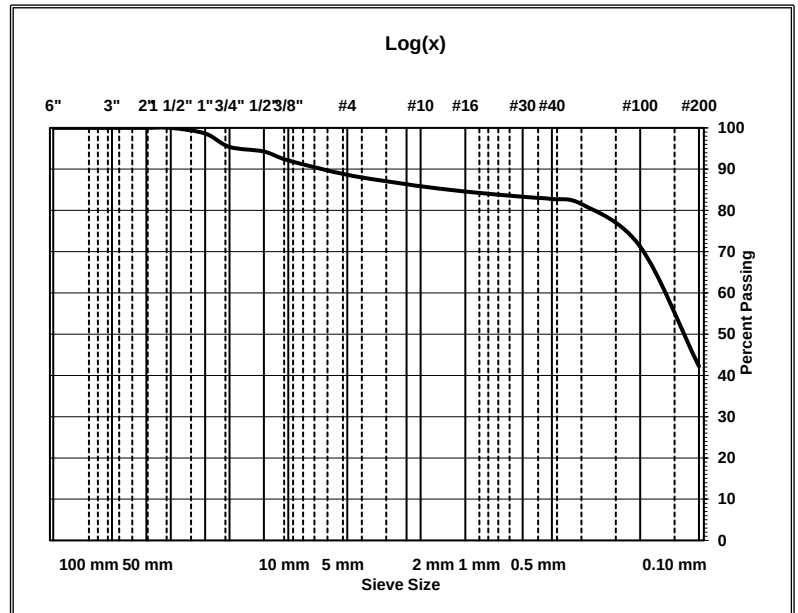
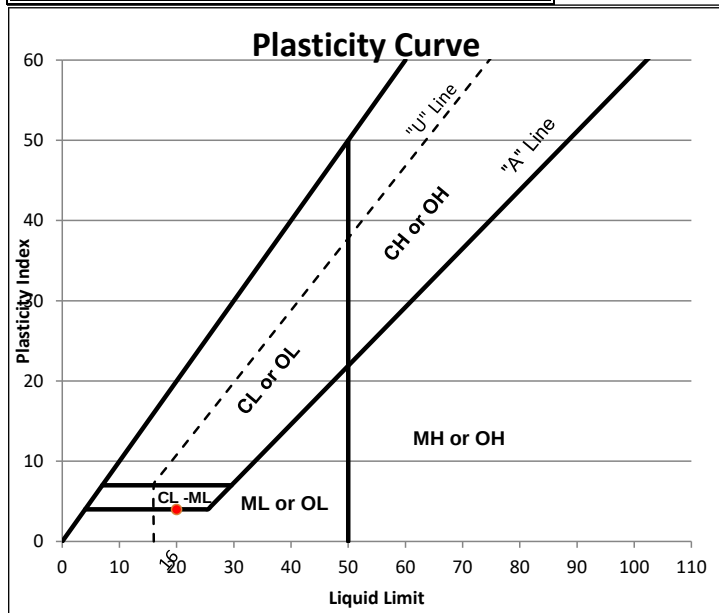


Figure B-4



SOIL CLASSIFICATION REPORT

Client: Home Hospitality Group
107 S 1470 E, Ste 302
St George, UT 84790

Date of Report: 1/30/2024

Reviewed By: Z. Girsberger

Lab#: 24SG0569

Project: Hilton Home 2

Project #: 240016

Location: St George

Sampled By: M. Meyers

Date: 1/23/2024

Type of Sample: Purple Silty Sand with Gravel

Tested By: A. Pay

Date: 1/30/2024

Location of Sample: Test Pit 5 at 3.0

Authorized By: Client

Date: 1/23/2024

Sieve Analysis , ASTM C136 and C117

Sieve Size	% Passing Cumulative	Specification
150 mm 6"		
75 mm 3"		
50 mm 2"		
37.5 mm 1-1/2"		
25 mm 1"	100	
19 mm 3/4"	97	
12.5 mm 1/2"	94	
9.5 mm 3/8"	90	
4.75 mm #4	81	
2.00 mm #10	72	
1.18 mm #16	68	
425 µm #40	62	
300 µm #50	59	
75 µm #200	22.9	

Test	Result	Specification	Test Standard
Natural Moisture Content, %	5.3		ASTM D 2216
Liquid Limit	NP		ASTM D 4318
Plasticity Index	NP		ASTM D 4318
Unified Classification System	SM		ASTM D 2487
AASHTO Classification System	A-2-4(0)		AASHTO M145

% Cobble > 3"	% Gravel < 3" - #4	% Sand < #4 - #200	% Silt-Clay < #200
0.0	19.0	58.1	22.9

Diameter D ₆₀	Diameter D ₃₀	Diameter D ₁₀	Coefficient of Uniformity, C _u	Coefficient of Concavity, C _c

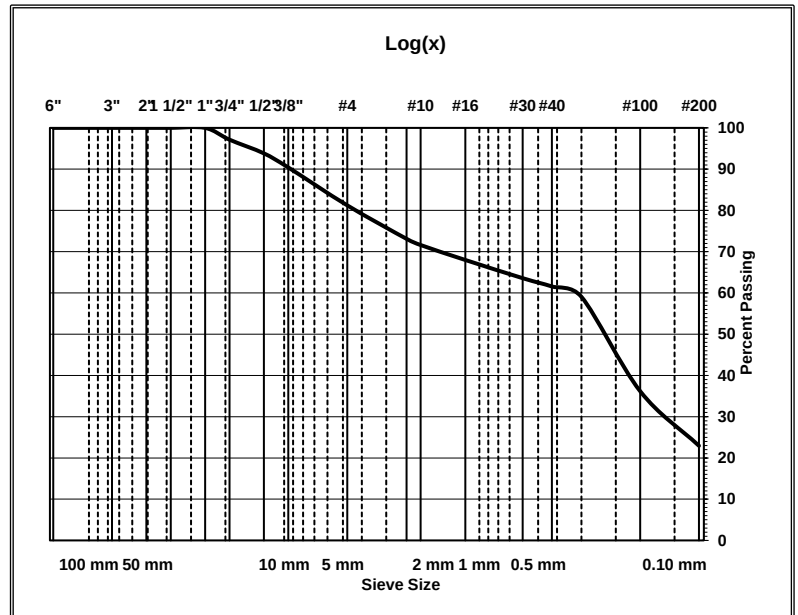
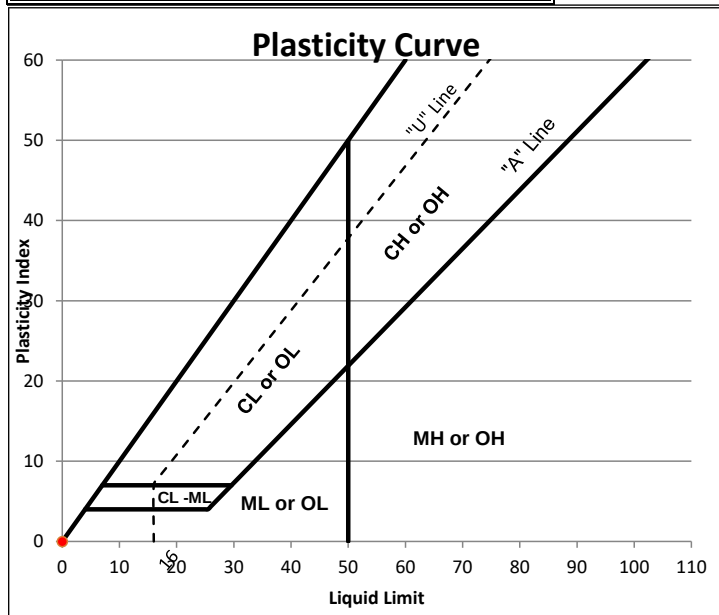


Figure B-5



WATER-SOLUBLE SULFATE IN SOIL

Client: Home Hospitality Group
107 S 1470 E, Ste 302
St George, UT 84790

Date of Report: 1/31/2024

Reviewed By: Z. Girsberger

Lab#: 24SG0571

Project: Hilton Home 2

Project #: 240016

Location: St George

Sampled By: M. Meyers

Date: 1/23/2024

Type of Sample: Red-Brown Silty Sand

Tested By: A. pay

Date: 1/30/2024

Location of Sample: Test Pit 7 at 1.5'

Authorized By: Client

Date: 1/23/2024

Test	Result %	Exposure Class	Test Standard
Percent Water-Soluble Sulfate in Soil	1.89	S2	ASTM C1580

Figure B-6

Array Location

Datum: UTM Zone 12N NAD83
Site Name: **Hilton Home2 Suites - North Line**
Center: 4109275.0, -273346.0
Geophone 1: 4109264.0, -273308.0
Geophone6: 4109287.0, -273391.0

Results

Vs100: **1,756 ft/s**
IBC Site Class: C
IBC Version: IBC 2018
ASCE: ASCE 7-16
Depth: **65.6 feet**

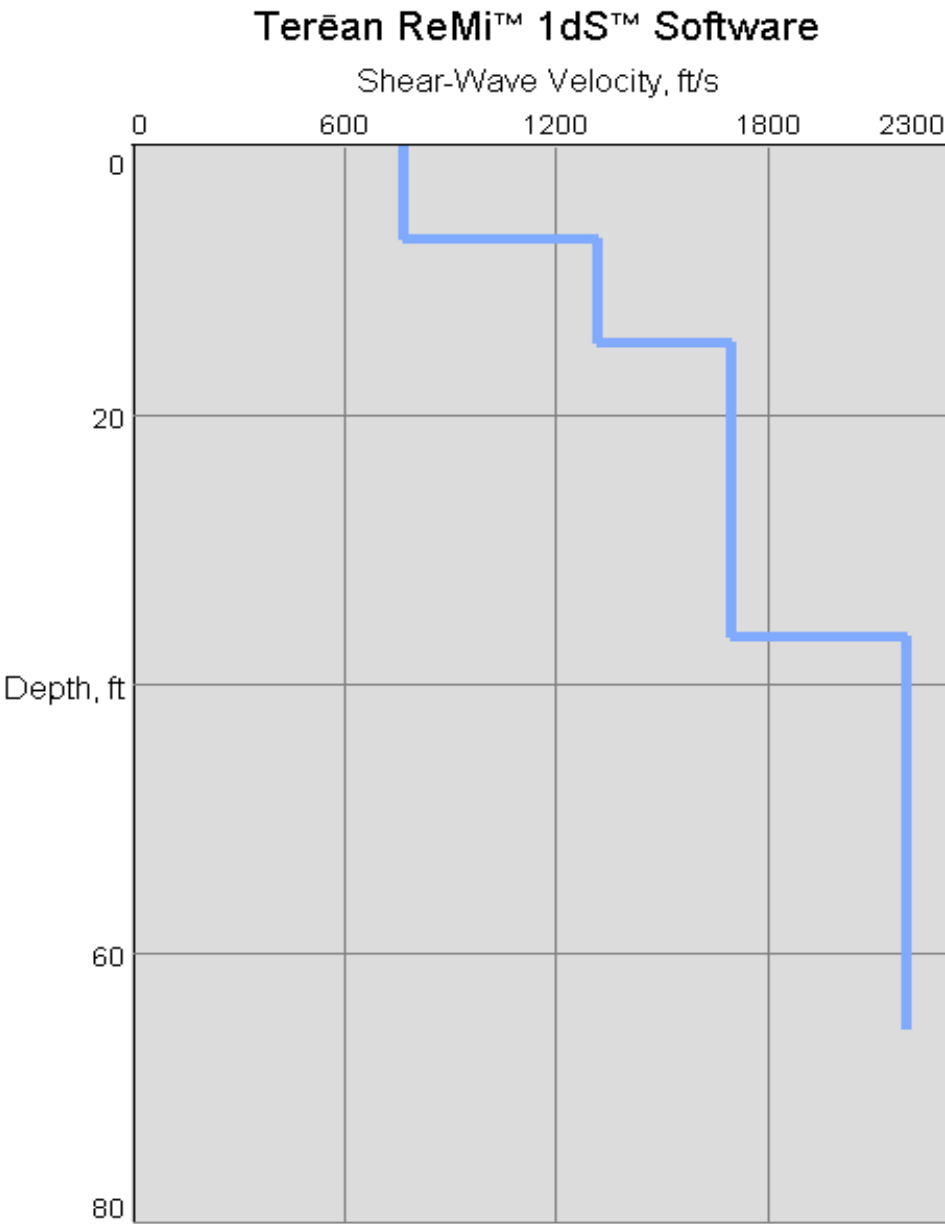
Survey Parameters

Geophone Count: 6
Geophone Spacing: 26.25 feet
Array Length: 131 feet
Survey Date: Jan 19, 2024
Performed By: Landmark Testing & Engineering
Analysis By: SteveW
Analysis Date: Mon Jan 22 20:13:20 MST 2024

Narrative**SHEAR WAVE VELOCITIES AND SEISMIC SITE CLASS**

Landmark Testing & Engineering's geophysical site evaluation included subsurface seismic imaging and earthquake ground shaking potential evaluation using Terēan's VsSurf ReMi™ seismic data processing software. Seismic surveys were performed to evaluate depth to bedrock and the seismic site class per IBC 2018 and ASCE 7-16 using the weighted-average soil shear wave velocity for the upper 100 feet (Vs100). The surveys were performed by recording active and/or ambient (passive) seismic sources. The seismic recording array for these surveys consisted of 6, 4.5-Hz geophones at a 26.25 feet (8 m, 26.25 ft) spacing for a total survey length of 131 feet. Noise generated by walking and hammer hits along the survey line during data acquisition while ambient noise was generated from traffic along the nearby roads. The seismic data were acquired using a ReMiDAQ™ 4-12 seismograph (terean.com/products), while data was processed using Terēan's ReMi™ software. Survey results indicate a weighted-average soil shear wave velocity of the upper 100 feet (Vs100) of 1,756 ft/s. This results in a designation of a Seismic Site Class C according to Table ASCE 7-16.

Depth (ft)	Vs (ft/s)
0.0	765
6.8	765
6.8	1,314
14.6	1,314
14.6	1,694
36.4	1,694
36.4	2,187
364.5	2,187



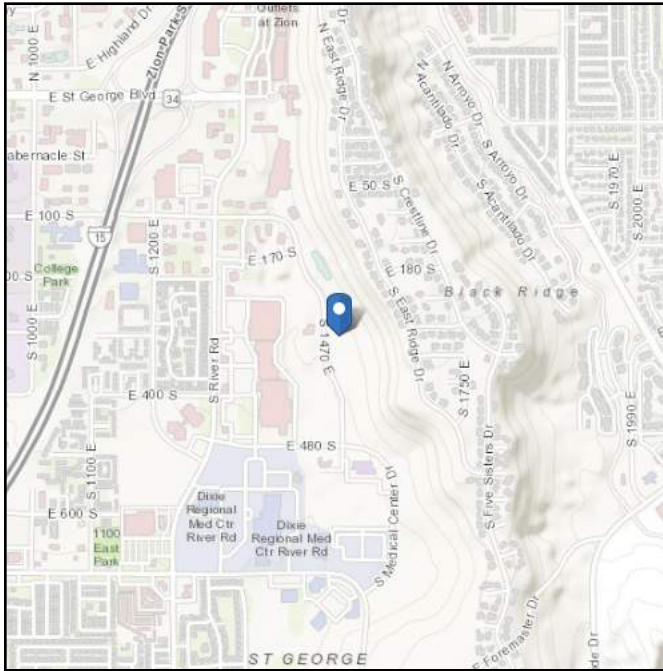


ASCE Hazards Report

Address:
No Address at This Location

Standard: ASCE/SEI 7-16
Risk Category: II
Soil Class: C - Very Dense
Soil and Soft Rock

Latitude: 37.102952
Longitude: -113.551219
Elevation: 0 ft (NAVD 88)

