

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

Public Notice

Notice is hereby given that the Hillside Review Board of the City of St. George, Washington County, Utah, will hold meetings at the referenced site on **Wednesday, March 23, 2022**, commencing on-site at approximately 8:30 a.m.

The estimated site times are in bold.

The agenda for the meeting is as follows:

1. Consider a request for a hillside development permit at the Commerce Point Development. The applicant is proposing to construct in the area shown on the slope map labeled 20-30%, 30-40% and 40% and above. The property is located at Southeast quadrant of the intersection of Auto Mall Drive and Blackridge Drive. The property is currently zoned Highway Commercial (C-2). The applicant is Commerce Point, LC. Case No. 2022-HS-005. (*See 'Meeting Place' exhibit below*). **Meeting time approx. 8:30 am**
2. Consider a request to amend the hillside overlay map by adding approximately 23 acres to the existing Middleton Ridge hillside overlay area. The property is generally located north of Red Hills Drive and Middleton Drive and approximately 2200-2300 East. The applicant is the City of St. George. Case No. 2022-HS-009. **Meeting time approx. 9:30 am**
3. Consider approval of the meeting minutes from February 23, 2022.

Dan Boles, AICP
Senior Planner
Development Services

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.

Meeting Locations

Item #1 - Just south of Blackridge Dr. & Auto Mall Dr. Intersection



Item #2 Approximately 2300 East Middleton Drive



HILLSIDE REVIEW BOARD AGENDA REPORT: 03/23/2022

Commerce Point West Hillside Development Permit (Case No. 2022-HS-005)		
Request:	A Hillside Development Permit to allow disturbance of areas in the 20-30%, 30-40% and 40% and above slope areas. This application is in anticipation of the construction of a new hotel.	
Applicant:	Commerce Point, LC	
Representative:	Austin Atkin	
Location:	Southeast quadrant of the intersection of Auto Mall Drive and Blackridge Drive	
General Plan:	COM (Commercial)	
Existing Zoning:	Highway Commercial (C-2)	
Surrounding Zoning:	North	Planned Development Commercial (PD-C)
	South	Planned Development Commercial (PD-C)
	East	Highway Commercial (C-2)
	West	Planned Development Commercial (PD-C)
Land Area:	Approximately 7.95 acres	



BACKGROUND

This is a request to obtain a hillside permit for the property located on the northeast corner of Auto Mall Drive and Blackridge Drive. The applicants are proposing to build a new commercial development on this property. This property is in the hillside overlay. Section 10-13A-7 of the Zoning Regulations requires that all major development (i.e., cut greater than 4', etc.) 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 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.

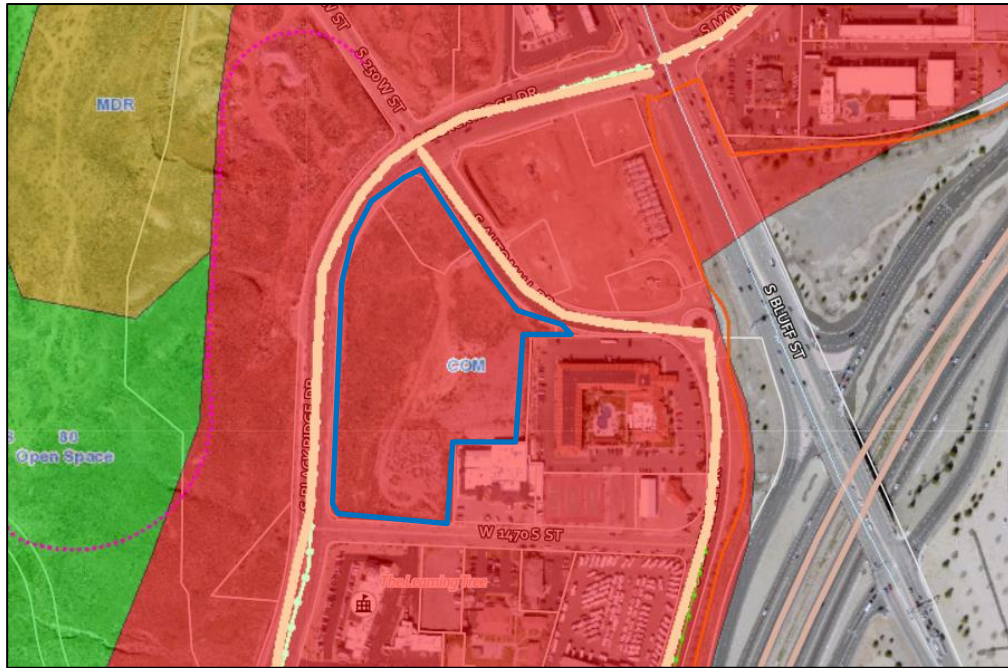
EXHIBITS PROVIDED

1. Exhibit A – Site Plan/ Grading Plan
“Exhibit A” in the packet shows the location of the new commercial development and the grading plan with cross sections
2. Exhibit B – Slope Analysis Map
“Exhibit B” in the packet shows the overall slope analysis for the area to be disturbed.
3. Exhibit C – Drainage Report
“Exhibit C” – This is the drainage report for this location.
4. Exhibit D – Geotechnical Report
“Exhibit D” – This is the Geotechnical report for Commerce Point.

RECOMMENDATION

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

General Plan - COM



Zoning - C-2

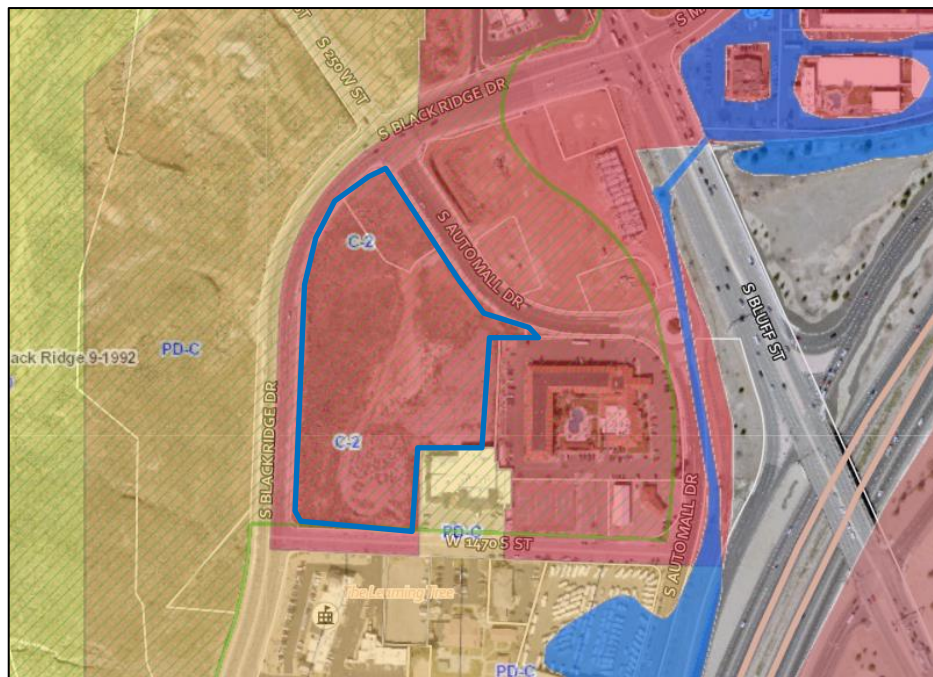
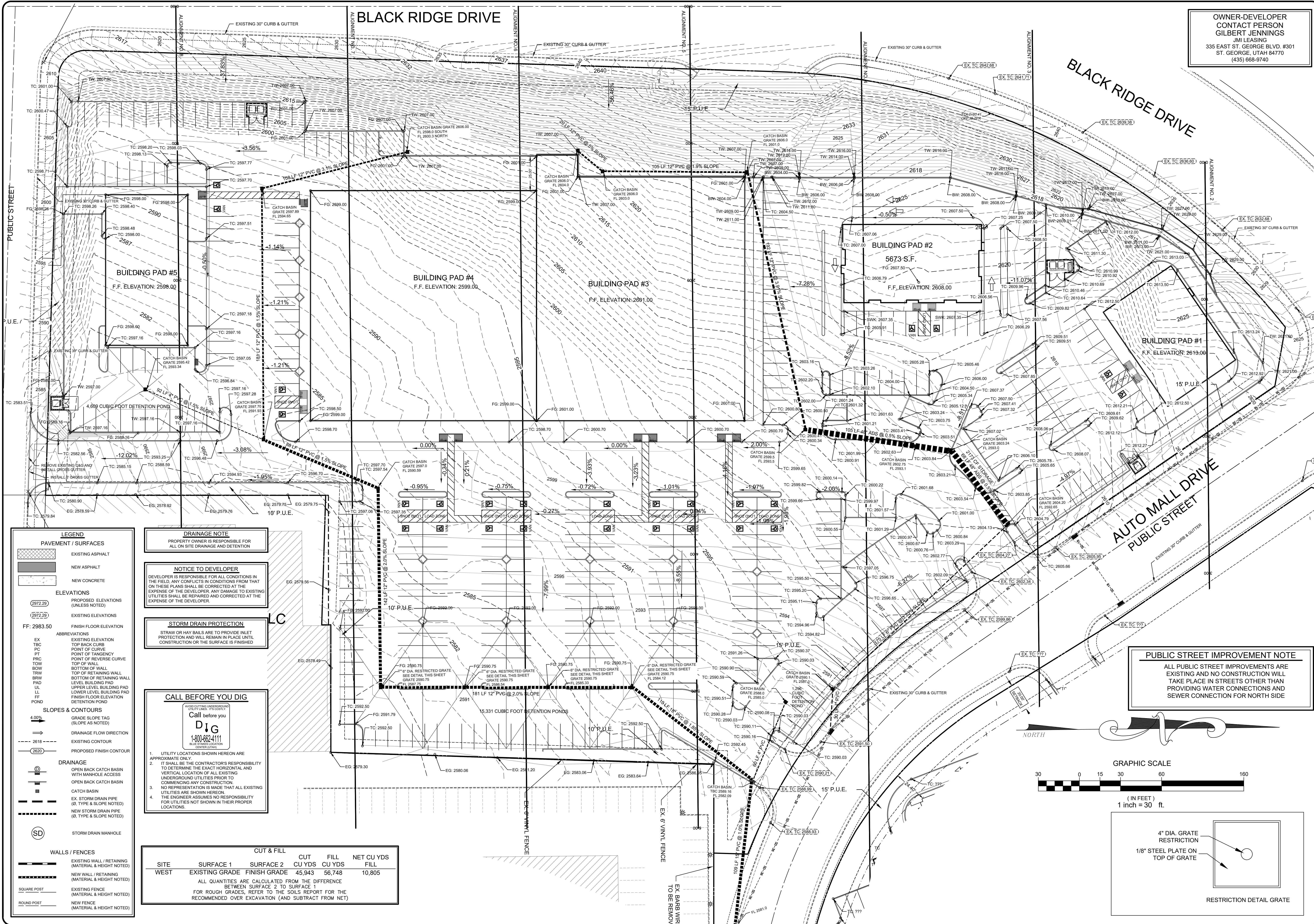
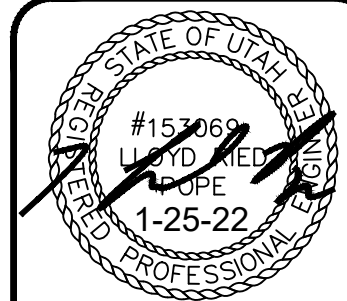


Exhibit A
SITE PLAN/GRADING PLAN



OWNER-DEVELOPER
CONTACT PERSON
GILBERT JENNINGS
JMI LEASING
335 EAST ST. GEORGE BLVD. #301
ST. GEORGE, UTAH 84770
(435) 668-9740

NO. DATE BY APPVD REVISION DESCRIPTION

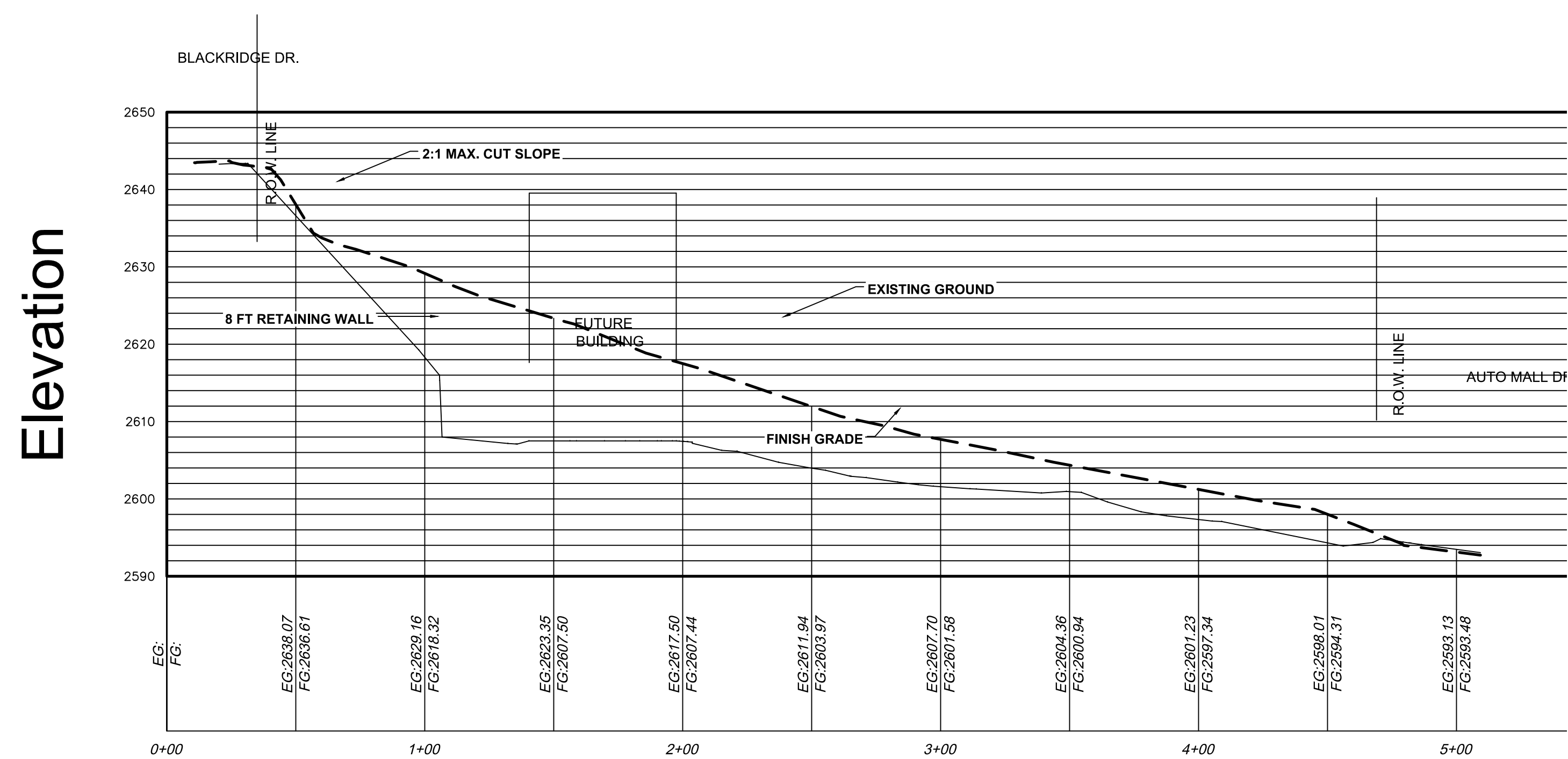
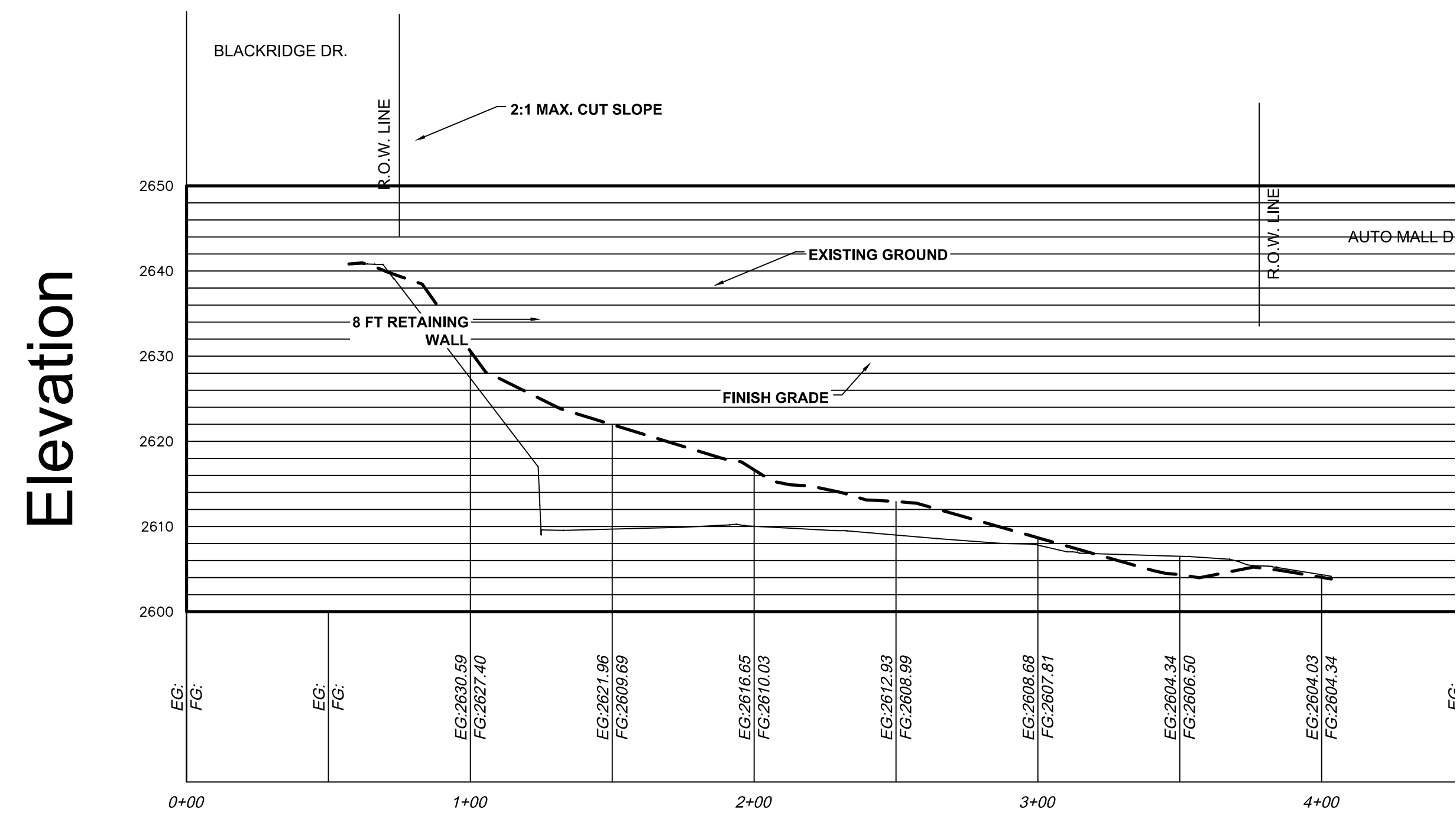
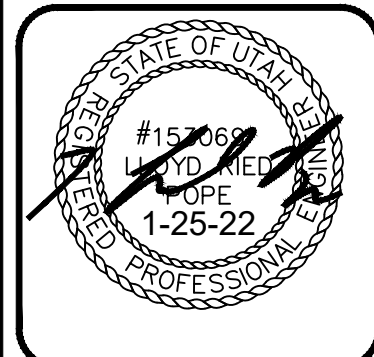


1300 EAST 100 SOUTH, SUITE 100
ST. GEORGE, UTAH 84790
(PHONE) 435-628-1675
(FAX) 435-628-1789
(EMAIL) lrpope@lrpe.com

L.R. POPE ENGINEERING INC.
STRUCTURAL ENGINEERS, CIVIL ENGINEERS & SURVEYORS
REGISTERED PROFESSIONAL ENGINEERS
UTAH LICENSE NO. 15206
EXPIRATION DATE 1-25-22

**COMMERCE POINT WEST
SHOPPING CENTER**
ENLARGED GRADING - WEST SIDE
LOCATED IN SECTION 36, T. 42 S. R. 16 W. SLB&M & IN SECTION 31, T. 42 S. R. 15 W. SLB&M

DESIGN BY
LRP
DATE
JUNE 2016
FILE NAME
COMMERCE POINT WEST R1
24" x 36"
SCALE 1" = 30'
12" x 18"
SCALE 1" = 60'
SHEET NUMBER
C3.00

[illegible]

L. R. POPE ENGINEERING INC.

1240 EAST 100 SOUTH SUITE 14-B
 ST. GEORGE, UTAH 84790
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STRUCTURAL ENGINEERS, CIVIL ENGINEERS & SURVEYORS

ALL OURS ARE ACTIVE LICENSED PROFESSIONALS. WE HAVE OVER 100 YEARS OF EXPERIENCE IN THE DESIGN AND CONSTRUCTION OF A WIDE VARIETY OF STRUCTURES. WE ARE CURRENTLY EMPLOYING 15 ACTIVE PROFESSIONALS AND ARE CURRENTLY OPEN TO QUALIFIED INDIVIDUALS. WE ARE CURRENTLY OPEN TO QUALIFIED INDIVIDUALS. WE ARE CURRENTLY OPEN TO QUALIFIED INDIVIDUALS.

