

**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 a meeting at the referenced site on **Wednesday, November 20, 2024**, commencing on-site at 8:30 a.m.

The agenda for the meeting is as follows:

Call to Order

Discuss conflicts of interest and recusals

- 1. Consider a request for a Hillside Development Permit to allow disturbance of areas in the 20-30%, 30-40% and 40%+ slope areas and review possible construction in a rockfall hazard overlay area. The applicant is Bush and Gudge, and the representative is Rick Meyer. Case No. 2024-HS-0004.**

BACKGROUND AND RECOMMENDATION: This is a request to obtain a hillside permit for the property located at Canyon View Dr and Ostler Way. The applicants are proposing to build a new apartment development on this property. This property is in the hillside overlay. **Meeting time is approximately 9:00 am at Canyon View Dr. and Ostler Way.**

- 2. Consider a request for a Hillside Development Permit to allow the applicant to cut into the (20-40%+) hillside for access to a proposed townhome development. The hillside cut would also allow construction of the northern portion of the townhome site. The applicant has provided a slope analysis, proposed drainage report and site layout for consideration. The applicant is Premier Design & Engineering Inc., and the representative is Eric Mcfadden. Case No. 2024-HS-014.**

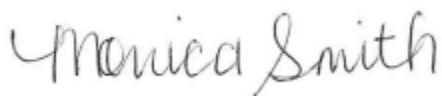
BACKGROUND AND RECOMMENDATION: The northern portion of the property has slopes that are in the 20-40%+ range. When Riverside Drive was constructed in approximately 2005 some of those slopes were disturbed to make room for the road. The Willow Bend Townhomes project was previously approved by the City Council in April 2021. The previous approvals have expired so the project is being re-processed. **Meeting time is approximately 10:00 am at Riverside Dr. between Judy Lane and Tagans Way.**

- 3. Consider a request for a Hillside Development Permit to adjust the location of the ridgeline and ridgeline setback on lot 44 of the Foremaster Ridge subdivision in anticipation of the construction of a residential home. The applicant is Jack de Ryk/Floyd Jackson. Case No. 2024-HS-010.**

BACKGROUND AND RECOMMENDATION: This is a request to obtain a hillside permit for the property located at 1856 E. Joe Cir (Lot 44, Foremaster Ridge). This location is a residential neighborhood, and the applicant would like to build a house on this lot. The rear of the applicant's property abuts the ridge line of Foremaster Ridge. The applicant is requesting to review the location of the 30-foot ridgeline setback as shown on the final plat for Foremaster Ridge lot 44 and establish a ridgeline which the applicant feels is more indicative of the actual ridgeline. This application came before Planning Commission once before on August 27, 2024, at which time the Planning Commission recommended that the City Council approve the ridgeline as proposed by the Hillside Review Board. On October 23, 2024, the Hillside Review Board (HSRB) reviewed the application again and recommended the same coordinates for the ridgeline. The applicant would like the chance to present additional information to the HSRB. **Meeting time is approximately 11:00 am at 1856 E. Joe Cir.**

- 4. Minutes**

Consider a request to approve the meeting minutes from the October 23, 2024, meeting.



Monica Smith – Development Office Supervisor

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
Canyon View Dr and Ostler Way



Item #2 Meeting Location
East of Riverside Dr. between Judy Ln and Tagans Way



Item # 3 Meeting Location

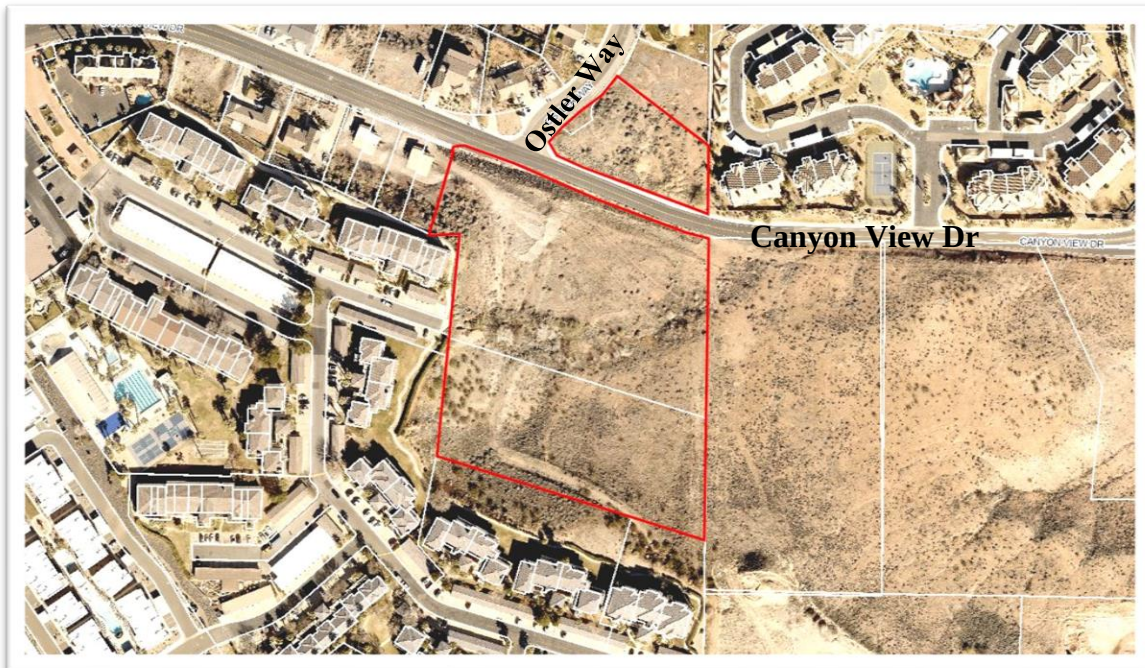
1856 E Joe Cir.



HILLSIDE REVIEW BOARD AGENDA REPORT:

**Hillside Permit
11/20/2024**

Canyon View Apartments Hillside Development Permit (Case No. 2024-HS-004)		
Request:	A Hillside Development Permit to allow disturbance of areas in the 20-30%, 30-40% and 40%+ slope areas and review possible construction in a rockfall hazard overlay area.	
Applicant:	Bush and Gudgell, Inc.	
Representative:	Rick Myer	
Location:	Canyon View Dr and Ostler Way	
General Plan:	HDR (High Density Residential)	
Existing Zoning:	R-3 (Multi-Family Residential)	
Surrounding Zoning:	North	R-1-10 (Single Family Residential, 10,000 ft² lots)
	South	PD-R (Planned Development Residential)
	East	PD-R (Planned Development Residential)
	West	PD-R (Planned Development Residential)
Land Area:	Approximately 7.51 acres	



BACKGROUND

This is a request to obtain a hillside permit for the property located at Canyon View Dr and Ostler Way. The applicants are proposing to build a new apartment development on this property. This property is in the hillside overlay. Section 10-13A-3 of the Zoning Regulations requires that all development on slopes above 20% requires a 'hillside development permit' granted by the City Council upon recommendation from the Hillside Review Board and the Planning Commission.

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

Exhibit A – Slope Analysis Map

Exhibit B – Cut Fill Heat Map

Exhibit C – Preliminary Drainage Study

Exhibit D – Grading Plan

Exhibit E – Site Plan

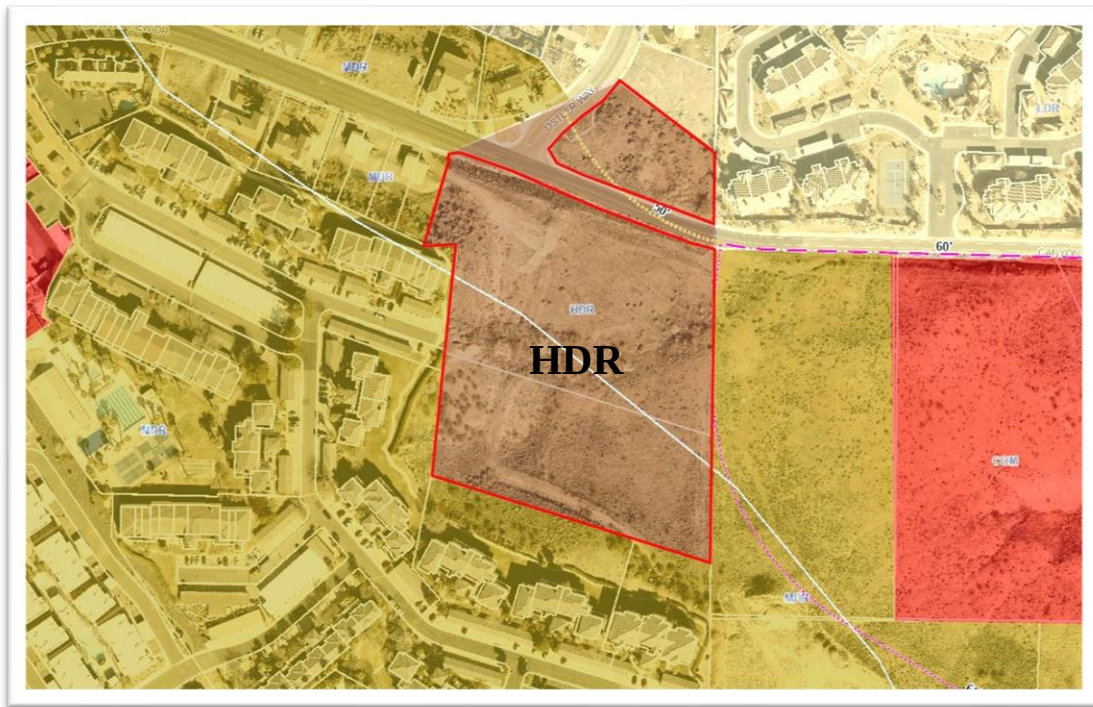
Exhibit F – Landscape Plan

Exhibit G – Geotechnical Investigation

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 – HDR– (High Density Residential)



Zoning –R-3 (Planned Development Residential)

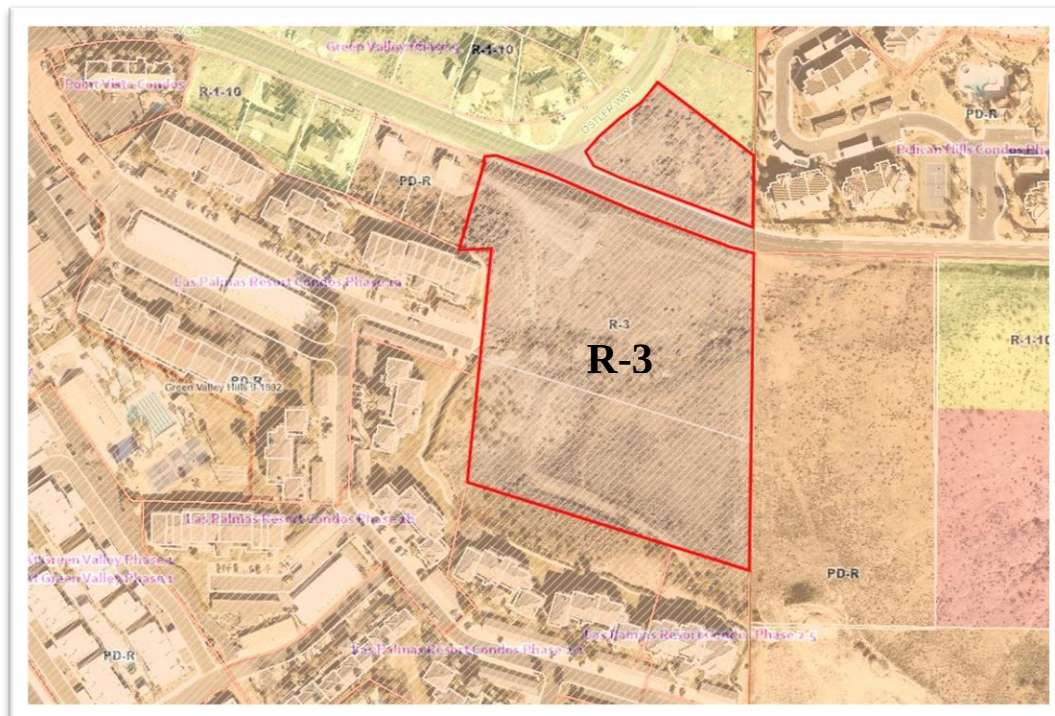
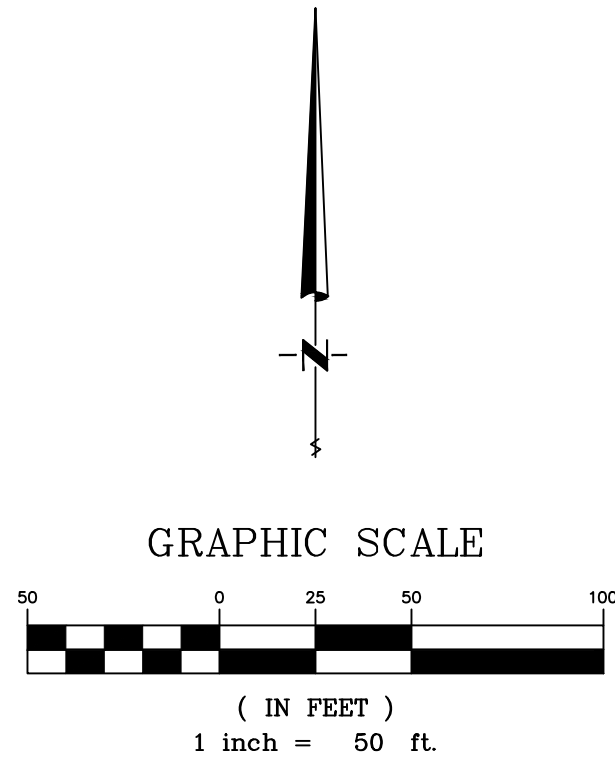


Exhibit A
Slope Analysis Map



SURFACE SLOPE DATA				
NUMBER	MINIMUM SLOPE	MAXIMUM SLOPE	COLOR	AREA, AC
1	20.000%	29.999%	Green	1.20
2	30.000%	39.999%	Yellow	0.64
3	40.000%	7944.292%	Red	0.32

TOTAL AREA: 7.51 ACRES
DEVELOPABLE AREA: 5.74 ACRES

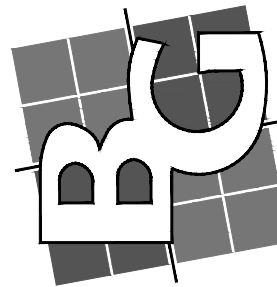
OWNER / DEVELOPER
SHAKESPEARE DEVELOPMENT GROUP

BEN SHAKESPEARE
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ST GEORGE, UTAH 84770

ENGINEERING CONTACT
BUSH AND GUDGELL, INC.
205 EAST TABERNACLE #4
ST GEORGE, UT 84770

RICK MEYER - PROJECT MANAGER
(435)-673-2337

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St. George, Utah 84770
Phone (435) 673-2337 / Fax (435) 673-3161
www.bushandgudgell.com



DATE: JAN 2024
DRAWN: RM
APPROVED:
SCALE: NOTED
JOB NO. 221018

HILLSIDE MAP
CANYON VIEW APARTMENTS
ST GEORGE, UTAH

SHEET 1 OF 2 SHEETS
FILE:

Preliminary.
For Review Only.
Not For
Construction.



GRADING NOTES

APPROXIMATELY 57,511 CU.YD. OF CUT, 6,246 CU.YD. OF FILL AND 51,265 CU.YD. OF EXPORT MATERIAL IS REQUIRED (FOR GRADING PERMIT ONLY). THE CONTRACTOR SHOULD VERIFY THE QUANTITIES FOR COMPLETION OF WORK. QUANTITIES ARE BASED ON FINISH GRADE OF ROADS & PADS.

ALL IMPORTED STRUCTURAL FILL SHALL BE APPROVED BY THE GEOTECHNICAL ENGINEER PRIOR TO DELIVERY TO THE SITE. ALL IMPORTED STRUCTURAL FILL SHALL BE PLACED IN 8-INCH LOOSE HORIZONTAL LIFTS AND COMPACTED TO A MINIMUM OF 95 PERCENT OF MAXIMUM DRY DENSITY (ASTM D-1557).

ALL EXCAVATION, GRADING AND FILL OPERATIONS WITHIN THE BUILDING AREA SHOULD BE OBSERVED BY THE GEOTECHNICAL ENGINEER TO VERIFY SUB-SOIL CONDITIONS AND DETERMINE ADEQUACY OF SITE PREPARATION, SUITABILITY OF FILL MATERIALS AND COMPLIANCE WITH COMPACTION REQUIREMENTS.

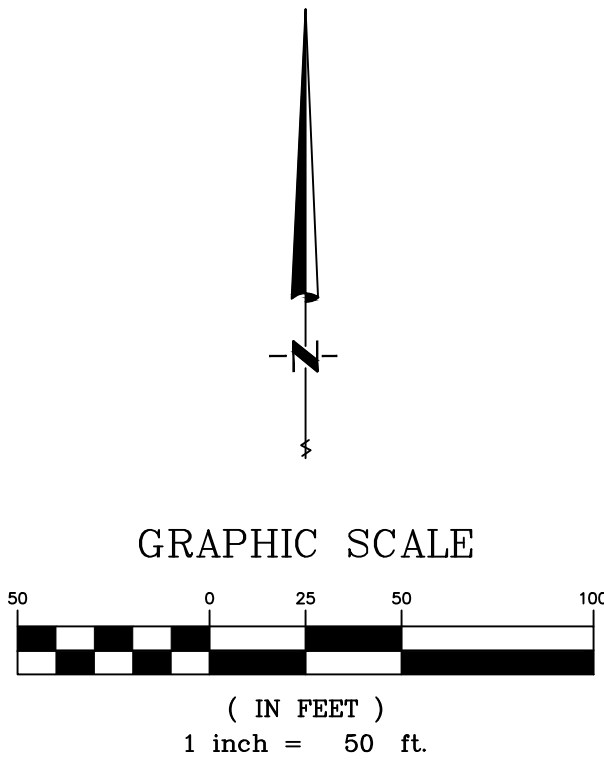
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ALL EXCAVATION AND GRADING SHALL BE IN ACCORDANCE WITH THE REQUIREMENTS OF ST. GEORGE CITY AND APPENDIX J OF THE INTERNATIONAL BUILDING CODE, 2018 EDITION, AND THE SPECIFICATIONS AND REQUIREMENTS INCLUDED IN THE GEOTECHNICAL STUDY.

GEOTECHNICAL ENGINEER TO PROVIDE GRADING COMPLETION REPORT TO CONFIRM WORK HAS BEEN PERFORMED IN CONFORMANCE WITH THEIR RECOMMENDATIONS.

OWNER IS RESPONSIBLE FOR ALL ON-SITE DRAINAGE AND DETENTION.

- LEGEND**
- EXISTING GROUND CONTOUR
 - FINISH GROUND CONTOUR
 - LOT LINE
 - RETAINING WALL
 - LANDSCAPE DRAINAGE SWALE
 - PAD: 00.00
PAD ELEVATION IN FEET
 - TW: 00.00
TOP OF WALL ELEVATION IN FEET
 - BW: 00.00
BOTTOM OF EXPOSED WALL ELEVATION IN FEET
 - FL: 00.00
FLOW LINE
 - TC: 00.00
TC = TOP OF CONCRETE
 - TBC: 00.00
TBC = TOP BACK OF CURB
 - SLOPE IN RUN:RISE
 - 2650
CONTOUR ELEVATION IN FEET



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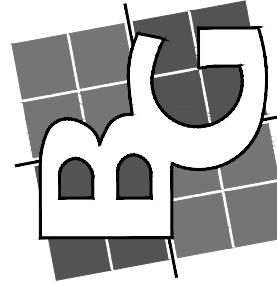
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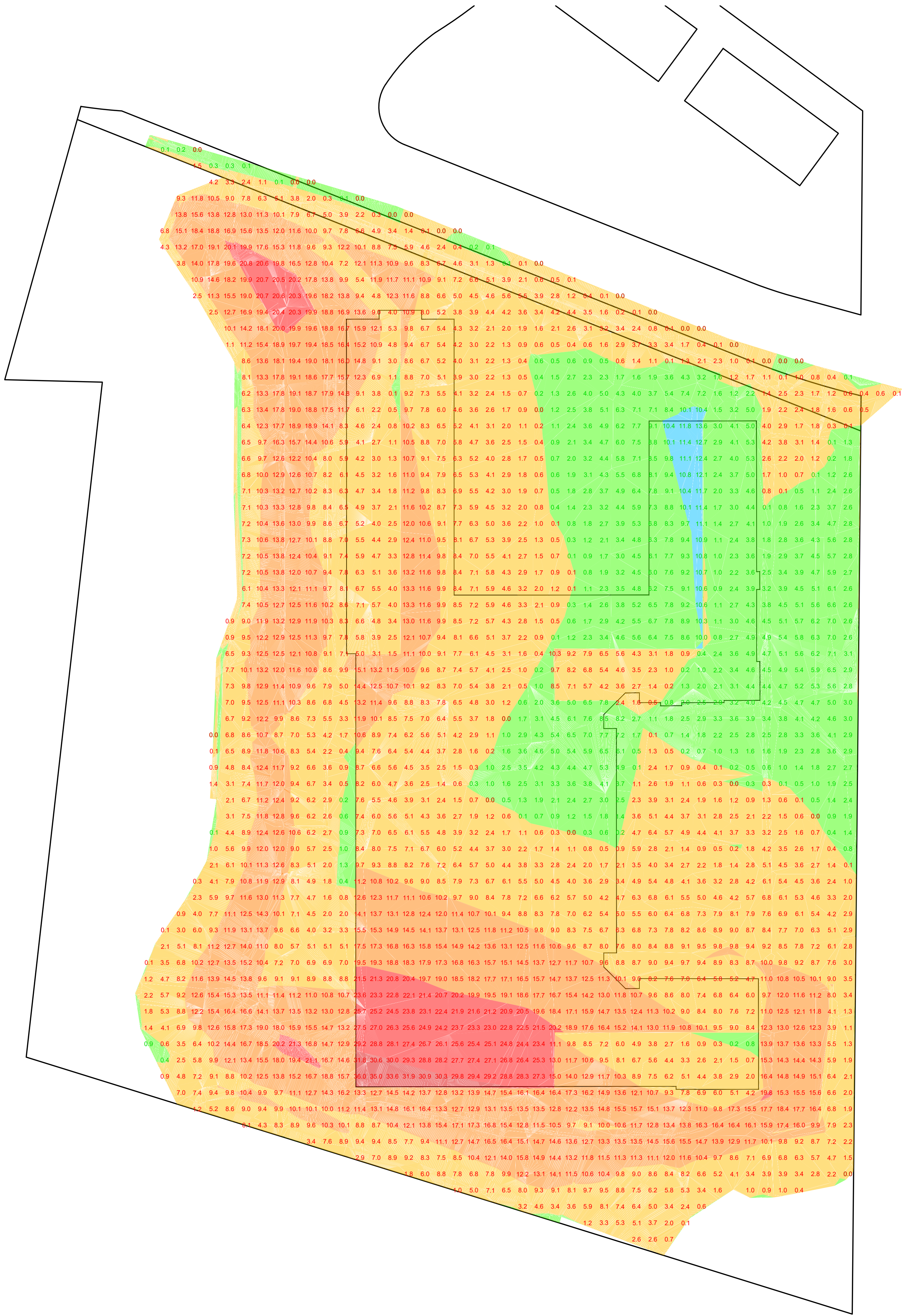


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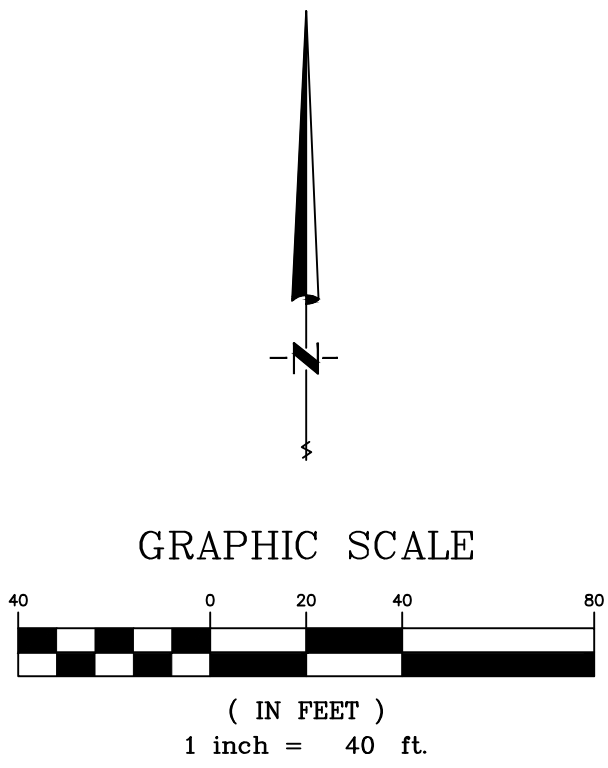
GRADING PLAN
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SHEET 2 OF 2 SHEETS
FILE:

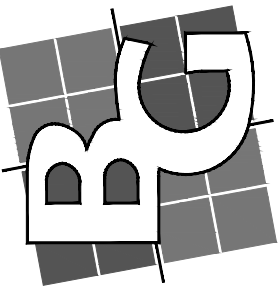
Exhibit B
Cut Fill Heat Map



Elevations Table				
Number	Minimum Elevation	Maximum Elevation	Area	Color
1	-40.00	-30.00	960.11	
2	-30.00	-20.00	7872.09	
3	-20.00	-10.00	57106.30	
4	-10.00	0.00	114449.82	
5	0.00	10.00	48668.92	
6	10.00	20.00	1550.60	



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CUT FILL HEAT MAP
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Exhibit C
Preliminary Drainage Study

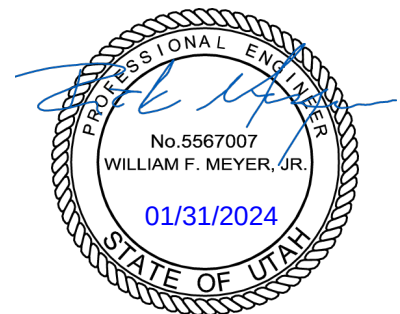
PRELIMINARY DRAINAGE STUDY
FOR
Canyon View Apartments
A Residential Development located in
St George, Utah



PREPARED BY: **Bush & Gudgell Engineering**



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Project Engineer

Rick Meyer, P.E.

Date

January 31, 2024

Job Number

B&G #221249

I. INTRODUCTION

The subject property is located in St George, Utah. Access to the property is granted from Canyon View Drive. The project site is located south of the intersection with Ostler Way. It is on parcels SG-6-2-35-433 and SG-6-2-35-3009.

The project is located within the northwest quarter of Section 35, Township 42 South, Range 16 West, Salt Lake Base and Meridian. The land is currently zoned R-3.

The purpose of the project is to grade and develop approximately 5.45 acres of the 6.56 acres of the parcels. See site plan in appendix. There is approximately 9.28 acres of offsite land that releases stormwater onto the property. The purpose of this study is to determine the magnitude of expected runoff and how to handle the water to avoid flooding or property damage.

In summary, the expected runoff through the site during the 100-year storm event is 15.56 cfs. There are several locations where this water will be released. Ultimately it will end up in Canyon View Drive after being detained. The detention system will be underground on the site. This will help prevent flooding downstream of the project.

In addition to the detention system, drainage swales will be constructed throughout the site to direct runoff where it needs to go. Dimensions of these swales vary by location. A map in the appendix shows the locations and dimensions of the swales.

II. METHODOLOGY

Software

Autodesk Storm and Sanitary Analysis (SSA) software was used to calculate runoff rates and volumes for the site. SSA uses the TR-55 method to calculate stormwater runoff. TR-55 uses rainfall rate, curve number, time of concentration, and area as inputs.

Model Setup

The rainfall rates were taken from the *City of St George Drainage Manual*. The 3-hour Farmer-Fletcher and 24-hour SCS Type II rainfall distributions were used for the three design storms used. The table below shows the rainfall intensities used in the model.

Design Rainfall Depths, inches	
10-year 3-hour	1.00
100-year 3-hour	1.64
100-year 24-hour	2.51

Curve number for the site is taken from a land use table that includes hydrologic soil group as a variable. A web soil survey was conducted to estimate the hydrologic soil group. The entire site is soil group D.

Terrain slopes and Manning's roughness was used in SSA to calculate time of concentration.

III. RESULTS

The SSA model was run three times for the three rainfall rates (see above). Results can be seen in the table below. These are total post-development runoff rates before detention.

SSA Model Results		
Storm I.D.	Peak Flow, cfs	Total Runoff, cu ft
10-year 3-hour	5.81	22,122
100-year 3-hour	15.56	49,709
100-year 24-hour	20.46	92,142

Detention for the site will be calculated at a later time.

IV. CONCLUSION

Contributing area of this site is approximately 16 acres, including 9 acres from offsite and 7 acres onsite. This area has a potential for stormwater runoff, which will cause flooding and/or erosion if not properly handled. Three design storms were analyzed and drainage swales were designed to safely convey water through the site. The final site design will include underground detention east and west of the proposed building.

IV. APPENDICES

- A. Site Plan
- B. SSA Model Schematic
- C. SSA Model Hydrographs and Reports
- D. Drainage Channel Calculations and Details

Appendix A - Site Plan



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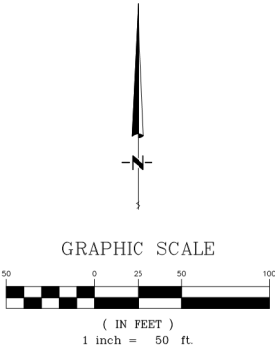
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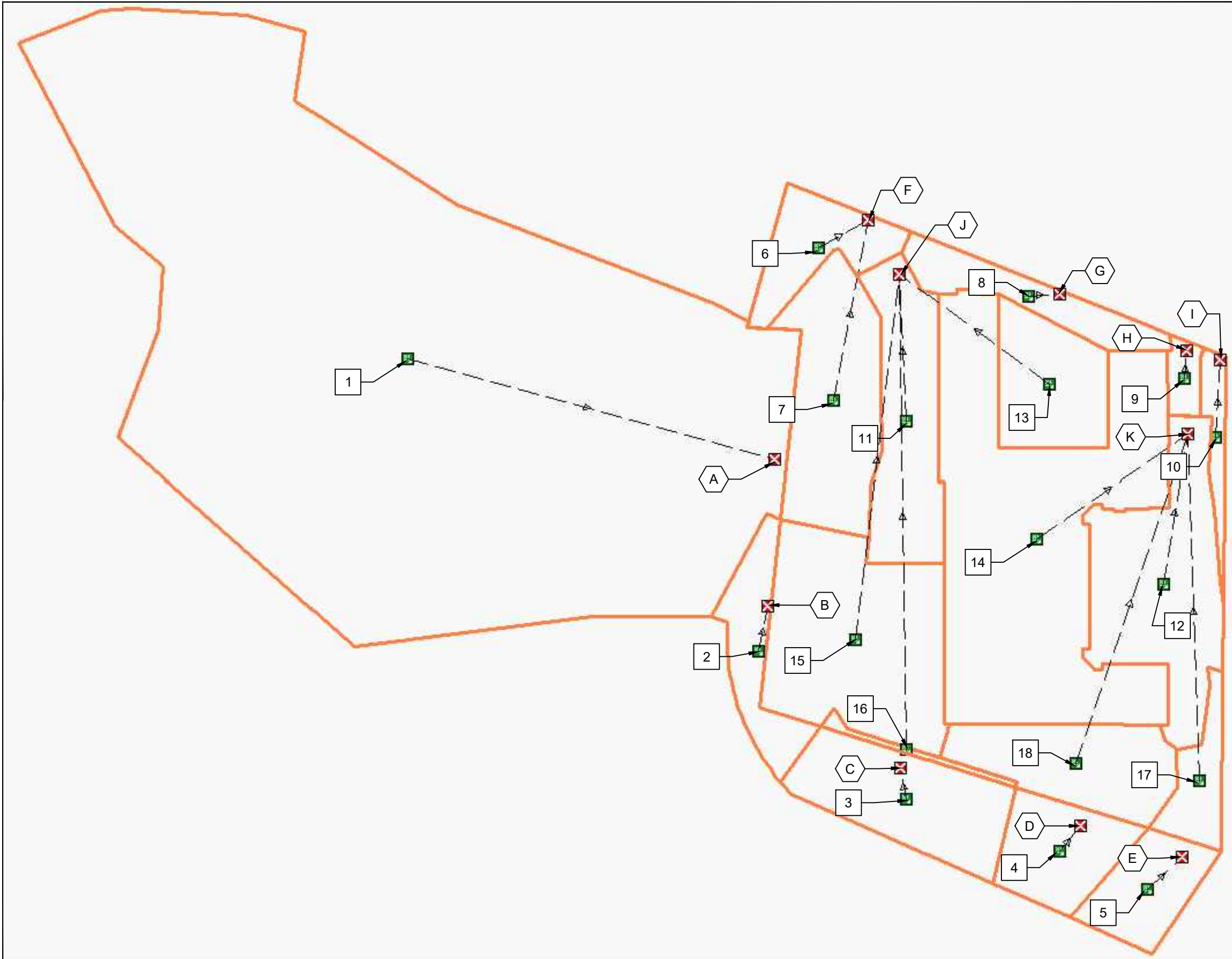
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GRADING PLAN
CANYON VIEW APARTMENTS
ST GEORGE, UTAH

Appendix B – SSA Model Schematic



BASIN NAMES

1	BAS_OFF_LAS_PALMAS
2	BAS_OFF_01
3	BAS_OFF_02
4	BAS_OFF_03
5	BAS_OFF_04
6	BAS_BP_01
7	BAS_BP_02
8	BAS_BP_03
9	BAS_BP_04
10	BAS_BP_05
11	BAS_DRIVE_WEST
12	BAS_DRIVE_EAST
13	BAS_POOL
14	BAS_BLDG
15	BAS_LS_W_01
16	BAS_LS_W_02
17	BAS_LS_E_01
18	BAS_LS_E_02

OUTFALL NAMES

A	OUT_OFF_LAS_PALMAS
B	OUT_OFF_01
C	OUT_OFF_02
D	OUT_OFF_03
E	OUT_OFF_04
F	OUT_BP_1-2
G	OUT_BP_03
H	OUT_BP_04
I	OUT_BP_05
J	OUT_DRIVE_WEST
K	OUT_DRIVE_EAST

SSA MODEL SCHEMATIC
CANYON VIEW APARTMENTS
ST GEORGE, UTAH



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Appendix C – SSA Model Hydrographs and Reports

Subbasin Hydrology

Subbasin : BAS_BLDG

Input Data

Area (ac) 1.80
Peak Rate Factor 0.00
Weighted Curve Number 98.00
Rain Gage ID STGEORGE

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Paved parking & roofs	1.80	D	98.00
Composite Area & Weighted CN	1.80		98.00

Time of Concentration

TOC Method : SCS TR-55

Sheet Flow Equation :

$T_c = (0.007 * ((n * L_f)^{0.8})) / ((P^{0.5}) * (S_f^{0.4}))$

Where :

Tc = Time of Concentration (hr)
n = Manning's roughness
Lf = Flow Length (ft)
P = 2 yr, 24 hr Rainfall (inches)
Sf = Slope (ft/ft)

Shallow Concentrated Flow Equation :

V = 16.1345 * (Sf^0.5) (unpaved surface)
V = 20.3282 * (Sf^0.5) (paved surface)
V = 15.0 * (Sf^0.5) (grassed waterway surface)
V = 10.0 * (Sf^0.5) (nearly bare & untilled surface)
V = 9.0 * (Sf^0.5) (cultivated straight rows surface)
V = 7.0 * (Sf^0.5) (short grass pasture surface)
V = 5.0 * (Sf^0.5) (woodland surface)
V = 2.5 * (Sf^0.5) (forest w/heavy litter surface)
Tc = (Lf / V) / (3600 sec/hr)

Where:

Tc = Time of Concentration (hr)
Lf = Flow Length (ft)
V = Velocity (ft/sec)
Sf = Slope (ft/ft)

Channel Flow Equation :

V = (1.49 * (R^(2/3)) * (Sf^0.5)) / n
R = Aq / Wp
Tc = (Lf / V) / (3600 sec/hr)

Where :

Tc = Time of Concentration (hr)
Lf = Flow Length (ft)
R = Hydraulic Radius (ft)
Aq = Flow Area (ft^2)
Wp = Wetted Perimeter (ft)
V = Velocity (ft/sec)
Sf = Slope (ft/ft)
n = Manning's roughness

	Subarea	Subarea	Subarea
	A	B	C
Sheet Flow Computations			
Manning's Roughness :	.2	0.00	0.00
Flow Length (ft) :	150	0.00	0.00
Slope (%) :	.5	0.00	0.00
2 yr, 24 hr Rainfall (in) :	1.1	0.00	0.00
Velocity (ft/sec) :	0.05	0.00	0.00
Computed Flow Time (min) :	50.66	0.00	0.00
Channel Flow Computations			
Manning's Roughness :	.01	0.00	0.00
Flow Length (ft) :	400	0.00	0.00
Channel Slope (%) :	.5	0.00	0.00
Cross Section Area (ft²) :	1	0.00	0.00
Wetted Perimeter (ft) :	2	0.00	0.00
Velocity (ft/sec) :	6.64	0.00	0.00
Computed Flow Time (min) :	1.00	0.00	0.00
Total TOC (min)	51.66		

Subbasin Runoff Results

Total Rainfall (in)	1.64
Total Runoff (in)	1.42
Peak Runoff (cfs)	2.56
Weighted Curve Number	98.00
Time of Concentration (days hh:mm:ss)	0 00:51:40

Subbasin : BAS_BP_01**Input Data**

Area (ac) 0.28
 Peak Rate Factor 0.00
 Weighted Curve Number 89.34
 Rain Gage ID STGEORGE

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Paved parking & roofs	0.04	D	98.00
Natural western desert	0.24	D	88.00
Composite Area & Weighted CN	0.28		89.34

Time of Concentration

	Subarea A	Subarea B	Subarea C
Sheet Flow Computations			
Manning's Roughness :	.35	0.00	0.00
Flow Length (ft) :	50	0.00	0.00
Slope (%) :	30	0.00	0.00
2 yr, 24 hr Rainfall (in) :	1.1	0.00	0.00
Velocity (ft/sec) :	0.13	0.00	0.00
Computed Flow Time (min) :	6.40	0.00	0.00
Shallow Concentrated Flow Computations			
Flow Length (ft) :	125	0.00	0.00
Slope (%) :	30	0.00	0.00
Surface Type :	Unpaved	Unpaved	Unpaved
Velocity (ft/sec) :	8.84	0.00	0.00
Computed Flow Time (min) :	0.24	0.00	0.00
Total TOC (min)	6.64		

Subbasin Runoff Results

Total Rainfall (in) 1.64
 Total Runoff (in) 0.76
 Peak Runoff (cfs) 0.41
 Weighted Curve Number 89.34
 Time of Concentration (days hh:mm:ss) 0 00:06:38

Subbasin : BAS_BP_02**Input Data**

Area (ac) 0.62
 Peak Rate Factor 0.00
 Weighted Curve Number 88.00
 Rain Gage ID STGEORGE

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Natural western desert	0.62	D	88.00
Composite Area & Weighted CN	0.62		88.00

Time of Concentration

	Subarea A	Subarea B	Subarea C
Sheet Flow Computations			
Manning's Roughness :	.35	0.00	0.00
Flow Length (ft) :	100	0.00	0.00
Slope (%) :	30	0.00	0.00
2 yr, 24 hr Rainfall (in) :	1.1	0.00	0.00
Velocity (ft/sec) :	0.15	0.00	0.00
Computed Flow Time (min) :	11.14	0.00	0.00
Channel Flow Computations			
Manning's Roughness :	.055	0.00	0.00
Flow Length (ft) :	320	0.00	0.00
Channel Slope (%) :	.5	0.00	0.00
Cross Section Area (ft ²) :	1	0.00	0.00
Wetted Perimeter (ft) :	5	0.00	0.00
Velocity (ft/sec) :	0.66	0.00	0.00
Computed Flow Time (min) :	8.14	0.00	0.00
Total TOC (min)	19.28		

Subbasin Runoff Results

Total Rainfall (in) 1.64
 Total Runoff (in) 0.68
 Peak Runoff (cfs) 0.67
 Weighted Curve Number 88.00
 Time of Concentration (days hh:mm:ss) 0 00:19:17

Subbasin : BAS_BP_03**Input Data**

Area (ac) 0.26
 Peak Rate Factor 0.00
 Weighted Curve Number 88.00
 Rain Gage ID STGEORGE

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Natural western desert	0.26	D	88.00
Composite Area & Weighted CN	0.26		88.00

Time of Concentration

	Subarea A	Subarea B	Subarea C
Sheet Flow Computations			
Manning's Roughness :	.35	0.00	0.00
Flow Length (ft) :	50	0.00	0.00
Slope (%) :	30	0.00	0.00
2 yr, 24 hr Rainfall (in) :	1.1	0.00	0.00
Velocity (ft/sec) :	0.13	0.00	0.00
Computed Flow Time (min) :	6.40	0.00	0.00
Channel Flow Computations			
Manning's Roughness :	.015	0.00	0.00
Flow Length (ft) :	300	0.00	0.00
Channel Slope (%) :	8	0.00	0.00
Cross Section Area (ft ²) :	.5	0.00	0.00
Wetted Perimeter (ft) :	2	0.00	0.00
Velocity (ft/sec) :	11.15	0.00	0.00
Computed Flow Time (min) :	0.45	0.00	0.00
Total TOC (min)	6.85		

Subbasin Runoff Results

Total Rainfall (in) 1.64
 Total Runoff (in) 0.68
 Peak Runoff (cfs) 0.35
 Weighted Curve Number 88.00
 Time of Concentration (days hh:mm:ss) 0 00:06:51

Subbasin : BAS_BP_04**Input Data**

Area (ac) 0.07
 Peak Rate Factor 0.00
 Weighted Curve Number 98.00
 Rain Gage ID STGEORGE

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Paved parking & roofs	0.07	D	98.00
Composite Area & Weighted CN	0.07		98.00

Time of Concentration

	Subarea A	Subarea B	Subarea C
Sheet Flow Computations			
Manning's Roughness :	.02	0.00	0.00
Flow Length (ft) :	80	0.00	0.00
Slope (%) :	10	0.00	0.00
2 yr, 24 hr Rainfall (in) :	1.1	0.00	0.00
Velocity (ft/sec) :	0.91	0.00	0.00
Computed Flow Time (min) :	1.47	0.00	0.00
Total TOC (min)	1.47		

Subbasin Runoff Results

Total Rainfall (in) 1.64
 Total Runoff (in) 1.42
 Peak Runoff (cfs) 0.23
 Weighted Curve Number 98.00
 Time of Concentration (days hh:mm:ss) 0 00:01:28

Subbasin : BAS_BP_05**Input Data**

Area (ac) 0.09
 Peak Rate Factor 0.00
 Weighted Curve Number 88.00
 Rain Gage ID STGEORGE

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Natural western desert	0.09	D	88.00
Composite Area & Weighted CN	0.09		88.00

Time of Concentration

	Subarea A	Subarea B	Subarea C
Sheet Flow Computations			
Manning's Roughness :	.35	0.00	0.00
Flow Length (ft) :	30	0.00	0.00
Slope (%) :	20	0.00	0.00
2 yr, 24 hr Rainfall (in) :	1.1	0.00	0.00
Velocity (ft/sec) :	0.10	0.00	0.00
Computed Flow Time (min) :	5.00	0.00	0.00
Shallow Concentrated Flow Computations			
Flow Length (ft) :	200	0.00	0.00
Slope (%) :	5	0.00	0.00
Surface Type :	Unpaved	Unpaved	Unpaved
Velocity (ft/sec) :	3.61	0.00	0.00
Computed Flow Time (min) :	0.92	0.00	0.00
Total TOC (min)	5.92		

Subbasin Runoff Results

Total Rainfall (in) 1.64
 Total Runoff (in) 0.68
 Peak Runoff (cfs) 0.13
 Weighted Curve Number 88.00
 Time of Concentration (days hh:mm:ss) 0 00:05:55

Subbasin : BAS_DRIVE_E**Input Data**

Area (ac) 0.77
 Peak Rate Factor 0.00
 Weighted Curve Number 91.60
 Rain Gage ID STGEORGE

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Paved parking & roofs	0.50	D	98.00
> 75% grass cover, Good	0.27	D	80.00
Composite Area & Weighted CN	0.77		91.60

Time of Concentration

	Subarea A	Subarea B	Subarea C
Sheet Flow Computations			
Manning's Roughness :	.2	0.00	0.00
Flow Length (ft) :	40	0.00	0.00
Slope (%) :	2	0.00	0.00
2 yr, 24 hr Rainfall (in) :	1.1	0.00	0.00
Velocity (ft/sec) :	0.07	0.00	0.00
Computed Flow Time (min) :	10.11	0.00	0.00

	Subarea A	Subarea B	Subarea C
Channel Flow Computations			
Manning's Roughness :	.015	0.00	0.00
Flow Length (ft) :	335	0.00	0.00
Channel Slope (%) :	2	0.00	0.00
Cross Section Area (ft ²) :	1	0.00	0.00
Wetted Perimeter (ft) :	5	0.00	0.00
Velocity (ft/sec) :	4.80	0.00	0.00
Computed Flow Time (min) :	1.16	0.00	0.00
Total TOC (min)11.27			

Subbasin Runoff Results

Total Rainfall (in) 1.64
 Total Runoff (in) 0.89
 Peak Runoff (cfs) 1.36
 Weighted Curve Number 91.60
 Time of Concentration (days hh:mm:ss) 0 00:11:16

Subbasin : BAS_DRIVE_WEST**Input Data**

Area (ac) 0.52
 Peak Rate Factor 0.00
 Weighted Curve Number 89.16
 Rain Gage ID STGEORGE

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Paved parking & roofs	0.26	D	98.00
> 75% grass cover, Good	0.26	D	80.00
Composite Area & Weighted CN	0.52		89.16

Time of Concentration

	Subarea A	Subarea B	Subarea C
Sheet Flow Computations			
Manning's Roughness :	.2	0.00	0.00
Flow Length (ft) :	50	0.00	0.00
Slope (%) :	2	0.00	0.00
2 yr, 24 hr Rainfall (in) :	1.1	0.00	0.00
Velocity (ft/sec) :	0.07	0.00	0.00
Computed Flow Time (min) :	12.08	0.00	0.00

	Subarea A	Subarea B	Subarea C
Channel Flow Computations			
Manning's Roughness :	.015	0.00	0.00
Flow Length (ft) :	325	0.00	0.00
Channel Slope (%) :	1	0.00	0.00
Cross Section Area (ft ²) :	1	0.00	0.00
Wetted Perimeter (ft) :	5	0.00	0.00
Velocity (ft/sec) :	3.40	0.00	0.00
Computed Flow Time (min) :	1.59	0.00	0.00
Total TOC (min)	13.68		

Subbasin Runoff Results

Total Rainfall (in) 1.64
 Total Runoff (in) 0.75
 Peak Runoff (cfs) 0.70
 Weighted Curve Number 89.16
 Time of Concentration (days hh:mm:ss) 0 00:13:41

Subbasin : BAS_LS_E_01**Input Data**

Area (ac) 0.18
 Peak Rate Factor 0.00
 Weighted Curve Number 88.00
 Rain Gage ID STGEORGE

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Natural western desert	0.18	D	88.00
Composite Area & Weighted CN	0.18		88.00

Time of Concentration

	Subarea A	Subarea B	Subarea C
Sheet Flow Computations			
Manning's Roughness :	.35	0.00	0.00
Flow Length (ft) :	100	0.00	0.00
Slope (%) :	30	0.00	0.00
2 yr, 24 hr Rainfall (in) :	1.1	0.00	0.00
Velocity (ft/sec) :	0.15	0.00	0.00
Computed Flow Time (min) :	11.14	0.00	0.00
Channel Flow Computations			
Manning's Roughness :	.055	0.00	0.00
Flow Length (ft) :	125	0.00	0.00
Channel Slope (%) :	1	0.00	0.00
Cross Section Area (ft ²) :	1	0.00	0.00
Wetted Perimeter (ft) :	5	0.00	0.00
Velocity (ft/sec) :	0.93	0.00	0.00
Computed Flow Time (min) :	2.25	0.00	0.00
Total TOC (min)	13.39		

Subbasin Runoff Results

Total Rainfall (in) 1.64
 Total Runoff (in) 0.68
 Peak Runoff (cfs) 0.21
 Weighted Curve Number 88.00
 Time of Concentration (days hh:mm:ss) 0 00:13:23

Subbasin : BAS_LS_E_02**Input Data**

Area (ac) 0.46
 Peak Rate Factor 0.00
 Weighted Curve Number 88.00
 Rain Gage ID STGEORGE

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Natural western desert	0.46	D	88.00
Composite Area & Weighted CN	0.46		88.00

Time of Concentration

	Subarea A	Subarea B	Subarea C
Sheet Flow Computations			
Manning's Roughness :	.35	0.00	0.00
Flow Length (ft) :	30	0.00	0.00
Slope (%) :	30	0.00	0.00
2 yr, 24 hr Rainfall (in) :	1.1	0.00	0.00
Velocity (ft/sec) :	0.12	0.00	0.00
Computed Flow Time (min) :	4.25	0.00	0.00
Channel Flow Computations			
Manning's Roughness :	.055	0.00	0.00
Flow Length (ft) :	235	0.00	0.00
Channel Slope (%) :	1	0.00	0.00
Cross Section Area (ft ²) :	1	0.00	0.00
Wetted Perimeter (ft) :	5	0.00	0.00
Velocity (ft/sec) :	0.93	0.00	0.00
Computed Flow Time (min) :	4.23	0.00	0.00
Total TOC (min)	8.48		

Subbasin Runoff Results

Total Rainfall (in) 1.64
 Total Runoff (in) 0.68
 Peak Runoff (cfs) 0.61
 Weighted Curve Number 88.00
 Time of Concentration (days hh:mm:ss) 0 00:08:29

Subbasin : BAS_LS_W_01**Input Data**

Area (ac) 0.92
 Peak Rate Factor 0.00
 Weighted Curve Number 80.43
 Rain Gage ID STGEORGE

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Paved parking & roofs	0.02	D	98.00
> 75% grass cover, Good	0.89	D	80.00
Composite Area & Weighted CN	0.91		80.43

