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, November 1, 2023,** commencing on-site at approximately 9:00 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 to make modifications to the ridgeline along the southeast slope of the Tech Ridge Development. **Meeting time is approx. 9:00 am**

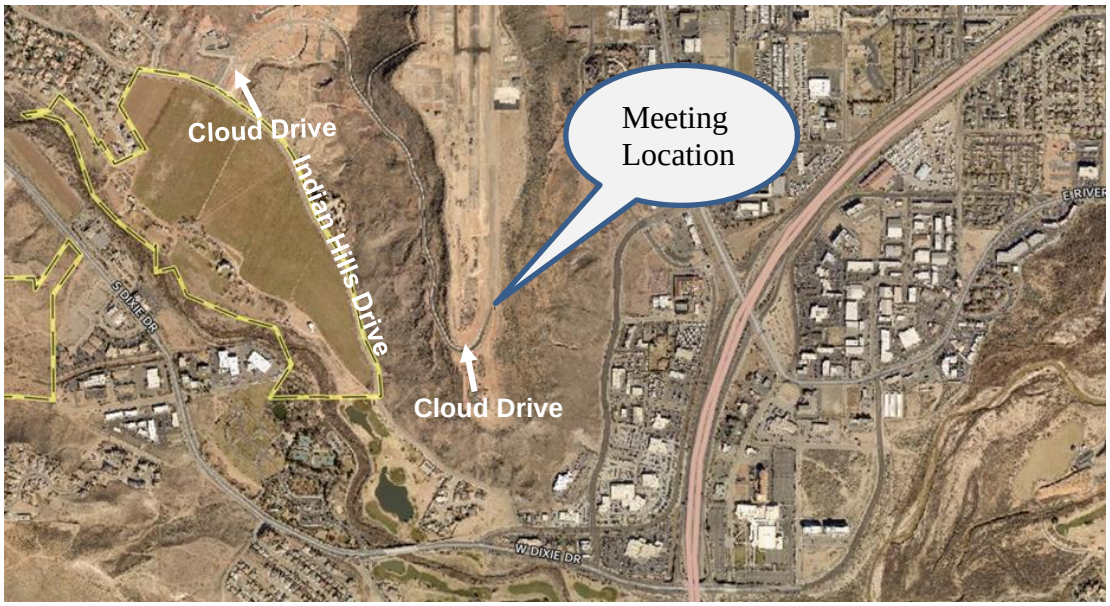
2. Consider a request for a hillside development permit to construct the southeast access road from 250 West St. to the Tech Ridge Development. **Meeting time is approx. 9:00 am**

3. Approval of the meeting minutes from the August 23, 2023.

Brenda Hatch
Development Office Supervisor

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

Item #1&2 – At the terminus of Cloud Drive in Tech Ridge

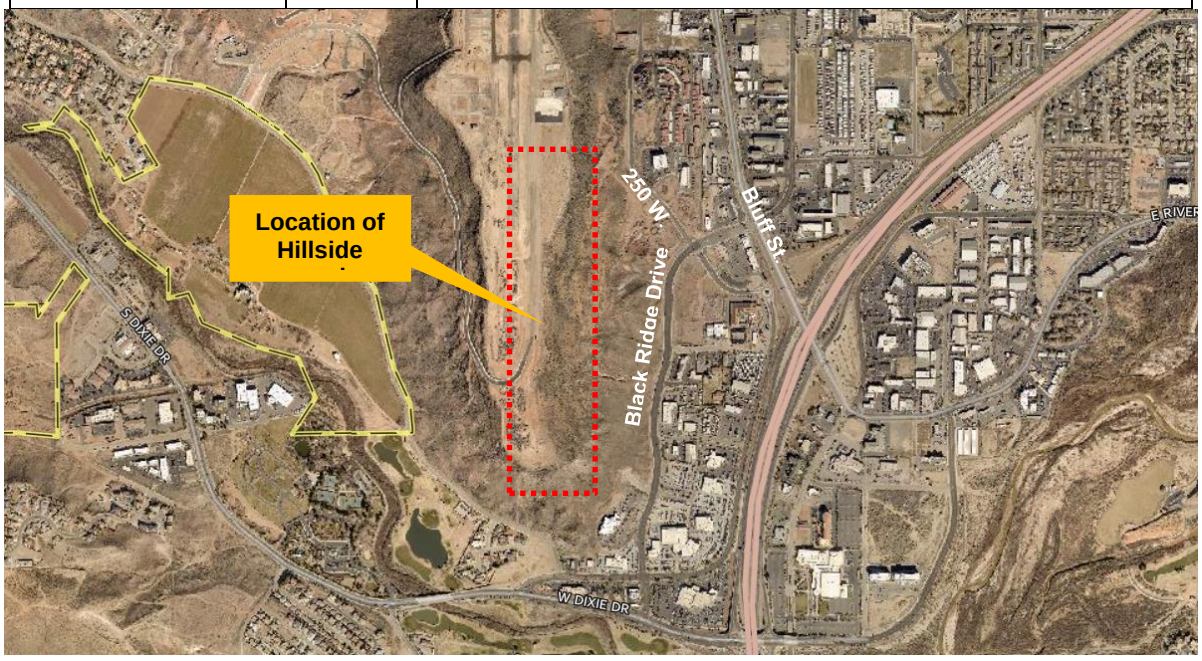


St.George
Community Development

ITEM 1
Hillside Permit

HILLSIDE REVIEW BOARD AGENDA REPORT: **011/01/2023**

Tech Ridge Southeast Slope Hillside Development Permit (Case No. 2023-HS-002)		
Request:	Consider a Hillside Development Permit to make modifications to the ridgeline along the southeast slope of the Tech Ridge Development.	
Applicant:	Isaac Barlow	
Representative:	Mike Bradshaw	
Location:	250 West Street at approximately 1170 South	
General Plan:	COM (Commercial), OS (Open Space), and LDR (Low Density Residential)	
Existing Zoning:	R-1-10 (Single Family Residential 10,000sf), PD-MU (Planned Development Mixed Use), and OS (Open Space)	
Surrounding Zoning:	North	PD-MU and R-1-10
	South	PD-MU and R-1-10
	East	R-1-10
	West	OS, PD-MU



BACKGROUND

This is a request to obtain a hillside development permit to be able to perform work along the hillside located on the southeast portion of Tech Ridge adjacent to the proposed southeast access road that leads from 250 West Street to the Tech Ridge development. There is an existing ridgeline along the southeast portion of the Tech Ridge development that is prominent at certain locations but then fades out in other locations. This proposal is to add material to the areas where the ridgeline is not definite and to blend the new material into the existing prominent ridgeline. This proposal will add in fill and retaining walls to four specific locations. Refer to Exhibit C for the location of these four areas and the plans to alter the current lay of the land.

EXHIBITS PROVIDED

1. Exhibit A – Maps
   "Exhibit A" in the packet shows the general plan land use map and the zoning map.

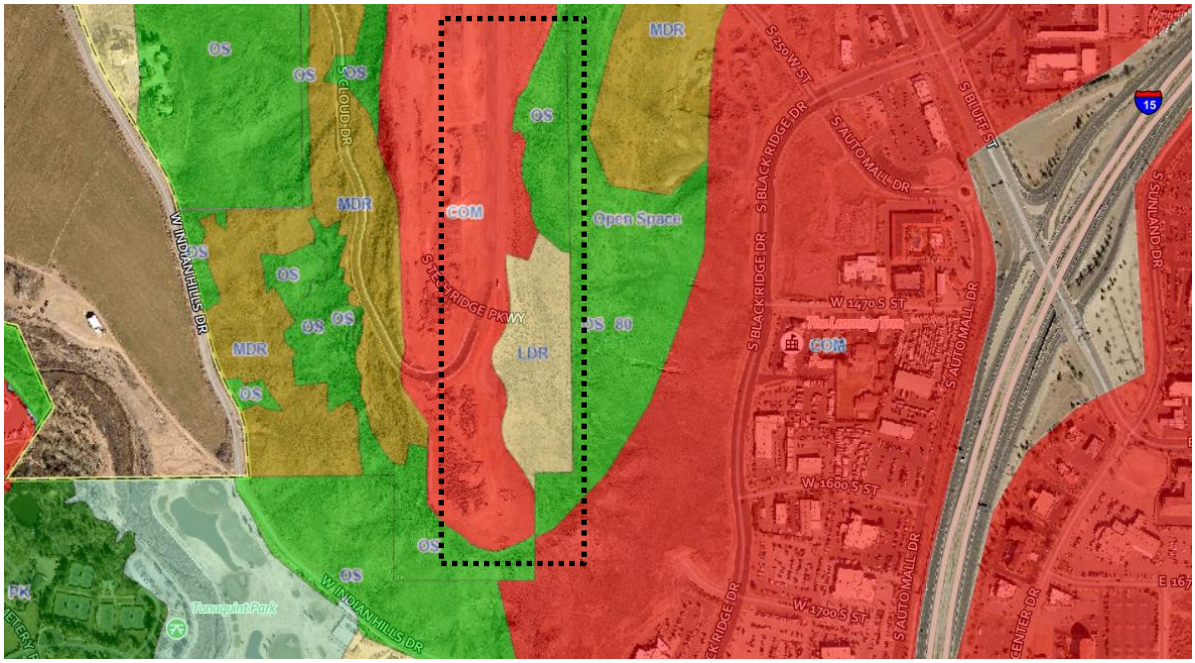
2. Exhibit B – Applicable Ordinances
   "Exhibit B" in the packet lists the applicable zoning regulation that apply to this case found in Title 10, Chapter 13A.

3. Exhibit C – Tech Ridge Southeast Hillside Protection Plan
   "Exhibit C" in the packet shows the development plan along with grading and slope analysis.

4. Exhibit D – Geotechnical Report
   "Exhibit D" in the packet shows the Geotech report for this proposal.

Exhibit A
MAPS

General Plan - COM



Zoning - R-1-10

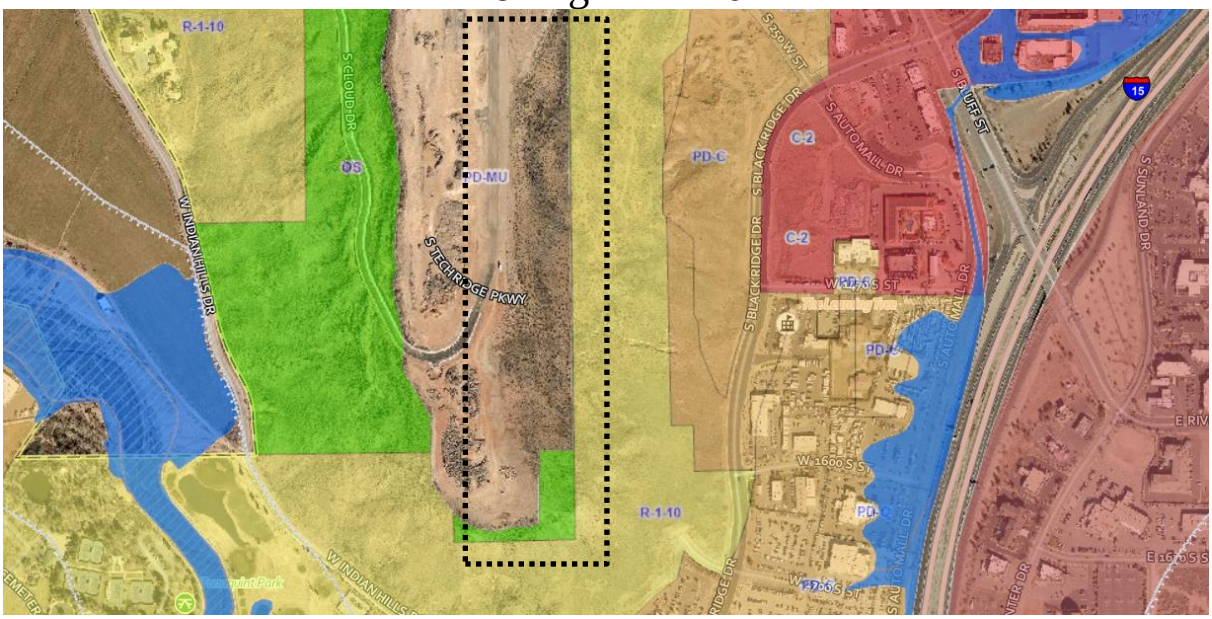


Exhibit B
APPLICABLE ORDINANCES

I. *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%).

F. The applicant may:

1. Transfer all development density from steeper slope categories (sending areas), to areas within the development with natural slopes of twenty percent (20%) or less (receiving areas); and

2. Develop additional bonus density, calculated from each slope category, as follows:

a. Natural slopes twenty percent (20%) or less transferred on a one-to-one (1:1) unit basis; plus

b. One (1) additional density unit for each density unit transferred from natural slopes of twenty-one percent (21%) to thirty percent (30%); plus

c. Two (2) additional density units for each density unit transferred from natural slopes of thirty-one percent (31%) to forty percent (40%).

3. Unit calculation for the receiving area shall be based on the requirements of the sending area zone.

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

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

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

J. Disturbance standards do not apply to the city for limited city facilities: trails, parks, and utilities. (Ord. 2019-10-002, 10-10-2019)

II. 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. (Ord. 2019-10-002, 10-10-2019)

III. Street Design

The following standards apply to public and private streets within the zone:

A. Street Grades: The maximum allowed street grade is fifteen percent (15%).

B. Intersections: Roads shall intersect at ninety-degree (90°) angles.

C. Intersection Spacing: Intersections should be spaced far enough apart so that the traffic stopped to make left turns at one intersection does not interfere with traffic movements at the adjacent intersections.

1. On low-volume streets such as access roads to minor collectors or minor collectors to minor collectors, the minimum spacing distance is one hundred twenty-five feet (125');

2. For minor collectors to major collectors, the minimum spacing distance is two hundred fifty feet (250').

D. Design Speed: The design of geometric features such as horizontal and vertical alignment will depend on the design speed selected for each street. The design speed is primarily determined by the street function and classification and is the maximum speed for safe and comfortable operation of a vehicle. Other than a major collector, all streets in hillside areas are classified as low speed streets (thirty-five (35) miles per hour or less).

Street Design Classification	Design Speed	Posted Speed
Minor collector	*30*	*30*
Local road	*25 – 30*	*25*
Hillside local	*25*	*25*
Hillside access	*25*	*25*

E. Clear Sight Distance at Intersections: Adequate, clear sight distance is required at intersections, as follows:

Posted Speed of Higher Order Road	Minimum Y	Desired Y
20	*210*	*240*
25	*260*	*300*
30	*310*	*380*
35	*365*	*475*

F. Vertical Curves and Intersection Relationship: The vertical alignment of residential streets shall comply with latest editions of AASHTO geometric design of highways and streets. See table below for listing of pertinent design criteria:

Design Speed	Crest "K" Value	Sag "K" Value
	Minimum Length of Vertical Curves	
20	*10*	*20*
25	*20*	*30*
30	*30*	*40*
35	*40*	*50*

L = KA (for minimum sight distance on a vertical curve).

L = Length of vertical curve for proper sight distance.

A = Algebraic difference in grade.

Vertical alignment with the intersection is also of special nature, and design alternatives may be required. As a guideline, the approach area where vehicles stop while waiting to enter an intersection shall not exceed four (4%) to five percent (5%) from the gutter line of the street being intersected for a distance of fifty feet (50'), though a range of fifty feet (50') to one hundred feet (100') is more desirable. This applies to all intersections, except those intersections where both intersecting streets are minor collectors. The landing area for a minor collector shall be designed for a grade of two percent (2%) to three percent (3%) for a distance of one hundred feet (100').

G. Safe Stopping Sight Distance: The minimum sight distance to be provided before a stop is required is included in the table below:

Design Speed	Computed	Recommended Distance	Add-On for 15% Grade
20	106.7	125	20
25	146.5	150	36
30	195.7	200	64
35	248.4	250	95

H. Horizontal Curves: The minimum centerline radius for horizontal curves on low-speed residential streets is:

Street Classification or Speed	Curve Radius in Feet
Minimum Centerline Radius	
Private streets	50 – 100
20 mph	100 – 150
25 mph	185
30 mph	310

I. Street Cross-Section Standards: The requirements for street cross-section configurations are based on the following factors:

1. Traffic capacity;

2. Design speed;

3. Projected traffic;

4. Designs to reduce scarring.

J. Alternate road cross sections, such as grade separated streets, may be used if applicable safety and traffic standards are met.