COMMERCE POINT WEST
SHOPPING CENTER

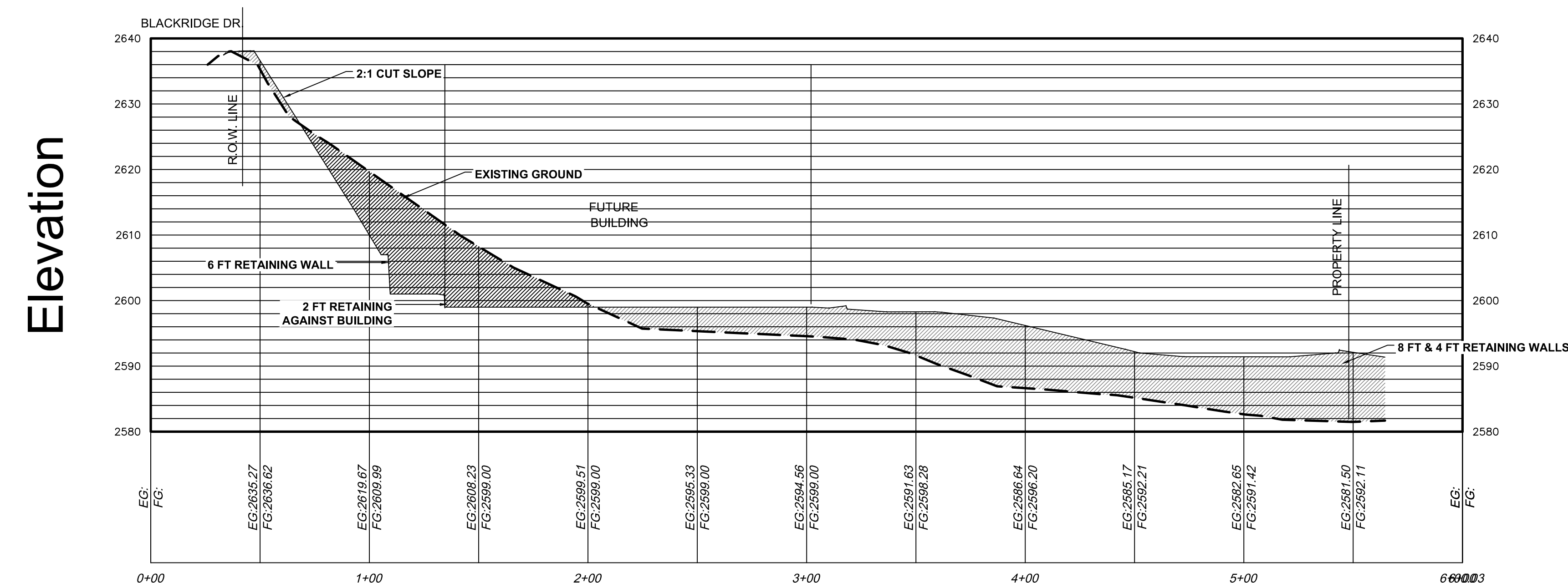
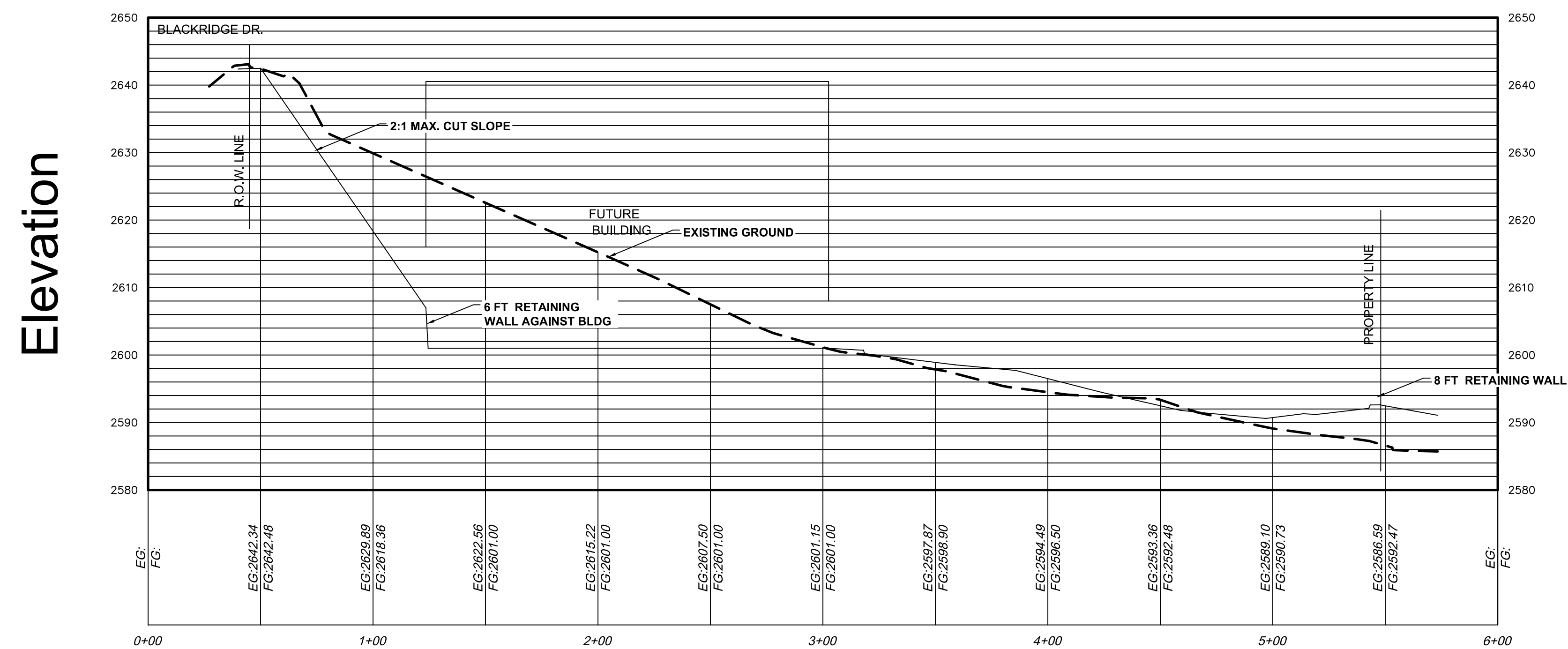
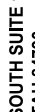
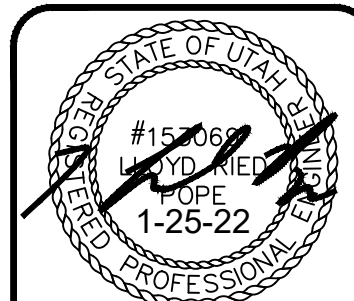
CROSS SECTIONS

DESIGN BY	LRP
DATE	JUNE 2016
FILE NAME	COMMERCE POINT WEST R1

24" x 36"
SCALE 1" = 40'

12" x 18"
SCALE 1" = 80'

SHEET NUMBER
C6.00

[illegible]

L. R. POPE ENGINEERING INC.

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STRUCTURAL ENGINEERS, CIVIL ENGINEERS & SURVEYORS

ALL DRAWINGS AND SPECIFICATIONS RELEASED WITHOUT FEE. NO DESIGN REQUIRED FOR THE L. R. POPE ENGINEERING INC. DESIGN OF CONCRETE, STEEL, WOOD, AND COMPOSITE STRUCTURES. WE CAN PROVIDE DESIGN AND CONSTRUCTION OF ALL TYPES OF STRUCTURES. WE CAN PROVIDE DESIGN AND CONSTRUCTION OF ALL TYPES OF STRUCTURES. WE CAN PROVIDE DESIGN AND CONSTRUCTION OF ALL TYPES OF STRUCTURES.

**COMMERCE POINT WEST
SHOPPING CENTER**

**CROSS SECTIONS - PLAN & PROFILE (E, F, G & H)
LOCATED IN SECTION 36, T 42 S, R 16 W, SLB&M & IN SECTION 31, T 42 S, R 15 W, SLB&M**

DESIGN BY	LRP
DATE	JUNE 2016
FILE NAME	
COMMERCE POINT WEST R	

24" x 36"
SCALE 1" = 40'

12" x 18"
SCALE 1" = 80'

SHEET NUMBER
C6.10

Exhibit B

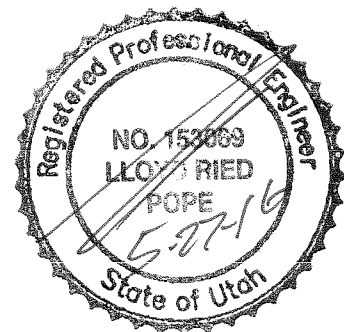
Slope Analysis

Exhibit C
Drainage Report

DRAINAGE CONTROL PLAN & REPORT FOR COMMERCE POINT IN ST. GEORGE, UTAH

May 23, 2016

L.R. POPE ENGINEERING, Inc.
1240 EAST 100 SOUTH #15B
ST. GEORGE, UTAH 84790
435-628-1676



GENERAL DESCRIPTION OF DEVELOPMENT

The project is located on the east and north side of Black Ridge Drive, and on the west side of Bluff Street. For development and reference purposes the project has been divided into three separate parcels, North, East, and West. The North parcel contains 3.67 acres, the East parcel contains 5.36 acres, and the West parcel contains 7.89 acres. The three parcels contain 16.92 acres total.

4.2.2 DESCRIPTION OF PROPERTY

A part of the North parcel has been developed previously for commercial use. The 'Soil Survey of Washington County Area, Utah' classifies the soil conditions as JaB (Junction) and SY (Stony). JaB is described as being fine sandy loam with a hydrologic grouping of 'A'. Stony is described as stony colluvial land with a hydrologic grouping of 'C'.

The East and West parcels do not have any development on them. All three parcels share the same soil conditions.

4.2.3 GENERAL DESCRIPTION OF OFFSITE DRAINAGE

All three parcels are surrounded by streets that divert any offsite storm runoff from entering the parcels.

4.2.4 DESCRIPTION OF ONSITE DRAINAGE

Each parcel will have its own detention for onsite drainage.

The onsite drainage for the North parcel will generally drain easterly into the proposed parking lot and will be collected in a detention pond. The pond will be depressed into the asphalt parking lot and then drain into an existing storm drain in Bluff Street.

The onsite drainage for the East parcel will drain towards the interior of the parcel and be collected into two separate detention ponds. The ponds will be depressed into the asphalt parking lot and then drain into an existing storm drain running parallel to the east property boundary.

The onsite drainage for the West parcel will drain easterly into the proposed parking lot where it will be collected into five separate detention ponds. The ponds will be depressed into the asphalt parking lot and then drain into an existing storm drain in Hilton Drive.

4.2.5 DESCRIPTION OF MASTER PLANNED DRAINAGE FACILITIES

There is an existing 96" storm drain pipe that conveys runoff along Bluff Street and a 36" storm drain pipe that conveys runoff along Hilton Drive.

4.2.6 FEMA FLOODPLAIN BOUNDARIES

The development does not lie within any Zone 'A' 100 year floodplain.

4.2.7 DESCRIPTION OF OTHER DRAINAGE STUDIES AFFECTING SITE

There are no other known drainage studies affecting this site.

4.2.8 DESCRIPTION OF PROPOSED DRAINAGE FACILITIES

The North parcel will have a detention pond installed on the east side of the parcel in the proposed parking lot. The parking lot will be inverted with a catch basin in the center that will convey runoff through a 6" orifice opening into a 8" storm drain that conveys runoff into the existing 72" storm drain that runs along the west side of Bluff Street. The calculated volume of the detention pond as shown is at least 9,220 cu. ft. The drainage calculations indicated that the 7,379 cu. ft. of storage would attenuate the peak runoff to pre-developed conditions for a 100 year storm event.

The East parcel will have two detention ponds installed near the center of the parcel in the proposed parking lot. The parking lot will be inverted with a catch basin in the center of each pond, the southern pond will convey runoff through an 8" orifice opening into a 12" storm drain which will tie into the northern ponds catch basin. The northern pond will have a restricted grate that will convey runoff into an existing 36" storm drain that is running through the parcel. The calculated volume of the detention ponds as shown is at least 19,115 cu. ft. The drainage calculations indicated that the 16,308 cu. ft. of storage would attenuate the peak runoff to pre-developed conditions for a 100 year storm event.

The West parcel will have 4 detention ponds installed on the east side of the parcel in the proposed parking lot and a smaller detention pond on the south side of the parcel in a proposed parking lot. The parking lot for the southern pond will be inverted with a catch basin in the center and will convey water through an 8" orifice opening into a 12" storm drain which will tie into the east ponds. The parking lot for the east ponds will be inverted with a catch basin in the center of each pond that will convey runoff through an restricted grate into a 12" storm drain that conveys runoff into the existing 36" storm drain that runs along the west side Hilton Drive and ties into an existing 96" cmp storm drain along the east side of Hilton Drive parallel to the freeway. The calculated volume of the ponds as shown is at least 22,483 cu. ft. The drainage calculations indicated that the 20,449 cu. ft. of storage would attenuate the peak runoff to pre-developed conditions for a 100 year storm event.

4.2.9 DESCRIPTION OF COMPLIANCE WITH APPLICABLE FLOOD CONTROL REQUIREMENTS AND FEMA REQUIREMENTS

Not applicable.

4.2.10 DESCRIPTION OF DESIGN RUNOFF CALCULATIONS

The rational method was used in calculating surface runoff in this project. The following parameters were used for these calculations.

Assume type 'C' and 'A' soil conditions

North Parcel

Existing conditions:

$C = 0.33$

$T_c = 15 \text{ min.}$

Developed conditions:

$C = 0.95$

$T_c = 15 \text{ min.}$

East Parcel

Existing conditions:

$C = 0.01$

$T_c = 15 \text{ min.}$

Developed conditions:

$C = 0.95$

$T_c = 15 \text{ min.}$

West Parcel

Existing conditions:

$C = 0.15$

$T_c = 15 \text{ min.}$

Developed conditions:

$C = 0.95$

$T_c = 15 \text{ min.}$

Rainfall: 3.60 inches/hr for 15 min. (100 yr.); 2.00 inches/hr for 15 min. (10 yr.)

4.2.11 DESCRIPTION OF DRAINAGE FACILITY DESIGN COMPUTATIONS

The rational method was used in calculating the amount of detention required for the project. The following table shows the amount of storage required for the site:

North Parcel

Detention Basin	100 Year Storm	10 Year Storm
Detention	(7,379 cu.ft.)	(4,099 cu.ft.)

East Parcel

Detention Basin	100 Year Storm	10 Year Storm
Detention	(16,308 cu.ft.)	(9,060 cu.ft.)

West Parcel

Detention Basin	100 Year Storm	10 Year Storm
Detention	(20,449 cu.ft.)	(11,360 cu.ft.)

4.2.12 DESCRIPTION OF ALL EASEMENTS AND RIGHT OF WAYS

No easements or right-of-ways are required at this time.

4.2.13 DESCRIPTION OF FEMA FLOODPLAIN CALCULATIONS

Not applicable.

4.2.14 CONCLUSIONS

The methods used in determining the peak runoff flows and required storm detention for this project are generally accepted engineering practices. It is our professional opinion that the design and recommendations put forth in this report meet the City requirements in controlling a theoretical 100 year storm event. It should be noted that the 100 year storm event is a theoretical storm with a 1% probability of being equaled or exceeded in any given year. It should also be noted that floods equaling or exceeding the 100 year storm event can and do occur. Construction of this development should follow L.R. Pope Engineering, Inc. design and recommendations and any deviation or modification to said development should be approved by L.R. Pope Engineering, Inc., the City of St. George, and the Developer/Owner prior to commencing modification.

APPENDIX 'A'
CALCULATIONS
EXISTING ONSITE DRAINAGE CONDITIONS AND
DEVELOPED ONSITE CONDITIONS

**10 YR RATIONAL METHOD PEAK DISCHARGES FOR PREDEVELOPED CONDITIONS
FOR COMMERCE POINT NORTH**

Soil Type =	A	Runoff		
		Coefficient,		
Land Use/Cover	C	Area, sq. ft.	Area, acres	
Commercial/Highways/Parking	0.95	53336	1.22	
Apartments/Offices	0.75	0		
Industry/Institutional	0.90	0		
HD Residential: > 9 units/acre	0.70	0		
MD Residential: > 6-9 units/acre	0.60	0		
MD Residential: > 4-6 units/acre	0.50	0		
LD Residential: > 3-4 units/acre	0.35	0		
LD Residential: > 2-3 units/acre	0.25	0		
LD Residential: > 1-2 units/acre	0.15	0		
VLD Residential: > 0.5-1 units/acre	0.10	0		
VLD Residential: > 0.2-0.5 units/acre	0.08	0		
VLD Residential: > 0.1-0.5 units/acre	0.05	0		
Urban Lawns/Parks	100.00	0		
Urban Landscaping/Gardens	0.00	0		
Bare/Newly Graded	0.02	106673	2.45	
Irrigated Pasture/Agriculture	0.02	0		
Wetlands	0.99	0		
Desert Shrub: < 30% Cover	0.01	0		
Desert Shrub: < 30-70% Cover	0.01	0		
Desert Shrub: > 70% Cover	0.01	0		
Total Area =		160009	3.67	

Weighted runoff coefficient, $C_w = \sum C_i A_i / \sum A_i = 0.330$

Time of concentration = 0.25 hours
 Recurrence interval = 10 year storm
 Intensity, $i = 2.000$ in/hr

$Q = C_w \cdot i \cdot A = 2.42$ CFS



**100 YR RATIONAL METHOD PEAK DISCHARGES FOR PREDEVELOPED CONDITIONS
FOR COMMERCE POINT NORTH**

Soil Type =	A	Runoff		
		Coefficient,		
Land Use/Cover	C	Area, sq. ft.	Area, acres	
Commercial/Highways/Parking	0.95	53336	1.22	
Apartments/Offices	0.75	0		
Industry/Institutional	0.90	0		
HD Residential: > 9 units/acre	0.70	0		
MD Residential: > 6-9 units/acre	0.60	0		
MD Residential: > 4-6 units/acre	0.50	0		
LD Residential: > 3-4 units/acre	0.35	0		
LD Residential: > 2-3 units/acre	0.25	0		
LD Residential: > 1-2 units/acre	0.15	0		
VLD Residential: > 0.5-1 units/acre	0.10	0		
VLD Residential: > 0.2-0.5 units/acre	0.08	0		
VLD Residential: > 0.1-0.5 units/acre	0.05	0		
Urban Lawns/Parks	100.00	0		
Urban Landscaping/Gardens	0.00	0		
Bare/Newly Graded	0.02	106673	2.45	
Irrigated Pasture/Agriculture	0.02	0		
Wetlands	0.99	0		
Desert Shrub: < 30% Cover	0.01	0		
Desert Shrub: < 30-70% Cover	0.01	0		
Desert Shrub: > 70% Cover	0.01	0		
Total Area =		160009	3.67	

Weighted runoff coefficient, $C_w = \sum C_j A_j / \sum A_j = 0.330$

Time of concentration = 0.25 hours
 Recurrence interval = 100 year storm
 Intensity, $i = 3.600$ in/hr
 $Q = C_w \cdot i \cdot A = 4.36$ CFS



**10 YR RATIONAL METHOD PEAK DISCHARGES FOR DEVELOPED CONDITIONS
FOR COMMERCE POINT NORTH**

Soil Type =	A	Runoff		
		Coefficient,		
Land Use/Cover	C	Area, sq. ft.	Area, acres	
Commercial/Highways/Parking	0.95	160009	3.67	
Apartments/Offices	0.75	0		
Industry/Institutional	0.90	0		
HD Residential: > 9 units/acre	0.70	0		
MD Residential: > 6-9 units/acre	0.60	0		
MD Residential: > 4-6 units/acre	0.50	0		
LD Residential: > 3-4 units/acre	0.35	0		
LD Residential: > 2-3 units/acre	0.25	0		
LD Residential: > 1-2 units/acre	0.15	0		
VLD Residential: > 0.5-1 units/acre	0.10	0		
VLD Residential: > 0.2-0.5 units/acre	0.08	0		
VLD Residential: > 0.1-0.5 units/acre	0.05	0		
Urban Lawns/Parks	100.00	0		
Urban Landscaping/Gardens	0.00	0		
Bare/Newly Graded	0.02	0		
Irrigated Pasture/Agriculture	0.02	0		
Wetlands	0.99	0		
Desert Shrub: < 30% Cover	0.01	0		
Desert Shrub: < 30-70% Cover	0.01	0		
Desert Shrub: > 70% Cover	0.01	0		
Total Area =		160009	3.67	

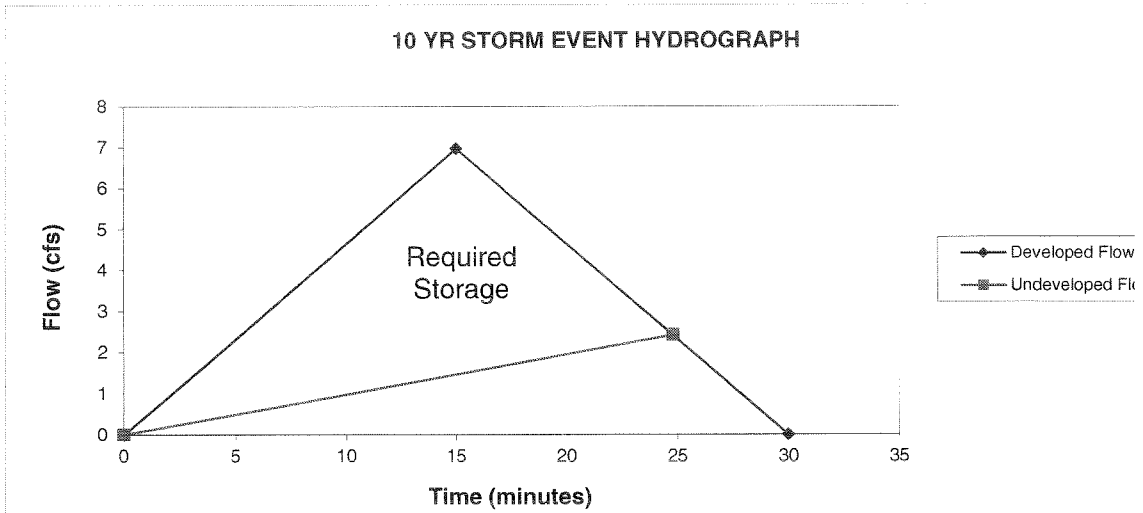
Weighted runoff coefficient, $C_w = \sum C_i A_i / \sum A_i = 0.950$

Time of concentration = 0.25 hours
 Recurrence interval = 10 year storm
 Intensity, $i = 2.000$ in/hr

$Q = C_w \cdot i \cdot A = 6.98$ CFS



**GRAPHICAL SUMMARY FOR MAXIMUM REQUIRED STORAGE FOR PREDEVELOPED CONDITIONS
FOR COMMERCE POINT NORTH**



	Tc, min	i, in/hr	Q, cfs
Developed peak =	15	2.000	6.98

Return Frequency =	10	yr
Allowable outflow =	2.42	cfs
Peak Inflow =	6.98	cfs

Required Storage =	0.094	acre-ft = 4099.417 ft³
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Points of intersection
Undeveloped/Developed @ Time = 24.79 minutes