Time of Concentration

	Subarea A	Subarea B	Subarea C
Sheet Flow Computations			
Manning's Roughness :	.35	0.00	0.00
Flow Length (ft) :	30	0.00	0.00
Slope (%) :	30	0.00	0.00
2 yr, 24 hr Rainfall (in) :	1.1	0.00	0.00
Velocity (ft/sec) :	0.12	0.00	0.00
Computed Flow Time (min) :	4.25	0.00	0.00

	Subarea A	Subarea B	Subarea C
Channel Flow Computations			
Manning's Roughness :	.055	0.00	0.00
Flow Length (ft) :	207	0.00	0.00
Channel Slope (%) :	1	0.00	0.00
Cross Section Area (ft ²) :	1	0.00	0.00
Wetted Perimeter (ft) :	5	0.00	0.00
Velocity (ft/sec) :	0.93	0.00	0.00
Computed Flow Time (min) :	3.72	0.00	0.00
Total TOC (min)	7.98		

Subbasin Runoff Results

Total Rainfall (in) 1.64
 Total Runoff (in) 0.37
 Peak Runoff (cfs) 0.59
 Weighted Curve Number 80.43
 Time of Concentration (days hh:mm:ss) 0 00:07:59

Subbasin : BAS_LS_W_02**Input Data**

Area (ac) 0.04
 Peak Rate Factor 0.00
 Weighted Curve Number 88.00
 Rain Gage ID STGEORGE

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Natural western desert	0.04	D	88.00
Composite Area & Weighted CN	0.04		88.00

Time of Concentration

	Subarea A	Subarea B	Subarea C
Channel Flow Computations			
Manning's Roughness :	.055	0.00	0.00
Flow Length (ft) :	215	0.00	0.00
Channel Slope (%) :	.5	0.00	0.00
Cross Section Area (ft²) :	1	0.00	0.00
Wetted Perimeter (ft) :	5	0.00	0.00
Velocity (ft/sec) :	0.66	0.00	0.00
Computed Flow Time (min) :	5.47	0.00	0.00
Total TOC (min)5.47			

Subbasin Runoff Results

Total Rainfall (in) 1.64
 Total Runoff (in) 0.68
 Peak Runoff (cfs) 0.05
 Weighted Curve Number 88.00
 Time of Concentration (days hh:mm:ss) 0 00:05:28

Subbasin : BAS_OFF_01**Input Data**

Area (ac) 0.28
 Peak Rate Factor 0.00
 Weighted Curve Number 80.00
 Rain Gage ID STGEORGE

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
> 75% grass cover, Good	0.28	D	80.00
Composite Area & Weighted CN	0.28		80.00

Time of Concentration

	Subarea A	Subarea B	Subarea C
Sheet Flow Computations			
Manning's Roughness :	.35	0.00	0.00
Flow Length (ft) :	50	0.00	0.00
Slope (%) :	2	0.00	0.00
2 yr, 24 hr Rainfall (in) :	1.1	0.00	0.00
Velocity (ft/sec) :	0.04	0.00	0.00
Computed Flow Time (min) :	18.90	0.00	0.00
Shallow Concentrated Flow Computations			
Flow Length (ft) :	20	0.00	0.00
Slope (%) :	2	0.00	0.00
Surface Type :	Unpaved	Unpaved	Unpaved
Velocity (ft/sec) :	2.28	0.00	0.00
Computed Flow Time (min) :	0.15	0.00	0.00
Total TOC (min)	19.05		

Subbasin Runoff Results

Total Rainfall (in) 1.64
 Total Runoff (in) 0.36
 Peak Runoff (cfs) 0.14
 Weighted Curve Number 80.00
 Time of Concentration (days hh:mm:ss) 0 00:19:03

Subbasin : BAS_OFF_02**Input Data**

Area (ac) 0.52
 Peak Rate Factor 0.00
 Weighted Curve Number 80.00
 Rain Gage ID STGEORGE

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
> 75% grass cover, Good	0.52	D	80.00
Composite Area & Weighted CN	0.52		80.00

Time of Concentration

	Subarea A	Subarea B	Subarea C
Sheet Flow Computations			
Manning's Roughness :	.35	0.00	0.00
Flow Length (ft) :	50	0.00	0.00
Slope (%) :	15	0.00	0.00
2 yr, 24 hr Rainfall (in) :	1.1	0.00	0.00
Velocity (ft/sec) :	0.10	0.00	0.00
Computed Flow Time (min) :	8.44	0.00	0.00
Shallow Concentrated Flow Computations			
Flow Length (ft) :	50	0.00	0.00
Slope (%) :	15	0.00	0.00
Surface Type :	Unpaved	Unpaved	Unpaved
Velocity (ft/sec) :	6.25	0.00	0.00
Computed Flow Time (min) :	0.13	0.00	0.00
Total TOC (min)	8.58		

Subbasin Runoff Results

Total Rainfall (in) 1.64
 Total Runoff (in) 0.36
 Peak Runoff (cfs) 0.32
 Weighted Curve Number 80.00
 Time of Concentration (days hh:mm:ss) 0 00:08:35

Subbasin : BAS_OFF_03**Input Data**

Area (ac) 0.32
 Peak Rate Factor 0.00
 Weighted Curve Number 80.00
 Rain Gage ID STGEORGE

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
> 75% grass cover, Good	0.32	D	80.00
Composite Area & Weighted CN	0.32		80.00

Time of Concentration

	Subarea A	Subarea B	Subarea C
Sheet Flow Computations			
Manning's Roughness :	.35	0.00	0.00
Flow Length (ft) :	50	0.00	0.00
Slope (%) :	15	0.00	0.00
2 yr, 24 hr Rainfall (in) :	1.1	0.00	0.00
Velocity (ft/sec) :	0.10	0.00	0.00
Computed Flow Time (min) :	8.44	0.00	0.00
Shallow Concentrated Flow Computations			
Flow Length (ft) :	70	0.00	0.00
Slope (%) :	15	0.00	0.00
Surface Type :	Unpaved	Unpaved	Unpaved
Velocity (ft/sec) :	6.25	0.00	0.00
Computed Flow Time (min) :	0.19	0.00	0.00
Total TOC (min)	8.63		

Subbasin Runoff Results

Total Rainfall (in) 1.64
 Total Runoff (in) 0.36
 Peak Runoff (cfs) 0.20
 Weighted Curve Number 80.00
 Time of Concentration (days hh:mm:ss) 0 00:08:38

Subbasin : BAS_OFF_04**Input Data**

Area (ac) 0.27
 Peak Rate Factor 0.00
 Weighted Curve Number 80.00
 Rain Gage ID STGEORGE

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
> 75% grass cover, Good	0.27	D	80.00
Composite Area & Weighted CN	0.27		80.00

Time of Concentration

	Subarea A	Subarea B	Subarea C
Sheet Flow Computations			
Manning's Roughness :	.35	0.00	0.00
Flow Length (ft) :	50	0.00	0.00
Slope (%) :	15	0.00	0.00
2 yr, 24 hr Rainfall (in) :	1.1	0.00	0.00
Velocity (ft/sec) :	0.10	0.00	0.00
Computed Flow Time (min) :	8.44	0.00	0.00
Shallow Concentrated Flow Computations			
Flow Length (ft) :	80	0.00	0.00
Slope (%) :	15	0.00	0.00
Surface Type :	Unpaved	Unpaved	Unpaved
Velocity (ft/sec) :	6.25	0.00	0.00
Computed Flow Time (min) :	0.21	0.00	0.00
Total TOC (min)	8.66		

Subbasin Runoff Results

Total Rainfall (in) 1.64
 Total Runoff (in) 0.36
 Peak Runoff (cfs) 0.17
 Weighted Curve Number 80.00
 Time of Concentration (days hh:mm:ss) 0 00:08:40

Subbasin : BAS_OFF_LAS_PALMAS**Input Data**

Area (ac) 7.89
 Peak Rate Factor 0.00
 Weighted Curve Number 92.00
 Rain Gage ID STGEORGE

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
1/8 acre lots, 65% impervious	7.89	D	92.00
Composite Area & Weighted CN	7.89		92.00

Time of Concentration

	Subarea A	Subarea B	Subarea C
Sheet Flow Computations			
Manning's Roughness :	.35	0.00	0.00
Flow Length (ft) :	100	0.00	0.00
Slope (%) :	2	0.00	0.00
2 yr, 24 hr Rainfall (in) :	1.1	0.00	0.00
Velocity (ft/sec) :	0.05	0.00	0.00
Computed Flow Time (min) :	32.92	0.00	0.00
Shallow Concentrated Flow Computations			
Flow Length (ft) :	800	0.00	0.00
Slope (%) :	2	0.00	0.00
Surface Type :	Paved	Unpaved	Unpaved
Velocity (ft/sec) :	2.87	0.00	0.00
Computed Flow Time (min) :	4.65	0.00	0.00
Total TOC (min)	37.56		

Subbasin Runoff Results

Total Rainfall (in) 1.64
 Total Runoff (in) 0.92
 Peak Runoff (cfs) 8.50
 Weighted Curve Number 92.00
 Time of Concentration (days hh:mm:ss) 0 00:37:34

Subbasin : BAS_POOL**Input Data**

Area (ac) 0.38
 Peak Rate Factor 0.00
 Weighted Curve Number 98.00
 Rain Gage ID STGEORGE

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Paved parking & roofs	0.38	D	98.00
Composite Area & Weighted CN	0.38		98.00

Time of Concentration

	Subarea A	Subarea B	Subarea C
Sheet Flow Computations			
Manning's Roughness :	.2	0.00	0.00
Flow Length (ft) :	215	0.00	0.00
Slope (%) :	.5	0.00	0.00
2 yr, 24 hr Rainfall (in) :	1.1	0.00	0.00
Velocity (ft/sec) :	0.05	0.00	0.00
Computed Flow Time (min) :	67.57	0.00	0.00
Total TOC (min)	67.57		

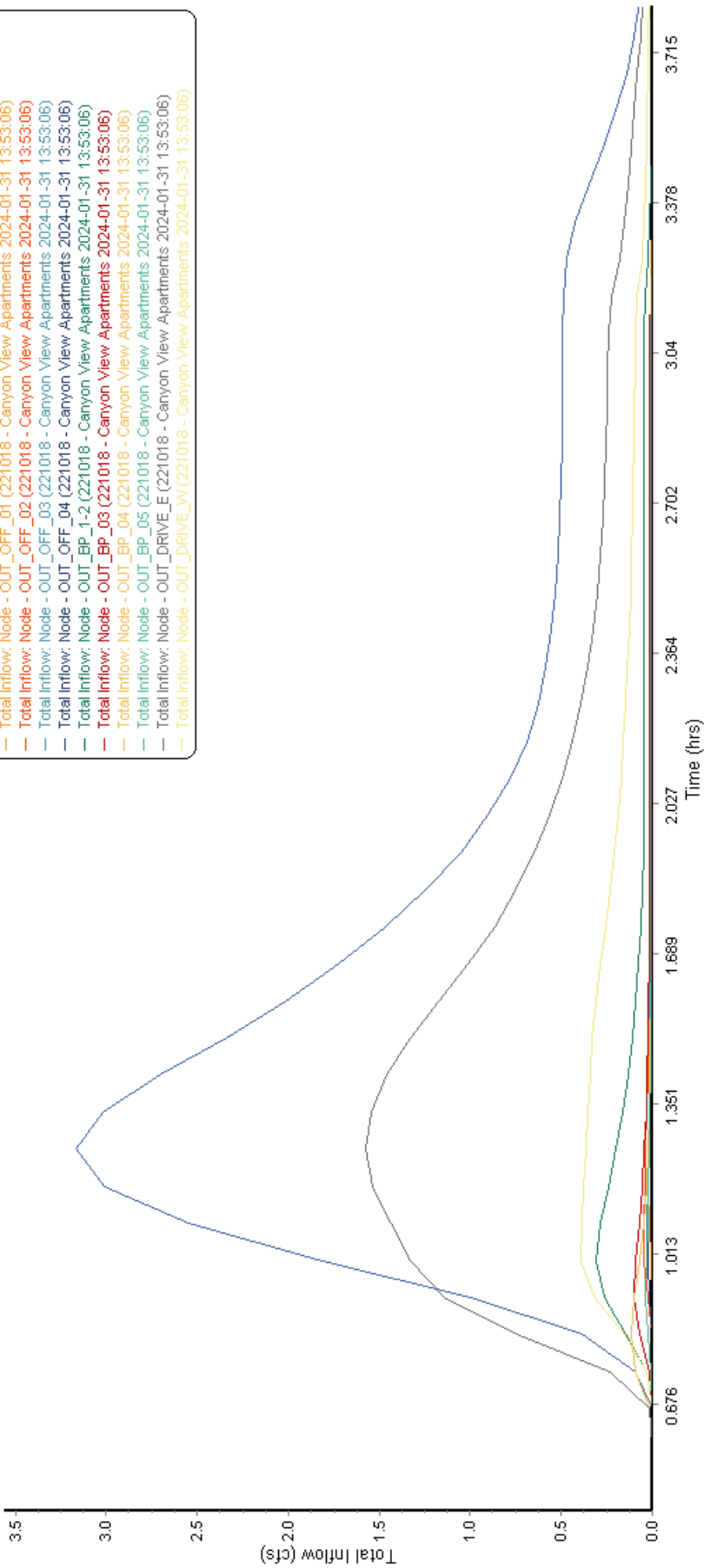
Subbasin Runoff Results

Total Rainfall (in) 1.64
 Total Runoff (in) 1.42
 Peak Runoff (cfs) 0.44
 Weighted Curve Number 98.00
 Time of Concentration (days hh:mm:ss) 0 01:07:34

10-year 3-hour, Farmer Fletcher

HYDROGRAPHS

- Total Inflow: Node - OUT_OFF_LAS_PALMAS (221018 - Canyon View Apartments 2024-01-31 13:53:06)
- Total Inflow: Node - OUT_OFF_01 (221018 - Canyon View Apartments 2024-01-31 13:53:06)
- Total Inflow: Node - OUT_OFF_02 (221018 - Canyon View Apartments 2024-01-31 13:53:06)
- Total Inflow: Node - OUT_OFF_03 (221018 - Canyon View Apartments 2024-01-31 13:53:06)
- Total Inflow: Node - OUT_OFF_04 (221018 - Canyon View Apartments 2024-01-31 13:53:06)
- Total Inflow: Node - OUT_BP_1-2 (221018 - Canyon View Apartments 2024-01-31 13:53:06)
- Total Inflow: Node - OUT_BP_03 (221018 - Canyon View Apartments 2024-01-31 13:53:06)
- Total Inflow: Node - OUT_BP_04 (221018 - Canyon View Apartments 2024-01-31 13:53:06)
- Total Inflow: Node - OUT_BP_05 (221018 - Canyon View Apartments 2024-01-31 13:53:06)
- Total Inflow: Node - OUT_DRIVE_E (221018 - Canyon View Apartments 2024-01-31 13:53:06)
- Total Inflow: Node - OUT_DRIVE_W (221018 - Canyon View Apartments 2024-01-31 13:53:06)



Total Inflow Summary Table

Element ID	OUT_OFF_LAS_PALMAS	OUT_OFF_01	OUT_OFF_02	OUT_OFF_03	OUT_OFF_04	OUT_BP_1-2	OUT_BP_03	OUT_BP_04	OUT_BP_05	OUT_DRIVE_E	OUT_DRIVE_W
Maximum Total Inflow (cfs)	3.17	0.02	0.04	0.02	0.31	0.10	0.12	0.04	1.57	0.39	
Minimum Total Inflow (cfs)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Event Mean Total Inflow (cfs)	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.01	
Duration of Exceedances (hrs)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	
Duration of Deficits (hrs)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	
Number of Exceedances	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	
Number of Deficits	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	
Volume of Exceedance (ft³)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	
Volume of Deficit (ft³)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	
Total Inflow Volume (ft³)	11524.57	82.68	156.08	96.52	80.81	239.71	202.26	88.11	6818.33	1962.05	
Detention Storage (ft³)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	

Time period

From: 08/28/2018, 12:00:00 AM

To: 09/01/2018, 12:00:00 AM

Thresholds

Exceedance: 0

Deficit: 0

Detention storage

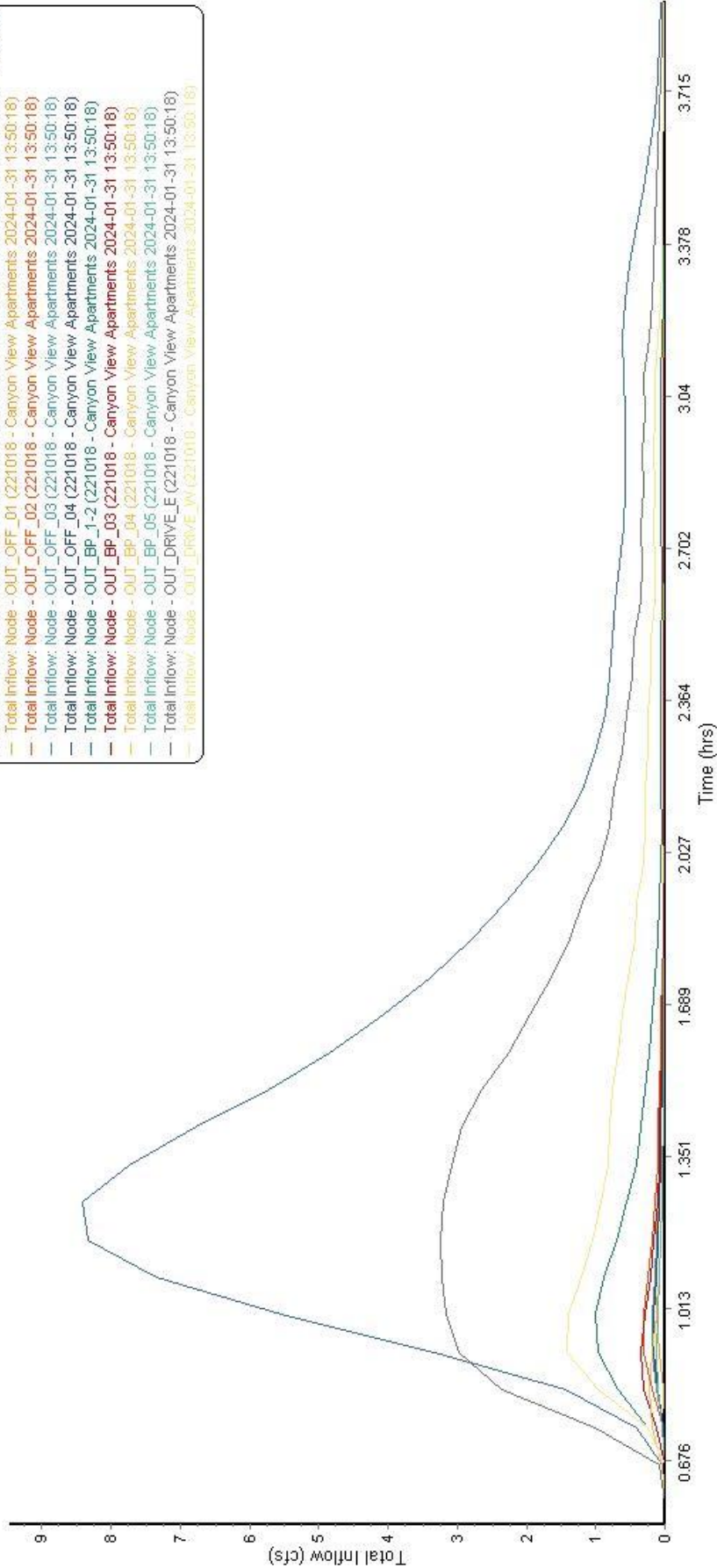
Max flow: 0

Subbasin Summary

SN Subbasin ID	Area	Peak Rate	Weighted	Total	Total	Total	Peak	Time of
		Factor	Curve	Rainfall	Runoff	Runoff	Runoff	Concentration
	(ac)		Number	(in)	(in)	Volume (ac-in)	(cfs)	(days hh:mm:ss)
1 BAS_BLDG	1.80	0.00	98.00	1.00	0.79	1.42	1.31	0 00:51:39
2 BAS_BP_01	0.28	0.00	89.34	1.00	0.30	0.08	0.13	0 00:10:00
3 BAS_BP_02	0.62	0.00	88.00	1.00	0.25	0.16	0.20	0 00:19:16
4 BAS_BP_03	0.26	0.00	88.00	1.00	0.25	0.07	0.10	0 00:10:00
5 BAS_BP_04	0.07	0.00	98.00	1.00	0.79	0.05	0.12	0 00:10:00
6 BAS_BP_05	0.09	0.00	88.00	1.00	0.25	0.02	0.04	0 00:10:00
7 BAS_DRIVE_E	0.77	0.00	91.60	1.00	0.39	0.30	0.49	0 00:11:16
8 BAS_DRIVE_WEST	0.52	0.00	89.16	1.00	0.29	0.15	0.22	0 00:13:40
9 BAS_LS_E_01	0.18	0.00	88.00	1.00	0.25	0.04	0.06	0 00:13:23
10 BAS_LS_E_02	0.46	0.00	88.00	1.00	0.25	0.12	0.18	0 00:10:00
11 BAS_LS_W_01	0.92	0.00	80.43	1.00	0.09	0.08	0.09	0 00:10:00
12 BAS_LS_W_02	0.04	0.00	88.00	1.00	0.25	0.01	0.02	0 00:10:00
13 BAS_OFF_01	0.28	0.00	80.00	1.00	0.08	0.02	0.02	0 00:19:03
14 BAS_OFF_02	0.52	0.00	80.00	1.00	0.08	0.04	0.05	0 00:10:00
15 BAS_OFF_03	0.32	0.00	80.00	1.00	0.08	0.03	0.03	0 00:10:00
16 BAS_OFF_04	0.27	0.00	80.00	1.00	0.08	0.02	0.02	0 00:10:00
17 BAS_OFF_LAS_PALMAS	7.89	0.00	92.00	1.00	0.40	3.18	3.17	0 00:37:33
18 BAS_POOL	0.38	0.00	98.00	1.00	0.79	0.30	0.23	0 01:07:34

100-year 3-hour, Farmer Fletcher
HYDROGRAPHS

- Total Inflow: Node - OUT_OFF_LAS_PALMAS (221018 - Canyon View Apartments 2024-01-31 13:50:18)
- Total Inflow: Node - OUT_OFF_01 (221018 - Canyon View Apartments 2024-01-31 13:50:18)
- Total Inflow: Node - OUT_OFF_02 (221018 - Canyon View Apartments 2024-01-31 13:50:18)
- Total Inflow: Node - OUT_OFF_03 (221018 - Canyon View Apartments 2024-01-31 13:50:18)
- Total Inflow: Node - OUT_OFF_04 (221018 - Canyon View Apartments 2024-01-31 13:50:18)
- Total Inflow: Node - OUT_BP_1-2 (221018 - Canyon View Apartments 2024-01-31 13:50:18)
- Total Inflow: Node - OUT_BP_03 (221018 - Canyon View Apartments 2024-01-31 13:50:18)
- Total Inflow: Node - OUT_BP_04 (221018 - Canyon View Apartments 2024-01-31 13:50:18)
- Total Inflow: Node - OUT_BP_05 (221018 - Canyon View Apartments 2024-01-31 13:50:18)
- Total Inflow: Node - OUT_DRIVE_E (221018 - Canyon View Apartments 2024-01-31 13:50:18)
- Total Inflow: Node - OUT_DRIVE_W (221018 - Canyon View Apartments 2024-01-31 13:50:18)



.....
Total Inflow Summary Table

Time period																	
From:	08/28/2018, 12:00:00 AM																
To:	09/01/2018, 12:00:00 AM																
Thresholds																	
Exceedance:	0																
Deficit:	0																
Detention storage																	
Max flow:	0																
Element ID	OUT_OFF_LAS_PALMAS	OUT_OFF_01	OUT_OFF_02	OUT_OFF_03	OUT_OFF_04	OUT_BP_1-2	OUT_BP_03	OUT_BP_04	OUT_BP_05	OUT_DRIVE_E	OUT_DRIVE_W						
Maximum Total Inflow (cfs)	8.41	0.14	0.31	0.19	0.16	0.00	0.34	0.23	0.13	3.24	1.41						
Minimum Total Inflow (cfs)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00						
Event Mean Total Inflow (cfs)	0.08	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.04	0.01						
Duration of Exceedances (hrs)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A						
Duration of Deficits (hrs)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A						
Number of Exceedances	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A						
Number of Deficits	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A						
Volume of Exceedance (ft³)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A						
Volume of Deficit (ft³)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A						
Total Inflow Volume (ft³)	26363.04	356.01	669.95	414.3	348.1	2313.03	652.01	361.19	238.29	13324.82	4668.16						
Detention Storage (ft³)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A						

Subbasin Summary

SN Subbasin ID	Area	Peak Rate Factor	Weighted Curve Number	Total Rainfall	Total Runoff	Total Runoff Volume	Peak Runoff	Time of Concentration
	(ac)			(in)	(in)	(ac-in)	(cfs)	(days hh:mm:ss)
1 BAS_BLDG	1.80	0.00	98.00	1.64	1.42	2.55	2.56	0 00:51:39
2 BAS_BP_01	0.28	0.00	89.34	1.64	0.76	0.21	0.41	0 00:10:00
3 BAS_BP_02	0.62	0.00	88.00	1.64	0.68	0.43	0.67	0 00:19:16
4 BAS_BP_03	0.26	0.00	88.00	1.64	0.68	0.18	0.35	0 00:10:00
5 BAS_BP_04	0.07	0.00	98.00	1.64	1.42	0.10	0.23	0 00:10:00
6 BAS_BP_05	0.09	0.00	88.00	1.64	0.68	0.06	0.13	0 00:10:00
7 BAS_DRIVE_E	0.77	0.00	91.60	1.64	0.89	0.69	1.36	0 00:11:16
8 BAS_DRIVE_WEST	0.52	0.00	89.16	1.64	0.75	0.39	0.70	0 00:13:40
9 BAS_LS_E_01	0.18	0.00	88.00	1.64	0.68	0.12	0.21	0 00:13:23
10 BAS_LS_E_02	0.46	0.00	88.00	1.64	0.68	0.31	0.61	0 00:10:00
11 BAS_LS_W_01	0.92	0.00	80.43	1.64	0.37	0.34	0.59	0 00:10:00
12 BAS_LS_W_02	0.04	0.00	88.00	1.64	0.68	0.02	0.05	0 00:10:00
13 BAS_OFF_01	0.28	0.00	80.00	1.64	0.36	0.10	0.14	0 00:19:03
14 BAS_OFF_02	0.52	0.00	80.00	1.64	0.36	0.19	0.32	0 00:10:00
15 BAS_OFF_03	0.32	0.00	80.00	1.64	0.36	0.12	0.20	0 00:10:00
16 BAS_OFF_04	0.27	0.00	80.00	1.64	0.36	0.10	0.17	0 00:10:00
17 BAS_OFF_LAS_PALMAS	7.89	0.00	92.00	1.64	0.92	7.26	8.50	0 00:37:33
18 BAS_POOL	0.38	0.00	98.00	1.64	1.42	0.54	0.44	0 01:07:34

HYDROGRAPHS

[illegible]

Time period

From: 08/28/2018, 12:00:00 AM

To: 09/01/2018, 12:00:00 AM

Thresholds

Exceedance: 0

Deficit: 0

Detention storage

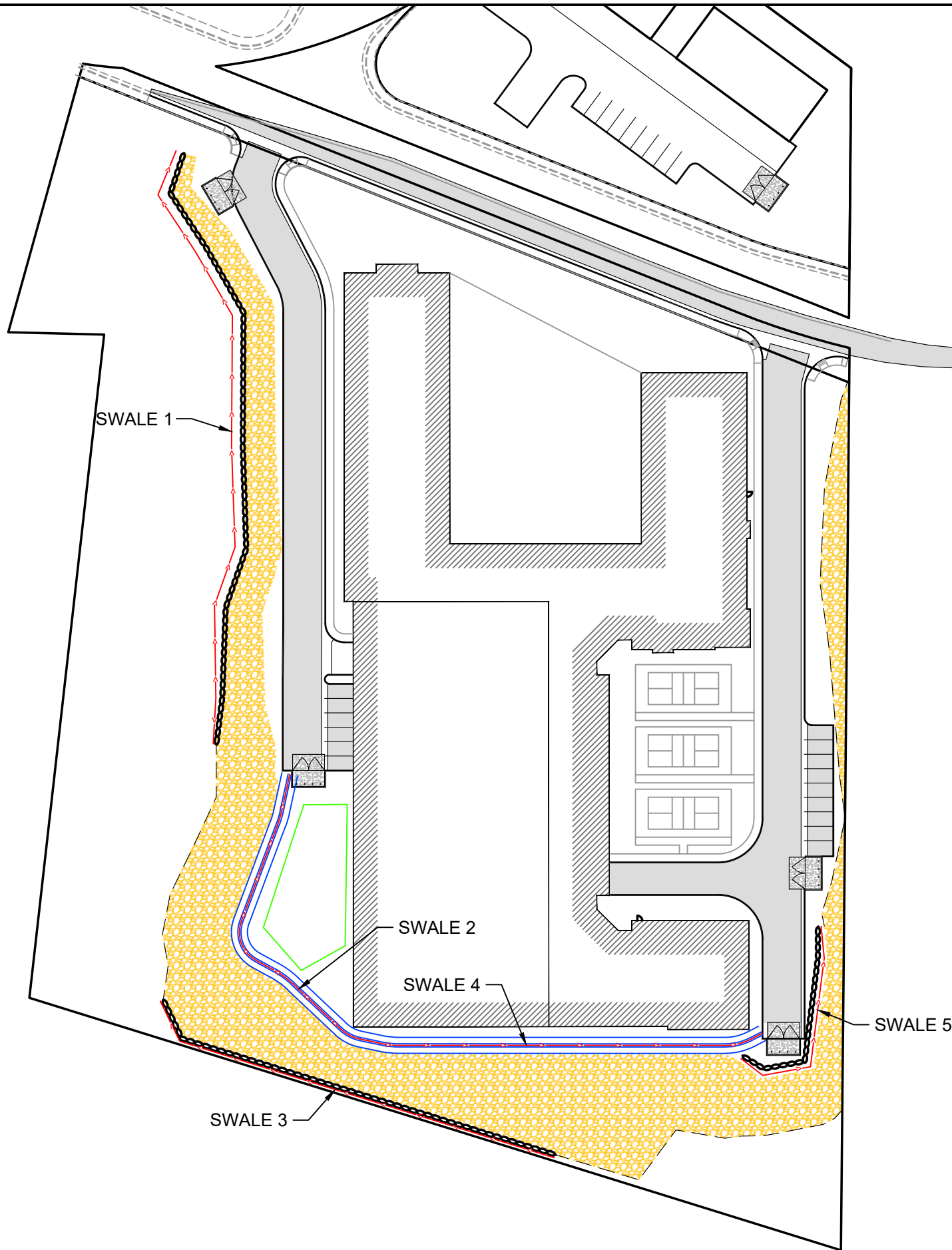
Max flow: 0

Subbasin Summary

SN Subbasin ID	Area	Peak Rate	Weighted	Total	Total	Total	Peak	Time of
		Factor	Curve	Rainfall	Runoff	Runoff	Runoff	Concentration
	(ac)		Number	(in)	(in)	Volume (ac-in)	(cfs)	(days hh:mm:ss)
1 BAS_BLDG	1.80	0.00	98.00	2.51	2.28	4.10	2.37	0 00:51:39
2 BAS_BP_01	0.28	0.00	89.34	2.51	1.49	0.41	0.57	0 00:10:00
3 BAS_BP_02	0.62	0.00	88.00	2.51	1.39	0.87	0.98	0 00:19:16
4 BAS_BP_03	0.26	0.00	88.00	2.51	1.39	0.36	0.51	0 00:10:00
5 BAS_BP_04	0.07	0.00	98.00	2.51	2.27	0.16	0.20	0 00:10:00
6 BAS_BP_05	0.09	0.00	88.00	2.51	1.38	0.13	0.18	0 00:10:00
7 BAS_DRIVE_E	0.77	0.00	91.60	2.51	1.67	1.29	1.71	0 00:11:16
8 BAS_DRIVE_WEST	0.52	0.00	89.16	2.51	1.48	0.77	0.98	0 00:13:40
9 BAS_LS_E_01	0.18	0.00	88.00	2.51	1.39	0.24	0.31	0 00:13:23
10 BAS_LS_E_02	0.46	0.00	88.00	2.51	1.39	0.64	0.89	0 00:10:00
11 BAS_LS_W_01	0.92	0.00	80.43	2.51	0.92	0.84	1.15	0 00:10:00
12 BAS_LS_W_02	0.04	0.00	88.00	2.51	1.31	0.05	0.07	0 00:10:00
13 BAS_OFF_01	0.28	0.00	80.00	2.51	0.90	0.25	0.27	0 00:19:03
14 BAS_OFF_02	0.52	0.00	80.00	2.51	0.90	0.47	0.63	0 00:10:00
15 BAS_OFF_03	0.32	0.00	80.00	2.51	0.90	0.29	0.39	0 00:10:00
16 BAS_OFF_04	0.27	0.00	80.00	2.51	0.90	0.24	0.33	0 00:10:00
17 BAS_OFF_LAS_PALMAS	7.89	0.00	92.00	2.51	1.70	13.43	10.26	0 00:37:33
18 BAS_POOL	0.38	0.00	98.00	2.51	2.28	0.87	0.41	0 01:07:34

Appendix D – Drainage Channel Calculations and Details

SCALE: 1" = 80'



SWALE INFO					
NAME	CONTRIBUTING BASINS	FLOW IN (CFS)	DEPTH	BOTTOM WIDTH	SIDE SLOPES
SWALE 1	BAS_OFF_LAS_PALMAS BAS_BP_01 BAS_BP_02	9.41	2'	2'	2:1
SWALE 2	BAS_LS_W_01 BAS_LS_W_02 BAS_OFF_01 BAS_OFF_02	1.07	2'	2'	2:1
SWALE 3	BAS_LS_W_02 BAS_OFF_02	0.36	1'	0'	2:1
SWALE 4	BAS_LS_E_02 BAS_OFF_03	0.80	2'	2'	2:1
SWALE 5	BAS_LS_E_01	0.21	1'	0'	2:1

SWALE LOCATIONS
CANYON VIEW APARTMENTS
ST GEORGE, UTAH



BUSH & GUDGELL, INC.

Engineers - Planners - Surveyors

205 East Tabernacle Suite #4

St. George, Utah 84770

Phone (435) 673-2337 / Fax (435) 673-3161

PROJECT: Canyon View Apartments
SUBJECT: Drainage Swale Calcs

PROJECT NO: 221018
ENGINEER: RM

DATE: 1/31/2024
SHEET:

Swale 1 Calcs

Version: December 2010 / rmeyer

File Name: CE_Civil_Open_Channel_Steady_State_Flow.xls

Code Ref.: n/a

Choose Units	English ▼
Channel Section	Trapezoidal, Triangle, Sqaure ▼
Choose Mannings n	0.040 Rough rocks ▼

Manning's Equation:

$$Q = \frac{\alpha * A^{5/3}}{n * P^{2/3}} \sqrt{S}$$

INPUT		
		Manning's n
y	1.00 ft	Water Depth
S	0.0088 ft/ft	Channel Slope
b	2 ft	Channel Bottom Width
mL	2 (horiz):1(vert)	Channel Side Slope, Left Side
mR	2 (horiz):1(vert)	Channel Side Slope, Right Side
OUTPUT		
Q	10.114 cfs	Open Channel Flow
V	2.529 ft/sec	
Tw	6.000 ft	Top Width (Gutter Spread)

S _s	2.8
D ₅₀	0.04 ft

PROJECT: Canyon View Apartments
SUBJECT: Drainage Swale Calcs

PROJECT NO: 221018
ENGINEER: RM

DATE: 1/31/2024
SHEET:

Swale 2 Calcs

Version: December 2010 / rmeyer

File Name: CE_Civil_Open_Channel_Steady_State_Flow.xls

Code Ref.: n/a

Choose Units	English ▼
Channel Section	Trapezoidal, Triangle, Sqaure ▼
Choose Mannings n	0.040 Rough rocks ▼

Manning's Equation:

$$Q = \frac{\alpha * A^{5/3}}{n * P^{2/3}} \sqrt{S}$$

INPUT		
		Manning's n
y	0.33 ft	Water Depth
S	0.0071 ft/ft	Channel Slope
b	2 ft	Channel Bottom Width
mL	2 (horiz):1(vert)	Channel Side Slope, Left Side
mR	2 (horiz):1(vert)	Channel Side Slope, Right Side
OUTPUT		
Q	1.098 cfs	Open Channel Flow
V	1.251 ft/sec	
Tw	3.320 ft	Top Width (Gutter Spread)

S _s	2.8
D ₅₀	0.01 ft

PROJECT: Canyon View Apartments
SUBJECT: Drainage Swale Calcs

PROJECT NO: 221018
ENGINEER: RM

DATE: 1/31/2024
SHEET: _____

Swale 3 Calcs

Version: December 2010 / rmeyer

File Name: CE_Civil_Open_Channel_Steady_State_Flow.xls

Code Ref.: n/a

Choose Units	English ▼
Channel Section	Trapezoidal, Triangle, Sqaure ▼
Choose Mannings n	0.040 Rough rocks ▼

Manning's Equation:

$$Q = \frac{\alpha * A^{5/3}}{n * P^{2/3}} \sqrt{S}$$

INPUT		
		Manning's n
y	0.43 ft	Water Depth
S	0.0061 ft/ft	Channel Slope
b	0 ft	Channel Bottom Width
mL	2 (horiz):1(ver)	Channel Side Slope, Left Side
mR	2 (horiz):1(ver)	Channel Side Slope, Right Side
OUTPUT		
Q	0.357 cfs	Open Channel Flow
V	0.967 ft/sec	
Tw	1.720 ft	Top Width (Gutter Spread)

S _s	2.8
D ₅₀	0.01 ft

PROJECT: Canyon View Apartments
SUBJECT: Drainage Swale Calcs

PROJECT NO: 221018
ENGINEER: RM

DATE: 1/31/2024
SHEET: _____

Swale 4 Calcs

Version: December 2010 / rmeyer

File Name: CE_Civil_Open_Channel_Steady_State_Flow.xls

Code Ref.: n/a

Choose Units	English ▼
Channel Section	Trapezoidal, Triangle, Square ▼
Choose Mannings n	0.040 Rough rocks ▼

Manning's Equation:

$$Q = \frac{\alpha * A^{5/3}}{n * P^{2/3}} \sqrt{S}$$

INPUT		
		Manning's n
y	0.14 ft	Water Depth
S	0.0764 ft/ft	Channel Slope
b	2 ft	Channel Bottom Width
mL	2 (horiz):1(vert)	Channel Side Slope, Left Side
mR	2 (horiz):1(vert)	Channel Side Slope, Right Side
OUTPUT		
Q	0.804 cfs	Open Channel Flow
V	2.520 ft/sec	
Tw	2.560 ft	Top Width (Gutter Spread)

S _s	2.8
D ₅₀	0.09 ft

PROJECT: Canyon View Apartments
SUBJECT: Drainage Swale Calcs

PROJECT NO: 221018
ENGINEER: RM

DATE: 1/31/2024
SHEET:

Swale 5 Calcs

Version: December 2010 / rmeyer

File Name: CE_Civil_Open_Channel_Steady_State_Flow.xls

Code Ref.: n/a

Choose Units	English ▼
Channel Section	Trapezoidal, Triangle, Sqaure ▼
Choose Mannings n	0.040 Rough rocks ▼

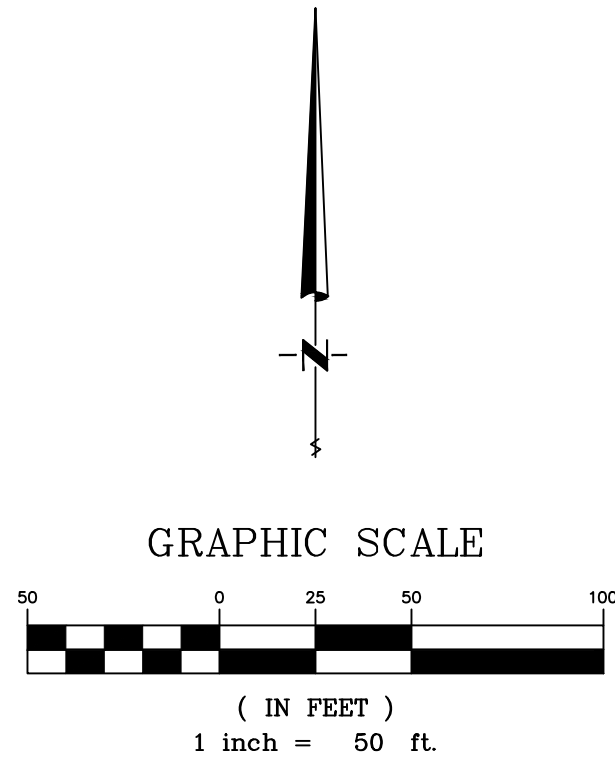
Manning's Equation:

$$Q = \frac{\alpha * A^{5/3}}{n * P^{2/3}} \sqrt{S}$$

INPUT		
		Manning's n
y	0.26 ft	Water Depth
S	0.0294 ft/ft	Channel Slope
b	0 ft	Channel Bottom Width
mL	2 (horiz):1(vert)	Channel Side Slope, Left Side
mR	2 (horiz):1(vert)	Channel Side Slope, Right Side
OUTPUT		
Q	0.205 cfs	Open Channel Flow
V	1.517 ft/sec	
Tw	1.040 ft	Top Width (Gutter Spread)

S _s	2.8
D ₅₀	0.02 ft

Exhibit D
Grading Plan



SURFACE SLOPE DATA				
NUMBER	MINIMUM SLOPE	MAXIMUM SLOPE	COLOR	AREA, AC
1	20.000%	29.999%	Green	1.20
2	30.000%	39.999%	Yellow	0.64
3	40.000%	7944.292%	Red	0.32

TOTAL AREA: 7.51 ACRES
DEVELOPABLE AREA: 5.74 ACRES

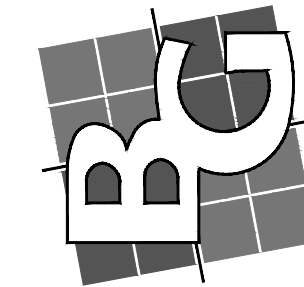
OWNER / DEVELOPER
SHAKESPEARE DEVELOPMENT GROUP

BEN SHAKESPEARE
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www.bushandgudgell.com



DATE: JAN 2024
DRAWN: RM
APPROVED:
SCALE: NOTED
JOB NO. 221018

HILLSIDE MAP
CANYON VIEW APARTMENTS
ST GEORGE, UTAH

SHEET 1 OF 3 SHEETS
FILE:



GRADING NOTES

APPROXIMATELY 57,511 CU.YD. OF CUT, 6,246 CU.YD. OF FILL AND 51,265 CU.YD. OF EXPORT MATERIAL IS REQUIRED (FOR GRADING PERMIT ONLY). THE CONTRACTOR SHOULD VERIFY THE QUANTITIES FOR COMPLETION OF WORK. QUANTITIES ARE BASED ON FINISH GRADE OF ROADS & PADS.

ALL IMPORTED STRUCTURAL FILL SHALL BE APPROVED BY THE GEOTECHNICAL ENGINEER PRIOR TO DELIVERY TO THE SITE. ALL IMPORTED STRUCTURAL FILL SHALL BE PLACED IN 8-INCH LOOSE HORIZONTAL LIFTS AND COMPACTED TO A MINIMUM OF 95 PERCENT OF MAXIMUM DRY DENSITY (ASTM D-1557).

ALL EXCAVATION, GRADING AND FILL OPERATIONS WITHIN THE BUILDING AREA SHOULD BE OBSERVED BY THE GEOTECHNICAL ENGINEER TO VERIFY SUB-SOIL CONDITIONS AND DETERMINE ADEQUACY OF SITE PREPARATION, SUITABILITY OF FILL MATERIALS AND COMPLIANCE WITH COMPACTION REQUIREMENTS.

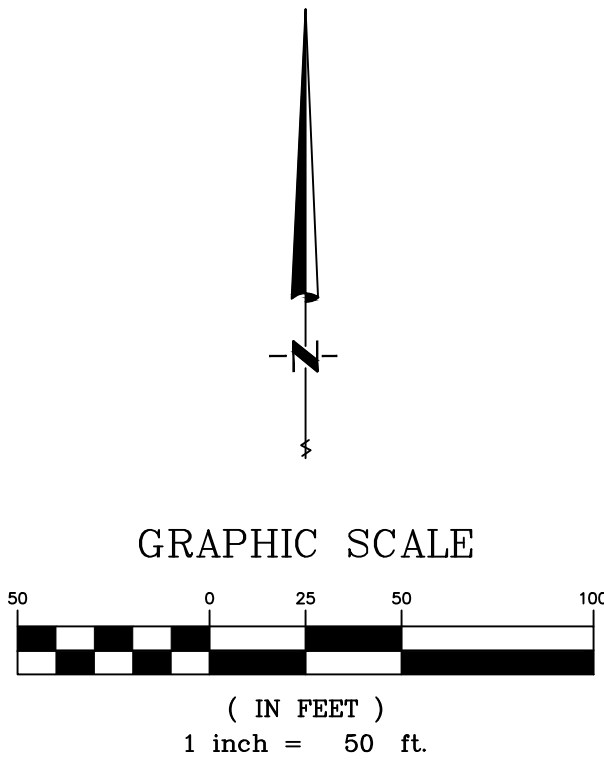
THE CONTRACTOR SHALL PROVIDE SUITABLE EQUIPMENT TO CONTROL DUST AND AIR POLLUTION CAUSED BY CONSTRUCTION OPERATIONS. THE CONTRACTOR SHALL ALSO PROVIDE SUITABLE MUD AND DIRT CONTAINMENT TO MAINTAIN THE WORK SITE, ACCESS ROADWAYS AND ADJACENT PROPERTIES IN A CLEAN CONDITION.

ALL EXCAVATION AND GRADING SHALL BE IN ACCORDANCE WITH THE REQUIREMENTS OF ST. GEORGE CITY AND APPENDIX J OF THE INTERNATIONAL BUILDING CODE, 2018 EDITION, AND THE SPECIFICATIONS AND REQUIREMENTS INCLUDED IN THE GEOTECHNICAL STUDY.

GEOTECHNICAL ENGINEER TO PROVIDE GRADING COMPLETION REPORT TO CONFIRM WORK HAS BEEN PERFORMED IN CONFORMANCE WITH THEIR RECOMMENDATIONS.

OWNER IS RESPONSIBLE FOR ALL ON-SITE DRAINAGE AND DETENTION.