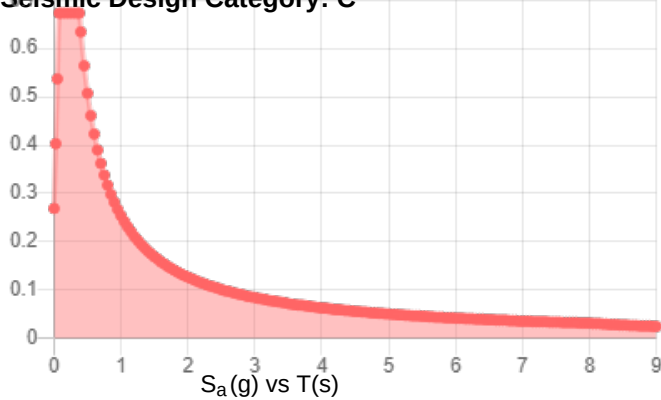


Site Soil Class: C - Very Dense Soil and Soft Rock

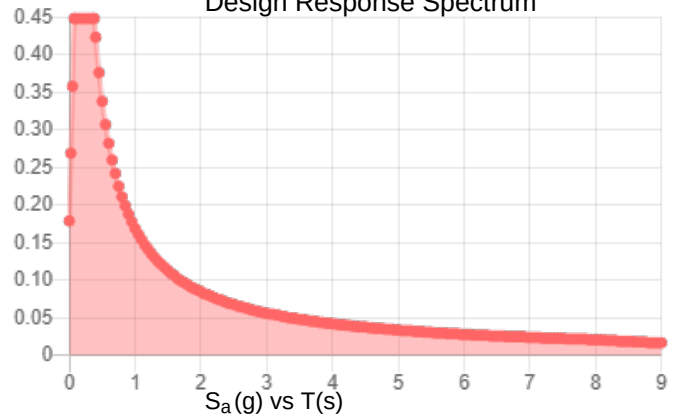
Results:

S_S :	0.521	S_{D1} :	0.169
S_1 :	0.169	T_L :	8
F_a :	1.292	PGA :	0.229
F_v :	1.5	PGA _M :	0.275
S_{MS} :	0.673	F_{PGA} :	1.2
S_{M1} :	0.254	I_e :	1
S_{DS} :	0.448	C_v :	0.947

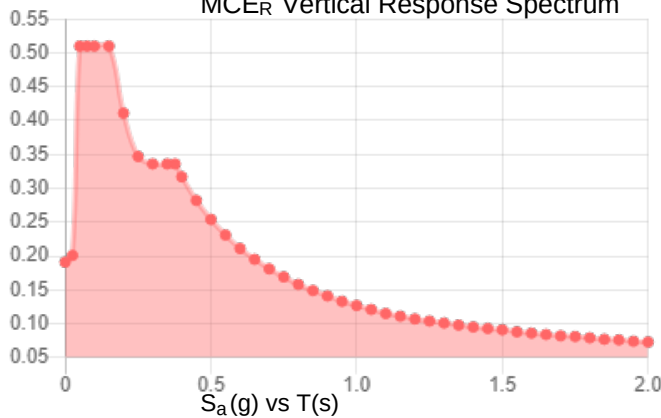
Seismic Design Category: C **MCE_R Response Spectrum**



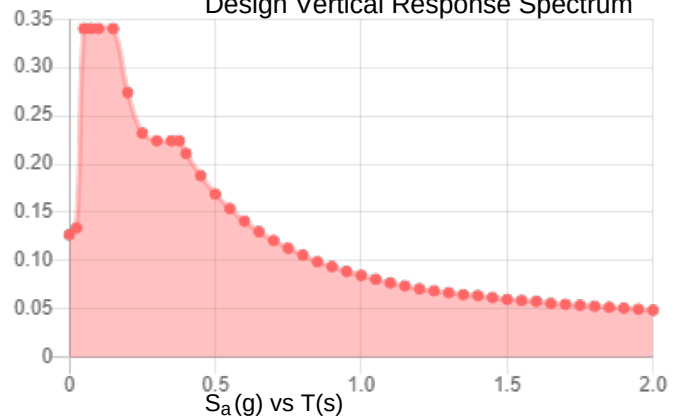
Design Response Spectrum



MCE_R Vertical Response Spectrum



Design Vertical Response Spectrum



Data Accessed: Mon Feb 05 2024

Date Source:

USGS Seismic Design Maps based on ASCE/SEI 7-16 and ASCE/SEI 7-16 Table 1.5-2. Additional data for site-specific ground motion procedures in accordance with ASCE/SEI 7-16 Ch. 21 are available from USGS.

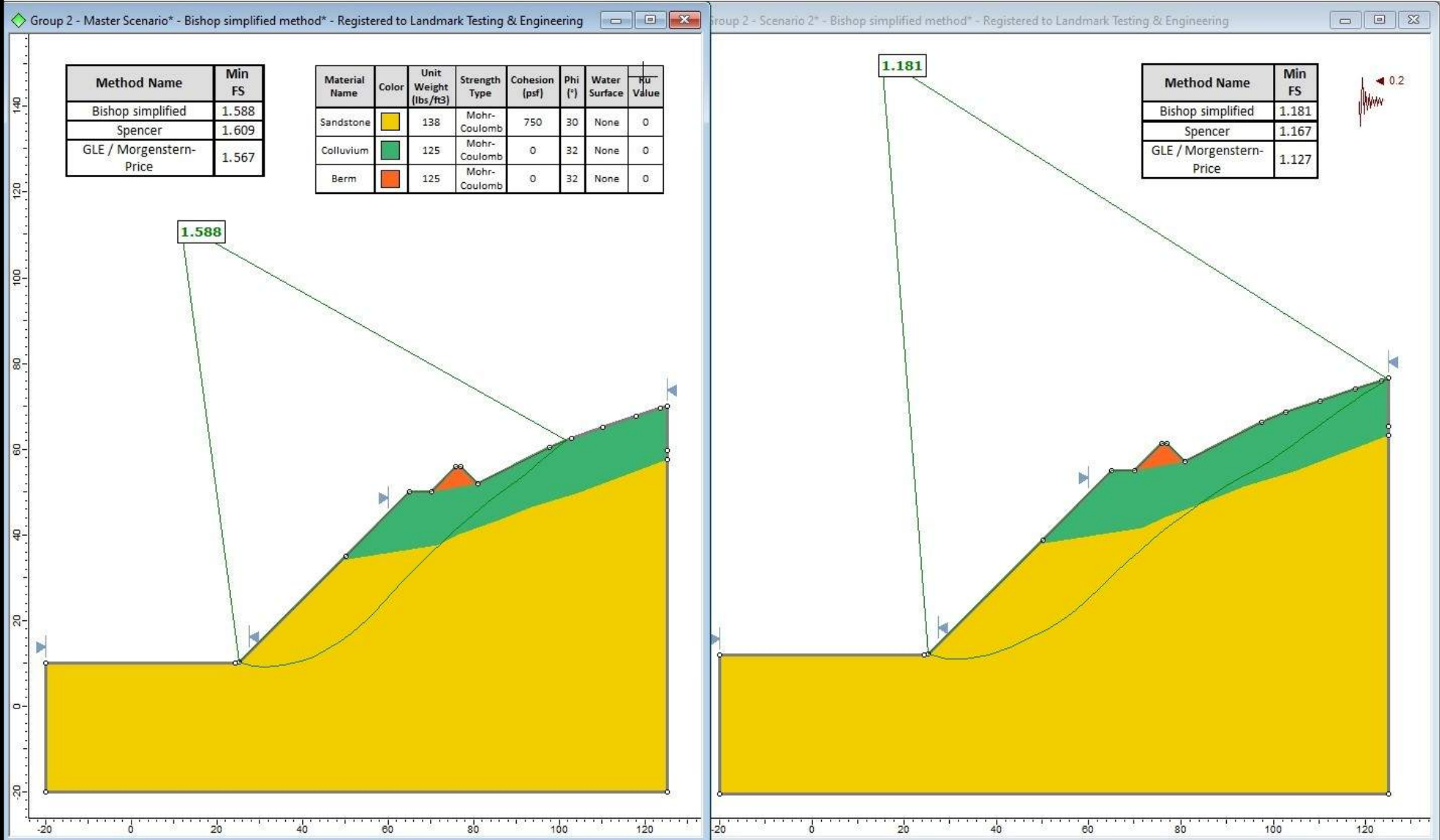
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The allowable factor of safety for the static condition is 1.5. All methods show FS greater than 1.5. The condition as analyzed is stable.

The allowable factor of safety for the seismic condition is 1.1. All methods show FS greater than 1.1. The condition as analyzed is stable.



Slope Stability Output – Static and Seismic Condition
Landmark Project No 240016

Figure D-1



240016 Hilton Home 2
Slide2 - An Interactive Slope Stability Program
Date Created: 1/25/2024, 2:24:19 PM
Software Version: 9.031

FIGURE D-2 (35 Pages)

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Slide2 Analysis Information

240016 Hilton Home 2

Project Summary

File Name:	240016 Hilton Home 2.slmd
Slide2 Modeler Version:	9.031
Project Title:	Slide2 - An Interactive Slope Stability Program
Date Created:	1/25/2024, 2:24:19 PM

Currently Open Scenarios

Group Name	Scenario Name	Global Minimum	Compute Time
Group 2 	Master Scenario	Bishop Simplified: 1.588080 Spencer: 1.608550 Gle/morgenstern-price: 1.566820	00h:00m:06.984s
	Scenario 2	Bishop Simplified: 1.180800 Spencer: 1.166840 Gle/morgenstern-price: 1.126630	00h:00m:06.810s

General Settings

Units of Measurement:	Imperial Units
Time Units:	days
Permeability Units:	feet/second
Data Output:	Standard
Failure Direction:	Right to Left

Analysis Options

All Open Scenarios

Slices Type:	Vertical
Analysis Methods Used	
	Bishop simplified
	GLE/Morgenstern-Price with interslice force function (Half Sine)
	Spencer
Number of slices:	50
Tolerance:	0.005
Maximum number of iterations:	75
Check malpha < 0.2:	Yes
Create Interslice boundaries at intersections with water tables and piezos:	Yes
Initial trial value of FS:	1
Steffensen Iteration:	Yes
Eliminate vertical segments in non-circular search	Yes

Groundwater Analysis

All Open Scenarios

Groundwater Method:

Pore Fluid Unit Weight [lbs/ft³]:

Advanced Groundwater Method:

Water Surfaces

62.4

None

Random Numbers

All Open Scenarios

Pseudo-random Seed:

10116

Random Number Generation Method:

Park and Miller v.3

Surface Options

All Open Scenarios

Search Method:	Particle Swarm Search
Initial # of Surface Vertices:	8
Maximum Iterations:	500
Number of Particles:	50
Minimum Elevation:	Not Defined
Minimum Depth:	Not Defined
Minimum Area:	Not Defined
Minimum Weight:	Not Defined
Convex Surfaces Only:	Enabled

Seismic Loading

◆ **Group 2 - Master Scenario**

Advanced seismic analysis:	No
Staged pseudostatic analysis:	No

◆ **Group 2 - Scenario 2**

Advanced seismic analysis:	No
Staged pseudostatic analysis:	No
Seismic Load Coefficient (Horizontal):	0.2

Materials

Sandstone	
Color	
Strength Type	Mohr-Coulomb
Unit Weight	138 lbs/ft3
Cohesion	750 psf
Phi	30 °
Water Surface	Assigned per scenario
Ru Value	0
Colluvium	
Color	
Strength Type	Mohr-Coulomb
Unit Weight	125 lbs/ft3
Cohesion	0 psf
Phi	32 °
Water Surface	Assigned per scenario
Ru Value	0
Berm	
Color	
Strength Type	Mohr-Coulomb
Unit Weight	125 lbs/ft3
Cohesion	0 psf
Phi	32 °
Water Surface	Assigned per scenario
Ru Value	0

Materials In Use

Material		Group 2		Scenario 2	
Sandstone					
Colluvium					
Berm					

Global Minimums

◆ Group 2 - Master Scenario

Method: bishop simplified

FS	1.588080
Axis Location:	11.480, 112.568
Left Slip Surface Endpoint:	25.191, 10.190
Right Slip Surface Endpoint:	101.609, 62.110
Resisting Moment:	1.01864e+07 lb-ft
Driving Moment:	6.41429e+06 lb-ft
Total Slice Area:	869.076 ft ²
Surface Horizontal Width:	76.4174 ft
Surface Average Height:	11.3727 ft

Method: spencer

FS	1.608550
Axis Location:	12.653, 121.477
Left Slip Surface Endpoint:	25.191, 10.190
Right Slip Surface Endpoint:	109.205, 64.735
Resisting Moment:	1.00113e+07 lb-ft
Driving Moment:	6.2238e+06 lb-ft
Resisting Horizontal Force:	79215.4 lb
Driving Horizontal Force:	49246.6 lb
Total Slice Area:	812.285 ft ²
Surface Horizontal Width:	84.0144 ft
Surface Average Height:	9.66841 ft

Method: gle/morgenstern-price

FS	1.566820
Axis Location:	13.741, 129.092
Left Slip Surface Endpoint:	25.191, 10.190
Right Slip Surface Endpoint:	115.733, 66.911
Resisting Moment:	1.09768e+07 lb-ft
Driving Moment:	7.00579e+06 lb-ft
Resisting Horizontal Force:	82577.7 lb
Driving Horizontal Force:	52703.9 lb
Total Slice Area:	870.217 ft ²
Surface Horizontal Width:	90.5415 ft
Surface Average Height:	9.61124 ft

◆ Group 2 - Scenario 2

Method: bishop simplified

FS	1.180800
Axis Location:	15.227, 139.492
Left Slip Surface Endpoint:	25.191, 10.190
Right Slip Surface Endpoint:	124.647, 69.882
Resisting Moment:	1.54646e+07 lb-ft
Driving Moment:	1.30967e+07 lb-ft
Total Slice Area:	1209.1 ft ²
Surface Horizontal Width:	99.4554 ft
Surface Average Height:	12.1572 ft

Method: spencer

FS	1.166840
Axis Location:	17.458, 137.691
Left Slip Surface Endpoint:	26.779, 11.771
Right Slip Surface Endpoint:	123.787, 69.596
Resisting Moment:	1.02878e+07 lb-ft
Driving Moment:	8.8168e+06 lb-ft
Resisting Horizontal Force:	76229.6 lb
Driving Horizontal Force:	65330.2 lb
Total Slice Area:	852.331 ft ²
Surface Horizontal Width:	97.0079 ft
Surface Average Height:	8.7862 ft

Method: gle/morgenstern-price

FS	1.126630
Axis Location:	14.709, 128.766
Left Slip Surface Endpoint:	25.839, 10.835
Right Slip Surface Endpoint:	115.732, 66.911
Resisting Moment:	1.01487e+07 lb-ft
Driving Moment:	9.00805e+06 lb-ft
Resisting Horizontal Force:	78291.2 lb
Driving Horizontal Force:	69491.6 lb
Total Slice Area:	894.986 ft ²
Surface Horizontal Width:	89.8936 ft
Surface Average Height:	9.95606 ft

Global Minimum Coordinates

◆ **Group 2 - Master Scenario**

Method: bishop simplified

X	Y
25.1911	10.1902
28.2356	9.30606
31.2801	9.10939
35.4965	9.54779
39.7129	10.4867
42.5789	11.5381
45.4449	13.0094
48.3109	14.8567
51.1769	16.9126
53.1063	18.6303
55.0357	20.2805
56.9651	22.0644
58.8945	24.2244
61.1343	26.7336
63.3742	29.1647
65.614	31.5175
67.8538	33.7921
70.0936	35.9884
72.3334	38.1066
75.3171	40.824
78.3007	43.4372
81.2844	45.9462
84.268	48.351
86.8312	50.3274
89.3944	52.2143
91.9577	54.0117
94.5209	56.2695
97.0841	58.4637
99.6473	60.5683
101.609	62.1102

Method: spencer

X	Y
25.1911	10.1902
28.0357	10.4313
30.8803	10.8515
35.4008	11.7493
39.8562	13.3164
42.7582	15.0604
45.6602	16.7235
48.5396	18.5674
51.419	20.4324
54.7553	23.0995
58.0916	25.7688
61.4279	28.7091
64.7642	31.8162
68.1004	34.8068
71.4367	37.6809
73.8213	39.6518
76.2058	41.5395
79.015	43.6652
81.8242	45.6929
85.1043	47.9459
88.3844	50.0843
91.6635	52.1076
94.9426	54.6125
98.2217	57.0029
101.883	59.7055
105.544	62.2802
109.205	64.7352

Method: gle/morgenstern-price

X	Y
25.1911	10.1902
29.7557	9.5602
33.711	10.3361
36.9619	11.6136
39.4972	12.9352
42.099	14.528
44.6281	16.074
46.8308	17.6492
49.1963	19.3996
51.5389	21.1212
54.9836	23.7703
57.0694	25.3266
59.1551	27.0605
61.2408	28.8587
63.4057	30.852
65.6732	32.8606
67.5604	34.4664
69.3158	35.8988
71.1935	37.3654
73.0711	38.7663
75.8505	40.7431
78.6298	42.6227
82.1908	44.9066
86.0386	47.2402
90.2958	49.6733
94.6213	52.785
96.8316	54.2979
99.0419	55.8688
103.462	59.0772
106.526	61.1934
109.589	63.2027
112.655	65.107
115.733	66.9109