K. Elimination of sidewalk on one side of the road may be approved when elimination of one (1) sidewalk can appreciably reduce the amount of hillside disturbance. Other considerations may also warrant its elimination. When one (1) sidewalk is eliminated, the remaining sidewalk shall be increased by one foot (1') in width.

L. The following table sets forth the requirements for street standards for single-family residential development.

Maximum Grade	Street Classification	Width ROW	Width TBC	Pavement Width	Width Sidewalk	ADT
Street Cross-Section Standards for Single-Family Residential						
12%	Minor collector	60'	50'	45'	5'	1,500 – 3,500
15%	Local road	50'	40'	35'	4'	750 – 1,500
15%	Hillside local	45'	35'	30'	4'	150 – 750
15%	Hillside access	41'	31'	26'	4'	0 – 150

(Ord. 2019-10-002, 10-10-2019)

IV. Additional Design Standards

1. *Retaining walls shall be colored to blend into the surrounding natural geology.*

2. *Retaining wall height is limited to the heights set forth in chapter 18 of this title and the standards for rock wall construction.*

3. *Building exterior colors shall be earth tone and blend with the surrounding natural landscape.*

4. *In residential zones, "no disturbance" areas shall be held as the "common area" of a project. Common areas shall be owned and maintained by the homeowners' association or may be deeded to the city when accepted by the city.*

5. *In nonresidential zones, any "no disturbance" area shall be identified on the final site plan or final plat.*

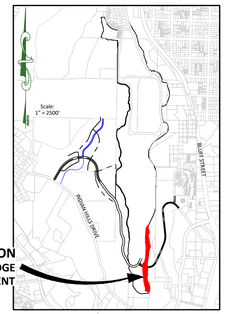
6. *Any required no disturbance area shall be identified on the ground with temporary fencing or other approved means to prevent accidental disturbance of the area during construction and such fencing shall be installed prior to issuance of a grading permit.*

7. *The building site shall be located on the flattest portion of the parcel.*

8. *No structure shall extend over any natural ridgeline. The structure shall be in contact with the ground at all edges. (Ord. 2019-10-002, 10-10-2019)*

Exhibit C

TECH RIDGE SOUTHEAST HILLSIDE PROTECTION PLAN

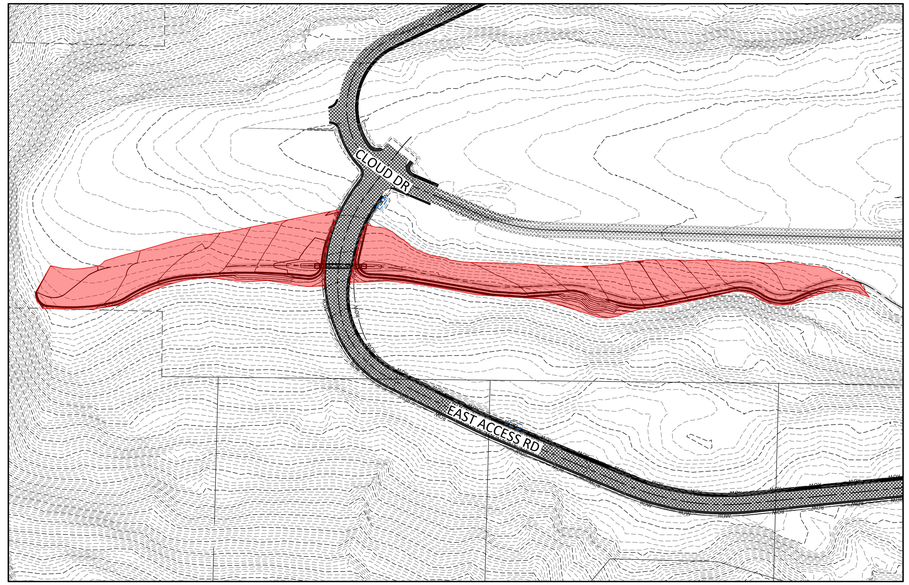


PROJECT LOCATION
TECH RIDGE
SOUTHEAST DEVELOPMENT

VICINITY MAP

TECH RIDGE SOUTHEAST DEVELOPMENT
HILLSIDE APPLICATION
FOR
TECH RIDGE DEVELOPMENT, LLC
LOCATED IN
CITY OF ST. GEORGE, WASHINGTON COUNTY, UT

SHEET INDEX	
SHEET NO.	DESCRIPTION
C1.0	COVER SHEET
C1.1	SHEET LAYOUT
C1.2	EXISTING GRADE SLOPE ANALYSIS
C1.3	OVERALL CUT AND FILL
C2.0	GRADING SECTIONS
C2.1- C2.3	SOUTHEAST DEVELOPMENT GRADING



GRAPHIC SCALE

200 0 100 200 400

(IN FEET)
1 inch = 200 ft.
If Printed 11x17 use Half Scale

NORTH

DEVELOPER

CITY OF ST. GEORGE
ATT: MR. CAMERON CUTLER
175 W 200 N
ST. GEORGE, UT 84770
EMAIL: CAMERON.CUTLER@SGCITY.ORG

ENGINEER

ALLIANCE CONSULTING
2303 N. CORAL CANYON BLVD. SUITE 201
WASHINGTON, UT 84780-0577
PHONE: (435) 673-8060
FAX: (435) 673-8065
ENGINEER: MR. DELOSS HAMMON P.E.
CONTACT: MR. MIKE BRADSHAW
EMAIL: mwb@allianceconsulting.us

GEOTECHNICAL REPORTS:

The contractor is responsible to read and fully understand the Geotech report and to coordinate with the geotechnical engineer throughout the grading process to ensure that the report's recommendations are implemented from the beginning to the end of the projects construction. The owner will contract with the geotechnical engineer for their representatives to be on site throughout the grading process to ensure full compliance with the geotechnical report's recommendations. Refer to following reports.

1. Applied GeoTech Geotechnical Investigation, Tech Ridge South Access Road, Project No. 2180295: Oct 19, 2018

GENERAL NOTES:

1. Unless shown otherwise on these plans, all construction shall conform to the codes and ordinances of St. George City, the State of Utah Administrative Codes, "The International Plumbing Code", and the "International Building Code" latest editions as administered by St. George City.
2. The Contractor shall be responsible for the location of and protection of all existing underground utilities and overhead power line during construction.
3. The Benchmark for this Project is the South 1/4 of Section 36, Township 42 South, Range 16 West Salt Lake Base and Meridian - St. George HCN #181 - Elevation: 2667.70
3. Existing contour and finish contour interval is 2 feet.
4. Any necessary design modifications shall be approved by the design engineer.
5. All grading to be within ±0.1' of proposed elevation.
6. Project shall install an information sign on site before construction begins. This sign shall have a minimum size, placement location and content information with the company name, phone & permit number.
7. A mandatory pre-construction meeting shall be required on all projects prior to any grubbing, grading, or construction activities. The permit holder shall be required to notify all Development Services inspectors.
8. Projects shall submit a dust control plan with details on equipment scheduling and reporting of dust control activities.
9. Follow Appendix J standards found in the IBC.
10. All work materials shall meet City of St. George standards.
11. The Developer will Maintain the Temporary Detention Basin until Decommission.

CONSTRUCTION NOTES:

1. All excavations and grading shall be in accordance with the requirements of the City of St. George [phone:435-627-4000], of the "International Building Code", 2018 edition, and the specifications and requirements included in the Tech Ridge Grading Recommendations...
1. All excavation, grading, and fill operations within the building area should be observed by the Field Engineer to verify subsoil conditions and determine adequacy of site preparation, suitability of fill materials and compliance with compaction requirements.
2. The Contractor shall provide suitable equipment to control dust and air pollution caused by construction operations. The Contractor shall also provide suitable mud and dirt containment to maintain clean conditions on the work site, access roadways, and adjacent properties.
3. Project shall submit a Dust Control Plan with details on equipment, scheduling and reporting of dust control activities.
4. Contractor is responsible and required to obtain their own UPDES/NOI permits.
5. It is the contractors responsibility to identify all and any SWPPP requirements.
6. Prior to and during compaction operations, all backfill material shall have the required moisture content uniform throughout each layer.
7. All Rip-Rap rock shall be approved by owner.
8. Contractor must coordinate with other Contractors working in areas.
9. Contractor must protect existing facilities.
10. All rock walls are to match in color and composition with the native basalt lava rock. Rock to be to be stained black.

Date: 12-29-2022

REVISIONS

No.	Date	by	Description
		ARL	

File Name
Southeast Ridge Walls.dwg

ALLIANCE CONSULTING
A PLANNING AND ENGINEERING FIRM

UTAH
2303 N CORAL CANYON BLVD
SUITE 201,
WASHINGTON, UT 84780
435-673-8060

NORTH DAKOTA
621 26th STREET W.
WILLISTON, ND 58801
701-572-8100

TECH RIDGE SOUTHEAST DEVELOPMENT HILLSIDE PROTECTION PLAN

FOR

CITY OF ST. GEORGE

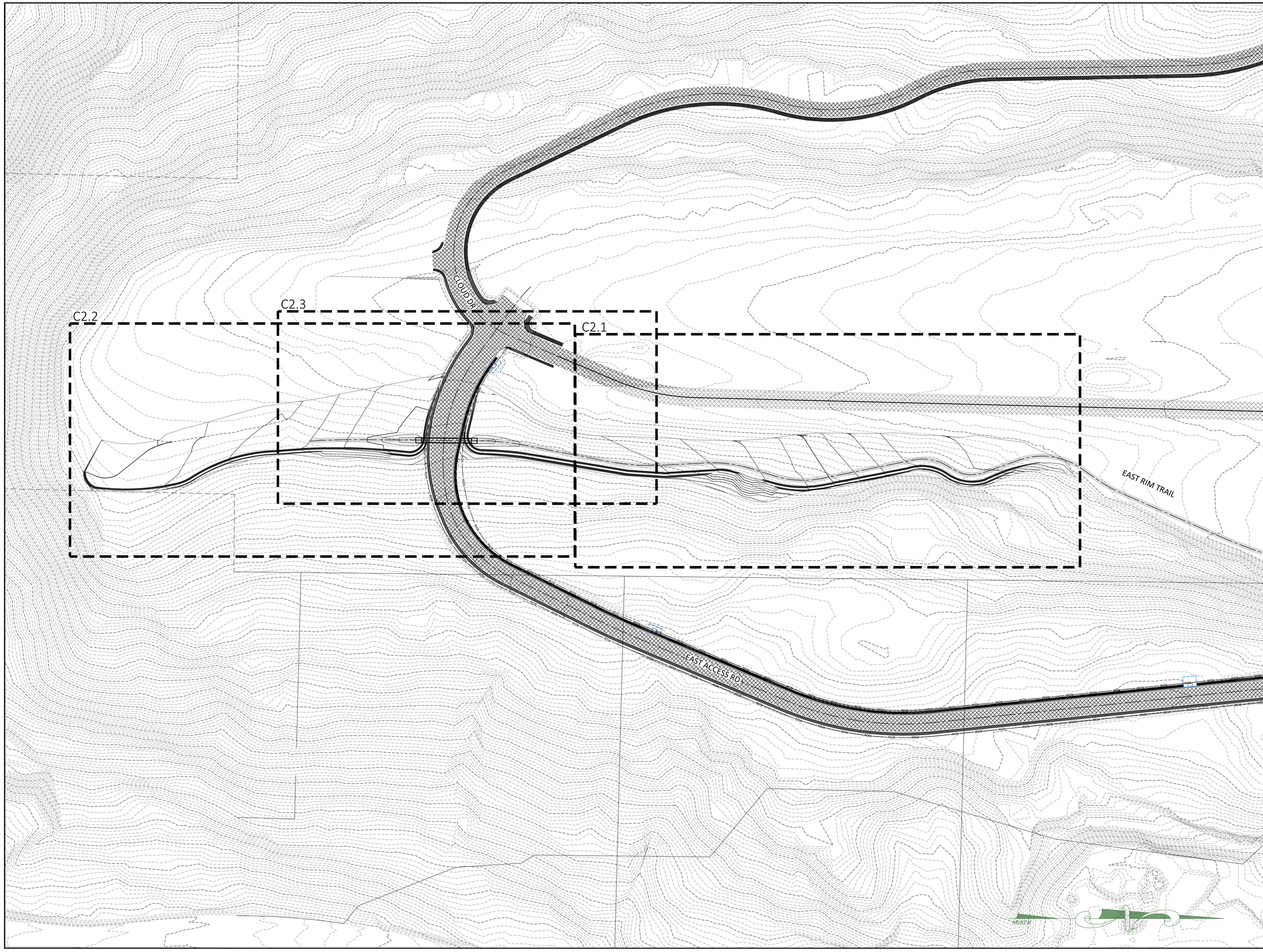
LOCATED IN SEC 36
T 42 SOUTH, R 16 WEST SLB&M
CITY OF ST. GEORGE, WASHINGTON COUNTY, UT

NOT FOR CONSTRUCTION REVIEW ONLY

Drawn By:	Scale:
ARL	1"=200'
Client No.	Project No.
4568	4568-21

Drawing Sheet
C1.0

Sheet 1 of 8 Sheets



Date:
12-30-2022

REVISIONS

No.	Date	by	Description
		ARL	

File Name
Southeast Ridge Walls.dwg

LEGEND

- EXISTING ASPHALT
- EXISTING CONCRETE
- (2622) EXISTING CONTOUR
- 2622 DESIGN CONTOUR

GRAPHIC SCALE

100 0 50 100 200

(IN FEET)
1 inch = 100 ft.
If Printed 11x17 use Half Scale

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A PLANNING AND ENGINEERING FIRM

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621 26th STREET W.
WILLISTON, ND 58801
701-572-8100