- LEGEND**
- EXISTING GROUND CONTOUR
 - FINISH GROUND CONTOUR
 - LOT LINE
 - RETAINING WALL
 - LANDSCAPE DRAINAGE SWALE
 - PAD: 00.00
 - TW: 00.00
 - BW: 00.00
 - FL: 00.00
 - TC: 00.00
 - TBC: 00.00
 - SLOPE IN RUN:RISE
 - CONTOUR ELEVATION IN FEET



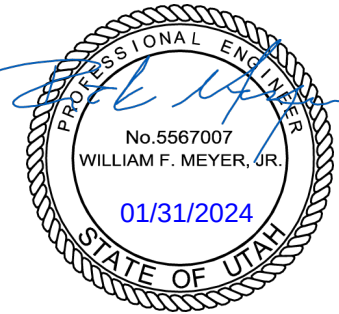
OWNER / DEVELOPER
SHAKESPEARE DEVELOPMENT GROUP

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37 W 1070 S STE 101
ST GEORGE, UTAH 84770

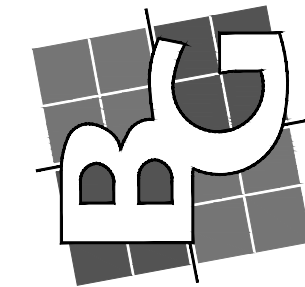
ENGINEERING CONTACT

BUSH AND GUDGELL, INC.
205 EAST TABERNACLE #4
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RICK MEYER - PROJECT MANAGER
(435)-673-2337



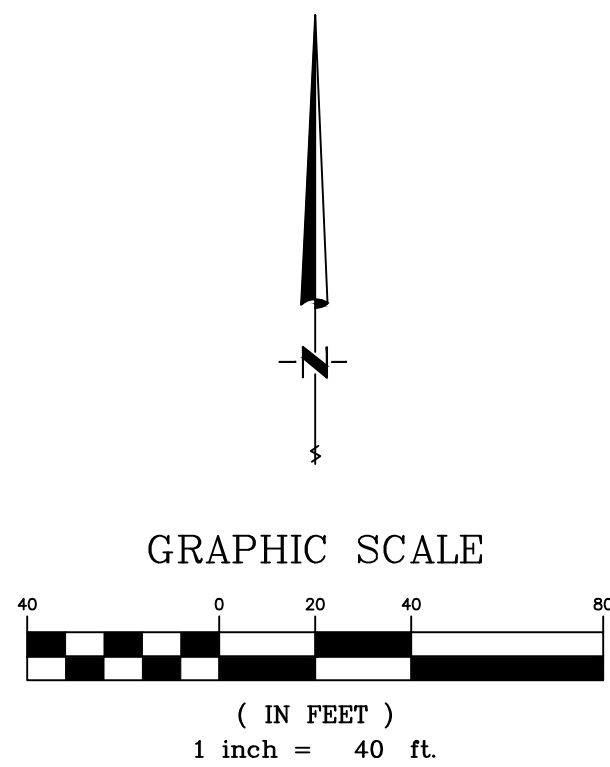
BUSH & GUDGELL, INC.
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205 East Tabernacle Suite #4
St. George, Utah 84770
Phone (435) 673-2337 / Fax (435) 673-3161
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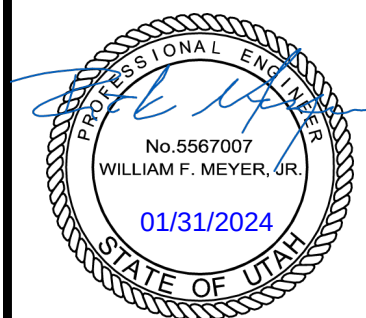
DATE: JAN 2024
DRAWN: RM
APPROVED:
SCALE: NOTED
JOB NO. 221018

GRADING PLAN
CANYON VIEW APARTMENTS
ST GEORGE, UTAH

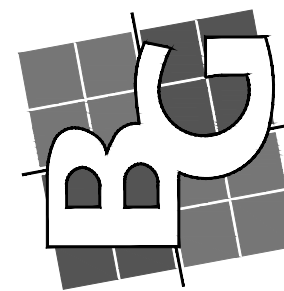
SHEET 2 OF 3 SHEETS
FILE:



Number	Minimum Elevation	Maximum Elevation	Area	Color
1	-40.00	-30.00	960.11	
2	-30.00	-20.00	7872.09	
3	-20.00	-10.00	57106.30	
4	-10.00	0.00	114449.82	
5	0.00	10.00	48668.92	
6	10.00	20.00	1550.60	



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DATE: JAN 2024

DRAWN: RM

APPROVED:

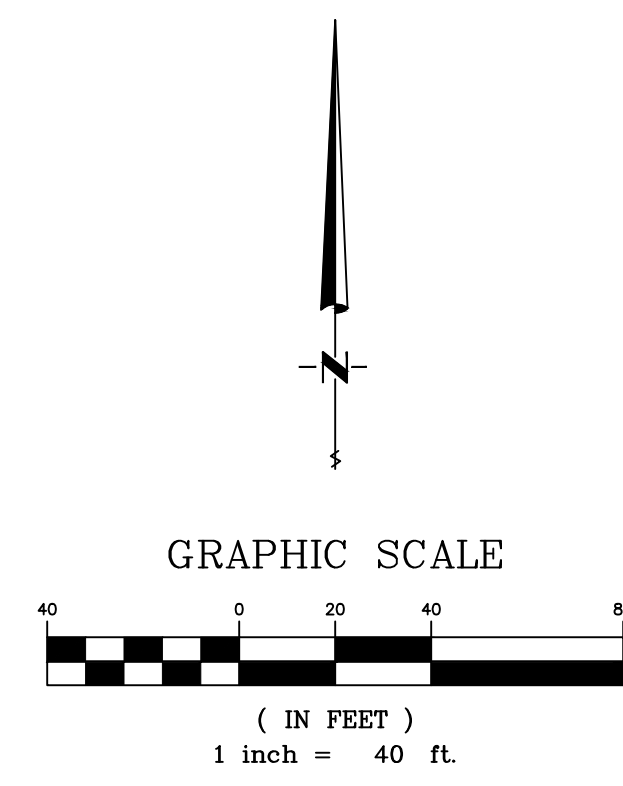
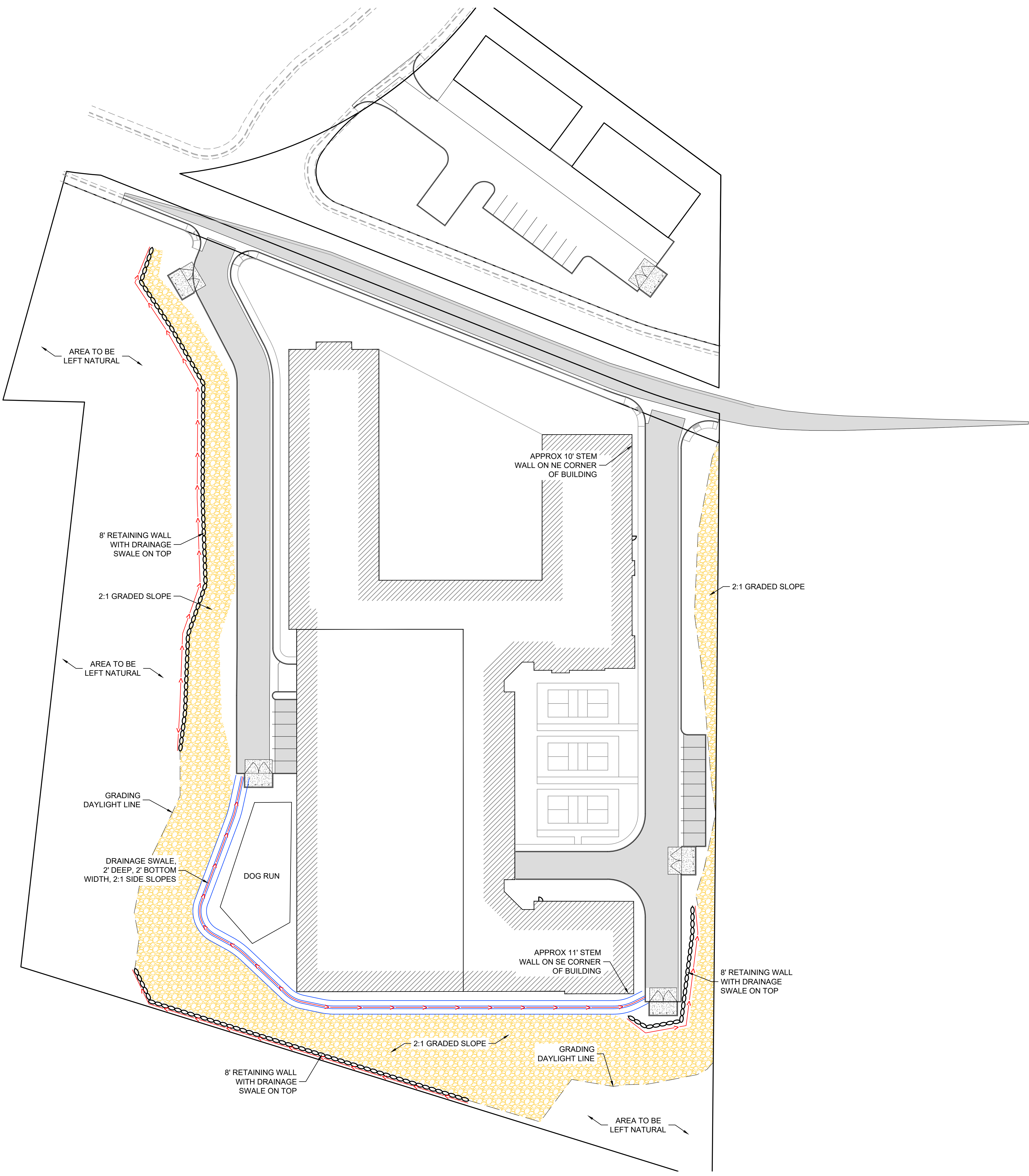
SCALE: NOTED

JOB NO. 221018

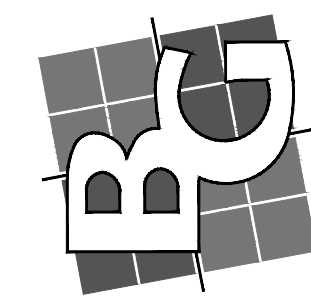
CUT FILL HEAT MAP
CANYON VIEW APARTMENTS
ST GEORGE, UTAH

SHEET 3 OF 3 SHEETS
FILE:

Exhibit E
Site Plan



BUSH & GUDGELL, INC.
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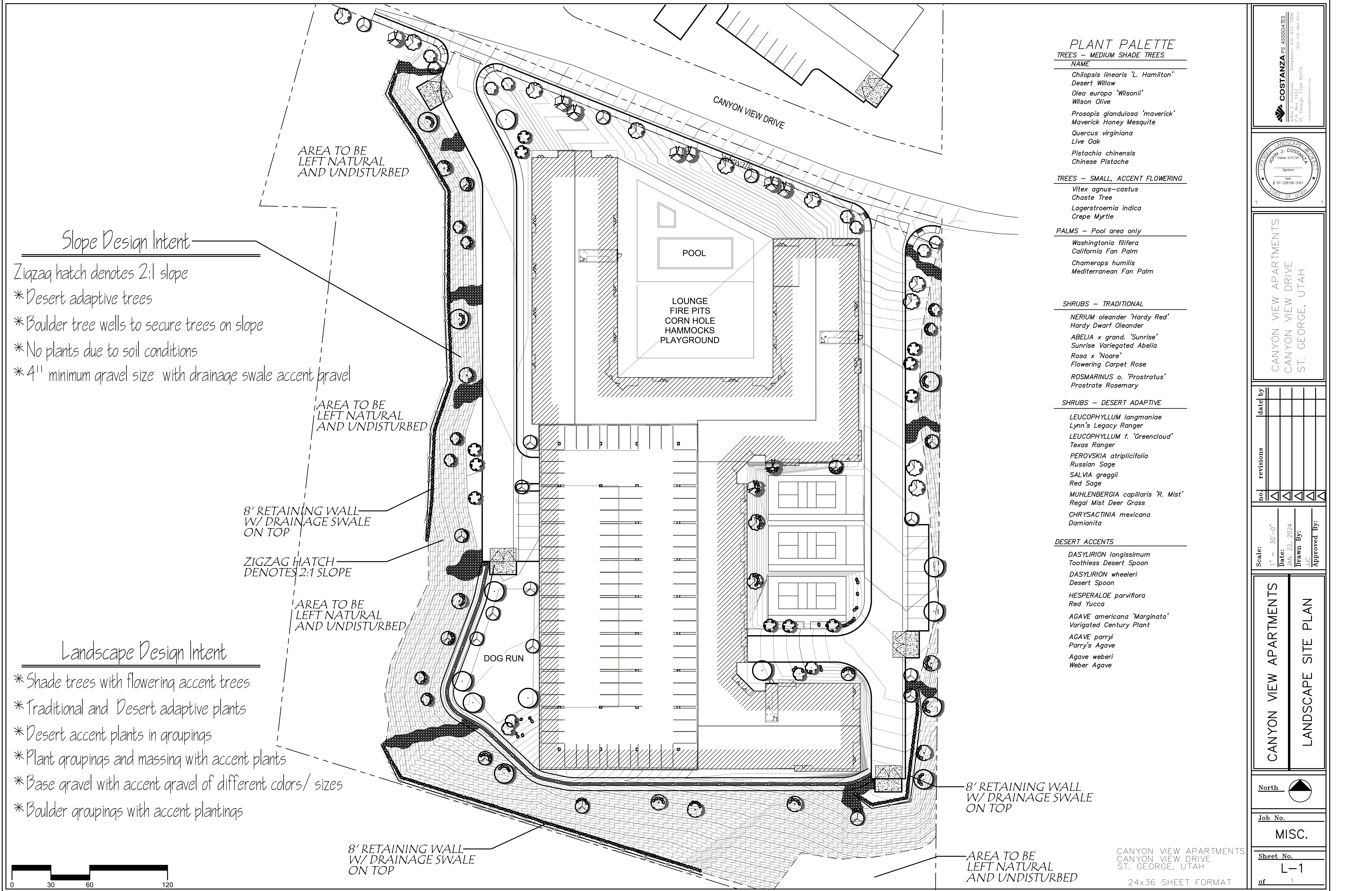


DATE: _____	DRAWN: _____	APPROVED: _____	SCALE: _____	JOB NO. 221018

SITE EXHIBIT
CANYON VIEW APARTMENTS

Preliminary.
For Review Only.
Not For
Construction.

Exhibit F
Landscape Plan



Slope Design Intent

- Zigzag hatch denotes 2:1 slope
- *Desert adaptive trees
- *Boulder tree wells to secure trees on slope
- *No plants due to soil conditions
- *4" minimum gravel size with drainage swale accent gravel

Landscape Design Intent

- *Shade trees with flowering accent trees
- *Traditional and Desert adaptive plants
- *Desert accent plants in groupings
- *Plant groupings and massing with accent plants
- *Base gravel with accent gravel of different colors/ sizes
- *Boulder groupings with accent plantings

PLANT PALETTE

TREES – MEDIUM SHADE TREES

- NAME
- Chilopsis linearis* 'L. Hamilton'
 - Desert Willow
 - Olea europaea* 'Wilsonii'
 - Wilson Olive
 - Prosopis glandulosa* 'maverick'
 - Maverick Honey Mesquite
 - Quercus virginiana*
 - Live Oak
 - Pistachio chinensis*
 - Chinese Pistache

TREES – SMALL, ACCENT FLOWERING

- Vitex agnus-castus*
- Chaste Tree
- Lagerstroemia indica*
- Crepe Myrtle

PALMS – Pool area only

- Washingtonia filifera*
- California Fan Palm
- Chamerops humilis*
- Mediterranean Fan Palm

SHRUBS – TRADITIONAL

- NERIUM oleander* 'Hardy Red'
- Hardy Dwarf Oleander
- ABELIA x grand.* 'Sunrise'
- Sunrise Variegated Abelia
- Rosa x 'Noare'*
- Flowering Carpet Rose
- ROSMARINUS o. 'Prostratus'*
- Prostrate Rosemary

SHRUBS – DESERT ADAPTIVE

- LEUCOPHYLLUM langmaniae*
- Lynn's Legacy Ranger
- LEUCOPHYLLUM f. 'Greencloud'*
- Texas Ranger
- PEROVSKIA atriplicifolia*
- Russian Sage
- SALVIA greggii*
- Red Sage
- MUHLENBERGIA capillaris* 'R. Mist'
- Regal Mist Deer Grass
- CHRYSANTHINIA mexicana*
- Damianita

DESERT ACCENTS

- DASYLIRION longissimum*
- Toothless Desert Spoon
- DASYLIRION wheeleri*
- Desert Spoon
- HESPERALOE parviflora*
- Red Yucca
- AGAVE americana* 'Marginata'
- Variegated Century Plant
- AGAVE parryi*
- Parry's Agave
- Agave weberi*
- Weber Agave

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JOHN J. COSTANZA
Landscape Architect
Stamp: 97-328108-5301
Date: 5/31/24

CANYON VIEW APARTMENTS
CANYON VIEW DRIVE
ST. GEORGE, UTAH

no.	revisions	date	by

Scale: 1" = 30'-0"
Date: JAN. 22, 2024
Drawn By: JUC
Approved By: JUC

CANYON VIEW APARTMENTS
LANDSCAPE SITE PLAN

North
Job No.
MISC.
Sheet No.
L-1
of 1

CANYON VIEW APARTMENTS
CANYON VIEW DRIVE
ST. GEORGE, UTAH
24x36 SHEET FORMAT

Exhibit G
Geotechnical Investigation



GEOTECHNICAL INVESTIGATION

CANYON VIEW APARTMENTS

ST. GEORGE, UTAH

PREPARED FOR:

**SHAKESPEAR DEVELOPMENT
37 WEST 1070 SOUTH
ST. GEORGE, UTAH 84770**

ATTENTION: BEN SHAKESPEAR

PROJECT NO. 2211499

NOVEMBER 6, 2024

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SUMMARY

1. AGECE was requested to conduct a geotechnical and geological investigation to provide recommendations for the proposed Canyon View Property as shown on Figure 1. Our investigation included the excavation of 9 test pits and the drilling of 12 borings at the approximate locations shown on Figure 2.
2. The project is located on a hillside area where there is a moderate slope on the west and south sides of the property and the lower area slopes down less to the northeast. There is approximately 70 feet of elevation change across the property. The entire site is underlain by the Chinle Formation and in particular the Petrified Forest Member of this formation. The member is also known as "blue clay" and expansive when wetted and also weak in strength when wetted. On adjacent properties, there are slopes to the east and northwest along the same ridge that have experienced slope failure and have required mitigation to stabilize. AGECE has evaluated the south and west slopes based on the proposed grading and have provided recommendations for design and construction of the project.
3. Due to the existing site topography, we anticipate significant amounts of retaining and grading. To assist in offsetting the amount of retaining required, we understand that portions of the retaining will be provided with the lower floor building walls being used as retaining walls. Depending on foundation types (micro piles or spread footings), AGECE should provide additional recommendations for design and construction for these walls.
4. The subsurface conditions across the site consist of varied thickness amounts of clay and gravel overlying mudstone. generally consist of varied thicknesses of silty sand, lean clay and silty gravel overlying mudstone bedrock. The mudstone bedrock is known as "blue clay" in the area and is moderately to highly expansive when significantly wetted.
5. The depth to mudstone is critical for limiting the potential amount of surface heave. Our experience has shown that approximately 15 feet of separation from the proposed grade to existing elevation of the mudstone is necessary to limit surface heave to less than 1 inch. The separation should be increased to 17 feet where the upper weathered portion of the mudstone is removed to allow the separation. The mudstone across the majority of the site will be less than the 15 feet depth and will need to be over-excavated to provide the separation. If the separation is provided by removing mudstone rather than raising the pad grade, our recommendation is to provide an overexcavation of 17 feet.

6. The on-site non-mudstone materials may be re-used as structural fill. The removed mudstone should be placed in non-structural or deeper fill zones of pavement/flatwork areas. Consideration may also be given to mixing the mudstone with non-expansive materials for re-use. AGECH has provided testing to allow a portion of the mudstone to be processed with additional moisture (4-6% over the optimum moisture content) and placed in the lower 5 feet (12-17 feet below grade) of the replacement zone of the overexcavation.
7. During the study(s), the portions of the site that have been previously graded contained varied amount of fill materials. These soils were primarily materials that were removed from the previous grading operations to the northwest portion of the property. The fill material is not properly compacted and will need to be removed and properly recompacted to support pavements and buildings. The majority of the fill materials are suitable to be re-used as fill. Portions of the fill contain debris or are mixed with mudstone.
8. Groundwater was encountered within Boring B-7 along the edge of the existing drainage that originates from the development above and west of the property. The drainage from this site should be piped through the site.
9. Site drainage recommendations should be implemented as recommended in the site drainage section of this report. We recommend that LID retention not be used on the site.
10. Detailed recommendations for subgrade preparation, materials, foundations, drainage and pavement are included in the report.
11. This summary should not be used independent of the information presented in the body of this report.

SCOPE OF WORK

AGEC was requested to conduct a geotechnical investigation and to provide geotechnical recommendations for the proposed Canyon View Apartments project. The property consists of two parcels with a smaller parcel located north of Canyon View Drive. The investigation covers both parcels, however, the north parcel is not part of our recommendations at this time, since there is no proposed details or construction to evaluate.

Our field investigation included the excavation of 9 test pits and the drilling of 12 borings to evaluate the subsurface conditions at the site. The locations of the explorations are shown on Figure 2. Laboratory testing was conducted on samples obtained during the field investigation to characterize the soils properties. In addition, borings B-11 and B-12 were drilled on adjacent properties above the slopes to characterize the subsurface profile for our slope evaluations.

AGEC has also reviewed the proposed grading plan at this time. The general recommendations for site grading, slope stabilization, retaining walls, foundations, pavement and drainage are included within this report.

SITE CONDITIONS

The property consists of two parcels with the northern parcel approximately 1 acre in size and the south parcel is approximately 6½ acres. The northern parcel has been filled with undocumented fill materials and slopes off to the north and east. This parcel is not part of the overall development at this time.

The remaining property is located south of Canyon View Drive. Located to the south and west is the Las Palmas Resort Development. The Las Palmas Resort is primarily several multi unit buildings that are multistory and are generally set back approximately 50 to 70 feet from the crest of the slope with exception to the northern most unit which is approximately 30 to

40 feet from the crests. The crest of the slope is generally on the Las Palmas Resort Property. Adjacent and to the east of the property is undeveloped property.

The property is primarily a sloping property with approximately 60 feet of elevation change from the SWC to the NEC. The steeper portions of the property are along the west and south portions of the property and the remainder of the property continues to slope to the northeast with less steepness.

There are several areas of the site that have been disturbed or previously graded. The Las Palmas area was developed in the 1980's and 1990's. During the grading it is our understanding from conversations with local excavators that there was a haul road that was used on the lower portion or on the west and south slopes of the property. This old road is visible in aerial photos. In addition, some fill piles exist on the northern portion of the site. There is a storm drain that exits onto the property from the Las Palmas Resort near the west center of the property. There is a drainage structure (drop box) and storm drain pipe that has been installed at the end of the roadway. This drainage seeps flows periodically along with landscape overflow water through the pipe and onto the surface to the east and northeast. There is a moderate amount of vegetation consisting of brush and small trees along this initial portion of the drainage path. The remainder of the site has sparse amounts of desert brush and small vegetation.

SUBSURFACE SOIL AND BEDROCK CONDITIONS

AGEC has evaluated the subsurface conditions on the site with the excavation of 9 test pits and the drilling of 12 borings at the locations shown on Figure 2. The pits were excavated using a small excavator. The borings were drilled with a truck mounted drill rig using solid and hollow stem augers to drill and periodic samples taken. The boring and test pit logs are shown on Figures 3 through 6 with notes, key and legend to the borings and test pits on Figure 7.

In general, the subsurface conditions consist of varied amounts of fill, silty sand, lean clay and silty gravel overlying mudstone bedrock. There was a layer of sandstone bedrock within boring B-1 above the mudstone. The fill was previously undocumented fill that was either dumped or spread on the property. The fill was encountered within Borings B-2, B-3, B-7, B-9 and B-11. The depth to mudstone varied in 2 to approximately 38 feet across the property. Generally the mudstone was within 5 to 15 feet below the surface through the majority of the site. The various types of soil/bedrock are described below:

Fill: The fill is generally undocumented or was not placed in a controlled or properly compacted manner. The fill consists of various type of materials consisting of lean clay (excavated mudstone), or silty sand and gravel. The fill was generally brown to grey in color.

Lean Clay (CL): The lean clay contained varied amounts of sand, occasional gravel and was generally stiff to very stiff, moist and varied in color from brown to grey to red.

Silty Sand (SM): The silty sand was generally encountered near the surface of the site and was medium dense in the upper 2 to 3 feet with dense and slightly to moderately cemented below. The material was light brown to grey in color and slightly moist to wet.

Clayey Gravel (GC): The clayey gravel contained varied amounts of clay mixed with small cobbles. The clayey gravels were generally near the surface and were primarily mixed as a part of the surface erosion process. generally dense with portions of the gravel being moderately cemented. The silty gravel varies from slightly moist.

Silty Gravel (GM): The silty gravel contained varied amounts of small cobbles and occasional boulders. The silty gravel is generally dense with portions of the gravel being moderately cemented. The silty gravel varies from slightly moist to wet.

Sandstone Bedrock: The sandstone is soft to moderately hard, occasional clayey zones, grey to brown in color.

Mudstone Bedrock: The mudstone is generally known in the area as “blue clay”. It is soft to moderately hard, moist to wet and varies from grey to red to purple in color. The mudstone is medium to highly plastic and varies from low to highly expansive.

The boring and test pits logs are provided on Figures 3 through 6 with the Legend and Notes to Exploratory Borings and Test Pits on Figure 7. The laboratory tests are also shown on the logs and summarized on Table 1, Summary of Laboratory Test Results. The consolidation tests are shown graphically on Figures 8 to 13.

SUBSURFACE WATER

Groundwater was observed in several of the borings including the deeper borings of B-11 and B-12 on the Las Palmas Property. The other boring was Boring B-7 near the drainage area from off the Las Palmas property. Typically the groundwater is perched over the bedrock or seeping through layers within the bedrock. The groundwater is likely the result of long term surface infiltration from the landscape watering above the property.

Fluctuations in the groundwater will occur over time and the fluctuations of the groundwater levels are beyond the scope of this study.

GEOLOGIC HAZARD EVALUATION

AGEC has reviewed the geologic literature and based on our review, there two significant items that require evaluation. The potential for landslides or slope instability is high along the south and west slope with the potential for expansive soils/rock throughout the site. These hazards were evaluated by AGECEC to provide recommendations for design and construction to mitigate the effects of the potential hazards.

A. SLOPE STABILITY

Borings B-11 and B-12 were drilled to provide information on the subsurface conditions in areas of the proposed development where significant grading is being contemplated for the development. The logs of Borings B-11 and B-12 are presented on Figure 6. Our analysis is based on a proposed grading plan prepared by Bush and Gudgeon for the Canyon View Apartments provided to us on September 20, 2024.

The ground surface, southwest of the building, slopes down from elevation 2,734 feet to 2,700 feet, which is a difference of 34 feet over approximately 42 feet (1.2:1, horizontal to vertical).

The grade, south of the building, changes from 2,738 feet down to 2,689 feet. This results in an overall slope with a drop in elevation of 45 feet over a distance of 60 feet (1.3:1, horizontal to vertical).

1. Background

The site proposed for development is located in a general area of previous ground movement. We are aware of two areas where there was landslide movement. One was located approximately 1,500 feet to the northwest and a second approximately 1,000 feet to the southeast.

Our involvement on the event located to the southeast has provided us with information that has been incorporated into this analysis.

2. Soil Characteristics

A critical issue in regard to the stability of slopes in this area is the likely presence of weak layers of soil within the bedrock that are sloped down at an angle of approximately 7 degrees and oriented in a northeast direction. Unfortunately, this characteristic is also in the direction of proposed new slopes that slope down in that same general direction.

The weak layer was the primary contributing factor to the movement experienced to the southeast of the site and resulted in back calculated strengths that were incorporated in this analysis.

Listed below is a table summarizing the materials encountered within the two borings that potentially will be impacted by the proposed change of grade.

Index Property	Low	High	Average	No. of Samples Tested
Moisture Content (%)	1	13	9	9
Dry Density (pcf)	86	123	105	6
Degree of Saturation (%)	37	70	57	6
Grain Size Distribution -200 sieve (silt and clay size)	6	93	59	9
Clay Fraction	17	27	22	3
Atterburg Limits				
Liquid limit (%)	24	48	38	7
Plasticity Index (%)	NP	27	21	7

Based on the characteristics of the soil and the index properties, the following strength values have been used in our analysis.

Material	Unit Weight (pcf)	Φ' (degrees)	c' (psf)
Gravel	135	38	0
Mudstone	125	17	900
Mudstone Weak Plane	125	21	0

3. Findings

In order to achieve appropriate factors of safety, all excavation slopes in the upper granular soil should be adjusted to be at a slope of 2.1:1, (horizontal to vertical) or flatter, which is slightly flatter than the 2:1 that is currently used in design.

Our stability analysis of the area south of the building indicates that the south basement walls will need to help support the slope by providing a buttress. The following conditions are needed to achieve a static factor of safety of 1.5.

Location	Lateral Buttress
	Loads (psf)
Garage South Wall	
West Corner	800
Mid-Point	
Floor at elevation of 2,700 feet	600
Floor at elevation of 2,689 feet	1,400
East Corner	
Apartments South Wall	250
West Corner	250
East Corner	65

The loads provided above apply at the locations indicated. Values can be linearly adjusted between the specific locations.

With the necessity of providing a buttress load we recommend that the design team consider what options they may have to either permanently improve the strength of the slope or provide a structural buttress as indicated above to maintain stability.

The factor of safety drops below 1 under seismic events. The amount of deformation under a major seismic event (2% in 50-years) would result in less than 4 inches of displacement.

4. Upper Rockery Retaining Wall South of Parking Structure

The 10-foot-high rockery, proposed to be located south of the facility will need to have reinforcement that extends behind the face of the rockery. In addition to the reinforcement needed for the rockery, additional length is needed for the overall slope stability. For planning purposes, we suggest that the length of the grid extend at least 20 feet beyond the face of the rockery on the west end of the rockery increasing to a distance of 30 feet at the location closest to the southwest corner of the parking structure. The 30-foot grid length will then continue to the east end of the rockery.

As project design proceeds, we recommend that the buttress loads and the grid designs be reviewed to verify that the design maintains the stability of the south slope.

5. Further Recommendations

The soil and bedrock strengths in the hillside need to remain similar to what has been used in this analysis in order for the stability to be maintained. This can be achieved by keeping the moisture conditions as they currently are, and drier if possible.

Recommendations to maintain if not to improve the current moisture conditions include:

- Collect and remove surface water that comes onto the property from off and on the site.
- The drainage system needs to be watertight. This type of construction is not standard and therefore would require specific attention to verify that the improvements are watertight. This would also include not storing storm water on site without positive methods to eliminate and verify that the water is not seeping into the subgrade.

- Waterways should be lined to prevent seepage into the ground.
- Positive measures need to be taken to eliminate the potential for water to ever pond on the site and on the hillside.
- Eliminate landscaping that requires irrigation as much as possible.

PROPOSED CONSTRUCTION

We understand the project will consist of a large Apartment Building with underground parking. The concept plan is shown on Figure 2. The building will be reinforced concrete on the lower sections and wood framed above grade. The parking garage will have two levels with the north eastern level being 2678 feet, the next tier to the south and west being 2689 feet. The main floor will be 2700 feet. There are planned to be several amenities including pickle ball courts and a possible swimming pool. We anticipate relatively heavy wall loads on the order of 6 to 8 kips per lineal foot with column loads up to 150 kips.

The public improvements will also include utilities and the widening of Canyon View Drive.

As more details of the proposed construction are known, AGECE should review and update our recommendations.

RECOMMENDATIONS

Based on subsurface soil conditions, engineering analysis, and the proposed construction, the following recommendations are provided:

A. Site Grading

Based on the grading plan provided by Bush & Gudgeon Engineering, there are cuts on the order of up to approximately 30 feet on the south end of the site with the majority of the building area being a cut with the deeper section being about a 10 foot step below the adjacent near surface area. There are fills on the west center upper level part of the building and along the majority of the northwestern portion of the site. The fills will be up to approximately 12 feet.

1. Subgrade Preparation

General: Prior to placing fill, the site should be grubbed to remove vegetation and soil containing roots and organics. The amount of materials will vary with the type of vegetation and location. These materials should be disposed off site.

Subsequent to grubbing and prior to placing fill, the subgrade preparation will vary across the site for different conditions as follows:

Roadways: The subgrade is anticipated to vary from silty sand and gravel to mudstone. We recommend a separation of at least 3 feet between the mudstone and pavement subgrade.

Building Pads: Pads that are located within a cut zone should be overexcavated to at least 2 feet below the proposed pad grade to provide a uniform pad. In areas where the building pad is not at least 15 feet above the mudstone, the mudstone should be overexcavated to remove the mudstone down to a depth of at least 17 feet below pad grade. AGECC should verify removal of the mudstone. The contractor should provide verification of the limits and depths by survey.

2. Excavation

In general, we anticipate that excavation of the bedrock at the site will likely require heavy duty excavation equipment.

3. Grading Slopes and Trenches

The following table provides the maximum recommended slope steepness for Sa given slope condition. Slopes should include benches in accordance with the 2021 IBC.

Slope Condition	Maximum Slope (Horizontal:Vertical)
Permanent Cut Slopes in Overburden Soils*	2.1:1
Unretained, Properly Compacted Fill	2:1
Utility Trenches in Bedrock (OSHA Soil Class A)	½:1

*see slope stability recommendations in the slope stability section above.

Fill slopes should be graded by overbuilding and then cutting back to the desired grade to provide a compacted slope face. Fill placed on existing slopes steeper than 3:1 should be placed using a benching procedure to key the fill into the existing slope. Benches should be of sufficient width to allow adequate area for the compaction equipment.

Steeper trenches may require the use of shoring or a trench box to provide as safe work environment. Safe trench excavation is the responsibility of the contractor.

4. Materials

The majority of the fill materials anticipated at the site will likely consist of silty sand, gravel and clay along with mudstone or sandstone bedrock. The majority of the soils are dry and will need to be moisture conditioned prior to use as fill. AGECE has evaluated the re-use of the mudstone in the lower 5

feet (12-17 feet below pad grade) of the deep overexcavation areas (see Fig 14). These materials may be used by wetting (marinating) the soil with 4 to 6 percent over the optimum moisture content and allowing to cure or marinate for 24 to 48 hours prior to placement or compaction. The materials should then be placed and compacted to approximately 90 to 95 percent of the maximum dry density as determined by ASTM D-698. The over compaction may result in additional heave. It is critical achieve the proper moisture and compaction range if these soils are re-used in the deeper excavation process.

Consideration may also be given to mixing the mudstone with non-expansive materials for re-use. Typically, a ratio of 2:1 (non expansive to mudstone) may be used in deeper fill zones. AGECC can provide additional laboratory testing upon request to provide recommendations for mixing ratios. We do not recommend that mixed materials be used in the upper 5 feet of building pads.

If additional materials are Imported, the materials should be non-expansive, non-gypsiferous, granular soil. Listed below are the materials recommended for imported fill.

Area	Fill Type	Recommendations
Foundations/slabs	Site grading/ structural fill	-200 < 35%, LL < 30%
		Maximum size: 4 inches Solubility < 1%
Underslab (upper 4 inches)	Base Course	-200 < 12% Maximum size: 1 inch Solubility < 1%

-200 = Percent Passing the No. 200 Sieve

LL = Liquid Limit

5. Compaction

Compaction of materials placed at the site should equal or exceed the following minimum densities when compared to the maximum dry density as determined by ASTM D-1557:

Area	Percent Compaction
Subgrade	90
Footings/building pad	95
Site grading	95
Utility trenches	95
Wall backfill	95

To facilitate the compaction process, the overburden soil and processed, non-expansive bedrock should be moisture conditioned to within 2 percentage points of the optimum moisture content as determined by ASTM D-1557 prior to placement.

Fill should be placed in loose lift thicknesses which do not exceed the capacity of the equipment being utilized. Generally, 6 to 8-inch loose lifts are adequate. Lift thicknesses should be reduced to 4-inches for hand compaction equipment.

6. Surface Drainage

Positive site drainage should be maintained during the course of construction. After construction has been completed, positive drainage of the surface water away from the buildings in each direction must be maintained. To reduce infiltration adjacent to foundations we recommend the following:

- a. A minimum slope of 6 inches in the first 10 feet from the perimeters of the structures should be provided.

- b. Roof gutter systems should be installed around the perimeters of the structures. Roof downspouts should discharge away from the buildings so as to prevent ponding adjacent to foundations. We recommend piping roof gutter downspouts of site directly into the adjacent curb and gutter.
- c. Placement of 3 to 4 foot wide concrete aprons around the perimeters of the structures.
- d. Landscaping requiring water should not be placed adjacent to foundations or within 10 feet of foundations.
- e. Due to the presence of the underlying expansive layers, we recommend protection of the underlying foundation support soils with a 10 mil impermeable PVC membrane. The membrane should be attached to the perimeter foundation of the residence and slope away from the residence at a 5 percent slope into a perimeter drain trench to collect and discharge water off site. The drain trench should include gravel and a 4 inch perforated PVC pipe to collect and transport water off site. It is critical the line extend into line both sides and the bottom of the trench.
- f. Below grade portions of walls/fences which are backfilled with soil should be protected with an impermeable membrane and a subsurface drain on the backfilled side. A gravel covered, perforated PVC pipe should also be placed at the base of the wall to carry water to a discharge point. This is intended to reduce the potential for salt weathering and sulfate attack on concrete/masonry.

7. Low Impact Development (LID) Drainage

AGEC has reviewed the planned areas for surface infiltration areas shown as LID on the grading plans and the Dixie Storm Water Coalition Guide (DSWCG) for Low Impact Development (Ref No. 1) and provided the following evaluation:

Using the reference No. 2 for determining the USDA mapped soil, there are several soil types including "WBD" or Winkel, gravelly fine sandy loam, "NLE" and "EB"- Eroded land Shalet complex. The site has a Hydrologic Soil Group of D. Our evaluation Geotech evaluation has shown that we have shallow mudstone bedrock. There is also localized groundwater conditions.

Using the DSWCG, Figure 2 (flow chart), and based on the soil types and conditions, Steps- 1-3 are "No" due to the shallow bedrock on the site. Based on the rock conditions, we do not recommend using any of the Best Method Practices (BMP's) within Reference No. 1.

The following parameters may be used in the application-Template form:

Subsurface Information	
Groundwater	
Depth to Groundwater (ft)	Varies
Historical High Depth to Groundwater if known (ft)	Not Known
Source	Geotech Study
Groundwater Contamination at Site:	N/A
Soil Information	
Infiltration Rate (in/hr) ^{Ref No. 3}	< 1
Hydrologic Soil Group/Map Unit Symbol:	D
Source:	USDA Web Site Ref. No. 2
Soil Contamination at Site:	N/A

Due to the underlying expansive mudstone the groundwater will perch to create an artificial groundwater condition, which exists on portions of the site from the development to the north. The perching will likely result in lateral movement of water and resulting in the introduction of water to locations that may be a concern, such as utility trenches, next to slopes that would reduce stability and cause seepage concerns. We would recommend that infiltration be limited and that the basin areas be allowed to overflow into storm drainage that allows water to leave the property to regional drainage areas.

B. Foundations

1. Conventional spread and spot footings:

Foundation subgrade should be prepared as outlined above in order to utilize conventional foundations.

The following foundations recommendations may be used

a. Bearing Material

The proposed residences may be supported on conventional spread footings bearing on properly compacted structural fill underlain by a properly prepared subgrade. Specifically, the subgrade should be prepared during site grading by overexcavating the building pads to remove unsuitable soils as recommended in the Subgrade Preparation section of this report. Imported structural fill should be used in the upper 2 feet below foundations.

b. Bearing Pressures

Footings bearing on properly compacted structural fill may be designed for the following net allowable bearing pressures.

Load Condition/Foundation width (ft)	Net Allowable Bearing Pressure (psf)
Walls (2 ft)	2,000
Walls (2-3 ft)	2,500 psf
Walls (3-4 ft)	3,000 psf
Columns (2-4 ft)	2,500 psf
Columns (4-6 ft)	3,000 psf
Columns (6-8 ft)	3,500 psf

c. Footing Width and Embedment

Footings should have a minimum width of 18 inches and should be embedded at least 12 inches below the lowest adjacent grade.

d. Temporary Loading Conditions

The allowable bearing pressures may be increased by one-half for temporary loading conditions such as wind or seismic loads.

e. Settlement

We estimate that settlement will be approximately 1 inch for footings designed as indicated above due to the load of the structure. Differential settlement is estimated to be approximately ½ inch.

f. Foundation Base

The base of excavations should be cleared of loose or deleterious material prior to placement of fill or concrete.

C. Concrete Slab-on-Grade**1. Slab Support**

Concrete slabs may be supported on a zone of properly prepared (overexcavated) and compacted fill as stated in the Subgrade Preparation and Materials sections of this report with a minimum thickness of at least 12 inches.

2. Underslab Base Course

A 4-inch layer of properly compacted base course should be placed below slabs to provide a firm and consistent subgrade and promote even curing of the concrete.

3. Vapor Barrier

A vapor barrier should be placed below slabs in areas which will receive sensitive floor coverings or coverings which are impermeable. Vapor barriers also provide protection from salt and sulfate attack.

D. Lateral Earth Pressures**1. Lateral Resistance for Footings**

Lateral resistance for spread footings is controlled by sliding resistance developed between the footing and the subgrade soil. An ultimate friction value of 0.40 may be used in design for ultimate lateral resistance of footings bearing on properly compacted on-site soils. The friction value may be increased to 0.45 if the foundations bear on imported structural fill.

2. Retaining Structures

The following equivalent fluid weights are given for design of subgrade walls and retaining structures. The active condition is where the wall moves away from the soil. The passive condition is where the wall moves into the soil and the at-

rest condition is where the wall does not move. We recommend the basement walls be designed in an at-rest condition.

The values listed below assume a horizontal surface adjacent the top and bottom of the wall.

Description	Active	At-Rest	Passive
Granular Backfill - Equivalent Fluid Weight	35 pcf	55 pcf	325 pcf
Granular Backfill- Earth Pressure Coefficient (Processed/mixed mudstone)	0.28	0.44	-
Fine-Grained Backfill - Equivalent Fluid Weight	50 pcf	65 pcf	190 pcf
Fine-Grained backfill - Earth Pressure Coefficient	0.36	0.55	-

Care should be taken to prevent percolation of surface water into the backfill material adjacent to the retaining walls. The risk of hydrostatic buildup can be reduced by placing a subdrain behind the walls consisting of free-draining gravel wrapped in a filter fabric.

3. Seismic Conditions

Under seismic conditions, the equivalent fluid weight should be modified as follows according to the Mononobe-Okabe method assuming a level backfill condition:

Lateral Earth Pressure Condition	Seismic Modification (2% PE in 50 yrs)	
	Granular Backfill	Fine-Grained Backfill
Active	9 pcf increase	10 pcf increase
At-rest	no increase	no increase
Passive	22 pcf decrease	16 pcf decrease

The resultant of the seismic increase should be placed up $\frac{1}{2}$ the distance up from the base of the wall.

4. Safety Factors

The values recommended assume mobilization of the soil to achieve the assumed soil strength. Conventional safety factors used for structural analysis for such items as overturning and sliding resistance should be used in design.

E. Seismicity, Liquefaction and Faulting

1. Listed below is a summary of the site parameters as required by the 2021 International Building Code and ASCE 7-16:

Description	Seismic Parameter
	2,500 yr event ($\approx 2\%$ PE in 50 yrs)
Site Class	C
S_s (0.2 second period)	0.49g
S_1 (1 second period)	0.16g
PGA	0.22g
F_a	1.3
F_v	1.5
F_{pga}	1.2

The values provided above were generated using the ASCE 7-16 Seismic Hazard Tool. Based on the observed subsurface conditions, a ground motion hazard analysis (GMHA) as per ASCE 7-16 is not required by the 2021 International Building Code.

2. Liquefaction

Based on subsurface conditions encountered in the borings and the test pits, the subsurface soils and bedrock observed are non-liquefiable during a seismic event.

3. Faulting

Based on a review of available geologic literature, there are no mapped faults extending near or through the site.

F. Soil Corrosion

Based upon our experience in the area, the on-site soils, bedrock, and many imported sources may contain sulfates in sufficient concentration to be corrosive to concrete. Therefore, we recommend concrete elements that will be exposed to the on-site soils be designed in accordance with provisions provided in the American Concrete Institute Manual of Concrete Practice (ACI) 318-14. Tables 19.3.1.1 and 19.3.2.1 of ACI 318-14 should be referenced for design of concrete elements utilizing a Sulfate Exposure Class of S2.

Consideration should also be given to cathodic protection of buried metal pipes. We recommend utilizing PVC pipes where local building codes allow.

G. Roadway-Pavements

1. Subgrade Support

We anticipate that the subgrade materials beneath the pavement areas will consist of silty to clayey sand or compacted fill materials. The subgrade should be prepared as outlined in the subgrade preparation section of this report. A California Bearing Ratio (CBR) of 10 percent was assumed for a properly compacted subgrade for purposes of design.

2. Pavement Thickness

Based on the assumed traffic loadings and St. George City traffic indexes, a 20-year design life, and AASHTO design methods, the following pavement sections are recommended.

FLEXIBLE PAVEMENT SECTIONS				
Roadway	Traffic Index	ROW	Asphaltic Concrete (inches)	Base Course (inches)
Canyon View Drive	7	80	4	8
Interior Parking	5	NA	2.5	6
Traffic/Access	5	NA	3	6

3. Pavement Materials

The pavement materials should meet City of St. George specifications for gradation and quality. The pavement thicknesses indicated above assume that the base course is a high quality material with a CBR of at least 50 percent and the asphaltic concrete has a minimum Marshall stability of 1,800 pounds. Other materials may be considered for use in the pavement section. The use of other materials may result in other pavement material thicknesses.

4. Drainage

The collection and diversion of drainage away from the pavement surface is extremely important to the satisfactory performance of the pavement section. Proper drainage should be provided.

H. Construction Testing and Observations

We recommend the following testing and observations be done as a minimum as required by the City of St. George.

1. Observe grubbing and verify removal of soil containing roots and organics.
2. Verify that recommended overexcavation depths are achieved in the building pads and beneath roadways. The lateral extent of the building pad should be located by survey (not included in AGECE's Scope of Services) and include the area which extends at least 5 feet beyond the buildable area as per city set-back requirements. Additional test pits and engineering observation may be necessary during site/pad grading to assist in locating and defining the potentially expansive layers of mudstone bedrock.
3. After mass grading is complete, additional exploration will be necessary in cut areas to verify subsurface conditions and the depth to underlying potentially expansive layers of bedrock.
4. Verify that recommended structural fill depths are provided below foundations and slabs.
5. Conduct compaction testing on fill placed below foundations and in building pads. We recommend testing each foot of fill placed.

6. Conduct construction materials testing on city improvements at a frequency which meets or exceeds St. George City requirements.

I. Geotechnical Recommendation Review

The client should familiarize themselves with the information contained in this report. If specific questions arise or if the client does not fully understand the conclusions/recommendations provided, AGECE should be contacted to provide clarification.

LIMITATIONS

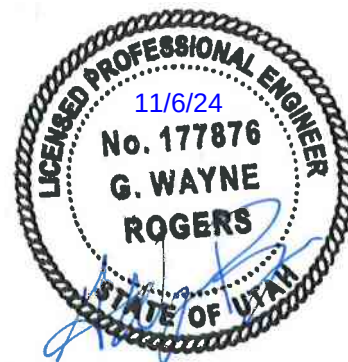
This report has been prepared in accordance with generally accepted soil and foundation engineering practices in the area for the use of the client for design purposes. The conclusions and recommendations included within the report are based on the information obtained from the field and laboratory testing, the information from the referenced studies and our experience in the area. Variations in the subsurface conditions may not become evident until excavation is conducted. If the subsurface conditions are found to be significantly different from those described above, we should be notified to reevaluate our recommendations.

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

APPLIED GEOTECHNICAL ENGINEERING CONSULTANTS, INC.

G. Wayne Rogers, P.E.

James E. Nordquist, P.E.