 Group 2 - Scenario 2

Method: bishop simplified

X	Y
25.1911	10.1902
29.1923	9.12644
33.2152	9.0967
38.2385	10.1152
43.2624	11.8162
45.99	13.0673
48.5551	14.3561
50.8973	15.5232
54.595	17.9582
57.0175	19.6727
59.44	21.763
62.4191	24.7041
65.3985	27.5416
68.3779	30.275
71.0282	32.6139
73.6784	34.8602
76.3286	37.0139
78.9787	39.075
81.7026	41.0985
84.4265	43.0267
87.2235	44.909
89.9123	46.6247
92.8045	48.3691
96.0492	50.2128
99.294	51.9433
101.829	53.8248
104.365	55.625
106.9	57.5287
109.435	59.4031
111.97	61.2458
114.506	63.0608
117.041	64.8545
119.576	66.5597
122.111	68.2086
124.647	69.8822

Method: spencer

X	Y
26.7794	11.7707
30.1542	12.603
32.9321	13.4538
35.71	14.6087
38.3789	15.7555
41.0478	16.9625
45.6264	19.3922
49.0413	21.4697
51.6338	23.1801
53.8262	24.6534
56.0186	26.1126
58.2172	27.6038
60.2577	29.1534
62.4692	30.9781
64.6807	32.7255
66.8922	34.3957
69.1037	35.9886
71.5522	37.6668
74.0007	39.2595
76.4492	40.7667
80.9218	43.3636
85.3945	45.8044
89.8671	48.7231
94.3398	51.4856
98.8124	54.0919
103.285	56.5538
106.537	58.3388
109.13	60.0981
112.377	62.1872
116.561	64.7879
118.97	66.3587
121.379	67.9831
123.787	69.5958

Method: gle/morgenstern-price

X	Y
25.8388	10.8347
28.0313	10.6489
30.2635	10.6379
34.0107	11.806
37.7599	13.4409
40.6088	14.8721
43.4576	16.5559
45.7855	18.1333
48.3199	19.9658
50.5403	21.5739
52.7607	23.1931
55.1885	24.9606
57.6186	26.9677
60.046	28.9982
62.9769	31.3476
65.9079	33.5947
69.1104	35.9381
72.313	38.1697
75.0938	40.0103
77.8715	41.7519
80.6464	43.3948
83.8181	45.1619
86.5769	46.6943
89.1644	48.1278
91.7488	49.5558
95.3451	51.5361
98.9245	53.5007
102.503	55.4585
105.814	57.2654
109.121	59.0653
112.426	62.2922
114.079	63.9026
115.732	66.9108

Global Minimum Support Data

All Open Scenarios

No Supports Present

Valid and Invalid Surfaces

◆ Group 2 - Master Scenario

Method: bishop simplified

Number of Valid Surfaces:	34560
Number of Invalid Surfaces:	69147

Error Codes

Error Code -111 reported for 2 surfaces
Error Code -112 reported for 3 surfaces
Error Code -121 reported for 1 surface
Error Code -1000 reported for 69141 surfaces

Method: spencer

Number of Valid Surfaces:	34548
Number of Invalid Surfaces:	69159

Error Codes

Error Code -111 reported for 12 surfaces
Error Code -112 reported for 5 surfaces
Error Code -121 reported for 1 surface
Error Code -1000 reported for 69141 surfaces

Method: gle/morgenstern-price

Number of Valid Surfaces:	34562
Number of Invalid Surfaces:	69145

Error Codes

Error Code -111 reported for 4 surfaces
Error Code -112 reported for 1 surface
Error Code -121 reported for 1 surface
Error Code -1000 reported for 69139 surfaces

◆ Group 2 - Scenario 2

Method: bishop simplified

Number of Valid Surfaces:	34552
Number of Invalid Surfaces:	69149

Error Codes

Error Code -112 reported for 4 surfaces
Error Code -121 reported for 4 surfaces
Error Code -1000 reported for 69141 surfaces

Method: spencer

Number of Valid Surfaces:	34510
Number of Invalid Surfaces:	69191

Error Codes

Error Code -111 reported for 19 surfaces
Error Code -112 reported for 10 surfaces
Error Code -121 reported for 4 surfaces
Error Code -1000 reported for 69158 surfaces

Method: gle/morgenstern-price

Number of Valid Surfaces:	34536
Number of Invalid Surfaces:	69165

Error Codes

Error Code -111 reported for 5 surfaces
Error Code -112 reported for 10 surfaces
Error Code -121 reported for 4 surfaces
Error Code -1000 reported for 69146 surfaces

Error Code Descriptions

The following errors were encountered during the computation:

- 111 = Safety factor equation did not converge
- 112 = The coefficient $M\text{-}\alpha = \cos(\alpha)(1 + \tan(\alpha)\tan(\phi)/F) < 0.2$ for the final iteration of the safety factor calculation. This screens out some slip surfaces which may not be valid in the context of the analysis, in particular, deep seated slip surfaces with many high negative base angle slices in the passive zone.
- 121 = Concave failure surface, only convex surfaces have been defined as being allowed.
- 1000 = No valid slip surface is generated

Slice Data

◆ Group 2 - Master Scenario

Global Minimum Query (bishop simplified) - Safety Factor: 1.58808

Slice Number	Width [ft]	Weight [lbs]	Angle of Slice Base [deg]	Base Material	Base Cohesion [psf]	Base Friction Angle [deg]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]	Base Vertical Stress [psf]	Effective Vertical Stress [psf]
1	1.52225	205.528	-16.1936	Sandstone	750	30	582.895	925.684	304.293	0	304.293	135.017	135.017
2	1.52225	616.585	-16.1936	Sandstone	750	30	692.654	1099.99	606.201	0	606.201	405.049	405.049
3	1.52225	991.537	-3.69613	Sandstone	750	30	726.127	1153.15	698.273	0	698.273	651.366	651.366
4	1.52225	1330.38	-3.69613	Sandstone	750	30	808.998	1284.75	926.224	0	926.224	873.963	873.963
5	2.10819	2350.37	5.93609	Sandstone	750	30	845.619	1342.91	1026.95	0	1026.95	1114.88	1114.88
6	2.10819	2896.89	5.93609	Sandstone	750	30	936.432	1487.13	1276.75	0	1276.75	1374.11	1374.11
7	2.10819	3407	12.5542	Sandstone	750	30	980.424	1556.99	1397.75	0	1397.75	1616.08	1616.08
8	2.10819	3880.7	12.5542	Sandstone	750	30	1056	1677.01	1605.62	0	1605.62	1840.78	1840.78
9	1.43301	2887.85	20.1446	Sandstone	750	30	1063.13	1688.34	1625.25	0	1625.25	2015.24	2015.24
10	1.43301	3065.87	20.1446	Sandstone	750	30	1102.98	1751.62	1734.86	0	1734.86	2139.47	2139.47
11	1.43301	3223.13	27.1749	Sandstone	750	30	1087.08	1726.37	1691.13	0	1691.13	2249.21	2249.21
12	1.43301	3359.62	27.1749	Sandstone	750	30	1116.27	1772.72	1771.4	0	1771.4	2344.46	2344.46
13	1.43301	3477.53	32.8045	Sandstone	750	30	1097.37	1742.7	1719.41	0	1719.41	2426.74	2426.74
14	1.43301	3576.85	32.8045	Sandstone	750	30	1117.78	1775.12	1775.56	0	1775.56	2496.05	2496.05
15	1.43301	3663.56	35.653	Sandstone	750	30	1111.78	1765.59	1759.05	0	1759.05	2556.56	2556.56
16	1.43301	3724.23	35.653	Sandstone	750	30	1123.98	1784.97	1792.62	0	1792.62	2598.89	2598.89
17	1.9294	5064.28	41.6771	Sandstone	750	30	1077.71	1711.5	1665.36	0	1665.36	2624.79	2624.79
18	1.9294	5092.95	40.5413	Sandstone	750	30	1092.27	1734.62	1705.4	0	1705.4	2639.66	2639.66
19	1.9294	5112.81	42.756	Sandstone	750	30	1074.49	1706.38	1656.49	0	1656.49	2649.94	2649.94
20	1.9294	5064.8	48.2272	Sandstone	750	30	1013.94	1610.22	1489.95	0	1489.95	2625.07	2625.07
21	1.11991	2894.79	48.2469	Sandstone	750	30	1003.35	1593.4	1460.8	0	1460.8	2584.84	2584.84
22	1.11991	2861.61	48.2469	Sandstone	750	30	995.695	1581.24	1439.75	0	1439.75	2555.22	2555.22
23	2.23982	5635.79	47.3441	Sandstone	750	30	994.582	1579.48	1436.69	0	1436.69	2516.18	2516.18
24	2.23982	5515.59	46.4092	Sandstone	750	30	989.601	1571.57	1423	0	1423	2462.51	2462.51
25	1.11991	2575.37	45.4412	Sandstone	750	30	955.524	1517.45	1329.26	0	1329.26	2299.62	2299.62
26	1.11991	2402.25	45.4412	Sandstone	750	30	914.48	1452.27	1216.36	0	1216.36	2145.03	2145.03
27	2.23982	4297.62	44.4388	Sandstone	750	30	862.388	1369.54	1073.08	0	1073.08	1918.73	1918.73
28	2.02817	3604.4	43.4008	Sandstone	750	30	832.235	1321.66	990.136	0	990.136	1777.16	1777.16
29	0.211648	376.24	43.4008	Colluvium	0	32	509.777	809.567	1295.58	0	1295.58	1777.67	1777.67
30	1.49182	2666.55	42.326	Colluvium	0	32	517.767	822.255	1315.88	0	1315.88	1787.44	1787.44
31	1.49182	2693.31	42.326	Colluvium	0	32	522.964	830.508	1329.09	0	1329.09	1805.38	1805.38
32	1.49182	2659.34	41.2131	Colluvium	0	32	521.643	828.411	1325.74	0	1325.74	1782.61	1782.61
33	1.49182	2322	41.2131	Colluvium	0	32	455.473	723.327	1157.57	0	1157.57	1556.49	1556.49
34	1.49182	1804.36	40.0611	Colluvium	0	32	357.589	567.88	908.797	0	908.797	1209.5	1209.5
35	1.49182	1302.53	40.0611	Colluvium	0	32	258.136	409.94	656.04	0	656.04	873.11	873.11
36	1.49182	1096.82	38.8687	Colluvium	0	32	219.636	348.8	558.195	0	558.195	735.222	735.222
37	1.49182	1015.56	38.8687	Colluvium	0	32	203.363	322.957	516.839	0	516.839	680.749	680.749
38	1.28161	811.143	37.635	Colluvium	0	32	191.065	303.427	485.585	0	485.585	632.91	632.91
39	1.28161	758.336	37.635	Colluvium	0	32	178.626	283.673	453.972	0	453.972	591.707	591.707
40	1.28161	709.114	36.3589	Colluvium	0	32	168.812	268.087	429.029	0	429.029	553.301	553.301
41	1.28161	663.477	36.3589	Colluvium	0	32	157.947	250.833	401.417	0	401.417	517.691	517.691
42	1.28161	621.425	35.0395	Colluvium	0	32	149.53	237.465	380.024	0	380.024	484.879	484.879
43	1.28161	582.958	35.0395	Colluvium	0	32	140.274	222.766	356.499	0	356.499	454.864	454.864
44	1.28161	526.054	41.3746	Colluvium	0	32	119.939	190.472	304.818	0	304.818	410.464	410.464
45	1.28161	450.713	41.3746	Colluvium	0	32	102.761	163.192	261.163	0	261.163	351.677	351.677
46	1.28161	377.919	40.5643	Colluvium	0	32	86.7935	137.835	220.581	0	220.581	294.878	294.878
47	1.28161	307.671	40.5643	Colluvium	0	32	70.6602	112.214	179.58	0	179.58	240.067	240.067
48	1.28161	236.562	39.3895	Colluvium	0	32	54.8933	87.1749	139.509	0	139.509	184.582	184.582
49	1.28161	155.502	39.3895	Colluvium	0	32	36.0836	57.3037	91.7048	0	91.7048	121.333	121.333
50	1.96124	87.6129	38.1738	Colluvium	0	32	13.4246	21.3193	34.118	0	34.118	44.6722	44.6722

Global Minimum Query (spencer) - Safety Factor: 1.60855

Slice Number	Width [ft]	Weight [lbs]	Angle of Slice Base [deg]	Base Material	Base Cohesion [psf]	Base Friction Angle [deg]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]	Base Vertical Stress [psf]	Effective Vertical Stress [psf]
1	1.4223	127.058	4.84463	Sandstone	750	30	621.935	1000.41	433.729	0	433.729	486.443	486.443
2	1.4223	381.174	4.84463	Sandstone	750	30	697.883	1122.58	645.328	0	645.328	704.478	704.478
3	1.4223	626.502	8.40303	Sandstone	750	30	737.725	1186.67	756.331	0	756.331	865.309	865.309
4	1.4223	863.04	8.40303	Sandstone	750	30	803.343	1292.22	939.147	0	939.147	1057.82	1057.82
5	2.26022	1840.17	11.2332	Sandstone	750	30	853.333	1372.63	1078.42	0	1078.42	1247.9	1247.9
6	2.26022	2401.64	11.2332	Sandstone	750	30	945.97	1521.64	1336.52	0	1336.52	1524.39	1524.39
7	2.22772	2864.09	19.3781	Sandstone	750	30	926.562	1490.42	1282.45	0	1282.45	1608.34	1608.34
8	2.22772	3304.66	19.3781	Sandstone	750	30	989.864	1592.25	1458.81	0	1458.81	1806.97	1806.97
9	1.451	2353.18	31.0047	Sandstone	750	30	897.493	1443.66	1201.46	0	1201.46	1740.83	1740.83
10	1.451	2467.68	31.0047	Sandstone	750	30	918.017	1476.68	1258.64	0	1258.64	1810.34	1810.34
11	1.451	2586.22	29.816	Sandstone	750	30	952.856	1532.72	1355.7	0	1355.7	1901.76	1901.76
12	1.451	2708.82	29.816	Sandstone	750	30	975.303	1568.82	1418.24	0	1418.24	1977.17	1977.17
13	1.43971	2799.29	32.6348	Sandstone	750	30	961.927	1547.31	1380.98	0	1380.98	1996.98	1996.98
14	1.43971	2900.73	32.6348	Sandstone	750	30	979.726	1575.94	1430.57	0	1430.57	2057.97	2057.97
15	1.43971	2996.88	32.931	Sandstone	750	30	992.923	1597.17	1467.34	0	1467.34	2110.45	2110.45
16	1.43971	3076.8	32.931	Sandstone	750	30	1006.87	1619.6	1506.19	0	1506.19	2158.34	2158.34
17	1.66814	3636.3	38.6399	Sandstone	750	30	946.866	1523.08	1339.02	0	1339.02	2095.97	2095.97
18	1.66814	3685.91	38.6399	Sandstone	750	30	953.597	1533.91	1357.77	0	1357.77	2120.1	2120.1
19	1.66814	3735.39	38.6626	Sandstone	750	30	960.032	1544.26	1375.7	0	1375.7	2143.8	2143.8
20	1.66814	3784.74	38.6626	Sandstone	750	30	966.725	1555.03	1394.34	0	1394.34	2167.8	2167.8
21	1.66814	3818.51	41.3894	Sandstone	750	30	937.703	1508.34	1313.49	0	1313.49	2139.87	2139.87
22	1.66814	3836.67	41.3894	Sandstone	750	30	940.043	1512.11	1320.01	0	1320.01	2148.46	2148.46
23	1.66814	3845.24	42.9631	Sandstone	750	30	921.985	1483.06	1269.69	0	1269.69	2128.35	2128.35
24	1.66814	3844.2	42.9631	Sandstone	750	30	921.855	1482.85	1269.33	0	1269.33	2127.87	2127.87
25	1.66814	3720.59	41.8727	Sandstone	750	30	919.332	1478.79	1262.3	0	1262.3	2086.38	2086.38
26	1.66814	3385.74	41.8727	Sandstone	750	30	876.608	1410.07	1143.27	0	1143.27	1929.05	1929.05
27	1.6003	2936.24	40.7439	Sandstone	750	30	846.776	1362.08	1060.16	0	1060.16	1789.63	1789.63
28	1.6003	2741.25	40.7439	Sandstone	750	30	820.274	1319.45	986.315	0	986.315	1692.96	1692.96
29	0.135675	233.033	40.7439	Colluvium	0	32	403.015	648.269	1037.45	0	1037.45	1384.63	1384.63
30	2.38455	4162.73	39.5754	Colluvium	0	32	419.039	674.045	1078.7	0	1078.7	1425.05	1425.05
31	2.38455	4292.38	38.3661	Colluvium	0	32	442.27	711.413	1138.5	0	1138.5	1488.61	1488.61
32	1.4046	2388.85	37.1151	Colluvium	0	32	427.944	688.37	1101.62	0	1101.62	1425.45	1425.45
33	1.4046	1992.43	37.1151	Colluvium	0	32	356.928	574.137	918.81	0	918.81	1188.9	1188.9
34	1.4046	1560.99	35.8212	Colluvium	0	32	286.555	460.938	737.654	0	737.654	944.485	944.485
35	1.4046	1212.95	35.8212	Colluvium	0	32	222.665	358.167	573.187	0	573.187	733.903	733.903
36	1.64004	1330.18	34.4838	Colluvium	0	32	214.433	344.927	551.997	0	551.997	699.284	699.284
37	1.64004	1272.02	34.4838	Colluvium	0	32	205.057	329.845	527.862	0	527.862	668.709	668.709
38	1.64004	1219.72	33.1021	Colluvium	0	32	201.744	324.515	519.335	0	519.335	650.861	650.861
39	1.64004	1173.3	33.1021	Colluvium	0	32	194.066	312.165	499.568	0	499.568	626.088	626.088
40	1.63956	1132.43	31.6756	Colluvium	0	32	192.365	309.429	495.19	0	495.19	613.884	613.884
41	1.63956	1097.77	31.6756	Colluvium	0	32	186.478	299.959	480.034	0	480.034	595.095	595.095
42	1.63956	1038.43	37.3761	Colluvium	0	32	158.581	255.085	408.221	0	408.221	529.361	529.361
43	1.63956	954.421	37.3761	Colluvium	0	32	145.751	234.448	375.195	0	375.195	486.534	486.534
44	1.63956	876.277	36.0911	Colluvium	0	32	137.11	220.549	352.952	0	352.952	452.902	452.902
45	1.63956	800.892	36.0911	Colluvium	0	32	125.315	201.575	322.588	0	322.588	413.939	413.939
46	1.83063	775.583	36.4333	Colluvium	0	32	107.989	173.706	277.989	0	277.989	357.702	357.702
47	1.83063	643.035	36.4333	Colluvium	0	32	89.5341	144.02	230.48	0	230.48	296.57	296.57
48	1.83063	511.623	35.1164	Colluvium	0	32	73.0217	117.459	187.974	0	187.974	239.326	239.326
49	1.83063	359.973	35.1164	Colluvium	0	32	51.3775	82.6432	132.257	0	132.257	168.387	168.387
50	3.66126	282.496	33.8427	Colluvium	0	32	20.646	33.2101	53.1473	0	53.1473	66.9908	66.9908