TECH RIDGE
SOUTHEAST DEVELOPMENT
HILLSIDE SHEET LAYOUT

FOR

CITY OF ST. GEORGE

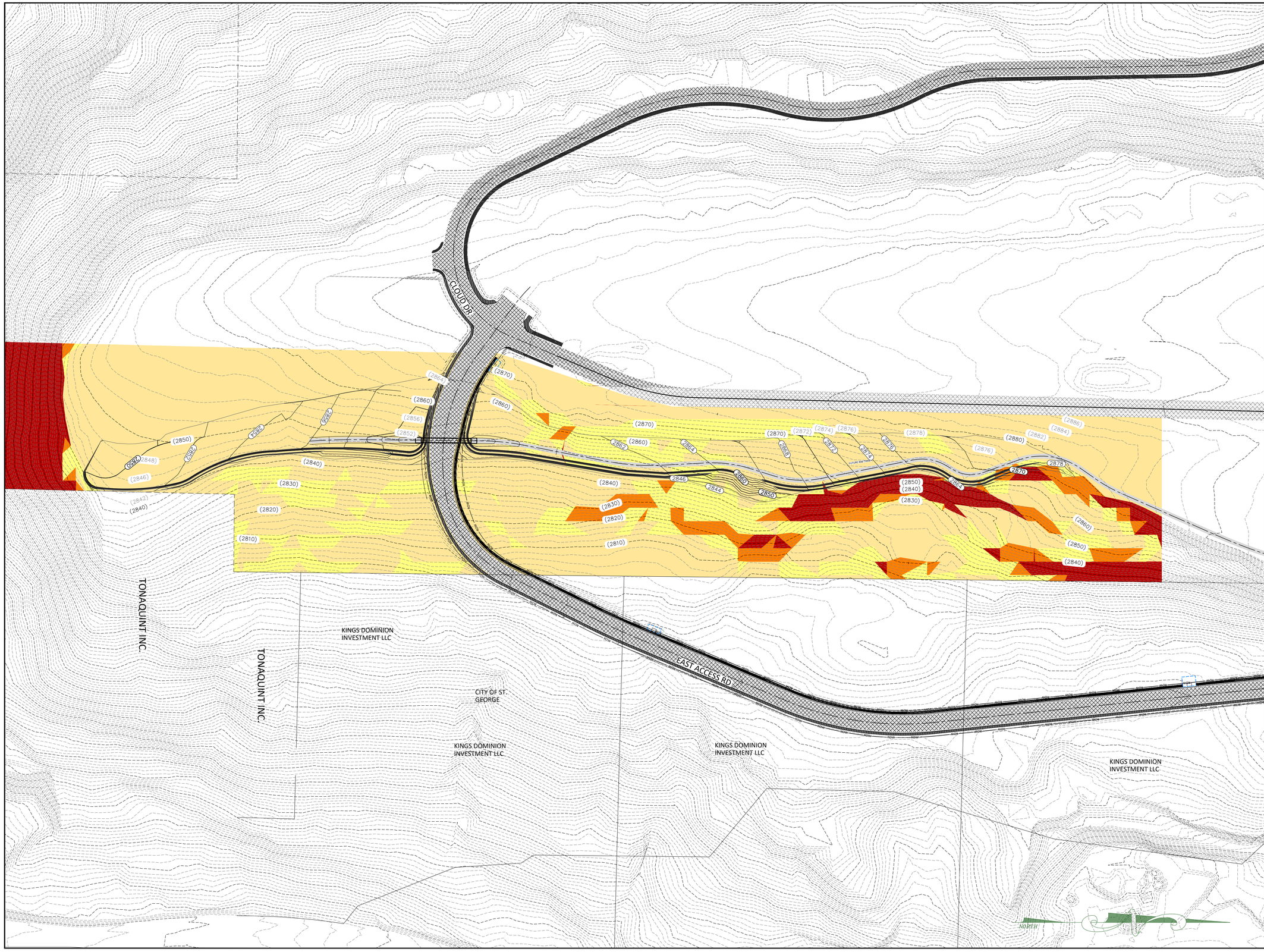
LOCATED IN SEC 36
T 42 SOUTH, R 16 WEST SLB&M
CITY OF ST. GEORGE, WASHINGTON COUNTY, UT

NOT FOR CONSTRUCTION
REVIEW ONLY

Drawn By:	Scale:
ARL	1"=100'
Client No.	Project No.
4568	4568-21

Drawing Sheet
C1.1

Sheet 2 of 8 Sheets



Date: 12-30-2022

REVISIONS

No.	Date	by	Description
		ARL	

File Name
Southeast Ridge Walls.dwg

SLOPE ANALYSIS LEGEND

- 0% to 20%
- 20% to 30%
- 30% to 40%
- 40% +

GRAPHIC SCALE

100 0 50 100 200

(IN FEET)
1 inch = 100 ft.
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ALLIANCE CONSULTING
A PLANNING AND ENGINEERING FIRM

UTAH
2303 N CORAL CANYON BLVD
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435-673-8060

NORTH DAKOTA
621 26th STREET W.
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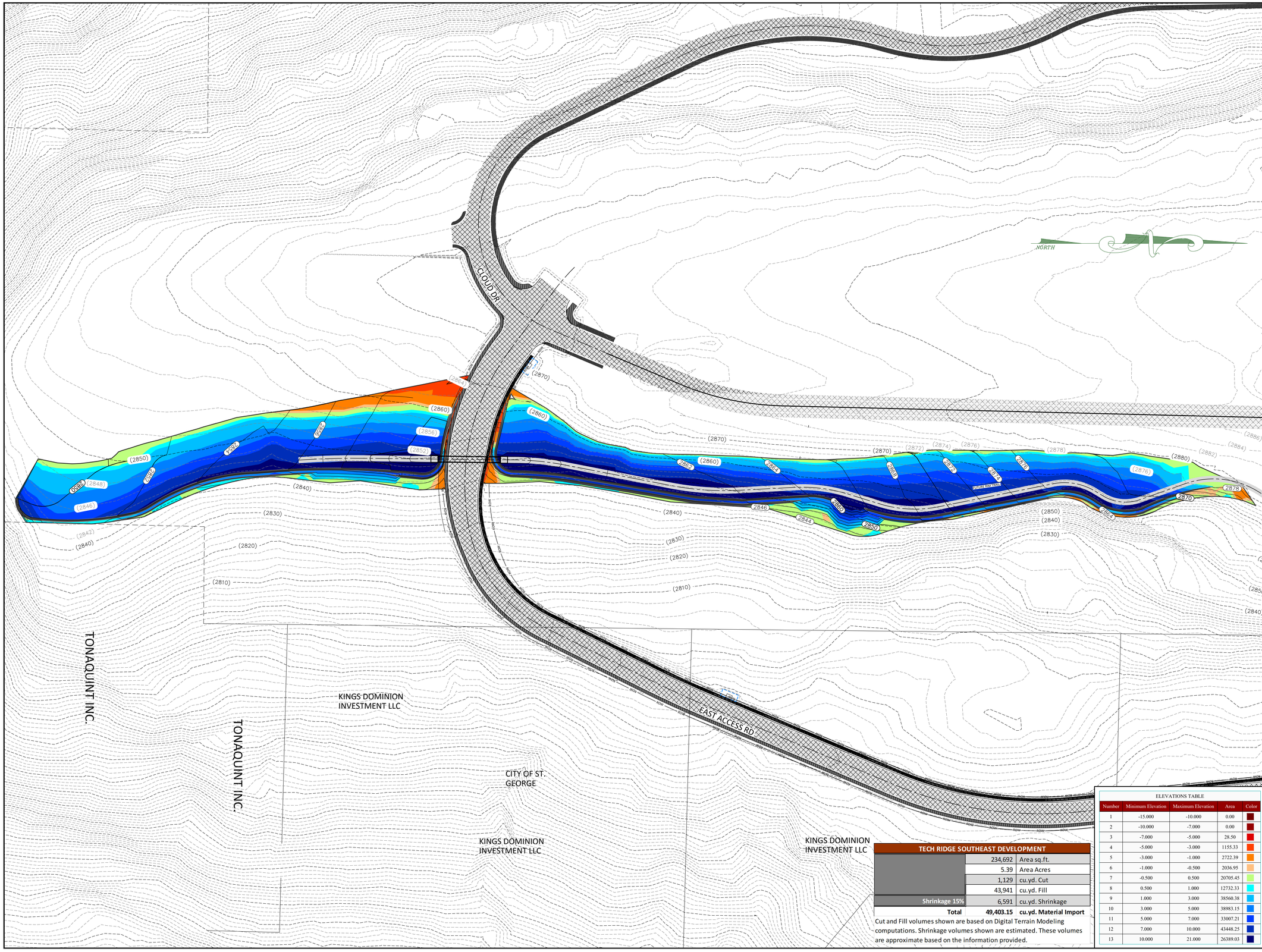
TECH RIDGE
SOUTHEAST DEVELOPMENT
HILLSIDE SLOPE ANALYSIS
FOR
CITY OF ST. GEORGE
LOCATED IN SEC 36
T 42 SOUTH, R 16 WEST SLB&M
CITY OF ST. GEORGE, WASHINGTON COUNTY, UT

NOT FOR CONSTRUCTION
REVIEW ONLY

Drawn By:	Scale:
ARL	1"=100'
Client No. 4568	Project No. 4568-21

Drawing Sheet
C1.2

Sheet 3 of 8 Sheets



TECH RIDGE SOUTHEAST DEVELOPMENT		
	234,692	Area sq.ft.
	5.39	Area Acres
	1,129	cu.yd. Cut
	43,941	cu.yd. Fill
Shrinkage 15%	6,591	cu.yd. Shrinkage
Total	**49,403.15**	**cu.yd. Material Import**

Cut and Fill volumes shown are based on Digital Terrain Modeling computations. Shrinkage volumes shown are estimated. These volumes are approximate based on the information provided.

ELEVATIONS TABLE

Number	Minimum Elevation	Maximum Elevation	Area	Color
1	-15.000	-10.000	0.00	
2	-10.000	-7.000	0.00	
3	-7.000	-5.000	28.50	
4	-5.000	-3.000	1155.33	
5	-3.000	-1.000	2722.39	
6	-1.000	-0.500	2036.95	
7	-0.500	0.500	20705.45	
8	0.500	1.000	12732.33	
9	1.000	3.000	38560.38	
10	3.000	5.000	38983.15	
11	5.000	7.000	33007.21	
12	7.000	10.000	43448.25	
13	10.000	21.000	26389.03	

Date: 12-30-2022

REVISIONS

No.	Date	by	Description
		ARL	

File Name: Southeast Ridge Walls.dwg

LEGEND

EXISTING ASPHALT
EXISTING CONCRETE
EXISTING CONTOUR
DESIGN CONTOUR

GRAPHIC SCALE

80 0 40 80 160

(IN FEET)
1 inch = 80 ft.
If Printed 11x17 use Half Scale

ALLIANCE CONSULTING
A PLANNING AND ENGINEERING FIRM

UTAH
2303 N CORAL CANYON BLVD
SUITE 201,
WASHINGTON, UT 84780
435-673-8060

NORTH DAKOTA
621 26th STREET W.
WILLISTON, ND 58801
701-572-8100

TECH RIDGE
SOUTHEAST DEVELOPMENT
HILLSIDE CUT/FILLS

FOR

CITY OF ST. GEORGE

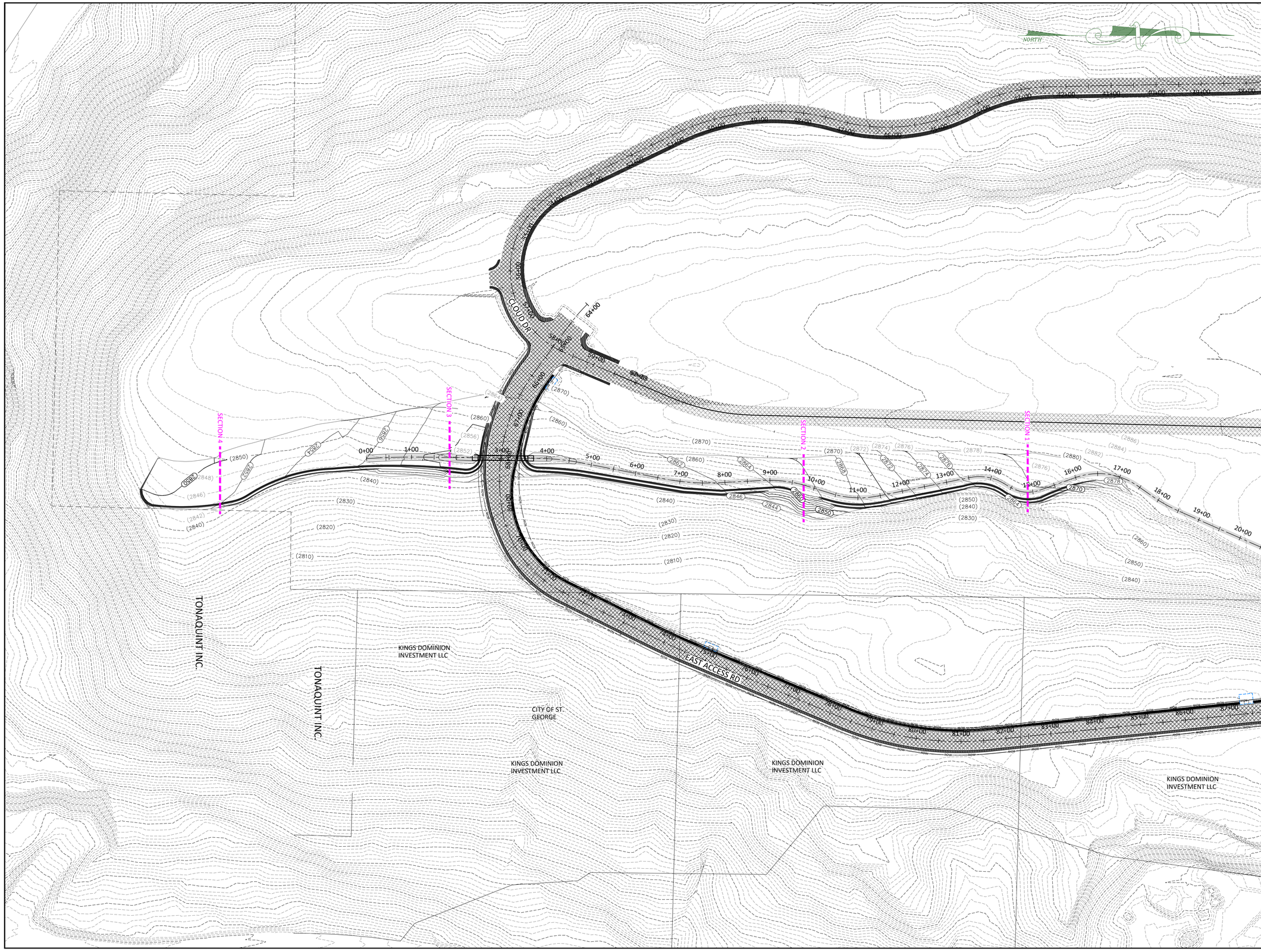
LOCATED IN SEC 36
T 42 SOUTH, R 16 WEST SLB&M
CITY OF ST. GEORGE, WASHINGTON COUNTY, UT

NOT FOR CONSTRUCTION REVIEW ONLY

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Client No. 4568	Project No. 4568-21

Drawing Sheet
C1.3

Sheet 4 of 8 Sheets



Date: 12-30-2022

REVISIONS

No.	Date	by	Description
		ARL	

File Name
Southeast Ridge Walls.dwg

LEGEND

- EXISTING ASPHALT
- EXISTING CONCRETE
- (2622) EXISTING CONTOUR
- 2622 DESIGN CONTOUR
- SECTION ALIGNMENT

GRAPHIC SCALE

100 0 50 100 200

(IN FEET)
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ALLIANCE CONSULTING
A PLANNING AND ENGINEERING FIRM

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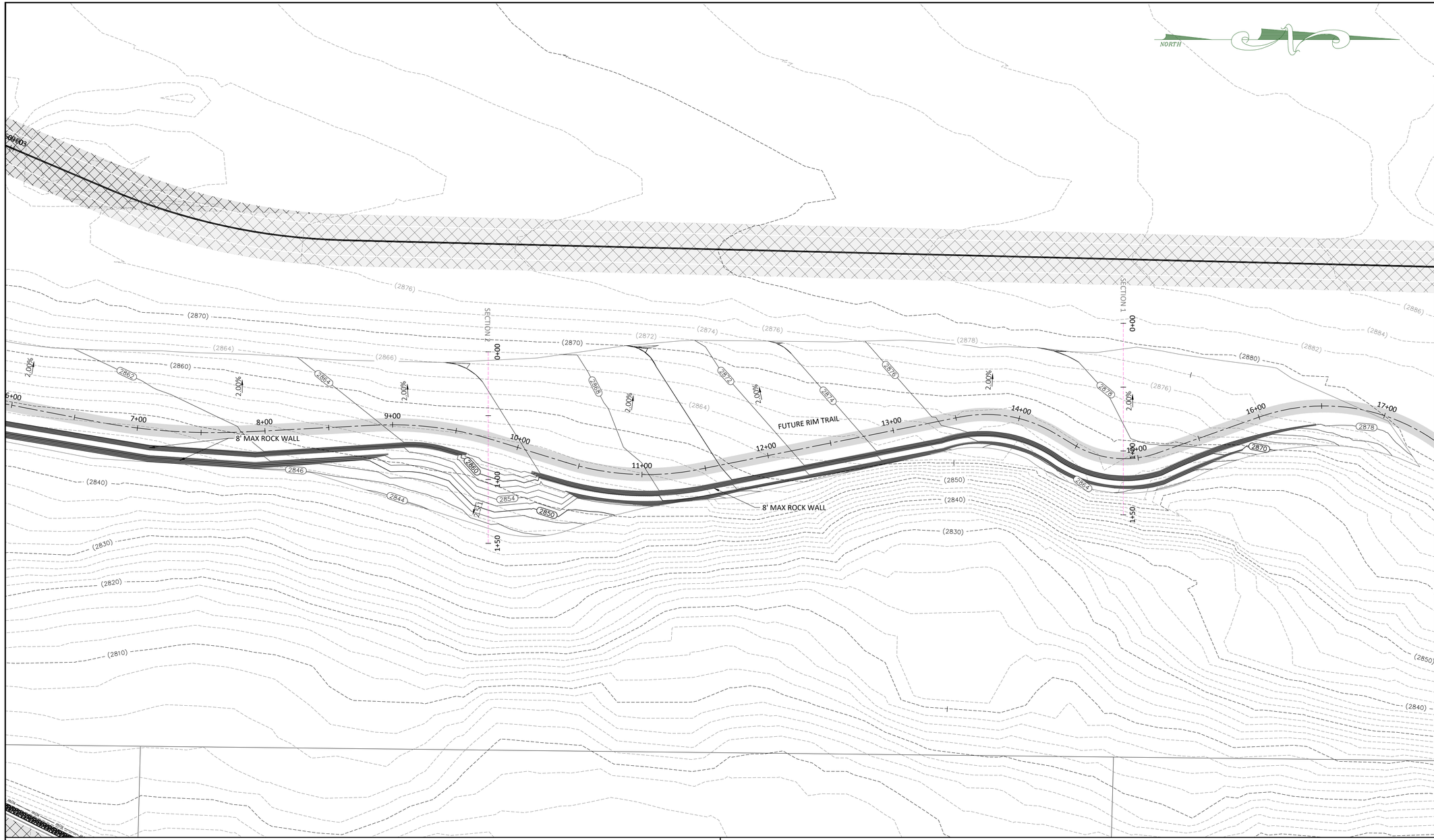
TECH RIDGE
SOUTHEAST DEVELOPMENT
HILLSIDE GRADING OVERALL
FOR
CITY OF ST. GEORGE
LOCATED IN SEC 12
T 154 NORTH, R 101 WEST 5 P.M.
CITY OF WILLISTON, WILLIAMS COUNTY, ND