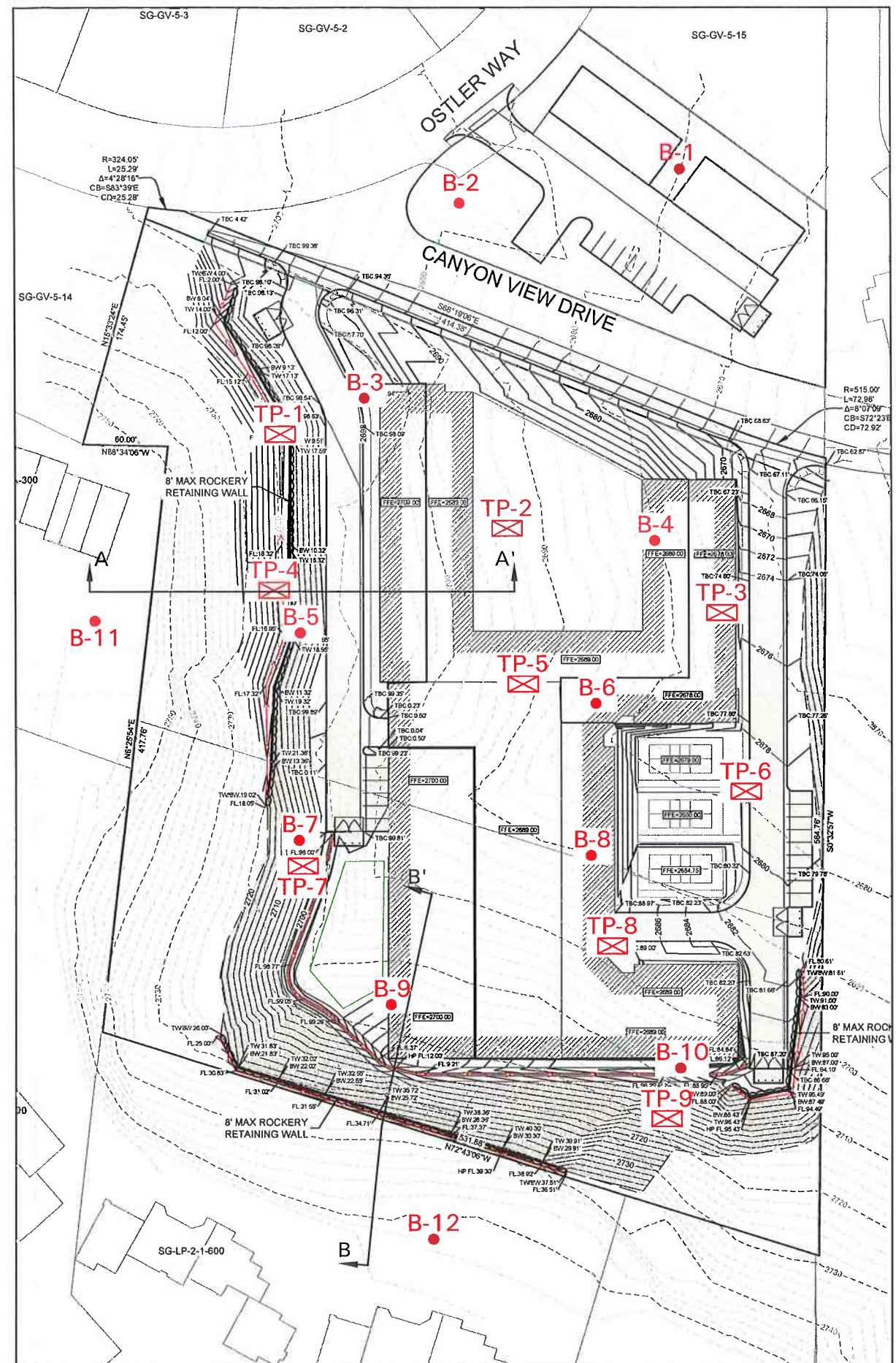
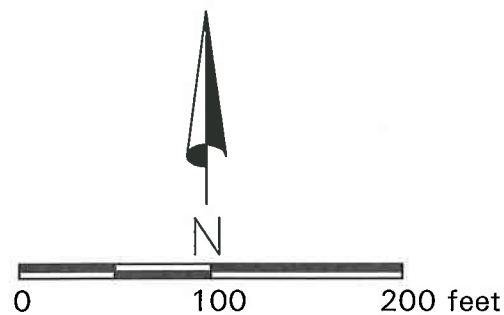


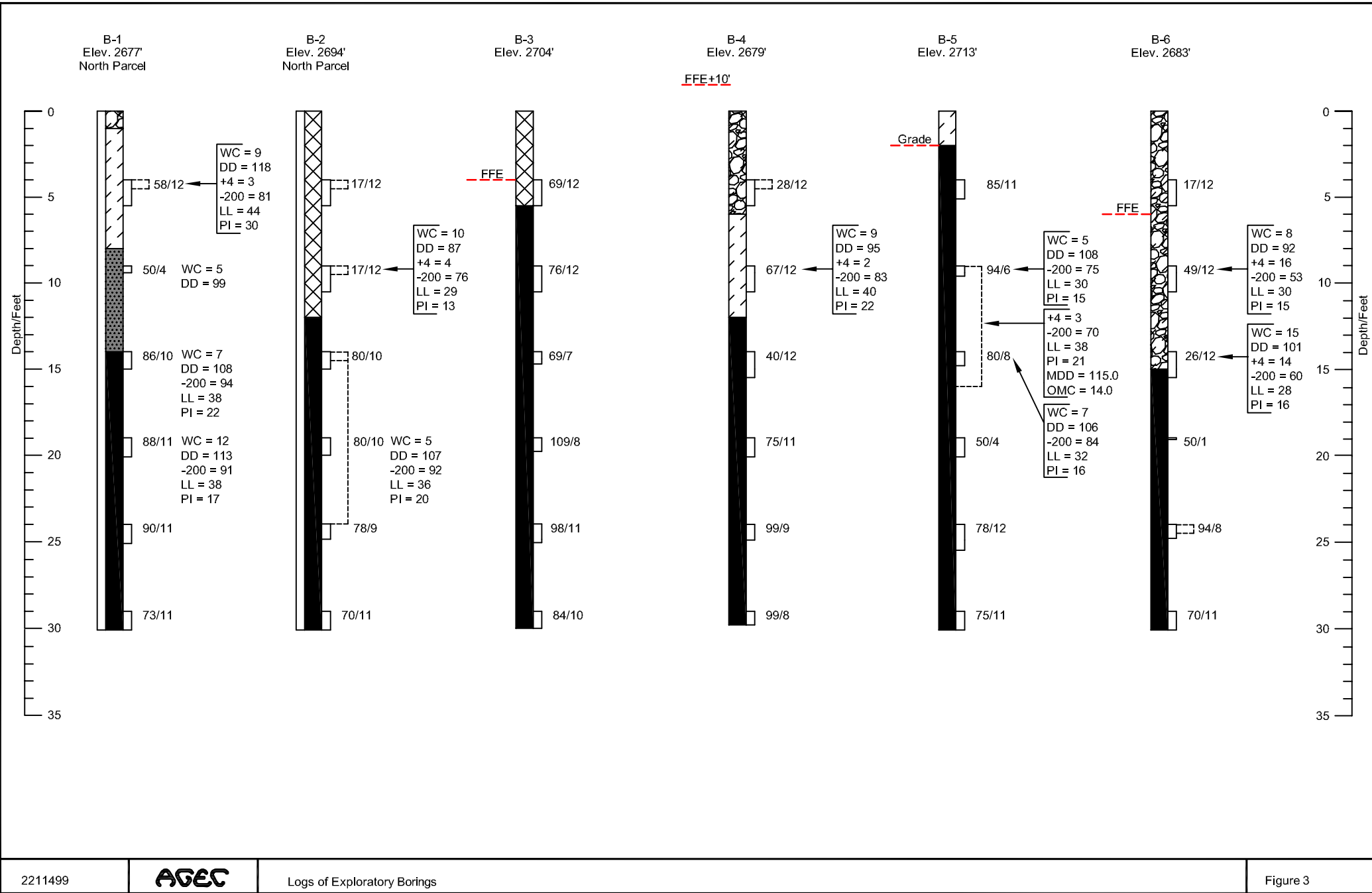
CANYON VIEW APARTMENTS
ST. GEORGE, UTAH

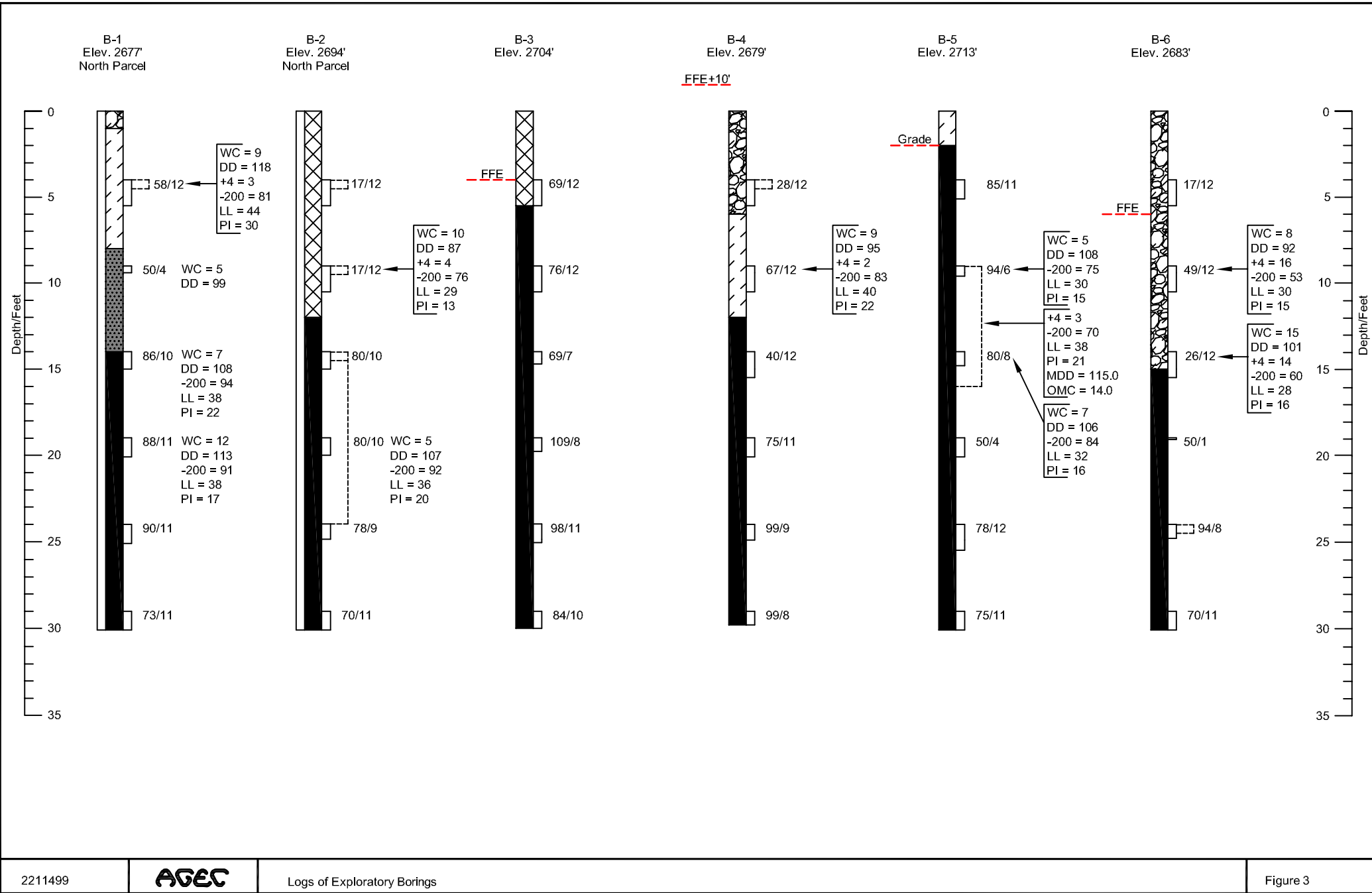
Not to Scale

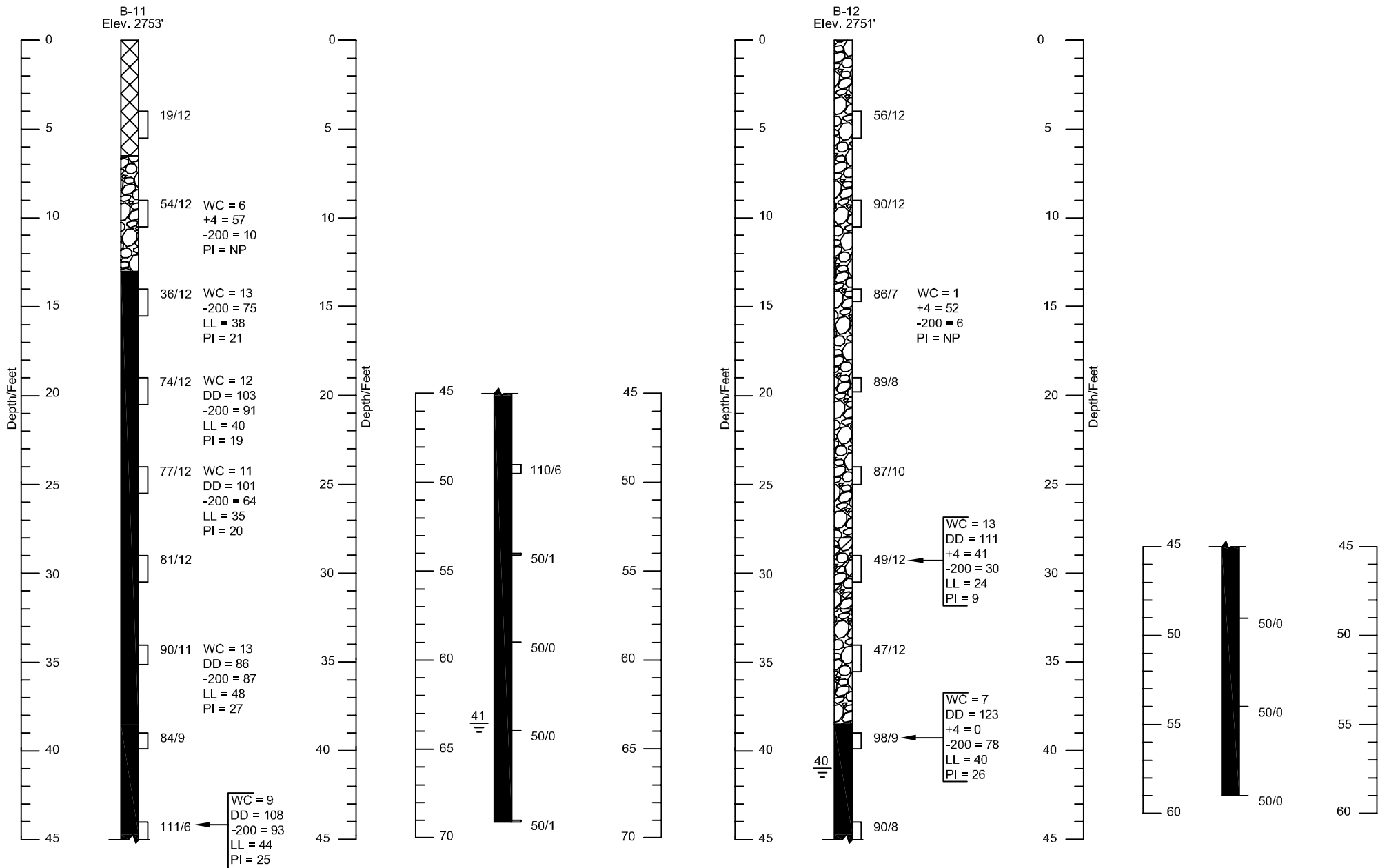
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ST. GEORGE, UTAH

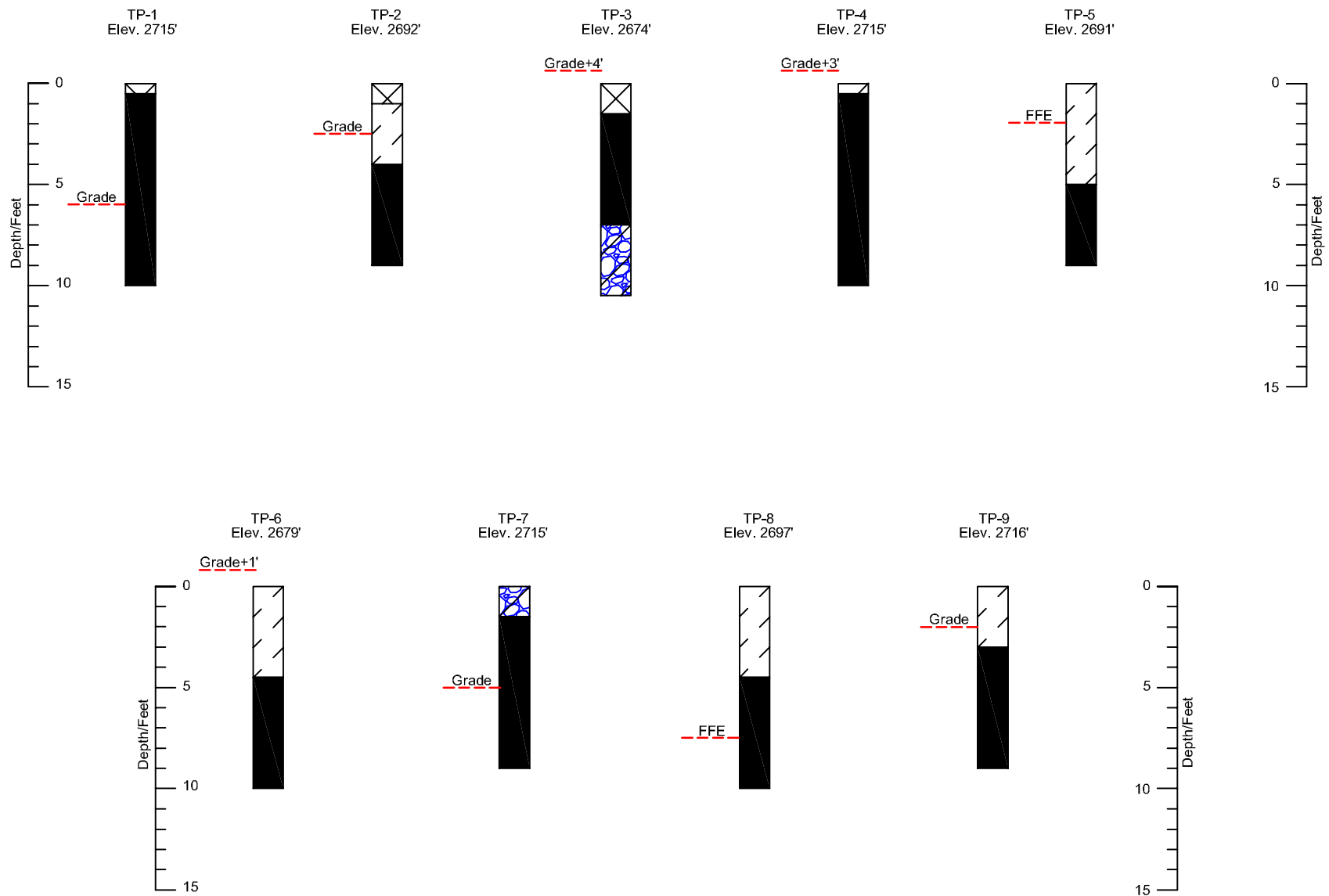
-  Approximate test pit location
-  Approximate boring location
-  Slope evaluation cross-sections











LEGEND:



Fill; varies from mudstone to silty gravel, poorly compacted, slightly moist, grey to brown to red.



Sandy Lean Clay with Gravel (CL); stiff, moist, brown to grey.



Clayey Gravel (GC); dense, generally in few feet above mudstone, moist, grey.



Silty Gravel with Sand (GM); dense to hard, contains cobbles size gravel, generally sub-rounded, dry to wet, grey.



Sandstone Bedrock; moderately hard, fine to medium grained, grey to brown.



Mudstone Bedrock; consists of lean to fat clay (blue clay), moderately to highly plastic, moist, grey to purple to red.



10/12 California drive sample taken. The symbol 10/12 indicates that 10 blows from a 140 pound hammer falling 30 inches were required to drive the sampler 12 inches.



Indicates slotted 1 inch PVC pipe installed in the boring to the depth shown.



Indicates disturbed sample taken.

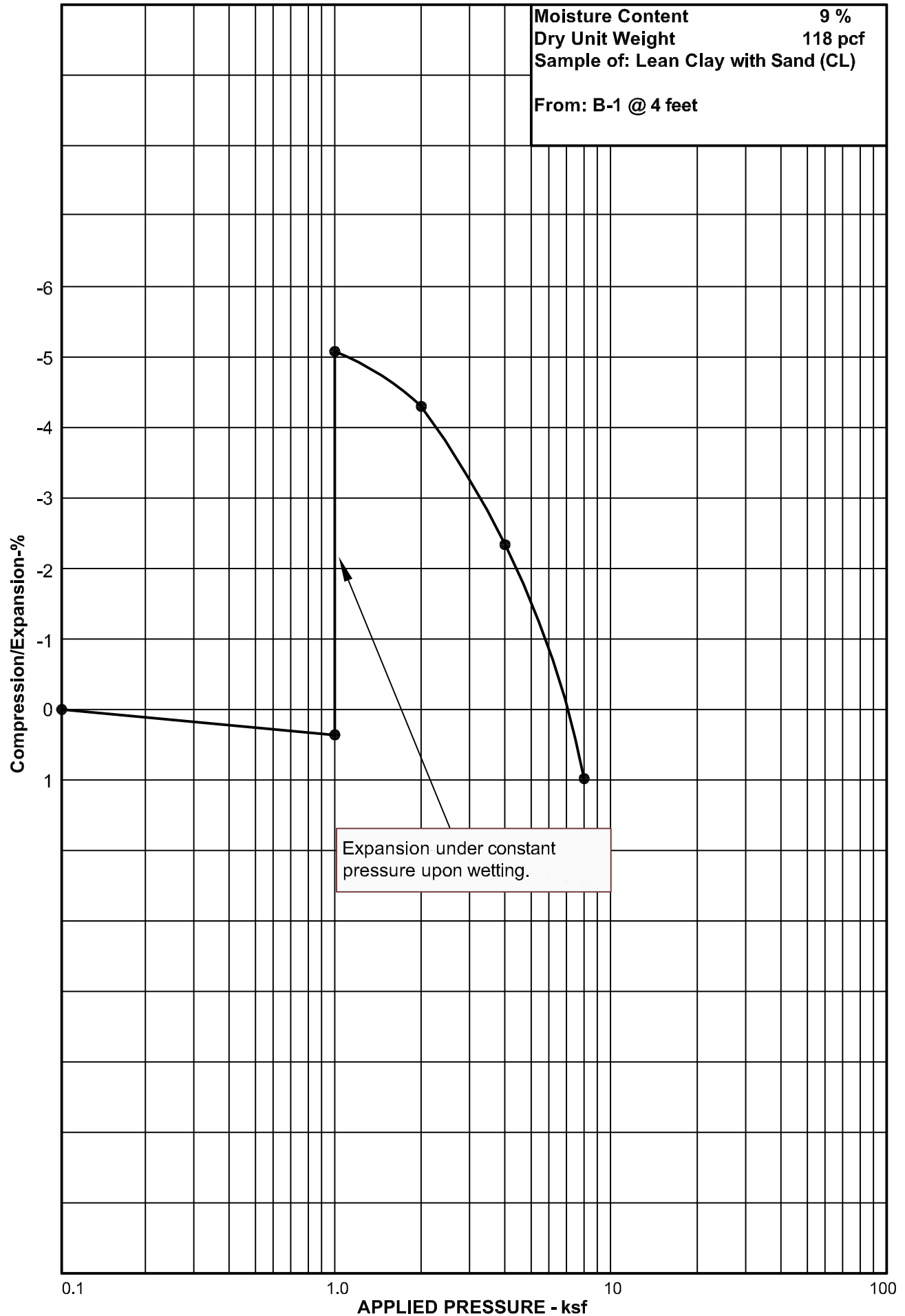


Indicates the depth to free water and the number days after excavation the measurement was taken.

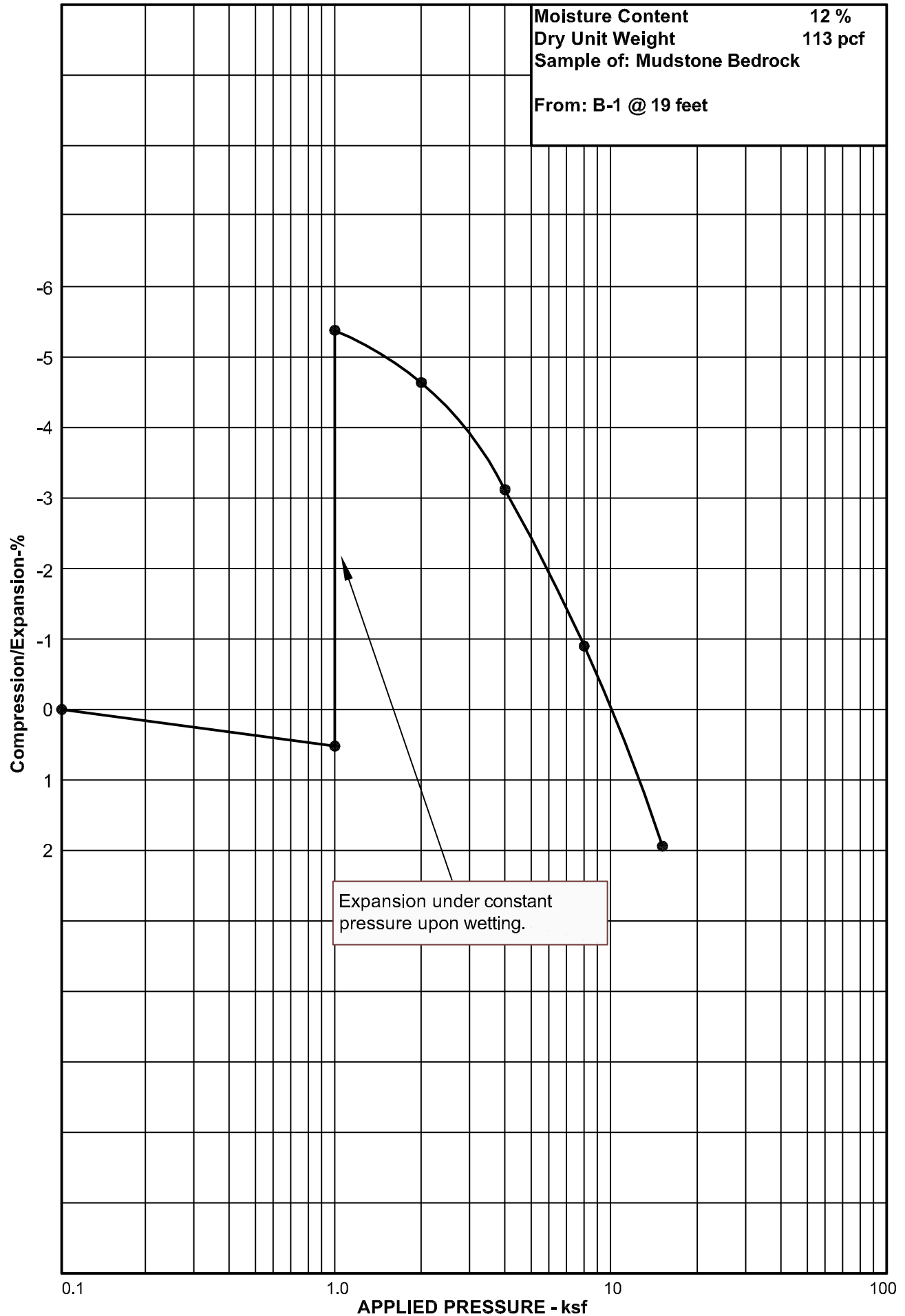
NOTES:

1. Borings B-1 to B-10 were drilled on July 19 and 20, 2023 with a truck mounted drill rig equipped with 8-inch hollow-stem augers. Borings B-11 and B-12 were drilled on March 26 and 27, 2024. The test pits were excavated on July 19, 2021 with a rubber tired backhoe.
2. The locations of the borings and test pits were measured by a hand held GPS.
3. The elevations of the borings and test pits were determined by interpolation between contours on the site plan provided.
4. The boring and test pit locations and elevations should be considered accurate only to the degree implied by the method used.
5. The lines between the materials shown on the logs represent the approximate boundaries between material types and the transitions may be gradual.
6. Free water was encountered in the boring B-7 at the time of drilling at the depth shown.
7. WC = water content (%);
DD = dry density (pcf);
+4 = percent retained on the No. 4 sieve;
-200 = percent passing No. 200 sieve;
LL = liquid limit (%);
PI = plasticity index (%);

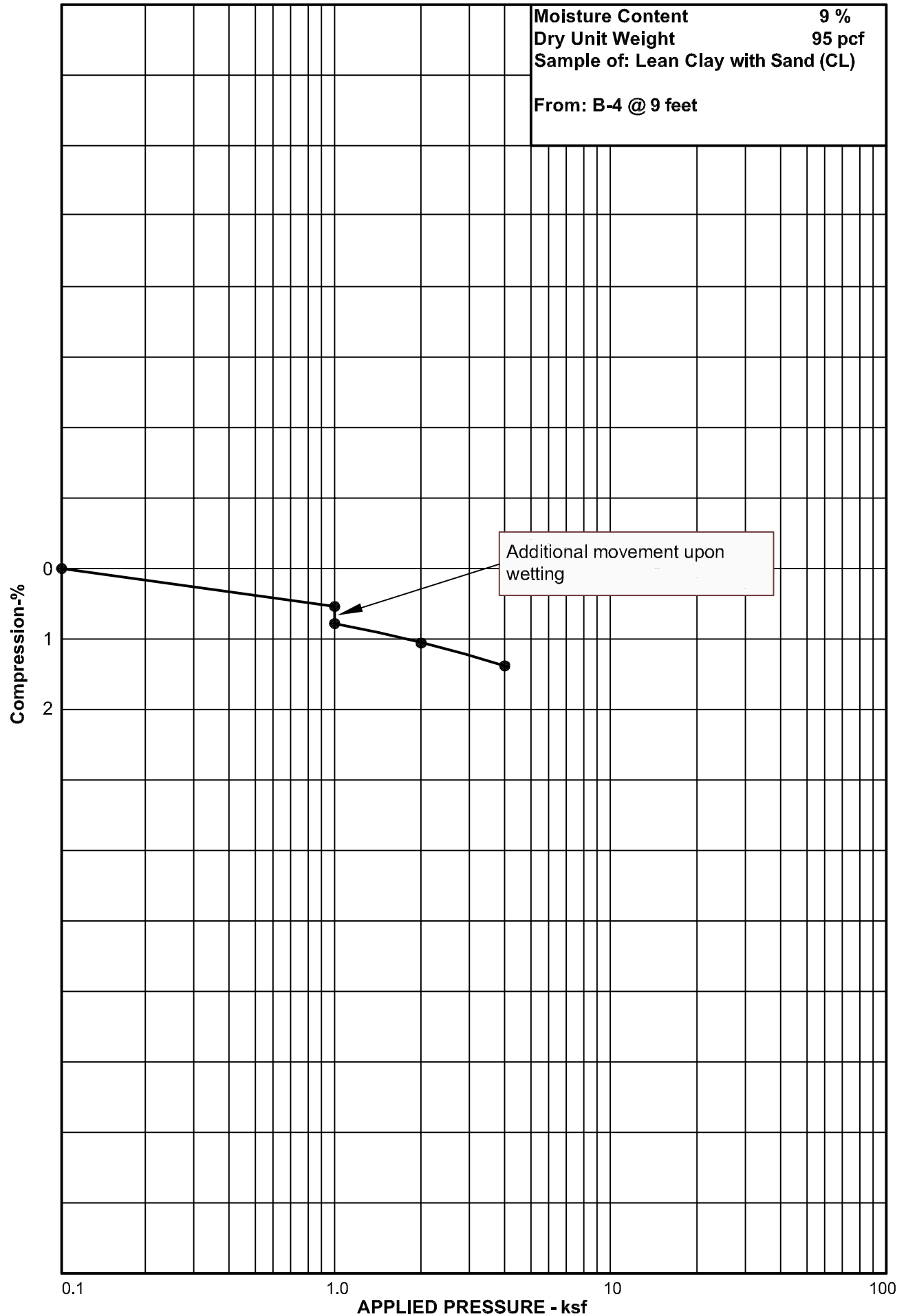
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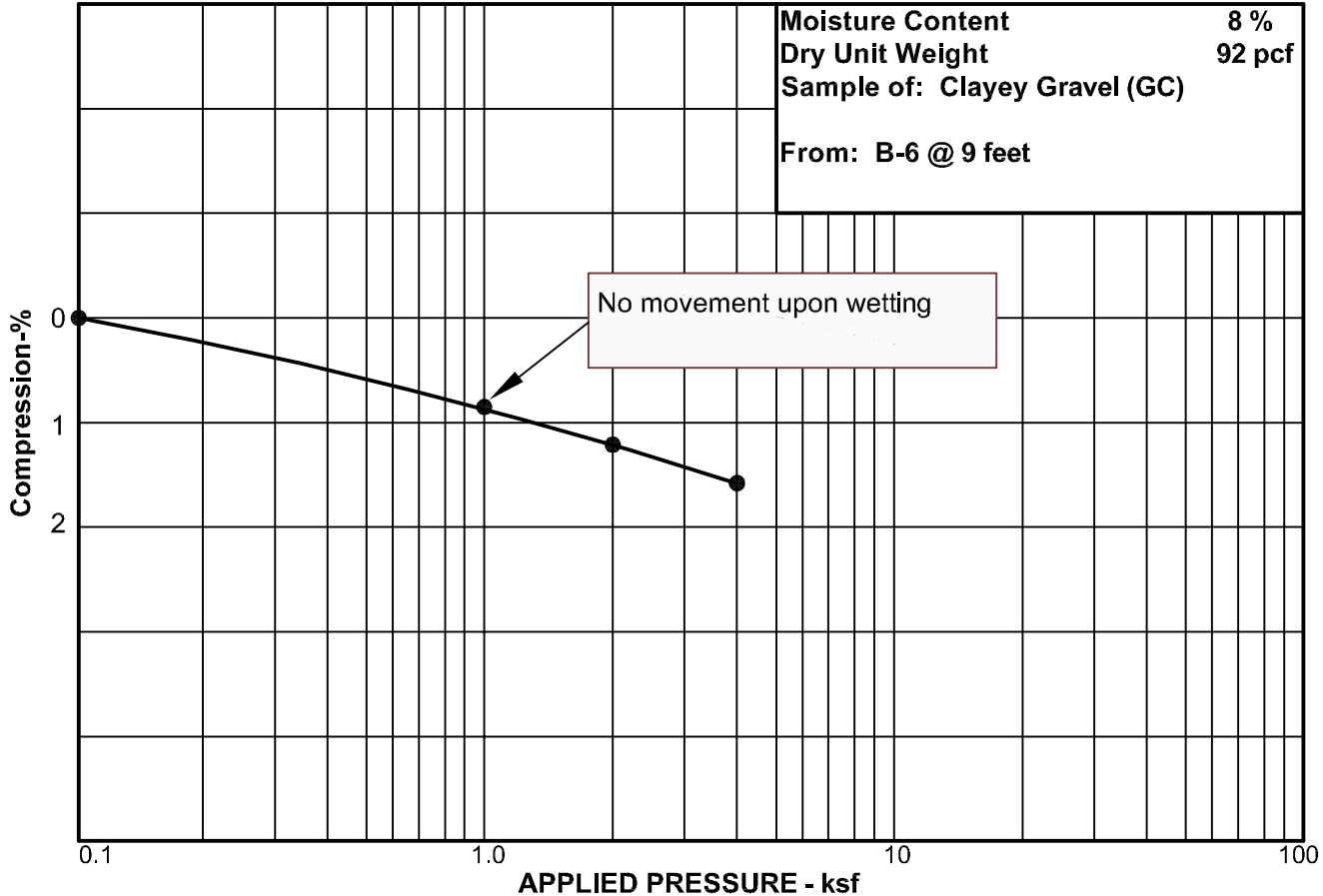
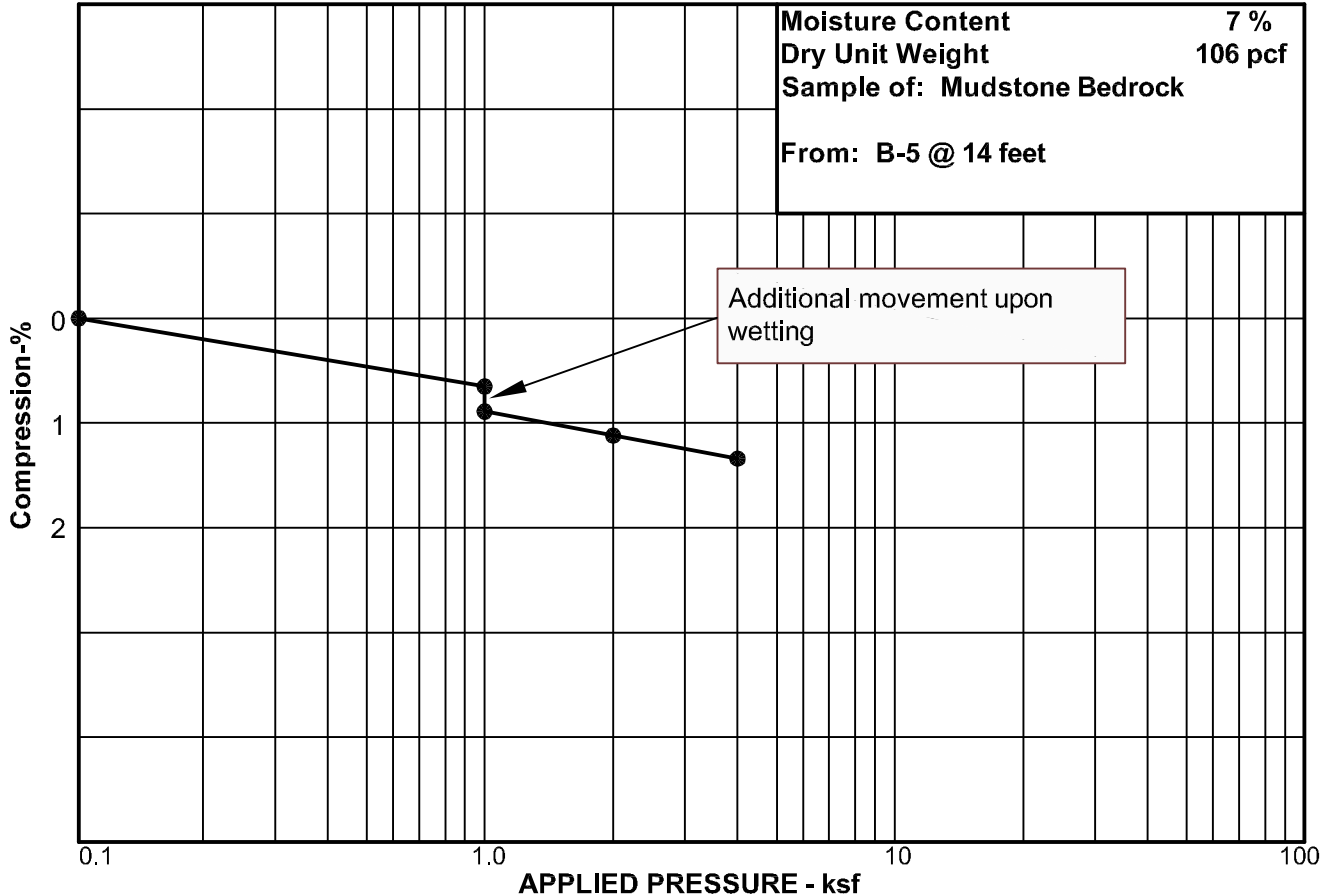
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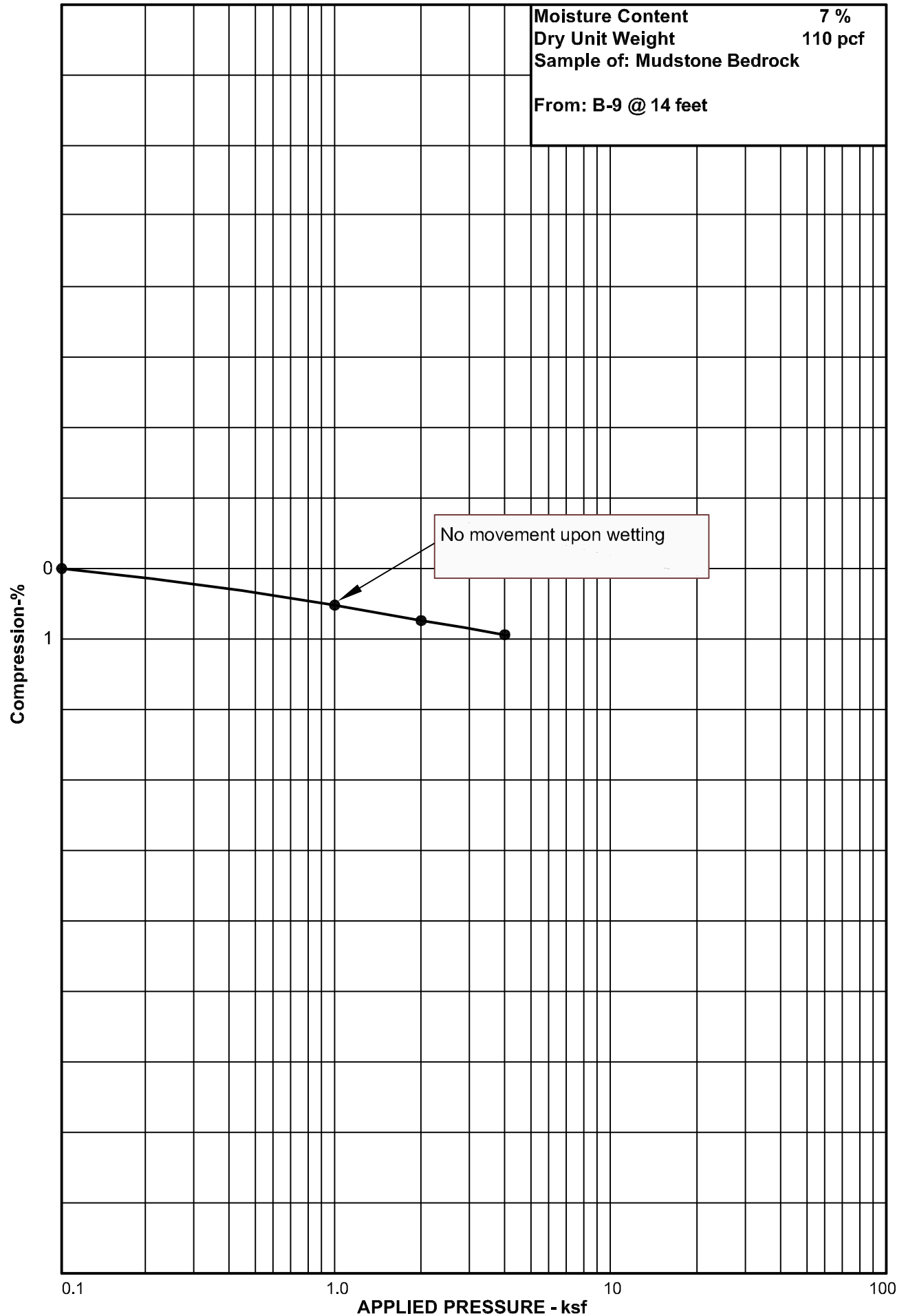
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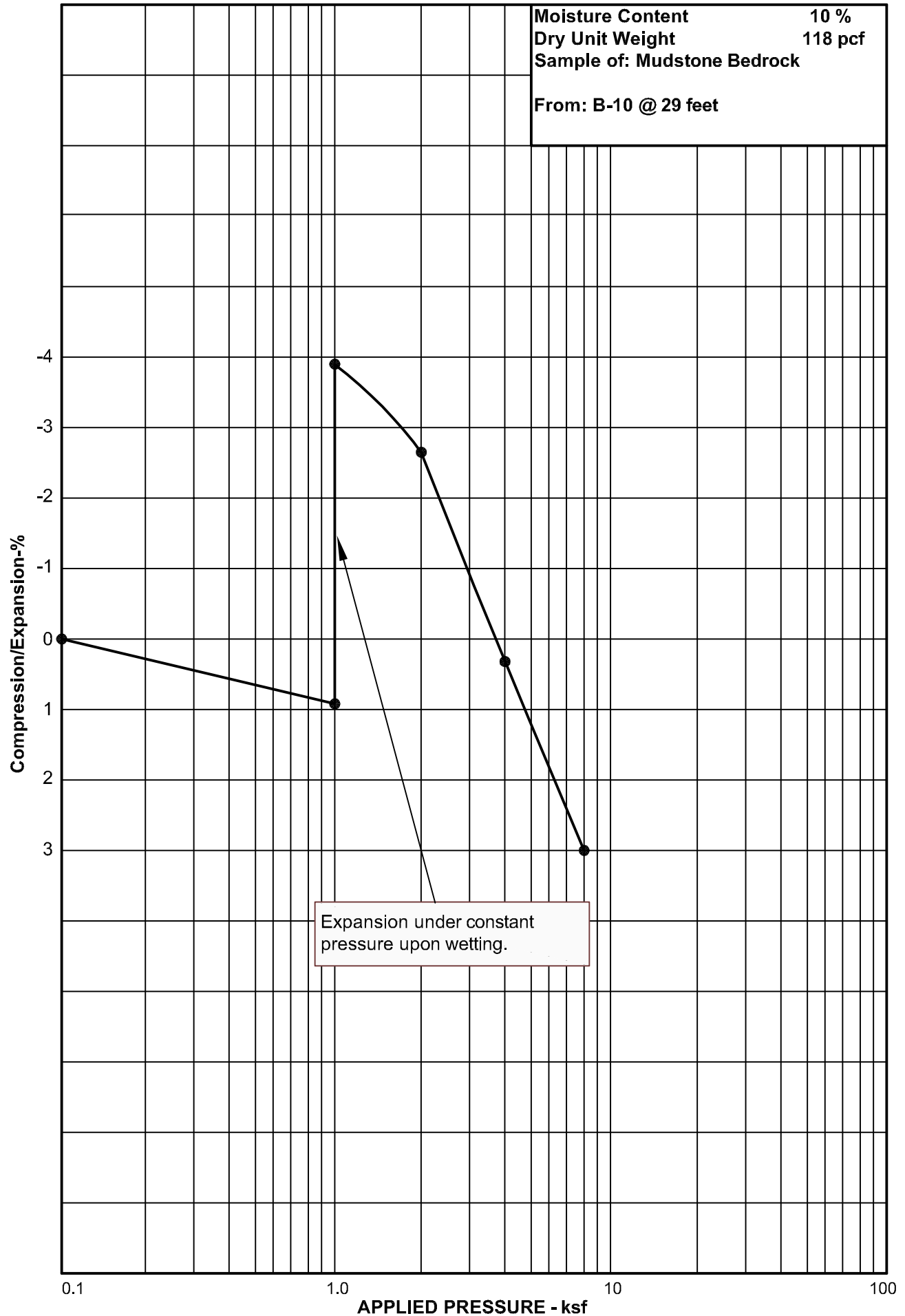
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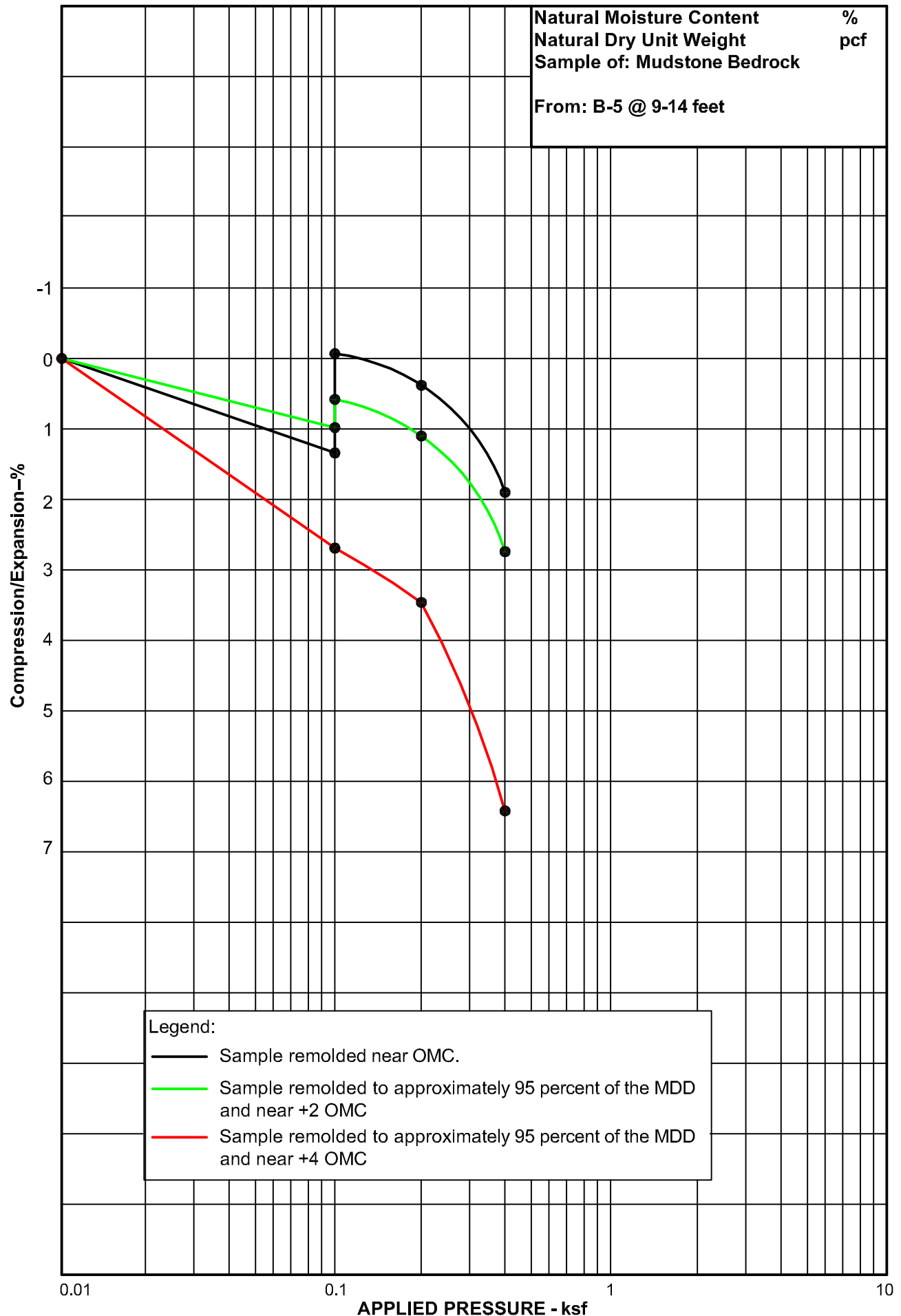
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Applied Geotechnical Engineering Consultants, Inc.



SIEVE ANALYSIS TEST REPORT Quality Control

Sample Date: 5/17/24
Project Number: 2211499
Project Name: Canyon View Property
Client: Shakespeare Development Group

Lab Number:
Sampled By:
Tested By: LAB

Sample Location: B-11 @ 9'
Supplier:
Aggregate Size:

Gradation

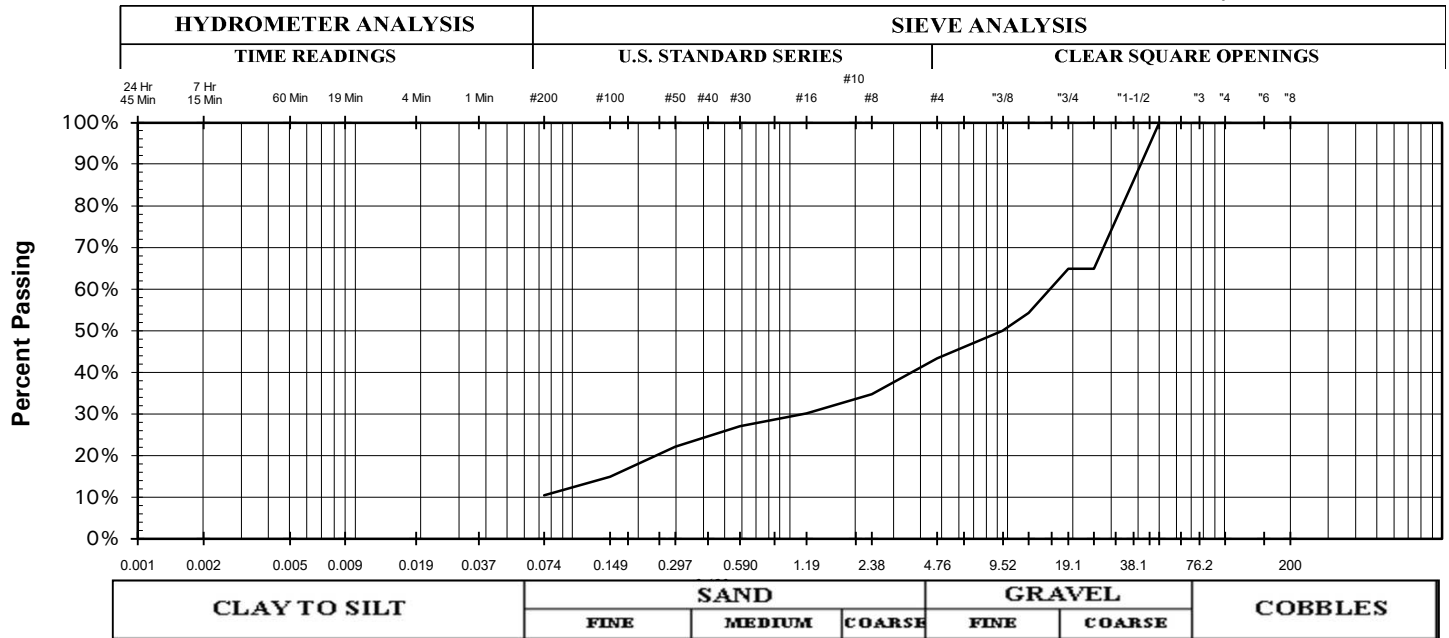
Gravel: 57%
Sand: 33%
Silt & Clay: 10%

Atterberg Limits

Liquid Limit:
Plasticity Index: Non-Plastic

USCS Classification: well-graded gravel with silt and sand (GW - GM)

Reviewed By: TT



GRADATION CURVE



Applied GeoTech

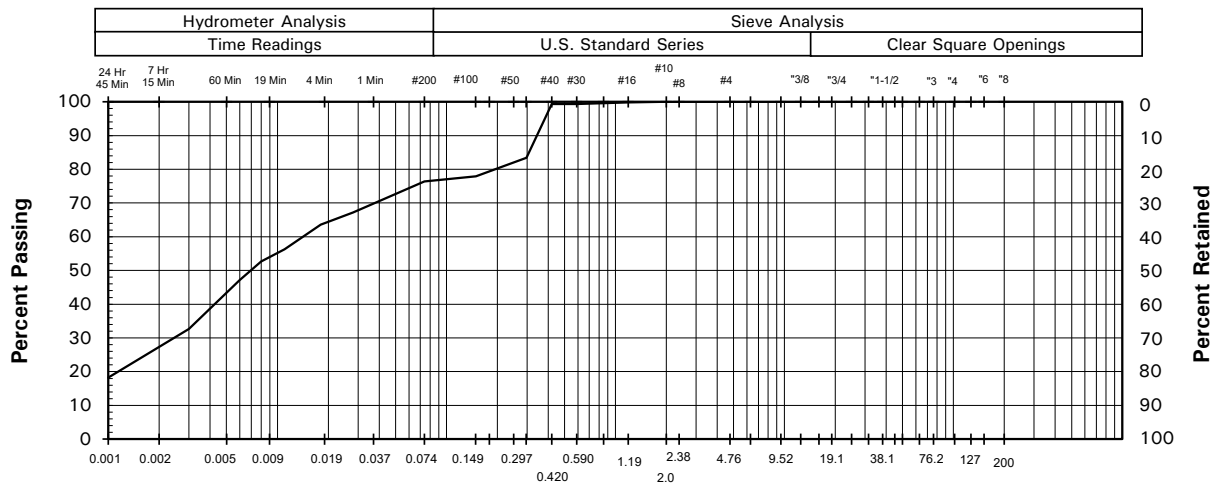
APPLIED GEOTECHNICAL ENGINEERING CONSULTANTS, INC.