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 1.56682

Slice Number	Width [ft]	Weight [lbs]	Angle of Slice Base [deg]	Base Material	Base Cohesion [psf]	Base Friction Angle [deg]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]	Base Vertical Stress [psf]	Effective Vertical Stress [psf]
1	1.52151	180.988	-7.85832	Sandstone	750	30	561.472	879.725	224.69	0	224.69	147.196	147.196
2	1.52151	542.963	-7.85832	Sandstone	750	30	681.816	1068.28	551.282	0	551.282	457.178	457.178
3	1.52151	904.939	-7.85832	Sandstone	750	30	811.819	1271.97	904.088	0	904.088	792.041	792.041
4	1.97767	1627.09	11.0985	Sandstone	750	30	810.189	1269.42	899.664	0	899.664	1058.6	1058.6
5	1.97767	2058.27	11.0985	Sandstone	750	30	915.046	1433.71	1184.22	0	1184.22	1363.72	1363.72
6	1.62545	1978.65	21.4531	Sandstone	750	30	913.221	1430.85	1179.27	0	1179.27	1538.14	1538.14
7	1.62545	2198.17	21.4531	Sandstone	750	30	968.769	1517.89	1330.02	0	1330.02	1710.71	1710.71
8	2.53528	3809.87	27.5331	Sandstone	750	30	968.382	1517.28	1328.97	0	1328.97	1833.79	1833.79
9	1.30089	2107.42	31.4739	Sandstone	750	30	966.865	1514.9	1324.85	0	1324.85	1916.74	1916.74
10	1.30089	2196.83	31.4739	Sandstone	750	30	986.955	1546.38	1379.37	0	1379.37	1983.56	1983.56
11	2.52908	4527.17	31.4367	Sandstone	750	30	1015.84	1591.64	1457.77	0	1457.77	2078.74	2078.74
12	2.20275	4184.26	35.5687	Sandstone	750	30	993.634	1556.85	1397.5	0	1397.5	2108.05	2108.05
13	2.36553	4692.53	36.501	Sandstone	750	30	998.581	1564.6	1410.92	0	1410.92	2149.86	2149.86
14	2.34255	4812.31	36.3125	Sandstone	750	30	1012.9	1587.03	1449.78	0	1449.78	2194.17	2194.17
15	1.72236	3624.28	37.562	Sandstone	750	30	1003.37	1572.11	1423.93	0	1423.93	2195.57	2195.57
16	1.72236	3689.6	37.562	Sandstone	750	30	1007.79	1579.03	1435.92	0	1435.92	2210.96	2210.96
17	2.08577	4562.43	36.7277	Sandstone	750	30	1025.08	1606.12	1482.85	0	1482.85	2247.69	2247.69
18	2.0857	4646.25	39.7374	Sandstone	750	30	987.216	1546.79	1380.08	0	1380.08	2200.77	2200.77
19	2.0857	4695.4	40.766	Sandstone	750	30	972.866	1524.31	1341.14	0	1341.14	2179.89	2179.89
20	2.1649	4896.94	42.6371	Sandstone	750	30	944.763	1480.27	1264.87	0	1264.87	2134.76	2134.76
21	2.26753	5118.37	41.5352	Sandstone	750	30	953.812	1494.45	1289.43	0	1289.43	2134.34	2134.34
22	1.8872	3930.8	40.3945	Sandstone	750	30	928.6	1454.95	1221.01	0	1221.01	2011.15	2011.15
23	1.75541	3295.06	39.2138	Sandstone	750	30	896.437	1404.56	1133.72	0	1133.72	1865.2	1865.2
24	1.87765	3243.51	37.992	Sandstone	750	30	875.308	1371.45	1076.38	0	1076.38	1760.05	1760.05
25	0.399389	692.997	36.7281	Sandstone	750	30	889.975	1394.43	1116.19	0	1116.19	1780.23	1780.23
26	1.47826	2608.78	36.7281	Colluvium	0	32	433.932	679.894	1088.06	0	1088.06	1411.83	1411.83
27	1.38969	2521.66	35.4211	Colluvium	0	32	457.614	716.998	1147.44	0	1147.44	1472.9	1472.9
28	1.38969	2592.81	35.4211	Colluvium	0	32	469.749	736.012	1177.86	0	1177.86	1511.96	1511.96
29	1.38965	2532.32	34.0704	Colluvium	0	32	471.804	739.232	1183.02	0	1183.02	1502.1	1502.1
30	1.38965	2207.91	34.0704	Colluvium	0	32	410.218	642.738	1028.6	0	1028.6	1306.03	1306.03
31	1.78047	2240.83	32.6752	Colluvium	0	32	332.771	521.392	834.4	0	834.4	1047.83	1047.83
32	1.78047	1741.89	32.6752	Colluvium	0	32	256.345	401.647	642.77	0	642.77	807.184	807.184
33	1.9239	1807.48	31.235	Colluvium	0	32	253.275	396.836	635.07	0	635.07	788.67	788.67
34	1.9239	1764.65	31.235	Colluvium	0	32	247.364	387.575	620.248	0	620.248	770.263	770.263
35	2.1286	1912.38	29.7495	Colluvium	0	32	249.983	391.678	626.815	0	626.815	769.689	769.689
36	2.1286	1879.72	29.7495	Colluvium	0	32	246.439	386.125	617.927	0	617.927	758.776	758.776
37	2.16277	1833.23	35.7307	Colluvium	0	32	212.662	333.203	533.237	0	533.237	686.223	686.223
38	2.16277	1713.07	35.7307	Colluvium	0	32	201.079	315.054	504.193	0	504.193	648.846	648.846
39	2.21031	1637.24	34.3902	Colluvium	0	32	195.273	305.957	489.635	0	489.635	623.292	623.292
40	2.21031	1511.13	35.401	Colluvium	0	32	179.964	281.971	451.249	0	451.249	579.148	579.148
41	2.21026	1332.51	35.9722	Colluvium	0	32	160.027	250.733	401.257	0	401.257	517.404	517.404
42	2.21026	1143.24	35.9722	Colluvium	0	32	140.077	219.476	351.236	0	351.236	452.904	452.904
43	1.53157	664.287	34.6398	Colluvium	0	32	121.807	190.85	305.424	0	305.424	389.579	389.579
44	1.53157	559.449	34.6398	Colluvium	0	32	103.985	162.925	260.735	0	260.735	332.576	332.576
45	1.53157	459.731	33.2633	Colluvium	0	32	88.1524	138.119	221.037	0	221.037	278.862	278.862
46	1.53157	365.132	33.2633	Colluvium	0	32	70.938	111.147	177.872	0	177.872	224.404	224.404
47	1.5331	275.887	31.8419	Colluvium	0	32	55.0982	86.329	138.156	0	138.156	172.374	172.374
48	1.5331	191.359	31.8419	Colluvium	0	32	38.682	60.6078	96.993	0	96.993	121.016	121.016
49	1.53887	112.242	30.3753	Colluvium	0	32	23.18	36.3189	58.1225	0	58.1225	71.7088	71.7088
50	1.53887	37.4139	30.3753	Colluvium	0	32	7.80045	12.2219	19.5592	0	19.5592	24.1312	24.1312

◆ Group 2 - Scenario 2

Global Minimum Query (bishop simplified) - Safety Factor: 1.1808

Slice Number	Width [ft]	Weight [lbs]	Angle of Slice Base [deg]	Base Material	Base Cohesion [psf]	Base Friction Angle [deg]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]	Base Vertical Stress [psf]	Effective Vertical Stress [psf]
1	2.00061	348.217	-14.8883	Sandstone	750	30	827.885	977.567	394.158	0	394.158	174.056	174.056
2	2.00061	1044.65	-14.8883	Sandstone	750	30	1023.53	1208.58	794.285	0	794.285	522.169	522.169
3	2.01141	1680.23	-0.423477	Sandstone	750	30	1047.39	1236.76	843.092	0	843.092	835.351	835.351
4	2.01141	2239.9	-0.423477	Sandstone	750	30	1183.93	1397.99	1122.35	0	1122.35	1113.6	1113.6
5	2.51169	3491.31	11.4617	Sandstone	750	30	1196.22	1412.5	1147.48	0	1147.48	1390.03	1390.03
6	2.51169	4181.06	11.4617	Sandstone	750	30	1318.38	1556.75	1397.33	0	1397.33	1664.64	1664.64
7	2.51192	4812.14	18.7055	Sandstone	750	30	1348.59	1592.42	1459.11	0	1459.11	1915.72	1915.72
8	2.51192	5383.73	18.7055	Sandstone	750	30	1444.05	1705.13	1654.34	0	1654.34	2143.28	2143.28
9	2.72764	6431.79	24.639	Sandstone	750	30	1460.56	1724.63	1688.1	0	1688.1	2358	2358
10	2.56508	6531.04	26.6768	Sandstone	750	30	1509.31	1782.19	1787.8	0	1787.8	2546.14	2546.14
11	2.34225	6338.79	26.4869	Sandstone	750	30	1574.73	1859.44	1921.6	0	1921.6	2706.29	2706.29
12	1.84885	5195.37	33.3654	Sandstone	750	30	1519.79	1794.57	1809.26	0	1809.26	2810.06	2810.06
13	1.84885	5322.77	33.3654	Sandstone	750	30	1545.28	1824.67	1861.38	0	1861.38	2878.97	2878.97
14	2.4225	7147.2	35.2886	Sandstone	750	30	1543.57	1822.65	1857.89	0	1857.89	2950.34	2950.34
15	2.4225	7263.26	40.7897	Sandstone	750	30	1477.71	1744.88	1723.19	0	1723.19	2998.25	2998.25
16	1.48953	4473.38	44.6331	Sandstone	750	30	1418.72	1675.23	1602.54	0	1602.54	3003.21	3003.21
17	1.48953	4455.41	44.6331	Sandstone	750	30	1414.75	1670.53	1594.41	0	1594.41	2991.15	2991.15
18	1.48972	4443.34	43.602	Sandstone	750	30	1428.4	1686.66	1622.34	0	1622.34	2982.68	2982.68
19	1.48972	4426.06	43.602	Sandstone	750	30	1424.53	1682.09	1614.42	0	1614.42	2971.08	2971.08
20	1.48968	4219.36	42.5343	Sandstone	750	30	1394.51	1646.64	1553.02	0	1553.02	2832.4	2832.4
21	1.48968	3943.09	42.5343	Sandstone	750	30	1331.91	1572.72	1425	0	1425	2646.94	2646.94
22	2.6503	6413.71	41.4288	Sandstone	750	30	1270.28	1499.95	1298.95	0	1298.95	2420	2420
23	1.32512	3144.66	40.2843	Sandstone	750	30	1269.41	1498.92	1297.18	0	1297.18	2373.12	2373.12
24	1.32512	3170.49	40.2843	Sandstone	750	30	1276.15	1506.88	1310.96	0	1310.96	2392.62	2392.62
25	2.65017	6417.72	39.0997	Sandstone	750	30	1301.9	1537.28	1363.61	0	1363.61	2421.63	2421.63
26	2.6501	5717.69	37.874	Sandstone	750	30	1224.45	1445.83	1205.22	0	1205.22	2157.54	2157.54
27	1.36198	2332.45	36.606	Sandstone	750	30	1080.18	1275.48	910.159	0	910.159	1712.55	1712.55
28	1.36198	1976.45	36.606	Sandstone	750	30	986.431	1164.78	718.414	0	718.414	1451.16	1451.16
29	2.34447	3216.53	35.295	Sandstone	750	30	970.174	1145.58	685.167	0	685.167	1371.96	1371.96
30	0.379409	506.066	35.295	Colluvium	0	32	513.488	606.327	970.325	0	970.325	1333.83	1333.83
31	1.39847	1839.43	33.94	Colluvium	0	32	513.263	606.061	969.9	0	969.9	1315.32	1315.32
32	1.39847	1800.54	33.94	Colluvium	0	32	502.409	593.245	949.392	0	949.392	1287.51	1287.51
33	1.34443	1698.24	32.5406	Colluvium	0	32	499.721	590.07	944.307	0	944.307	1263.16	1263.16
34	1.34443	1670.18	32.5406	Colluvium	0	32	491.463	580.32	928.706	0	928.706	1242.29	1242.29
35	1.44606	1769.67	31.0961	Colluvium	0	32	490.926	579.685	927.687	0	927.687	1223.79	1223.79
36	1.44606	1746.34	31.0961	Colluvium	0	32	484.453	572.042	915.459	0	915.459	1207.65	1207.65
37	1.6224	1937.27	29.6063	Colluvium	0	32	485.811	573.646	918.026	0	918.026	1194.08	1194.08
38	1.6224	1919.38	29.6063	Colluvium	0	32	481.327	568.351	909.553	0	909.553	1183.06	1183.06
39	1.62236	1907.01	28.0712	Colluvium	0	32	485.127	572.838	916.731	0	916.731	1175.45	1175.45
40	1.62236	1882.21	28.0712	Colluvium	0	32	478.818	565.388	904.809	0	904.809	1160.16	1160.16
41	2.53531	2783.98	36.5804	Colluvium	0	32	417.236	492.672	788.439	0	788.439	1098.08	1098.08
42	2.53531	2523.33	35.376	Colluvium	0	32	382.84	452.058	723.445	0	723.445	995.274	995.274
43	2.5353	2208.01	36.9023	Colluvium	0	32	329.82	389.451	623.253	0	623.253	870.909	870.909
44	2.5353	1877.17	36.4766	Colluvium	0	32	281.633	332.552	532.195	0	532.195	740.414	740.414
45	2.53525	1555.95	36.0112	Colluvium	0	32	234.56	276.968	443.241	0	443.241	613.729	613.729
46	2.53525	1244.19	35.5991	Colluvium	0	32	188.348	222.401	355.918	0	355.918	490.757	490.757
47	2.53522	940.177	35.2801	Colluvium	0	32	142.787	168.603	269.821	0	269.821	370.846	370.846
48	2.53522	653.577	33.9247	Colluvium	0	32	100.613	118.804	190.126	0	190.126	257.799	257.799
49	2.53522	389.922	33.04	Colluvium	0	32	60.5503	71.4978	114.42	0	114.42	153.802	153.802
50	2.53522	131.277	33.43	Colluvium	0	32	20.308	23.9797	38.3756	0	38.3756	51.7815	51.7815