**100 YR RATIONAL METHOD PEAK DISCHARGES FOR DEVELOPED CONDITIONS
FOR COMMERCE POINT NORTH**

Soil Type =	A	Runoff Coefficient,		
		C	Area, sq. ft.	Area, acres
Land Use/Cover				
Commercial/Highways/Parking		0.95	160009	3.67
Apartments/Offices		0.75	0	
Industry/Institutional		0.90	0	
HD Residential: > 9 units/acre		0.70	0	
MD Residential: > 6-9 units/acre		0.60	0	
MD Residential: > 4-6 units/acre		0.50	0	
LD Residential: > 3-4 units/acre		0.35	0	
LD Residential: > 2-3 units/acre		0.25	0	
LD Residential: > 1-2 units/acre		0.15	0	
VLD Residential: > 0.5-1 units/acre		0.10	0	
VLD Residential: > 0.2-0.5 units/acre		0.08	0	
VLD Residential: > 0.1-0.5 units/acre		0.05	0	
Urban Lawns/Parks		100.00	0	
Urban Landscaping/Gardens		0.00	0	
Bare/Newly Graded		0.02	0	
Irrigated Pasture/Agriculture		0.02	0	
Wetlands		0.99	0	
Desert Shrub: < 30% Cover		0.01	0	
Desert Shrub: < 30-70% Cover		0.01	0	
Desert Shrub: > 70% Cover		0.01	0	
Total Area =			160009	3.67

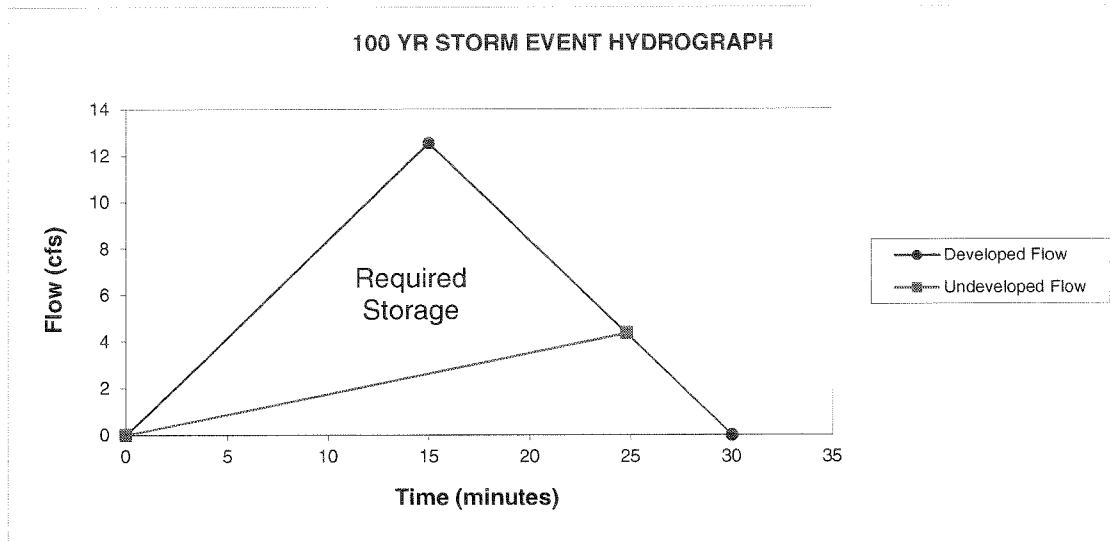
Weighted runoff coefficient, $C_w = \sum C_i A_i / \sum A_i = 0.950$

Time of concentration = 0.25 hours
 Recurrence interval = 100 year storm
 Intensity, i = 3.600 in/hr

$Q = C_w \cdot i \cdot A = 12.56 \text{ CFS}$



**GRAPHICAL SUMMARY FOR MAXIMUM REQUIRED STORAGE FOR DEVELOPED CONDITIONS
FOR COMMERCE POINT NORTH**



Developed peak = Tc, min i, in/hr Q, cfs
 15 3.600 12.56

Return Frequency = 100 yr

Allowable outflow = 4.36 cfs

Peak Inflow = 12.56 cfs

Required Storage = 0.169 acre-ft = 7379 ft³

Points of intersection

Undeveloped/Developed @ Time = 24.79 minutes

Detention Study Summary

Frequency Years	Adjusted 'C'	Intensity in/hr	Qpeak cfs	Allowable cfs	Required Storage acre-ft	Required Storage ft ³
10	0.950	2.000	6.98	2.42	0.094	4099
100	0.950	3.600	12.56	4.36	0.169	7379



**10 YR RATIONAL METHOD PEAK DISCHARGES FOR PREDEVELOPED CONDITIONS
FOR COMMERCE POINT EAST**

Soil Type =	A	Runoff Coefficient,		
Land Use/Cover	C	Area, sq. ft.	Area, acres	
Commercial/Highways/Parking	0.95	0		
Apartments/Offices	0.75	0		
Industry/Institutional	0.90	0		
HD Residential: > 9 units/acre	0.70	0		
MD Residential: > 6-9 units/acre	0.60	0		
MD Residential: > 4-6 units/acre	0.50	0		
LD Residential: > 3-4 units/acre	0.35	0		
LD Residential: > 2-3 units/acre	0.25	0		
LD Residential: > 1-2 units/acre	0.15	0		
VLD Residential: > 0.5-1 units/acre	0.10	0		
VLD Residential: > 0.2-0.5 units/acre	0.08	0		
VLD Residential: > 0.1-0.5 units/acre	0.05	0		
Urban Lawns/Parks	100.00	0		
Urban Landscaping/Gardens	0.00	0		
Bare/Newly Graded	0.02	0		
Irrigated Pasture/Agriculture	0.02	0		
Wetlands	0.99	0		
Desert Shrub: < 30% Cover	0.01	233252	5.35	
Desert Shrub: < 30-70% Cover	0.01	0		
Desert Shrub: > 70% Cover	0.01	0		
Total Area =		233252	5.35	

Weighted runoff coefficient, $C_w = \sum C_i A_i / \sum A_i =$ 0.010

Time of concentration = 0.25 hours
 Recurrence interval = 10 year storm
 Intensity, $i =$ 2.000 in/hr

$Q = C_w \cdot i \cdot A =$ 0.11 CFS



**100 YR RATIONAL METHOD PEAK DISCHARGES FOR PREDEVELOPED CONDITIONS
FOR COMMERCE POINT EAST**

Soil Type =	A	Runoff		
		Coefficient,		
Land Use/Cover	C	Area, sq. ft.	Area, acres	
Commercial/Highways/Parking	0.95	0		
Apartments/Offices	0.75	0		
Industry/Institutional	0.90	0		
HD Residential: > 9 units/acre	0.70	0		
MD Residential: > 6-9 units/acre	0.60	0		
MD Residential: > 4-6 units/acre	0.50	0		
LD Residential: > 3-4 units/acre	0.35	0		
LD Residential: > 2-3 units/acre	0.25	0		
LD Residential: > 1-2 units/acre	0.15	0		
VLD Residential: > 0.5-1 units/acre	0.10	0		
VLD Residential: > 0.2-0.5 units/acre	0.08	0		
VLD Residential: > 0.1-0.5 units/acre	0.05	0		
Urban Lawns/Parks	100.00	0		
Urban Landscaping/Gardens	0.00	0		
Bare/Newly Graded	0.02	0		
Irrigated Pasture/Agriculture	0.02	0		
Wetlands	0.99	0		
Desert Shrub: < 30% Cover	0.01	233252	5.35	
Desert Shrub: < 30-70% Cover	0.01	0		
Desert Shrub: > 70% Cover	0.01	0		
Total Area =		233252	5.35	

Weighted runoff coefficient, $C_w = \sum C_i A_i / \sum A_i =$ 0.010

Time of concentration = 0.25 hours
 Recurrence interval = 100 year storm
 Intensity, $i =$ 3.600 in/hr

$Q = C_w \cdot i \cdot A =$ 0.19 CFS



**10 YR RATIONAL METHOD PEAK DISCHARGES FOR DEVELOPED CONDITIONS
FOR COMMERCE POINT EAST**

Soil Type =	A	Runoff Coefficient,		
		C	Area, sq. ft.	Area, acres
Land Use/Cover				
Commercial/Highways/Parking	0.95	233252	5.35	
Apartments/Offices	0.75	0		
Industry/Institutional	0.90	0		
HD Residential: > 9 units/acre	0.70	0		
MD Residential: > 6-9 units/acre	0.60	0		
MD Residential: > 4-6 units/acre	0.50	0		
LD Residential: > 3-4 units/acre	0.35	0		
LD Residential: > 2-3 units/acre	0.25	0		
LD Residential: > 1-2 units/acre	0.15	0		
VLD Residential: > 0.5-1 units/acre	0.10	0		
VLD Residential: > 0.2-0.5 units/acre	0.08	0		
VLD Residential: > 0.1-0.5 units/acre	0.05	0		
Urban Lawns/Parks	100.00	0		
Urban Landscaping/Gardens	0.00	0		
Bare/Newly Graded	0.02	0		
Irrigated Pasture/Agriculture	0.02	0		
Wetlands	0.99	0		
Desert Shrub: < 30% Cover	0.01	0		
Desert Shrub: < 30-70% Cover	0.01	0		
Desert Shrub: > 70% Cover	0.01	0		
Total Area =		233252	5.35	

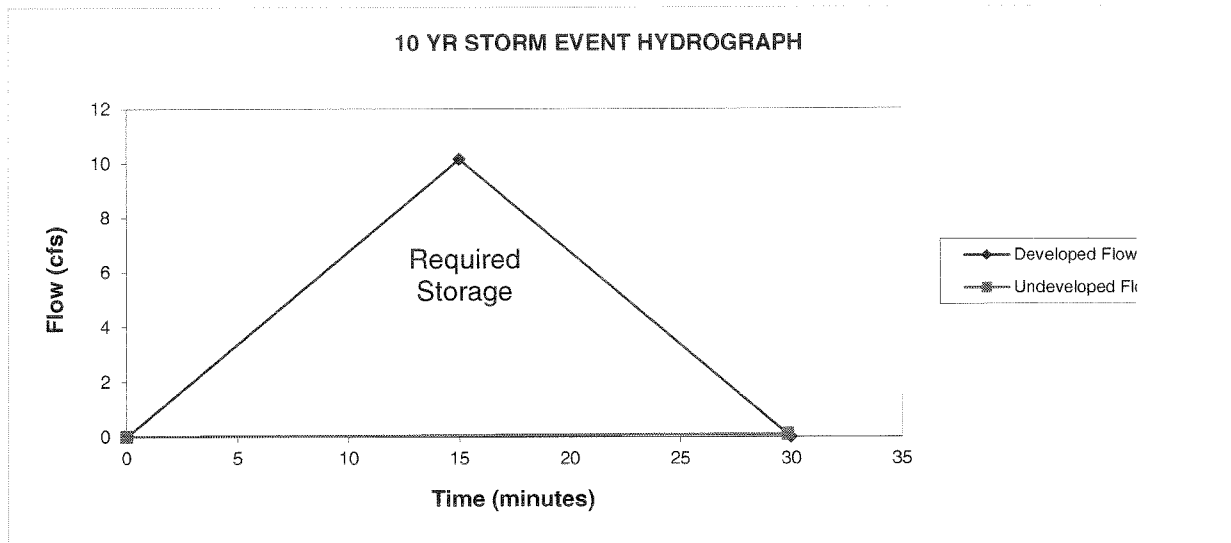
Weighted runoff coefficient, $C_w = \sum C_j A_j / \sum A_j = 0.950$

Time of concentration = 0.25 hours
 Recurrence interval = 10 year storm
 Intensity, i = 2.000 in/hr

$Q = C_w \cdot i \cdot A = 10.17 \text{ CFS}$



**GRAPHICAL SUMMARY FOR MAXIMUM REQUIRED STORAGE FOR PREDEVELOPED CONDITIONS
FOR COMMERCE POINT EAST**



	Tc, min	i, in/hr	Q, cfs
Developed peak =	15	2.000	10.17

Return Frequency = 10 yr

Allowable outflow = 0.11 cfs

Peak Inflow = 10.17 cfs

Required Storage = 0.208 acre-ft = 9060.202 ft³

Points of intersection

Undeveloped/Developed @ Time = 29.84 minutes



**100 YR RATIONAL METHOD PEAK DISCHARGES FOR DEVELOPED CONDITIONS
FOR COMMERCE POINT EAST**

Soil Type =	A	Runoff		
		Coefficient,		
Land Use/Cover	C	Area, sq. ft.	Area, acres	
Commercial/Highways/Parking	0.95	233252	5.35	
Apartments/Offices	0.75	0		
Industry/Institutional	0.90	0		
HD Residential: > 9 units/acre	0.70	0		
MD Residential: > 6-9 units/acre	0.60	0		
MD Residential: > 4-6 units/acre	0.50	0		
LD Residential: > 3-4 units/acre	0.35	0		
LD Residential: > 2-3 units/acre	0.25	0		
LD Residential: > 1-2 units/acre	0.15	0		
VLD Residential: > 0.5-1 units/acre	0.10	0		
VLD Residential: > 0.2-0.5 units/acre	0.08	0		
VLD Residential: > 0.1-0.5 units/acre	0.05	0		
Urban Lawns/Parks	100.00	0		
Urban Landscaping/Gardens	0.00	0		
Bare/Newly Graded	0.02	0		
Irrigated Pasture/Agriculture	0.02	0		
Wetlands	0.99	0		
Desert Shrub: < 30% Cover	0.01	0		
Desert Shrub: < 30-70% Cover	0.01	0		
Desert Shrub: > 70% Cover	0.01	0		
Total Area =		233252	5.35	

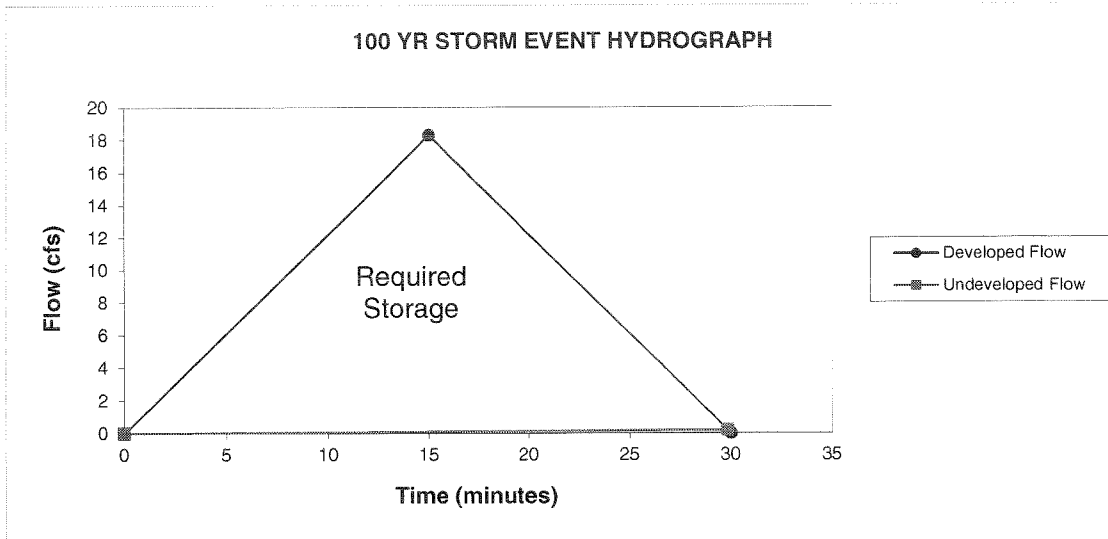
Weighted runoff coefficient, $C_w = \sum C_i A_i / \sum A_i = 0.950$

Time of concentration = 0.25 hours
 Recurrence interval = 100 year storm
 Intensity, i = 3.600 in/hr

$Q = C_w \cdot i \cdot A = 18.31 \text{ CFS}$



**GRAPHICAL SUMMARY FOR MAXIMUM REQUIRED STORAGE FOR DEVELOPED CONDITIONS
FOR COMMERCE POINT EAST**



Developed peak = Tc, min i, in/hr Q, cfs
 15 3.600 18.31

Return Frequency = 100 yr
 Allowable outflow = 0.19 cfs
 Peak Inflow = 18.31 cfs

Required Storage = 0.374 acre-ft = 16308 ft³

Points of intersection

Undeveloped/Developed @ Time = 29.84 minutes

Detention Study Summary

Frequency Years	Adjusted 'C'	Intensity in/hr	Qpeak cfs	Allowable cfs	Required Storage acre-ft	Required Storage ft ³
10	0.950	2.000	10.17	0.11	0.208	9060
100	0.950	3.600	18.31	0.19	0.374	16308



**10 YR RATIONAL METHOD PEAK DISCHARGES FOR PREDEVELOPED CONDITIONS
FOR COMMERCE POINT WEST**

Soil Type =	C	Runoff Coefficient,		
		C	Area, sq. ft.	Area, acres
Commercial/Highways/Parking		0.95	0	
Apartments/Offices		0.85	0	
Industry/Institutional		0.90	0	
HD Residential: > 9 units/acre		0.80	0	
MD Residential: > 6-9 units/acre		0.70	0	
MD Residential: > 4-6 units/acre		0.60	0	
LD Residential: > 3-4 units/acre		0.45	0	
LD Residential: > 2-3 units/acre		0.35	0	
LD Residential: > 1-2 units/acre		0.25	0	
VLD Residential: > 0.5-1 units/acre		0.20	0	
VLD Residential: > 0.2-0.5 units/acre		0.17	0	
VLD Residential: > 0.1-0.5 units/acre		0.15	0	
Urban Lawns/Parks		0.10	0	
Urban Landscaping/Gardens		0.05	0	
Bare/Newly Graded		0.30	0	
Irrigated Pasture/Agriculture		0.15	0	
Wetlands		0.99	0	
Desert Shrub: < 30% Cover		0.15	343653	7.89
Desert Shrub: < 30-70% Cover		0.10	0	
Desert Shrub: > 70% Cover		0.05	0	
		Total Area =	343653	7.89

Weighted runoff coefficient, $C_w = \sum C_j A_j / \sum A_j =$ 0.150

Time of concentration = 0.25 hours
 Recurrence interval = 10 year storm
 Intensity, i = 2.000 in/hr

 $Q = C_w \cdot i \cdot A =$ 2.37 CFS



**100 YR RATIONAL METHOD PEAK DISCHARGES FOR PREDEVELOPED CONDITIONS
FOR COMMERCE POINT WEST**

Soil Type =	C	Runoff Coefficient,		
		C	Area, sq. ft.	Area, acres
Land Use/Cover				
Commercial/Highways/Parking	0.95	0		
Apartments/Offices	0.85	0		
Industry/Institutional	0.90	0		
HD Residential: > 9 units/acre	0.80	0		
MD Residential: > 6-9 units/acre	0.70	0		
MD Residential: > 4-6 units/acre	0.60	0		
LD Residential: > 3-4 units/acre	0.45	0		
LD Residential: > 2-3 units/acre	0.35	0		
LD Residential: > 1-2 units/acre	0.25	0		
VLD Residential: > 0.5-1 units/acre	0.20	0		
VLD Residential: > 0.2-0.5 units/acre	0.17	0		
VLD Residential: > 0.1-0.5 units/acre	0.15	0		
Urban Lawns/Parks	0.10	0		
Urban Landscaping/Gardens	0.05	0		
Bare/Newly Graded	0.30	0		
Irrigated Pasture/Agriculture	0.15	0		
Wetlands	0.99	0		
Desert Shrub: < 30% Cover	0.15	343653	7.89	
Desert Shrub: < 30-70% Cover	0.10	0		
Desert Shrub: > 70% Cover	0.05	0		
Total Area =		343653	7.89	

Weighted runoff coefficient, $C_w = \sum C_j A_j / \sum A_j = 0.150$

Time of concentration = 0.25 hours
 Recurrence interval = 100 year storm
 Intensity, i = 3.600 in/hr

 $Q = C_w \cdot i \cdot A = 4.26$ CFS



**10 YR RATIONAL METHOD PEAK DISCHARGES FOR DEVELOPED CONDITIONS
FOR COMMERCE POINT WEST**

Soil Type = C

**Runoff
Coefficient,**

Land Use/Cover	C	Area, sq. ft.	Area, acres
Commercial/Highways/Parking	0.95	343653	7.89
Apartments/Offices	0.85	0	
Industry/Institutional	0.90	0	
HD Residential: > 9 units/acre	0.80	0	
MD Residential: > 6-9 units/acre	0.70	0	
MD Residential: > 4-6 units/acre	0.60	0	
LD Residential: > 3-4 units/acre	0.45	0	
LD Residential: > 2-3 units/acre	0.35	0	
LD Residential: > 1-2 units/acre	0.25	0	
VLD Residential: > 0.5-1 units/acre	0.20	0	
VLD Residential: > 0.2-0.5 units/acre	0.17	0	
VLD Residential: > 0.1-0.5 units/acre	0.15	0	
Urban Lawns/Parks	0.10	0	
Urban Landscaping/Gardens	0.05	0	
Bare/Newly Graded	0.30	0	
Irrigated Pasture/Agriculture	0.15	0	
Wetlands	0.99	0	
Desert Shrub: < 30% Cover	0.15	0	
Desert Shrub: < 30-70% Cover	0.10	0	
Desert Shrub: > 70% Cover	0.05	0	
Total Area =		343653	7.89