Project Number: 2211499

Project Name: Canyon View Property

Boring: B-11

Depth: 19'



Gravel:	0%	Liquid Limit:	38%
Sand:	24%	Plasticity Index:	21%
Silt and Clay:	76%	Sample Location:	Boring: - B-11 @ 19'

Sample Description: Lean clay (CL)



Applied GeoTech

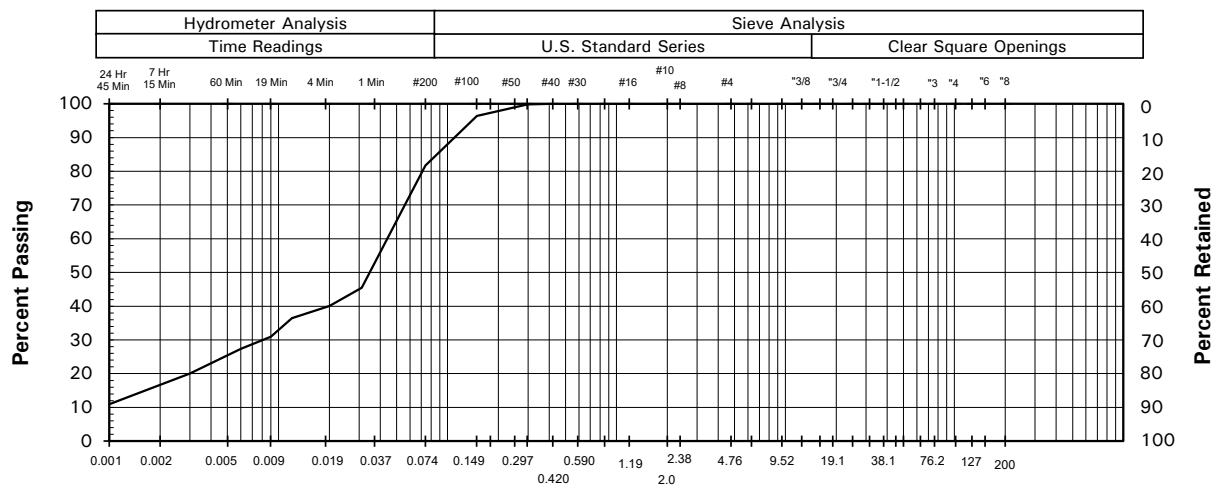
APPLIED GEOTECHNICAL ENGINEERING CONSULTANTS, INC.

Project Number: 2211499

Project Name: Canyon View Property

Boring: B-11

Depth: 34



Gravel:	0%	Liquid Limit:	48%
Sand:	18%	Plasticity Index:	27%
Silt and Clay:	82%	Sample Location:	Boring: - B-11 @ 34

Sample Description: Lean clay (CL)



Applied GeoTech

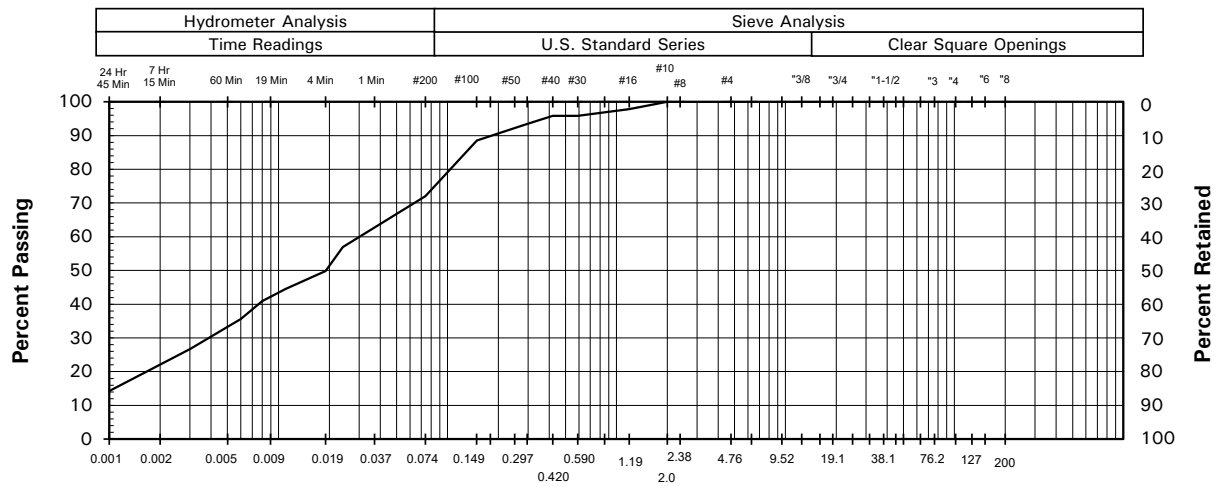
APPLIED GEOTECHNICAL ENGINEERING CONSULTANTS, INC.

Project Number: 2211499

Project Name: Canyon View Property

Boring: B-12

Depth: 39



Gravel:	0%	Liquid Limit:	40%
Sand:	28%	Plasticity Index:	26%
Silt and Clay:	72%	Sample Location:	Boring: - B-12 @ 39

Sample Description: Lean clay (CL)

APPLIED GEOTECHNICAL ENGINEERING CONSULTANTS, INC.

TABLE I SUMMARY OF LABORATORY TEST RESULTS

Canyon View Apartments

Project Number 2211499

Sample Location		Natural Moisture Content (%)	Natural Dry Density (pcf)	Gradation			Atterberg Limits		Moisture-Density Relationship		Sample Classification
Boring No.	Depth (feet)			Gravel (%)	Sand (%)	Silt/ clay (%)	Liquid Limit (%)	Plasticity Index (%)	Maximum Dry Density (pcf)	Optimum Moisture Content (%)	
B-1	4	9	118	3	16	81	44	30			Lean Clay with Sand (CL)
B-1	9	5	99								Sandstone Bedrock
B-1	14	7	108			94	38	22			Mudstone Bedrock
B-1	19	12	113			91	38	17			Mudstone Bedrock
B-2	9	10	87	4	20	76	29	13			Fill; Lean Clay with Sand (CL)
B-2	19	5	107			92	36	20			Mudstone Bedrock
B-4	9	9	95	2	15	83	40	22			Lean Clay with Sand (CL)
B-5	9	5	108			75	30	15			Mudstone Bedrock
B-5	14	7	106			84	32	16			Mudstone Bedrock
B-5	9-14			3	27	70	38	21	115.0	14.0	Mudstone Bedrock
B-6	9	8	92	16	31	53	30	15			Clayey Gravel (GC)
B-6	14	15	101	14	26	60	28	16			Clayey Gravel (GC)
B-7	9	9	102			91	38	19			Mudstone Bedrock
B-8	9	4	116			65	32	16			Mudstone Bedrock
B-8	14	7	109			85	42	27			Mudstone Bedrock

APPLIED GEOTECHNICAL ENGINEERING CONSULTANTS, INC.

TABLE I SUMMARY OF LABORATORY TEST RESULTS

Canyon View Apartments

Project Number 2211499

Sample Location		Natural Moisture Content (%)	Natural Dry Density (pcf)	Gradation			Atterberg Limits		Moisture-Density Relationship		Sample Classification
Boring No.	Depth (feet)			Gravel (%)	Sand (%)	Silt/ clay (%)	Liquid Limit (%)	Plasticity Index (%)	Maximum Dry Density (pcf)	Optimum Moisture Content (%)	
B-8	19	7	109			88	43	22			Mudstone Bedrock
B-9	14	7	110				33	18			Mudstone Bedrock
B-10	9	7	115								Mudstone Bedrock
B-10	29	10	118				57	29			Mudstone Bedrock
B-11	9	6		57	33	10		NP			Well Graded Gravel with Silt and Sand
B-11	14	13				75	38	21			Mudstone Bedrock
B-11	19	12	103			91	40	19			Mudstone Bedrock
B-11	24	11	101			64	35	20			Mudstone Bedrock
B-11	34	13	86			87	48	27			Mudstone Bedrock
B-11	44	9	108			93	44	25			Mudstone Bedrock
B-12	14	1		52	42	6		NP			Poorly Graded Gravel with Silt and Sand (SP)
B-12	29	13	111	41	29	30	24	9			Clayey Gravel with Sand (GC)
B-12	39	7	123	0	22	78	40	26			Mudstone Bedrock

Hillside Permit**HILLSIDE REVIEW BOARD AGENDA REPORT: 11/20/2024****HILLSIDE DEVELOPMENT PERMIT****Willow Bend Townhomes**

Case No. 2024-HS-014

Request: This is a request for a Hillside Development Permit to allow the applicant to cut into the (20-40%+) hillside for access to a proposed townhome development. The hillside cut would also allow construction of the northern portion of the townhome site. The applicant has provided a slope analysis, proposed drainage report and site layout for consideration.

Exhibits Provided: 1) Exhibit A - Slope Analysis Maps
2) Exhibit B – Site plan
3) Exhibit C – Preliminary Drainage Control Plan and Report
4) Exhibit D – Geotechnical Study
5) Exhibit E – Applicant Narrative

Background: The northern portion of the property has slopes that are in the 20-40%+ range. When Riverside Drive was constructed in approximately 2005 some of those slopes were disturbed to make room for the road. The Willow Bend Townhomes project was previously approved by the City Council in April 2021. The previous approvals have expired so the project is being re-processed.

Owner: Smoothie Kings Holdings LLC

Engineer: Eric Mcfadden, Premier Design & Engineering Inc.

APN: SG-5-2-33-429

Location: The property is generally located on the east side of Riverside Drive between Judy Ln. and Tagans Way. The site is on the southern portion of the parcel.

Acreage: 10.53 Acres

Zoning: R-3

Adjacent zones: R-3 (Multiple-Family Residential), A-1 (Agricultural), PD-C (Planned Development Commercial), C-3 (General Commercial)

Powers & Duties: 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).

Permit required: Section 10-13A-3 requires that all development on slopes above 21% requires a ‘hillside development permit’ granted by the City Council upon recommendation from the Hillside Review Board and the Planning Commission.

Analysis: The applicant is proposing to cut into areas that are 20%, 30%, 40% or greater slope (see slope analysis attached). The site will need a second access on the north end of the property. Due to the placement of the required road, the developer will need to cut into the hillside to accommodate approximately ten of the units and the road. The stated reason or justification for the cut is that the cuts are not affecting “significant features” and are just overburden blue clay from the construction of Blue Clay.

The Hillside Review Board will need to determine whether or not the areas to be disturbed are “significant” or not. If so, are there conditions that can be placed on the request to mitigate the impacts or is it just not feasible and warrants a denial? Applicable ordinances which may help the board in their review can be found below.

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.

Section 10-13A-1: Density and Disturbance Standards

F. The applicant may:

1. Transfer all development density from steeper slope categories (sending areas), to areas within the development with natural slopes of twenty percent (20%) or less (receiving areas); and
2. Develop additional bonus density, calculated from each slope category, as follows:
 - a. Natural slopes twenty percent (20%) or less transferred on a one-to-one (1:1) unit basis; plus
 - b. One (1) additional density unit for each density unit transferred from natural slopes of twenty-one percent (21%) to thirty percent (30%); plus

- c. Two (2) additional density units for each density unit transferred from natural slopes of thirty-one percent (31%) to forty percent (40%).
3. Unit calculation for the receiving area shall be based on the requirements of the sending area zone.

G. Density transfers to the receiving area may occur without a zone change within the receiving area even though the resulting density or configuration may exceed the density limits of the receiving area zone. Other than density, the receiving area's zoning requirements apply to development in the receiving area. For instance, lot sizes may vary, but single-family zoning districts only allow single-family detached dwellings.

H. If the applicant proposes to develop within the twenty-one percent (21%) to forty percent (40%) slope area, the applicant cannot employ partial density transfers from the sending area and must propose a design, site development plans, and a grading plan that blends and harmonizes all aspects of the proposed development into the natural topography, and that minimizes road cuts and fills.

I. Non-disturb areas within a residential lot as shown on the slope analysis map shall not be used to calculate minimum lot size.

J. Disturbance standards do not apply to the city for limited city facilities: trails, parks, and utilities.

10-13A-2: Density and Disturbance Standards

A. Slope shall be determined for each significant portion of a 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.

HSRB Motion Options: The hillside board can recommend several different options to the Planning Commission and the City Council:

1. Denial
2. Approval as presented
3. Approval with specific conditions and comments added as required.

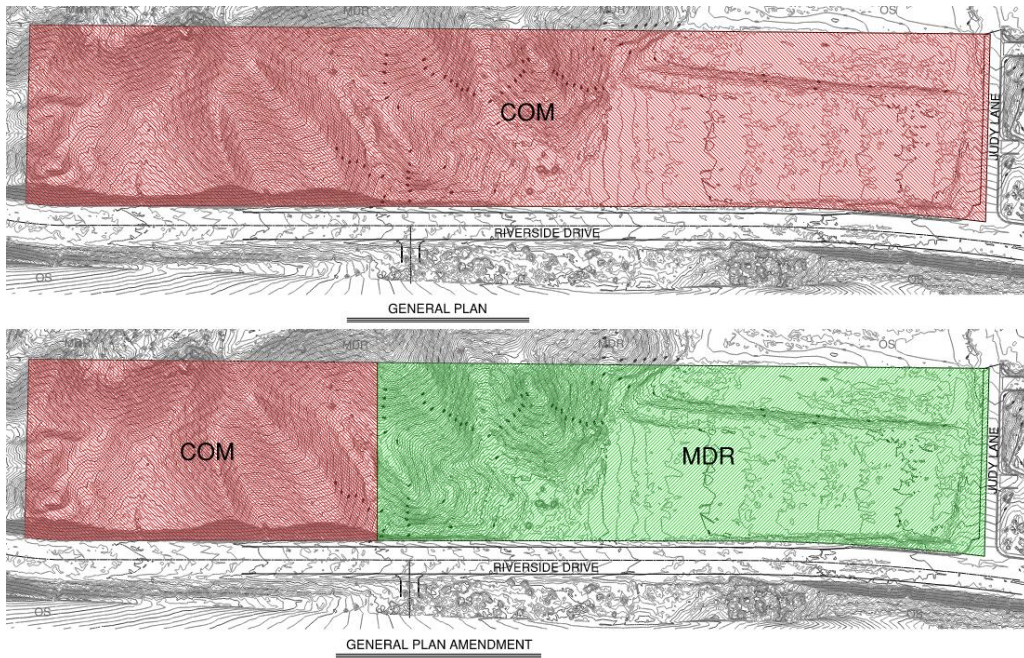
Example Motion: The hillside board recommends _____ of the request for a Hillside Development Permit to allow development of Willow Bend Townhomes as requested and outlined in the staff report including the following comments:

1. _____
2. _____

Vicinity Map



General Plan Amendment – COM to MDR



Zone Change – R-3 to PD-R

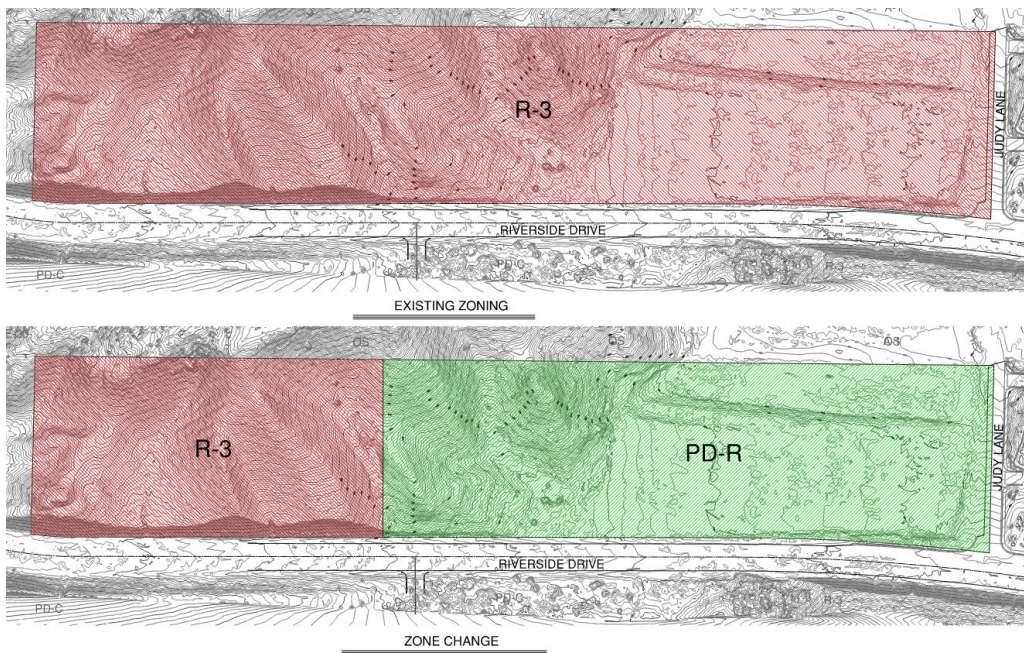
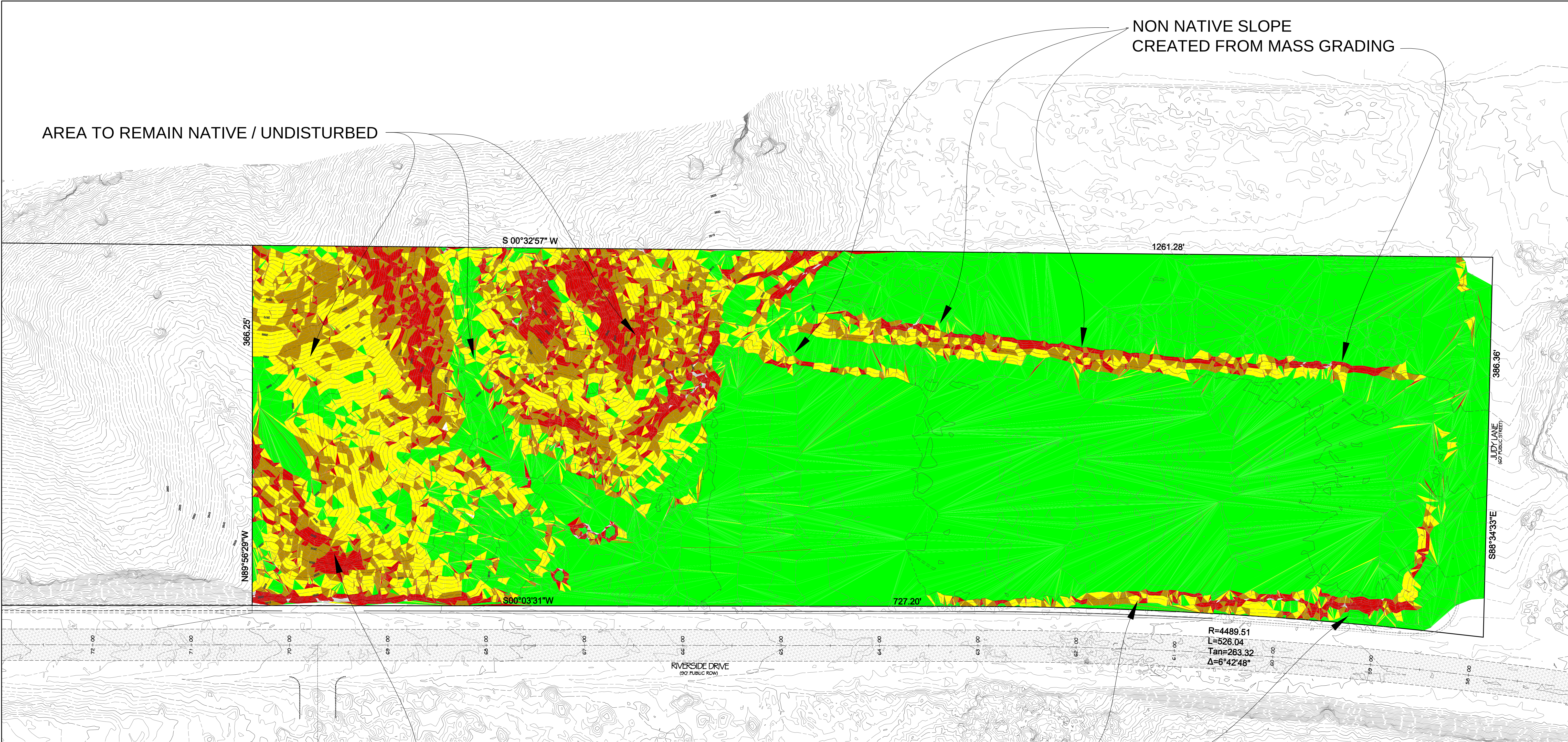


Exhibit A

Slope Analysis Maps



AREA TO BE CUT FOR APPROVED ACCESS
ONTO RIVERSIDE DRIVE

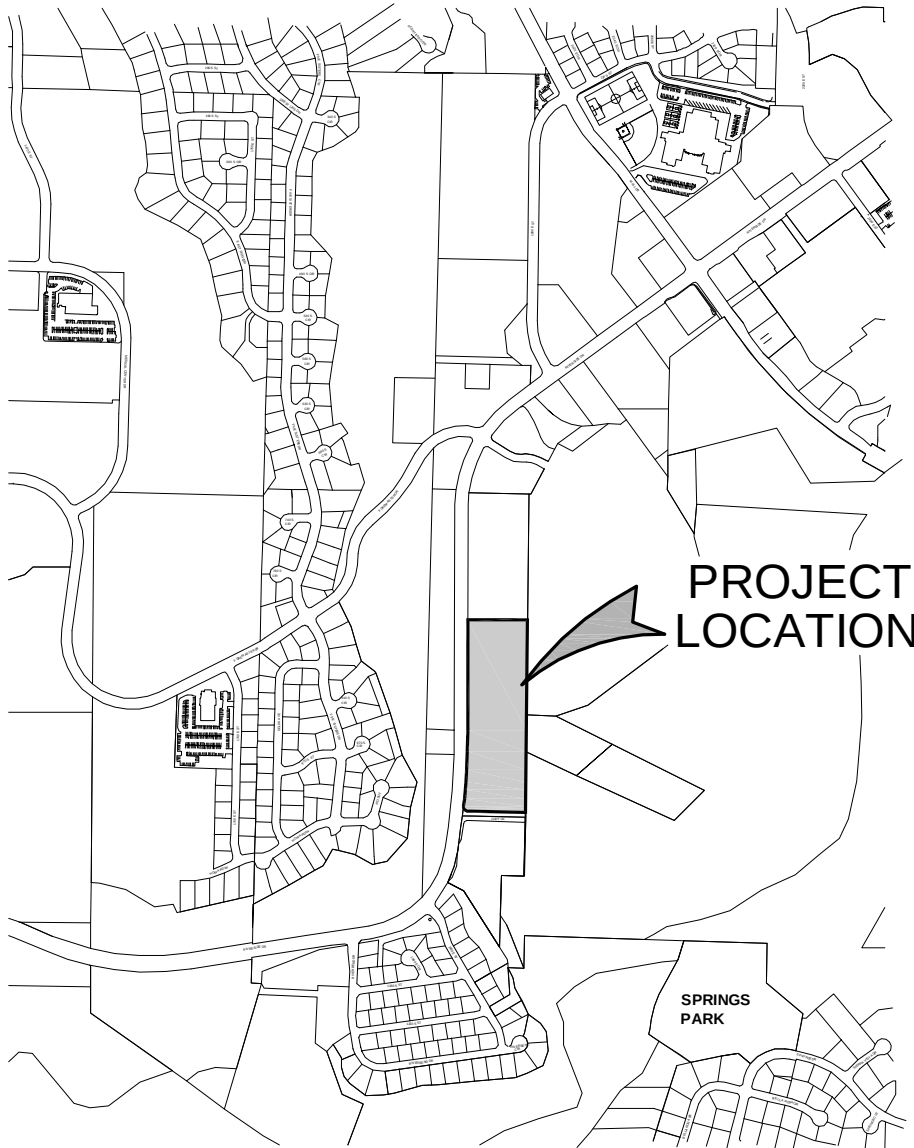
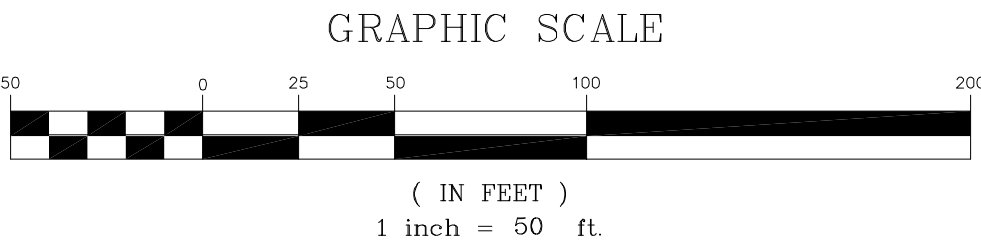
NON NATIVE SLOPE
CREATED FROM RIVERSIDE DR
& JUDY LANE CONSTRUCTION

SLOPE LEGEND

Color	Range Beg.	Range End	Percent	Area
■	0.00	19.99	67.7	308818.98
■	20.00	29.99	14.8	67445.65
■	30.00	39.99	10.3	46934.71
■	40.00	100.00	7.2	32666.69

SITE DATA

TOTAL SITE AREA = 459,016 SQ.FT. / 10.53 ACRES (100%)
NATIVE / UNDISTURBED AREA = 77,153 SQ.FT. / 1.77 ACRES (16.8%)
HILLSIDE CUT AREA = 43,637 SQ.FT. / 1.00 ACRES (9.5%)



VICINITY MAP

DATE: 1/26/2021
DRAWN BY: E.A.M.
CHECKED BY: M.R.F.
CLIENT: SP

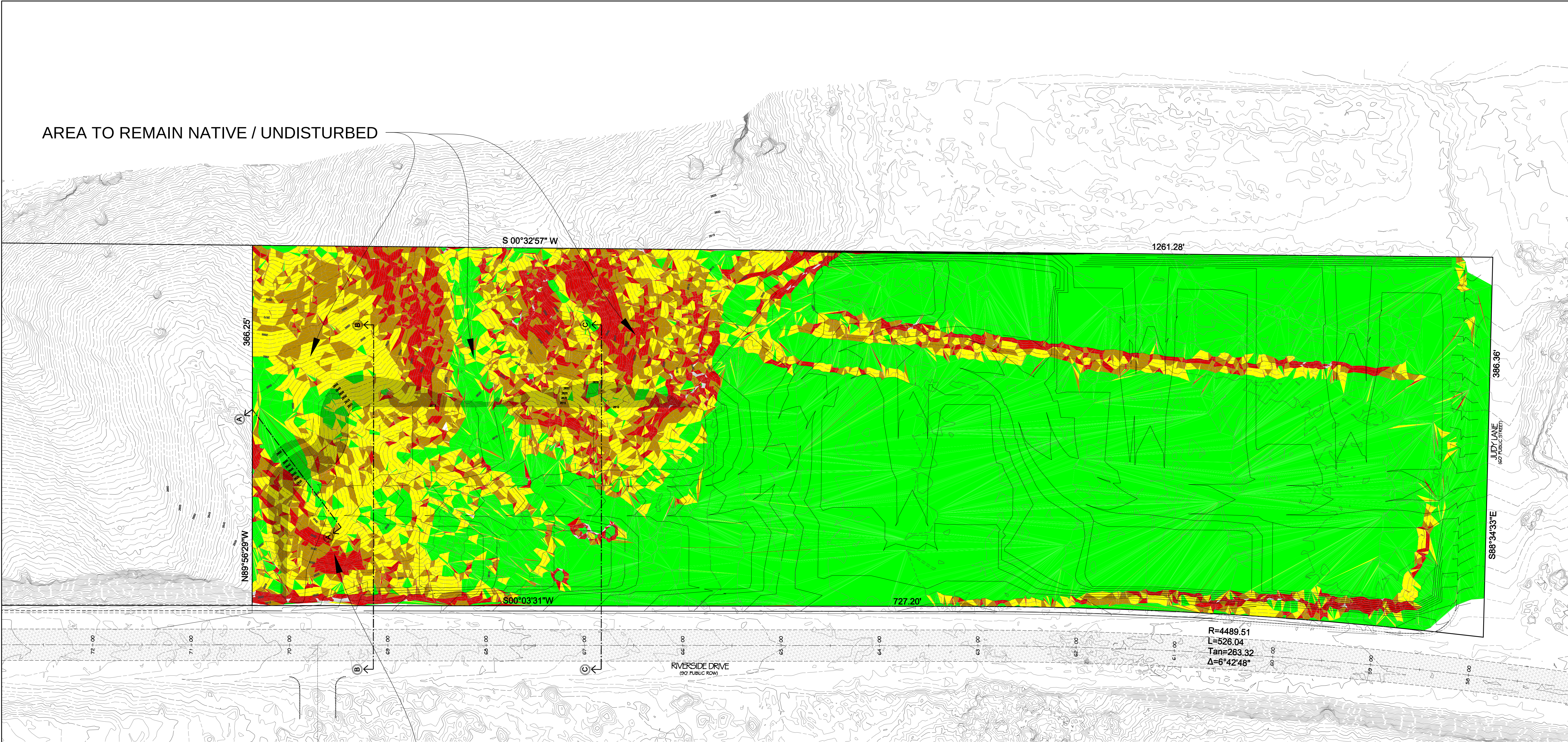
SCALE: 1" = 50'

SLOPE ANALYSIS
WILLOW BEND TOWNHOMES
STEVEN PARK
ST. GEORGE, UTAH 84-770

75 EAST 100 NORTH WINS, UTAH 84738 (435) 313-2267

PROFESSIONAL ENGINEER
1/26/2021
License No. 323806
Marc R. Fonger

SHEET
SAI



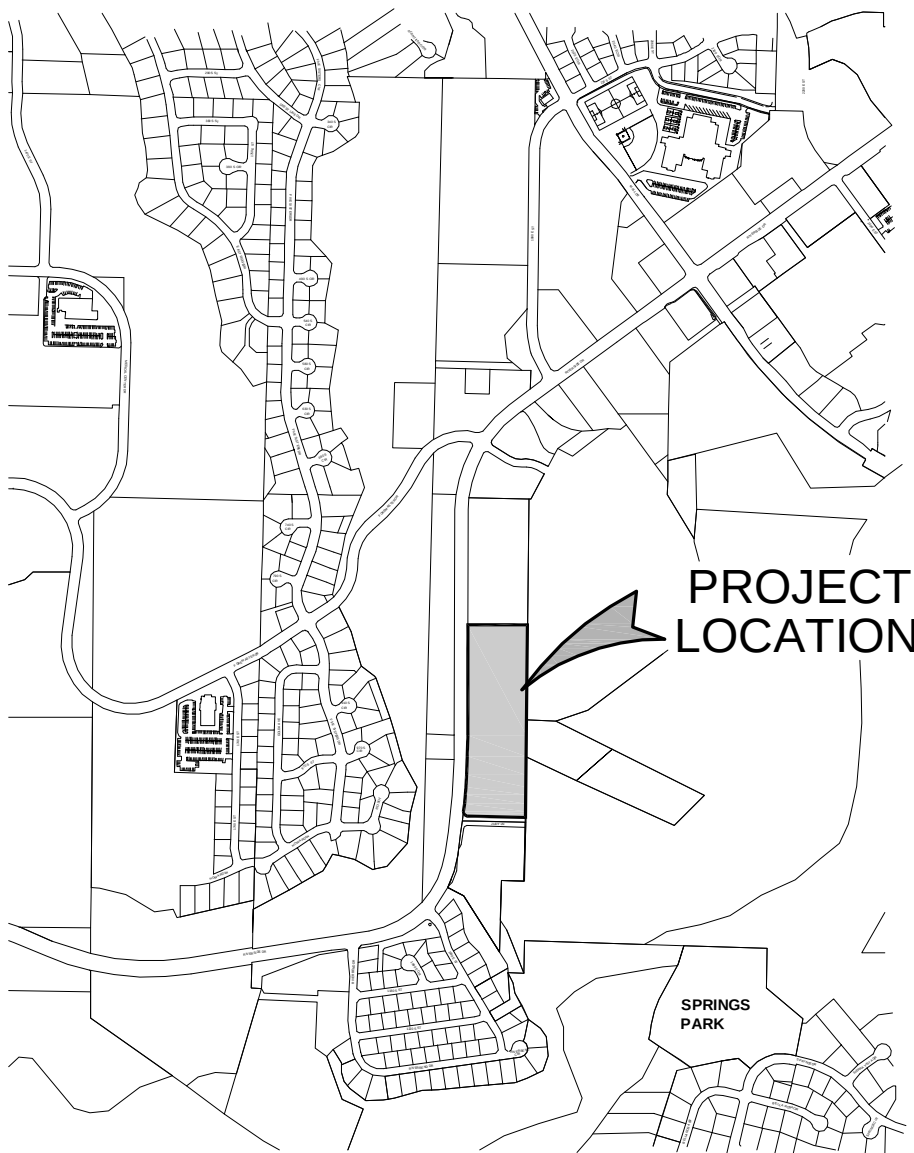
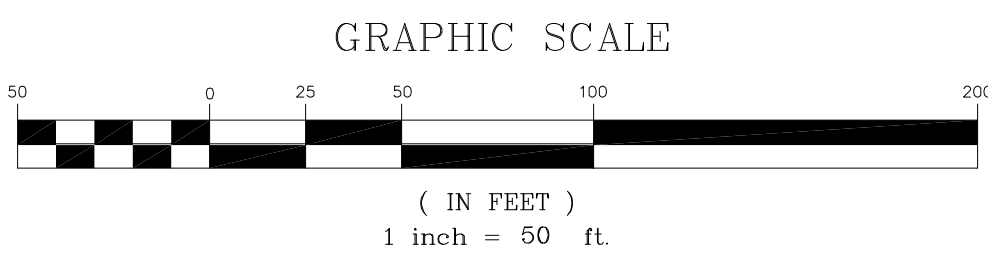
AREA TO BE CUT FOR APPROVED ACCESS
ONTO RIVERSIDE DRIVE

SLOPE LEGEND

Color	Range Beg.	Range End	Percent	Area
Green	0.00	19.99	67.7	308818.98
Yellow	20.00	29.99	14.8	67445.65
Orange	30.00	39.99	10.3	46934.71
Red	40.00	100.00	7.2	32666.69

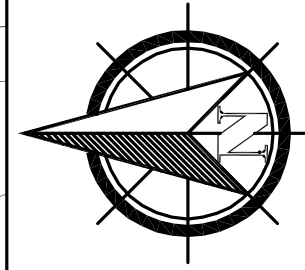
SITE DATA

TOTAL SITE AREA = 459,016 SQ.FT. / 10.53 ACRES (100%)
NATIVE / UNDISTURBED AREA = 77,153 SQ.FT. / 1.77 ACRES (16.8%)
HILLSIDE CUT AREA = 43,637 SQ.FT. / 1.00 ACRES (9.5%)



VICINITY MAP

DATE:	1/26/2021
DRAWN BY:	E.A.M.
CHECKED BY:	M.R.F.
CLIENT:	SP



SCALE: 1" = 50'

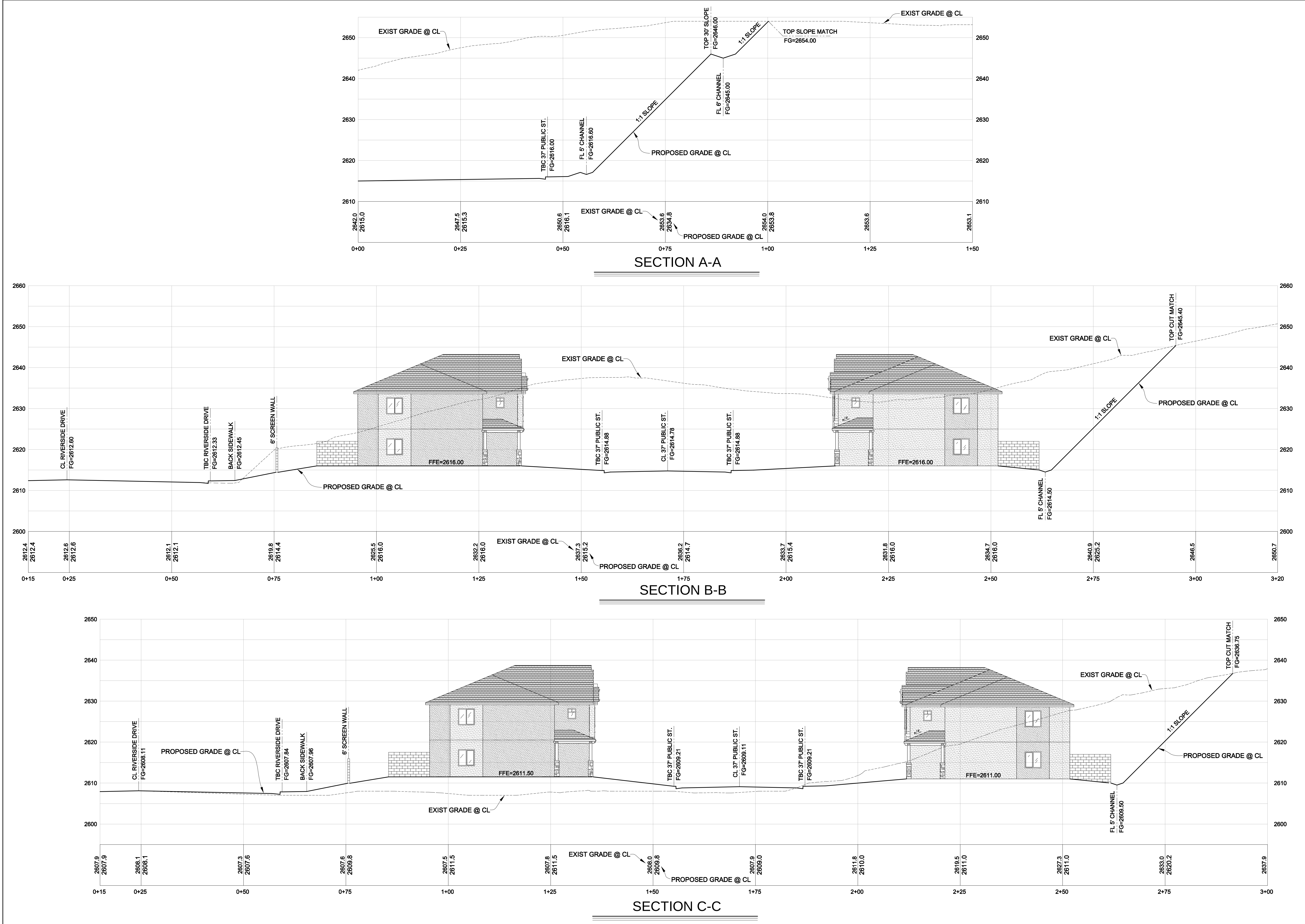
SLOPE ANALYSIS WITH PROPOSED GRADING
WILLOW BEND TOWNHOMES
STEVEN PARK
ST. GEORGE, UTAH 84770

PREMIER
Design & Engineering
75 EAST 100 NORTH WINS, UTAH 84738 (435) 313-2267



SHEET

SA2



DATE: 1/26/2021

DRAWN BY: E.A.M.

CHECKED BY: M.R.F.

CLIENT: SP

SCALE: 1" = 10'

CUT SLOPE CROSS SECTIONS

WILLOW BEND TOWNHOMES

STEVEN PARK

ST. GEORGE, UTAH 84770

75 EAST 100 NORTH IVINS, UTAH 84738 (435) 313-2267

PROFESSIONAL ENGINEER

1/26/2021

License No. 323806

Marc R. Fonger

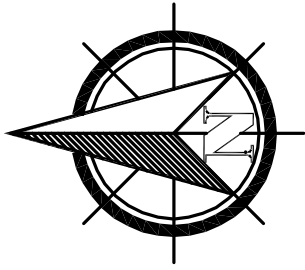
Marc R. Fonger

SHEET

X-1

Exhibit B

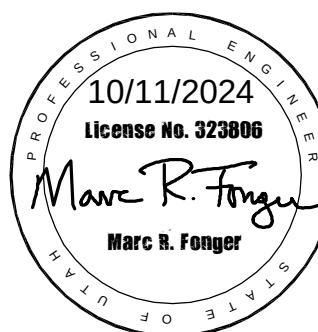
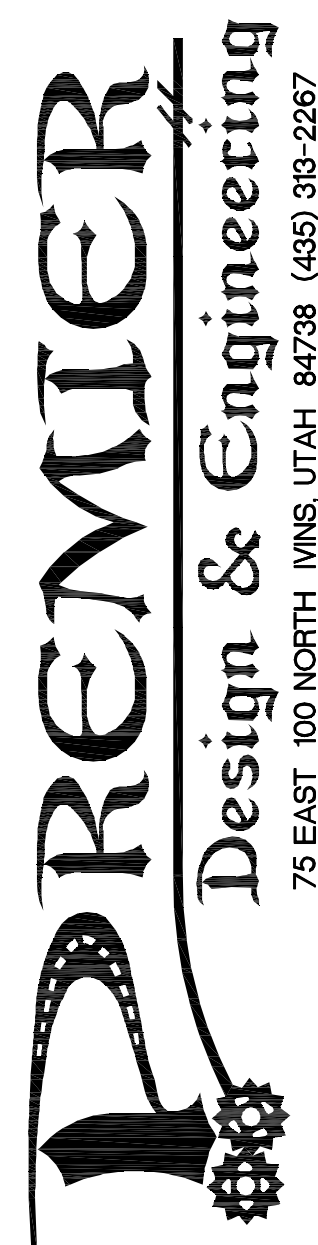
Site Plan



SCALE: 1" = 50'

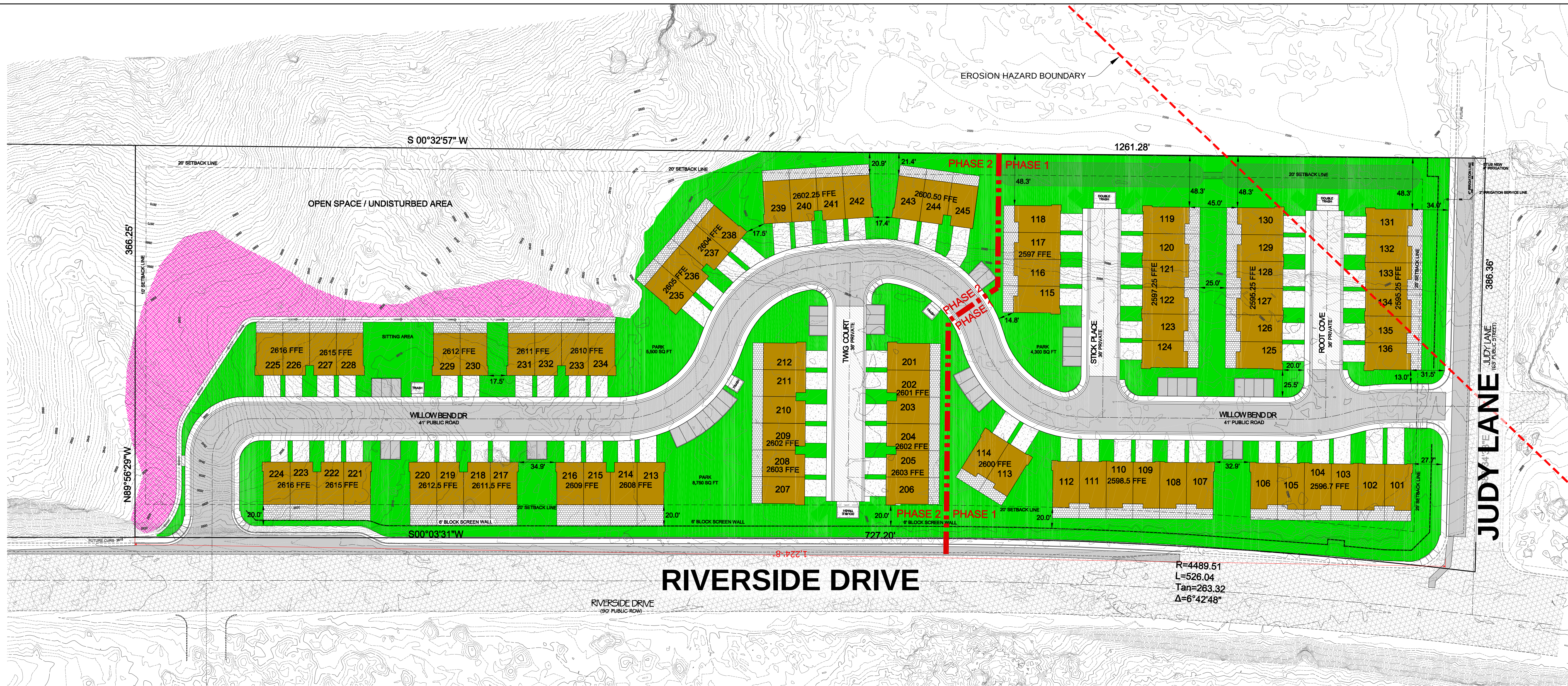
ZONE CHANGE COLORED SITE PLAN
WILLOW BEND TOWNHOMES

ST. GEORGE, UTAH 84770



SHEET

ZC



*NOTES:

- 1.) ALL LANDSCAPE, STREETSCAPE, PARKS, OPEN SPACE, HILLSIDE CUT, AND RETENTION/DETENTION TO BE OWNED/MAINTAINED BY DEVELOPER/HOA.
- 2.) ALL 46 VISITOR PARKING STALLS ARE 17' DEEP (FROM BACK OF SIDEWALK) X 9' WIDE SIDEWALK IN FRONT OF PARKING STALLS & STALLS AT THE END OF THE PRIVATE ROADS TO BE 6" THICK WITH 8" TYPE II BASE

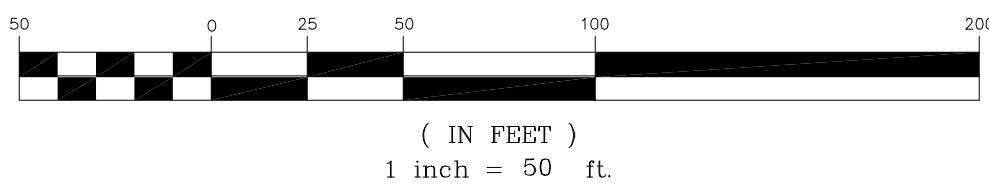
LEGEND

-----2561-----	EXISTING 1' CONTOUR
-----2570-----	EXISTING 5' CONTOUR
-----	PROPERTY LINE
	BUILDING AREA (PRIVATE AREA)
	ASPHALT AREA (PUBLIC RIGHT OF WAY)
	ASPHALT AREA (PRIVATE STREET)
	LANDSCAPE AREA (COMMON AREA) (SEE LANDSCAPING PLANS L1.01 - L2.04)
	HILLSIDE CUT AREA (COMMON AREA)
	DRIVEWAY AREA (LIMITED COMMON AREA)
	REAR PATIO AREA (PRIVATE AREA)
	DETENTION AREA (COMMON AREA)

SITE DATA

TOTAL SITE AREA = 459,016 SQ.FT. / 10.54 ACRES (100%)
OPEN SPACE / UNDISTURBED AREA = 60,541 SQ.FT. / 1.38 ACRES (13.2%)
BUILDING AREA = 81,553 SQ.FT. / 1.87 ACRES (17.8%)
IMPERVIOUS AREA = 148,812 SQ.FT. / 3.42 ACRES (32.4%)
LANDSCAPED AREA = 141,634 SQ.FT. / 3.25 ACRES (30.9%)
HILLSIDE GRADED AREA = 26,476 SQ.FT. / 0.60 ACRES (5.7%)
TOTAL UNITS = 81
DENSITY = 81 / 10.53 = 7.692 UNITS PER ACRE
LANDSCAPED AMENITY AREA REQUIRED = 16,200 SQ.FT.
PROVIDED = 25,550 SQ.FT.
AMENITIES PROVIDED:
SECURE PLAYGROUND & 2 OUTDOOR SOCIAL AREAS
ALL UNITS HAVE 2 CAR GARAGE WITH 16' WIDE X 20' LONG DRIVEWAY
PARKING:
ADDITIONAL GUEST PARKING REQUIRED = 27 SPACES
PROVIDED = 46 SPACES

GRAPHIC SCALE



willow bend

Exhibit C

Preliminary Drainage Control Plan and Report



Willow Bend Townhomes

St. George, Utah
Drainage Control Plan and Report

Prepared By

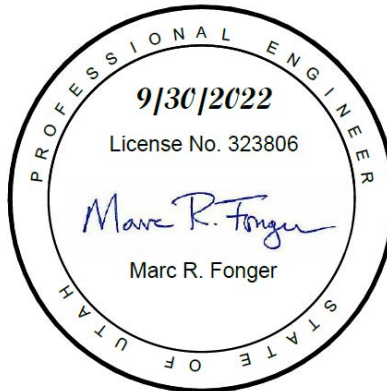
PREMIER DESIGN & ENGINEERING

75 E 100 N

Ivins, Utah, 84738

Phone: (775) 385-7647

Contact: Marc Fonger, P.E.



September 30, 2022

Table of Contents

Property Description	1
Existing Site Description	
Proposed Site Description	
Off-Site Drainage Description	1
On-Site Drainage Description	1
Description of Proposed Drainage Facilities	1
Design Runoff Computations.....	2
Drainage Facility Design Calculations	3
Conclusions	3

Property Description

Existing Site Description

The existing site is located on the east side of Riverside Drive at approximately 900 South. The subject site is bound on three (2) sides by undeveloped ground (North and East) and by partially developed public roads on the West (Riverside Drive) and the South (Judy Lane).

The existing site partially disturbed by previous landowners hauling in fill to bring the site up to an elevation closer to the existing elevation of Riverside Dr. This comprises approximately the southern 2/3 of the site. The remaining (northern) portion is largely undisturbed desert shrub.

Proposed Site Description

The proposed use is a multifamily residential housing complex including 20 individual units that are comprised of two (2) to six (6) units each. There will be landscaping, driveways, sidewalks, and parking areas included on the site. The site is approximately 50% landscaping or undisturbed.

Off-Site Drainage Description

Off-site drainage enters the site from the north and east (along the northern segment). The stormwater from this off-site area will be captured and conveyed in the multiple drainage systems inside the project to the outlet of the site.

On-Site Drainage Description

Existing runoff patterns run from north to south. This pattern will be matched for the finished grading of the site.