Global Minimum Query (spencer) - Safety Factor: 1.16684

Slice Number	Width [ft]	Weight [lbs]	Angle of Slice Base [deg]	Base Material	Base Cohesion [psf]	Base Friction Angle [deg]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]	Base Vertical Stress [psf]	Effective Vertical Stress [psf]
1	1.68739	147.012	13.8526	Sandstone	750	30	886.88	1034.85	493.37	0	493.37	712.073	712.073
2	1.68739	441.092	13.8526	Sandstone	750	30	965.409	1126.48	652.082	0	652.082	890.15	890.15
3	1.38895	575.795	17.0294	Sandstone	750	30	984.053	1148.23	689.755	0	689.755	991.163	991.163
4	1.38895	759.157	17.0294	Sandstone	750	30	1038.78	1212.09	800.367	0	800.367	1118.54	1118.54
5	1.38895	927.95	22.5741	Sandstone	750	30	1001.59	1168.69	725.191	0	725.191	1141.58	1141.58
6	1.38895	1082.18	22.5741	Sandstone	750	30	1041.74	1215.54	806.337	0	806.337	1239.42	1239.42
7	2.66885	2505.41	23.253	Sandstone	750	30	1088.29	1269.87	900.435	0	900.435	1368.07	1368.07
8	2.66886	3050.02	24.3361	Sandstone	750	30	1141.75	1332.24	1008.48	0	1008.48	1524.86	1524.86
9	1.52622	1971.37	27.9525	Sandstone	750	30	1129.67	1318.14	984.048	0	984.048	1583.5	1583.5
10	1.52622	2120.65	27.9525	Sandstone	750	30	1160.85	1354.53	1047.07	0	1047.07	1663.07	1663.07
11	1.52622	2269.93	27.9525	Sandstone	750	30	1192.03	1390.91	1110.09	0	1110.09	1742.64	1742.64
12	1.70743	2700.72	31.3158	Sandstone	750	30	1161.5	1355.29	1048.39	0	1048.39	1755.03	1755.03
13	1.70743	2856.28	31.3158	Sandstone	750	30	1188.4	1386.67	1102.74	0	1102.74	1825.75	1825.75
14	2.59249	4577.33	33.4147	Sandstone	750	30	1177.88	1374.4	1081.49	0	1081.49	1858.59	1858.59
15	2.19239	4060.61	33.9003	Sandstone	750	30	1193.45	1392.57	1112.96	0	1112.96	1914.94	1914.94
16	2.1924	4232.98	33.6469	Sandstone	750	30	1220.03	1423.58	1166.67	0	1166.67	1978.7	1978.7
17	2.19859	4415.91	34.1476	Sandstone	750	30	1232.3	1437.89	1191.47	0	1191.47	2027.29	2027.29
18	2.04056	4224.62	37.2129	Sandstone	750	30	1192.23	1391.14	1110.5	0	1110.5	2015.87	2015.87
19	2.2115	4666.13	39.5252	Sandstone	750	30	1161.01	1354.71	1047.39	0	1047.39	2005.31	2005.31
20	2.21149	4747.76	38.3142	Sandstone	750	30	1191.79	1390.62	1109.59	0	1109.59	2051.29	2051.29
21	2.21148	4627.34	37.0613	Sandstone	750	30	1200.7	1401.02	1127.61	0	1127.61	2034.42	2034.42
22	2.21147	4146.15	35.7657	Sandstone	750	30	1166.63	1361.28	1058.76	0	1058.76	1899.1	1899.1
23	2.35042	4028.69	34.4264	Sandstone	750	30	1146.07	1337.28	1017.19	0	1017.19	1802.69	1802.69
24	0.0980942	170.011	34.4264	Colluvium	0	32	517.976	604.395	967.237	0	967.237	1322.25	1322.25
25	2.44851	4382	33.0429	Colluvium	0	32	552.604	644.8	1031.89	0	1031.89	1391.35	1391.35
26	2.44849	4634.7	31.6144	Colluvium	0	32	604.516	705.374	1128.83	0	1128.83	1500.95	1500.95
27	2.23633	3844.14	30.1407	Colluvium	0	32	568.464	663.307	1061.51	0	1061.51	1391.58	1391.58
28	2.23633	2868.45	30.1407	Colluvium	0	32	424.182	494.952	792.088	0	792.088	1038.38	1038.38
29	2.23633	2365	28.6217	Colluvium	0	32	362.608	423.106	677.112	0	677.112	874.991	874.991
30	2.23633	2345.1	28.6217	Colluvium	0	32	359.557	419.546	671.413	0	671.413	867.626	867.626
31	1.49088	1537.5	33.1271	Colluvium	0	32	317.798	370.82	593.436	0	593.436	800.82	800.82
32	1.49088	1498.97	33.1271	Colluvium	0	32	309.833	361.526	578.561	0	578.561	780.748	780.748
33	1.49088	1460.44	33.1271	Colluvium	0	32	301.869	352.233	563.693	0	563.693	760.682	760.682
34	2.23632	2129.31	31.7013	Colluvium	0	32	303.458	354.087	566.659	0	566.659	754.089	754.089
35	2.23632	2064.44	31.7013	Colluvium	0	32	294.213	343.3	549.395	0	549.395	731.114	731.114
36	2.23632	2010.49	30.2304	Colluvium	0	32	296.677	346.175	553.995	0	553.995	726.876	726.876
37	2.23632	1957.33	30.2304	Colluvium	0	32	288.833	337.022	539.349	0	539.349	707.658	707.658
38	1.49088	1256.65	28.83	Colluvium	0	32	287.578	335.557	537.003	0	537.003	695.296	695.296
39	1.49088	1220.89	28.83	Colluvium	0	32	279.395	326.009	521.724	0	521.724	675.513	675.513
40	1.49088	1182.95	28.83	Colluvium	0	32	270.712	315.878	505.51	0	505.51	654.52	654.52
41	1.62587	1226.03	28.7647	Colluvium	0	32	257.675	300.666	481.167	0	481.167	622.618	622.618
42	1.62587	1154.78	28.7647	Colluvium	0	32	242.702	283.194	453.205	0	453.205	586.436	586.436
43	2.59347	1640.17	34.1503	Colluvium	0	32	190.244	221.984	355.25	0	355.25	484.299	484.299
44	1.62345	884.845	32.7576	Colluvium	0	32	169.43	197.698	316.383	0	316.383	425.396	425.396
45	1.62345	782.69	32.7576	Colluvium	0	32	149.87	174.874	279.856	0	279.856	376.284	376.284
46	2.09184	863.842	31.867	Colluvium	0	32	131.099	152.971	244.805	0	244.805	326.302	326.302
47	2.09184	706.141	31.867	Colluvium	0	32	107.166	125.045	200.114	0	200.114	266.733	266.733
48	2.40884	606.752	33.1079	Colluvium	0	32	77.6567	90.613	145.011	0	145.011	195.65	195.65
49	2.40885	367.492	33.9926	Colluvium	0	32	46.0634	53.7486	86.0159	0	86.0159	117.077	117.077
50	2.40885	121.914	33.8024	Colluvium	0	32	15.371	17.9355	28.7028	0	28.7028	38.9938	38.9938

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 1.12663

Slice Number	Width [ft]	Weight [lbs]	Angle of Slice Base [deg]	Base Material	Base Cohesion [psf]	Base Friction Angle [deg]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]	Base Vertical Stress [psf]	Effective Vertical Stress [psf]
1	2.19249	358.119	-4.84216	Sandstone	750	30	822.179	926.291	305.345	0	305.345	235.696	235.696
2	2.23224	1073.05	-0.283189	Sandstone	750	30	1038.04	1169.49	726.579	0	726.579	721.448	721.448
3	3.74719	3040.48	17.3129	Sandstone	750	30	1097.67	1236.67	842.939	0	842.939	1185.1	1185.1
4	1.87458	1987.77	23.5618	Sandstone	750	30	1180.24	1329.69	1004.06	0	1004.06	1518.75	1518.75
5	1.87458	2258.82	23.5618	Sandstone	750	30	1266.47	1426.84	1172.32	0	1172.32	1724.63	1724.63
6	1.42447	1888.41	26.6725	Sandstone	750	30	1282.41	1444.8	1203.44	0	1203.44	1847.65	1847.65
7	1.42447	2026.37	26.6725	Sandstone	750	30	1331.61	1500.24	1299.45	0	1299.45	1968.38	1968.38
8	1.42438	2151.78	30.5861	Sandstone	750	30	1300.32	1464.97	1238.37	0	1238.37	2006.95	2006.95
9	1.42438	2264.88	30.5861	Sandstone	750	30	1332.06	1500.74	1300.33	0	1300.33	2087.67	2087.67
10	2.32797	3912.79	34.1198	Sandstone	750	30	1294.57	1458.5	1227.15	0	1227.15	2104.3	2104.3
11	2.5344	4509.54	35.8689	Sandstone	750	30	1285.75	1448.56	1209.95	0	1209.95	2139.61	2139.61
12	2.22034	4137.23	35.9156	Sandstone	750	30	1301.69	1466.52	1241.06	0	1241.06	2183.86	2183.86
13	2.2204	4275.14	36.0998	Sandstone	750	30	1306.94	1472.44	1251.3	0	1251.3	2204.34	2204.34
14	2.42778	4830.17	36.0556	Sandstone	750	30	1315.6	1482.19	1268.19	0	1268.19	2225.97	2225.97
15	2.43012	4958.33	39.5543	Sandstone	750	30	1242.44	1399.77	1125.43	0	1125.43	2151.59	2151.59
16	2.4274	5032.01	39.9126	Sandstone	750	30	1230.58	1386.41	1102.3	0	1102.3	2131.69	2131.69
17	1.46548	3079.37	38.7151	Sandstone	750	30	1252.73	1411.36	1145.51	0	1145.51	2149.68	2149.68
18	1.46548	3117.02	38.7151	Sandstone	750	30	1251.76	1410.27	1143.62	0	1143.62	2147.02	2147.02
19	2.93096	6315.72	37.476	Sandstone	750	30	1275.13	1436.6	1189.22	0	1189.22	2166.81	2166.81
20	1.60128	3221.32	36.1945	Sandstone	750	30	1259.03	1418.46	1157.81	0	1157.81	2079.1	2079.1
21	1.60128	2967.82	36.1945	Sandstone	750	30	1213.83	1367.54	1069.6	0	1069.6	1957.81	1957.81
22	2.46328	4238.06	34.8696	Sandstone	750	30	1199.3	1351.17	1041.25	0	1041.25	1876.95	1876.95
23	0.739271	1296.45	34.8696	Colluvium	0	32	475.884	536.145	858.011	0	858.011	1189.62	1189.62
24	1.39038	2499.9	33.5006	Colluvium	0	32	503.049	566.75	906.988	0	906.988	1239.96	1239.96
25	1.39038	2583.29	33.5006	Colluvium	0	32	515.451	580.722	929.353	0	929.353	1270.53	1270.53
26	1.38889	2637.61	32.0869	Colluvium	0	32	545.648	614.743	983.793	0	983.793	1325.9	1325.9
27	1.38889	2468.25	32.0869	Colluvium	0	32	506.882	571.068	913.898	0	913.898	1231.7	1231.7
28	1.3874	2092.22	30.628	Colluvium	0	32	442.574	498.617	797.953	0	797.953	1059.98	1059.98
29	1.3874	1706.7	30.628	Colluvium	0	32	353.699	398.488	637.714	0	637.714	847.125	847.125
30	1.58587	1649.91	29.1239	Colluvium	0	32	305.069	343.7	550.034	0	550.034	720	720
31	1.58587	1629.54	29.1239	Colluvium	0	32	299.749	337.706	540.443	0	540.443	707.444	707.444
32	1.37942	1406.54	29.0512	Colluvium	0	32	297.562	335.242	536.499	0	536.499	701.787	701.787
33	1.37942	1396.65	29.0512	Colluvium	0	32	295.718	333.165	533.175	0	533.175	697.439	697.439
34	1.29375	1301.08	28.986	Colluvium	0	32	295.106	332.475	532.071	0	532.071	695.557	695.557
35	1.29375	1292.68	28.986	Colluvium	0	32	294.618	331.925	531.19	0	531.19	694.405	694.405
36	1.29216	1282.87	28.9235	Colluvium	0	32	295.177	332.555	532.199	0	532.199	695.303	695.303
37	1.29216	1274.79	28.9235	Colluvium	0	32	295.807	333.265	533.335	0	533.335	696.788	696.788
38	1.79818	1760.96	28.8398	Colluvium	0	32	297.898	335.621	537.104	0	537.104	701.144	701.144
39	1.79818	1746.09	28.8398	Colluvium	0	32	300.48	338.53	541.761	0	541.761	707.223	707.223
40	3.57934	3420.94	28.7606	Colluvium	0	32	305.387	344.058	550.608	0	550.608	718.223	718.223
41	1.78905	1647.13	28.6853	Colluvium	0	32	304.071	342.576	548.235	0	548.235	714.608	714.608
42	1.78905	1596.95	28.6853	Colluvium	0	32	301.55	339.735	543.69	0	543.69	708.683	708.683
43	1.65577	1421.06	28.6187	Colluvium	0	32	296.774	334.354	535.077	0	535.077	697.009	697.009
44	1.65577	1348.43	28.6187	Colluvium	0	32	287.5	323.906	518.357	0	518.357	675.229	675.229
45	1.6537	1274.37	28.5549	Colluvium	0	32	278.236	313.469	501.655	0	501.655	653.071	653.071
46	1.6537	1202.29	28.5549	Colluvium	0	32	268.338	302.318	483.81	0	483.81	629.839	629.839
47	1.65232	1055.54	44.318	Colluvium	0	32	191.623	215.888	345.493	0	345.493	532.607	532.607
48	1.65232	836.054	44.318	Colluvium	0	32	159.144	179.296	286.934	0	286.934	442.333	442.333
49	1.65312	617.203	44.251	Colluvium	0	32	123.416	139.044	222.517	0	222.517	342.748	342.748
50	1.65312	253.872	61.2094	Colluvium	0	32	40.1341	45.2163	72.3612	0	72.3612	145.393	145.393

Interslice Data

◆ Group 2 - Master Scenario

Global Minimum Query (bishop simplified) - Safety Factor: 1.58808

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [deg]
1	25.1911	10.1902	0	0	0
2	26.7134	9.74813	1021.83	0	0
3	28.2356	9.30606	2344.21	0	0
4	29.7579	9.20772	3518.22	0	0
5	31.2801	9.10939	4840.8	0	0
6	33.3883	9.32859	6398.42	0	0
7	35.4965	9.54779	8092.73	0	0
8	37.6047	10.0173	9503.45	0	0
9	39.7129	10.4867	10975.9	0	0
10	41.1459	11.0124	11645	0	0
11	42.5789	11.5381	12313.6	0	0
12	44.0119	12.2737	12627.3	0	0
13	45.4449	13.0094	12923.8	0	0
14	46.8779	13.9331	12908.1	0	0
15	48.3109	14.8567	12869.9	0	0
16	49.7439	15.8847	12654.9	0	0
17	51.1769	16.9126	12422.9	0	0
18	53.1063	18.6303	11641.7	0	0
19	55.0357	20.2805	10934.8	0	0
20	56.9651	22.0644	10052.9	0	0
21	58.8945	24.2244	8790.93	0	0
22	60.0144	25.479	8081.84	0	0
23	61.1343	26.7336	7390.59	0	0
24	63.3742	29.1647	6125.65	0	0
25	65.614	31.5175	4994.16	0	0
26	66.7339	32.6548	4552.5	0	0
27	67.8538	33.7921	4193.28	0	0
28	70.0936	35.9884	3768.01	0	0
29	72.1218	37.9064	3556.84	0	0
30	72.3334	38.1066	3405.42	0	0
31	73.8253	39.4653	2389.96	0	0
32	75.3171	40.824	1364.31	0	0
33	76.8089	42.1306	410.307	0	0
34	78.3007	43.4372	-422.677	0	0
35	79.7925	44.6917	-1029.3	0	0
36	81.2844	45.9462	-1467.21	0	0
37	82.7762	47.1486	-1810.73	0	0
38	84.268	48.351	-2128.8	0	0
39	85.5496	49.3392	-2363.79	0	0
40	86.8312	50.3274	-2583.49	0	0
41	88.1128	51.2709	-2771.91	0	0
42	89.3944	52.2143	-2948.2	0	0
43	90.6761	53.113	-3098.09	0	0
44	91.9577	54.0117	-3238.71	0	0
45	93.2393	55.1406	-3429.1	0	0
46	94.5209	56.2695	-3592.22	0	0
47	95.8025	57.3666	-3722.98	0	0
48	97.0841	58.4637	-3829.44	0	0
49	98.3657	59.516	-3905.89	0	0
50	99.6473	60.5683	-3956.15	0	0
51	101.609	62.1102	0	0	0