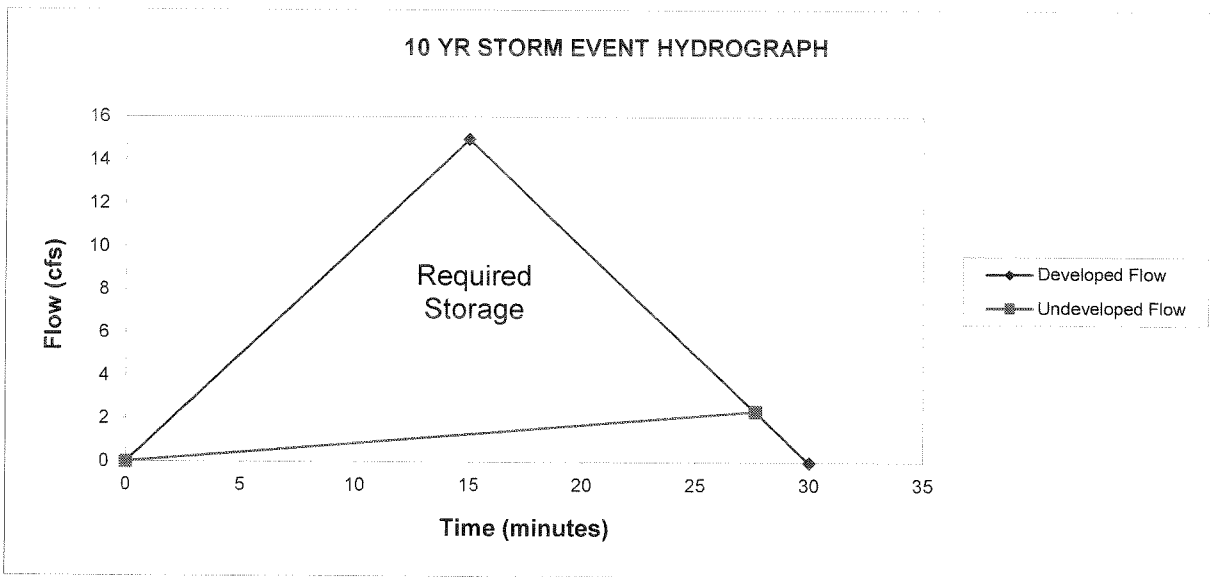
Weighted runoff coefficient, $C_w = \sum C_j A_j / \sum A_j =$ 0.950

Time of concentration = 0.25 hours
 Recurrence interval = 10 year storm
 Intensity, i = 2.000 in/hr

$Q = C_w \cdot i \cdot A =$ 14.99 CFS



**GRAPHICAL SUMMARY FOR MAXIMUM REQUIRED STORAGE FOR PREDEVELOPED CONDITIONS
FOR COMMERCE POINT WEST**



	Tc, min	i, in/hr	Q, cfs
Developed peak =	15	2.000	14.99

Return Frequency =	10	yr
Allowable outflow =	2.37	cfs
Peak Inflow =	14.99	cfs

Required Storage =	0.261	acre-ft = 11360.43 ft ³
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Points of intersection
 Undeveloped/Developed @ Time = 27.63 minutes



**100 YR RATIONAL METHOD PEAK DISCHARGES FOR DEVELOPED CONDITIONS
FOR COMMERCE POINT WEST**

Soil Type = C

**Runoff
Coefficient,**

Land Use/Cover	C	Area, sq. ft.	Area, acres
Commercial/Highways/Parking	0.95	343653	7.89
Apartments/Offices	0.85	0	
Industry/Institutional	0.90	0	
HD Residential: > 9 units/acre	0.80	0	
MD Residential: > 6-9 units/acre	0.70	0	
MD Residential: > 4-6 units/acre	0.60	0	
LD Residential: > 3-4 units/acre	0.45	0	
LD Residential: > 2-3 units/acre	0.35	0	
LD Residential: > 1-2 units/acre	0.25	0	
VLD Residential: > 0.5-1 units/acre	0.20	0	
VLD Residential: > 0.2-0.5 units/acre	0.17	0	
VLD Residential: > 0.1-0.5 units/acre	0.15	0	
Urban Lawns/Parks	0.10	0	
Urban Landscaping/Gardens	0.05	0	
Bare/Newly Graded	0.30	0	
Irrigated Pasture/Agriculture	0.15	0	
Wetlands	0.99	0	
Desert Shrub: < 30% Cover	0.15	0	
Desert Shrub: < 30-70% Cover	0.10	0	
Desert Shrub: > 70% Cover	0.05	0	
Total Area =		343653	7.89

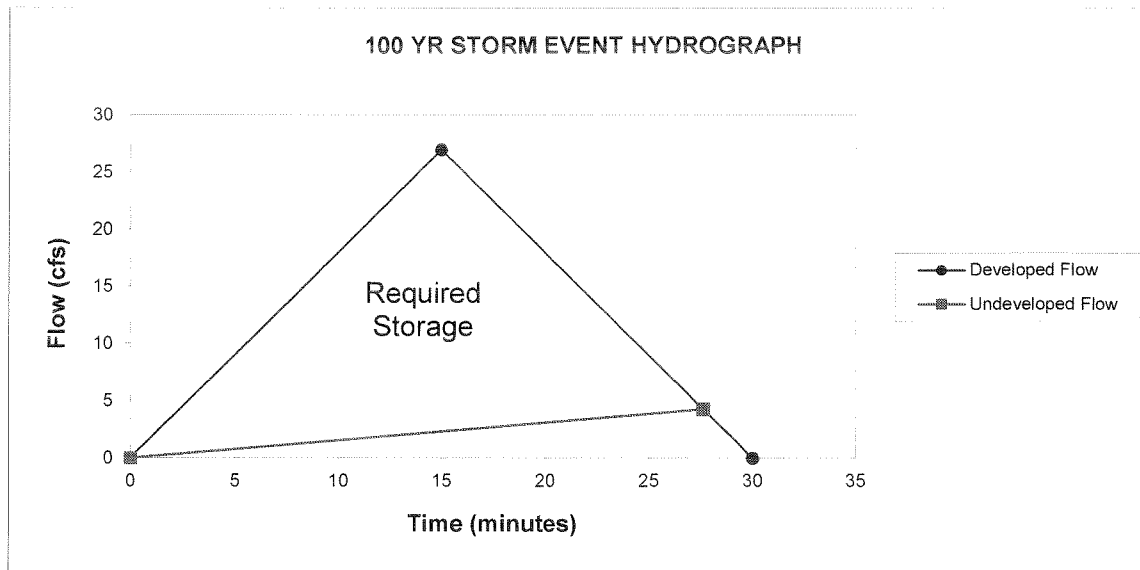
Weighted runoff coefficient, $C_w = \sum C_j A_j / \sum A_j =$ 0.950

Time of concentration = 0.25 hours
 Recurrence interval = 100 year storm
 Intensity, i = 3.600 in/hr

 $Q = C_w \cdot i \cdot A =$ 26.98 CFS



**GRAPHICAL SUMMARY FOR MAXIMUM REQUIRED STORAGE FOR DEVELOPED CONDITIONS
FOR COMMERCE POINT WEST**



Developed peak = Tc, min i, in/hr Q, cfs
 15 3.600 26.98

Return Frequency = 100 yr

Allowable outflow = 4.26 cfs

Peak Inflow = 26.98 cfs

Required Storage = 0.469 acre-ft = 20449 ft³

Points of intersection

Undeveloped/Developed @ Time = 27.63 minutes

Detention Study Summary

Frequency Years	Adjusted 'C'	Intensity in/hr	Qpeak cfs	Allowable cfs	Required Storage acre-ft	Required Storage ft ³
10	0.950	2.000	14.99	2.37	0.261	11360
100	0.950	3.600	26.98	4.26	0.469	20449



APPENDIX 'B'
SOIL MAPS
SOIL DESCRIPTIONS

Washington County Area, Utah

JaB—Junction fine sandy loam, 1 to 2 percent slopes

Map Unit Setting

National map unit symbol: j8f3
Elevation: 2,700 to 3,400 feet
Mean annual precipitation: 8 to 11 inches
Mean annual air temperature: 57 to 67 degrees F
Frost-free period: 190 to 195 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition

Junction and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Junction

Setting

Landform: Alluvial fans
Down-slope shape: Concave
Across-slope shape: Convex

Typical profile

H1 - 0 to 2 inches: fine sandy loam
H2 - 2 to 9 inches: fine sandy loam
H3 - 9 to 21 inches: fine sandy loam
H4 - 21 to 32 inches: fine sandy loam
H5 - 32 to 60 inches: fine sandy loam

Properties and qualities

Slope: 1 to 2 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Runoff class: Very low
Capacity of the most limiting layer to transmit water (Ksat): High (2.00 to 6.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 20 percent
Gypsum, maximum in profile: 7 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water storage in profile: Moderate (about 7.2 inches)

Interpretive groups

Land capability classification (irrigated): 2e
Land capability classification (nonirrigated): 7e
Hydrologic Soil Group: A

Ecological site: Desert Loam (Creosotebush) (R030XY110UT)

Minor Components

Pintura

Percent of map unit: 5 percent

Tobler

Percent of map unit: 5 percent

Harrisburg

Percent of map unit: 5 percent

Data Source Information

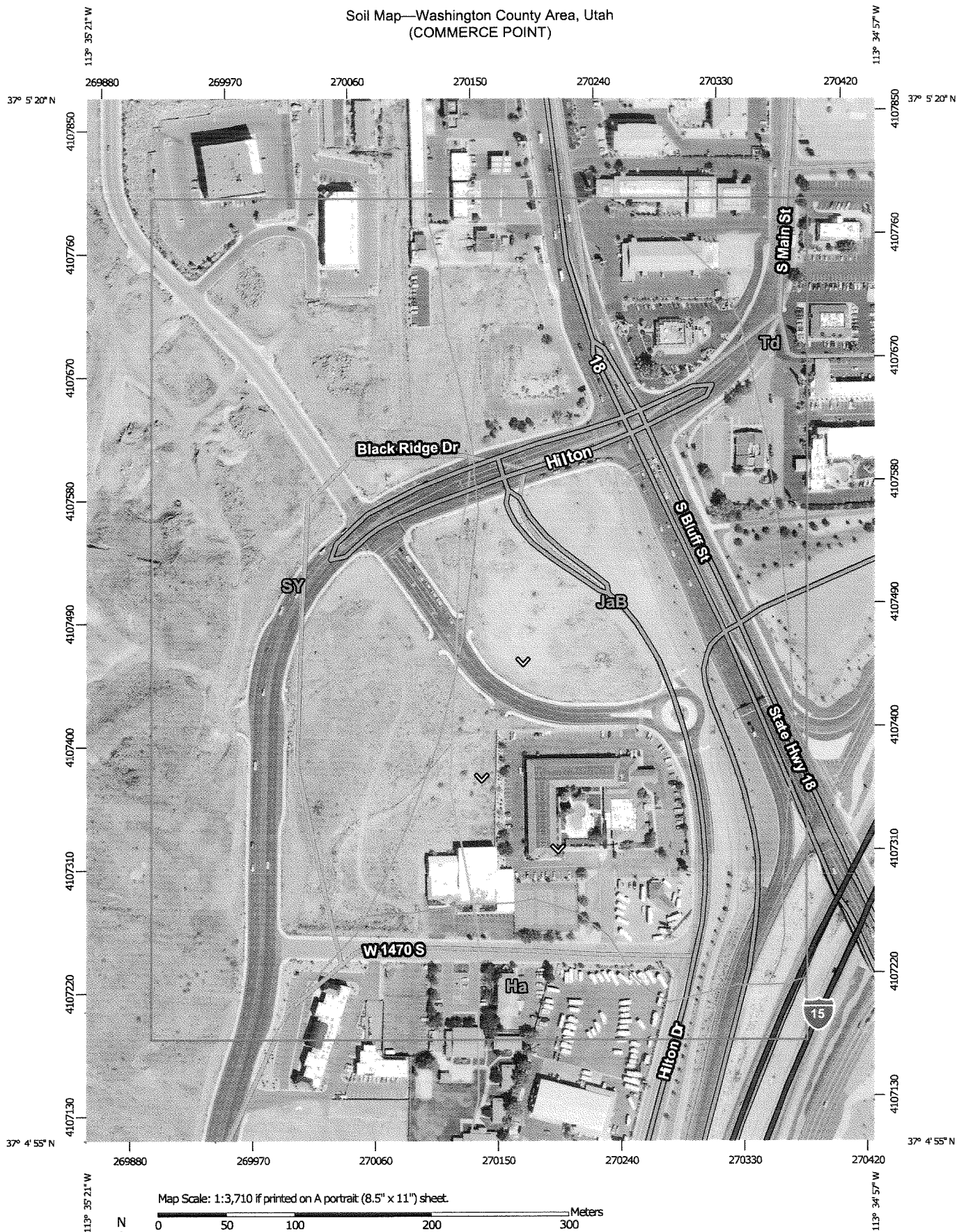
Soil Survey Area: Washington County Area, Utah

Survey Area Data: Version 9, Sep 23, 2015

TABLE 6.--SOIL RESOURCE INTERPRETATIONS--Continued

Map symbol	Soil name	Land capability	Vegetative group	Hydrologic group	Timber management group	Erosion hazard	Frost-heave potential	Degree of limitation for--		
								Road location	Excavation	Dwellings
MsE	Meeks very stony loamy coarse sand, 15 to 30 percent slopes.	VIIIs	J	B	3x5	High----	Moderate-	Severe---	Severe---	Severe.
MsG	Meeks very stony loamy coarse sand, 30 to 60 percent slopes.	VIIIs	J	B	4x8	High----	Moderate-	Severe---	Severe---	Severe.
MtE	Meeks extremely stony loamy coarse sand, 15 to 30 percent slopes.	VIIIs	J	B	3x5	High----	Moderate-	Severe---	Severe---	Severe.
MtG	Meeks extremely stony loamy coarse sand, 30 to 60 percent slopes.	VIIIs	J	B	4x8	High----	Moderate-	Severe---	Severe---	Severe.
MxE	Meiss cobbly loam, 9 to 30 percent slopes.	VIIe	J	D	(1/)	Moderate-	Moderate-	Severe---	Severe---	Severe.
MxF	Meiss cobbly loam, 30 to 50 percent slopes.	VIIe	J	D	(1/)	High----	Moderate-	Severe---	Severe---	Severe.
Px	Pits and dumps-----	VIIIIs	J	D	(1/)	Variable-	Variable-	Severe---	Variable-	Severe.
Ra	Rock land-----	VIIIIs	J	D	(1/)	Moderate-	Moderate-	Severe---	Severe---	Severe.
RcF	Rock outcrop-Cagwin complex, 30 to 50 percent slopes.	VIIIs	J	C	4x8	High----	Moderate-	Severe---	Severe---	Severe.
RcG	Rock outcrop-Cagwin complex, 50 to 70 percent slopes.	VIIIs	J	C	4x8	High----	Moderate-	Severe---	Severe---	Severe.
RtF	Rock outcrop-Toem complex, 30 to 50 percent slopes.	VIIIs	J	C	5x10	High----	Slight---	Severe---	Severe---	Severe.
RtG	Rock outcrop-Toem complex, 50 to 70 percent slopes.	VIIIs	J	C	5x10	High----	Slight---	Severe---	Severe---	Severe.
Rx	Rock outcrop and Rubble land.	VIIIIs	J	D	(1/)	Slight---	Not rated.	Severe---	Severe---	Severe.
ShE	Shakespeare gravelly loam, 9 to 30 percent slopes.	VIe	B	C	3o2	Moderate-	Severe---	Severe---	Moderate-	Severe.
SkF	Shakespeare stony loam, 30 to 50 percent slopes.	VIIe	J	C	3r4	High----	Severe---	Severe---	Moderate-	Severe.
Sm	Stony colluvial land---	VIIIIs	J	<u>C</u>	(1/)	Moderate-	Variable-	Severe---	Severe---	Severe.
TaD	Tahoma stony sandy loam, 2 to 15 percent slopes.	IVe	A	<u>B</u>	2o1	Slight---	Severe---	Moderate-	Slight---	Moderate.
TbD	Tahoma very stony sandy loam, 2 to 15 percent slopes.	VIIs	B	B	2o1	Slight---	Severe---	Moderate-	Moderate-	Moderate.
TcB	Tallac gravelly coarse sandy loam, seeped, 0 to 5 percent slopes.	IVe	B	C	3o2	Slight---	Moderate-	Moderate-	Moderate-	Moderate.
TcC	Tallac gravelly coarse sandy loam, seeped, 5 to 9 percent slopes.	IVe	B	C	3o2	Slight---	Moderate-	Moderate-	Moderate-	Moderate.
TdD	Tallac stony coarse sandy loam, 5 to 15 percent slopes.	VIe	B	B	3x5	Slight--	Moderate-	Moderate-	Severe---	Severe.
TeE	Tallac very stony coarse sandy loam, 15 to 30 percent slopes.	VIIs	B	B	3x5	Moderate-	Moderate-	Severe---	Severe---	Severe.

Soil Map—Washington County Area, Utah (COMMERCE POINT)



Map Scale: 1:3,710 if printed on A portrait (8.5" x 11") sheet.



Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 12N WGS84



**Natural Resources
Conservation Service**

Web Soil Survey
National Cooperative Soil Survey

5/13/2016
Page 1 of 3

Soil Map—Washington County Area, Utah
(COMMERCE POINT)

MAP LEGEND

Area of Interest (AOI)

 Area of Interest (AOI)

Soils

 Soil Map Unit Polygons

 Soil Map Unit Lines

 Soil Map Unit Points

Special Point Features

 Blowout

 Borrow Pit

 Clay Spot

 Closed Depression

 Gravel Pit

 Gravelly Spot

 Landfill

 Lava Flow

 Marsh or swamp

 Mine or Quarry

 Miscellaneous Water

 Perennial Water

 Rock Outcrop

 Saline Spot

 Sandy Spot

 Severely Eroded Spot

 Sinkhole

 Slide or Slip

 Sodic Spot

 Spoil Area

 Stony Spot

 Very Stony Spot

 Wet Spot

 Other

 Special Line Features

Water Features

 Streams and Canals

Transportation

 Rails

 Interstate Highways

 US Routes

 Major Roads

 Local Roads

Background

 Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service

Web Soil Survey URL: <http://websoilsurvey.nrcs.usda.gov>

Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Washington County Area, Utah

Survey Area Data: Version 9, Sep 23, 2015

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Aug 11, 2010—Nov 3, 2010

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.



Natural Resources
Conservation Service

Web Soil Survey
National Cooperative Soil Survey

5/13/2016
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Map Unit Legend

Washington County Area, Utah (UT641)			
Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
Ha	Hantz silty clay loam	6.4	8.8%
JaB	Junction fine sandy loam, 1 to 2 percent slopes	31.7	43.5%
SY	Stony colluvial land	30.6	41.8%
Td	Tobler silty clay loam	4.3	5.9%
Totals for Area of Interest		73.0	100.0%

APPENDIX 'C'
FIGURES AND TABLES FROM
ST. GEORGE HYDROLOGY MANUAL

Table 2-1
Precipitation Depth-Frequency Estimates for St. George, Utah*

Estimated Precipitation Depth (inches)						
Duration	Annual Exceedance Probability					
	2-yr	5-yr	10-yr	25-yr	50-yr	100-yr
5 min	0.15	0.21	0.26	0.34	0.40	0.48
10 min	0.22	0.32	0.40	0.52	0.62	0.73
15 min	0.28	0.40	0.50	0.64	0.76	0.90
30 min	0.37	0.54	0.67	0.86	1.03	1.22
60 min	0.46	0.67	0.83	1.07	1.27	1.51
2 hr	0.54	0.76	0.93	1.18	1.38	1.60
3 hr	0.60	0.83	1.00	1.24	1.43	1.64
6 hr	0.75	1.03	1.22	1.50	1.72	1.96
12 hr	0.91	1.23	1.46	1.76	1.94	2.22
24 hr	1.05	1.42	1.68	2.01	2.26	2.51
2 day	1.15	1.56	1.83	2.19	2.47	2.74
4 day	1.30	1.76	2.06	2.46	2.77	3.07

* From NOAA Atlas 14, 2006 (see Appendix A).

Table 2-6
Rational Method Runoff Coefficients

Land Use/Land Cover Category	Soil Type			
	A	B	C	D
Commercial	0.95	0.95	0.95	0.95
Business / Industrial	0.90	0.90	0.90	0.90
Institutional	0.90	0.90	0.90	0.90
High Density Multi-family Residential	0.70	0.75	0.80	0.85
Medium Density Multi-family Residential	0.60	0.65	0.70	0.75
High Density Single Family Residential	0.50	0.55	0.60	0.65
Medium Density Single Family Residential (Traditional Neighborhood)	0.25	0.30	0.35	0.40
Low Density Single Family Residential	0.15	0.20	0.25	0.30
Very Low Density Single Family Residential	0.08	0.12	0.17	0.22
Urban Lawns/Parks	0.00	0.02	0.10	0.20
Urban Landscaping/Gardens	0.00	0.01	0.05	0.10
Bare Soil: Newly Graded Areas	0.02	0.10	0.30	0.50
Irrigated Pasture/Agriculture	0.02	0.05	0.15	0.25
Wetlands	0.99	0.99	0.99	0.99
Desert Shrub: < 30% ground cover	0.01	0.10	0.15	0.20
Desert Shrub: 30% to 70% ground cover	0.01	0.05	0.10	0.15
Desert Shrub: > 70% ground cover	0.01	0.02	0.05	0.10

Exhibit D
Geotechnical Report

GEOTECHNICAL INVESTIGATION REPORT

COMMERCE POINTE SHOPPING CENTER

St. George, Utah

Submitted to:

JMI Development
Attention: Gilbert Jennings
335 E. St. George Blvd. Suite 301
St. George, Utah 84770

Landmark Project No. 16110

May 6, 2016



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GEOTECHNICAL INVESTIGATION REPORT

for

Commerce Pointe Shopping Center

St. George, Utah

Submitted to:

JMI Development
Attn: Gilbert Jennings
335 E. St. George Blvd. Suite 301
St. George, Utah 84770

May 6, 2016

Landmark Testing & Engineering
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 COMMERCE POINTE SHOPPING CENTER

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COMMERCE POINTE SHOPPING CENTER

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FIGURE 10:	UNIFIED SOIL CLASSIFICATION SYSTEM
FIGURES 11-14:	CONSOLIDATION CURVES
FIGURE 15:	LABORATORY TEST SUMMARY

1.0 INTRODUCTION

This report presents the results of Landmark Testing & Engineering's geotechnical investigation for the proposed Commerce Pointe Shopping Center located adjacent to Black Ridge Drive in St George, Utah. We understand that the project will include 10 to 12 building pads with associated parking and site access. Figure 1 is a Vicinity map showing the location of the project relative to surrounding features. A site plan showing the preliminary project layout is shown on Figure 2.

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

2.0 PROPOSED CONSTRUCTION

We understand that proposed construction will consist of a commercial development with 10 to 12 building pads and associated roadways and other infrastructure. Retail pads are expected to range in size from approximately 5,000 to 30,000 square feet. Structural loads have not been provided, however, maximum wall loads are anticipated to be on the order of 2 to 4 kips per lineal foot. Isolated, column loads are expected to range up to 60 kips. Any significant changes to the anticipated loads should be reviewed by Landmark to evaluate the continued applicability of the recommendations contained in this report.