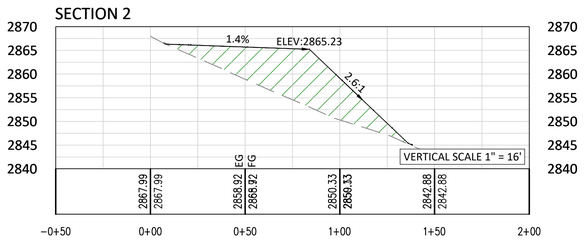
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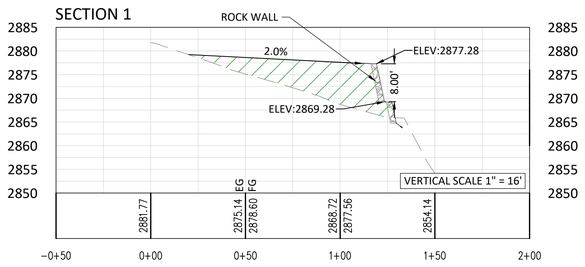
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Client No.	Project No.
4568	4568-21

Drawing Sheet
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Sheet 5 of 8 Sheets







Date: 12-30-2022

REVISIONS

No.	Date	by	Description
		ARL	

File Name
Southeast Ridge Walls.dwg

LEGEND

- EXISTING ASPHALT
- EXISTING CONCRETE
- (2622) EXISTING CONTOUR
- 2622 DESIGN CONTOUR
- SECTION ALIGNMENT

GRAPHIC SCALE

40 0 20 40 80

(IN FEET)
1 inch = 40 ft.
If Printed 11x17 use Half Scale

ALLIANCE CONSULTING
A PLANNING AND ENGINEERING FIRM

UTAH
2303 N CORAL CANYON BLVD
SUITE 201,
WASHINGTON, UT 84780
435-673-8060

NORTH DAKOTA
621 26th STREET W.
WILLISTON, ND 58801
701-572-8100

TECH RIDGE
SOUTHEAST DEVELOPMENT
HILLSIDE GRADING

FOR

CITY OF ST. GEORGE

LOCATED IN SEC 12
T 154 NORTH, R 101 WEST 5 P.M.
CITY OF WILLISTON, WILLIAMS COUNTY, ND

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Drawn By:	Scale:
ARL	1"=40'
Client No. 4568	Project No. 4568-21

Drawing Sheet
C2.1

Sheet 6 of 8 Sheets

Date: 12-30-2022

REVISIONS

No.	Date	by	Description
		ARL	

File Name
Southeast Ridge Walls.dwg

LEGEND

- EXISTING ASPHALT
- EXISTING CONCRETE
- (2622) EXISTING CONTOUR
- 2622 DESIGN CONTOUR
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SOUTHEAST DEVELOPMENT
HILLSIDE GRADING

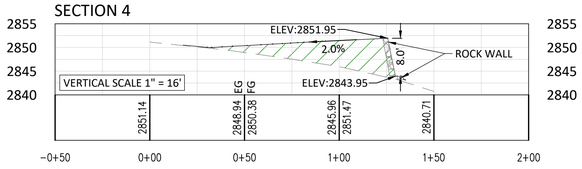
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CITY OF ST. GEORGE

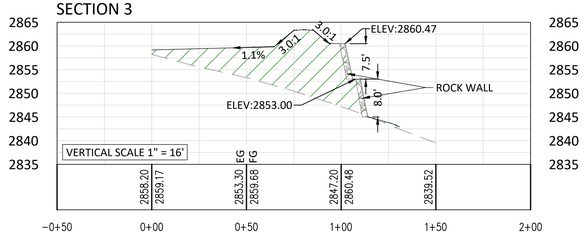
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SECTION 4



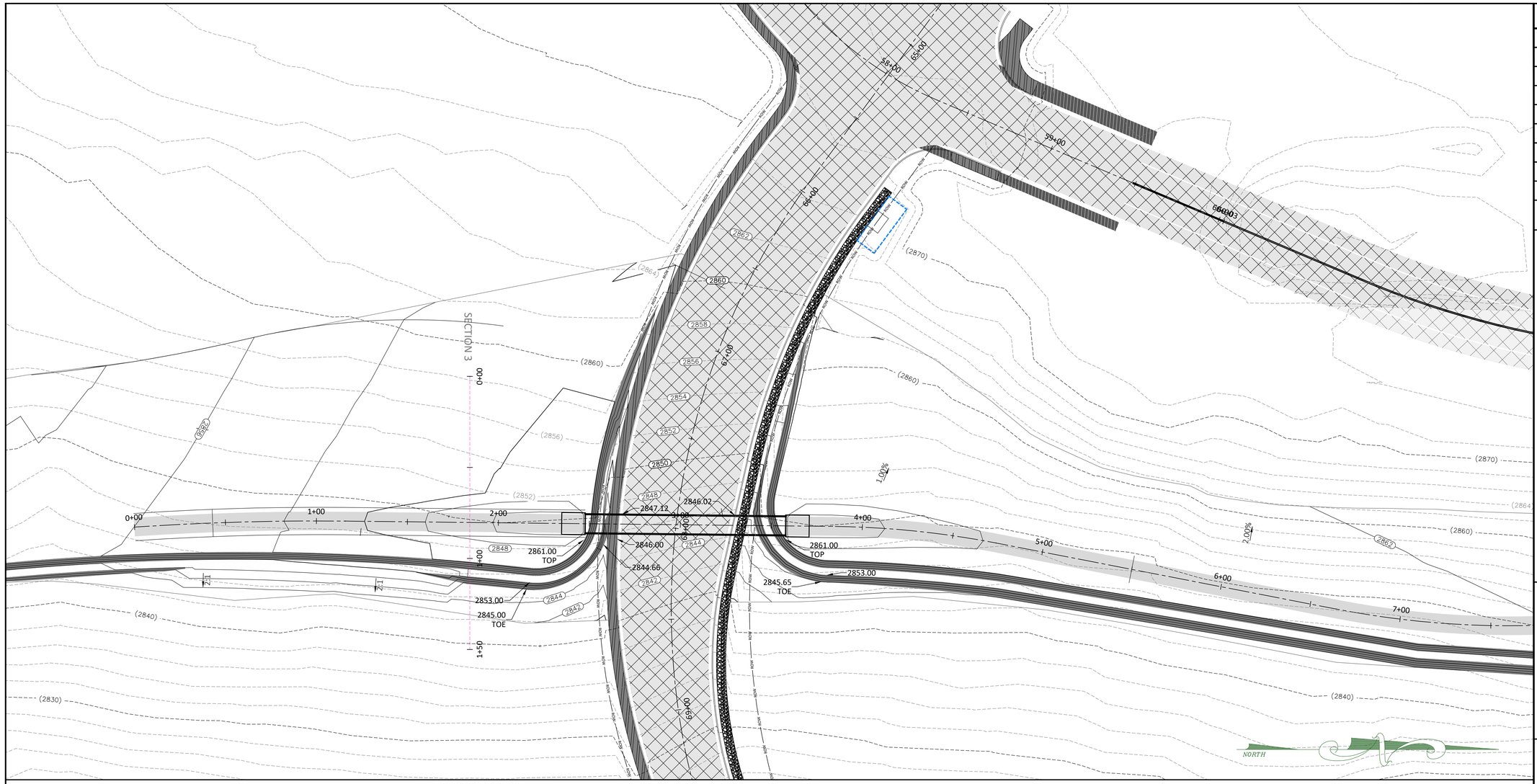
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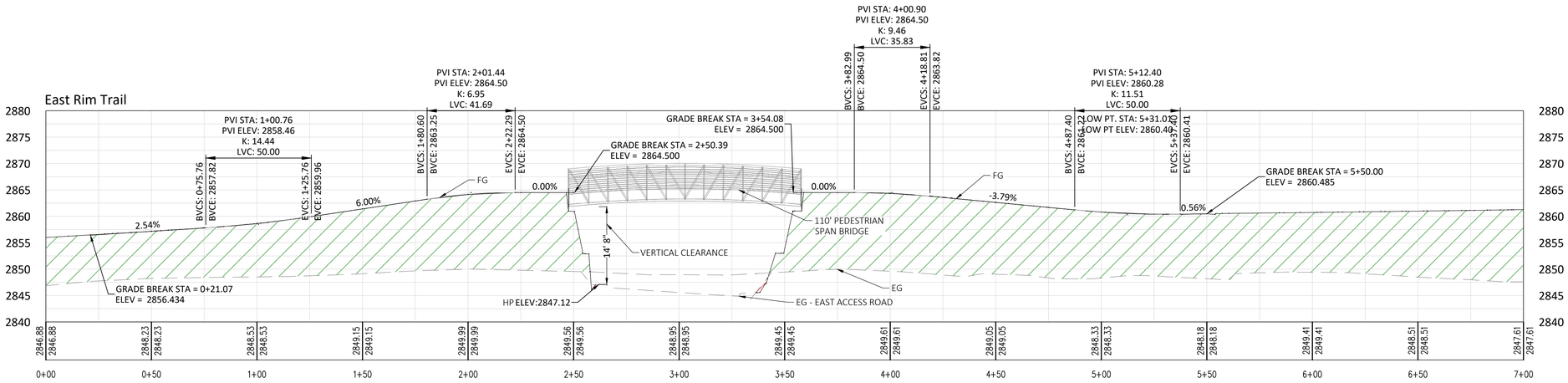


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Client No. 4568	Project No. 4568-21

Drawing Sheet
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Sheet 7 of 8 Sheets





Date: 12-30-2022

REVISIONS

No.	Date	by	Description
		ARL	

File Name: Southeast Ridge Walls.dwg

LEGEND

- EXISTING ASPHALT
- EXISTING CONCRETE
- (2622) EXISTING CONTOUR
- 2622 DESIGN CONTOUR
- SECTION ALIGNMENT

GRAPHIC SCALE

30 0 15 30 60

(IN FEET)
1 inch = 30 ft.
If Printed 11x17 use Half Scale

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TECH RIDGE
SOUTHEAST DEVELOPMENT
HILLSIDE GRADING

FOR
CITY OF ST. GEORGE
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CITY OF WILLISTON, WILLIAMS COUNTY, ND

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Drawn By:	Scale:
ARL	1"=30'
Client No.	Project No.
4568	4568-21

Drawing Sheet
C2.3

Sheet 8 of 8 Sheets

Exhibit D
GEOTECHNICAL REPORT

AGEC
Applied GeoTech

GEOTECHNICAL INVESTIGATION

TECH RIDGE SOUTH ACCESS ROAD
ST. GEORGE, UTAH

PREPARED FOR:

TECH RIDGE, LLC
446 SOUTH MALL DRIVE
ST. GEORGE, UTAH 84790

ATTENTION: ISAAC BARLOW

PROJECT NO. 2180295 **OCTOBER 19, 2018**

1420 South 270 East • St. George, Utah 84790 • (435) 673-6850 • FAX (435) 673-1044

TABLE OF CONTENTS

SUMMARY . . . . . Page 1

SCOPE OF WORK . . . . . Page 3

SITE CONDITIONS . . . . . Page 4

PROPOSED CONSTRUCTION . . . . . Page 4

GEOLOGY AND GEOLOGIC HAZARDS . . . . . Page 5

ROADWAY SUBSURFACE CONDITIONS . . . . . Page 6

ROADWAY SUBSURFACE WATER . . . . . Page 11

EAST SLOPE STABILITY . . . . . Page 11

ROADWAY RECOMMENDATIONS . . . . . Page 15
- A. Site Grading . . . . . Page 16
- B. Soil Corrosion . . . . . Page 23
- C. Pavement Analysis and Design . . . . . Page 23
- D. Pavement Support, Section, and Materials . . . . . Page 24
- E. Drainage and Maintenance . . . . . Page 26
- F. Construction Materials Observation and Testing . . . . . Page 27
- G. Geotechnical Recommendation Review . . . . . Page 27

LIMITATIONS . . . . . Page 28

REFERENCES . . . . . Page 29

FIGURES AND TABLE

Vicinity and Geologic Map	Figure 1
Test Pit Locations	Figures 2
Logs of Test Pits	Figures 3-4
Legend and Notes of Test Pits	Figure 5
Consolidation Test Results	Figures 6-12
Gradation/Soil Class. & Moisture Density Relationship Test Results	Figures 13-17
California Bearing Ratio Test Results	Figures 18-22
Summary of Laboratory Test Results	Table 1

SUMMARY

A. East Slope Stability

1. Much of the proposed roadway crosses historical landslide deposits.

2. An evaluation of the east slope stability was included in the scope of this investigation.

3. Based on the available information obtained from previous investigations, inclinometer measurements, and past performance of the slope, it is apparent that the east slope for this project is currently maintaining its stability.

   Using the information available from our subsurface exploration, the laboratory test results along with our experience in the area, it is our professional opinion that the stability of the east slope is marginal. Even with the lack of apparent movement, small changes in the slope configuration and/or weakening of the material in the slope could trigger future movement.

   The strength of the slope will be adversely impacted by water infiltration. Therefore, we recommend strict drainage recommendations be followed to reduce the risk of future slope instability.

B. Roadway

If construction of the roadway is to proceed, the following information and recommendations apply.

1. A variety of soil and bedrock types were encountered in the test pits. Lean clay, silt, silty sand, well graded sand with silt, silty gravel with sand, basalt, mudstone, and shale bedrock were encountered. Practical excavator refusal was encountered on stiff clay, boulders, basalt and shale bedrock

2. Potentially expansive mudstone, potentially expansive lean clay and potentially collapsible silty sand were encountered in the test pits.

3. Subsurface water was not encountered in the excavated test pits to the maximum depths investigated. Fluctuation in groundwater level may occur over time. An evaluation of such fluctuations is beyond the scope of this report.

4. The on-site granular soils such as the silty gravel with sand (GM), silty sand (SM), and well graded sand with silt (SW-SM) free of organics, debris, and material greater than 6 inches in size, are suitable for use as site grading fill. Oversized rocks (greater than 6 inches and smaller than 12 inches) may be used as fill at depths greater than 3 feet below finished subgrade. The oversized rock should be placed so that rock to rock contact is minimized to reduce potential for nesting and voids.