Global Minimum Query (spencer) - Safety Factor: 1.60855

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [deg]
1	25.1911	10.1902	0	0	0
2	26.6134	10.3107	832.293	564.818	34.1619
3	28.0357	10.4313	1747.1	1185.63	34.1619
4	29.458	10.6414	2637.46	1789.85	34.1619
5	30.8803	10.8515	3582.74	2431.35	34.1619
6	33.1405	11.3004	5027.37	3411.71	34.1619
7	35.4008	11.7493	6565.52	4455.54	34.1619
8	37.6285	12.5328	7624.79	5174.4	34.1619
9	39.8562	13.3164	8686.89	5895.17	34.1619
10	41.3072	14.1884	8941.47	6067.93	34.1619
11	42.7582	15.0604	9175.97	6227.07	34.1619
12	44.2092	15.8919	9431.26	6400.31	34.1619
13	45.6602	16.7235	9667.11	6560.37	34.1619
14	47.0999	17.6454	9778.8	6636.17	34.1619
15	48.5396	18.5674	9870.39	6698.32	34.1619
16	49.9793	19.4999	9931.63	6739.88	34.1619
17	51.419	20.4324	9976.72	6770.48	34.1619
18	53.0872	21.766	9770.57	6630.58	34.1619
19	54.7553	23.0995	9550.64	6481.33	34.1619
20	56.4235	24.4342	9316.05	6322.13	34.1619
21	58.0916	25.7688	9067.73	6153.62	34.1619
22	59.7597	27.2389	8700.98	5904.73	34.1619
23	61.4279	28.7091	8328.55	5651.99	34.1619
24	63.096	30.2626	7894.01	5357.1	34.1619
25	64.7642	31.8162	7459.82	5062.44	34.1619
26	66.4323	33.3115	7105.87	4822.24	34.1619
27	68.1004	34.8068	6858.65	4654.47	34.1619
28	69.7007	36.1854	6752.21	4582.24	34.1619
29	71.301	37.564	6705.15	4550.3	34.1619
30	71.4367	37.6809	6638.57	4505.12	34.1619
31	73.8213	39.6518	5511.74	3740.42	34.1619
32	76.2058	41.5395	4417.24	2997.67	34.162
33	77.6104	42.6024	3847.45	2610.99	34.1619
34	79.015	43.6652	3372.22	2288.48	34.1619
35	80.4196	44.6791	3026.87	2054.12	34.1619
36	81.8242	45.6929	2758.51	1872	34.1619
37	83.4643	46.8194	2488.38	1688.68	34.1618
38	85.1043	47.9459	2230.05	1513.37	34.1618
39	86.7443	49.0151	2005.64	1361.08	34.1618
40	88.3844	50.0843	1789.77	1214.59	34.162
41	90.0239	51.0959	1604.21	1088.66	34.1619
42	91.6635	52.1076	1424.33	966.588	34.1619
43	93.303	53.36	1173.05	796.067	34.162
44	94.9426	54.6125	942.107	639.34	34.1619
45	96.5822	55.8077	745.061	505.619	34.1619
46	98.2217	57.0029	564.967	383.403	34.162
47	100.052	58.3542	387.011	262.637	34.162
48	101.883	59.7055	239.468	162.51	34.162
49	103.714	60.9928	131.152	89.0036	34.162
50	105.544	62.2802	54.9422	37.2853	34.1619
51	109.205	64.7352	0	0	0

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 1.56682

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [deg]
1	25.1911	10.1902	0	0	0
2	26.7126	9.9802	901.469	42.9716	2.72913
3	28.2342	9.7702	2054.63	195.609	5.4384
4	29.7557	9.5602	3479.68	495.765	8.10861
5	31.7333	9.94815	4732.94	962.225	11.4918
6	33.711	10.3361	6083.18	1600.95	14.7446
7	35.3365	10.9748	6814.32	2122.46	17.3003
8	36.9619	11.6136	7539.46	2704.96	19.7367
9	39.4972	12.9352	8238.16	3544.24	23.2785
10	40.7981	13.7316	8440.87	3930.29	24.9679
11	42.099	14.528	8626.29	4313.85	26.5688
12	44.6281	16.074	8941.76	5043.96	29.4269
13	46.8308	17.6492	8929.15	5503.21	31.6463
14	49.1963	19.3996	8821.56	5896.26	33.7585
15	51.5389	21.1212	8698.44	6223.96	35.5847
16	53.2612	22.4458	8540.51	6381.32	36.7664
17	54.9836	23.7703	8374.3	6499.9	37.8176
18	57.0694	25.3266	8204.71	6625.78	38.9229
19	59.1551	27.0605	7870.85	6569.92	39.8523
20	61.2408	28.8587	7488.36	6421.31	40.6133
21	63.4057	30.852	7012.39	6145.72	41.2316
22	65.6732	32.8606	6585.2	5866.81	41.6981
23	67.5604	34.4664	6376.94	5731.43	41.9484
24	69.3158	35.8988	6326.63	5710.64	42.0705
25	71.1935	37.3654	6391.57	5771.96	42.0839
26	71.5929	37.6634	6414.4	5789.98	42.0711
27	73.0711	38.7663	5855.75	5268.12	41.9761
28	74.4608	39.7547	5357.59	4793.26	41.818
29	75.8505	40.7431	4846.22	4301.53	41.5924
30	77.2402	41.6829	4390.04	3856.57	41.2987
31	78.6298	42.6227	3993.41	3463.54	40.9356
32	80.4103	43.7647	3633.05	3088.32	40.3666
33	82.1908	44.9066	3355.45	2783.58	39.6781
34	84.1147	46.0734	3101.75	2493.41	38.7948
35	86.0386	47.2402	2853.97	2210.66	37.761
36	88.1672	48.4567	2623.52	1936.63	36.434
37	90.2958	49.6733	2396.34	1672.03	34.9051
38	92.4585	51.2292	2026.63	1322.91	33.135
39	94.6213	52.785	1677.07	1013.13	31.1365
40	96.8316	54.2979	1367.92	753.555	28.8493
41	99.0419	55.8688	1056.86	522.512	26.3078
42	101.252	57.473	766.859	333.601	23.5101
43	103.462	59.0772	513.012	191.398	20.4599
44	104.994	60.1353	376.389	123.779	18.2039
45	106.526	61.1934	259.757	73.6944	15.8389
46	108.057	62.1981	172.704	41.0603	13.3738
47	109.589	63.2027	102.652	19.619	10.82
48	111.122	64.1549	55.5832	7.99883	8.18906
49	112.655	65.107	22.5383	2.17012	5.49982
50	114.194	66.0089	5.78533	0.27892	2.76018
51	115.733	66.9109	0	0	0

Group 2 - Scenario 2

Global Minimum Query (bishop simplified) - Safety Factor: 1.1808

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [deg]
1	25.1911	10.1902	0	0	0
2	27.1917	9.65832	1796.27	0	0
3	29.1923	9.12644	4057.48	0	0
4	31.2038	9.11157	5840.69	0	0
5	33.2152	9.0967	7790.77	0	0
6	35.7269	9.60596	9512.67	0	0
7	38.2385	10.1152	11276.2	0	0
8	40.7505	10.9657	12460.4	0	0
9	43.2624	11.8162	13603.9	0	0
10	45.99	13.0673	14189.5	0	0
11	48.5551	14.3561	14450.7	0	0
12	50.8973	15.5232	14628.6	0	0
13	52.7462	16.7407	14196.6	0	0
14	54.595	17.9582	13722.8	0	0
15	57.0175	19.6727	12847.3	0	0
16	59.44	21.763	11372.5	0	0
17	60.9296	23.2336	10234.4	0	0
18	62.4191	24.7041	9105.91	0	0
19	63.9088	26.1229	8043.48	0	0
20	65.3985	27.5416	6989.98	0	0
21	66.8882	28.9083	6100.99	0	0
22	68.3779	30.275	5348.98	0	0
23	71.0282	32.6139	4394.72	0	0
24	72.3533	33.737	3990.97	0	0
25	73.6784	34.8602	3575.51	0	0
26	76.3286	37.0139	2805.39	0	0
27	78.9787	39.075	2422.67	0	0
28	80.3407	40.0867	2506.54	0	0
29	81.7026	41.0985	2727.92	0	0
30	84.0471	42.7581	3222	0	0
31	84.4265	43.0267	3054.99	0	0
32	85.825	43.9679	2492.07	0	0
33	87.2235	44.909	1941.04	0	0
34	88.5679	45.7669	1463.17	0	0
35	89.9123	46.6247	993.195	0	0
36	91.3584	47.4969	540.051	0	0
37	92.8045	48.3691	92.8815	0	0
38	94.4269	49.2909	-352.709	0	0
39	96.0492	50.2128	-794.186	0	0
40	97.6716	51.078	-1181.7	0	0
41	99.294	51.9433	-1564.18	0	0
42	101.829	53.8248	-2546.64	0	0
43	104.365	55.625	-3383	0	0
44	106.9	57.5287	-4174.9	0	0
45	109.435	59.4031	-4833.87	0	0
46	111.97	61.2458	-5367.17	0	0
47	114.506	63.0608	-5784.48	0	0
48	117.041	64.8545	-6094.5	0	0
49	119.576	66.5597	-6294.34	0	0
50	122.111	68.2086	-6407.49	0	0
51	124.647	69.8822	0	0	0

Global Minimum Query (spencer) - Safety Factor: 1.16684

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [deg]
1	26.7794	11.7707	0	0	0
2	28.4668	12.1868	1261.83	1054.68	39.89
3	30.1542	12.603	2531.32	2115.75	39.8898
4	31.5432	13.0284	3489.54	2916.66	39.8899
5	32.9321	13.4538	4440.05	3711.12	39.8898
6	34.3211	14.0312	5226.88	4368.78	39.8899
7	35.71	14.6087	5991.77	5008.11	39.8899
8	38.3789	15.7555	7362.6	6153.89	39.8899
9	41.0478	16.9625	8582.52	7173.53	39.8899
10	42.574	17.7724	9115.42	7618.95	39.8899
11	44.1002	18.5823	9615.02	8036.52	39.8899
12	45.6264	19.3922	10081.3	8426.26	39.8899
13	47.3338	20.431	10435.3	8722.16	39.89
14	49.0413	21.4697	10747.7	8983.25	39.8899
15	51.6338	23.1801	11036.1	9224.34	39.89
16	53.8262	24.6534	11200.9	9362.04	39.8899
17	56.0186	26.1126	11326.7	9467.19	39.8899
18	58.2172	27.6038	11376.1	9508.49	39.8899
19	60.2577	29.1534	11243.2	9397.42	39.8899
20	62.4692	30.9781	10966.5	9166.1	39.8898
21	64.6807	32.7255	10713.6	8954.78	39.89
22	66.8922	34.3957	10560.2	8826.54	39.8899
23	69.1037	35.9886	10624.4	8880.21	39.8899
24	71.4541	37.5996	10873.8	9088.65	39.8899
25	71.5522	37.6668	10825.6	9048.34	39.8898
26	74.0007	39.2595	9658.76	8073.08	39.8899
27	76.4492	40.7667	8510.64	7113.45	39.8899
28	78.6855	42.0651	7634.75	6381.35	39.8899
29	80.9218	43.3636	6981.16	5835.07	39.8899
30	83.1581	44.584	6492.75	5426.83	39.8899
31	85.3945	45.8044	6008.44	5022.03	39.8899
32	86.8854	46.7773	5597.39	4678.47	39.8899
33	88.3762	47.7502	5196.64	4343.51	39.8899
34	89.8671	48.7231	4806.2	4017.17	39.8899
35	92.1034	50.1043	4276.28	3574.24	39.8899
36	94.3398	51.4856	3762.5	3144.81	39.8899
37	96.5761	52.7887	3301.93	2759.85	39.8899
38	98.8124	54.0919	2853.54	2385.07	39.8898
39	100.303	54.9125	2590.27	2165.03	39.8899
40	101.794	55.7332	2334.5	1951.25	39.89
41	103.285	56.5538	2086.67	1744.11	39.89
42	104.911	57.4463	1830.97	1530.38	39.8899
43	106.537	58.3388	1590.12	1329.07	39.8899
44	109.13	60.0981	1130.52	944.921	39.8898
45	110.754	61.1426	898.137	750.69	39.8899
46	112.377	62.1872	692.585	578.883	39.8899
47	114.469	63.4876	475.716	397.617	39.8898
48	116.561	64.7879	298.437	249.443	39.8899
49	118.97	66.3587	136.371	113.983	39.8899
50	121.379	67.9831	34.1151	28.5144	39.8899
51	123.787	69.5958	0	0	0

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 1.12663

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [deg]
1	25.8388	10.8347	0	0	0
2	28.0313	10.6489	1787.71	158.641	5.07113
3	30.2635	10.6379	3898.28	696.041	10.1235
4	34.0107	11.806	6418.77	2096.35	18.0869
5	35.8853	12.6235	7412.86	2955.62	21.7379
6	37.7599	13.4409	8376.83	3929.76	25.1323
7	39.1843	14.1565	8964.75	4673.27	27.5328
8	40.6088	14.8721	9526.47	5450.8	29.7771
9	42.0332	15.714	9905.66	6157.69	31.8665
10	43.4576	16.5559	10255.3	6866.47	33.8044
11	45.7855	18.1333	10550.8	7852.43	36.6585
12	48.3199	19.9658	10690.3	8765.53	39.3501
13	50.5403	21.5739	10757.2	9477.22	41.3804
14	52.7607	23.1931	10778.1	10096.6	43.1301
15	55.1885	24.9606	10764.5	10670.6	44.749
16	57.6186	26.9677	10533.3	10940.8	46.0871
17	60.046	28.9982	10275.7	11083.1	47.1648
18	61.5115	30.1729	10150.1	11154.1	47.6982
19	62.9769	31.3476	10017.7	11183.5	48.1474
20	65.9079	33.5947	9819.62	11218.6	48.8044
21	67.5092	34.7664	9834.78	11326.5	49.0323
22	69.1104	35.9381	9931.61	11493.7	49.17
23	71.5737	37.6546	10250.9	11879.1	49.2079
24	72.313	38.1697	9901.46	11462.2	49.1784
25	73.7034	39.09	9266.21	10686.3	49.0711
26	75.0938	40.0103	8610.95	9869.52	48.896
27	76.4827	40.8811	7984.58	9073.45	48.6524
28	77.8715	41.7519	7399.1	8315.91	48.3388
29	79.259	42.5733	6939.22	7694.32	47.9539
30	80.6464	43.3948	6564.77	7162.93	47.495
31	82.2322	44.2783	6232.61	6654.84	46.8765
32	83.8181	45.1619	5904.55	6147.21	46.1535
33	85.1975	45.9281	5622.62	5708.73	45.4354
34	86.5769	46.6943	5342.68	5274.14	44.6301
35	87.8707	47.411	5082.91	4872.94	43.7918
36	89.1644	48.1278	4824.81	4478.65	42.8691
37	90.4566	48.8418	4569.66	4094.22	41.859
38	91.7488	49.5558	4316.13	3719.79	40.7559
39	93.5469	50.546	3967.78	3219.62	39.0573
40	95.3451	51.5361	3622.44	2745.24	37.1564
41	98.9245	53.5007	2949.63	1895.05	32.7195
42	100.714	54.4796	2627.55	1526.4	30.1532
43	102.503	55.4585	2315.44	1197.32	27.3436
44	104.158	56.3619	2039.19	930.344	24.524
45	105.814	57.2654	1777.23	699.93	21.4961
46	107.468	58.1653	1531.01	505.535	18.2731
47	109.121	59.0653	1298.9	344.805	14.8668
48	110.774	60.6787	846.983	169.302	11.3038
49	112.426	62.2922	479.775	64.1229	7.61258
50	114.079	63.9026	202.002	13.5216	3.82955
51	115.732	66.9108	0	0	0