3.0 SITE SETTING

3.1 SURFACE CONDITIONS

The project is located near the toe of the southeast end of the West Black Ridge mesa in St. George, Utah, as shown on Figures 1-3. The site generally slopes downward to the east with an overall elevation change on the order of 60 feet. Black Ridge Drive and Hilton Drive both cross the site. Hilton Drive appears to have been built up near the intersection with Black Ridge Drive with embankment fill on the order of 15 feet. Relatively steep slopes were noted near the west side of the site. Vegetation generally consists of sparse to moderate brush, low-lying weeds, grasses, and occasional cactus. Undocumented fill was noted south of Hilton Drive, near the intersection of Hilton and Black Ridge Drives. Fill was also noted in test pit TP-11.

in the vicinity of the hotel that was previously located at the site. Basalt cobbles and boulders are present at the surface throughout much of the site, particularly at the slopes on the western portion of the site.

3.2 SEISMICITY AND FAULTING

Seismicity at the site was determined using the United States Geological Survey, Earthquake Hazards Program website. The following values are presented to assist with seismic design:

- ▶ Site Class = D (Stiff Soil) based on the ASCE7 (Table 20.3.1) as referenced in 2012 IBC 1613.3.2.
- ▶ Latitude = 37.0851, Longitude = -113.5863

Period (sec)	Sa (g)	Site Class
0.2	0.498 S_s	B
1.0	0.153 S_1	B
0.2	0.466 SD_s	D
1.0	0.223 SD_1	D

(2010 ASCE-7, USGS, U.S. Seismic Design Maps Calculator)

The two major faults in the area, the Washington Fault and the Hurricane Fault Zone are located within approximately 5 miles and 15 miles east of the site, respectively.¹ More recent mapping identifies the St. George Fault as a Quaternary (movement within the last 1,800,000 years) fault and projects the fault trace within approximately 1.5 miles east of the site. The site has also been mapped within a moderate rock-fall hazard area.² Although surface rupture at the site is considered unlikely, strong ground motion at the site, rockfall, and instability of slopes at the western portion of the site are possible.

Groundwater was not encountered in any of the test pits. Clay is prevalent throughout much of the site and hard excavating conditions were also noted. Therefore, the liquefaction potential is considered low.

¹ Anderson, R.E., and Christenson, G.E., 1989, Quaternary faults, folds, and selected volcanic features in the Cedar City 1° x 2° quadrangle, Utah. Utah Geological and Mineral Survey Miscellaneous Publication 89-6.

² William R. Lund, Tyler R. Knudsen, Garrett S. Vice, and Lucan M. Shaw, Geologic Hazards and Adverse Construction Conditions - St. George-Hurricane Metropolitan Area, Washington County, Utah, 2008, Utah Geological Survey Special Study 127.

3.3 SUBSURFACE CONDITIONS

Fourteen (14) test pits were completed throughout the project to characterize subsurface conditions. The approximate test pit locations are shown on Figure 2. Subsurface soils encountered in the test pits are shown on the test pit logs on Figures 3 through 9. A key to the soil descriptions used on the logs is presented on Figure 10. Test pits generally encountered lean to fat clay, with varying amounts of sand and basalt cobbles, throughout the majority of the test pits. Silty sand, silty gravel, and sandy silt were also encountered. Sandstone was encountered in test pit TP-7, which graded hard and practical backhoe refusal was encountered at a depth of 7.0 feet below the existing grade.

Previous geologic mapping by Hayden and Willis³, 2011, classifies the majority of soils within the site as mixed alluvial and eolian deposits (Qaeo), which consist of moderately to well sorted, clay to sand sized sediment of alluvial origin that locally includes abundant eolian sand and minor gravel. The western portion of the site has been mapped within Holocene to middle Pleistocene aged landslide deposits, with basal detachments in the Petrified Forest Member of the Chinle formation. The Petrified Forest Member appears to underlie the majority of the site.

Due to the very high landslide hazard category, Lund et. al (2008)⁴ recommend a detailed engineering geologic and geotechnical-engineering evaluation and predevelopment stabilization for the area included in the western portion of the site. However, landslides involving the Petrified Forest Member are difficult to mitigate. We are aware of recent landslide movement and significant structural damage within 1,000 feet north of the site. An evaluation of the landslide is beyond the scope of this report.

4.0 LABORATORY TESTING

Laboratory tests included mechanical gradation analyses and Atterberg limits to aid in soil classification, swell consolidation tests to assess potential volume change within clays at the site due to saturation, and

³ Hayden, E.M., and Willis, G.C., Geologic Map of the St. George 7.5' Quadrangle, Washington County, Utah, 2011, Utah Geological Survey Map 251DM.

⁴ William R. Lund, Tyler R. Knudsen, Garrett S. Vice, and Lucan M. Shaw, Landslide Hazard Map for the St. George-Hurricane Metropolitan Area, Washington County, Utah, 2008, Utah Geological Survey Special Study 127, Plate 4.

soluble sulfate tests to assess the corrosion potential of site soils on concrete. Results of the laboratory tests are shown on the test pit logs on Figures 3 through 9 and on the laboratory summary table on Figure 10.

Published correlations exist between the plasticity index noted in the Atterberg Limits tests and the swell potential³. These correlations are shown below.

Swell Potential	Plasticity Index (%)	Direct Measurement (% Swell)
Low	0-15	0-4
Moderate	10-35	4-8
High	20-55	8-12
Critical	35 and above	above 12

Atterberg limits tests had plasticity indices ranging from 18 to 37 and would be expected to experience moderate to high swell if the clay were dry and allowed to become saturated.

There were consolidation tests performed on 4 clay samples at varying depths. The samples were air dried prior to testing and were wetted at 500 psf. Upon wetting, the samples experienced swell from 3.3 to 4.8 percent. Swell curves are shown on Figures 11-14.

Based on an average swell of 4.1 percent, an estimated swell of ½ inch per foot of clay may be expected if the clay underneath the buildings becomes saturated. Assuming 15 feet of clay becomes saturated, a swell of 7.5 inches may be expected. In the parking lot areas, where the confining pressure is lower, a much greater swell would be expected.

³Nelson, J.D. and Miller, D.J., 1992 Expansive soils, problem and practice in foundation and pavement engineering: New York, New York, John Wiley & Sons, Inc.

5.0 SITE GRADING AND EARTHWORK

A +17 feet separation between building foundations and the underlying expansive clay is typically sufficient to reduce the potential of saturating the clay due to vertical migration of precipitation or irrigation water through suitable soils into the clay. Lean to fat clay was encountered throughout the majority of the site.

Three options are subsequently presented for building support. These options include:

1. Establishing structures on drilled piers extending below the zone of significant moisture variation (recommended minimum depth of 30 feet below the anticipated footing elevations) and allowing the floor slab to "float" with the understanding that the floor slab will require repair if subsurface soils swell. We recommend a minimum overexcavation of 9.0 feet below floating slabs. Additional overexcavation will provide greater separation and reduce the potential for saturation of the clay.
2. Establishing the structures on drilled piers, including constructing the floors as a suspended structural slab. We recommend a minimum pier depth of 30 feet below the anticipated footing elevations. This option generally gives the best assurance against differential movement due to subsurface moisture variation.
3. Overexcavation of expansive soils and establishing the structures on a mat of improved, relatively impervious soil may be a viable option. Subsequent to overexcavation utilize conventional footings and slab-on-grade construction with a separation between structural elements (i.e. footings and slabs) and underlying clay. A 17 feet separation is typically sufficient to reduce the potential of saturating the clay due to vertical migration of surface water. At a minimum, we recommend an overexcavation depth of 8 feet below footings and floor slabs. Additional overexcavation will provide greater separation and reduce the potential for saturation of the clay. With this option excessive heave is likely if the underlying clay becomes saturated. However, if landscaping can be minimized and strict drainage improvements are implemented throughout the life of the structures, the heave potential can be greatly reduced.

The option chosen will depend on the final product to be constructed, on the degree of risk the owner is willing to accept, cost of repair if required (including lost revenue) and on construction costs for each option. The type of construction will be important in assessing the foundation option. Typically, tilt-up concrete panels are less prone to cracking due to differential movement than is masonry block construction. Additionally, steel buildings provide more flexibility than masonry or tilt-up construction. Other considerations include the amount and type of plumbing beneath the structures and implementation of adjacent landscaping throughout the life of the structures.

Any option will require stringent moisture controls to minimize potential saturation of the clay. Distress of sidewalks, curb/gutter, pavement, and other surface elements will occur if expansive clay beneath these elements becomes saturated. Detailed recommendations for each option are presented.

5.1 DRILLED PIERS WITH FLOATING FLOOR

Piers should be installed a minimum of 30 feet below the anticipated footing elevations. A minimum pier diameter of 8-inches is recommended to allow for insertion of the re-bar cage and to allow adequate concrete cover. We recommend a minimum overexcavation of 9.0 feet in order to establish a non-expansive zone below floating slabs. The overexcavated material should be replaced with structural fill, as outlined below. Cobbles that may impede drilling would likely be removed during overexcavation. Therefore, the overexcavation and replacement should proceed pier installation. Helical piers are not recommended since they will likely not be able to achieve the desired depth. Pier recommendations are as follows:

1. Piers should be designed for a maximum allowable end bearing pressure of 14,000 psf and an allowable skin friction value of 1,100 psf for the portion of pier extending below 8 feet.
2. Piers should be designed and spaced for a minimum deadload pressure of 10,000 psf based on the pier cross-sectional area.
3. Piers should be reinforced the full length to resist tension forces in the event of swelling of adjacent soils. Potential tension forces may be calculated using at least 15 feet of pier length with a skin friction of 1,100 psf. The minimum percent of steel should be 1% of the concrete area. Reinforcement should extend into grade beams and foundation walls.
4. Laterally loaded piers should be at least three diameters apart and may be designed utilizing the parameters in the following table.

Soil Type	Total Unit Weight (pcf)	ϵ_{50} (in/in)	K value (lb/in ³)	Friction Angle	Cohesion (psf)	Unconfined Compressive Strength (psf)	Modulus of Elasticity (psi)
Granular Fill	130	NA	120	34	NA	NA	2,500
Lean to fat clay	120	0.005	1,000	NA	4,000	8,000	14,000

5. Pier excavations should be carefully cleaned prior to placing concrete. Concrete should be poured into the pier excavations immediately after the excavations are cleaned and inspected. Pumping or tremie methods of concrete placement are recommended to minimize segregation of the concrete. The maximum aggregate size should be less than $1/3$ of the clearance between rebar ties. Concrete with a slump of 4 to 6 inches is recommended.
6. A minimum 12-inch continuous void beneath all grade beams and foundations walls supported on piers is recommended to concentrate dead loads and to minimize potential uplift pressures.
7. Pier installation should be observed by competent personnel to assure that adequate bearing is achieved, cleanout is performed, and the re-bar cage is properly placed.
8. Mushrooming or enlargement at the top of piers should be avoided during pier drilling and subsequent construction operations.
9. Concrete should be continuously poured to the bottom of the grade beams such that construction joints are not formed.
10. Ensure that exterior concrete elements are not placed beneath protruding components of the building that may limit free vertical movement of the concrete element.

5.2 DRILLED PIERS WITH A SUSPENDED SLAB

The building perimeter would be installed as previously indicated, however, the floor would consist of a post-tensioned or other structural slab and would also be established on drilled piers. Significant loads would be carried on piers, which may require larger diameters and/or deeper piers. Additional analyses can be performed once exact loads are determined. A minimum 12-inch continuous void beneath all grade beams, suspended slab, and foundations walls supported on piers is recommended to minimize potential uplift pressures due to swell of underlying clay.

With this option excavation would generally be limited to removing material to achieve desired pad elevations, removal of any cobbles that would impede drilling, and to allow for the required void space. Pier design and recommendations would generally follow the parameters previously provided. As with the previous pier option exterior concrete elements should not be placed beneath protruding components of the building that may limit free vertical movement of the concrete elements that are not supported on piers.

5.3 CONVENTIONAL FOUNDATION SYSTEMS

Typically, if there is a +17 feet separation between building foundations and the underlying clay, the potential of saturating the clay due to vertical migration of precipitation or irrigation water through suitable soils into the clay is low. We recommend deep foundation options, as they provide the greatest protection against swell. However, overexcavation and replacement may be a viable option if strict moisture control is implemented and the owner is willing to assume the risk that excessive differential movement will occur if the underlying clay becomes saturated. At a minimum, clays should be overexcavated to allow for a separation of at least 8 feet between the footings and floor slabs and the underlying clay. Overexcavated soils should be replaced with structural fill. Clays underlying the site were generally dry and swell will occur if the clays become saturated. The building type, the owner's risk tolerance, and construction costs should be considered when selecting this option. Strict moisture control recommendations should be followed to minimize the potential for saturation of clays. The following table presents estimates of swell with corresponding overexcavation depths.

Overexcavation Depth (ft.)	Potential Swell (in.)
8	4.4
10	3.4
12	2.5
14	1.5
16	0.5
17	0.0

Structural fill should be placed following the recommendations outlined in section 6 of this report. The foundation recommendations presented below should be followed for structurally loaded elements.

1. Foundations established on a minimum of 8.0 feet of imported, structural fill may be designed for a maximum allowable soil bearing pressure of 2,000 pounds per square foot based upon dead load plus long term live load. A one-third increase in allowable bearing pressure may be used for short term transient loads such as wind and seismic events. The bearing capacity may be increased by 500 psf for each additional foot of footing width or depth up to a maximum value of 3,000 psf.
2. The minimum recommended footing width for continuous footings is 24 inches and a minimum width of 24 inches is also recommended for isolated spread footings.

3. Footings should be established at least 12 inches below the lowest adjacent final grade for confinement purposes.
4. For buildings areas overexcavation, moisture conditioning, and compaction should extend laterally a minimum of 5 feet beyond the building perimeter in each direction. For exterior concrete flatwork and asphalt pavements, the soil preparation should extend laterally a minimum of 2 feet beyond the pavement or flatwork perimeter.
5. Lateral loads imposed on foundations may be resisted by the development of passive earth pressures against the sides of footings and friction between the base of the footing and the supporting soils. In determining the frictional resistance a coefficient of friction of 0.36 should be used between supporting granular soils and foundation concrete. Passive resistance may be calculated using a coefficient of 2.7 and a unit weight of 125 pcf for an equivalent fluid weight of 338 pcf.

6.0 SITE GRADING AND EARTHWORK

6.1 REMOVALS AND SUBGRADE PREPARATION

Preparation of the site for construction should include the removal of existing vegetation, undocumented fill, any debris and other deleterious materials from beneath structurally loaded elements (i.e. conventional footings, slabs-on-grade, parking areas, and concrete flatwork).

We recommend overexcavation of at least 8.0 feet of soils for the conventional footing option and a minimum of 9 feet for drilled piers with a floating floor. Granular on-site soils (silty sand and gravel) are suitable for use as structural fill provided that all organics, oversized material greater than 6-inches in size, and other deleterious materials are removed. However, very little granular material was noted at the site and large quantities of imported structural fill should be anticipated, particularly for the overexcavated building pad option. Excavated clay can be processed and blended with suitable on-site sand or imported structural fill and utilized to backfill the lower portion of excavated areas. Clay should comprise 30% or less of the blended total. For fill consistency and ease of construction, it is recommended that the clay be removed from the site and replaced with low permeable imported fill, as recommended in section 6.2 of this report. Following removal of the clayey material and prior to fill placement, the exposed subgrade should be scarified to a depth of 8-inches, moisture conditioned to at least +4% above the optimum moisture content, and compacted to 90% of the maximum dry density as determined by ASTM D-1557. If dense cobble or

competent claystone or sandstone is encountered in the bottom of the excavation, scarification will not be required. Structural fill can then be placed on the prepared subgrade.

In paved areas and beneath exterior concrete flatwork where near-surface clay is encountered, expansive clay should be removed from within 2.0 feet of pavement and concrete flatwork. Excavated clay can be blended with imported structural fill and utilized to backfill the excavated pavement and flatwork areas. Clay should comprise 30% or less of the blended total. It should be noted that movement will occur if moisture variation occurs in the underlying clays. Additional overexcavation to depths greater than 2.0 feet will provide greater protection against clay expansion.

6.2 FILL PLACEMENT AND COMPACTION

Following removals and subgrade preparation as described above, structural fill should be placed in accordance with the following recommendations. The on-site silty sand and gravel may be stockpiled and used for structural fill, provided cobbles are removed.

Imported structural fill should consist of relatively impervious granular soils that contain 15-30% fines (percent passing the No. 200 sieve) and the fines should have a liquid limit of 30% or less and a plasticity index less than 9. Structural fill should be placed in maximum 8-inch thick loose lifts at a moisture content within 2 percent of the optimum moisture content and compacted to 95% of the maximum dry density as determined by ASTM D-1557. Material not meeting the above requirements may be suitable for use as structural fill at the discretion of the geotechnical engineer. Samples of import material should be submitted to the geotechnical engineer for testing prior to transporting to the site.

Scarified subgrade soils and each eight-inch lift of structural fill material placed at the site should be tested for compliance with the required relative compaction and moisture content prior to proceeding with additional lifts.

7.0 FLOOR SLABS

If the overexcavation and replacement option is chosen, we recommend that floor slabs be established on a pad that has been improved as indicated in sections 5 and 6. If the pier option is chosen, we recommend a minimum of 9 feet of overexcavation.

A minimum four-inch thick layer of free-draining gravel (containing less than 5% fine grained material passing the #200 sieve), should be placed immediately below the floor slabs to help distribute floor loads, break the rise of capillary water, and aid in the concrete curing process. The gravel should be adequately consolidated and placed directly below the floor slab. Alternatively, floor slabs may be established on a minimum of 6-inches of minus 1.5 inch road base.

Concrete placement and curing should meet ACI⁴ requirements including following hot weather placement recommendations, when appropriate. A vapor barrier should be placed beneath the slab if a moisture-sensitive floor covering will be installed. The moisture sensitivity of floor finishes, anticipated project conditions and the potential effects of slab curling and cracking should be considered in determining if the barrier should be placed directly beneath the slab or beneath the free-draining gravel (see ACI 302.1R-96 for more information regarding vapor barrier location). If the moisture barrier is installed directly beneath the slab, measures should be taken to minimize excessive slab curl such as reduced joint spacing and use of a low shrinkage (low water-cement ratio) mix.

8.0 LATERAL EARTH PRESSURES

We do not recommend using clay soil for wall backfill. Lateral loads imposed on footings may be resisted by the development of passive earth pressures against the sides of footings and friction between the base of the footing and the supporting soils. Lateral earth pressure values typical of imported structural fill are presented in the following table.

⁴

American Concrete Institute

Case Evaluated	Soil Type	Value
Active	Granular (import)	37 psf/ft
		55 psf/ft (with seismic)
At-Rest	Granular (import)	57 psf/ft
Passive	Granular (import)	460 psf/ft
		404 psf/ft (with seismic)
Coefficient of friction $\tan(\phi \times 0.6)$, where $\phi = 34^\circ$	Granular (import)	0.37

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

9.0 CUT AND FILL SLOPES

Development to the north of the site has cut into the toe of the landslide material. Removal of the toe and the introduction of significant moisture due to irrigation has resulted in slope instability in areas north of the site. Substantial cuts have previously been made into the landslide slope during construction of Black Ridge Drive. Existing slopes of the landslide material generally vary from about one vertical to horizontal (1V:2 H) to one vertical to four horizontal (1V:4H). Significant elevation changes are present at the site and we recommend that overall slope configurations be similar to the existing slopes. We recommend limiting cuts at the site and limiting maximum wall heights to 8.0 feet. Permanent slopes within the clays at the north side of the site should be maintained at one vertical to three horizontal (1V:3H) or flatter. It is recommended

that cut and fill slopes in soil elsewhere at the site be maintained at a slope of one vertical to two horizontal (1V:2H) or flatter unless structurally retained. If structurally retained, retaining structures should be limited to 8 feet and the overall slope should not be steeper than one vertical to two horizontal (1V:2H). Grading of both cut and fill slopes should be such that surface water is directed away from the slopes and not concentrated on slopes or in unprotected channels. All excavations should conform to OSHA standards.

10.0 MOISTURE CONTROL

Wetting of the foundation soils may cause a volume change within the soil and should be prevented both during and after construction. If relatively shallow overexcavation options are selected then measures to minimize potential moisture infiltration such as installation of impervious barriers, extending asphalt or concrete to the perimeter walls, and/or constructing pockets of landscaping that are downgradient of all structures should be considered. Due to the expansive nature of soils at the site, it is recommended that the following general precautions be taken to minimize the potential for soil saturation beneath structural elements.

- (1) The ground surface should be graded to drain surface water away from the buildings in all directions. A minimum grade of 5% (IBC 1803.3) in the first 10 feet is recommended. Impervious surfaces such as asphalt or concrete within 10 feet of the building foundations should be sloped a minimum of 2% away from the structures.
- (2) Xeriscape (landscaping that eliminates the need for supplemental irrigation of plants) is recommended within 5 feet of the building foundations. Bubblers, although more efficient than sprinkler irrigation, still have a significant potential of introducing excessive water into the ground and saturating foundation soils. Bubblers are not recommended in the 5 feet buffer zone area. Sealed planter boxes should be considered if landscaping is required.
- (3) Grass should not be used at this site.
- (4) Inadequate compaction of foundation backfill and utility trench backfill provides a conduit for water migration. All utility trenches within the building footprints and extending 5 feet beyond the footprints should be backfilled with structural fill similar to that approved for the foundations. Backfill adjacent to structures should be compacted to at least 90 percent of the maximum dry density as determined by ASTM D-1557 and the minimum slope requirements should be followed. Backfill beneath structures and pavements should be compacted to at least 95% of the maximum dry density.

-
- (5) Consideration should be given to installing rain-gutters and downspouts and discharging collected water well outside of the foundation backfill limits. We recommend that runoff be piped downgradient of all structures to an approved storm-drain system.
 - (6) Drains within the building should be constructed to allow for movement of the floor slab.
 - (7) Water from upgradient sources should be channeled around the buildings.