5. The on-site fine grained soils range between non-plastic silt to highly plastic mudstone. The silt and portions of the lean clay observed in test pits TP-7 and TP-8 are suitable for use as low permeable fill above expansive subgrade. The mudstone and expansive lean clay similar to that encountered in test pits TP-1, should not be used as fill within 6 feet of the finished roadway subgrade elevation.

6. Consolidation testing of remolded samples of mudstone and lean clay indicate the material remains expansive upon processing and adding moisture. However, the laboratory tests also indicate the expansion potential of the processed and remolded mudstone and lean clay can be reduced with moisture contents of 4 to 6 percent above the optimum moisture content and a compaction of approximately 90 percent of the modified proctor value (ASTM D-1557). Conversely, remolded samples with moisture contents below 4 percent and compaction near or above 95% will likely exhibit higher expansive properties.

7. The proposed roadway may be supported on a properly prepared subgrade as recommended in the Subgrade Preparation section of this report.

   The on-site, potentially expansive mudstone and expansive lean clay should be overexcavated to an appropriate depth beneath the proposed roadway. Overexcavation depths may be determined from the information provided in the Subgrade Preparation section of this report.

   Areas which expose near surface loose, dry, potentially collapsible silty sand should be overexcavated prior to placing fill as recommended in the Subgrade Preparations section of this report.

   Drainage recommendations are also provided in this report to reduce the risk of the underlying expansive subgrade.

   Moisture conditioning and compaction criteria are also included in this report. The calculated asphalt, untreated base course, and borrow thickness vary depending on subgrade and traffic loading.

8. The information provided in this summary should not be used independent of that provided within the body of this report.

SCOPE OF WORK

This report presents the results of a geotechnical investigation for the proposed south access road construction project to Tech Ridge located in St. George, Utah as shown on Figures 1 and 2. The geotechnical investigation includes access from the east and west sides of Tech Ridge. AGEC was requested to perform the following tasks:

1. Conduct a subsurface investigation to determine the subsurface conditions. The subsurface investigation included the excavation of 21 test pits along the roadway alignment. The first 13 test pits which include the west access road (TP-1 through TP-11) and a portion of the east access road (TP-12 and TP-13) were excavated with a track mounted excavator (CAT 336E) equipped with a 30-inch wide bucket. A ripper tooth attachment was also used to loosen boulders encountered during test pit excavations.

2. Log the subsurface soil profile and obtain samples of the subsurface soils to conduct laboratory testing.

3. Conduct a laboratory testing program on the subsurface soils to determine their engineering characteristics and determine the support value of the subsurface soil.

4. Prepare a report which presents the subsurface conditions encountered and recommendations for the geotechnical aspects of the project including slope stability of the eastern facing slope. Our conclusions and recommendations are based on the subsurface investigation, the results of laboratory testing and our engineering analysis.

This report was prepared in accordance with our "Proposal for Professional Geotechnical Services" dated, April 30, 2018.

SITE CONDITIONS

The existing site topography consists of sloping hillsides and relatively flat areas. A dry wash runs through the west side access from the north to the south. The majority of the hillside along the proposed alignment have been mapped geologically as ancient landslide deposits and consists of undulating hummocky terrain with relatively gently benches and steeper sloping areas. Existing vegetation across the site consists of sparse, low brush. Basalt boulders are also exposed at the surface across the site. Various dirt roads traverse the sides of both hill slopes.

PROPOSED CONSTRUCTION

The proposed project consists of constructing a 2 lane roadway to the west and a 4 lane roadway to the east near the south end of Tech Ridge. Detailed roadway cross-sections and grading plans for the east access road were not provided for the preparation of this report.

Based on a review of the plan and profile sheet (dated 03/28/2018) prepared by Alliance Consulting for the west access road, we anticipate cuts of up to 9 feet and fills on the order of 19 feet will be required to grade the proposed roadway. The grading plan also indicates a 12-foot by 12-foot underpass will be constructed over the existing drainage. A flexible pavement section is proposed for the project and we anticipate the project will include curb, gutter and sidewalk.

The Average Daily Traffic (ADT) provided by Alliance Consulting includes 2,500 to 5,000 vehicles for the west access and approximately 15,000 vehicles for the east access road. These ADT values correspond to a Traffic Index of 6 for the west side access road and 7 for the east side as provided by the City of St. George Design Criteria.

GEOLOGY AND GEOLOGIC HAZARDS

Geologic conditions at the site were evaluated by a review of geologic literature and aerial photographs. Aerial photographs used during the investigation were downloaded from the Utah Geological Survey website. They have photograph numbers of 810941 AM-4-1 and 2 and a photograph date of October 23, 1981.

A. Geologic Literature Review

The site is located in the transition zone of the Basin and Range, and Colorado Plateau provinces. Hayden and Willis (2011) map the area to be underlain by the Moenave and Chinle Formations (See Figure 1). The bedrock dips gently down to the north. The bedrock is capped by the Cedar Bench lava flow at the top of the hill. Alluvial and colluvial sediments overlie the bedrock at the northwest end of the road alignment. Landslide deposits are mapped for the south and central portions of the road alignment. A geologist from AGEC visited on September 12, 2018. The geology of the area was found to be consistent with mapping by Hayden and Willis (2011).

Geologic hazards mapped by Lund and others (2008) are mostly limited to landslide and rockfall. Rockfall is not generally a hazard for the road for the current condition of the hillside but could become a hazard depending on how cut slopes are developed for the road. Similarly, landslide is not currently a significant hazard on the slope in its present condition, but could be a concern with added water or steepened slopes. This will be addressed in the geotechnical study for the project.

B. Aerial Photograph Review

Based on review of aerial photographs of the site, faulting and debris flow are not potential hazards at the site. The area of landslide deposits appears to be similar to that mapped by Hayden and Willis (2011). Lineations formed in the landslide deposits and likely representative of intermediate landslide scarps are shown on Figure 1.

C. Seismicity

The property is located in the Intermountain Seismic Zone, which consists of an area of relatively high historical seismic activity. The most intense seismic ground shaking at the site is expected to originate from the Washington fault zone. The Washington fault zone is considered capable of producing earthquakes on the order of 7 to 7.5 magnitude and can result in significant seismic ground shaking at the site. The US Geological Survey data indicate that a peak ground acceleration in bedrock of 0.24g can be expected to have a 2 percent probability of being exceeded in a 50-year time period at this site (IBC, 2015). The St George fault zone may also add to the seismic hazard in the area, although there is no evidence that the fault displaces Holocene sediments, suggesting the fault may not be active. The St George Fault is not included in the Quaternary Fault and Fold Database (Utah Geological Survey, 2018).

ROADWAY SUBSURFACE CONDITIONS

On August 8 and 9, 2018, an engineer from AGEC visited the site and observed the excavation of 13 test pits at the approximate locations shown on Figure 2. The 8 additional test pits (TP-14 to TP-21) were excavated during a previous geotechnical investigation by AGEC in August of 1998. The subsurface profile observed within the excavated test pits at the site is highly variable and consists of lean clay, silt, silty sand with gravel, well graded sand with silt, silty gravel with sand, basalt, mudstone bedrock, and shale bedrock.

Potentially expansive mudstone was encountered in test pits TP-1, TP-2, TP-10, TP-14, and TP-15 as shown on Figures 3-5. Expansive lean clay was encountered in test pits TP-1, TP-3, TP-5, TP-6, TP-7, TP-8, TP-14, TP-16 and TP-20. The shale bedrock encountered in test pits TP-16, TP-19, and TP-21 may also contain expansive layers. The dry loose nature of the near surface silty sand with gravel encountered in test pit TP-10 indicates the material is potentially collapsible if exposed to water.

Practical excavator refusal was encountered on stiff clay and boulders in test pits TP-3, TP-7, TP-8 and TP-20. Practical excavator refusal on basalt was encountered in test pits TP-11, TP-12, TP-13, and TP-17 with refusal on shale bedrock encountered in test pit TP-19. The maximum depth investigated in the test pits was 19 feet.

Detailed descriptions of the bedrock and soil types observed follow.

Lean Clay - The lean clay is medium stiff to very stiff, moist, medium plastic, contains varied amounts of sand, gravel, and boulders (1 to 4 feet in size). The lean clay varies from red-brown to brown with white mottles in color.

Laboratory tests conducted on samples of the lean clay indicate in-place moisture contents ranging from 5 to 16 percent, in-place dry densities ranging from 93 to 124 pounds per cubic foot (pcf), gravel contents (percent retained on the No. 4 sieve) ranging from 0 to 12 percent, and fines contents (percent passing the No. 200 sieve) ranging from 62 to 96 percent. Atterberg Limits tests conducted on samples of the lean clay indicated liquid limits ranging from 27 to 48 percent and plasticity indices ranging from 14 to 35 percent.

Moisture-Density relationship (ASTM D-1557) tests conducted on samples of the lean clay from test pits TP-3 and TP-8 indicate maximum dry densities (MDD) ranging from 116.5 pcf to 123.5 pcf and optimum moisture contents (OMC) ranging from 10.0 to 12.5 percent. California Bearing Ratio (CBR) tests conducted on remolded samples of the lean clay indicate CBR values ranging from 4 to 5 percent. The samples were remolded to near 90 percent of the maximum dry density (ASTM D-1557) and approximately 2% above the optimum moisture content.

One-dimensional consolidation tests conducted on samples of the native lean clay indicate it is slightly moisture sensitive when wetted under a constant pressure of approximately 1,000 pounds per square foot (psf). Swell potentials of 1 to 1½ percent and swell pressures ranging from 2,650 psf to 3,500 psf were measured in the laboratory testing.

Remolded one-dimensional consolidation tests conducted on samples of the lean clay indicate moisture conditioned and remolded samples are still expansive when wetted. The remolded one-dimensional consolidation results indicate a reduction in expansion potential with an increase moisture content during processing.

Silt - The silt is medium stiff to stiff, slightly moist to moist, contains various amount of sand, and is reddish brown in color.

Laboratory tests conducted on samples of the silt indicate in-place moisture contents ranging from 6 to 17 percent, in-place dry densities ranging from 101 to 112 pcf, and a fines content ranging from 81 to 94 percent. Atterberg Limits tests conducted on samples of the silt indicate it is non-plastic.

Silty Sand - The silty sand is loose to medium dense, dry, fine to medium grained, contains occasional gravel, cobbles, and boulders and ranges in color from light reddish brown to brown in color.

Laboratory tests conducted on samples of the silty sand indicate in-place moisture contents ranging from 3 to 8 percent, in-place dry densities ranging from 88 to 108 pcf, a gravel content of 2 percent, and fines contents ranging from 35 to 48 percent. The relatively low dry density and moisture content of the near surface silty sand indicates it is potentially collapsible.

A Moisture-Density relationship (ASTM D-1557) test indicates the silty sand has a maximum dry density of 126.0 pcf and an optimum moisture content of 7.5 percent.

Well Graded Sand with Silt - The well graded sand with silt is medium dense, dry, contains gravel, and brown in color.

Laboratory tests conducted on samples of the silty to clayey gravel with sand indicate an in-place moisture content of 1 percent, and a fines content of 6 percent.

Silty Gravel with Sand - The silty gravel with sand is medium dense to dense, dry to moist, and light brown to brown in color.

Laboratory tests conducted on the silty gravel with sand from test pit TP-4 indicate an in-place moisture content of 11 percent.

Basalt - The basaltic rock is moderately hard to very hard, dry, highly fractured to less fractured, and black in color.

A Moisture-Density relationship (ASTM D-1557) test indicates the fractured basalt with silt and sand has a maximum dry density of 134.5 pcf and an optimum moisture content of 5.5 percent.

Mudstone - The mudstone, known locally as “blue clay” is soft to moderately hard, dry to moist, medium to highly plastic, and grey to purple in color.

Laboratory tests conducted on samples of the mudstone indicate in-place moisture contents ranging from 7 to 15 percent, in-place dry densities ranging from 96 to 118 pcf, and fines contents ranging from 59 to 99 percent. Atterberg Limits tests conducted on samples of the mudstone indicate liquid limits ranging from 35 to 76 percent and plasticity indexes ranging from 19 to 39 percent.

A Moisture-Density relationship (ASTM D-1557) test indicates the mudstone has a maximum dry density of 115.0 pcf and an optimum moisture content of 12.5 percent. A CBR test conducted on a remolded sample of the mudstone indicates a CBR value of 6 percent. The sample was remolded to near 90 percent of the maximum dry density (ASTM D-1557) and approximately 2 percent above the optimum moisture content.

One-dimensional consolidation tests conducted on natural samples of the mudstone indicate it is moisture sensitive (expansive) when wetted under a constant pressure of approximately 1,000 psf. Swell potentials of ½ to 1 percent with swell pressures of 2,170 to 4,000 psf were measured in the laboratory testing.

Remolded one-dimensional consolidation tests conducted on samples of the mudstone indicate moisture conditioned and remolded samples are still expansive when wetted. The remolded one-dimensional consolidation results indicate a reduction in expansion potential with an increase moisture content during processing.

Shale Bedrock - The shale bedrock is soft to hard, dry to slightly moist, interbedded with layers of siltstone and claystone, and dark brown to dark red in color.

Laboratory tests conducted on a sample of the shale bedrock indicate an in-place moisture content of 5 percent, an in-place dry density of 110 pcf, and a fines content of 71 percent.

The Logs, Legend and Notes of Test Pits are shown on Figures 3-5. The results of laboratory testing are also shown on Figures 3 and 4 and are summarized in the Summary of Laboratory Test Results, Table 1. The One-dimensional Consolidation Test Results are shown graphically on Figures 6-12. The Gradation/Soil Classification and Moisture-Density Relationship Test Results are shown graphically on Figures 13-17. The California Bearing Ratio Test Results are shown graphically on Figures 18-22.

ROADWAY SUBSURFACE WATER

Groundwater was not encountered during the subsurface investigation to the maximum depth investigated, approximately 19 feet. Fluctuations in the groundwater level may occur over time. An evaluation of such fluctuations is beyond the scope of this report.

EAST SLOPE STABILITY

AGEC previously investigated the subsurface conditions of the east facing slope by drilling five borings to depths varying from 110 to 250 feet. Inclinometer casings were installed at each of the five locations along with an adjacent boring to facilitate measurements of the groundwater level.

Our findings of the stability analysis are presented without the boring logs, laboratory test results, inclinometer measurements, and our calculations as stipulated in our agreement for this project.

Existing Conditions

As indicated on Figure 1, portions of both arms of the access road are located on landslide deposits. In addition to verifying the geologic mapping presented on Figure 1, the east hillside stability has been evaluated. Site conditions that reflect the material behavior and characteristics of the landslide include:

1. The hummocky nature of the ground surface along with the lineations associated with each of the landslide slumps .

2. Landslide masses will often reach equilibrium at a slope angle close to the internal material strengths. The ground surface slopes from 8 to 18 degrees (3 to 7:1 horizontal to vertical) which are consistent with the internal friction values obtained from our earlier studies and from samples tested in the laboratory.

Contributing Factors

In addition to the surface geology, the following items contribute to the status of the slope stability.

1. The bedding planes in the area generally slope down to the northeast at an angle of approximately 7 to 8 degrees.

2. The weakest clay sample tested from explorations conducted on the east slope has been found to have a residual coefficient of friction of 7.5 degrees. This angle closely matches the dip of the bedding plane. With this strength and bedding plane combination, slippage would occur on 7.5 degree downward slope if the interface strength is less than 7.5 degrees or slippage would also occur if there are areas or zones where the dip angle of the bedding plane is steeper than the 7.5 degrees.

3. Investigation into landslide movements on the east slope indicate a relatively thick deposit that contains layers of this potentially weak clay. Measurements indicate that the hillside movement occurs at multiple depths indicating similar strength characteristics throughout the deposit.

4. Groundwater was encountered in each of the deep borings.

Status of Movement

Inclinometers were installed at five locations to depths of 92 to 258 feet on the east hillside in 2007. Inclinometer Measurements were obtained in 2008, 2011 and April 4, 2018. The 2018 measurements on 4 of the 5 inclinometers are within the accuracy of the equipment indicating no measurable movement.