Discharge Sections

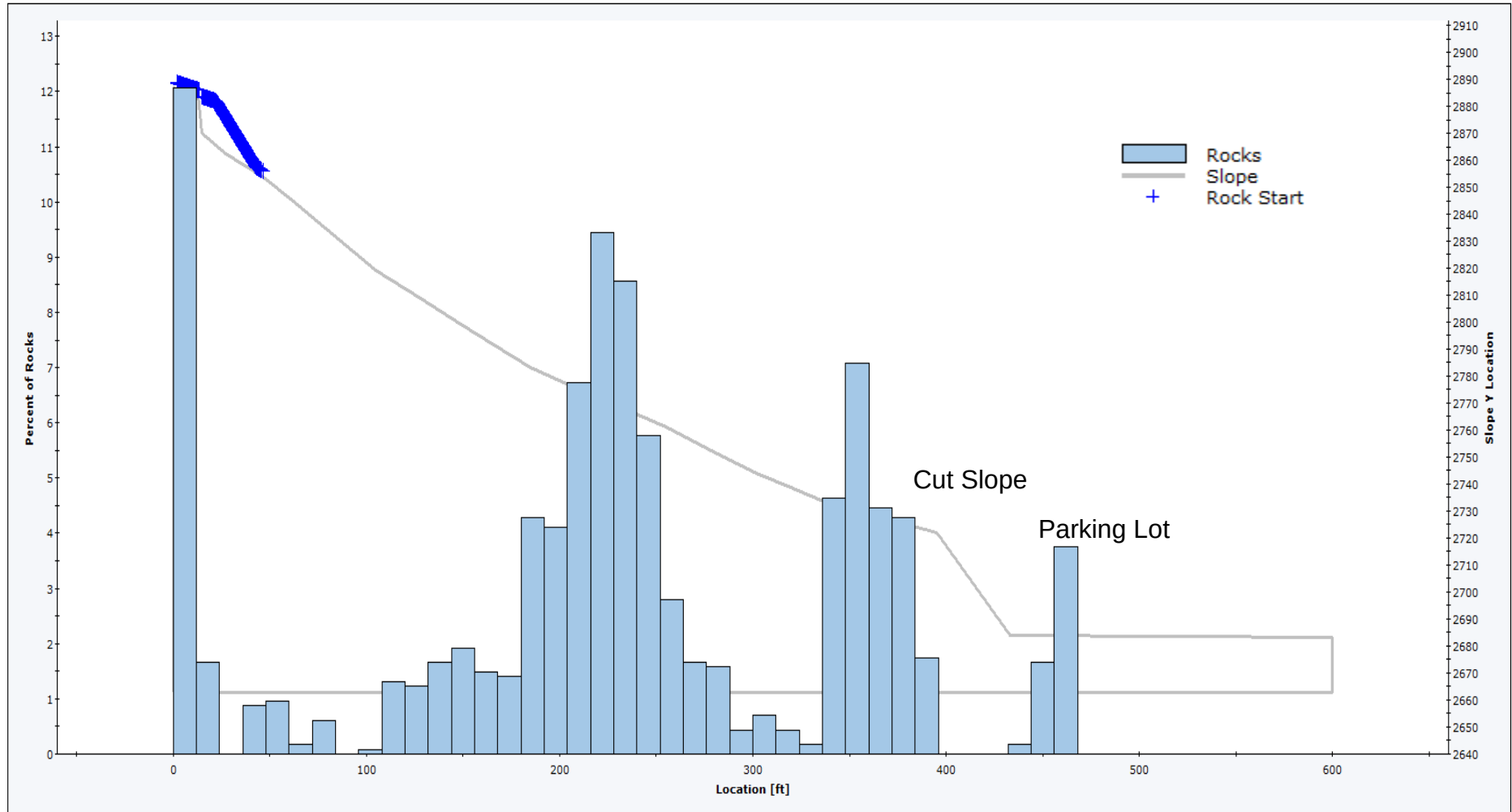
Entity Information

◆ Group 2

Shared Entities

Type	Coordinates (x,y)
External Boundary	-20, -20 125, -20 125, 57.6703 125, 59.6053 125, 70 123.448, 69.4825 117.796, 67.5988 110.163, 65.0544 102.656, 62.5521 97.487, 60.372 80.913, 51.855 76.995, 55.813 75.788, 55.813 70.0205, 50.0054 70.017, 50 70, 50 65, 50 50.15, 35.027 25.1911, 10.1902 24.2836, 10 -20, 10
Material Boundary	25.1911, 10.1902 49.093, 33.956 71.418, 37.583 76.771, 40.043 86.464, 43.66 93.565, 46.455 104.446, 49.744 125, 57.6703
Material Boundary	70.0205, 50.0054 80.913, 51.855

Distribution of Rock Path End Locations



Total number of rock paths: 1143

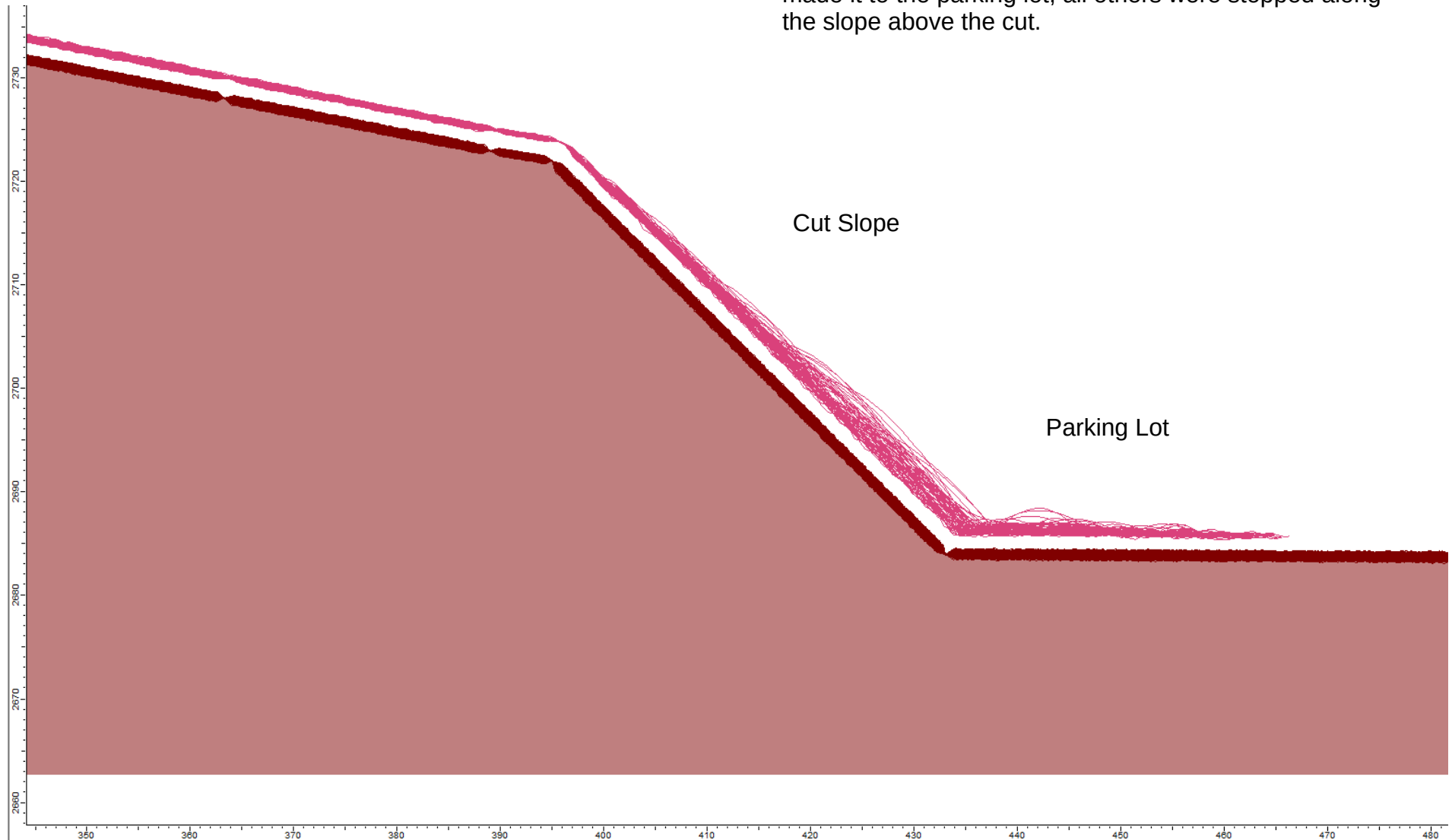


Rocfall2 Rock Endpoint Distribution

Landmark Project No 240016

Figure E-1

Pink lines show rock paths accelerating down the 1H:1V slope into the parking lot area and approaching the proposed structure location. Roughly 5% of the rock paths analyzed made it to the parking lot, all others were stopped along the slope above the cut.



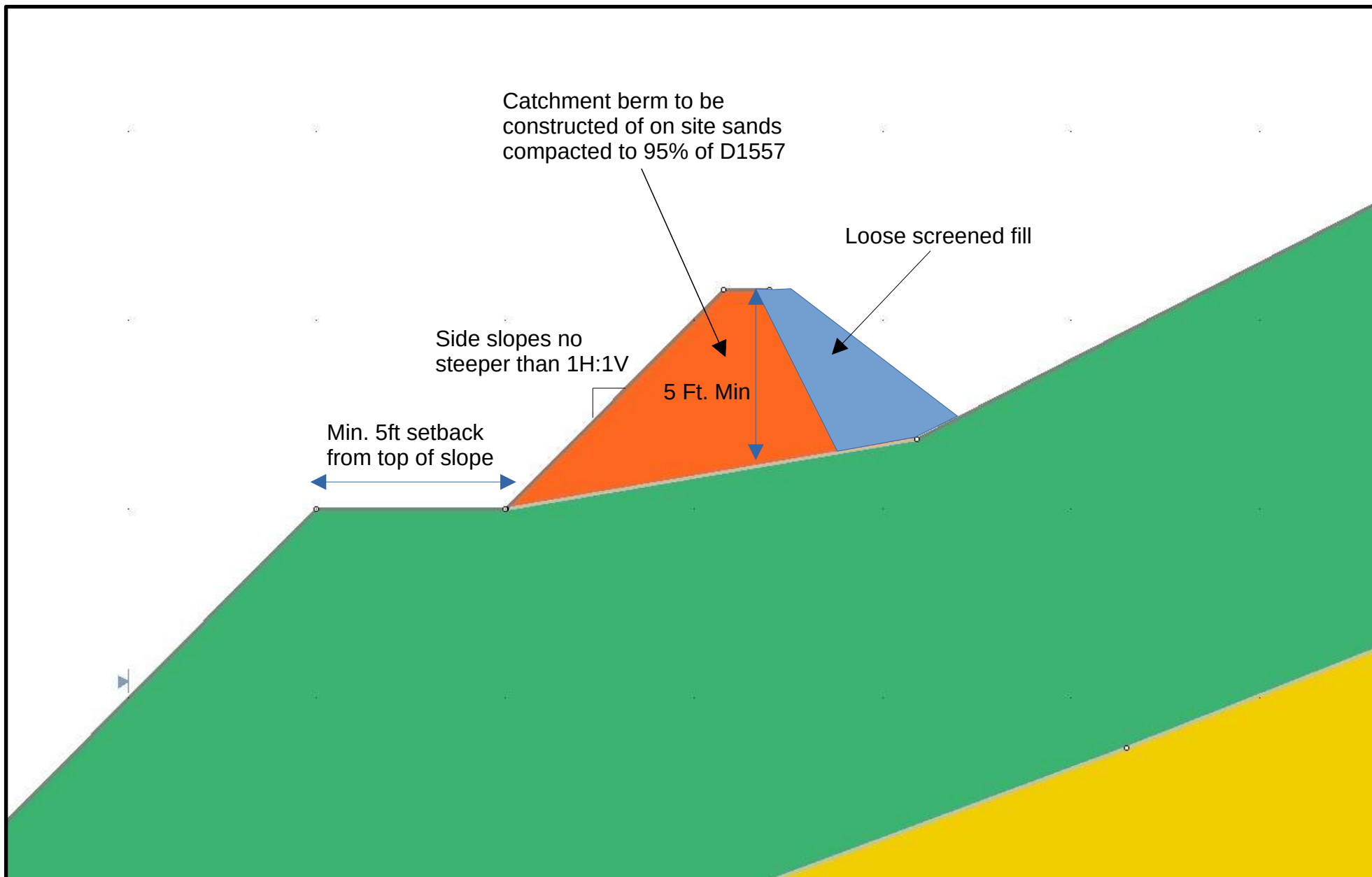
Rocfall2 Round Rock Paths
Landmark Project No 240016

Figure E-2



Rocfall2 Round Rock Paths with Berm
Landmark Project No 240016

Figure E-3





CSH CRSP A-A' Rocfall Two Roc Types
Software Version: 8.024

FIGURE E-5 (14 Pages)

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CSH CRSP A-A' Rocfall Two Roc Types

RocFall2 Analysis Information

Project Summary

File Name
File Version

CSH CRSP A-A' Rocfall Two Roc Types
8.024

Project Settings

General Settings

Engine	Rigid Body
Units	Imperial Foot-Pounds (ft, lbm, ft-lbf)
Rock throw mode	2000 rocks thrown overall
Use tangential CRSP damping	Yes

Engine Conditions

Maximum steps per rock	30000
Normal velocity cutoff (ft/s)	0.1
Stopped velocity cutoff (ft/s)	0.33
Maximum timestep (s)	0.01
Switch velocity (ft/s)	-1e-09

Random Number Generation

Sampling method	Latin-Hypercube
Material Properties Sampling	Per simulation
Random seed	Pseudo-random seed: 12345234

Slope Geometry

Vertex	X	Y	X Std.Dev.	Y Std.Dev.
1	0	2887		
2	12.8278	2884.08		
3	14.722	2870.04		
4	26.934	2862.25		
5	46	2854		
6	62.1623	2844.69		
7	79	2835		
8	105	2819		
9	127.842	2808.62		
10	149	2799		
11	165.95	2791.47		
12	185	2783		
13	201.228	2777.9		
14	218.125	2772.59		
15	240.925	2765.42		
16	255	2761		
17	280.713	2751.7		
18	302	2744		
19	320.839	2738.24		
20	338	2733		
21	363.274	2728.04		
22	389	2723		
23	395	2722		
24	433	2684		
25	600	2683		

Slope Material Assignment

Material	From Vertex	To Vertex
Bedrock Outcrops	1	5
Cell 0001	5	25

Material Properties

Bedrock Outcrops

"Bedrock Outcrops" Properties

Color					
	Mean	Distribution	Std.Dev.	Rel. Min	Rel. Max
Normal Restitution	0.35	Normal	0.04	0.12	0.12
Tangential Restitution	0.85	Normal	0.04	0.12	0.12
Dynamic Friction	0.5	Normal	0.04	0.12	0.12
Rolling Friction	0.15	Normal	0.02	0.06	0.06

"Bedrock Outcrops" Advanced Properties

Forest and Vegetation Damping	Disabled
Scarring	Disabled
Viscoplastic Damping	Disabled

Cell 0001

"Cell 0001" Properties

Color					
	Mean	Distribution	Std.Dev.	Rel. Min	Rel. Max
Normal Restitution	0.28	None			
Tangential Restitution	0.88	None			
Dynamic Friction	0.55	None			
Rolling Friction	0.1	None			
Slope Roughness Spacing	1.2	Normal	0.2	0.6	0.6
Slope Roughness Amplitude	0	Normal	0.2	0.6	0.6

"Cell 0001" Advanced Properties

Forest and Vegetation Damping	Disabled
Scarring	Disabled
Viscoplastic Damping	Disabled

Berm(s) Geometry

Berm 1

Assigned Berm Property: Default Berm		
Vertex	X	Y
1	363.274	2728.04
2	370.415	2733.04
3	377.556	2728.04
4	383.11	2724.15