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

11.0 SOIL CORROSIVITY

Based on laboratory tests, site soils have a water soluble sulfate content of 0.06% and classify as having severe sulfate exposure. We recommend that concrete mixes in contact with site soils be designed in accordance with ACI 318, Section 4.3 for severe sulfate exposure. This includes 4,500 psi concrete and a low water to cement ratio. Sulfate-resistant CMU block is recommended for privacy walls at the project. Buried pipes should be plastic (PVC or HDPE) instead of metal, where possible.

12.0 PAVEMENTS

Design of roadways within the project is based on the procedures outlined in the 1993 Guidelines for Design of Pavement Structures by the American Association of State Highway and Transportation Officials (AASHTO). For traffic loading we assumed a traffic index of 5.5 for site access roads, which reflects traffic for a roadway classified as a residential collector and a traffic index of 5.0 for parking lots.

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

- ▶ Pavement Design Life - 20 years
- ▶ Subgrade CBR Value - 2 (from lab test)

► Structural Layer Coefficients

- Asphalt = 0.42

- Type II = 0.12

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

	Asphalt Thickness (inches)	Type II Base Course (inches)	Subbase (inches)	Scarified and Compacted Subgrade (in)
Access Roads	3.0	8.0	16.0	8.0
Parking Lot	3.0	8.0	10.0*	8.0

*The above recommended parking lot section is based on the CBR value and assumed traffic loading, but does not provide the recommended 2.0 feet of separation between asphalt and underlying clays. The pavement sections listed above are adequate for the anticipated traffic loading. However, saturation of the underlying clays will cause heave that could adversely affect the parking lot. Greater separation between paved surfaces and the underlying clay will decrease the likelihood of differential movement within the pavement section. Pavement maintenance, such as regular crack sealing, will also prolong the life of the pavement section and reduce the potential for subsurface moisture.

Subbase should consist of imported, granular, structural fill meeting St. George City requirements. The upper 8-inches of clayey on-site soils should be scarified to a depth of 8-inches, moisture conditioned to between optimum and 4% above the optimum moisture content, and compacted to 90% of the maximum dry density as determined by ASTM D-1557. Silty or granular subgrade, where encountered, should be moisture conditioned to within 2% of the optimum moisture content and compacted to a minimum of 90% of the maximum dry density as determined by ASTM-D 1557. Compacted subgrade should extend at least two feet beyond the pavement limits. Trafficking upon and compaction of fine-grained, on-site soils will be extremely difficult during periods of wet weather when the subgrade becomes wet. If excessive rutting occurs, a stabilizing geogrid may be required to allow for access by construction vehicles.

Recompacted subbase and base course soils should be compacted to a minimum of 95% of the maximum

dry density (ASTM D-1557). Asphalt should be compacted to at least 96% of the Marshall maximum density. Asphaltic concrete and aggregate base should conform with mix and placement specifications of St. George City. Asphaltic concrete and base should be tested prior to site delivery and during placement for conformance with project specifications.

13.0 FOUNDATION REVIEW AND TESTING

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

14.0 LIMITATIONS

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

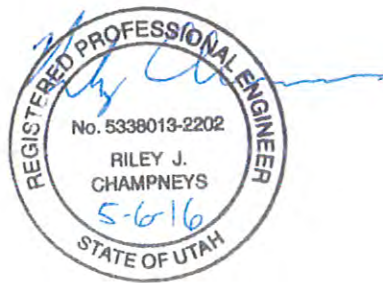
This report has been prepared to assist in project design and construction. We respectfully request the opportunity to review the final design drawings and specifications in order to determine whether the assumptions and recommendations presented herein are applicable to the anticipated designs.

This report is not intended to be used as a bid document. Any information concerning the environmental

conditions of the site is beyond the scope of this geotechnical study. This geotechnical report has been prepared to meet the specific needs of our client and may not be appropriate to satisfy the needs of other users.

LANDMARK TESTING & ENGINEERING

Riley Champneys, P.E.

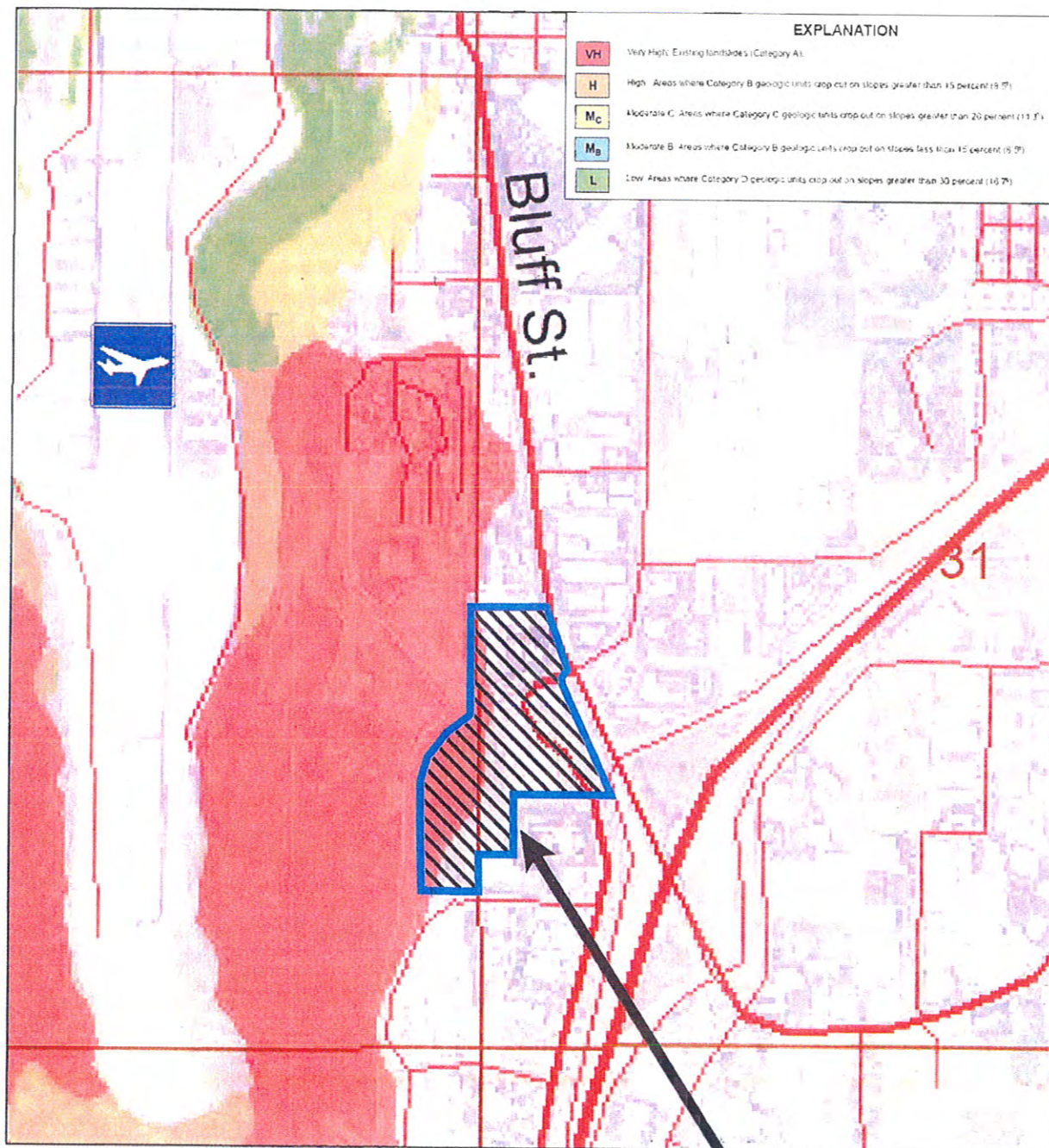


Reviewed by:

A handwritten signature in blue ink, appearing to read "Russell Owens", written over the printed name.

Russell Owens, P.E.

Geotechnical Manager



Project
Site

Adapted from Plate 4 - Landslide-Hazard Map for the
St. George-Hurricane Metropolitan Area



VICINITY/LANDSLIDE MAP
LANDMARK PROJECT 16110

Figure 1

LABORATORY RESULTS										SAMPLE DATA			TP-1	
DEPTH (FEET)	PERCENT GRAVEL	PERCENT SAND	PERCENT FINES	LIQUID LIMIT	PLASTICITY INDEX	MOISTURE CONTENT %	WATER SOLUBLE SOLIDS % SWELL AT 5000 PSI	SAMPLE DEPTH (FT)	SAMPLE NUMBER	SAMPLE TYPE	LITHOLOGY	USCS	FIELD DATE: March 16, 2016	SURFACE ELEVATION:
													DESCRIPTION	
0											SM-GM FILL		SILTY SAND GRAVEL (SM-GM), reddish brown, medium dense, occasional cobbles, occasional concrete debris, fill	
5				43	19		139	3.0	1	⊗	CL		LEAN CLAY (CL), reddish brown, moist, some gypsum crystals	
10	64	26				6.7		7.5	2	⊗	SM		SILTY SAND (SM), brown, medium dense, occasional small gravel, moist	
10													Grades with small cobbles.	
													Grades hard to excavate	
													Complete to 11.0 feet. Groundwater not encountered	

COMMERCE POINTE
Landmark Project # 16110

TEST PIT LOG

LANDMARK TESTING & ENGINEERING
795 E. Factory Drive, St. George, UT 84790

KEY

- Relatively undisturbed sample obtained by
- Hand
- Hand Driven Shelby Tube Sample
- Bulk Sample
- Sampling attempt with no recovery
- Groundwater depth at time of excavation

LABORATORY RESULTS										SAMPLE DATA			TP-2	
DEPTH (FT)	PERCENT GRAVEL	PERCENT SAND	PERCENT FINES	LIQUID LIMIT	PLASTICITY INDEX	MOISTURE CONTENT %	IN-PLACE DRY DENSITY (PCF)	% SWELL AT 1,000 PSF	SAMPLE DEPTH (FT)	SAMPLE NUMBER	SAMPLE TYPE	LITHOLOGY	USCS	FIELD DATE: March 16, 2016
														SURFACE ELEVATION:
														DESCRIPTION
0													CL	LEAN CLAY (CL), reddish brown, gravel at surface, medium stiff to stiff, slightly moist
5														Grades less plastic, with abundant gypsum stringers
10														Grades more plastic, moist to very moist
													CL-CH	LEAN TO FAT CLAY (CL-CH), purple, mottled moist. Complete to 11.0 feet. Groundwater not encountered.

COMMERCE POINTE
Landmark Project # 16110

TEST PIT LOG

LANDMARK TESTING & ENGINEERING

795 E. Factory Drive, St. George, UT 84790

KEY

- Relatively undisturbed sample obtained by hand
- Hand Driven Shelby Tube Sample
- Bulk Sample
- Sampling stringer with no recovery
- Groundwater depth at time of excavation

FIGURE 3

LABORATORY RESULTS										SAMPLE DATA			TP-3	
DEPTH (FT)	PERCENT GRAVEL	PERCENT SAND	PERCENT FINES	LIQUID LIMIT	PLASTICITY INDEX	MOISTURE CONTENT %	IN-PLACE DRY DENSITY (PCF)	% SWELL AT 500 PSF	SAMPLE DEPTH (FT)	SAMPLE NUMBER	SAMPLE TYPE	LITHOLOGY	USCS	FIELD DATE: March 16, 2016
														SURFACE ELEVATION:
														DESCRIPTION
0	9	25	66	45	28	11.4			0.5-1.5	1	⊗		GM CL-CH	SILTY GRAVEL (GM) LEAN TO FAT CLAY (CL-CH), reddish brown, stiff, slightly moist
5													ML	SANDY SILT (ML), brown, occasional basalt cobbles, sandy intervals, gypsiferous
10														Grades light brown, sandy
														Complete to 12.0 feet - Groundwater not encountered
COMMERCE POINTE Landmark Project # 16110 TEST PIT LOG LANDMARK TESTING & ENGINEERING 795 E. Factory Drive, St. George, UT 84790													KEY  Relatively undisturbed sample obtained by hand  Hand Driven Shelby Tube Sample  Bulk Sample  Sampling attempt with no recovery  Groundwater depth at time of excavation	

LABORATORY RESULTS										SAMPLE DATA			TP-4	
DEPTH (FT)	PERCENT GRAVEL	PERCENT SAND	PERCENT FINES	LIQUID LIMIT	PLASTICITY INDEX	MOISTURE CONTENT %	IN-PLACE DRY DENSITY (PCF)	% SWELL AT 500 PSF	SAMPLE DEPTH (FT)	SAMPLE NUMBER	SAMPLE TYPE	LITHOLOGY	USCS	FIELD DATE: March 16, 2016
														SURFACE ELEVATION:
														DESCRIPTION
0													CL-CH	LEAN TO FAT CLAY (CL-CH), reddish brown, occasional basalt cobbles, moist
5														Grades with basalt boulders, hard to excavate, slightly moist, gypsiferous.
														Grades with fewer cobbles/boulders.
														Grades less plastic, stiff to very stiff, dry to slightly moist.
														Grades purple, mantled.
10														Complete to 7.0 feet - Groundwater not encountered.
COMMERCE POINTE Landmark Project # 16110 TEST PIT LOG LANDMARK TESTING & ENGINEERING 795 E. Factory Drive, St. George, UT 84790													KEY  Relatively undisturbed sample obtained by hand  Hand Driven Shelby Tube Sample  Bulk Sample  Sampling attempt with no recovery  Groundwater depth at time of excavation	

FIGURE 4

LABORATORY RESULTS										SAMPLE DATA				TP-7	
DEPTH (FT)	PERCENT GRAVEL	PERCENT SAND	PERCENT FINES	LIQUID LIMIT	PLASTICITY INDEX	MOISTURE CONTENT %	IN-PLACE DRY DENSITY (PCF)	% SWELL AT 500 PSF	SAMPLE DEPTH (FT)	SAMPLE NUMBER	SAMPLE TYPE	LITHOLOGY	USCS	FIELD DATE: March 16, 2016	
														SURFACE ELEVATION:	
DESCRIPTION															
0													CL	LEAN CLAY (CL), reddish brown	
0	0	21	79	48	31	9.1			2.0	1	⊗		SM-SF	SILTY POORLY-GRADED SAND (SM-SF), light brown, coarse, slightly cemented, dry. Grades well cemented. Grades hard to excavate. Practical refusal at 7.0 feet in sandstone. Groundwater not encountered.	
5															
10															
COMMERCE POINTE Landmark Project # 16110 TEST PIT LOG <u>LANDMARK TESTING & ENGINEERING</u> 795 E. Factory Drive, St. George, UT 84790															
KEY ☐ Relatively undisturbed sample obtained by hand ● Hand Driven Shelby Tube Sample ⊗ Bulk Sample ○ Sampling attempt with no recovery ▽ Groundwater depth at time of excavation															

LABORATORY RESULTS										SAMPLE DATA				TP-8	
DEPTH (FT)	PERCENT GRAVEL	PERCENT SAND	PERCENT FINES	LIQUID LIMIT	PLASTICITY INDEX	MOISTURE CONTENT %	IN-PLACE DRY DENSITY (PCF)	% SWELL AT 500 PSF	SAMPLE DEPTH (FT)	SAMPLE NUMBER	SAMPLE TYPE	LITHOLOGY	USCS	FIELD DATE: March 16, 2016	
														SURFACE ELEVATION:	
														DESCRIPTION	
0															
0	0	13	87	45	19	11.3			3.0	1	⊗		CL-CH	LEAN TO FAT CLAY (CL-CH), reddish brown, stiff, blocky, slightly moist. Grades less blocky. Grades pale purple gray. Complete to 7.0 feet. Groundwater not encountered.	
5															
10															

COMMERCE POINTE

Landmark Project # 16110

TEST PIT LOG

LANDMARK TESTING & ENGINEERING

795 E. Factory Drive St. George, UT 84790

KEY

☐

Relatively undisturbed sample obtained by hand.

●

Hand Driven Shelby Tube Sample

⊗

Bulk Sample

○

Sampling attempt with no recovery.

▽

Groundwater depth at time of excavation.

FIGURE 6

DEPTH (FT)	LABORATORY RESULTS								SAMPLE DATA				TP-9		
	PERCENT GRAVEL	PERCENT SAND	PERCENT FINES	LIQUID LIMIT	PLASTICITY INDEX	MOISTURE CONTENT %	IN-PLACE DRY DENSITY (PCF)	% SWELL AT 500 PSF	SAMPLE DEPTH (FT)	SAMPLE NUMBER	SAMPLE TYPE	LITHOLOGY	USCS	FIELD DATE: March 16, 2016	SURFACE ELEVATION:
														DESCRIPTION	
0															

LABORATORY RESULTS										SAMPLE DATA				TP-10	
DEPTH (FT)	PERCENT GRAVEL	PERCENT SAND	PERCENT FINES	LIQUID LIMIT	PLASTICITY INDEX	MOISTURE CONTENT %	IN-PLACE DRY DENSITY (PCF)	% SWELL AT 500 PSF	SAMPLE DEPTH (FT)	SAMPLE NUMBER	SAMPLE TYPE	LITHOLOGY	USCS	FIELD DATE: March 16, 2016	
														SURFACE ELEVATION:	
DESCRIPTION															
0													CL CL-CH	LEAN CLAY (CL), reddish brown, basalt cobbles and boulders at the surface. LEAN TO FAT CLAY (CL-CH), reddish brown/purple, dense, dry.	
5				48	18	9.9	112.6	4.7	4.0	1	X			Grades gray, breaks into 1/2 to 1" fragments, occasional gypsum crystals.	
10									7.5	2	X			Complete to 3.0 feet. Groundwater not encountered.	

COMMERCE POINTE Landmark Project # 16110 TEST PIT LOG LANDMARK TESTING & ENGINEERING 795 E. Factory Drive, St. George, UT 84790		KEY Relatively undisturbed sample obtained by hand Hand Driven Shelby Tube Sample Bulk Sample Sampling attempt with no recovery Groundwater depth at time of excavation
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FIGURE 7

LABORATORY RESULTS									SAMPLE DATA				TP-12			
DEPTH (FT)	PERCENT GRAVEL	PERCENT SAND	PERCENT FINES	LIQUID LIMIT	CBR	MOISTURE CONTENT %	IN-PLACU DRY DENSITY (PCF)	% SWELL AT 500 PSF	SAMPLE DEPTH (FT)	SAMPLE NUMBER	SAMPLE TYPE	LITHOLOGY	USCS	FIELD DATE: March 16, 2016		
														SURFACE ELEVATION:		
														DESCRIPTION		
0	3	13	84		2	17.2			0-1.5	1	X		CL	LEAN CLAY (CL), reddish brown/purple moist.		
																Grades very moist, occasional basalt cobbles.
						18.7	106.1	3.3	3.0	2				X		Grades dark reddish brown.
5														Grades very moist.		
10														Complete to 10.0 feet. Groundwater not encountered.		

COMMERCE POINTE

Landmark Project # 16110

TEST PIT LOG

LANDMARK TESTING & ENGINEERING

795 E. Factory Drive, St. George, UT 84790

KEY

Relatively undisturbed sample obtained by hand

Hand Driven Shelby Tube Sample

Bulk Sample

Sampling attempt with no recovery

Groundwater depth at time of excavation

DEPTH (FT)	LABORATORY RESULTS							SAMPLE DATA				TP-13	
	PERCENT GRAVEL	PERCENT SAND	PERCENT FINES	LIQUID LIMIT	PLASTICITY INDEX	MOISTURE CONTENT %	IN-PLACE DRY DENSITY (PCF)	% SWELL AT 500 PSF	SAMPLE DEPTH (FT)	SAMPLE NUMBER	SAMPLE TYPE	LITHOLOGY	USCS
0													FIELD DATE: March 16, 2016
													SURFACE ELEVATION:
													DESCRIPTION
						9.2	102.2	4.8	3.0	1	⊗		LEAN CLAY (CL), dark reddish brown purple, mottles, occasional basalt boulders, moist.
													Grades predominantly reddish brown.
													Grades very moist.
													Grades purple.
10													Complete to 10.0 feet. Groundwater not encountered.
COMMERCE POINTE Landmark Project # 16110 TEST PIT LOG LANDMARK TESTING & ENGINEERING 795 E. Factory Drive, St. George, UT 84790												KEY Relatively undisturbed sample obtained by hand Hand Driven Shelby Tube Sample Bulk Sample Sampling attempt with no recovery Groundwater depth at time of excavation	

DEPTH (FT)	LABORATORY RESULTS							SAMPLE DATA				TP-14	
	PERCENT GRAVEL	PERCENT SAND	PERCENT FINES	LIQUID LIMIT	PLASTICITY INDEX	MOISTURE CONTENT %	IN-PLACE DRY DENSITY (PCF)	% SWELL AT 500 PSF	SAMPLE DEPTH (FT)	SAMPLE NUMBER	SAMPLE TYPE	LITHOLOGY	USCS
0													FIELD DATE: March 16, 2016
													SURFACE ELEVATION:
													DESCRIPTION
													SILTY SAND/SANDY SILT (SM-MI), reddish brown, occasional basalt cobbles
				43	28				3.0	1	⊗		LEAN CLAY (CL), dark brown, blocky, abundant basalt cobbles, mottles.
													LEAN TO FAT CLAY (CL-CH), dark purple.
10													Complete to 7.0 feet. Groundwater not encountered.
COMMERCE POINTE Landmark Project # 16110 TEST PIT LOG LANDMARK TESTING & ENGINEERING 795 E. Factory Drive, St. George, UT 84790												KEY Relatively undisturbed sample obtained by hand Hand Driven Shelby Tube Sample Bulk Sample Sampling attempt with no recovery Groundwater depth at time of excavation	