Description of Proposed Drainage Facilities

Description of Proposed Drainage Facilities

All proposed drainage improvements were designed using the 100-year, 24-hour storm, the 100-yr 3-hr design storm, or the 10-year 3-hour design storm event per the St. George City Drainage Control Manual.

Underground and above ground storm water conveyance pipes and channels will be utilized to convey this storm water through the project. Specifically, a 5-foot wide lined channel is proposed to collect stormwater at the bottom of the large cuts along the north east boundary of the project and convey it to other storm water systems within the project.

Detention

Based on comparisons between the pre- and post-developed hydrographs, detention is warranted for this development. Two above-ground detention ponds/retention ponds are proposed for the

site. Each has a volume of 5,905.44 cf. The LID required retention is 2,782 cf and will be retained in the southernmost pond (nearest Judy Lane). This will be accomplished by setting the outlet box rim 1.14' above the bottom of the pond (at elevation 2591.14).

The outlet of each pond should be limited to 2.20 cfs with an emergency, rock-lined or concrete, spillway to the other pond or Judy Lane. This spillway should have a depth of 6 inches and be at least 5 feet wide at the bottom.

Design Runoff Computations

The site was modeled using HEC-HMS Version 4.7, which is a computer modeling program developed by the United States Army Corp of Engineers (USACE).

Model Input Parameters

The input parameters selected for computing discharge using the computer model were derived from site observations and field surveys. Input parameters for the project are included in the attached calculation sheets. The existing conditions were modeled and labeled as Pre-Developed where future conditions modeled were labeled as Post-Developed.

The site was modelled as Hydrologic Group C

Rainfall Depth and Design Storm

The current City of St. George Drainage Control Manual was used in this analysis to estimate stormwater generated on the site.

Model Output

The results of the HEC-HMS analysis are also illustrated in the attached calculations in the form of combined hydrographs for each set of subareas reporting to specific detention basins.

Available on request are the output from each run in HEC-HMS. These files include all input parameters used to determine the flow rates for the sub areas.

Drainage Facility Design Calculations

LID Retention/Detention Basin

See discussion above for details on the basins proposed for this project.

Outlet

In order to limit the outflow to 2.2 cfs, a 6 ¾" diameter orifice will need to be placed on the outlet pipe of each basin. See the attached calculation sheets for the input values used to calculate this orifice size.

Curb Inlet and Catch Basin Inlet Capacities

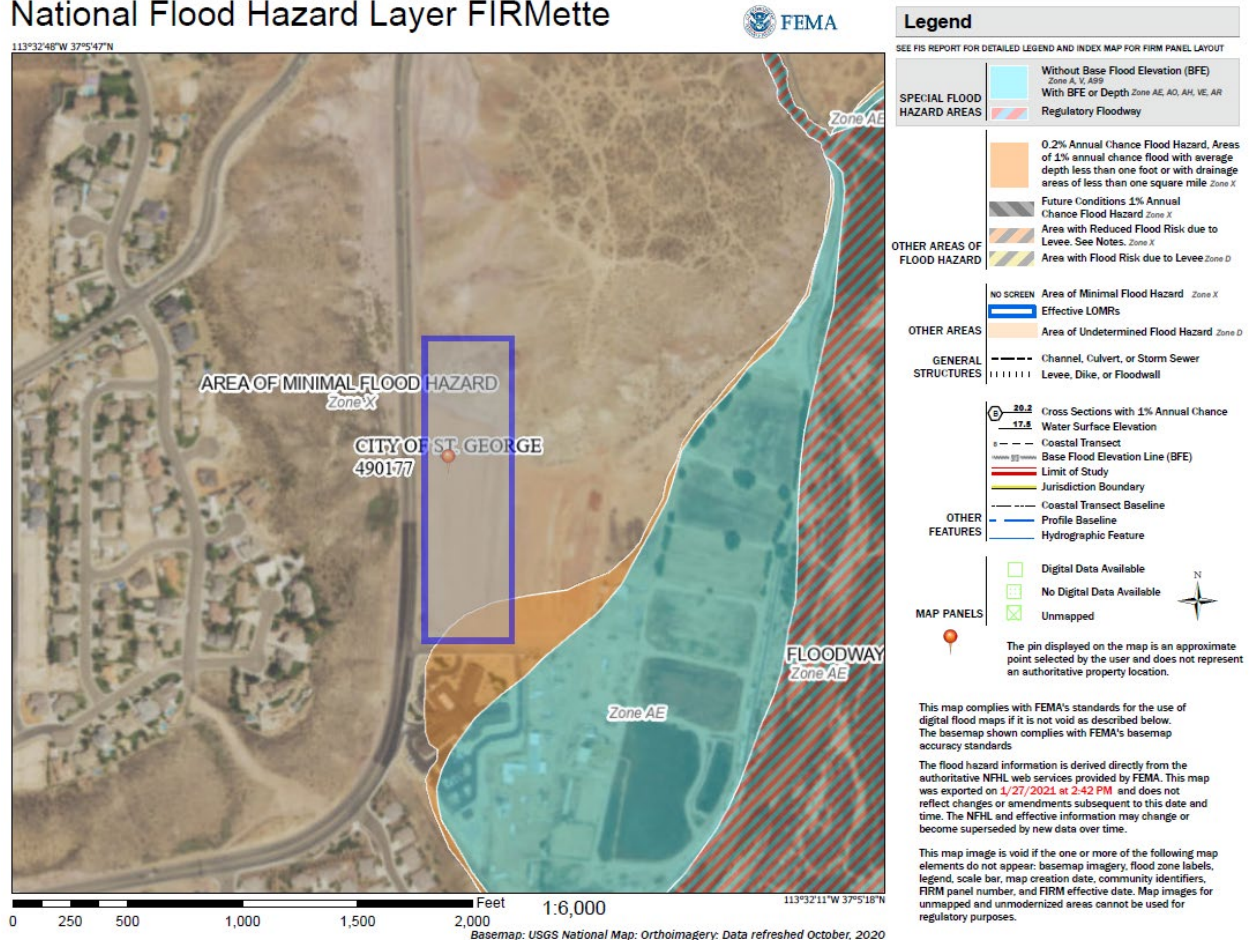
The curb inlets and catch basins for the proposed streets and/or parking lots were analyzed using HEC-22. The inlet capacity is 7.22 cfs for a single curb inlet and 9.30 cfs for a double inlet.

Calculations are available upon request.

FEMA Compliance

A portion of the site at the southwest corner is within the 500-year floodplain. The developer does not propose to remove this designation unless mandated by the city. See image below showing the FEMA floodplain lines in relation to this project.

National Flood Hazard Layer FIRMette



Conclusions

The following conclusions summarize the recommendations proposed for this development:

Onsite Drainage: The proposed storm water system is capable of handling a 10-year and 100-yr storms for the site and delivering it to the existing storm drain system.

Off-site Drainage: Off-site drainage enters the site from upstream and will be conveyed through the project. All drainage is adequately conveyed by the proposed improvements.



**Dixie Storm
Water Coalition**

St. George, Washington, Ivins, Santa Clara

Storm Water Quality Report

Date: February 3, 2023

Project Name: Willow Bend Townhomes

Project ID: _____

Design Engineer: Premier Design and Engineering, Inc.

Is the project within a watershed that is 303(d) listed? Yes

If yes:

Name of receiving water(s): Virgin River

Listed Impairment(s): Temperature, Total Dissolved Solids (TDS), Boron

Does the watershed have an approved TMDL? No

If yes:

Approved TMDL(s): _____

I have reviewed the storm water quality design and find this report to be complete, accurate, and current.



Marc Fonger, PE

Project Manager

Marc Fonger, PE

Designate Storm Water Coordinator

Dave Nasal

Head of Maintenance

Marc Fonger, PE

Landscape Architect or Equivalent



Dixie Storm Water Coalition

St. George, Washington, Ivins, Santa Clara

Project Information

Type of Project (New Development, Redevelopment): New Development

Area of Land Disturbance (ac): 10.54

Project Impervious Area (ac): 5.40

Project Imperviousness (%): 51

Project Volumetric Runoff Coefficient, R_v : 0.17

80th Storm Depth (in): 0.44

Project 80th Percentile Volume, V_{goal} (cf): 2,782

Subsurface Information Groundwater

Depth to Groundwater (ft): >10'

Historical High Depth to Groundwater if known (ft): >10'

Source: Geotechnical report cited below

Groundwater Contamination at Site: None

Soil Information

Infiltration Rate (in/hr): 1 in/hr

Hydrologic Soil Group: C

Source:

Geotechnical Report prepared by AGECE Dated December 20, 2022, Project No. 2180294, and Response Letter dated February 2, 2023. The hydrologic soil type C was chosen due to the prevalence of clay in the fill materials.

Soil Contamination at Site: None

Drinking Water

Within Drinking Water Source Area Protection: No

Additional Relevant Site Information

LID Drainage Areas

Add additional rows as needed.

Contributing Drainage Area	Area (ac)	Impervious Area (ac)	Imperviousness (%)	Volumetric Runoff Coefficient, R_v	Water Quality Volume, WQV (cf)
CDA 1	10.54	5.40	51	0.17	2,782
CDA 2					
CDA 3					
CDA 4					
Total WQV (cf)					2,782

LID BMP Design

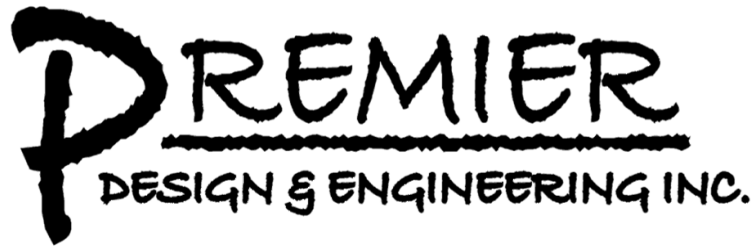
Add additional rows as needed.

Contributing Drainage Area	LID BMP Type	Water Quality Volume, WQV (cf)	Runoff Retained (cf)	Percent of Runoff Captured (%)
Preferred Alternative	Retention	2,782	2,782	100
Non-Preferred Alternative				
CDA 3				
CDA 4				
Total Volume Retained (cf)			2,782	

Percent of V_{goal} captured by LID BMPs: 100 %

If 100% of V_{goal} is not captured, document and provide narrative of technical infeasibilities and/or alternate compliance measures below:

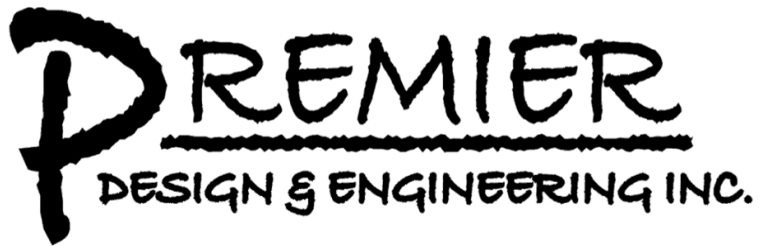
Describe additional storm water quality measures incorporated into the site:



PROJECT: Willow Bend Townhomes BY: Marc Fonger DATE: 9/30/2022
SUBJECT: Drainage Study CHKD. BY: Marc Fonger DATE: 9/30/2022

Watershed Area Delineation

Subarea	<u>Pre Sub Area 1</u>	Description:	<u>Pre Developed Sub Area 1</u>
	Area Summary =	459,016 sq ft 10.54 acres 0.0165 sq mi	
Longest Length	<u>1,628 ft</u>	Average Slope	<u>0.0639 ft/ft</u>
Subarea	<u>Post Sub Area 1</u>	Description:	<u>Post Developed Sub Area 1</u>
	Area Summary =	459,016 sq ft 10.54 acres 0.0165 sq mi	
Longest Length	<u>1,667 ft</u>	Average Slope	<u>0.0624 ft/ft</u>



BY: Marc Fonger

DATE: 9/30/2022

CHKD. BY: Marc Fonger

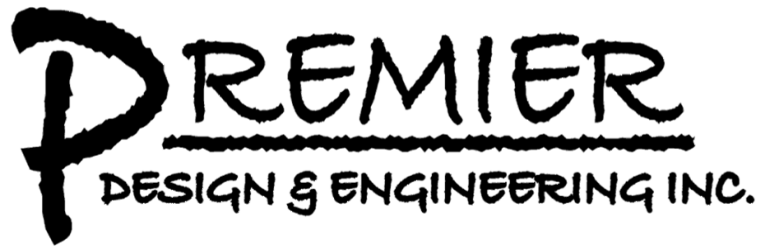
DATE: 9/30/2022

Runoff Curve Number

Subarea(s)	General Chart
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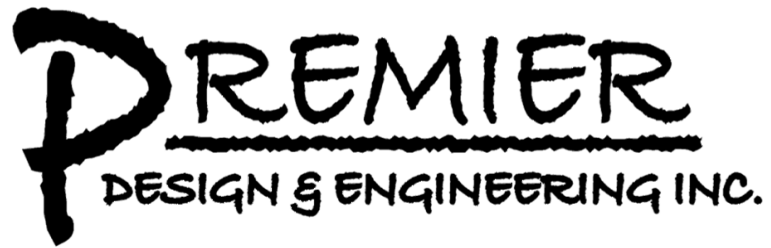
Soil Description	Existing soil is Type C
-------------------------	-------------------------

[illegible]



PROJECT:	Willow Bend Townhomes	BY: Marc Fonger	DATE: 9/30/2022
SUBJECT:	Drainage Study	CHKD. BY: Marc Fonger	DATE: 9/30/2022

				Poor	45	66	77	83			
	Woods ⁴			Fair	36	60	73	79			
				Good	30	55	70	77			
					59	74	82	86			
	Farmsteads-buildings, lanes, driveways,										
	and surrounding lots										
¹ Poor: <50% ground cover or heavily grazed with no mulch					³ CN's shown were computed for areas with 50% grass (pasture) cover. Other						
Fair: 50 to 75% ground cover and not heavily grazed.					combinations of conditions of may be computed from the CN's for woods and pasture.						
Good: >75% ground cover and lightly or only occasionally grazed.					⁴ Poor: Forest litter, small trees, and brush are destroyed by heavy grazing						
² Poor: <50% ground cover					or regular burning						
Fair: 50 to 75% ground cover					Fair: Woods are grazed but not burned, and some forest litter covers the soil						
Good: >75% ground cover					Good: Woods are protected from grazing, and litter and brush adequately cover the soil						
Arid and Semi-Arid Rangelands	Herbaceous-mixture of grass, weeds, and			Poor	0	80	87	93			
	low growing brush, with brush the minor			Fair	0	71	81	89			
	element.			Good	0	62	74	85			
	Oak-aspen-mountain brush mixture of oak			Poor	0	66	74	79			
	brush, aspen, mountain mahogany, bitter brush,			Fair	0	48	57	63			
	maple, and other brush			Good	0	30	41	48			
	Pinyon-juniper-pinyon, juniper, or both;			Poor	0	75	85	89			
	grass understory			Fair	0	58	73	80			
				Good	0	41	61	71			
	Sagebrush with Grass Understory			Poor	0	67	80	85			
				Fair	0	51	63	70			
				Good	0	35	47	55			
	Desert shrub-major plants include saltbrush,			Poor	63	77	85	88	85	Use for Existing Conditions	
	greasewood, creosotebush, blackbrush,			Fair	55	72	81	86			
	bursage, palo verde, mesquite, and cactus			Good	49	68	79	84			
Poor: <30% ground cover (litter, grass, and brush overstory)											
Fair: 30 to 70% ground cover											
Good: >70% ground cover											
Pre Sub Area 1			Total Area=	459,016	sq ft			Weighted Avg. CN =			85
			Impervious Area =	4,100							98
			Existing Ground =	454,916							85
Post Sub Area 1			Total Area=	459,016	sq ft			Weighted Avg. CN =			92
			Impervious Area =	235,227							98
			Landscaping =	223,789							86



PROJECT: Willow Bend Townhomes BY: Marc Fonger DATE: 9/30/2022
 SUBJECT: Drainage Study CHKD. BY: Marc Fonger DATE: 9/30/2022

SCS Lag Time

Time of Concentration = t_c

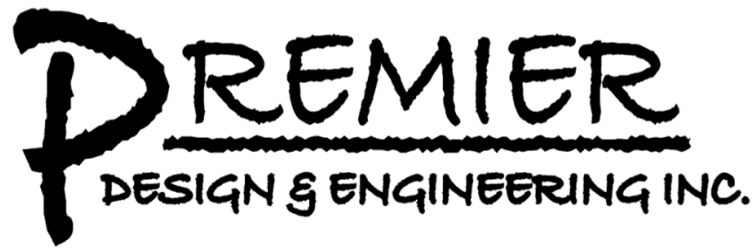
$$t_c = 0.00526 * L^{0.8} \left[\frac{1000}{CN} - 9 \right]^{0.7} S^{-0.5}$$

Where:

CN = SCS runoff curve number
 S = Average slope
 L_f = Longest Length in ft

SCS Lag = $0.6 * t_c$

Subarea	Post Sub Area 1	CN	L_f	S_f	t_c	Lag
Name	Description		(ft)	(ft/ft)	(min)	(min)
Pre Sub Area 1	Existing Conditions	85	1628	0.0639	15.67	9.40
Post Sub Area 1	Post developed Conditions	92	1,667	0.0624	12.26	7.35



PROJECT: Willow Bend Townhomes BY: Marc Fonger DATE: 9/30/2022
 SUBJECT: Drainage Study CHKD. BY: Marc Fonger DATE: 9/30/2022

Low Impact Design - Retention Volume Calculation

$$WQRV = \frac{P_{80\%} * R_{new} * A}{12}, \quad \text{EQ 1}$$

Where,

WQRV = Water Quality Retention Volume, in ac-ft,

P_{80%} = 80th percentile precipitation value (excluding snowfall, from gage analysis, in inches),

R_{new} = Storm Water Runoff Coefficient associated with the proposed new development, and

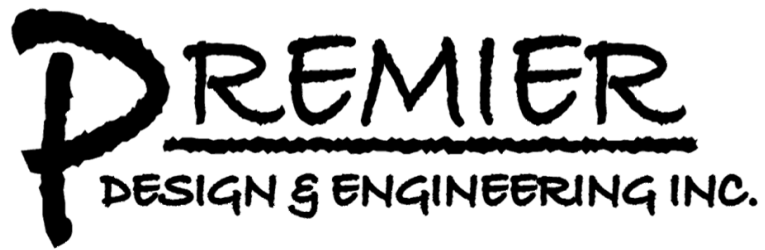
R_{new} = 1.14 (Imp) - 0.371 when imp ≥ 55%

R_{new} = .225 (Imp) + 0.05 when imp ≤ 55%

A = Area, in Acres.

Imp = decimal percentage of impervious surface in the contributing watershed

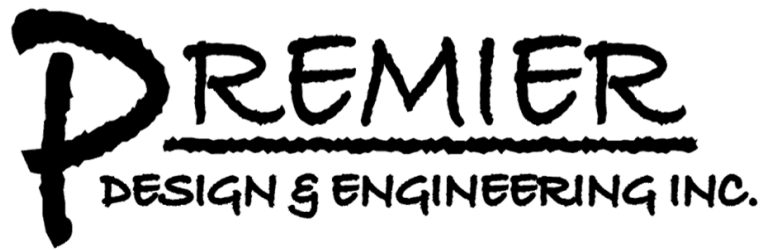
Area (ac)	P _{80%} (in)	A _{imp} (ft ²)	A _{total} (ft ²)	Imp (%)	R _{new} Imp>55%	R _{new} Imp<55%	R _{new}	WQRV (ac-ft)	WQRV (ft ³)
10.54	0.44	235,227	459,016	0.51	0.21	0.17	0.17	0.064	2,782
								Total	2,782



PROJECT:	<u>Willow Bend Townhomes</u>	BY:	<u>Marc Fonger</u>	DATE:	<u>9/30/2022</u>
SUBJECT:	<u>Drainage Study</u>	CHKD. BY:	<u>Marc Fonger</u>	DATE:	<u>9/30/2022</u>

Sub Area 1
 HEC-HMS 100-Year, 3-Hour Storm Hydrographs

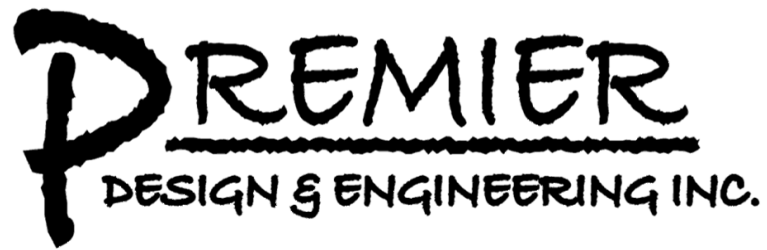
Time (min)	Pre-Dev Flow (cfs)	Volume (cf)	Post-Dev Flow (cfs)	Detention		
				Outflow (cfs)	Volume (cf)	Acc. Volume (cf)
	6.41		13.44			
0	0	0	0	0.00	0	0
5	0	0	0	0.00	0	0
10	0	0	0	0.00	0	0
15	0	0	0	0.00	0	0
20	0	0	0	0.00	0	0
25	0	0	0	0.00	0	0
30	0	0	0	0.00	0	0
35	0	0	0	0.00	0	0
40	0	0	0	0.00	0	0
45	0	0	0	0.00	0	0
50	0	0	0	0.00	0	0
55	0	0	0	0.00	0	0
60	0	0	0	0.00	0	0
65	0	0	0.38	0.38	0	0
70	0.74	222	4.96	4.96	0	0
75	2.98	894	11.92	6.41	1,653	1,653
80	5.07	1,521	13.44	6.41	2,109	3,762
85	5.89	1,767	11.93	6.41	1,656	5,418
90	6.31	1,893	11.14	6.41	1,419	6,837
95	6.41	1,923	10.1	6.41	1,107	7,944
100	5.77	1,731	8.24	6.41	549	8,493
105	5.12	1,536	7.07	6.41	198	8,691
110	4.82	1,446	6.64	6.41	69	8,760
115	4.74	1,422	6.48	6.41	21	8,781
120	4.76	1,428	6.45	6.41	12	8,793
125	4.38	1,314	5.47	6.41	-282	8,511
130	3.17	951	3.41	6.41	-900	7,611
135	2.05	615	2.06	6.41	-1,305	6,306
140	1.44	432	1.51	6.41	-1,470	4,836
145	1.14	342	1.27	6.41	-1,542	3,294
150	0.99	297	1.17	6.41	-1,572	1,722
155	0.82	246	0.92	6.41	-1,647	75
160	0.53	159	0.48	0.73	-75	0
165	0.27	81	0.2	0.20	0	0
170	0.13	39	0.09	0.09	0	0
175	0.06	18	0.04	0.04	0	0
180	0.03	9	0.02	0.02	0	0
	0.02		0.01			
				100-YR Storm Volume =		
				8,793		



PROJECT: Willow Bend Townhomes BY: Marc Fonger DATE: 9/30/2022
 SUBJECT: Drainage Study CHKD. BY: Marc Fonger DATE: 9/30/2022

Sub Area 1
 HEC-HMS 10-Year, 3-Hour Storm Hydrographs

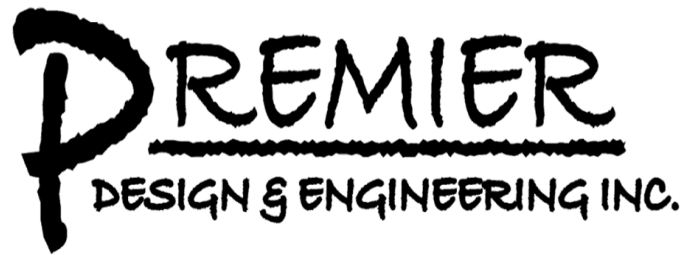
Time (min)	Pre-Dev Flow (cfs)	Volume (cf)	Post-Dev Flow (cfs)	Detention		
				Outflow (cfs)	Volume (cf)	Acc. Volume (cf)
	2.2		5.5			
0	0	0	0	0.0	0	0
5	0	0	0	0.0	0	0
10	0	0	0	0.0	0	0
15	0	0	0	0.0	0	0
20	0	0	0	0.0	0	0
25	0	0	0	0.0	0	0
30	0	0	0	0.0	0	0
35	0	0	0	0.0	0	0
40	0	0	0	0.0	0	0
45	0	0	0	0.0	0	0
50	0	0	0	0.0	0	0
55	0	0	0	0.0	0	0
60	0	0	0	0.0	0	0
65	0	0	0	0.0	0	0
70	0.1	30	1.6	1.6	0	0
75	0.4	120	4.4	2.2	660	660
80	1.1	330	5.5	2.2	990	1,650
85	1.6	480	5.4	2.2	960	2,610
90	2	600	5.3	2.2	930	3,540
95	2.2	660	4.9	2.2	810	4,350
100	2	600	3.8	2.2	480	4,830
105	1.7	510	3.1	2.2	270	5,100
110	1.6	480	2.8	2.2	180	5,280
115	1.6	480	2.7	2.2	150	5,430
120	1.6	480	2.7	2.2	150	5,580
125	1.5	450	2.4	2.2	60	5,640
130	1.2	360	1.7	2.2	-150	5,490
135	0.9	270	1.3	2.2	-270	5,220
140	0.7	210	1.1	2.2	-330	4,890
145	0.7	210	1	2.2	-360	4,530
150	0.6	180	1	2.2	-360	4,170
155	0.5	150	0.8	2.2	-420	3,750
160	0.4	120	0.4	2.2	-540	3,210
165	0.2	60	0.2	2.2	-600	2,610
170	0.1	30	0.1	2.2	-630	1,980
175	0	0	0	2.2	-660	1,320
180	0	0	0	2.2	-660	660
185	0.00	0.00	0	2.2	-660	0
				10-YR Storm Volume =		
				5,640		



PROJECT: Willow Bend Townhomes BY: Marc Fonger DATE: 9/30/2022
 SUBJECT: Drainage Study CHKD. BY: Marc Fonger DATE: 9/30/2022

Sub Area 1
 HEC-HMS 100-Year, 24-Hour Storm Hydrographs

Time (min)	Pre-Dev Flow (cfs)	Volume (cf)	Post-Dev Flow (cfs)	Detention		
				Outflow (cfs)	Volume (cf)	Acc. Volume (cf)
	11.2		16.2			
0	0	0	0	0.0	0	0
20	0	0	0.1	0.1	0	0
40	0.1	120	0.1	0.1	0	0
60	0.1	120	0.1	0.1	0	0
80	0.2	240	0.1	0.1	0	0
100	0.3	360	0.2	0.2	0	0
120	0.5	600	0.2	0.2	0	0
140	1.6	1,920	0.2	0.2	0	0
160	11.2	13,440	0.3	0.3	0	0
180	5.3	6,360	0.3	0.3	0	0
200	2.6	3,120	0.4	0.4	0	0
220	1.6	1,920	0.5	0.5	0	0
240	1.2	1,440	0.6	0.6	0	0
260	1	1,200	0.8	0.8	0	0
280	0.8	960	1.2	1.2	0	0
300	0.7	840	3.1	3.1	0	0
320	0.7	840	16.2	11.2	6,000	6,000
340	0.6	720	7.3	11.2	-4,680	1,320
360	0.6	720	3.3	4.4	-1,320	0
380	0.5	600	2	2.0	0	0
400	0.5	600	1.5	1.5	0	0
420	0.5	600	1.2	1.2	0	0
440	0.5	600	1	1.0	0	0
460	0.4	480	0.9	0.9	0	0
480	0.4	480	0.8	0.8	0	0
500	0.4	480	0.8	0.8	0	0
520	0.4	480	0.7	0.7	0	0
540	0.4	480	0.7	0.7	0	0
560	0.4	480	0.6	0.6	0	0
580	0.3	360	0.6	0.6	0	0
600	0.3	360	0.5	0.5	0	0
620	0.3	360	0.5	0.5	0	0
640	0.3	360	0.5	0.5	0	0
660	0.3	360	0.5	0.5	0	0
680	0.3	360	0.5	0.5	0	0
700	0.3	360	0.4	0.4	0	0
720	1.1	1,320	0.4	0.4	0	0
				100-YR 24-hr Storm Volume =		
				6,000		



PROJECT: Willow Bend Townhomes BY: Marc Fonger DATE: 9/30/2022
 SUBJECT: Drainage Study CHKD. BY: Marc Fonger DATE: 9/30/2022

Detention Basin Design

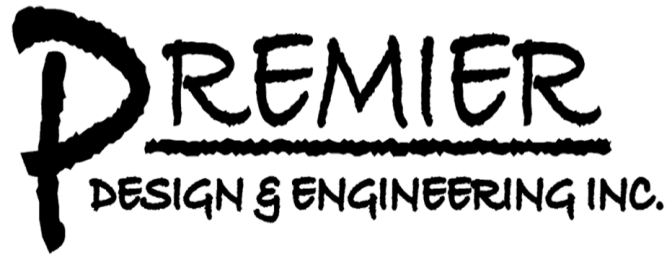
Subarea 1

Volume of Storage Required = 8,793 cf

Pipe Size (in)	(cf/lf)	Length Required	Length Provided	Volume Provided	Comments
12	0.79	11131		0	
18	1.77	4968		0	
24	3.14	2801		0	
30	4.91	1791		0	
36	7.07	1244		0	
42	9.62	915		0	
48	12.56	701		0	
54	15.9	554		0	
60	19.63	448		0	
66	23.75	371		0	
72	28.26	312		0	
78	33.17	266		0	
84	38.47	229		0	
Pond 1				5,905	cf 3' deep with 1' of freeboard
Pond 2				5,905	cf 3' deep with 1' of freeboard
Boxes					

Total Volume Provided = 11,811

Contour	Area (sf)	Volume (cf)	Acc Volume (cf)	LID Volume (cf)	Outlet Elevation
2590	1713.0			2,782	2591.14
2591	2442.0	2078			
2592	3169.0	2806	4883		



PROJECT: Willow Bend Townhomes BY: Marc Fonger DATE: 9/30/2022
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Detention Outlet Design

Subarea 1

Circular Orifice Equation

$$Q = C_d(0.25\pi D^2)(2gh)^{0.5}$$

Solving for A (Area of orifice, sf)

$$A = Q / (C_d(2gh)^{0.5})$$

$$Q = 2.20 \text{ cfs}$$

$$C_d = 0.62$$

$$g = 32.2 \text{ ft/s}^2$$

$$h = 3 \text{ ft}$$

$$\pi = 3.14$$

$$A = 0.26 \text{ sf}$$

$$D = 0.57 \text{ ft}$$

$$D = 6 \frac{3}{4} \text{ in}$$

Diameter of Orifice

Exhibit D

Geotechnical Study



February 1, 2021
Updated February 16, 2021

Smoothie King, LLC
1999 West Canyon View Drive
St. George, Utah 84770

Attention: Dave Nasal
email, davenasal@gmail.com

Subject: Hillside Evaluation – Geotechnical Study
Riverside Property
St. George, Utah
AGEC Project Number 2180294

REFERENCES

1. "Geotechnical Investigation", prepared by AGECE, project No. 2062788, dated March 16, 2007. (Incorporated grading recommendations from Letter dated March 8, 2007). Study included a larger parcel than is currently being evaluated.
2. "Addendum to Geotechnical Investigation", prepared by AGECE Project No. 2130396, dated May 19, 2014.
3. "Addendum No. 2, Geotechnical Recommendations", prepared by AGECE Project No. 2180294, dated November 16, 2018.
4. "Construction Testing", (initial grading), by AGECE, Project No. 2070336, March to December, 2007.
5. "Summary of Grading", prepared by AGECE Project No. 2180820, dated November 13, 2018.
6. "UGS Geologic Interactive Map, <http://geology.utah.gov/apps/intgeomap/#>
7. "Geologic Map of the St. George 7.5' Quadrangle, Washington County, Utah, Map 251DM, 2011, Hayden and Willis.
8. "Geologic Hazard Evaluation Study", St. George-Hurricane Metropolitan area, Washington, County, Utah, UGS Special Study 127-2008, Lund et al.

SCOPE OF WORK

Applied Geotechnical Engineering Consultants, Inc. (AGEC) was requested to conduct further evaluation for the above referenced property. Our study includes the hillside area east of Riverside Drive as shown on Figure 1 and 2. AGEC has previously conducted various levels of evaluation as referenced above. The information from the previous studies, References No. 1-3 above were utilized to assist in providing these recommendations. The previous work in References 2-5 were primarily for the southern portion of the property. AGEC has reviewed Reference No. 1, which was a hillside evaluation report that was taken to St. George City Hillside and previously approved. AGEC has not reviewed the minutes of those meetings.

In addition, AGEC has reviewed the past grading of the site during the 2007 time period (Reference No. 3). The grading history for the southern portion of the site is provided in Reference No. 3 (Addendum No. 2).

PROPOSED CONSTRUCTION

We understand it is proposed to construct a multi-family development on the property as shown on Figure 2. The preliminary grading for the project indicates cuts on the order of 30 feet in the northeast portion and where the roadway cut is planned. The approximate area of hillside disturbance or grading is shown on Photos 1 and 1B.

We anticipate that the structures would be multi-story, wood-framed and slab on grade type structures. Details of the buildings are not known at this time.

AGEC has worked with Premier Design in developing a grading plan for the property. We also anticipate that the widening of Riverside Drive will be necessary along with the interior road and improvements.

SITE CONDITIONS

The property is located east of Riverside Drive as shown on Figures 1 and 2 and Photos 1 and 2 (aerial), which shows the area of concern for this hillside evaluation. There is a significant portion of the overall project to the south that is not included in this hillside evaluation that has been evaluated and monitored during the previous grading (References 2-5).

The property is located on the west to southwest slope of what is known as Nettas Knoll.

The slope area slopes down steeply to near the property line. There is a knoll that will be partially cut on the south end of the hillside area (Photo No.5). Near the north end of the site, Riverside Drive has exposed a cut into the hillside, which is adjacent the proposed entrance to the project. The hillside continues to the north along Riverside Drive and to the east up to the crest of Nettas Knoll. The area to the south has been previously graded as a part of this project.

Mudstone and sandstone bedrock along with gravel soils are exposed throughout the proposed project area. The site is sparsely vegetated with small grasses and bushes. There are several 2 track paths from recreation vehicle use in the past. There are several photos of the site attached.

SUBSURFACE INVESTIGATION/CONDITIONS

On October 28, 2020, AGECE visited the site and observed the drilling of 4 borings at the approximate locations shown on Figure 2. The borings were drilled with a truck mounted drill rig equipped with HQ size core barrel where continuous core samples of the underlying bedrock were obtained. In addition, 2 borings in the hillside area were drilled as a part of the 2007 study (Reference No. 1) also included in this report.

The subsurface soils/rock consists primarily of varied amounts of silty sand and gravel overlying sandstone bedrock. The north end of the site contains weathered mudstone or lean clay overlying sandstone bedrock. Occasional thin layers of mudstone were encountered within the profile of sandstone. Mudstone bedrock (blue clay) was encountered at depths of 16 to 17 feet in borings B-3 and B-4 near the south end of the hillside where the previous pad grading on the southern portion of the property had been terminated.

Photos of the core samples obtained are attached along with the boring logs on figure 3 and the previous study information in the Appendix.

SUBSURFACE WATER

Groundwater was not encountered during this investigation to the depths investigated. . Fluctuations in the groundwater level may occur over time. An evaluation of such fluctuations is beyond the scope of this report.

GEOLOGY

The geologic conditions at the site were evaluated based on a review of geologic literature, and a site geologic reconnaissance.

A. Geomorphology of the Area

The site is located north of the Virgin River in St. George, Utah as shown on Figure 1. The site is on the hillside of the west side of what is known as the Nettas Knoll just east of the Lava Ridge (Middleton Black Ridge) lava flow. The site is also located on the north side of the Virgin River Anticline. This area is part of the St. George Basin which is bound on the north by the Pine Valley Mountains, on the east by the Hurricane Cliffs, on the west by the Beaver Dam Mountains, and on the south by the Mount Trumbull area.

Bedrock in the St. George basin mainly consists of Upper Permian and Lower Jurassic sandstone, shale, siltstone, limestone, gypsum, and conglomerate. These beds are folded to the southeast into the northeast trending Virgin anticline. Several north-trending faults are present within the St. George Basin, the most prominent of which is the Washington Fault (Christensen and Deen, 1983).

The St. George Basin is characterized by basalt capped buttes and cuestas that were once stream channels along which lava flowed. Erosion of the surrounding softer sedimentary rocks over time has resulted in an inverted topography of old stream channel becoming resistant basalt ridges such as the Middleton Black Ridge and the West Black Ridge (Christenson and Deen, 1983).

The geologic structure within the basin is dominated by the Virgin anticline which trends northwest to southeast and is located south of the site. The Virgin anticline is a broad, generally symmetrical fold with maximum flank dips of 25 to 30 degrees to the northwest and southeast (Christenson and Deen, 1983).

The geologic conditions at the site were evaluated based on a review of geologic literature, boring and test pit exploration and a reconnaissance of the site. Figure 5a indicates the most recent geologic mapping for the site.

B. Stratigraphy of the Area

The stratigraphy of the area consists of Lower Triassic - aged bedrock of the Chinle Formation. There is a recent mapped landslide deposit on the north end of the property extending north along Riverside Drive. This deposit is mapped within Reference No. 7 (2011), but not within Reference No. 8 from 2008. We believe this mapping is part of the material that has sluffed from the very steep roadway cut

during the extension and widening of Riverside Drive. The geologic descriptions of the various members or formations are described on Figure 7, the geologic map.

GEOLOGIC HAZARDS

Based on review of geologic literature and site reconnaissance, the following information is provided concerning geologic hazards.

A. Expansive Soil/Bedrock

The presence of potentially expansive layers of bedrock is identified by the geologic mapping hazard by Lund and others, 2008. The expansive bedrock is mapped as the Petrified Forest member of the Chinle Formation. Our subsurface investigation and laboratory testing by AGECEC and our experience in the area also indicate that mudstone bedrock on the project site is moderately to highly expansive.

When final design plans are provided, AGECEC will further evaluate and provide additional recommendations to address this concern for expansive layers. Currently, the building pads are planned above at least 15 to 17 feet of fill over sandstone.

B. Landslides

There are 3 sources of mapping that we have reviewed, (Ref No.s 6, 7 and 8). The 2008 Hazard Map (Ref No. 8) and 2016 Interactive On-line mapping both indicate that there are no landslides on the site, but there is a high hazard for potential landslide. The 2011 mapping (Ref No. 7) indicates the property to the north is a mapped area of landslide deposit. In our conversations recently with UGS geologists, they have indicated that we should reference the most recent mapping. During our site investigation, evidence of landslides or debris flow was not observed in the area of the proposed development. The high hazard is based on the steep slopes and the presence of the Chinle Formation. It should also be noted that there are some sluffing areas in the cut zone along Riverside Drive that have occurred since the construction of the roadway. The sluffing area is primarily due to the drying, shrinking and cracking on the very steep cut slope. The sluffing is surficial or shallow. See Figure 8 for current hazard map.

C. Rock Fall

Rockfall hazards generally occur with a rockfall source (such as a jointed caprock or cliff forming bedrock) and a slope or grade change to provide adequate energy for the rockfall to occur. There is a layer of cemented gravels (conglomerate) on the slope above the site on the eastern slope. Based on a review of the geologic hazard map (Ref No.s 6 and 8) the site has a moderate risk of rock fall, particularly on the

south end of the property. During our site visit, the potential source of rock fall is limited. A rock fall evaluation was not conducted. See Figure 9 for hazard map.

CONCLUSIONS

Base on our evaluation along with the proposed construction, the following conclusions are made:

- The site is suitable, provided the recommendations within this report are followed for grading the site.
- There is expansive soil/rock on the site and should be removed from at least 15 to 17 feet below the proposed pad grades. Based on the proposed building locations and the borings drilled, the 3 buildings in the hillside portion of the project will be supported on fill materials overlying sandstone bedrock. Based on the proposed grades, it appears that the thickness of separation is being provided at this time. A hand sketched profile of the north to south profile is provided in the appendix showing the profile across these buildings.
- There are significant cuts into the slope on the north and east sides of the property. The cuts are on the order of 30 feet. It is anticipated that the northern cut will be into the mudstone for the upper slope and sandstone at the base of the cut. The southern portion of the eastern slope cut will be in sandstone bedrock. The northern portion of the eastern slope is anticipated to be a combination of both materials (mudstone over sandstone).
- We anticipate that the cut slopes will be stable at approximately 1:1 based on the roadway cuts to the north and our evaluation. It may be necessary to flatten the slopes in the mudstone as they become exposed and additional observations are made.
- The potential for rockfall is low to moderate. Prior to grading, AGECE should inventory potential fall source rocks and either remove or stabilize.

GRADING RECOMMENDATIONS

A. Site Grading

Based on the subsurface conditions and proposed grading provided by Premier Engineering, the following recommendations are provided:

1. Subgrade Preparation

General: Prior to placing structural fill, site grading fill or concrete, the site should be grubbed to remove vegetation and soil containing roots and organics.

Expansive Bedrock Removal - Buildings and Structures: We recommend that a separation of 17 feet be provided between the expansive mudstone/clay layer and the building pad grades. The mudstone should be removed below structures, entry areas and canopies, extending at least 5 feet beyond the perimeter of the structure. The limits of removal should be determined by survey and documented following removal.

Expansive Bedrock Removal - Roadways and Flatwork: We recommend providing at least a separation of 4 feet below the proposed subgrade elevation and the surface of the expansive mudstone. The material should be removed a distance of at least 2 feet beyond the edge of roadway/flatwork improvements.

2. Excavation/Slopes

Based on the proposed grading, we anticipate that the majority of the cuts will be in the sands and gravels with portions of the parking cuts extending into the mudstone. In order to maintain stable slopes, they should be retained or slopes should be graded no steeper than 2:1 Horizontal to Vertical (H:V). Cut slopes into the competent bedrock may be steepened to 1:1. Fill slopes should be graded no steeper than 2:1 (H:V). Chapter 18, Appendix J of the International Building Code (IBC) should be referenced and followed with regards to benching and drainage on slopes.

Erosion/raveling of the exposed bedrock cut face should be anticipated due to weathering processes. This will be more evident where mudstone is exposed and less evident where sandstone is exposed. The mudstone will dry, shrink and shallow slumps will likely occur. This could result in

accumulation of soil deposits at the toe of the cut slope and will require maintenance to remove the deposits throughout the life of the structures.

To control erosion and weathering, the bedrock cut slopes should be protected by erosion protection. This would be particularly critical where softer mudstone is exposed. Benches may also be cut into the slopes to assist in controlling drainage and erosion. Benches should be at least 5 feet in width and should be constructed at intervals in accordance with the 2018 IBC.

Fill slopes should be constructed by overbuilding the slope and then cutting back the slope face to the desired grade to provide a properly compacted slope face. Fill placed on existing slopes steeper than 3:1 (H:V) should be keyed into the existing slope using a benching procedure. Benches should be of sufficient width to allow for operation of compaction equipment.

Utility trenches excavated in the on-site soils should be excavated in accordance with OSHA requirements using a OSHA Soil Class C (1½:1 H:V) for overburden soils and Soil Class A (½:1 H:V) for trenches excavated into the bedrock. Steeper trenches may require the use of shoring or a trench box to provide as safe work environment. Safe trench excavation is the responsibility of the contractor.

3. Materials

Import materials should be non-expansive, non-gypsiferous, granular soil. Listed below are the materials recommended for imported fill.

Area	Fill Type	Recommendations
Foundations/slabs	Site grading/ structural fill	-200 <35%, LL <30% Maximum size: 4 inches Solubility < 1%
Roadways	Base course	CBR>50%, 200 <12% Maximum size: ¾ inch
Underslab	Base course	-200 <12% Maximum size: 1 inch

-200 = Percent Passing the No. 200 Sieve
LL = Liquid Limit

The on-site silt, sand and gravel soils and fill soils, free of organics and debris, are suitable for use as structural fill, site grading fill, and utility trench backfill. The on-site mudstone is not suitable for use as structural fill or site grading fill, but may be used as fill in non structural areas, trench backfill, wall backfill, or at least 4 feet below pavement areas. An AGEC engineer should observed the bedrock removal to determine suitability for its intended use.

4. Compaction

Compaction of fill materials placed at the site should equal or exceed the following percentages when compared to the maximum dry density as determined by ASTM D-698 or ASTM D-1557:

Area	Percent Compaction ASTM D-698*	Percent Compaction ASTM D-1557**
Subgrade	90	90
Footings/foundations	NA	95
Slabs/Pad Fill (over excavation)	100	95
Utility trench backfill (Structural Areas)	100	95
Wall Backfill (Structural Areas)	100	95

* Fine-grained or processed mudstone/clay.

** Granular site grading/structural fill

Fill should be placed in lifts which do not exceed the capability of the equipment used. Generally, 6 to 8 inch lifts are adequate for heavy rubber tire equipment. Lift thicknesses should be reduced to 4 inches for hand compaction equipment. Fill placed at the site should be properly moisture conditioned prior to placement and should be tested to verify proper compaction.

Fill materials should be properly moisture conditioned prior to placement. Fine-grained should be moisture conditioned to 0 to 4 percentage points over the optimum moisture content as determined by ASTM D-698. Granular soil should be moisture conditioned to within 2 percentage points of the optimum moisture content as determined by ASTM D-1557.

5. Drainage

The following drainage recommendations should be implemented:

- Positive site drainage should be maintained during the course of construction. In no case should water be allowed to pond adjacent to buildings/foundations.
- After construction has been completed, positive drainage of surface water away from the structures should be maintained throughout the life of the structures. We recommend a minimum slope of 6 inches in the first 10 feet from the perimeter of the structures. Hard or impermeable surfaces may be used to direct water away from buildings.
- Roof gutters should also be utilized with downspouts which extend out away and down slope from buildings. Preferably, downspouts should discharge off-site.
- Landscaping that requires water (grass) should be limited to reduce the potential for wetting of foundation support soils and to reduce the potential future accumulation of perched water on top of the bedrock.
- We also recommend that desert landscaping, which requires little to no water, be used adjacent to concrete or masonry walls which will be backfilled to reduce salt migration of soluble salts and the subsequent salt weathering on cement containing elements. The below grade portions of walls/fences which are backfilled with soil should be protected with an impermeable membrane and a subsurface drain. A gravel covered, perforated PVC pipe should also be placed at the base of the wall to carry water to a discharge point. This is intended to reduce the potential for salt weathering and sulfate attack on concrete/masonry.

LIMITATIONS

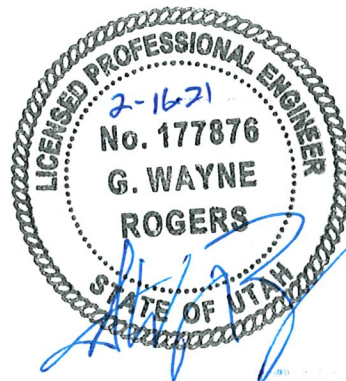
This report is prepared in accordance with generally accepted soil and foundation engineering practices in the area for the use of the client for design purposes. The conclusions and recommendations included within the report are based on the information obtained from the references, the borings drilled, our engineering analysis and our experience in the area. If the soil or groundwater conditions are found to be different from those described in the report, we should be notified to reevaluate the conclusions and recommendations given. AGECE will be providing further recommendations for foundations and site work including roadway pavement sections.

Please call if you have questions or further consultation is needed.

APPLIED GEOTECHNICAL ENGINEERING CONSULTANTS, INC.