The inclinometer located immediately west of the vacant restaurant, located at 1090 South Bluff Street, was measured before 2011. Displacement was measured at multiple depths.

Geotechnical Testing Services (GTS) installed an inclinometer on a berm placed behind the restaurant. We understand that recent measurements by GTS indicate lateral movement of approximately 0.7 inches in the last 5 years.

Anticipated Performance

With the lack of measured movement in the 4 inclinometers over the past 10½ years along with the lack of surficial evidence of movement, it is apparent that the portion of the slope for this project is currently maintaining its stability. Using the information available from our subsurface exploration, the laboratory test results along with our experience in the area, it is our professional opinion that the stability of the slope is marginal even with the lack of apparent movement.

With these conditions, small changes in the slope configuration or weakening of the material strengths in the slope could trigger future movement.

As stated in the 1996 Transportation Research Board, Special Report 247, (entitled Landslides, Investigation and Mitigation), "…old landslides are often barely stable, and they may not have significant resistance to new loadings or other changed conditions that tend to reduce their stability. Changing natural drainage patterns on the surfaces of old landslides may significantly influence their stability and cause unwanted movements. Thus, the decision to construct transportation facilities over ancient landslides must be carefully investigated and appropriate consideration given to remedial measures and long-term stability".

It is important to recognize that marginal stability of the slope indicates that:

1. A calculated factor of safety using the parameters selected to characterize the materials in the slope and the existing configuration is near 1.0 and will not meet the standard acceptable level of at least 1.5.

2. Changes in the internal conditions and/or surficial geometry modifications may improve or reduce the ability of the slope to maintain its stability. It may not be practical to quantify with confidence the impact that internal changes may have provided.

3. It is a matter of time before more movement on the slope occurs. Determining a location and/or timing of such an event is not possible with the information currently available.

4. A seismic event could introduce sufficient lateral load to initiate slope movement.

Mitigation

If the decision is made to continue with construction of the roadway on the landslides, we recommend the following items be seriously considered:

1. Introduction of moisture into the subgrade should be minimized if not eliminated. This could be accomplished by:

    a. Collecting and transporting surface drainage off of the slope in watertight catch basins and piping. This is not standard storm drainage procedures therefore, this would require specific attention to verify that the improvements are watertight.

    b. Water ways should be lined to prevent seepage into the ground.

    c. Measures need to be taken to eliminate the potential for water to pond on the slope.

    d. No water bearing utilities should be installed within the landslide area.

2. Cut and fill slopes need to be minimized. Overall impact of potential grade changes should be evaluated and the consequence of the change found to be acceptable before proceeding.

3. Water entering the ground in all areas above the slope (within the Tech Ridge area) should be reduced and ideally eliminated. Some, if not all, of the methods described above should be considered within the Tech Ridge area.

ROADWAY RECOMMENDATIONS

The following recommendations are provided with the assumption that all stakeholders recognize and accept the risk of landslide movement. The recommendations are based on the proposed construction, information obtained from the field and laboratory testing, engineering analysis, and our experience in the area.

A. Site Grading

Based on the subsurface conditions and the proposed grading provided by Alliance Consulting, the following recommendations are provided:

1. Subgrade Preparation

a. *General Subgrade Preparation*: Prior to conducting site grading, vegetation and soil containing significant amounts of roots and organics should be removed. Loose/disturbed soil, debris, deleterious material, previously placed fill, and undiscovered fill should be removed to the full depth.

b. *Expansive Mudstone and Lean Clay Subgrade Areas*: To reduce the potential for wetting and subsequent swelling of the expansive subgrade supporting the proposed roadway, we recommend the expansive mudstone and lean clay areas be overexcavated to remove a portion of the expansive material and it replace with properly compacted, low permeable fill. The low permeable fill is intended to provide a less permeable zone which reduces the potential for infiltration of water to the underlying expansive mudstone and lean clay. If the natural moisture content of the expansive mudstone and lean clay is maintained, distress to the asphalt/sidewalk and curb will be reduced.

Prior to placing the low permeable fill and subsequent to overexcavation, the exposed subgrade should be scarified a minimum of 8 inches, moisture conditioned to 4 to 6 percentage points above the optimum moisture content and compacted to 90 percent of the maximum dry density as determined by ASTM D-1557.

We recommend overexcavation and replacement of the expansive mudstone and lean clay be performed to provide a low permeable zone above expansive materials and reduce the risk of wetting and potential heave. The surface heave estimates are provided in the following table. The estimates are based on an assumed active zone (wetted depth) of 10 feet. The heave estimates should be used to assist in determining the depth of overexcavation and replacement desired based on the associated risk of surface heave.

Depth to Expansive Soil Below Finished Subgrade Elevation (feet)	Estimated Potential Surface Heave (inches)
0	3 to 4½
2	2½ to 4
4	2 to 3
6	1 to 2½

c. *Sand, and Gravel Areas (All Other Subgrades Encountered)*: Subsequent to grubbing and prior to placing fill, base course, or asphalt pavement, the exposed subgrade beneath pavement and fill slope areas should be scarified to a depth of 8 inches, moisture conditioned and properly compacted to at least 95 percent of the maximum dry density as determined by ASTM D-1557.

If the exposed subgrade consists of loose, dry silty sand or silty gravel (potentially collapsible soils), we recommend this soil be overexcavated to remove the full depth of this material. An engineer from AGEC should observe the exposed subgrade to provide guidance regarding the subgrade preparation in these areas.

d. *Potentially Soft Subgrade (Encountered in Area of TP-4):* Potentially soft subgrade conditions may be encountered near TP-4 resulting from heavy equipment and very moist subgrade conditions observed in the test pit. If soft/pumping conditions are encountered subgrade stabilization may be implemented using overexcavation to remove the soft soils or by implementing gravel and geosynthetic reinforcement may be necessary. Additional details may be provided upon request.

2. Excavation/Earthwork

The on-site soils and soft mudstone bedrock may be excavated with conventional excavation equipment. Excavations extending into large boulders, potential cemented zones, basalt and hard shale bedrock will likely require the use of heavy excavation equipment such as a trackhoe equipped with rock teeth or a single ripper tooth. A rock hammer may also be necessary to excavate portions of the basalt or shale bedrock. Difficulty may be particularly evident in confined excavations.

3. Grading Slopes

Review of the grading plan for the west side access road indicates existing slopes along the road alignment of the project will be excavated and cut to construct the roadway. We also anticipate grading along the east side access road will require cuts into hillside. Our experience with soil cut and fill slopes in the area has shown soils will tend to erode over time to their natural angle of repose. The following table provides recommendations for guidance of cut slopes based on the observed onsite soils:

Expected Soil Condition	Grading Recommendations (Horizontal:Vertical)
Basalt	½:1
Lean Clay	¾ :1
Silty Sand and gravel	1:1
Shale and Mudstone Bedrock	½ :1 (if faced) or 1½ :1 (if not faced)

Mudstone and clay slopes cut steeper than 1½ :1 would remain stable, but will dessicate, and likely ravel naturally to approximately a 1½ :1 slope. This process will require long term maintenance to remove the accumulated soils deposited at the toe of the slope. If this process is not acceptable, steep slopes may be flattened or faced to provide protection from weathering and erosion. Stacked rockery facing or reinforced gunnite facing anchored with soil nails may be considered to protect steeper cut slopes. Design and recommendations associated with reinforced/stabilized cut slopes are beyond the scope of AGEC's services.

Additionally, several existing cut slopes are part of a larger ancient landslide deposit. This analysis does not address the potential development, re-activation or stabilization of larger scale slope movement as could be possible due to the site being part of the larger landslide deposit.

We recommend fill slopes constructed with onsite soil not exceed a 2:1 (horizontal:vertical) slope. Fill slopes should be graded by overbuilding and then cutting them back to the desired grade to provide a compacted slope face. Fill placed on existing slopes steeper than 4:1 (horizontal to vertical) should be placed using a benching procedure to "key" the fill into the existing slope. Benches should be of sufficient width to extend fill placement through loose/surficial soils or to meet the criteria given in the following table, whichever is greater.

Approximate Slope Grade (Horizontal:Vertical)	Bench Width (feet)
1:1	2
2:1	4
3:1	6
4:1	8

4. Materials

The on-site granular soils such as the silty gravel with sand (GM), silty sand (SM), and well graded sand with silt (SW-SM) free of organics, debris, and material greater than 6 inches in size, are suitable for use as site grading fill. Oversized rocks (greater than 6 inches and smaller than 12 inches) may be used as fill at depths greater than 3 feet below finished subgrade. The oversized rock should be placed so that rock to rock contact is avoided to reduce potential voids and nesting of rocks.

The on-site fine grained soils range between non-plastic silt to low to medium plastic lean clay and highly plastic mudstone. The silt and portions of the lean clay observed in test pits TP-7 and TP-8 are suitable for use as low permeable fill above expansive subgrade. The on-site expansive soils (mudstone and lean clay) free of organics may be used as site grading fill in areas not supporting the roadway. The mudstone and the expansive lean clay should not be used as fill within 6 feet of the finished roadway subgrade elevation without accepting potential surface heave risks.

Listed below are the materials recommended for fill.

Area	Fill Type	Soil Type
Roadway	Untreated Base Course	CBR > 70%, **200** < 12% Maximum size: 1 inch
Roadway	Site Grading and Embankment Fill	**-200** < 35%, **LL** < 30% Maximum size: 4 inches Solubility < 1%

-200 = Percent Passing the No. 200 Sieve

LL = Liquid Limit

The potential impact of the expansive characteristics of the underlying expansive mudstone and lean clay can be reduced by protecting the expansive material from becoming wet. Placement of relatively low permeable fill above the expansive soil/bedrock can help reduce the possibility of water coming in contact with the expansive material.

Low permeable fill used to replace removed expansive soil should meet at least one of the following options:

Option No.	Liquid Limit (%)	Percent Passing the No. 200 Sieve
1	50+	15-20
2	30-50	20-40
3	0-30	30-100

Based on the above criteria, we anticipate some of the on-site soils will be suitable for use as low permeable fill. Mixing of onsite soils (lean clay and mudstone) with non-expansive fill may be necessary to produce low permeable fill meeting the above requirements. If mixing will be considered, AGEC should be contacted to conduct additional laboratory testing to determine mixing/blending recommendations.

5. Compaction

Compaction of fill materials placed at the site should meet the following moisture content criteria and equal or exceed the following compaction criteria:

Area	Moisture Content	Percent Compaction
Low Permeable Fill	+2% to +4% above OMC	90%
Subgrade - Expansive Materials	+4% to +6% above OMC	90%
Subgrade - Non-expansive Materials	± 2% of OMC	90%
Roadway Fill - Expansive Materials	+4% to+ 6% above OMC	90%
Roadway Fill - Non-expansive Materials	± 2% of OMC	95%
Roadway Base Course	± 2% of OMC	95%

OMC = Optimum moisture content

Fill tested should be compared to the maximum dry density as determined by ASTM D-1557. Soils placed as site grading fill should be moisture conditioned to the above recommendations. Soil at the site was generally below the optimum moisture content and will require moisture conditioning prior to placement to achieve the required compaction.

It is critical that the low permeable fill is moisture conditioned over the optimum moisture content (as recommended) to provide the low permeable properties necessary for the application. If the low permeable fill is placed dry of the optimum moisture content, the permeability or infiltration rate of water will be higher.

Fill should be placed in lift thicknesses which do not exceed the capacity of the compaction equipment used. Generally 6 inch loose lifts are appropriate for heavy rubber-tire compaction equipment. Lift thickness should be reduced to 4 inches for hand compaction equipment. Fill placed at the site should be tested frequently to verify proper compaction.

B. Soil Corrosion

Our experience has shown the on-site soils, bedrock and many import soils may contain sulfates in sufficient concentration to be corrosive to concrete. Therefore, we recommend concrete elements that will be exposed to the on-site soils be designed in accordance with provisions provided in the American Concrete Institute Manual of Concrete Practice (ACI) 318-14 Chapter 19. Tables 19.3.1.1 and 19.3.2.1 of ACI 318-14 should be referenced for design of concrete elements utilizing a Sulfate Exposure Class of S2.

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

C. Pavement Analysis and Design

The following pavement design criteria were used in our pavement design based on the UDOT Pavement Management and Pavement Design Manual dated November, 1998 and updated March, 2008.

- A 20 year design life with ADT values of 2,500 to 5,000 for the west access road and 15,000 for the east access road were provided by Alliance Consulting. These traffic conditions correspond to a Major Collector (TI = 6) for the west access roadway and a Minor Arterial (TI = 7) for the east access roadway according to the St. George City Design Specifications.
- A Standard Deviation of 0.45.
- Initial and Terminal Serviceabilities of 4.2 and 2.5, respectively.
- A Reliability of 90 percent.
- CBR values of 4 and 10 percent for varying on-site soil types.
- A Subgrade Resilient Modulus of 1500*CBR value.
- A Untreated Base Course Resilient Modulus of 27,000 psi.
- A Granular Borrow Resilient Modulus of 15,000 psi.
- Layer Coefficients of 0.4, 0.1, and 0.08 for the hot mix asphalt, untreated base course, and the granular borrow, respectively.
- A Drainage Coefficient of 1 for the untreated base course and the granular borrow.

D. Pavement Support, Section, and Materials

Based on the subsurface conditions encountered, UDOT/AASHTO Design methods, and a 20-year design life, the following recommendations are given. Although the following pavement sections are based on a 20 year design life, the life span of the pavement may be shorter if not properly maintained, drained, and due to the presence of expansive materials, and landslide deposits below the roadway on some portions of the project.

1. Subgrade Support

The subgrade should be prepared as outlined in the Site Grading section of this report. We anticipate the subgrade materials at the site will generally consist of lean clay, mudstone, silty sand and gravel, and silty gravel with sand.

AGEC measured CBR values ranging from 4 to 33 percent from remolded samples of the on-site soils obtained from the test pit excavations. For the purpose of this report, a CBR value of 4 was used for design of pavement supported over the mudstone and lean clay and a CBR value of 10 was used for the design of pavement supported over the remaining subgrade soils encountered at the site.

2. Pavement Thickness

Refer to the following tables for pavement section thicknesses.

East Access Roadway (TI = 7)

Subgrade Type	CBR Value	Asphalt Thickness (in)	Base Course Thickness (in)
Mudstone and Lean Clay	4	4	12
Other Soils	10	3½	8

West Access Roadway (TI = 6)

Subgrade Type	CBR Value	Asphalt Thickness (in)	Base Course Thickness (in)
Mudstone and Lean Clay	4	3½	8
Other Soils	10	3	6

3. Pavement Materials

The pavement materials should meet St. George City specifications for gradation and quality. The pavement thicknesses indicated above assume that the base course is a high quality material with a CBR of at least 50 percent and the asphaltic concrete has a minimum Marshal stability of 1,800 pounds.

Other materials may be considered for use in the pavement section. The use of other materials may result in other pavement material thicknesses.

E. Drainage and Maintenance

The collection and diversion of drainage away from the pavement surface is extremely important to the satisfactory performance and life span of the pavement section and the slope stability. Proper drainage and precautions presented in the stability section should be provided.

Due to the moisture sensitivity of the on-site mudstone and portions of the lean clay, it is critical that infiltration of water be minimized to reduce the potential for future movement of pavement and utilities. Maintaining natural soil moisture conditions of the moisture sensitive soil and bedrock reduces potential for expansion of underlying soil/bedrock and subsequent heave. To reduce infiltration, we recommend the following:

1. Maintain positive site drainage during and following construction. Ponding of water should be eliminated.

2. Surface drainage of streets should be maintained by providing sufficient crown/grade in the road to direct flows into the curb/gutter systems or off of roadway improvements in areas not including curb and gutter. Positive flow of the gutters should be provided and maintained.

3. Seams and joints in the asphalt and concrete should be properly sealed to reduce infiltration of water to the underlying expansive soil/bedrock.

4. Maintenance should be provided to maintain asphalt cracks which may occur over time.

F. Construction Materials Observation and Testing

Construction materials observation and testing should meet St. George City testing requirements. We also recommend the following be conducted during the construction of the roadway.