FIGURE 9

UNIFIED SOIL CLASSIFICATION SYSTEM				
MAJOR DIVISIONS		SYMBOL		TYPICAL NAMES
COARSE-GRAINED SOILS (More than 1/2 of soil > No. 200 sieve size)	GRAVELS (More than 1/2 of coarse fraction > No. 4 sieve size)	GW	Well graded gravels or gravel-sand mixtures little or no fines	
		GP	Poorly graded gravels or gravel-sand mixtures, little or no fines	
		GM	Silty gravels, gravel-sand-silt mixtures	
		GC	Clayey gravels, gravel-sand-clay mixtures	
	SANDS (More than 1/2 of coarse fraction < No. 4 sieve size)	SW	Well graded sands or gravelly sands, little or no fines	
		SP	Poorly graded sands or gravelly sands, little or no fines	
		SM	Silty sands, sand-silt mixtures	
		SC	Clayey sands, sand-clay mixtures	
FINE-GRAINED SOILS (More than 1/2 of soil < No. 200 sieve size)	SILTS & CLAYS Liquid Limit <50	ML	Inorganic silts and very fine sands, rock flour, silty fine sands or clayey silts with slight plasticity	
		CL	Inorganic clays of low to medium plasticity, gravelly clays, sandys clays, silty clays, lean clays	
		OL	Organic silts and organic silty clays of low plasticity	
	SILTS & CLAYS Liquid Limit >50	MH	Inorganic silts, micaceous or diatomaceous fine sand or silty soils, elastic silts	
		CH	Inorganic clays of high plasticity, fat clays	
		OH	Organic clays of medium to high plasticity, organic silty clays, organic silts	
HIGHLY ORGANIC SOILS		PT	Peat and other highly organic soils	
GRAIN SIZE CHART			Hardness of Rock	
CLASSIFICATION	RANGE OF GRAIN SIZE		Descriptive Term	Characteristics
	U.S. Standard Sieve Size	Grain Size in Millimeters		
BOULDERS	Above 12"	Above 305	Moderately Hard	Can be scratched with a knife with light to moderate pressure; breaks with moderate hammer blow
COBBLES	12" to 3"	305 to 76.2	Hard	Can be scratched with a knife with difficulty; can be broken with heavy hammer blow
GRAVEL	3" to No. 4	76.2 to 4.76		
Coarse	3" to 3/4"	76.2 to 19.1		
Fine	3/4" to No. 4	19.1 to 4.76	Very Hard	Cannot be scratched with a knife; can only be broken with repeated heavy hammer blows.
SAND	No. 4 to No. 200	4.76 to 0.074		
Coarse	No. 4 to No. 10	4.76 to 2.00		
Medium	No. 10 to No. 40	2.00 to 0.420		
Fine	No. 40 to No. 200	0.420 to 0.074		
SILT & CLAY	Below No. 200	Below 0.074		
			SOIL CLASSIFICATION	

FIGURE 10

LANDMARK TESTING AND ENGINEERING

COLLAPSE/SWELL CURVE



FIGURE 11

LANDMARK TESTING AND ENGINEERING

COLLAPSE/SWELL CURVE

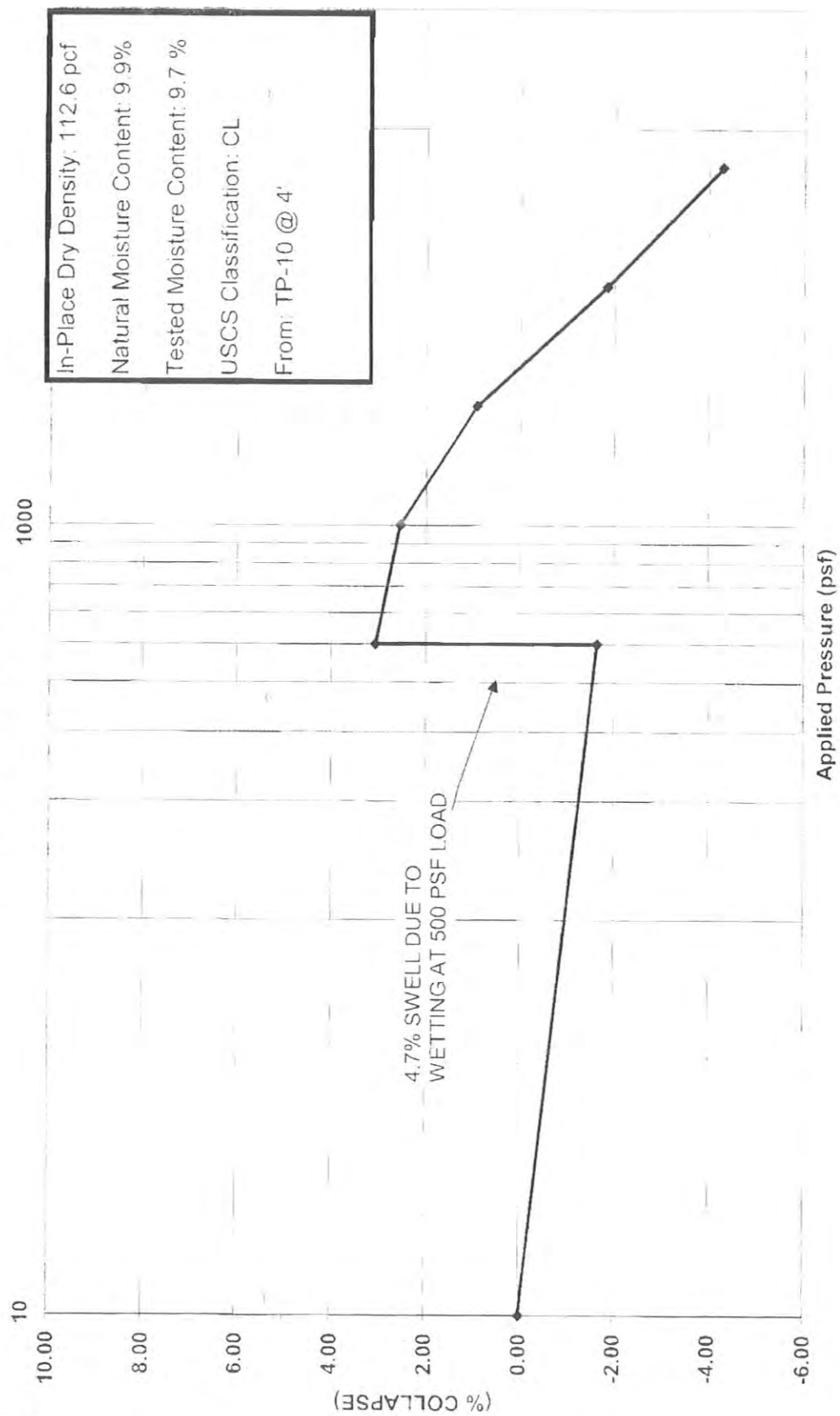


FIGURE 12

LANDMARK TESTING AND ENGINEERING

COLLAPSE/SWELL CURVE

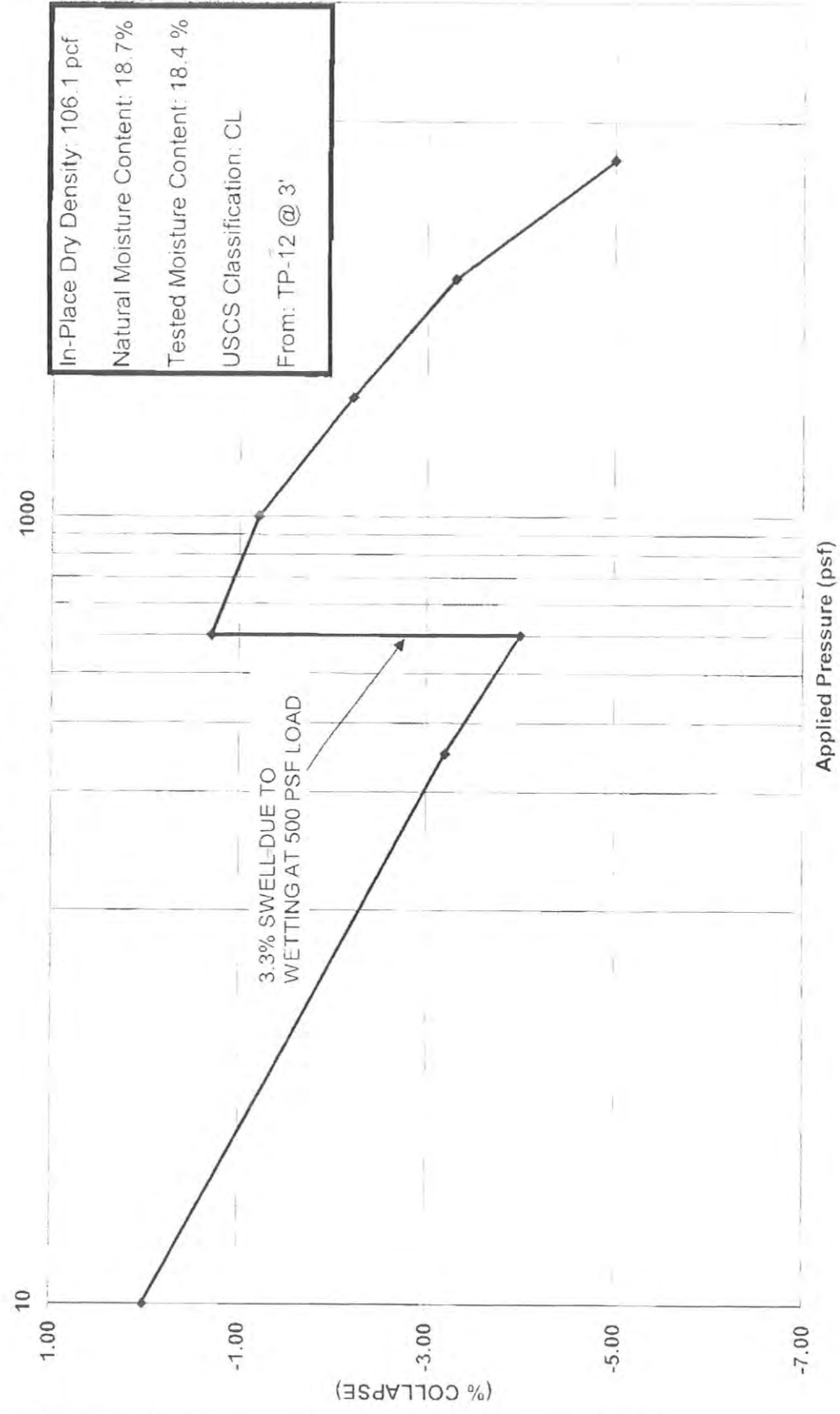


FIGURE 13

LANDMARK TESTING AND ENGINEERING

COLLAPSE/SWELL CURVE

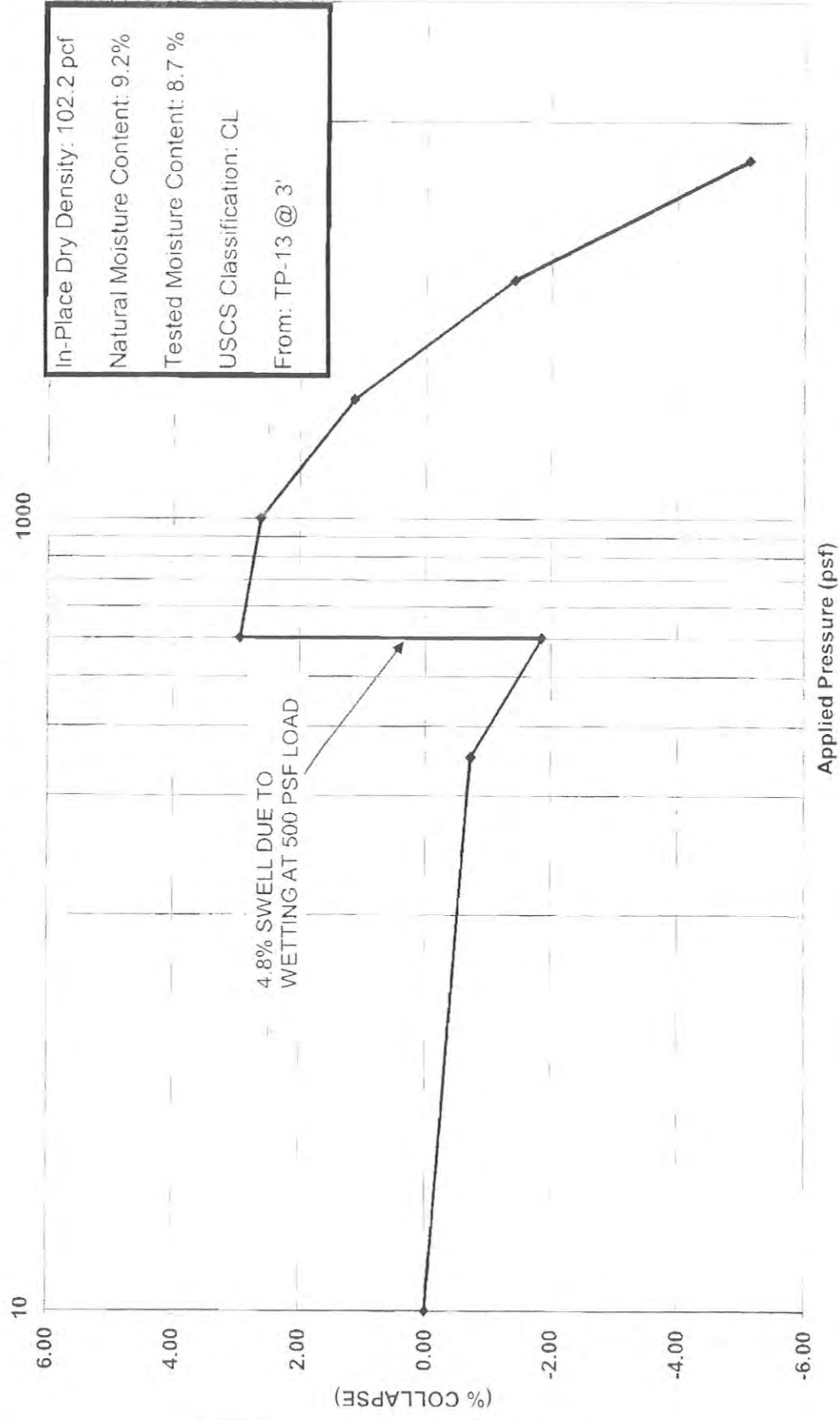


FIGURE 14

TABLE 1
LABORATORY TEST SUMMARY

Project: Commerce Pointe Shopping Center
Client: JMI Development

Project No. 16110

BORING/ TEST PIT NO.	DEPTH BELOW GROUND SURFACE (ft.)	MOISTURE CONTENT (%)	IN-PLACE DRY DENSITY (PCF)	% SWELL at 500 psf	MAX. DRY DENSITY (PCF)	OPTIMUM MOISTURE (%)	CBR (%)	WATER SOLUBLE SULFATES (%)	ATTERBERG LIMITS			MECHANICAL ANALYSIS			USCS GROUP SYMBOL
									LIQUID LIMIT (%)	PLASTICITY INDEX	(%)	GRAVEL (%)	SAND (%)	SILT & CLAY (%)	
TP-1	3.0							1.39	43	19			64	26	CL
	7.5	6.7										10			SM
TP-3	0.5-1.5	11.4							45	28		9	25	66	CL
TP-5	7.0	12.0	111.4	3.7					44	29					CL
TP-6	5.5								43	19					CL
TP-7	2.0	9.3							48	31		0	21	79	CL
TP-8	3.0	11.3							45	19		0	13	87	CL
TP-10	4.0	9.9	112.6	4.7											CL
	7.5								48	18					ML
TP-11	7.5								60	37					CH
TP-12	0-1.5	17.2			111.3	18.4	2.0					3	13	84	CL
	3.0	18.7	106.1	3.3											CL
TP-13	3.0	9.2	102.2	4.8											CL
TP-14	3.0								43	28					CL

Hillside Overlay Amendment

HILLSIDE REVIEW BOARD AGENDA REPORT: 03/23/2022

HILLSIDE OVERLAY AMENDMENT

Middleton Ridge 9-1992

Case No. 2022-HS-009

Request: To amend the hillside overlay map by adding approximately 23 acres to the existing Middleton Ridge hillside overlay.

Background: The Middleton Ridge overlay area was identified as part of the initial hillside overlay ordinance approved in the early 1990's. At that time, there were eight areas (including Middleton Ridge) that were included as areas of special interest to monitor. Middleton Ridge is the smallest of these areas. Through the years of reviews and discussions, staff has identified the subject area as an area that could be included in the hillside overlay due to topography. Staff is proposing that the outlined area be included to the Middleton Ridge overlay area.

Owner: Various owners

Location: The property is generally located north of Red Hills Drive and Middleton Drive and approximately 2200-2300 East.

Acreage: Approximately 23 Acres

Zoning: PD-R (Planned Development Residential), RE-12.5 (Residential Estates, 12,500 square foot minimum lot size), C-2 (Highway Commercial)

General Plan: COM (Commercial), OS (Open Space), LDR (Low Density Residential)

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).

HSRB Motion Options: The Hillside Review 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.

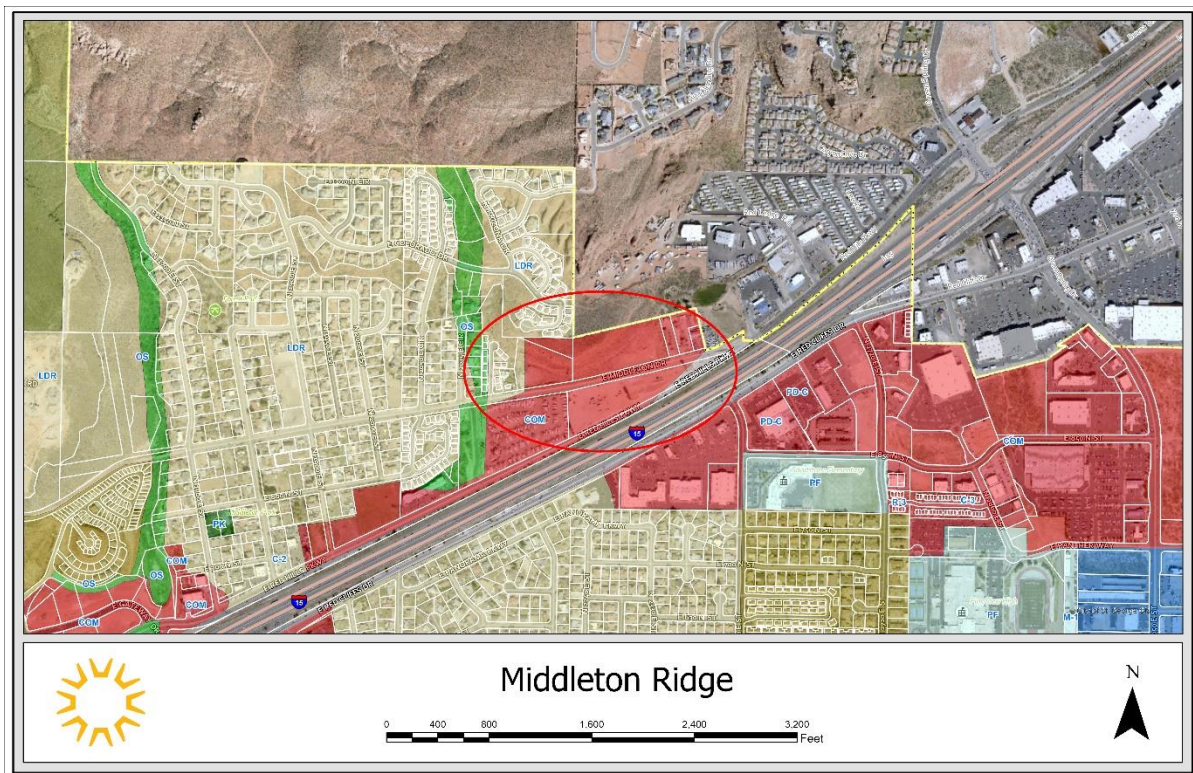
Example Motion: The hillside board recommends _____ of the request for an amendment to the hillside overlay map as outlined the staff report and has the following comments:

1. _____
2. _____
3. _____

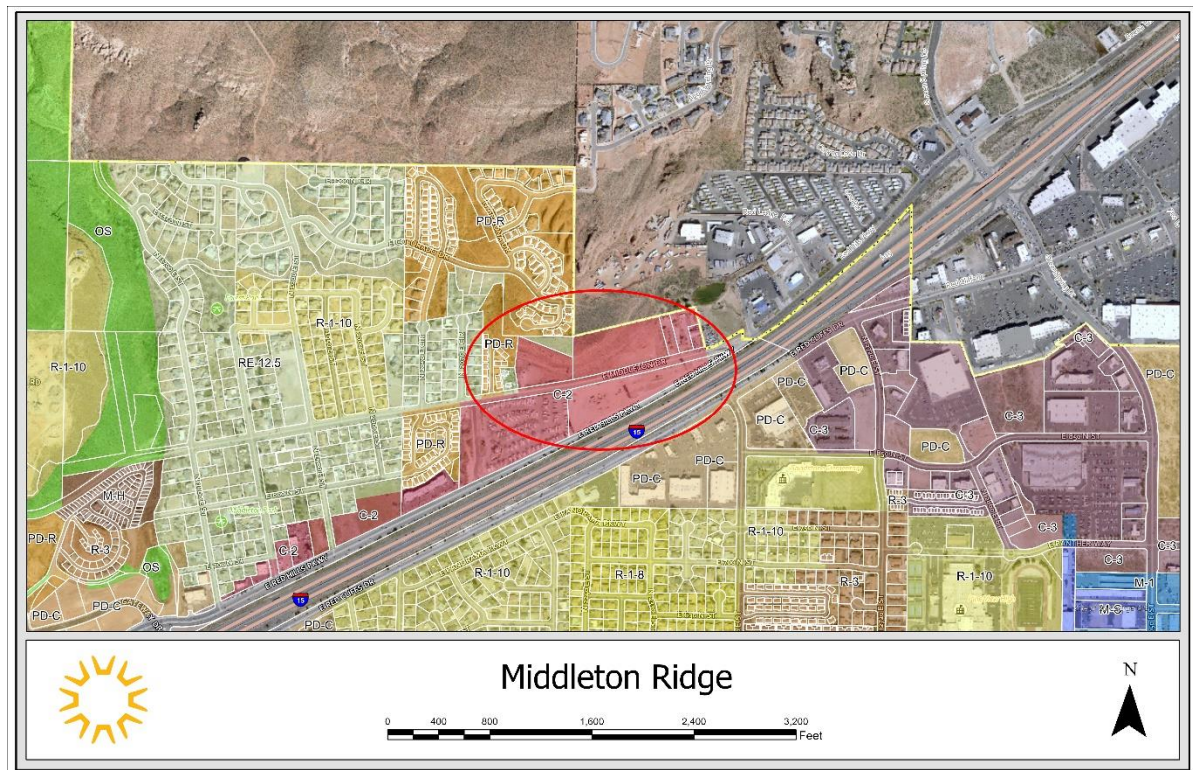
Vicinity Map



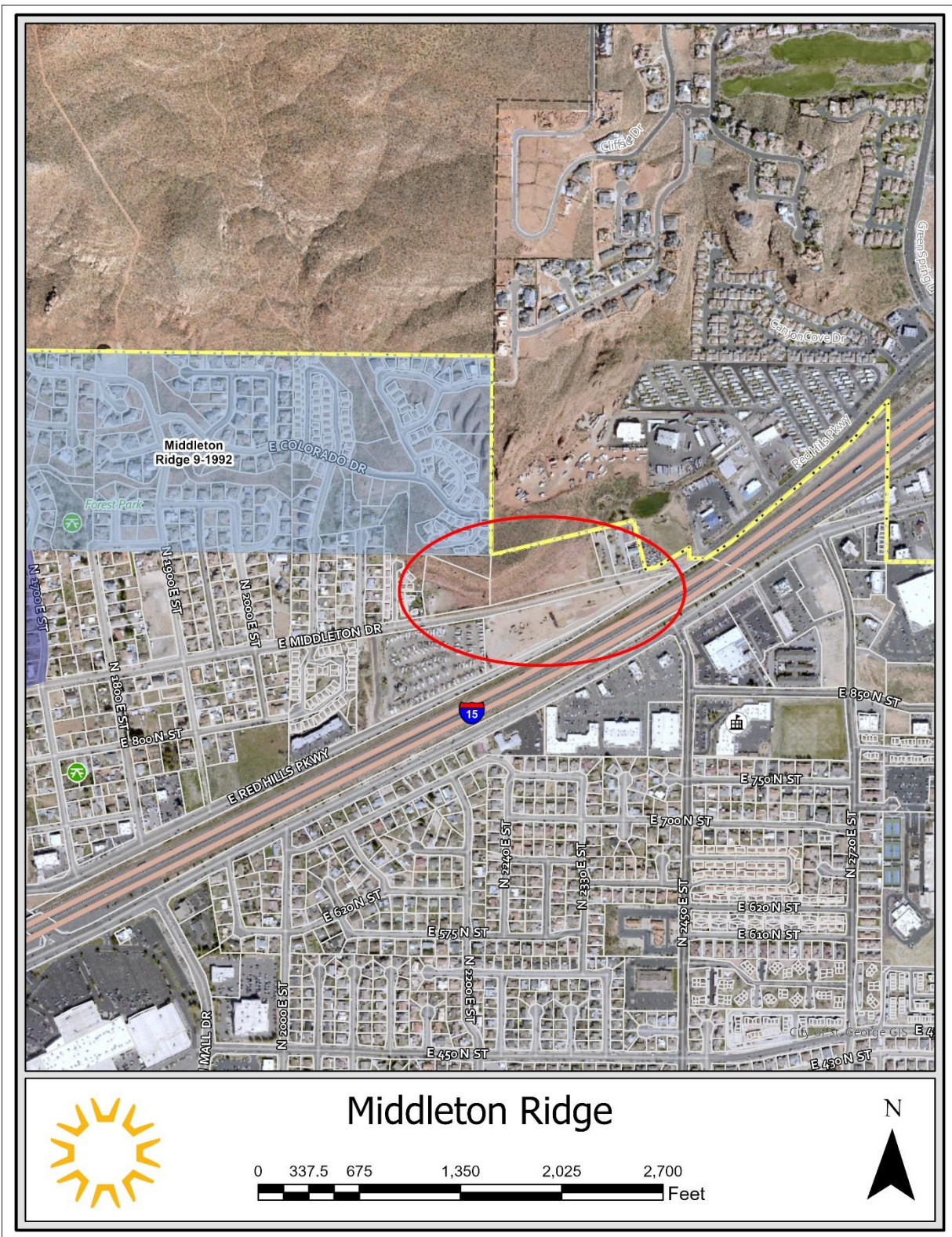
General Plan = LDR/OS/COM



Zoning = C-2, RE-12.5, PD-R



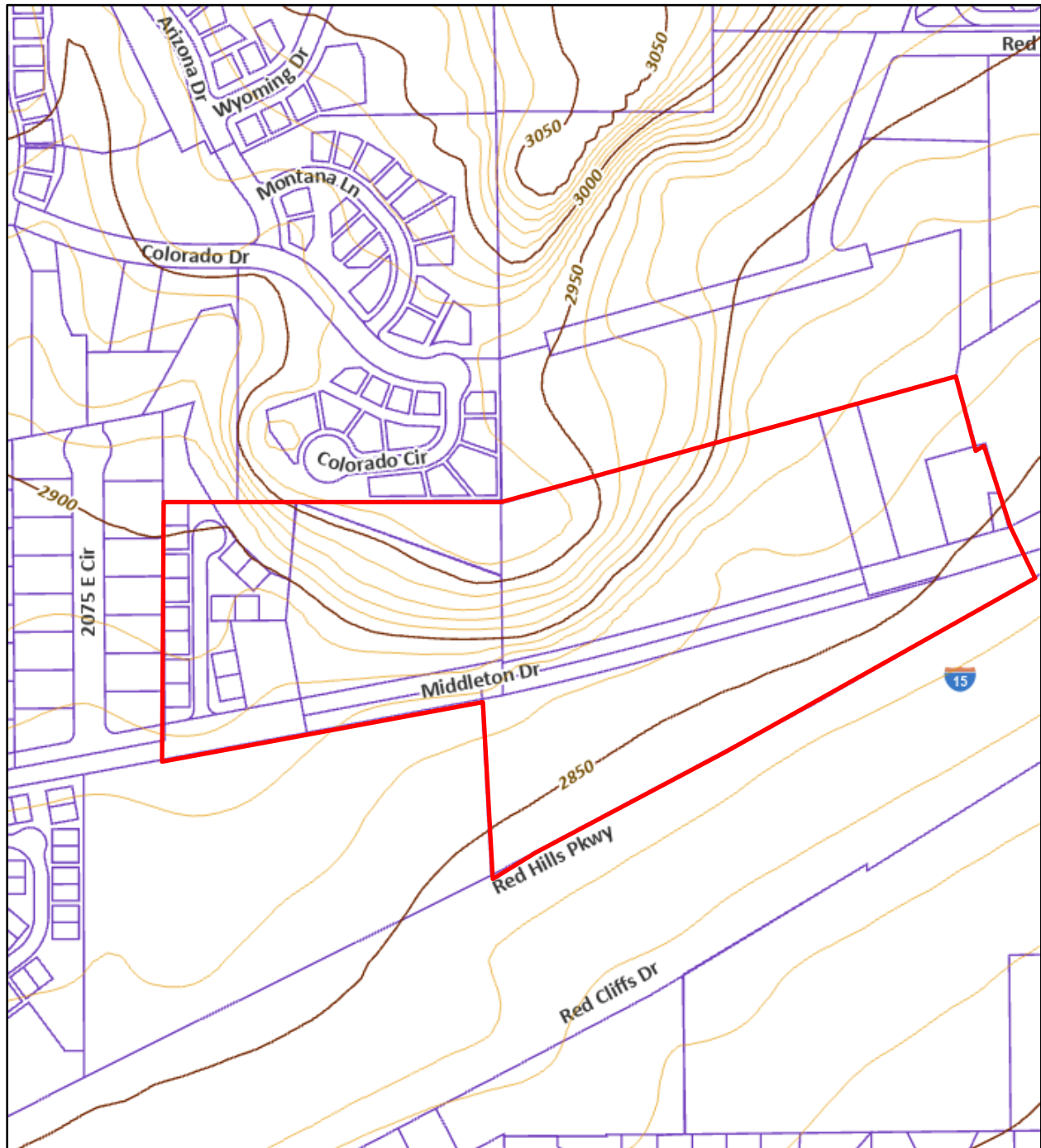
Existing Hillside Overlay Map



Proposed Hillside Overlay Map Amendment



Washington County Contours Map



Photos of Site





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

Public Notice

Notice is hereby given that the Hillside Review Board of the City of St. George, Washington County, Utah, will hold meetings at the referenced site on **Wednesday, February 23, 2022**, commencing on-site at approximately 8:30 a.m.

PRESENT:

James Sullivan
Dave Black
Jeff Mathis
James Dotson
Russ Owens

EXCUSED:

CITY STAFF:

Assistant Public Works Director, Wes Jenkins
Planner III, Dan Boles
Planner III, Carol Davidson
Development Office Supervisor, Brenda Hatch

James Sullivan called the meeting to order.

1. Consider a request for a hillside development permit at the Divario development. The applicant is proposing to construct in the area shown on the slope map labeled 20-29% and 30-39%. This is specifically in the PA-4 area which is situated in the far south west corner of the Divario development. The property is currently zoned Single-Family Residential, minimum lot size 10,000 square feet (R-1-10). The applicant is 730 St George, LLC. Case No. 2022-HS-003. This item was continued from the January 26, 2022, meeting.

James Sullivan – We did meet out here the last meeting, we asked them to come and stake out the layout on this wash.

Mark Teeppen – Handed out papers on the revised layout. What we should do is look at where we propose items to go recognizing that along this wash we're going to have the rock walls like we do in the rest of the development. What are hope is that we could maybe move some of these stakes and maybe come out with Parks and Rec and staff to finalize what we might do instead of coming back to hillside. The engineers didn't survey it and put them exactly where they might go.

Dave Black – How tall will the walls be?

Mark Teepen – Depending on the grading, they will be at least 8 feet. Between 16 and 4-8 feet. The stakes are going to be every lot corner along the wash.

Jeff Mathis – So this one is not the corner of the road?

Mark Teepen – I would like to take the entry and move it so that when people pull in they get the view of the wash and get some benefit out of it.

James Sullivan – Where would the drainage go with the road right here?

Mark Teepen – We intend to pipe it.

Jeff Mathis – Let's walk up there.

Mark Teepen – We have the road basically paralleling the open space.

James Dotson – Here's my first thought Mark. I feel like the 50 ft wide is a little hard to hold consistently up the whole thing because right in here, look at how nice this is. I feel like it will need to undulate a little bit. I know that makes the lot lines hard.

Mark Teepen – But we can do that. The other thing that we have worked on with Parks and Rec, and I don't know if it's eligible here, we have worked with them to put the pedestrian archway to go underneath. So, it is a matter of sewer and utility wise if we can achieve that here we would like to.

Discussion on where we are standing in relation to the layout presented to the Hillside Review Board.

Mark Teepen – Maybe some of the stakes on the other side need to be moved, the one on the corner there is the property line so I can't move it out, but I could move it to shorten up that lot. I agree we could make that adjustment and open up the wash. I think just looking at it, Wes and I and Parks could come out and maybe just take a marking can of paint and we'll just paint where they should be adjusted to, and I'll come out and resurvey it then digitize it in and adjust the lots. I'd like to do that and not have to come back to Hillside.

Discussion on what stakes should be moved, and which stakes are ok to leave where they are. The main concern being to preserve the black rocks from construction and that no construction material spill into the wash.

James Sullivan – Wes are you comfortable with what we are saying in where the stakes need to be moved?

Wes Jenkins – Yes, I can come out and take some photos and send them to you. We can say hey this is where we're at, are you guys good with those, when I send you the pictures.

James Sullivan – I would recommend when you submit it to Planning Commission and City Council that you have an aerial and you superimpose the layout showing the corners. Then they can see what we are protecting.

Dan Boles – Did you guys want to talk about the road alignment?

James Sullivan – Coming from the bottom?

Dan Boles – Yes.

Dave Black – It looks like that is lower than the area we were trying to preserve last time and so that alignment would be ok, and any adjustments lower would be fine as well. I think the road is out of the area that we were concerned about originally.

Russ Owens – I think the aerial is a good idea, I think that will help a lot.

Jeff Mathis – We definitely need to say something to the effect that the construction will not disturb the defined rock edge.

Dave Black – We could recommend they put up the orange safety fence to keep the contractor out of those.

Mark Teeppen – We always stake a disturbance line, and the contractors have to fix it, but you can't fix this.

MOTION: Jeff Mathis made a motion to recommend approval of a Hillside Permit with the following conditions: the west corner of lot 3 needs to move up past the edge of the ridge to the southwest corner, the corners between lots 3 and 2 need to move back away from the wash edge and the corner between lots 2 and 1 need to come back maybe 5 feet. On the north side of the wash the corners between lots 35 and 56 against the wash move back the corner between lots 56 and 57 move back, the overall guiding principle needs to be the defined rock edge of the top of the wash shall not be affected by any new development.

SECOND: James Dotson

AYES (5)

James Sullivan

Dave Black

Jeff Mathis

James Dotson

Russ Owens

NAYS (0)

Motion carries.

2. Consider a request for a hillside development permit at the Divario development. The applicant is proposing to construct in the area shown on the slope map labeled 20-29% and open space. This is specifically in the PA-18 area which is situated in the northern portion of the Divario development. The property is currently zoned Single-Family Residential, minimum lot size 10,000 square feet (R-1-10). The applicant is 730 St George, LLC. Case No. 2022-HS-004. (*See 'Meeting Place' exhibit below*).

Mark Teeppen – This is the park that you are looking at, this is Gap Canyon that we just kind of drove up. This is the neighborhood park, and we are currently working on the design. That access point is the trail going into the next subdivision. Two things are in

play here, the park design and the boundary for PA-18. In order to get the density that the builder wanted, and working with planning staff and public works, the road pushed that boundary into the wash. Our intention has always been to connect a trail from this part up to Divario Canyon Parkway. As you can see we've got a slope condition on this subdivision here. This area here will stay natural, the flood area will be filled in all the way to the road. The storm drain that dumps out from that subdivision into this wash that will be conveyed, carried through the park and through the streets, there will be no water in that wash at all. It will all be picked up with the storm drain design.

Discussion on where the trail connects to the park and what the grading would look like.

Mark Teepen – The question for hillside is can we fill that wash from that stake up to achieve the grade differential and the walls.

Discussion on what that would look like with the park and parts of the wash filled in.

Dave Black – From a hillside perspective I don't see anything we would want to preserve. I don't have any problems with what you want to do.

James Sullivan – I think you are preserving the best part of it.

Russ Owens – It's not like it's a pristine wash coming through so, the part is this.

James Sullivan – I think bringing that up will actually soften that hillside.

MOTION: James Dotson made a motion to recommend approval PA-18 park boundary adjustment and filling in the wash and creating the trail system that connects the park to Divario Canyon Drive.

SECOND: Jeff Mathis

AYES (5)

James Sullivan

Dave Black

Jeff Mathis

James Dotson

Russ Owens

NAYS (0)

Motion carries.

3. Consider a request for a hillside development permit at the South Rim at Foremaster Ridge Phase 4 development. The applicant is proposing to allow structures in the 30' ridgeline setback in anticipation of the construction of a residential home on lot 85. The property is generally located at 1709 Ridgeline Circle and is currently zoned Single Family Residential, minimum lot size 10,000 sf (R-1-10). The applicant is Robert and Rhonda Marshall. Case No. 2022-HS-007.

Please see the minutes below, both items were addressed at the same time.

MOTION:
SECOND:
AYES (5)
James Sullivan
Dave Black
Jeff Mathis
James Dotson
Russ Owens
NAYS (0)
Motion carries.

4. Consider a request for a hillside development permit at the South Rim at Foremaster Ridge Phase 4 development. The applicant is proposing to allow structures in the 30' ridgeline setback in anticipation of the construction of a residential home on lot 86. The property is generally located at 1721 Ridgeline Circle and is currently zoned Single Family Residential, minimum lot size 10,000 sf (R-1-10). The applicant is Joshua Ballantyne. Case No. 2022-HS-006.

Wes Jenkins – As you may recall, this was approved in about 2017. At that time Alpha Engineering did the drawings, we didn't take this to hillside because they weren't disturbing any slope greater than 20% and they drew a ridgeline. They did it along the south side and this north side. That's why they came back with those other 3 lots at the last Hillside meeting. They felt like when Alpha drew that it really wasn't a ridgeline. On these two 85 and 86, you can see the pink lath, that is the property line, the wall was built with the subdivision at the 30-foot ridgeline setback. So now the request is to move the wall and bring it out to where those lath are right along there similar to the other ones. The question is, is this a ridgeline or is it a rock formation what do you think? We wanted some input from you based on that information.

James Sullivan – The actual property is this closest lath to us?

Wes Jenkins – Yes, 83, 84 and 85 will be bringing their walls out to that lath that goes along there. You are kind of getting into a little of the rock there.

Jeff Mathis – It's not going to be on this side of that rock out cropping, it's going to be on the east side not the west side, right?

Wes Jenkins – Right. I think their intent is to put the rock wall right on top of that rock.

Dave Black – What is the height of the wall?

Ben xxx – It's undetermined. It will probably be, I'd say around 10 ft.

Wes Jenkins – Our maximum is only 8 ft. and then you have to step it back at least half the height of the rock wall.

James Sullivan – So in our last meeting we approved 82, 83 and 84 to come out to the property line with the walls. At this point they are just requesting the same thing. There is the 30 ft setback, are we just talking about the wall? The home is still going to be 30 ft. back.

Ben xxx – Right now, yes.

Dave Black – Is that how it reads, Wes?

Wes Jenkins – It reads for walls and basically the request is to eliminate that ridgeline setback because their argument is this is not really a ridgeline, it's more of just a rock formation.

James Dotson – So are you taking the wall to up the full height of the pad?

Ben xxx – It's got to have a walkout, so it will have a walkout. But the wall, if we go up 8 ft and then bring it back, you know we are just trying to level it off, so we don't have 3 different jogs in the lot itself.

James Dotson – I think the critical thing for me is that the mistake that was made over there, everything from those lots has been pushed out over the edge. You have over burden, and you see that from everywhere in the valley. So as long as those rock walls look and are approved like we said on the first two lots right here. That they are stained and are painted to match this then I don't see a problem. It's done, the ground is already disturbed into the 30 ft.

Wes Jenkins – We changed the ordinance a couple years ago and basically it allowed for, before we had to keep it native and you couldn't disturb it, so we changed the ordinance because we kept getting a lot of pushback from residents that they ought to be able to at least use it, put a pool in there. So as far as disturbing it, they could disturb it, they could put a pool or landscape it or so forth, but they couldn't bring a wall or a building out into that area. So basically, I guess the question is, they want to create a ridgeline now with these walls. Are we comfortable with that or do we want them to be set back the 30 ft.

Carol Davidson – The concern is what if lot 87 comes in?

Jeff Mathis – We have got to define somewhere, where does the ridge start, right?

Wes Jenkins – On the south side it was easier, that is the question.

Dave Black – I guess there are 2 questions in my mind. One, is that the ridgeline, in my opinion it is. The other question is are we ok with moving the wall out? But if we do that we go against the ordinance, right?

Wes Jenkins – Yes because you are saying that is the ridgeline.

Dave Black – And I think if we walk over here just a hundred feet you can see the natural ridgeline and this ties in and then it dies out. Am I ok if it moves out, personally, yes as

long as they did the rock and colored it and moved it out, it blends in.? But we would be going against the ordinance because I think that is the ridgeline so that is the dilemma.

James Sullivan – So in the ordinance said that they allow pools, so they are allowed to use it.

Wes Jenkins – We allowed anything below grade, so a pool works with the ordinance. The real intent of this whole thing was to keep the visual and keep that open. A pool really doesn't take away from that.

Discussion on what has happened along the rest of the ridgeline.

Ben xxx – The Newman's lot is in line with the other three that were approved, and it would look strange to step back in.

Dave Black – I think we are better off recommending what we did before, all fill slopes can't be exposed, they need to be covered with the rock. And none of the natural rock out crops can be disturbed.

Wes Jenkins – Some of my question too was is the rock wall going to go on top of the ledge right here and does it match the height of the rock wall over here on those lots? Are you ok with them coming up a little bit to that wall here?

Discussion on what the walls will look like.

Dave Black – I think we should be consistent right here on this face.

Carol Davidson – If there is a motion for approval, can I suggest that you just say the same conditions from the 82, 83, 84 except to add in no disturbance of the natural rock outcrop?

MOTION: Dave Black made a motion to recommend for approval on these 2 lots that they meet the same conditions that we had recommend previously to the adjacent lots to the south with the exception that there is no disturbance of the natural basalt rock outcrop along the property line, building out to the property line with an 8-foot rock wall with the contingency that there is no solid privacy wall above the rock wall, it has to be view fencing also the 8-foot rock wall be stained or painted to match the ridgeline rock and that there be no exposed fill slopes.

SECOND: Russ Owens

AYES (5)

James Sullivan

Dave Black

Jeff Mathis

James Dotson

Russ Owens

NAYS (0)

Motion carries.

5. Consider a request to determine the ridgeline at Foremaster Ridge Lot 120 subdivision. The applicant is proposing to build a residential home on this parcel and would like to know where the ridgeline falls on this property. The applicant would also like to receive a reduction in the front setbacks from 25' to 20'. The property is generally located at 445 S. Five Sisters Drive and is currently zoned Single Family Residential, minimum lot size 10,000 sf (R-1-10). The applicant is John Wilson. Case No. 2022-HS-008.

James Sullivan – We are looking at an application to determine the ridgeline.

Wes Jenkins – The plat says 30 feet from the abrupt edge, and that is where we want some guidance from you because their property lines are actually below the edge, so we need some guidance on what the abrupt ridgeline edge is.

John Wilson – The survey that we had matches what the plat show, so the plans we have been building for the last year are based off that, we will be in real trouble if that's not the case.

Carol Davidson – When you go down there you see that it is tiers, so it is questionable where the abrupt edge is.

The Hillside Committee walked the lot and discussed where the abrupt edge was located and how the other homes on the ridge were built and placed in regard to the ridgeline abrupt edge.

MOTION: Dave Black made a motion to recommend approval for lot 120 Foremaster Ridge that based on the drawings submitted and our onsite visit it is our opinion that if they can get a 5 foot reduction in front that the house would fit within the 30 foot setback from the abrupt edge as present onsite, also make the stipulation that during the construction process no fill soils be allowed to go over the edge of the slope and any exposed fills to create the pad be covered with retaining walls, either natural basalt rock or colored concrete that matches the surrounding area.

SECOND: Jeff Mathis

AYES (5)

James Sullivan

Dave Black

Jeff Mathis

James Dotson

Russ Owens

NAYS (0)

Motion carries.

6. Consider approval of the meeting minutes from January 26, 2022.

MOTION: Dave Black made a motion to approve the minutes from the January 26, 2022, meeting.

SECOND: James Dotson

AYES (5)

James Sullivan

Dave Black
Jeff Mathis
James Dotson
Russ Owens
NAYS (0)
Motion carries.