G. Wayne Rogers, P.E.

P:\2018 Project Files\2180200\2180294 - Riverside Property\addendum letter.wpd





Approximate site location

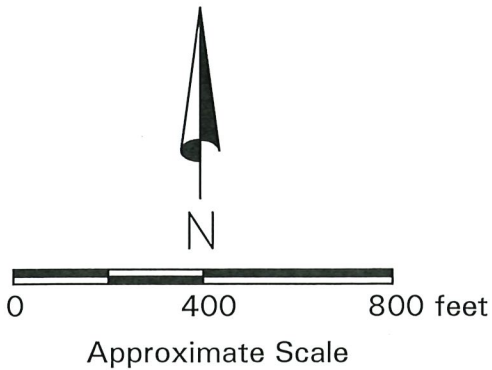
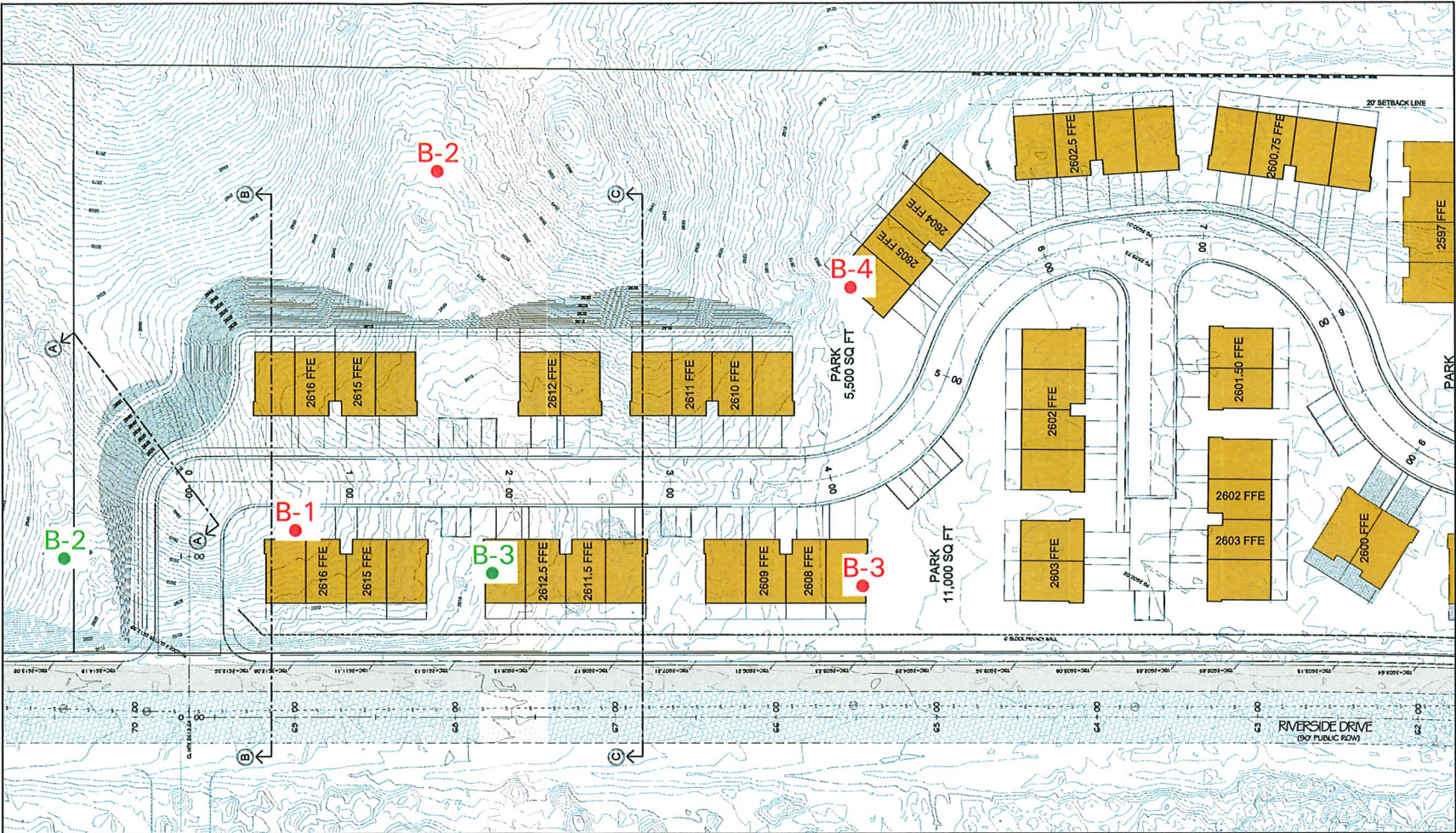


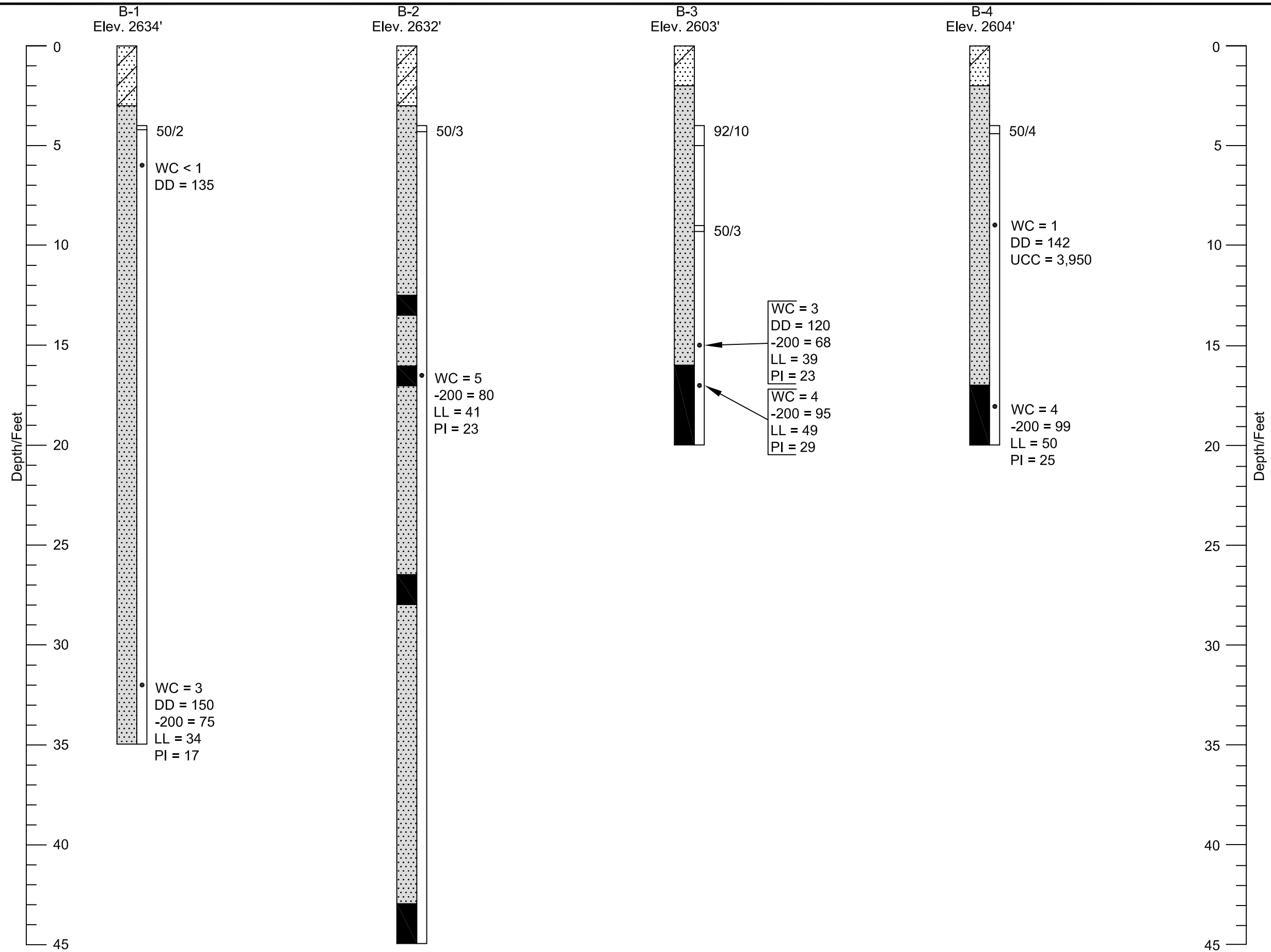
Not to Scale

RIVERSIDE PROPERTY
ST. GEORGE, UTAH

RIVERSIDE PROPERTY
ST. GEORGE, UTAH

- Approximate boring location, this study
- Approximate boring location during 2007 study, Project No. 2062788





LEGEND:



Poorly Graded Sand to Silty Sand with Gravel; medium dense to dense, slightly moist, occasional gravel up to cobble size and brown in color.



Mudstone Bedrock; soft to moderately hard, slightly moist, gypsiferous, and is purple to grey in color.



Sandstone Bedrock; moderately hard to hard, dry to slightly moist, occasional zones of low plastic layers, and red-brown to grey to purple in color.



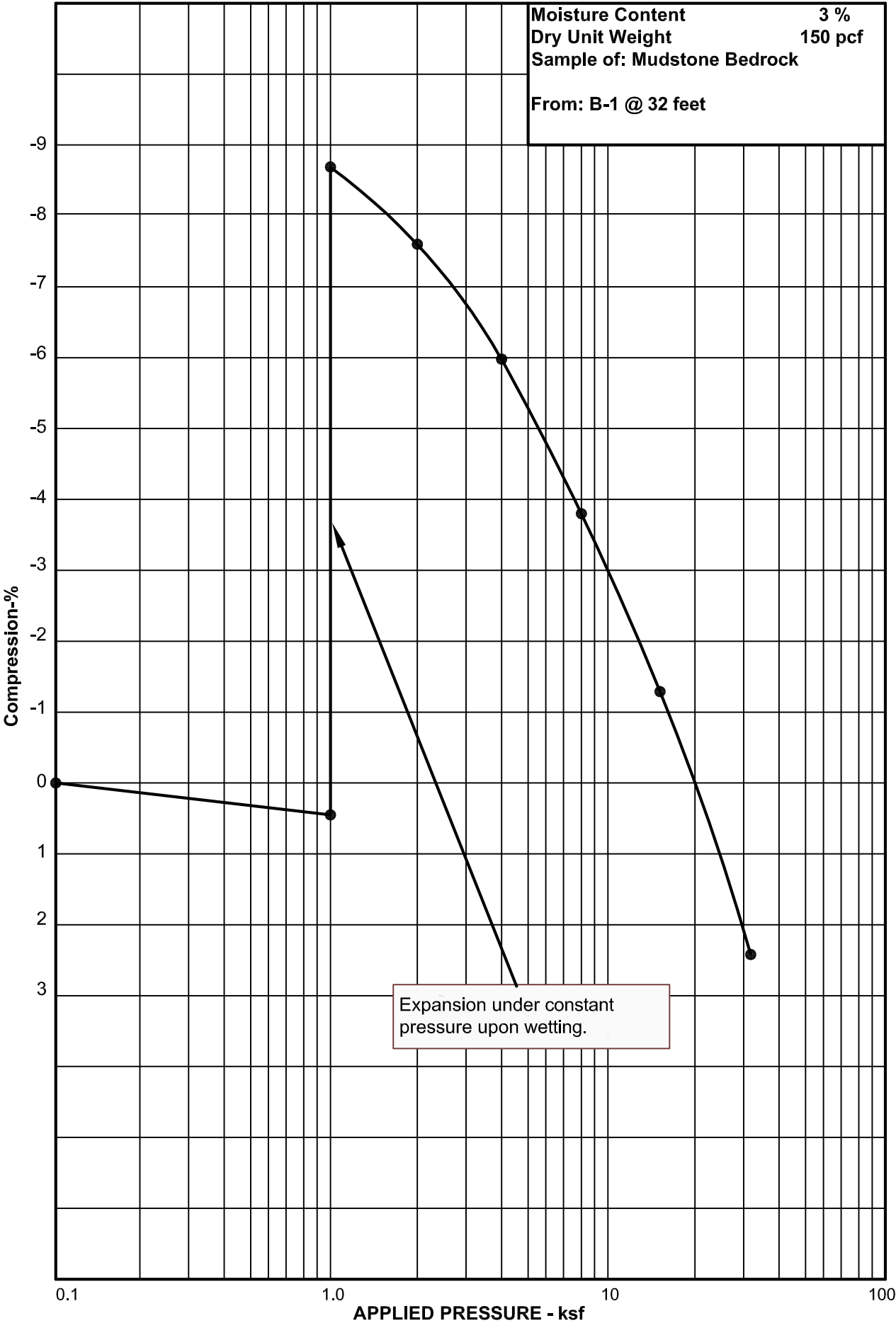
10/12 California drive sample taken. The symbol 10/12 indicates that 10 blows from a 140 pound hammer falling 30 inches were required to drive the sampler 12 inches.

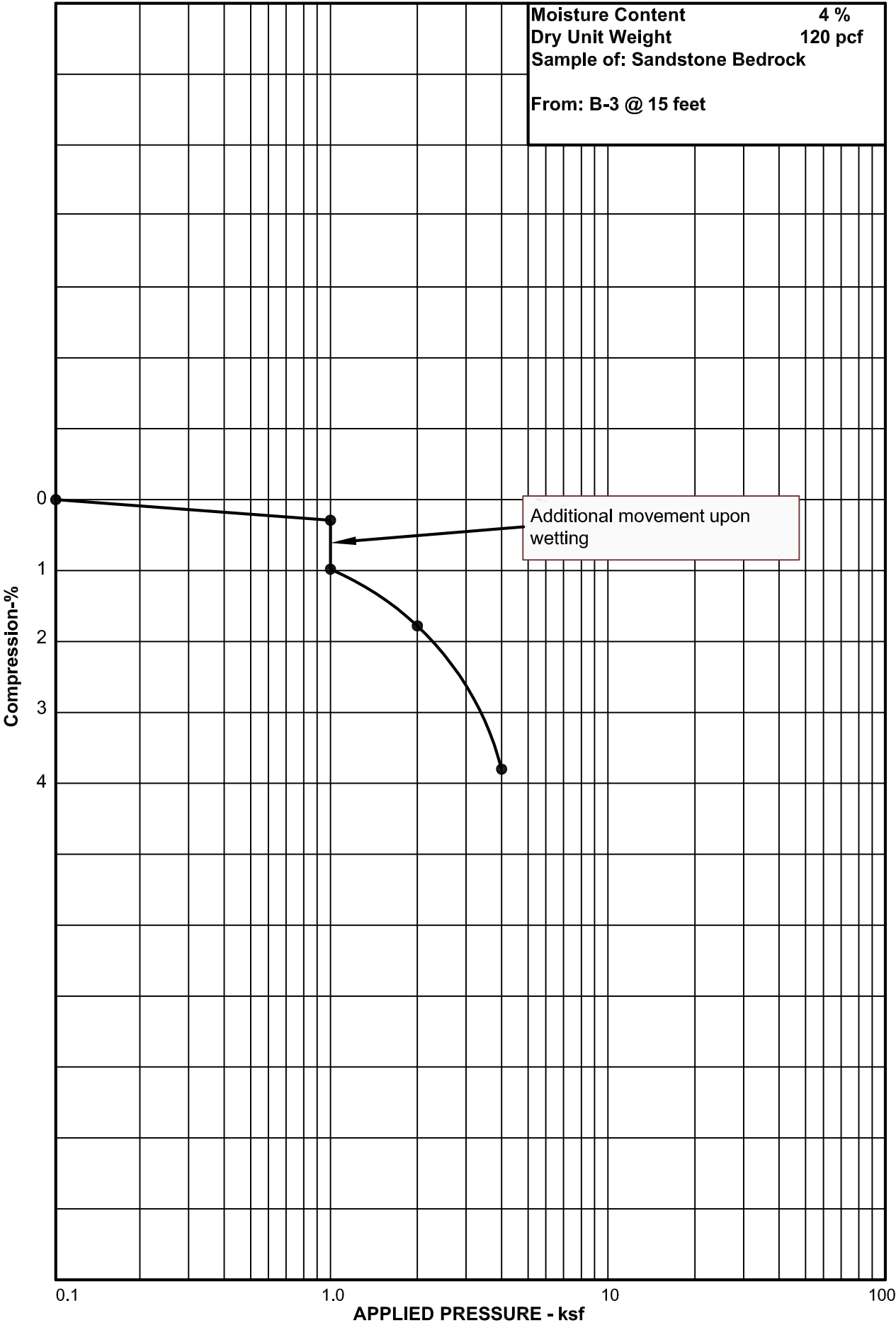


Indicates core sample taken.

NOTES:

1. The borings were drilled on October 28, 2020 with a truck mounted drill rig equipped with 8-inch hollow-stem augers to bedrock then cored using an HQ diamond core barrel with air to remove cuttings.
2. The locations of the borings were measured by pacing from features shown on Figure 2.
3. The elevations of the borings were determined by interpolation between the contours on the site plan provided.
4. The boring locations and elevations should be considered accurate only to the degree implied by the method used.
5. The lines between the materials shown on the boring logs represent the approximate boundaries between material types and the transitions may be gradual.
6. Free water was not encountered in the borings at the time of drilling.
7. WC = water content (%);
DD = dry density (pcf);
+4 = percent retained on the No. 4 sieve;
-200 = percent passing No. 200 sieve;
LL = liquid limit (%);
PI = plasticity index (%).





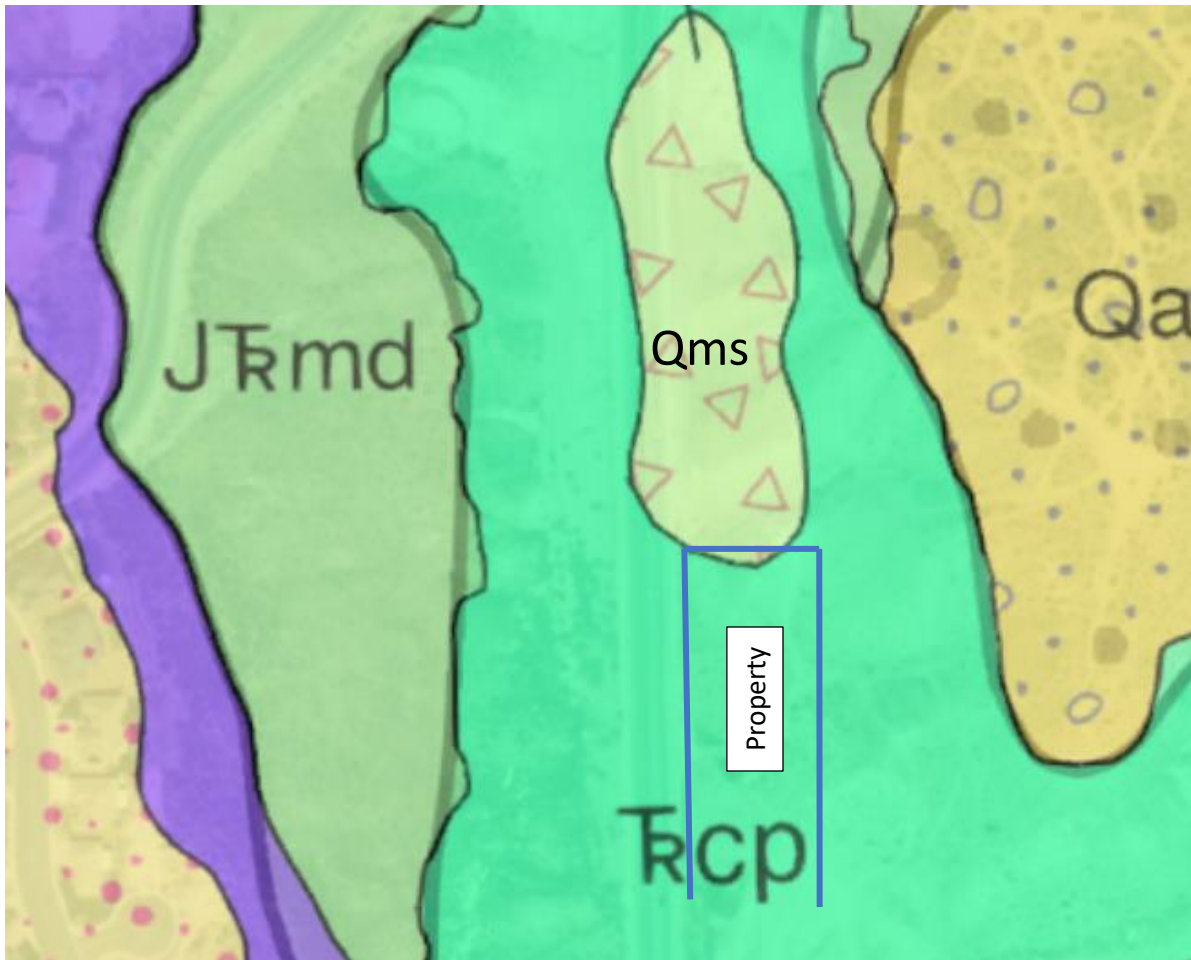
APPLIED GEOTECHNICAL ENGINEERING CONSULTANTS, INC.

TABLE I
SUMMARY OF LABORATORY TEST RESULTS

Riverside Property

Project Number 2180294

Sample Location		Natural Moisture Content (%)	Natural Dry Density (pcf)	Gradation			Atterberg Limits		Unconfined Compressive Strength (psi)	Sample Classification
Boring No.	Depth (feet)			Gravel (%)	Sand (%)	Silt/ clay (%)	Liquid Limit (%)	Plasticity Index (%)		
B-1	6	< 1								Sandstone Bedrock
B-1	32	3	150			75	34	17		Sandstone Bedrock (Lean Clay)
B-2	16½	5				80	41	23		Mudstone Bedrock
B-3	15	3	120			68	39	23		Sandstone Bedrock (Lean Clay)
B-3	17	4				95	49	29		Mudstone Bedrock
B-4	9	1	142						3,949	Sandstone Bedrock
B-4	18	4				99	50	25		Mudstone Bedrock



KEY TO GEOLOGIC MAP:

Qms: Landslide deposits- Extremely poorly sorted, clay- to boulder-sized, chaotic debris with blocks of rotated strata up to several hundred feet across that form chaotic, hummocky mounds; form primarily on steep slopes capped by basalt flows;

TRcp: Petrified Forest Member of Chinle Formation- Highly variegated, light-brownish-gray, pale-greenish-gray, to grayish-red-purple, bentonitic shale, mudstone, siltstone, and claystone, with several lenticular interbeds of pale-yellowish-brown, cross-bedded, resistant sandstone up to 10 feet (3 m) thick; pebble to small-cobble conglomerate near base; clasts are primarily chert and quartzite; contains minor chert, nodular limestone, very thin coal seams and lenses as much as 0.5 inch (1 cm) thick, and locally abundant, brightly colored fossilized wood; shale and mudstone weather to a "popcorn" surface with abundant mudcracks due to expansive clays and cause road and building foundation problems; weathers to badland topography; prone to landsliding along steep hillsides;

Figure 7

(Ref No. 7)

GEOLOGY MAP

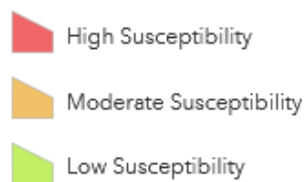
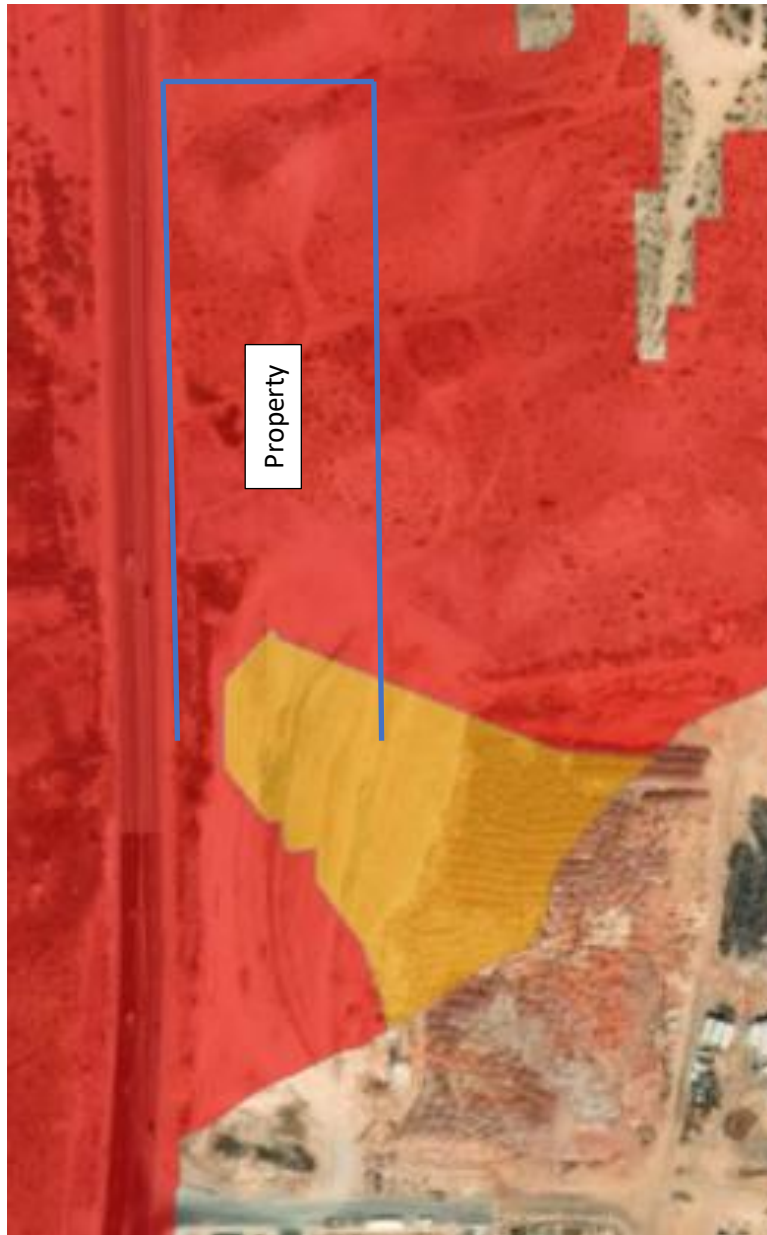


Figure 8
(Ref No. 6 & 8)

LANSLIDE SUSCEPTIBILITY MAP



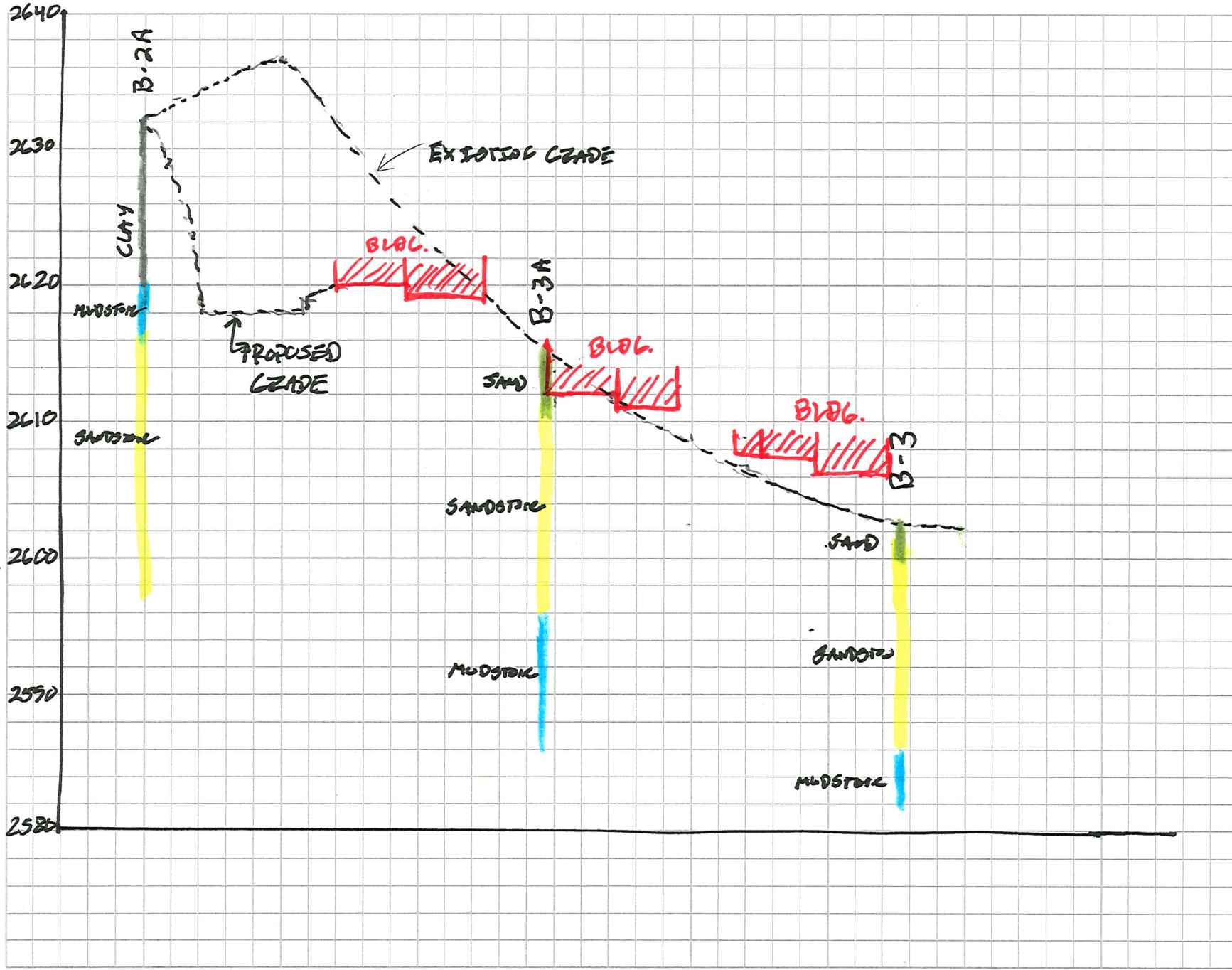
Figure 9
(Ref No. 6 &8)

ROCKFALL HAZARD MAP

Appendix

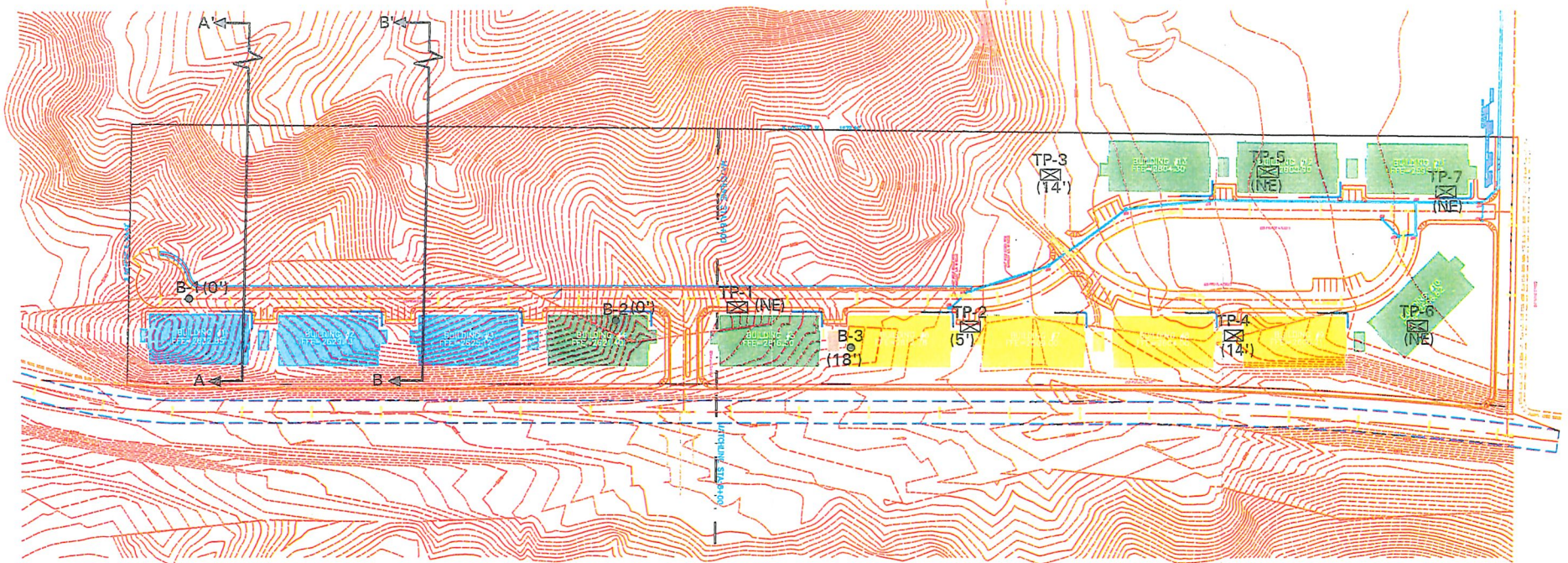
Profile North-South

PROJECT NO. 2180294 TITLE RIVERSIDE DR. DATE 2-1-21 BY WR
 SUBJECT CROSS SECTION SHEET OF



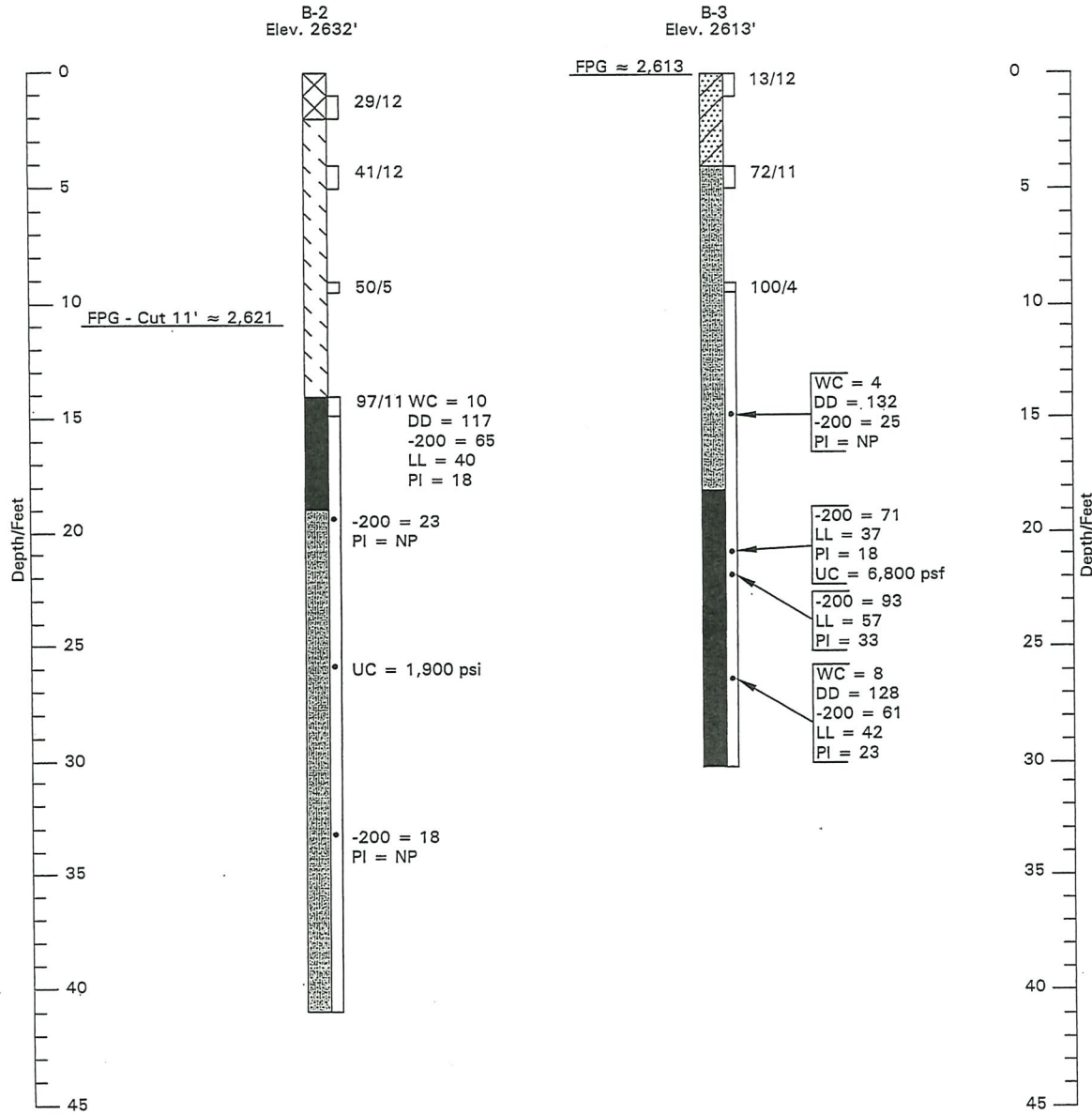
Previous Study Data

VILLA DE COLINA
ST. GEORGE, UTAH



- ⊗ Approximate test pit location
- Approximate boring location
- (5') Depth to expansive soil/bedrock below proposed finished pad grade
- (NE) Expansive bedrock/soil not encountered

- Pier foundation system with grade beams and structural floor
- Conventional spread footings/slab-on-grade floors with appropriate subgrade preparation
- Overexcavation of expansive mudstone to 20' below finished pad grade - Conventional spread footings/slab-on-grade floors (secondary alternative to piers/structural floor)



See Figure 6 for Legend and Notes

LEGEND:



Fill; processed mudstone bedrock (fat clay); poorly to moderately compacted, dry to slightly moist, high plastic, purple.



Fat clay (CH); hard to very hard, dry to slightly moist, high plastic, light gray mottled purple.



Lean clay (CL); varied amounts of sand and gravel, medium stiff to stiff, dry to slightly moist, low to medium plastic, brown.



Clayey sand (SC); occasional gravel and cobbles, medium dense, dry, light brown.



Silty sand (SM); loose to medium dense, slightly moist to moist, light brown.



Poorly graded sand (SP); medium dense, moist to very moist, light brown to gray.



Mudstone bedrock; soft, moist, medium to high plastic, purple to red-brown to gray.



Sandstone bedrock; weathered to moderately hard, dry to moist, non-plastic, purple to light gray to red-brown.



Indicates relatively undisturbed hand drive sample taken.



Indicates relatively undisturbed block sample taken.



Indicates disturbed sample taken.



Indicates practical trackhoe refusal on sandstone bedrock.



Indicates depth to caving.



10/12 California Drive sample taken. The symbol 10/12 indicates that 10 blows from a 140 pound automatic hammer falling 30 inches were required to drive the sampler 12 inches.

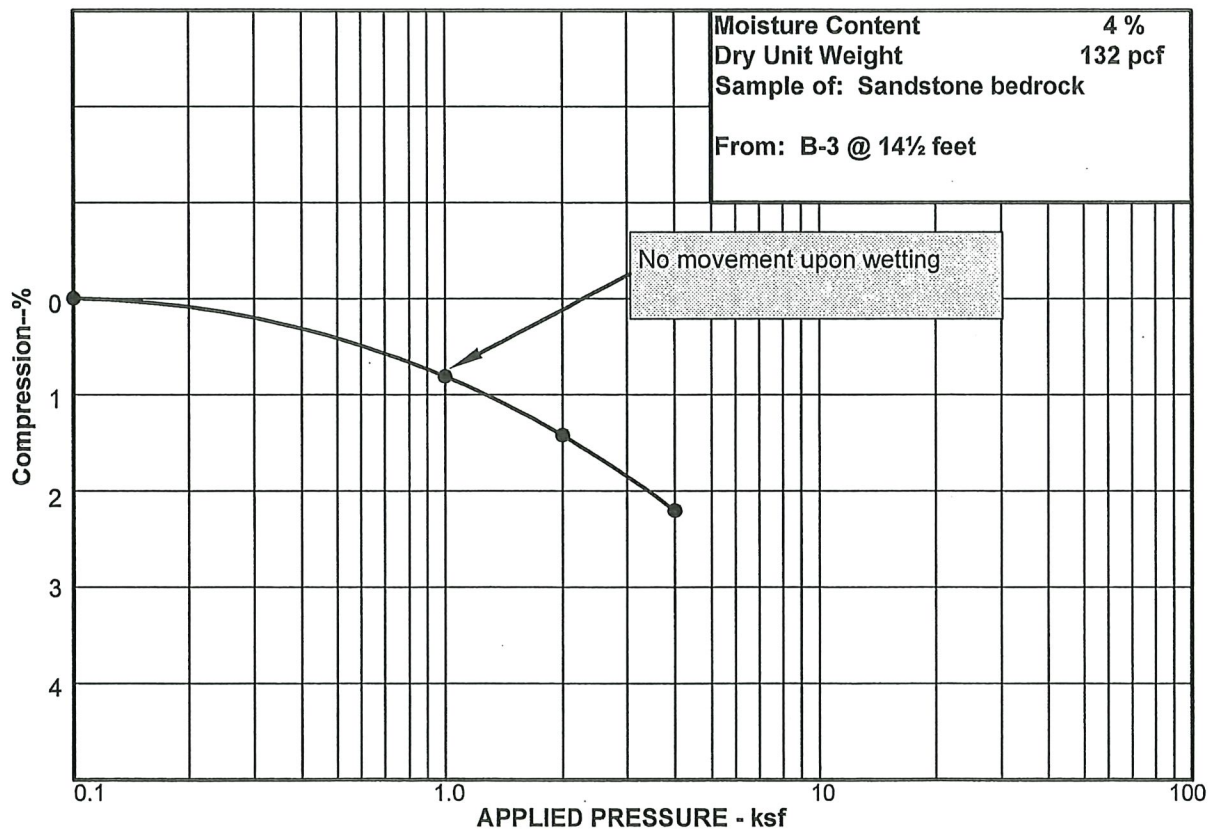
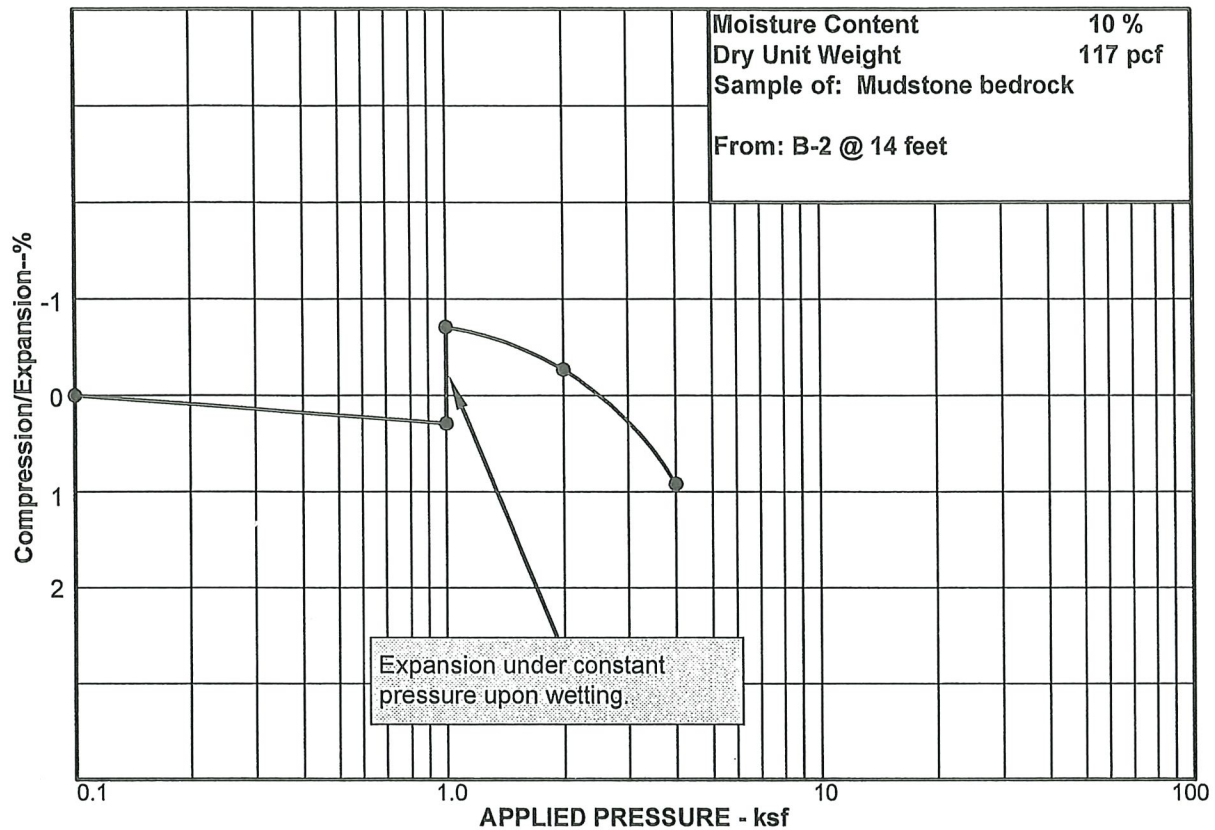


Indicates undisturbed continuous 2 inch core sample taken.

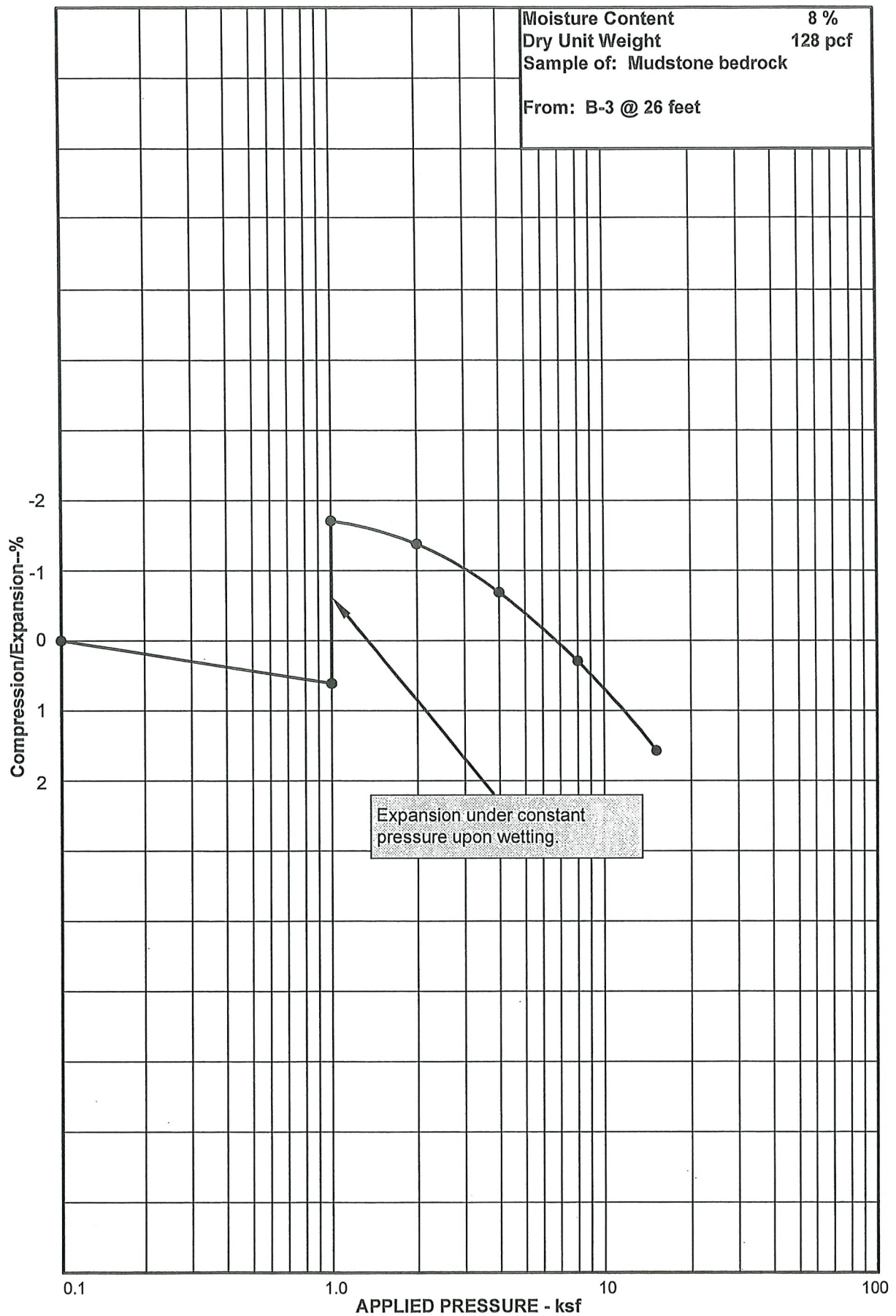
NOTES:

1. The borings were drilled on January 10, 11, 12, and 30, 2007 with all-terrain and truck mounted drill rigs equipped with 7-inch hollow-stem augers and a 2 inch NX core barrel with a carbide bit and air to remove cuttings. The test pits were excavated on January 23, 2007 with a trackhoe.
2. The locations of the test pits and borings were measured with a global positioning system (GPS).
3. The elevations of the test pits and borings were determined by interpolating between the contours shown on the site plan provided, Figure 2.
4. The test pit locations and elevations should be considered accurate only to the degree implied by the method used.
5. The lines between the materials shown on the test pit logs represent the approximate boundaries between material types and the transitions may be gradual.
6. Free water was not encountered in the borings/test pits at the time of drilling/excavation.
7. WC = Water Content (%);
DD = Dry Density (pcf);
-200 = Percent Passing No. 200 Sieve;
LL = Liquid Limit (%);
PI = Plasticity Index (%);
NP = Non-plastic;
WSS = Water Soluble Sulfates (ppm);
UCC = Unconfined Compressive Strength (psi or psf).

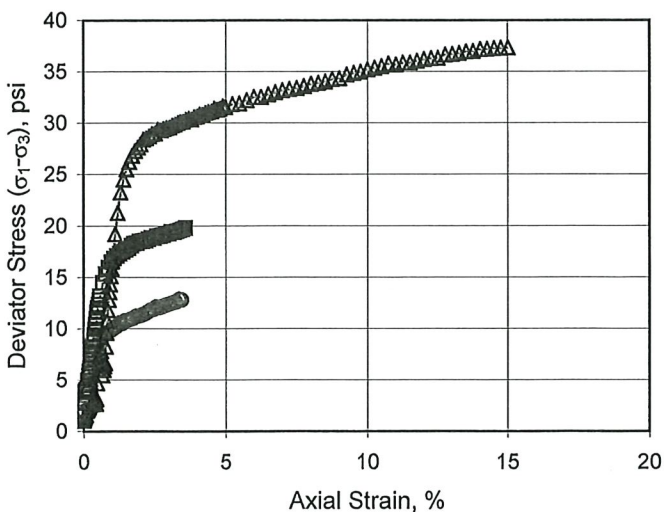
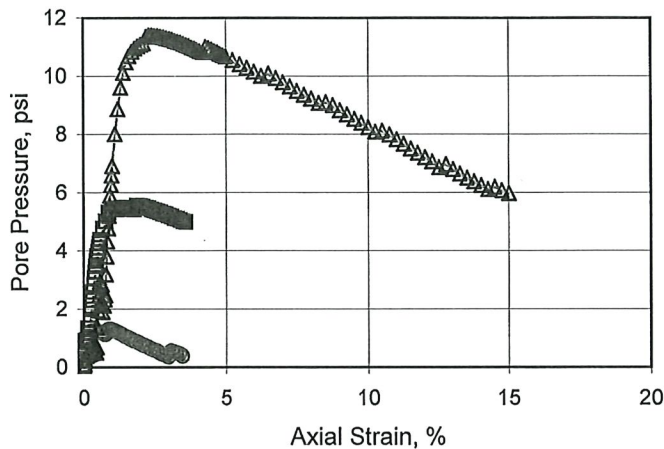
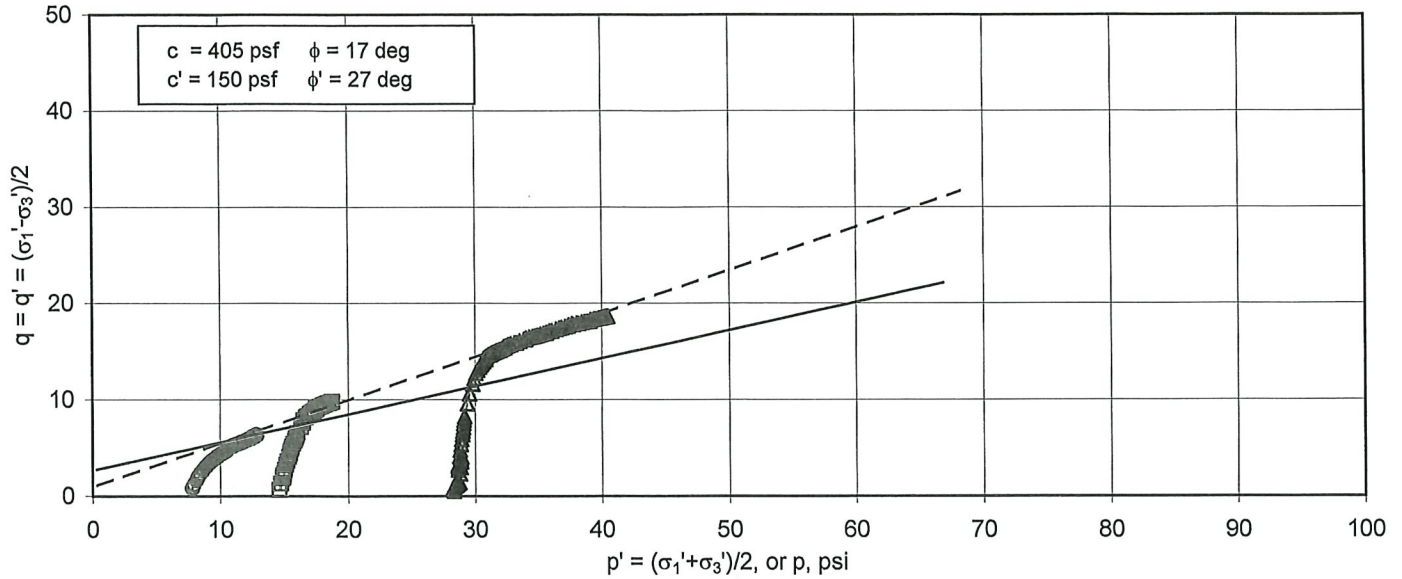
Applied Geotechnical Engineering Consultants, Inc.