1. Verify that the subgrade is properly prepared prior to placing fill and the recommended overexcavation depths are achieved to expose the underlying competent basalt.

2. Observe the placement and conduct compaction testing on each foot of site grading fill placed in roadway areas and within utility trenches.

3. Conduct materials testing on road-base, concrete, and asphalt in accordance with St. George City standards.

G. Geotechnical Recommendation Review

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

LIMITATIONS

This report has been prepared in accordance with generally accepted soil engineering practices in the area for design purposes. The conclusions and recommendations included within the report are based on the information obtained from the borings drilled and the test pits excavated at the locations indicated on the site plan, the results of laboratory testing, the referenced documents and our experience in the area. Variations in the subsurface conditions may not become evident until additional exploration or excavation is conducted. If the subsurface soil or groundwater conditions are found to be different from what is described in this report, we should be notified to reevaluate the recommendations given.

Sincerely,

APPLIED GEOTECHNICAL ENGINEERING CONSULTANTS, INC.





Jake Erickson, P.E.

James E. Nordquist, P.E.

Reviewed by Arnold DeCastro, P.E.

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References

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

International Building Code, 2015; International Code Council, Falls Church, Virginia.

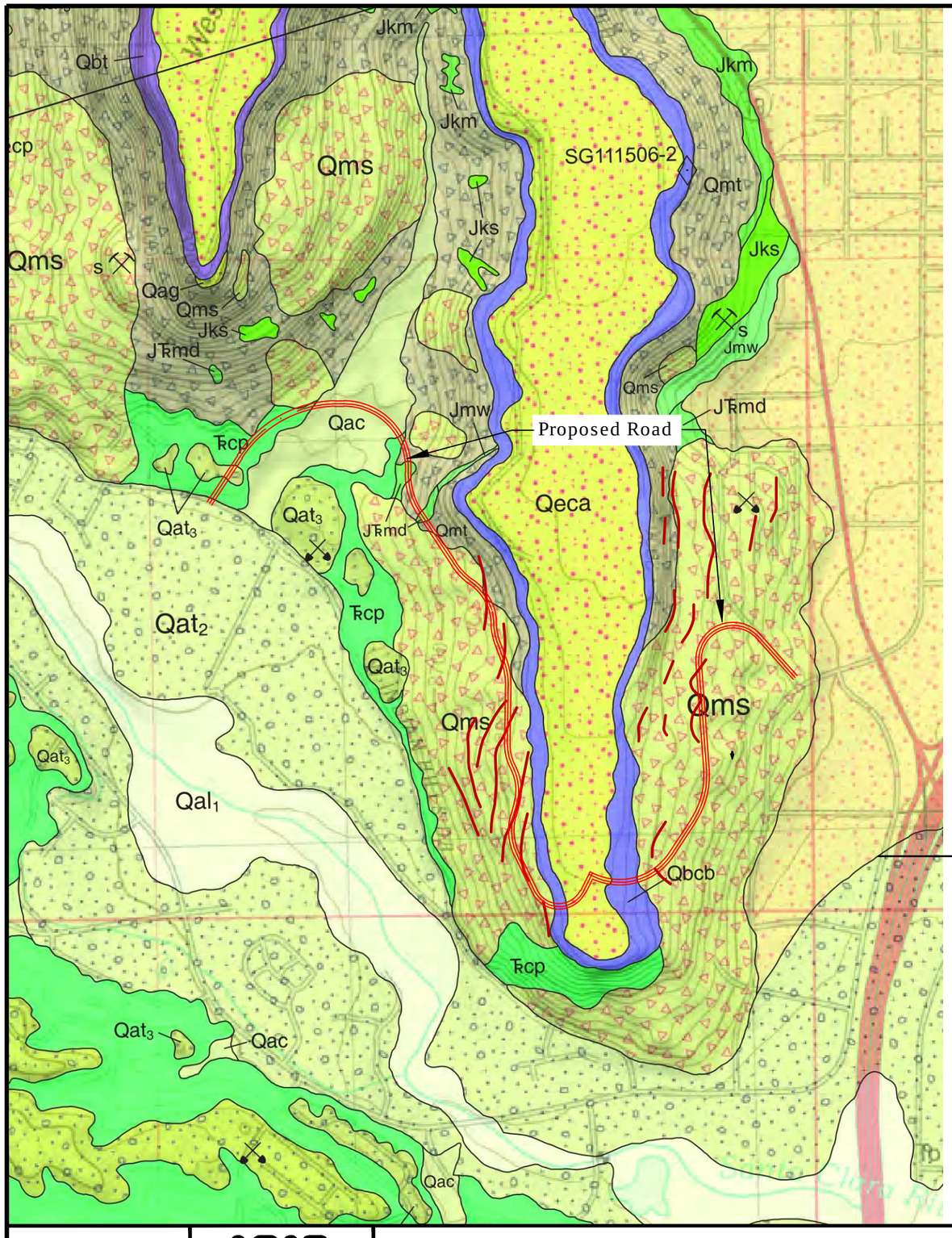
Lund, W.R., Knudsen, T.R., Vice, G.S. and Shaw, L.M., 2008; Geologic hazards and adverse conditions, St George-Hurricane metropolitan areas, Wasatch County, Utah, Utah Geological Survey Special Study 127.

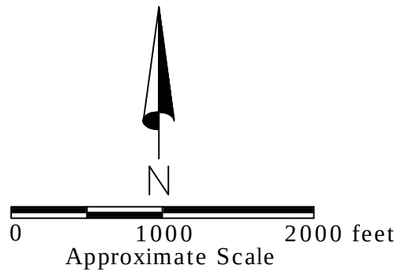
Utah Geological Survey, 2018; Utah Quaternary Fault and Fold Database, http://geology.utah.gov/resources/data-databases/qfaults/ Accessed September 24, 2018.

"Pavement Management and Pavement Design Manual", Utah Department of Transportation, November 1998, updated March 2008.

"Landslide-Hazard Map for the St. George-Hurricane Metropolitan Area", Utah Geological Survey, 2008.

"St. George Geologic Map Overlay", Utah Geological Survey, 2013.





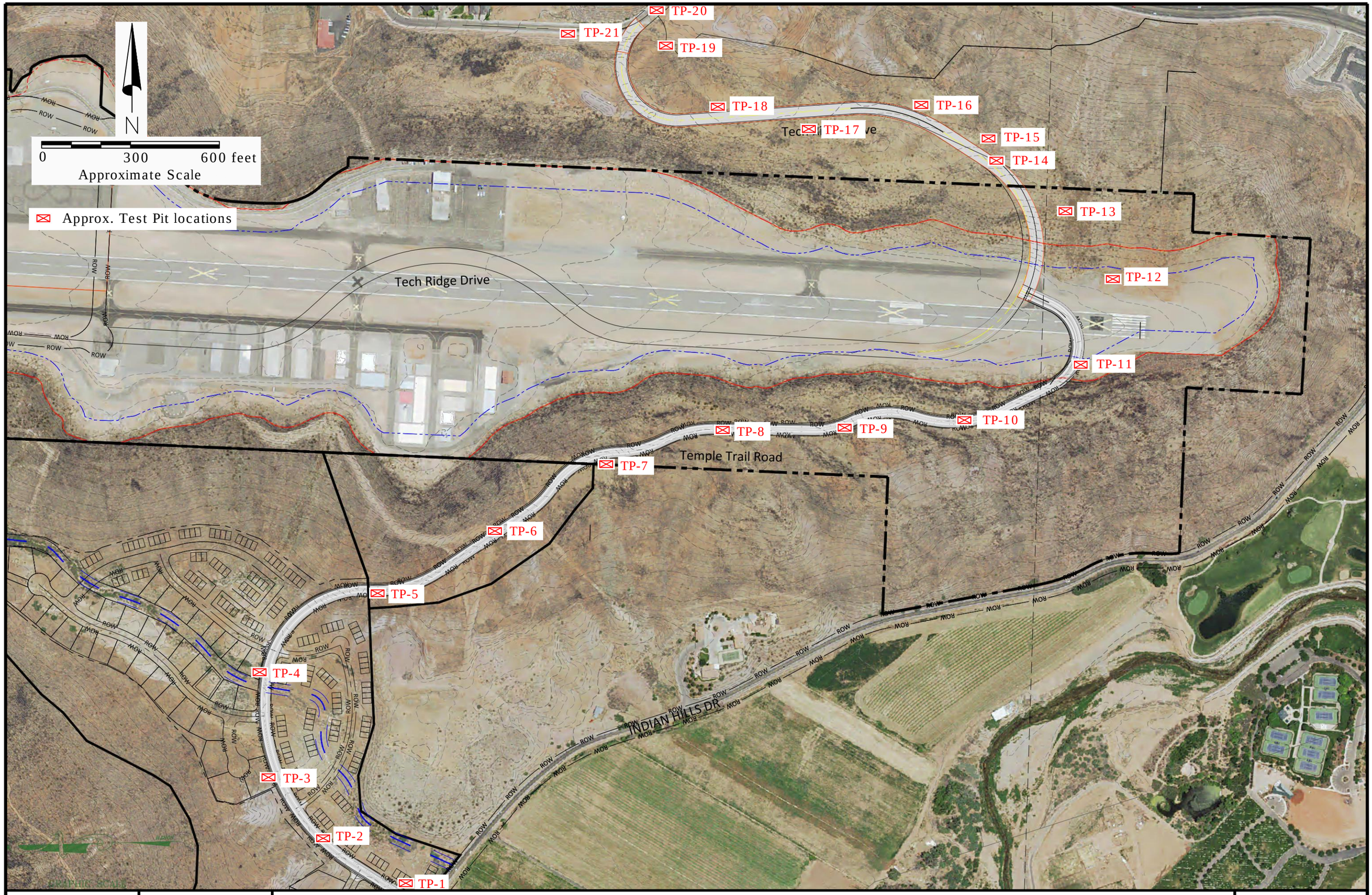
Explanation of Symbols and Geologic Units in Area of Proposed Road

Qal_1	-	Stream alluvium (Holocene)
Qac	-	Mixed alluvial and colluvial deposits (Holocene to upper Pleistocene)
Qeca	-	Eolian and alluvial deposits (Holocene to lower Pleistocene)
Qat_2	-	Alluvial-terrace deposits (Holocene)
Qat_3	-	Alluvial-terrace deposits (late Pleistocene)
Qmt	-	Talus deposits (Holocene to upper Pleistocene)
Qms	-	Landslide deposits (Holocene to middle Pleistocene)
Qbcb	-	Cedar Bench lava flow (lower Pleistocene)
Jmw	-	Whitmore Point Member of the Moenave Formation (Lower Jurassic)
JTrmd	-	Dinosaur Canyon Member of the Moenave Formation (Lower Jurassic)
Trcp	-	Petrified Forest Member of the Chinle Formation (Upper Triassic)
		Lineation within the landslide deposits
		Approximate location of proposed access roads