Berm Properties

Default Berm

"Default Berm" Properties					
Berm Property		Calculate Impact			
	Mean	Distribution	Std.Dev.	Rel. Min	Rel. Max
Normal Restitution	0.1	None			
Tangential Restitution	0.85	None			
Dynamic Friction	0.5	None			
Rolling Friction	0.15	None			

Seeders

Seeder 1

Seeder Properties					
Name	Seeder 1				
Location	(0, 2887), (12.8278, 2884.08), (14.722, 2870.04)				
Rocks to Throw					
Number of Rocks	Set in Project Settings				
Rock Types	Circles,		Squares		
Initial Conditions					
	Mean	Distribution	Std.Dev.	Rel. Min	Rel. Max
Horizontal Velocity (ft/s)	1	None			
Vertical Velocity (ft/s)	-1	None			
Rotational Velocity (deg/s)	0	None			
Initial Rotation (deg/s)	0	Uniform		0	360

Rock Types

Circles

Properties					
Name	Circles				
Color					
Smooth Shapes	Sphere				
Polygons	None				
	Mean	Distribution	Std.Dev.	Rel. Min	Rel. Max
Mass (lbm)	5529	None			
Density (lbm/ft3)	165	None			

Squares

Properties					
Name	Squares				
Color					
Smooth Shapes	Square				
Polygons	None				
	Mean	Distribution	Std.Dev.	Rel. Min	Rel. Max
Mass (lbm)	8100	None			
Density (lbm/ft3)	168.56	None			

Collectors

Record paths' first impacts only?	No
Analysis Point 1	
Name	Analysis Point 1
Location	(1, 2876.57) to (1, 2927.57)

Summary Results

Run Properties

Simulation Time (s)	19.75		
Envelope data:			
	Max	Mean	95%
Envelope Bounce Height (ft)	14.99	14.18	14.78
Envelope Total Kinetic Energy (ft-lbf)	1.269e+05	7.004e+04	1.269e+05
Envelope Translational Kinetic Energy (ft-lbf)	9.801e+04	5.289e+04	9.801e+04
Envelope Rotational Kinetic Energy (ft-lbf)	3.222e+04	1.723e+04	3.222e+04
Envelope Translational Kinetic Velocity (ft/s)	32.13	21.64	32.13
Envelope Rotational Kinetic Velocity (rad/s)	13.26	9.401	13.26

Stopping Reason

CONTINUE	0
Invalid Start Location	0
Invalid Slope Geometry	0
Invalid bad crest loss definition	0
Invalid relative size between rock and slope	0
Max Steps	0
Edge Model	0
Stopped	1261
Stopped (wedged)	0
Stopped (chattering)	0
Hit Barrier	0
Hit Berm with infinite capacity	0
No collision found	0
Bad Collision Geometry (location before)	739
Rock is freefalling onto a spike or a trough	0
END_ERROR_UNKNOWN	0
END_ERROR_POSITIVE_GAP	0
Bad collision calculation	0
Bad Collision Geometry (0 intersection)	0
Bad Collision Geometry (location after)	0
Bad Collision Geometry (missing intersection)	0
Error during results reading	0
Total Rocks	2000

Collector(s) Impact Results

Berm(s) Impact Results

Berm 1			
Berm Name	Berm 1		
Hits	405 / 2000 rocks		
Impact Statistics			
Based on actual values for all impacted rocks.			
	Mean	Min	Max
Impact Along Height (ft)	0.63	0.21	1.29
Translational Velocity (ft/s)	3.47	1.04	6.21
Translation Energy (ft-lbf)	1133.86	92.15	3316.51

HS HD24-000001
@Home Best Western

EXHIBIT G

Drainage Control Plan



43 South 100 East, Suite 100 T 435.628.6500
St George, Utah 84770 F 435.628.6553

alphaengineering.com

February 7, 2024

St. George City
175 East 200 North
St. George, UT 84770

Re: @Home Best Western – Drainage Control Plan

To Whom It May Concern,

The proposed plans for the @Home Best Western located on 1470 East (Parcel SG-5-2-29-1205) includes the construction of one building with associated parking and landscaping on a vacant lot. To find preliminary conservative flow rates between the existing and proposed storm runoff for the Hillside Development Permit, the Rational Method was used as outlined in the St. George Drainage Manual. The Rational Formula is shown below:

$$Q = CIA$$

Where,

Q = Runoff volume, cubic feet per second (cfs)

C = Land use coefficient; Table 2-6 in the St. George City Drainage Manual

I = Rainfall intensity, in/hr; Interpolated from Table 2-1 in the St. George City Drainage Manual

A = Area, acres

The project consists of 2.43 acres. The flat portion of the site consists of Badland (Ba) soil with a hydrologic soil group of "D" while the slopes consist of Stony Colluvial Land (SY) with a hydrologic soil group of "D". The rainfall intensity was determined by taking the average of the 100-year, 3-hour storm (1.64 inches) over the storm duration.

The existing site contains 0.45 acres of Desert Shrub: < 30% Ground Cover and 1.98 acres of Bare Soil: Newly Graded Areas. This corresponds to land use coefficients of 0.20 and 0.50 for a weighted coefficient of 0.44. The runoff volume for the existing conditions is 0.6 cfs.

The proposed site will consist of business land cover with an assumed coefficient of 0.90. The estimated runoff for the proposed conditions is 1.2 cfs. Due to the anticipated increase in storm water runoff, detention will be required. A detailed Drainage Study will be provided with the construction drawings and will detail the size of the detention basin and will provide a more in-depth determination of storm water runoff.

If you have any questions concerning the above or need us to modify any of the information, please feel free to call.

Sincerely,

Rhett Beazer, P.E.
ALPHA ENGINEERING COMPANY

NOTICE OF MEETING
HILLSIDE REVIEW BOARD
CITY OF ST. GEORGE
WASHINGTON COUNTY, UTAH

Public Notice

Notice is hereby given that the Hillside Review Board of the City of St. George, Washington County, Utah, will hold meetings at the referenced site on **Wednesday, January 24, 2024**, commencing on-site at approximately 9:00 a.m.

PRESENT:

James Sullivan
Dave Black
Jeff Mathis
Russ Owens
Kevin Holyoak

EXCUSED:

CITY STAFF:

Assistant Public Works Director, Wes Jenkins
Planner III, Daniel Boles
Development Office Supervisor, Brenda Hatch

James Sullivan called the meeting to order.

1. Consider a request for a hillside development permit in the hillside overlay zone and in areas exceeding 20% slope for single- and two-family homes located at approximately 1923 South River Road (see map below). The property is approximately 9.49 acres.

Bob Hermandson – Based on the comments from the previous meeting the comments were to remove the hillside and basically make attached units throughout the project. The consensus in the meeting was to try to save the hillside and try to wrap units the best that we could around the project and essentially utilize all the disturbed area all around the project. We have gone back and done that and basically in all cases I am not really touching anything that is not already disturbed except for this slope right here. I have two tiered walls right here trying to tie into this grading and to try and make all of this work. Other than that and that is actually a little in the 20% and a very small portion of the 30%. We would be submitting in a PD scenario to get the same density as we could with the current R-1-10 zoning. We would have some frontage units that would be duplexes along some of the steeper slopes up where the existing homes are and then wrapping with the detached homes along the existing detached homes and that is really it. We are really staying almost entirely out of the hillside.

Wes Jenkins – So then the cul-de-sac is staying right here, is that what you are saying?

Bob Hermandson – Yes, it's pushed out a little bit further, it's below the houses, it's kind of in the intersection of those driveways where it goes up and then continues to that house.

That is so we can stay away from the existing non disturbed hillside. We have removed a couple of units on the other side. We have a long road wrapping around. That is one item that I'm not excited about, it's costly. I would like to propose with this basically a driveway with these four units and then build a trail that would be drivable in case of an emergency scenario that could connect back here and not do the road connection. That would be something I could work through with Wes maybe. I'm proposing an all-weather surface.

Wes Jenkins – This kind of becomes a flag lot, so you would only be allowed two units off of a stem there, that is your only challenge.

Bob Hermandson – Honestly I think we have mitigated all the comments from a Hillside standpoint.

James Sullivan – So there isn't another option to come up here?

Bob Hermandson – I guess I could, with the cul-de-sac.

James Sullivan – Would that be private or public?

Bob Hermandson – This would all be public and then that would be private because of the size.

Jeff Mathis – You would landscape, and rock cover the slopes, to maintain the slopes, right? That is probably just standard.

Bob Hermandson – Yeah, we would just blend right into that whole thing, I don't think that you would have to bring a lot in.

MOTION: Russ Owens made a motion that we approve the Chandler Heights development with the understanding that the access road whether that terminates into a turn around or goes all the way through will be dealt with through staff and the City depending on what type of emergency access as requirements are met, we reviewed the area, and it has been pretty well disturbed before and that the rock wall slopes be armored and colored the same as the existing slopes.

SECOND: Jeff Mathis

AYES (4)

Jeff Mathis

Russ Owens

James Sullivan

Kevin Holyoak

NAYS (0)

Motion carries

2. Consider a request for a hillside development permit in the hillside overlay zone and in areas exceeding 20% slope for an office, ropes course and restaurant pad at approximately 2000 South Riverside Drive (see map below). The property is just under 5 acres. **Meeting time is approximately 9:45 am, on the south-east side of Riverside Drive across from the Foremaster & Riverside Drives intersection.**

Eric McFadden – We brought this in previously we took your thoughts into consideration when we laid this out again and we think this is the best situation for what can happen on this hill. This hill has been sitting here for years. We are all in agreement that this portion is useless and ugly. The City as you can see is harvesting clay out of it as recently as last week. The construction with the new road here and the lots up above, you can see there has been some disturbance here that was not done by us. We have gone and staked out the line to show where the top of our slope would be. Our maximum cut is about 28 ft. The last meeting we had 2:1 now we have 3:1, and on the Riverside facing slope we are actually into a 5:1 slopes. We are trying to lay that back because we know it's nasty.

Wes Jenkins – So 2:1 is your steepest?

Eric McFadden – No, 3:1, it's right in this gulley right here to tie in and keep the drainage flowing properly.

Russ Owens – Does the 28 ft include the slope?

Eric McFadden – That includes the slope. So basically, we're going to come to this 2640 contour line around Riverside which is about the flat part above that backhoe and that hill will just basically get chopped straight off along Riverside. We will tuck a 2-story office building that sits in the middle of that knoll. Really the only 40% we are disturbing is stuff that has already been disturbed, minus this little bit of wash right here, which has also been disturbed, but we will be filling that area, not cutting that area. That is so we can keep the drainage coming off both hills. We have a drainage ditch at the bottom of everything to carry the water.

Russ Owens – So the backside of the building will be supporting, you won't have walls, it will support at the hill?

Eric McFadden – Yes, it will be a 2-story ground level walk out this way, ground level walk out on the top. There is a layout page. After we grade this slope, we are going to leave this native as much as possible in the ropes course. There will be minimal disturbance in this area. We will just have the posts in the ground for the ropes course. As you can see most of the areas we are disturbing are green and yellow, the red are obviously man made.

Wes Jenkins – I noticed that they did have a landslide and slope stability analysis over at Commerce Point, I don't know if they need that here?

Russ Owens – They will need some type of stability analysis as they do their walls. I noticed in the Geotech report they said that has to be done. At that point you will have to come in and say we analyzed the slopes here and we will have to design the walls accordingly.

Jeff Mathis – We shouldn't be destabilizing the big hill, with that hill being flattened out, it should be more stable.

Eric McFadden – I think the original discussion was that they were going to go down and remove all the soil and go down 17 ft. and build on good soil. We will also spray the cut

slope with the green foam for revegetation. We have a nice wide ditch 6 ft with a 3 ft landing and the owners will maintain it. It has over 1% so it should flow.

Wes Jenkins – What was the mitigation on your cuts?

Eric McFadden – We are going to hydroseed it or spray it with erosion protection.

James Sullivan – Is that the same for the slope along the road here?

Eric McFadden – We are kind of just cutting off what is there. If the City wants us to we can look at trying to put something on that face. It's going to go from a 40 ft cut down to 15 ft. Right now, you have a way worse situation. It will be about a 12 to 13 ft rise off of Riverside. That will give us a little protection from the public. There is natural drainage that comes down between these two, you can see it as you drive down. We will be installing a restroom and little equipment type room at the end of the parking lot. We will check that and try to mitigate that. I would like to keep it from eroding any further than it already has.

James Sullivan – Knowing it's a clay slope I'm thinking reseed it but chances are not much is going to take. As it comes down who maintains what hits the sidewalk?

Eric McFadden – They would have to, it's their property. We will improve Riverside Drive all the way to the end of here so it will be curb and gutter.

Russ Owens – Does the City require vegetation on this? Is that something they can waive so that you don't have all this water on the clay?

Wes Jenkins – Your challenge is that I don't know how you revegetate the clay.

Eric McFadden – We will have landscaping up around the top. There is about a 5 ft flat area around the parking area. Obviously all our water will be contained, and we won't have anything coming off the slopes.

Russ Owens – I'm just wondering if that can get waived.

Wes Jenkins – We require along Riverside to be landscaped. Are you going to require the 15 ft of landscape?

Jami Brackin – Yup.

Dan Boles – Yes, that is all part of the City code.

Eric McFadden – If we could show that we have that 15 ft within the site somewhere else I think it would be used better.

Jami Brackin – You are still going to have to do it.

Eric McFadden – I guess we will throw some gravel on it, there is no water. They're obviously not going to get street trees.

Dan Boles – We will have to talk about it, they are required.

Jami Brackin – They can be in pots.

Eric McFadden – Maybe that is something we can do in popouts on the sidewalk.

Russ Owens – I think something will be built here eventually and this is probably the best option.

MOTION: Jeff Mathis made a motion to recommend approval to Planning Commission and City Council based on this submittal River Knoll project based on what they have given us for their slope maps the limits of excavation line and the grading as presented there are approximately 2 or 3 areas around this existing little knoll and around the edge that are over 40% that we are recommending that they are non-contiguous or man-made disturbed and that those can be disturbed as shown on the plan, all other comments obviously though engineering and planning and zoning will have to be addressed.

Russ Owens – Once they get the final grading a slope stability analysis needs to be done specifically for the walls on the building but also back here on some of the cuts to make sure everything is good when they put in the rock walls.

Jeff Mathis – I amend my motion as per Russ' comments.

SECOND: Kevin Holyoak

AYES (4)

Jeff Mathis

Russ Owens

James Sullivan

Kevin Holyoak

NAYS (0)

Motion carries

3. Consider a request for a hillside development permit in the hillside overlay zone and in areas exceeding 20% slope for a City Trail at approximately 1450 East 900 South. The property is 12.61 acres. **Meeting time is approximately 10:15 am, on the corner of 900 South and 1450 East.**

Phil Giles – We want to stay out of the flood plain.

Jeff Mathis – I saw you had a fill line pretty much all the way around, so there is really no cut line anywhere?

Phil Giles – Not really, I tried to match this with the cut on the uphill side. We have Alpha Engineering helping us with the flood plain.

James Sullivan – So are we sticking with the elevation that we are at?

Phil Giles – Yes, we're staying where it is disturbed.

Wes Jenkins – So you'll just slope it on that side?

Jeff Mathis – Will these fill slopes be rock lined?

Phil Giles – I don't know why you would want to rock line them.

Jeff Mathis – I guess if you hydroseed it.

Discussion on the fill slope and if it should be hydroseed or rock lined.

Jeff Mathis – The paint was on the rock where the boulders were back there, and we would want to keep those larger boulders.

MOTION: Jeff Mathis made a motion to recommend approval for the trail alignment as presented today with a couple concerns we have one rock outcropping, we want to maintain that natural feature, the fill slopes that go down we recommend verifying there are no flood plain issues and then the slopes be stabilized with seeding or if it is steeper than 3:1 maybe rocks or something like that. There are minimal spots over 30% that are non-contiguous that will not have an affect on the site that can be disturbed.

SECOND: Kevin Holyoak

AYES (3)

Jeff Mathis

James Sullivan

Kevin Holyoak

NAYS (0)

Motion carries

4. Approval of the meeting minutes from November 1, 2023, and the December 6, 2023, meeting.

MOTION: Jeff Mathis made a motion to recommend approval of the minutes for November and December as written.

SECOND: Kevin Holyoak

AYES (3)

Jeff Mathis

James Sullivan

Kevin Holyoak

NAYS (0)

Motion carries

James Sullivan moved to Adjourn.