Applied Geotechnical Engineering Consultants, Inc.



Applied Geotechnical Engineering Consultants, Inc.



Test No. (Symbol)	O	□	△
Sample Type	undisturbed		
Length, in.	3.19	3.08	2.97
Diameter, in.	1.93	1.82	1.71
Dry Density, pcf		N/A	N/A
Moisture Content, %		N/A	N/A
Consolidation Pressure, psi	6.9	13.9	27.8
"B" Parameter	0.96	0.96	0.96
Total Confining Stress (σ_3), psi	6.9	13.9	27.8
Total Axial Stress (σ_1), psi	19.7	33.6	58.0
Deviator Stress ($\sigma_1 - \sigma_3$), psi	12.8	19.7	30.2
Effective Lateral Stress (σ_3'), psi	6.5	8.9	16.7
Effective Axial Stress (σ_1'), psi	19.3	28.6	46.9
Pore Pressure (μ), psi	0.4	5.0	11.1
Strain, %	3.5	3.5	3.5
Remarks	Multistage Test (CU) Consolidated		
	Undrained with pore pressure measurements.		
	Sample saturated with back pressure saturation.		

Sample Index Properties	
Natural Dry Density, pcf	
Natural Moisture Content, %	
Liquid Limit, %	
Plasticity Index, %	
Percent Gravel	0
Percent Sand	
Percent Passing No. 200 Sieve	

Sample Description Mudstone Bedrock

Sample Location B-1 @ 29'

Project No. 2062788

Figure 17

Applied Geotechnical Engineering Consultants, Inc.

Table 1 - Summary of Laboratory Test Results

VILLA DE COLINA

Project No. 2062788

Sample Location		Natural Moisture Content (%)	Natural Dry Density (pcf)	Gradation			Atterberg Limits		Unconfined Compressive Strength	Water Soluble Sulfates (ppm)	Soil Type
Test Pit/ Boring No.	Depth (ft)			Gravel (%)	Sand (%)	Silt/Clay (%)	Liquid Limit (%)	Plastic Index (%)			
B-2	14	10	117			65	40	18			Mudstone bedrock
B-2	19					23		NP			Sandstone bedrock
B-2	26								1,900 psi		Sandstone bedrock
B-2	33					18		NP			Sandstone bedrock
B-3	14½	4	132			25		NP			Sandstone bedrock
B-3	20					71	37	18	6,800 psf		Mudstone bedrock
B-3	21					93	57	33			Mudstone bedrock
B-3	26	8	128			61	42	23			Mudstone bedrock

Site Photos

Date & Time: Mon, Oct 12, 2020, 11:44:50 MDT
Position: OUTSIDE GRID LIMITS (± 46.4 ft)
Altitude: 2757ft (± 19.1 ft)
Datum: NORTH AMERICAN 1927, Western US
Azimuth/Bearing: 061° N61E 1084mils True ($\pm 12^\circ$)
Elevation Grade: -012%
Horizon Grade: -002%
Zoom: 1.0X
Riverside property



Photo No. 1, View of property from Formaster Ridge looking east. Red box is approximate area of hillside development.

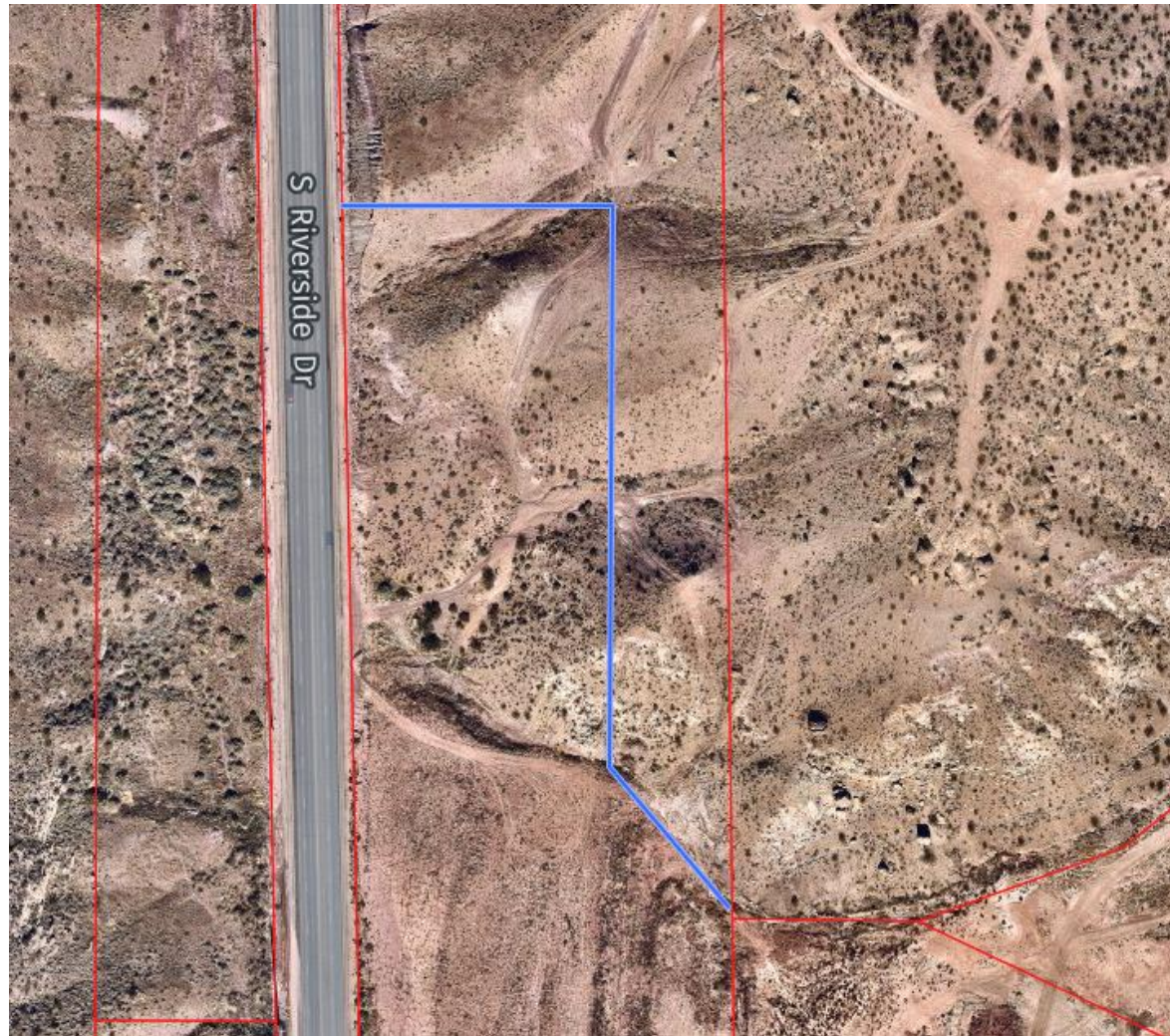


Photo No. 2 (aerial) – Blue line represents approximate area of grading into hillside

Date & Time: Tue, Oct 27, 2020, 14:21:58 MDT
Position: OUTSIDE GRID LIMITS (± 26.6 ft)
Altitude: 2601ft (± 24.7 ft)
Datum: NORTH AMERICAN 1927, Western US
Azimuth/Bearing: 357° N03W 6347mils True ($\pm 13^\circ$)
Elevation Grade: +001%
Horizon Grade: +002%
Zoom: 1.0X
b-1 and b-3



Photo No. 3, View of hillside looking north

Date & Time: Tue, Oct 27, 2020, 14:23:07 MDT
Position: OUTSIDE GRID LIMITS (± 16.4 ft)
Altitude: 2609ft (± 9.8 ft)
Datum: NORTH AMERICAN 1927, Western US
Azimuth/Bearing: 048° N48E 0853mils True ($\pm 12^\circ$)
Elevation Grade: -013%
Horizon Grade: +003%
Zoom: 1.0X
b-3



Photo No. 4, View of center area of hillside from Riverside Drive, looking east.

Date & Time: Tue, Oct 27, 2020, 14:24:14 MDT
Position: OUTSIDE GRID LIMITS (± 17.7 ft)
Altitude: 2622ft (± 7.0 ft)
Datum: NORTH AMERICAN 1927, Western US
Azimuth/Bearing: 084° N84E 1493mils True ($\pm 12^{\circ}$)
Elevation Grade: +006%
Horizon Grade: +002%
Zoom: 1.0X
b-2



Photo No. 5, View center area looking southeast.

Date & Time: Tue, Oct 27, 2020. 14:24:30 MDT
Position: OUTSIDE GRID LIMITS (± 17.0 ft)
Altitude: 2623ft (± 8.6 ft)
Datum: NORTH AMERICAN 1927, Western US
Azimuth/Bearing: 313° N47W 5564mils True ($\pm 12^{\circ}$)
Elevation Grade: +003%
Horizon Grade: +005%
Zoom: 1.0X

b-1



Photo No. 6, View of hillside area from near east property line looking northwest.



Photo No. 7, View south end of hillside area from Riverside Drive looking east.

Core Sample Photos



Boring B-1 @ 4-14 ft



Boring B-1 @ 14-23 ft.



Boring B-1 @ 23-33 ft.



Boring B-1 @ 33-34.5 ft.



Boring B-2 @ 4-14 ft



Boring B-2 @ 14-24 ft.



Boring B-2 @ 24-33 ft.



Boring B-2 @ 33-38 ft.



Boring B-2 @ 38-44 ft.



Boring B-3 @ 9-19 ft.



Boring B-4 @ 4-14 ft.



Boring B-4 @ 14-19 ft.

Exhibit E

Applicant Narrative

Willow Bend Zone Change Narrative

We are requesting that the existing zoning of R-3 be changed to PD-R. Planned development residential uses for Willow Bend include residential townhome units. The project is 10.53 acres with a proposed density of 7.69 units per acre, totaling 81 units.

The project provides 81 units with a building area of 81,553 sq ft, 1.87 acres which is 17.8% of the project. The landscaped area is 137,772 sq ft, 3.16 acres which is 30% of the project. The landscaped amenity area required is 16,200 sq ft and we are providing 25,550 sq ft. The guest parking required is 27 spaces and we are providing 38 spaces.

The zoning of the properties around it are as follows:

South- PD-C (Assisted Living)

North- C-3 (vacant land)

East- Open Space and A-1 (vacant land)

West- Across Riverside Dr. R-3 and PD-C (vacant land)

The property had been planned, was zoned and construction drawings are approved for an 81 unit townhome project called Willow Bend. This is resubmitting for that project so a permit can be pulled to begin the horizontal improvements.

HILLSIDE REVIEW BOARD AGENDA REPORT: **10/23/2024**
 PLANNING COMMISSION AGENDA REPORT: **11/12/2024**
 HILLSIDE REVIEW BOARD AGENDA REPORT: **11/20/2024**

Foremaster Ridge Lot 44 Hillside Development Permit (Case No. 2024-HS-010)	
Request:	A Hillside Development Permit to adjust the location of the ridgeline and ridgeline setback on lot 44 of the Foremaster Ridge subdivision in anticipation of the construction of a residential home.
Applicant:	Jack de Ryk/Floyd Jackson
Location:	1856 E Joe Cir
General Plan:	Low Density Residential (LDR)
Existing Zoning:	Single Family Residential, minimum lot size 10,000 sf (R-1-10)
Surrounding Zoning:	North R-1-10
	South R-1-10
	East R-1-10
	West R-1-10
Land Area:	Approximately 0.47 acres



BACKGROUND

This is a request to obtain a hillside permit for the property located at 1856 E. Joe Cir (Lot 44, Foremaster Ridge). (See Exhibit A, Foremaster Ridge final plat.) This location is a residential neighborhood, and the applicant would like to build a house on this lot. The rear of the applicant's property abuts the ridge line of Foremaster Ridge. The plat identifies this ridge line as having a 30' ridge line setback area and states, "*No structures, walls, or solid fences are allowed within the 30' foot ridge line setback area.*"

The applicant is requesting to review the location of the 30-foot ridgeline setback as shown on the final plat for Foremaster Ridge lot 44 and establish a ridgeline which the applicant feels is more indicative of the actual ridgeline.

Hillside Review: This application came before the Planning Commission once before on August 27, 2024, at which time the Planning Commission recommended that the City Council approve the ridgeline as proposed by the Hillside Review Board. The applicant wanted to take another look at the ridgeline with the Hillside Review Board and removed the application from the City Council agenda.

On October 23, 2024, the Hillside Review Board (HSRB) reviewed the application again and recommended the same coordinates for the ridgeline. The applicant would like the chance to present additional information to the HSRB.

APPLICABLE ORDINANCE(S) (Selected portions)

10-13A-6: Building Setbacks and Additional Design Standards:

- A. *Front Setback along Streets:* Along streets where the slope of the adjacent property to the street is over fifteen percent (15%), the minimum setback is twenty feet (20').
- B. *Setbacks:* All setbacks shall conform to the underlying zone criteria except as provided herein. No structure or accessory structure shall be constructed within the setback area as defined below. However, a see-through wrought iron fence with at least fifty percent (50%) of the fence open, landscaping, and a nonvertical swimming pool are permitted in the setback area.
 - 1. *Ridgelines:* All ridgelines as shown on the ridgeline map shall be subject to the setback provisions contained herein. Setbacks from ridgelines not identified on the ridgeline map shall be a minimum of thirty feet (30'), or greater if recommended in the geotechnical reports.
 - 2. *Plateaus:* On plateaus, the setback from the ridgeline shall be a minimum of fifty feet (50') unless a greater setback is recommended in the geotechnical reports.
- C. *Cuesta:* Where a ridgeline occurs on a cuesta, the minimum setback shall be one hundred feet (100') measured normal (perpendicular) to the closest point of the ridge, unless a greater setback is recommended in the geotechnical report.

D. Additional Design Standards:

1. Retaining walls shall be colored to blend into the surrounding natural geology.
2. Retaining wall height is limited to the heights set forth in chapter 18 of this title and the standards for rock wall construction.
3. Building exterior colors shall be earth tone and blend with the surrounding natural landscape.
4. In residential zones, “no disturbance” areas shall be held as the “common area” of a project. Common areas shall be owned and maintained by the homeowners’ association or may be deeded to the city when accepted by the city.
5. In nonresidential zones, any “no disturbance” area shall be identified on the final site plan or final plat.
6. Any required no disturbance area shall be identified on the ground with temporary fencing or other approved means to prevent accidental disturbance of the area during construction and such fencing shall be installed prior to issuance of a grading permit.
7. The building site shall be located on the flattest portion of the parcel.
8. No structure shall extend over any natural ridgeline. The structure shall be in contact with the ground at all edges. (Ord. 2019-10-002, 10-10-2019)

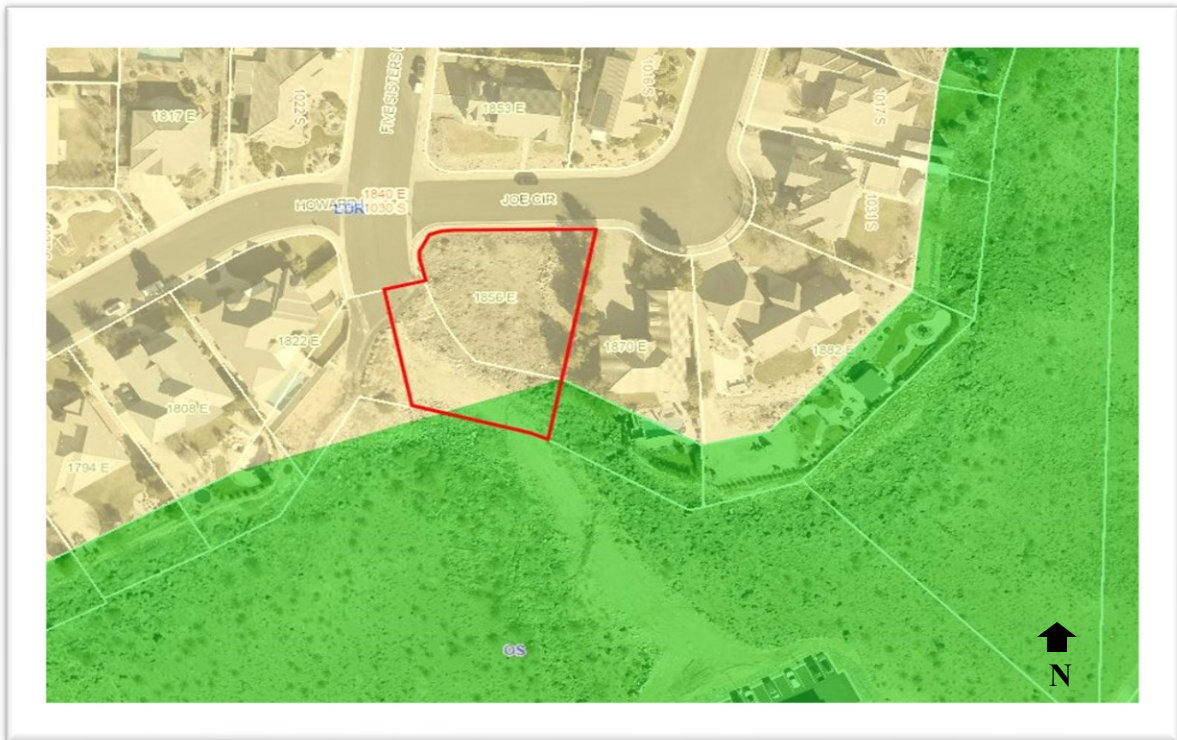
EXHIBITS PROVIDED

1. Exhibit A – Foremaster Ridge Plat
“Exhibit A” in the packet shows the plat of Foremaster Ridge.
2. Exhibit B – Aerial of Existing Project Area
“Exhibit B” is an aerial map of the project site for Foremaster Ridge Lot 44.
3. Exhibit C – Site Plan Map of Lot 44
“Exhibit D” is a map showing the site and ridgeline setback of Lot 44.
4. Exhibit D – Slope Map for Foremaster Ridge Lot 44
“Exhibit D” is the slope analysis map of lot 44.
5. Exhibit E – Updated Slope Map
“Exhibit E” is an updated site plan and slope map

POSSIBLE MOTION

I move we forward a recommendation to the Planning Commission that the ridgeline is located as proposed and shown in “Exhibit E” (and as modified by the following...) as discussed by the Hillside Review Board and outlined in this staff report and subject to all applicable ordinances adopted by the City of St. George.

General Plan – LDR (Low Density Residential)



Zoning - R-1-10



[illegible]

EXHIBIT B AERIAL IMAGE OF LOT 44

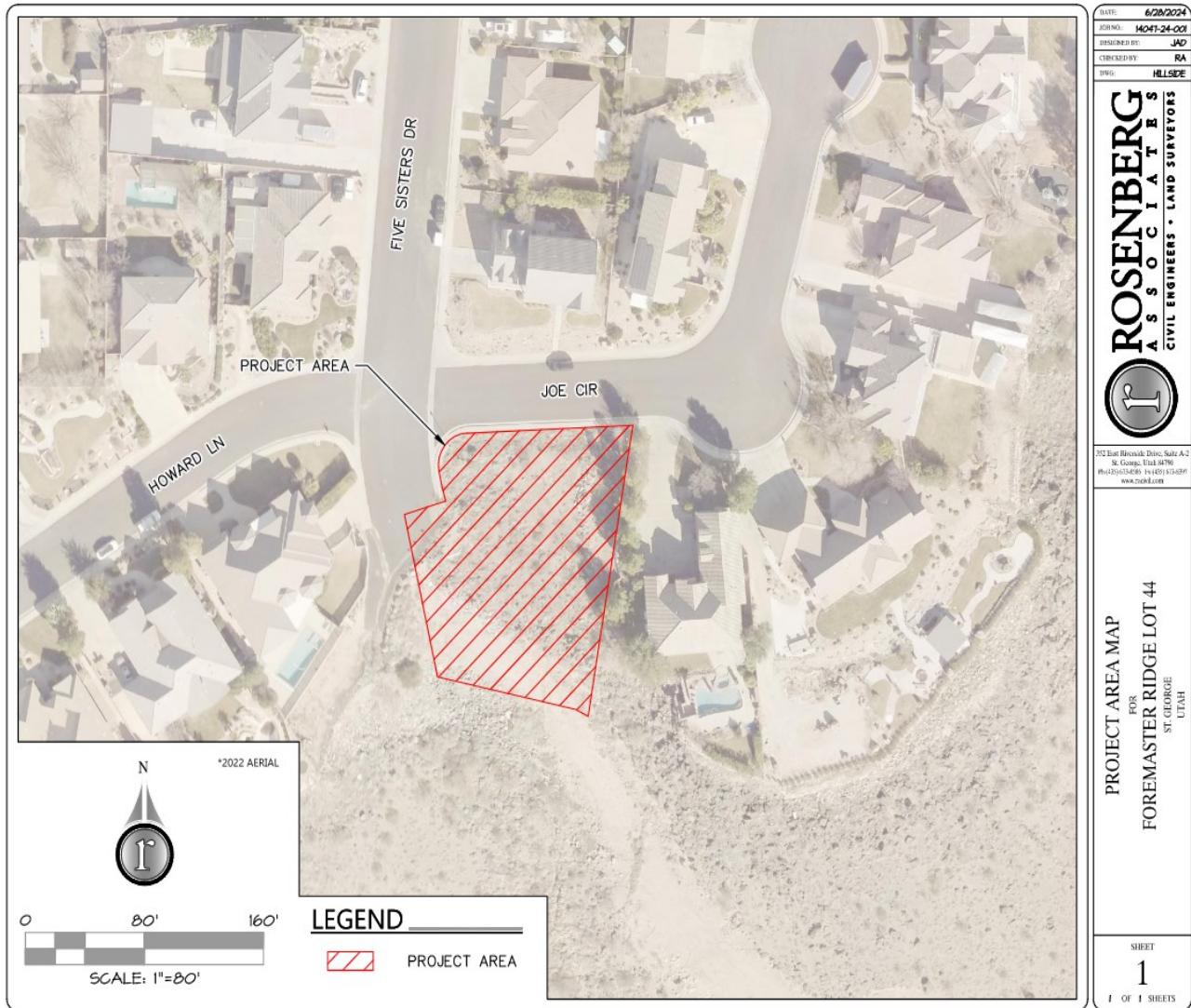


EXHIBIT C
SITE PLAN

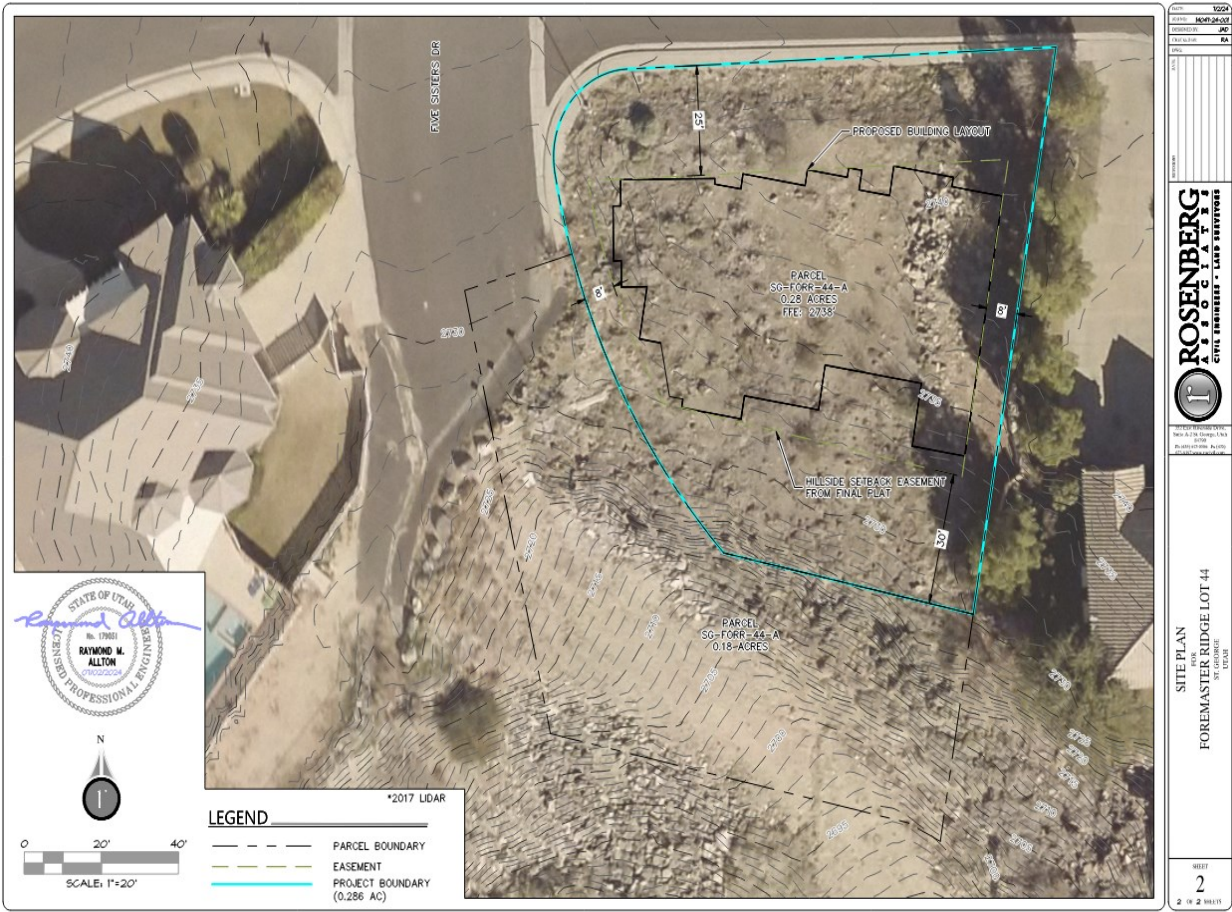


EXHIBIT D
SLOPE MAP

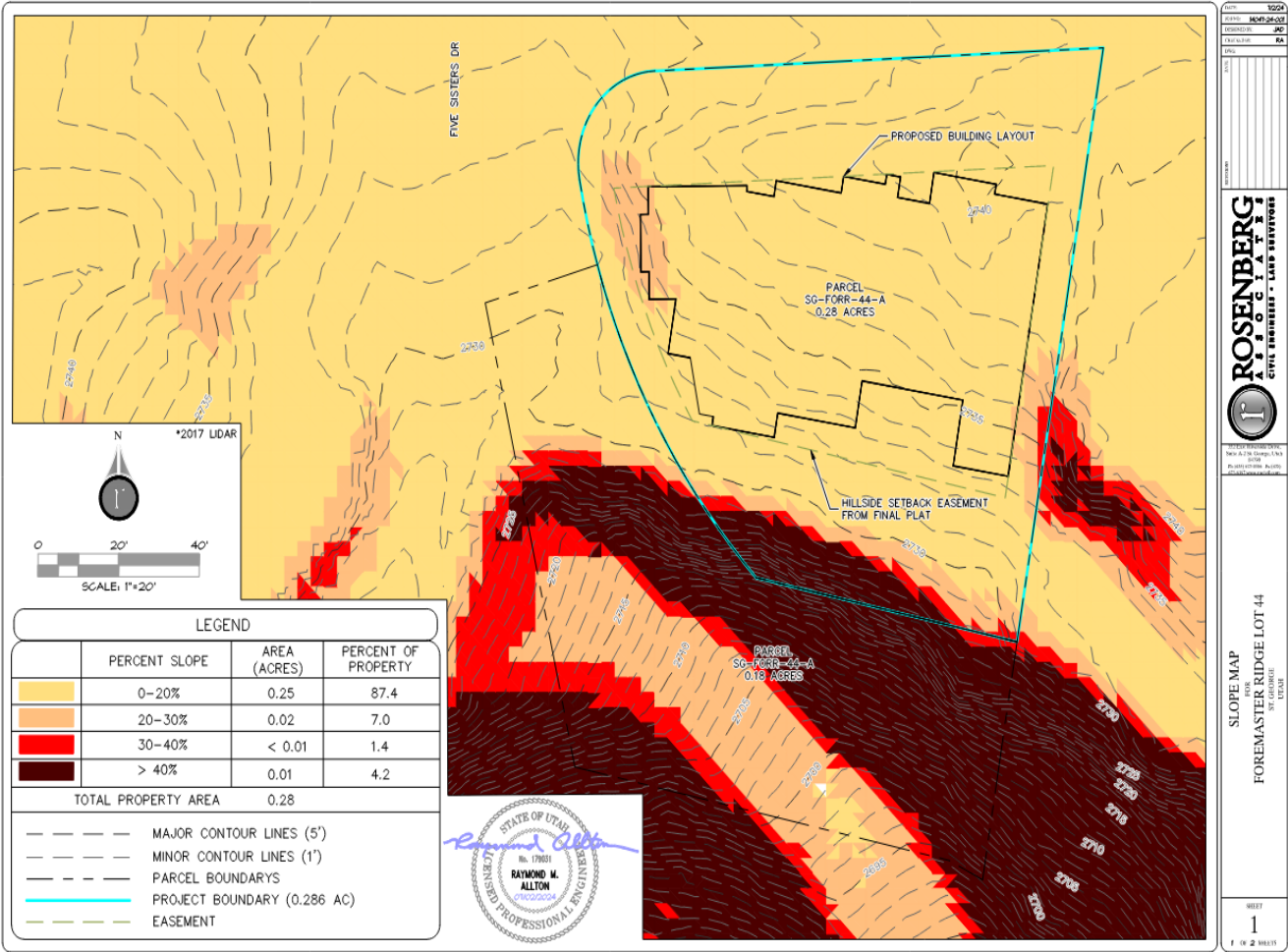
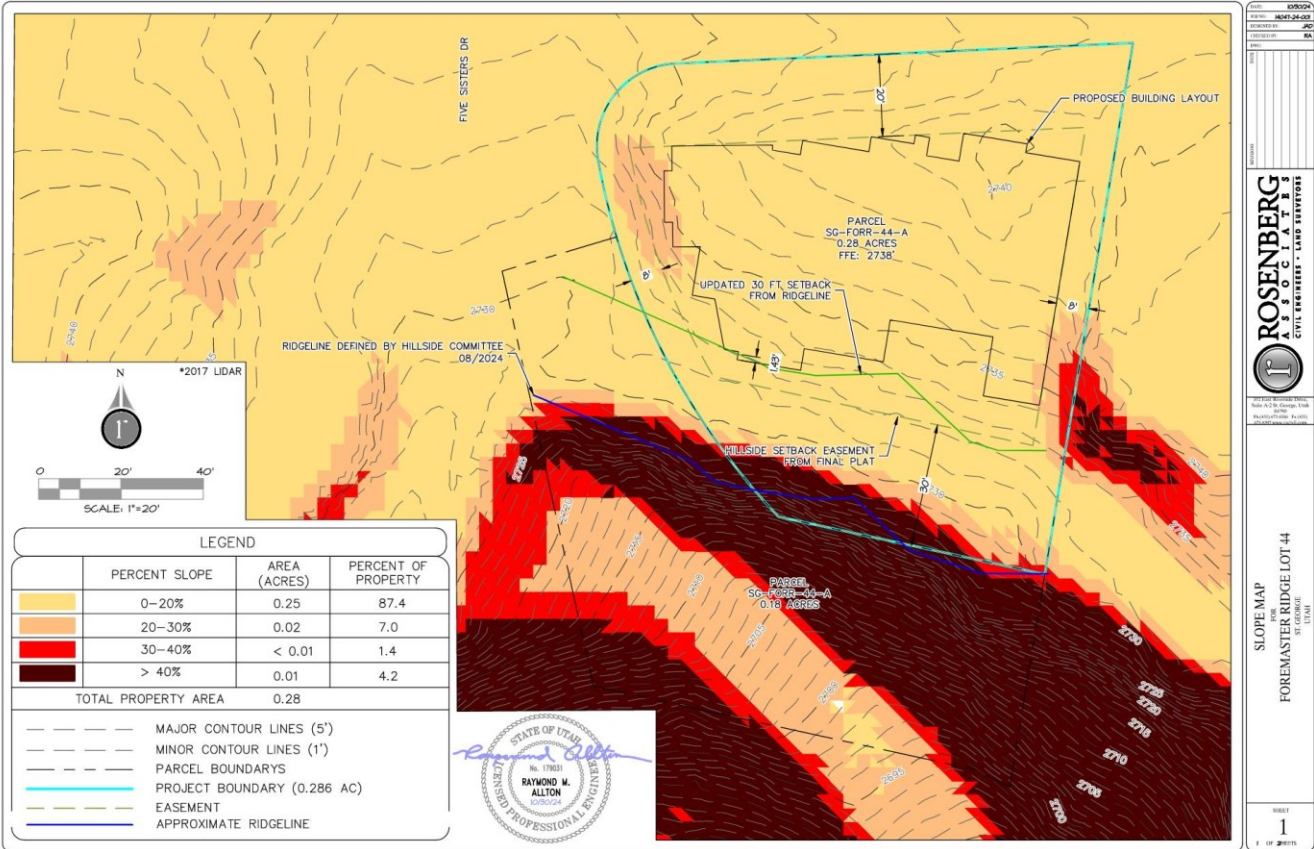
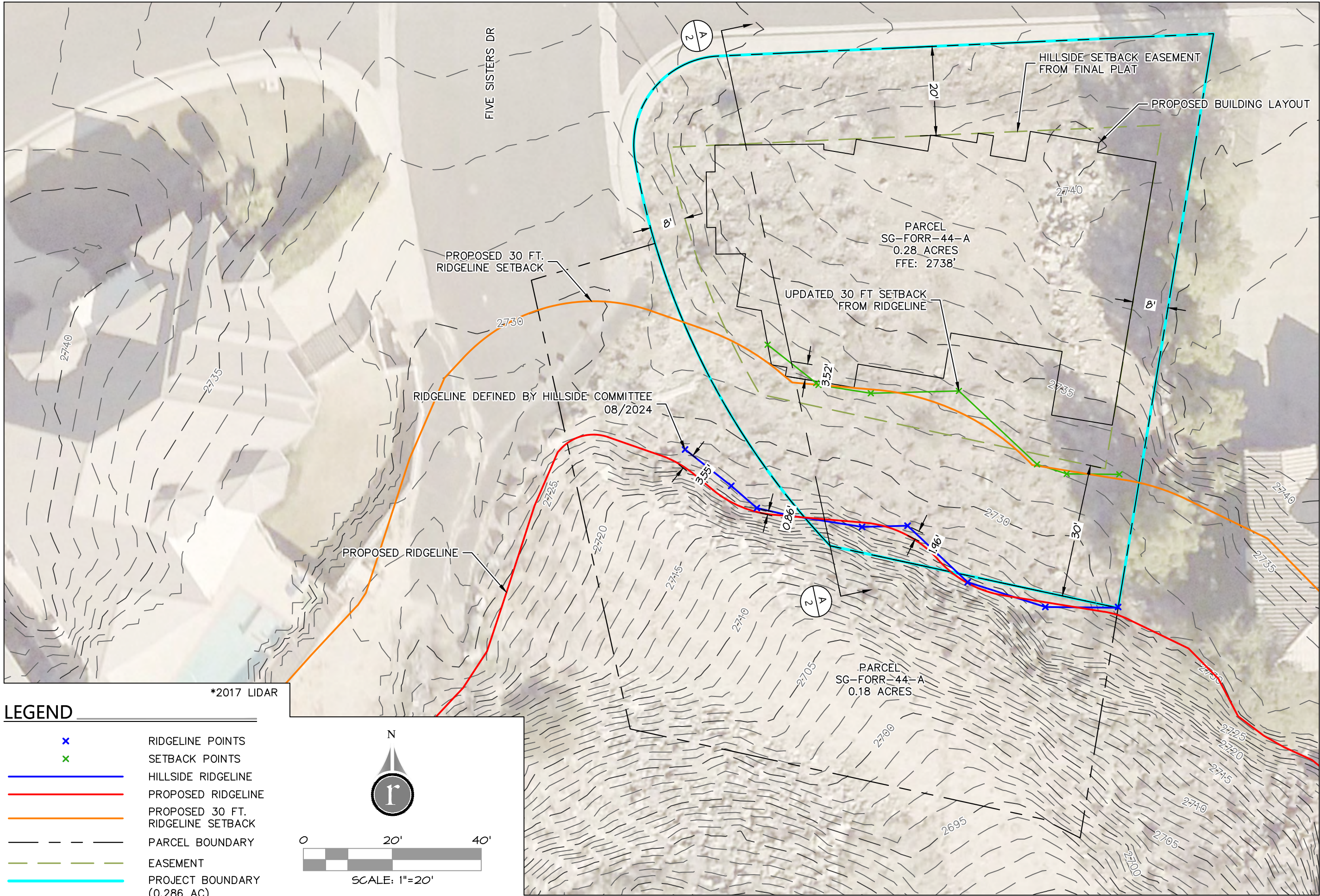


Exhibit E
Updated Slope Map





LEGEND

	RIDGELINE POINTS
	SETBACK POINTS
	HILLSIDE RIDGELINE
	PROPOSED RIDGELINE
	PROPOSED 30 FT. RIDGELINE SETBACK
	PARCEL BOUNDARY
	EASEMENT
	PROJECT BOUNDARY (0.286 AC)

N

0 20' 40'

SCALE: 1"=20'

DATE:	11/3/24
JOB NO.:	14041-24-001
DESIGNED BY:	JAD
CHECKED BY:	RMA
DWG:	
DATE	
REVISIONS	

ROSENBERG
A S S O C I A T E S
CIVIL ENGINEERS • LAND SURVEYORS

352 East Riverside Drive,
Suite A-2 St. George, Utah
84790
Ph (435) 673-8586 Fx (435)
673-8397 www.rncivil.com

SITE PLAN
FOR
FOREMASTER RIDGE LOT 44
ST. GEORGE
UTAH

SHEET
1
OF 2 SHEETS

DATE:	11/13/24
JOB NO.:	14047-24-001
DESIGNED BY:	JAD
CHECKED BY:	RMA
DWG:	
DATE	
REVISIONS	



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SITE PROFILE VIEW

FOR

FOREMASTER RIDGE LOT 44

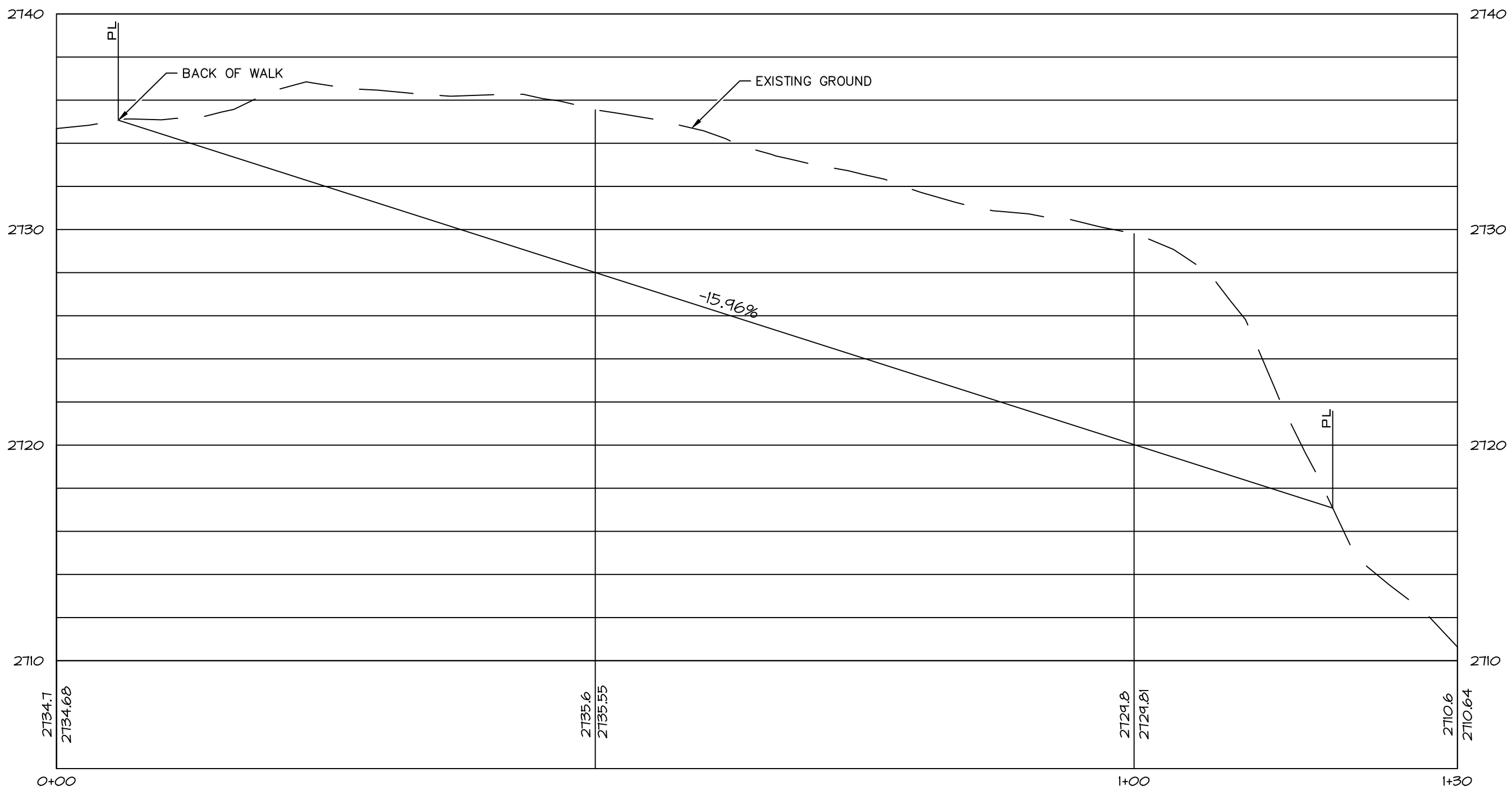
ST. GEORGE

UTAH

SHEET

2

OF 2 SHEETS

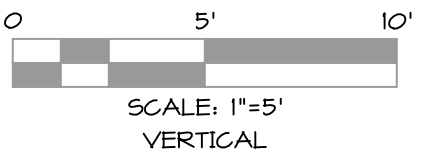
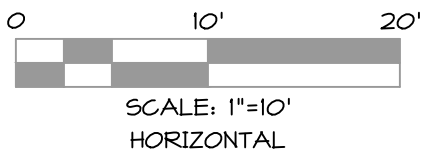


A

2

SITE PROFILE VIEW

SCALE: H: 1" = 10' V: 1" = 5'



**ST. GEORGE HILLSIDE REVIEW BOARD MINUTES
OCTOBER 23, 2024, 8:30 A.M.
ON SITE**

PRESENT:

Hillside Review Board Chair, James Sullivan
Board Member, Jeff Mathis
Board Member, Russ Owens
Board Member, Dave Black

EXCUSED:

Board Member, Kevin Holyoak

STAFF MEMBERS PRESENT:

Assistant Public Works Director, Wes Jenkins
Community Development Director, Carol Winner
Planner, Dan Boles
Planner, Brett Hamilton
City Landscape Architect, Mark Goble
Development Office Supervisor, Monica Smith
Assistant City Attorney, Daniel Baldwin

OTHERS PRESENT:

Jack de Ryk, Rosenberg Associates
Floyd Jackson, Contractor
William Haggerty, Property Owner
Logan Blake, DSG Engineering

Link to Call to Order by Chair Sullivan: [00:00:00](#)

Link to comment by Board Member Black regarding recusals: [00:00:28](#)

HILLSIDE DEVELOPMENT PERMIT:

Consider a request for a Hillside Development Permit to adjust the location of the ridgeline and ridgeline setback on lot 44 of the Foremaster Ridge Subdivision in anticipation of the construction of a residential home. Applicant – Jack de Ryk – Case No. 2024-HS-010 – ON SITE.

BACKGROUND AND RECOMMENDATION: This is a request to obtain a hillside development for the property located at 1856 E. Joe Cir. (Lot 44, Foremaster Ridge). This location is a residential neighborhood, and the applicant would like to build a house on this lot. The rear of the applicant's property abuts the ridge line of Foremaster Ridge. The applicant is requesting to review the location of the 30-foot ridgeline setback as shown on the final plat for Foremaster Ridge lot 44 and establish a ridgeline which the applicant feels is more indicative of the actual ridgeline. **Case No. 2024-HS-010** (Staff – Dan Boles).

Link to comment by Rosenberg Associates representative, Jack de Ryk, presenting the project, including discussion between Board Members, Assistant Public Works Director, Wes Jenkins, and Mr. de Ryk: [00:01:07](#)

Link to comment by Haggerty, property owner, including discussion between Board Members and Mr. Haggerty: [00:04:43](#)

5 Link to comment by Community Development Director, Carol Winner: [00:09:19](#)
6

7 Link to comment by Board Member Black, including discussion between Board
8 Members and Floyd Jackson: [00:09:47](#)
9

10 Link to comment by Chair Sullivan, including discussion between Board Members and
11 William Haggerty: [00:10:02](#)
12

13 Link to comment by Assistant Public Works Director, Wes Jenkins, including discussion
14 between Board Members and Mr. Jenkins: [00:11:05](#)
15

16 Link to question by Board Member Black, including discussion between Board
17 Members, Jack de Ryk, and Floyd Jackson: [00:18:43](#)
18

19 Link to comment by Community Development Director, Carol Winner, including
20 discussion between Board Members, Floyd Jackson, and Ms. Winner: [00:22:54](#)
21

22 Link to question by Floyd Jackson, including discussion between Board Members and
23 Mr. Jackson: [00:24:43](#)
24

25 Agenda packet [\[Page 3\]](#)
26

27 Link to motion: [00:27:23](#)
28

29 **MOTION:**

30 A motion was made by Board Member Owens to stay with the original
31 ridgeline as outlined in our last meeting, and they work off that however they
32 need to with the City from there.
33

34 **SECOND:**

35 The motion was seconded by Board Member Mathis.
36

37 **VOTE:**

38 Chair Sullivan called for a vote, as follows:
39

40 Chair Sullivan – aye
41 Board Member Mathis – aye
42 Board Member Owens – aye
43 Board Member Black – aye
44

45 The vote was unanimous and the motion carried
46
47
48
49
50
51
52
53

5 Chair Sullivan excused himself from the second meeting.
6

7 Link to Call to Order by Vice Chair Owens: [00:00:00](#) [Recording 2]
8

9 **HILLSIDE DEVELOPMENT PERMIT:**

10 **Consider a request for a Hillside Development Permit for the construction of**
11 **a road and the extension of utilities from the existing round-a-bout located**
12 **at the intersection of Movie Rock Dr and Ledges Parkway and continues**
13 **southerly (parallel to SR-18) to the location of the proposed Trails**
14 **Interchange project at mile post 7 of SR-18 with additional work within the**
15 **Utah State Trust lands property to the west of said project. The applicant is**
16 **DSG Engineering, Inc and the representative is Logan Blake. Case No. 2024-**
17 **HS-013– ON SITE.**
18

19 BACKGROUND AND RECOMMENDATION: This is a request to obtain a hillside
20 development permit to construct an interchange near mile post 7 on SR-18 and a
21 section of roadway to the west where existing slopes exceed 20%. No buildings or lots
22 are proposed at this time. **Case No. 2024-HS-013** (Staff – Dan Boles).
23

24 Link to comment by applicant, Logan Blake presenting the project, including discussion
25 between Board Members, Assistant Public Works Director, Wes Jenkins, and Mr. Blake:
26 [00:00:29](#)
27

28 Link to question by Assistant Public Works Director, Wes Jenkins, including discussion
29 between Board Members, Mr. Jenkins, and Logan Blake: [00:06:49](#)
30

31 Link to question by Board Member Black, including discussion between Board Members
32 and Logan Blake: [00:07:49](#)
33

34 Link to comment by Assistant Public Works Director, Wes Jenkins, including discussion
35 between Board Members, Logan Blake, and Mr. Jenkins: [00:09:12](#)
36

37 Link to comment by Board Member Black, including discussion between Board
38 Members, Logan Blake, and City Landscape Architect, Mark Goble: [00:12:07](#)
39

40 Agenda packet [\[Page 13\]](#)
41

42 Link to motion: [00:13:40](#)
43

44 **MOTION:**

45 A motion was made by Board Member Black that the overall slope is less than
46 40% with some localized outcrops, and to look at the large hill slope across
47 the wash, that they make it aesthetically a mixture of hydroseed and rocks,
48 other than bare slope, and to optimize the cut slope.
49

50 **SECOND:**

51 The motion was seconded by Board Member Mathis.
52
53

5 **VOTE:**

6 Vice Chair Owens called for a vote, as follows:
7

8 Board Member Black – aye
9 Board Member Mathis – aye
10 Board Member Owens – aye
11

12 The vote was unanimous and the motion carried
13
14

15 **APPROVAL OF MINUTES:**

16 Approval of the meeting minutes from the August 28, 2024 meeting.
17

18 Agenda packet [\[Page 212\]](#)
19

20 Link to motion: [00:19:43](#)
21

22 **MOTION:**

23 A motion was made by Board Member Black to approve the minutes.
24

25 **SECOND:**

26 The motion was seconded by Board Member Mathis.
27

28 **VOTE:**

29 Vice Chair Owens called for a vote, as follows:
30

31 Board Member Black – aye
32 Board Member Mathis – aye
33 Board Member Owens – aye
34

35 **ADJOURN:**

36 Link to move to adjourn: [00:19:56](#)
37

38 **MOTION:**

39 A motion was made by Board Member Black to adjourn.
40

41 **SECOND:**

42 The motion was seconded by Board Member Mathis.
43
44

45 **VOTE:**

46 Vice Chair Owens called for a vote, as follows:
47

48 Board Member Black – aye
49 Board Member Mathis – aye
50 Board Member Owens – aye
51

52 The vote was unanimous and the motion carried.
53

1 St. George City Hillside Review Board Meeting Minutes
2 October 23, 2024
3 Page Four

4
5 /s/Monica Smith

6
7 _____
Monica Smith, Secretary

DRAFT