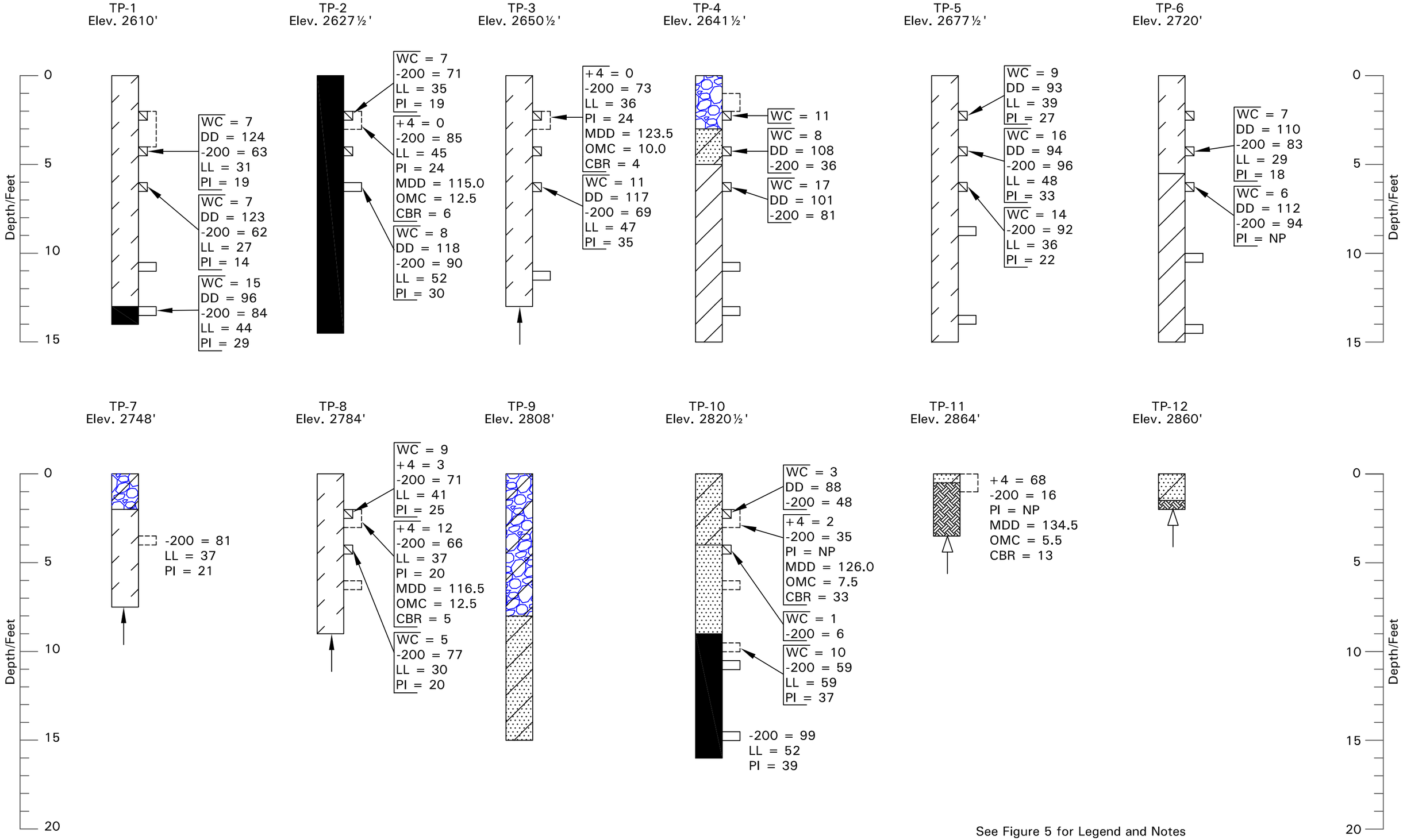
TECH RIDGE SOUTH ACCESS ROAD
ST. GEORGE, UTAH

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

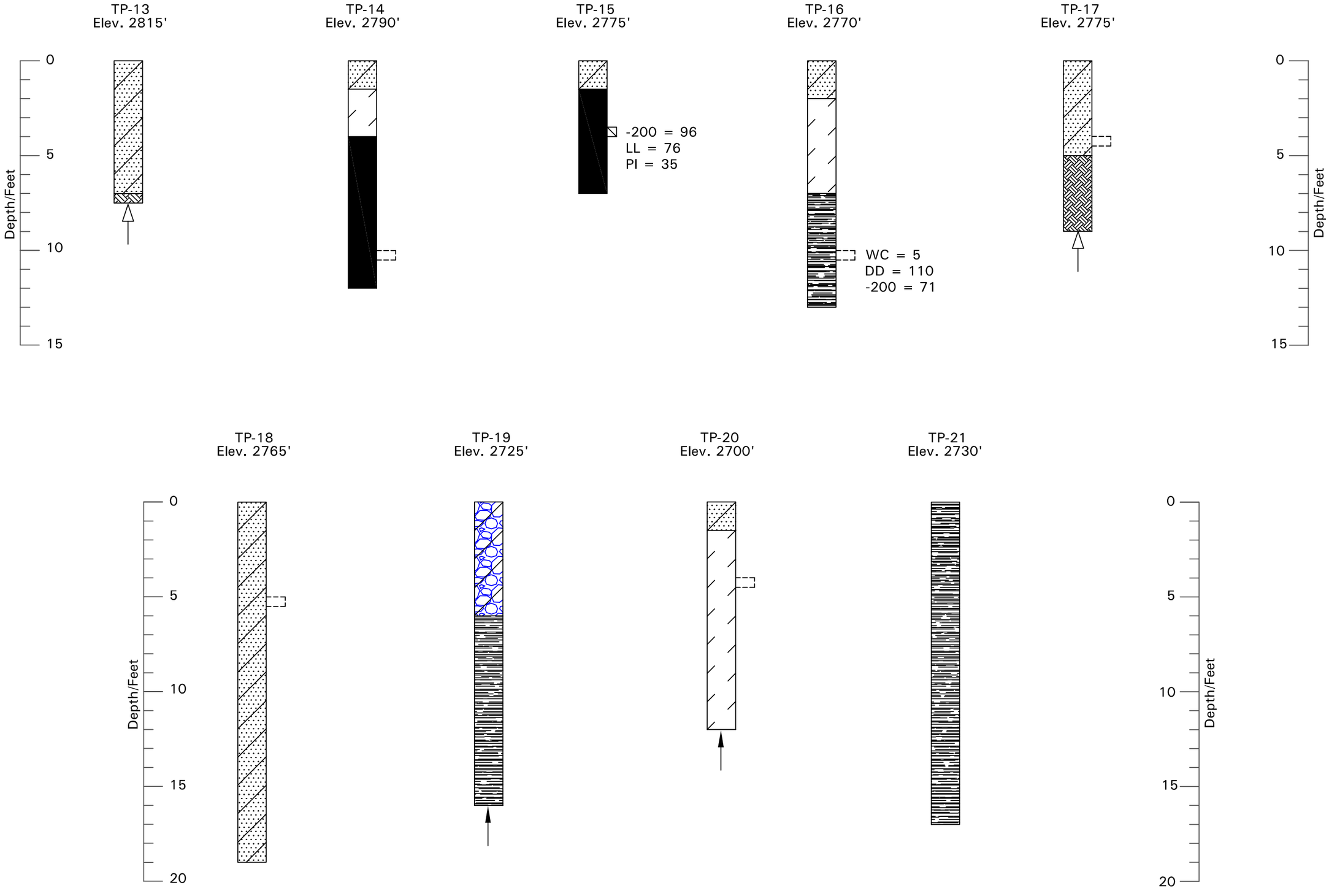
2180295	AGEC	Vicinity and Geologic Map	Figure 1



2180295	AGEC	Test Pit Locations	Figure 2



See Figure 5 for Legend and Notes



See Figure 5 for Legend and Notes

LEGEND:

Lean Clay (CL); medium stiff to very stiff, moist, medium plastic, contains varied amounts of sand, gravel, and boulders (1 to 4 feet in size), red-brown to brown with white mottles.

Silt (ML); medium stiff to stiff, slightly moist to moist, contains various amounts of sand, reddish brown.

Silty Sand (SM); loose to medium dense, dry, fine to medium grained, contains occasional gravel, cobbles and boulders (1 to 4 feet in size), light reddish brown to brown.

Well Graded Sand with Silt (SW-SM); medium dense, dry, contains gravel, brown.

Silty Gravel with Sand (GM); medium dense to dense, dry to moist, light brown to brown.

Basalt; moderately hard to very hard, dry, highly fractured near surface, black.

Mudstone; soft to moderately hard, dry to moist, medium to highly plastic, grey to purple.

Shale Bedrock; soft to hard, dry to slightly moist, interbedded with layers of siltstone and claystone, dark brown to dark red.

Indicates relatively undisturbed hand drive sample taken.

Indicates relatively undisturbed block sample taken.

Indicates disturbed sample taken.

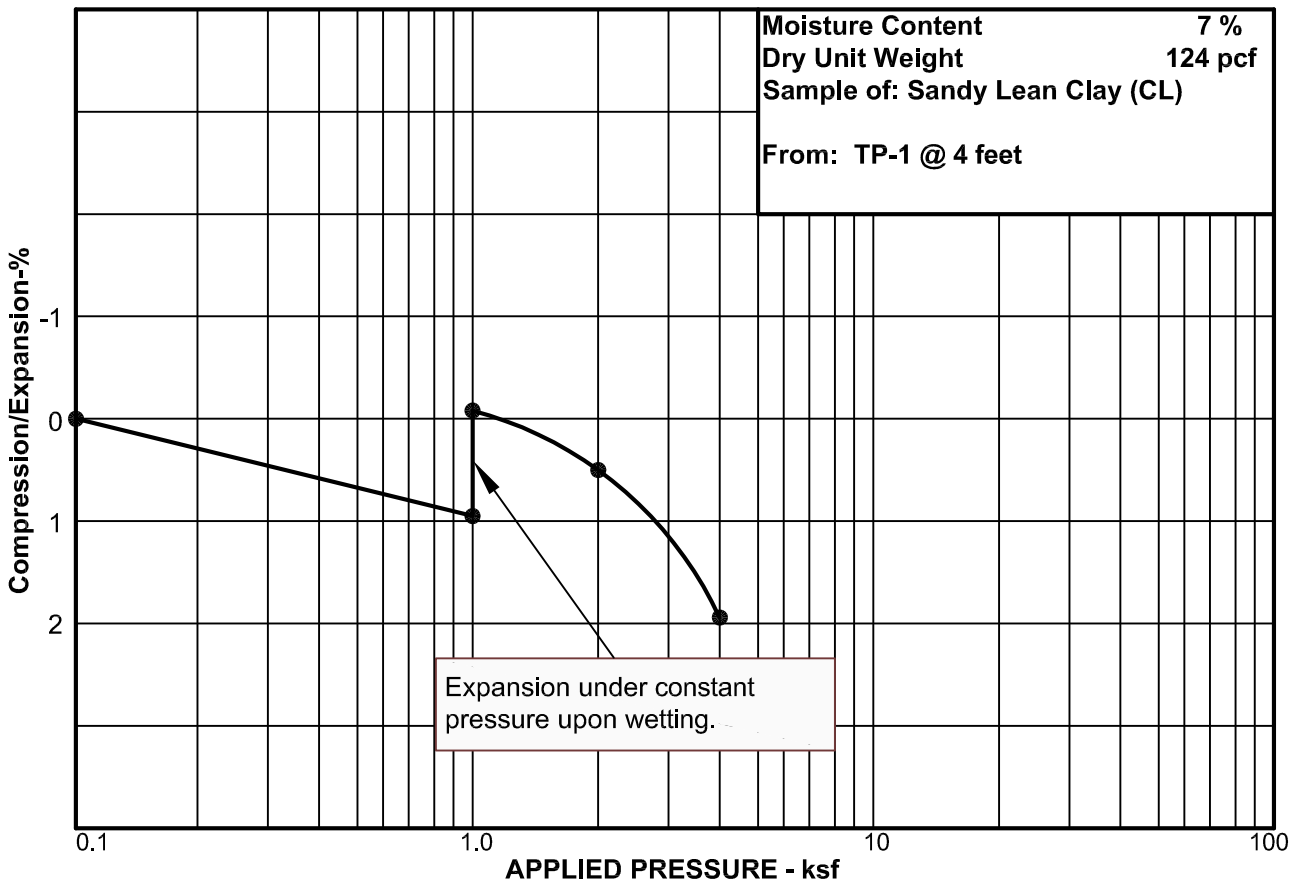
Indicates practical backhoe refusal on stiff clay and boulders or shale bedrock.

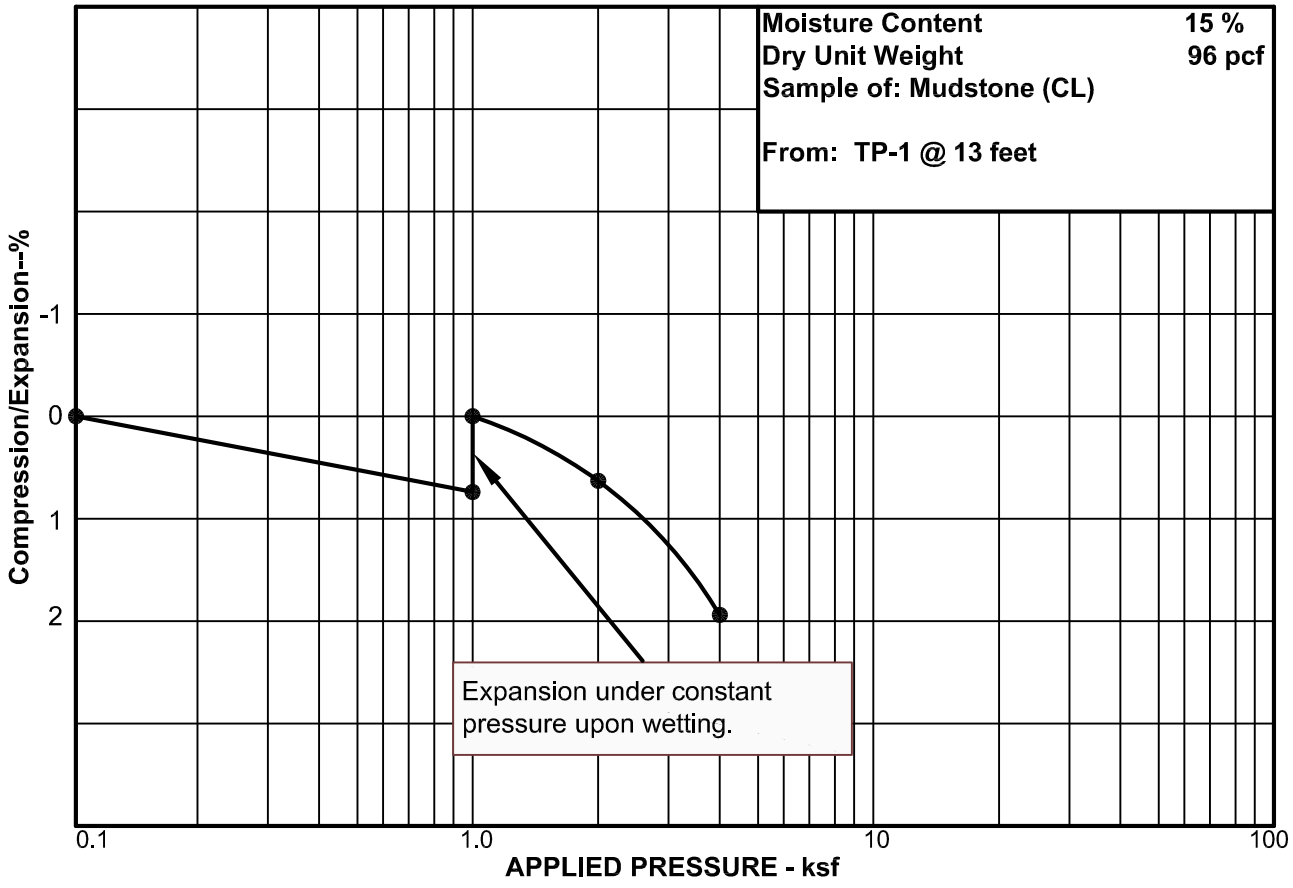
Indicates practical backhoe refusal on basalt.

NOTES:

1. Test pits TP-1 through TP-13 were excavated on August 8 and 9, 2018 and test pits TP-14 through TP-21 were excavated on August of 1998 with a trackhoe.
2. The locations and elevations of test pits TP-1 through TP-11 were measured using roadway centerline stakes, which were located using GPS by others.
3. The locations of test pits TP-12 through TP-21 were located by pacing from features shown on Figure 2. The elevations of test pits TP-12 through TP-21 were interpolated between contours shown on Figure 2.
4. The test pit locations and elevations should be considered accurate only to the degree implied by the method used.
5. The lines between the materials shown on the test pit logs represent the approximate boundaries between material types and the transitions may be gradual.
6. Free water was not encountered in the test pits at the time of excavation.
7. WC = water content (%);
   DD = dry density (pcf);
   +4 = percent retained on the No. 4 sieve;
   -200 = percent passing No. 200 sieve;
   LL = liquid limit (%);
   PI = plasticity index (%);
   NP = non-plastic;
   MDD = maximum dry density (pcf);
   OMC = optimum moisture content (%);
   CBR = california bearing ratio (%).

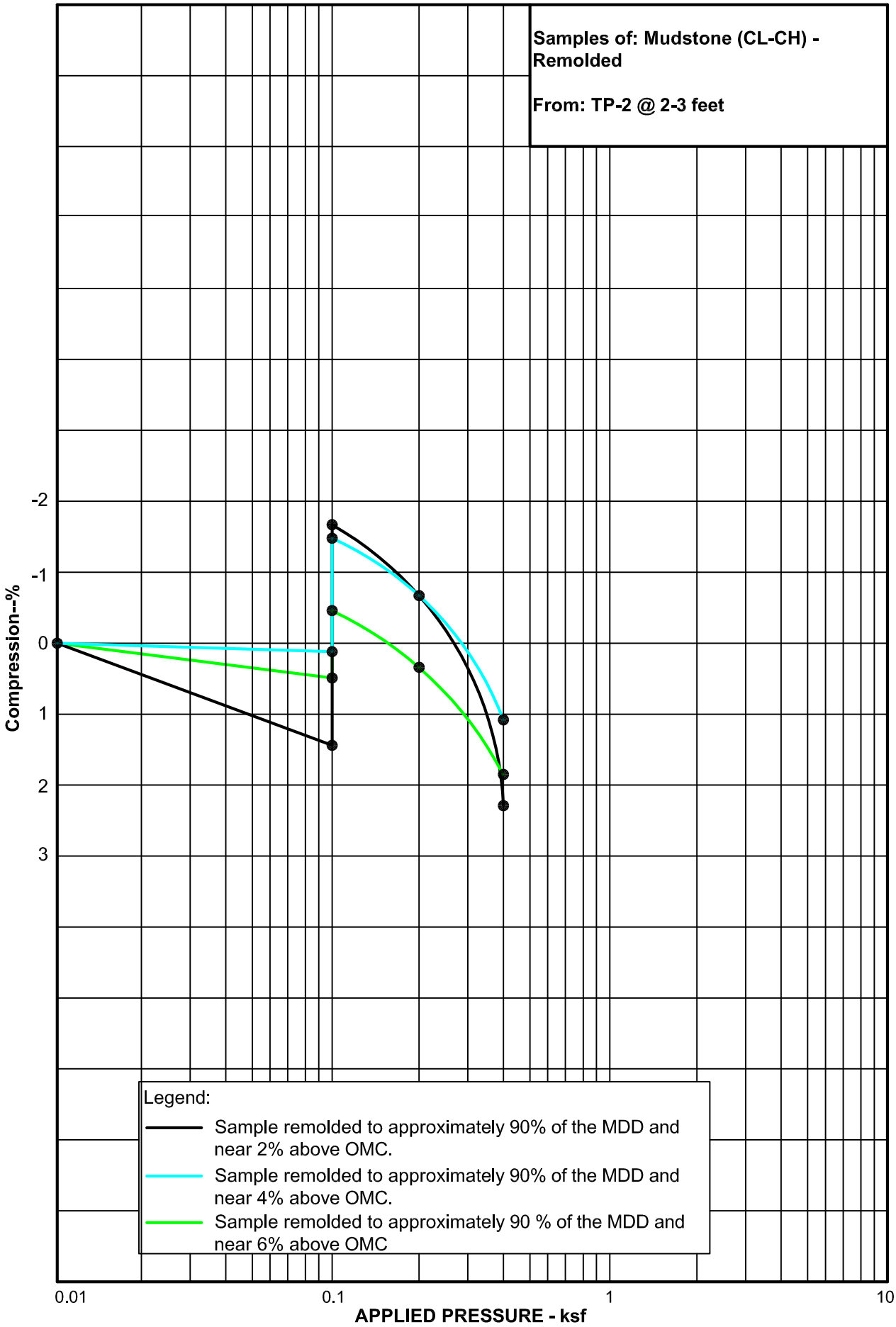
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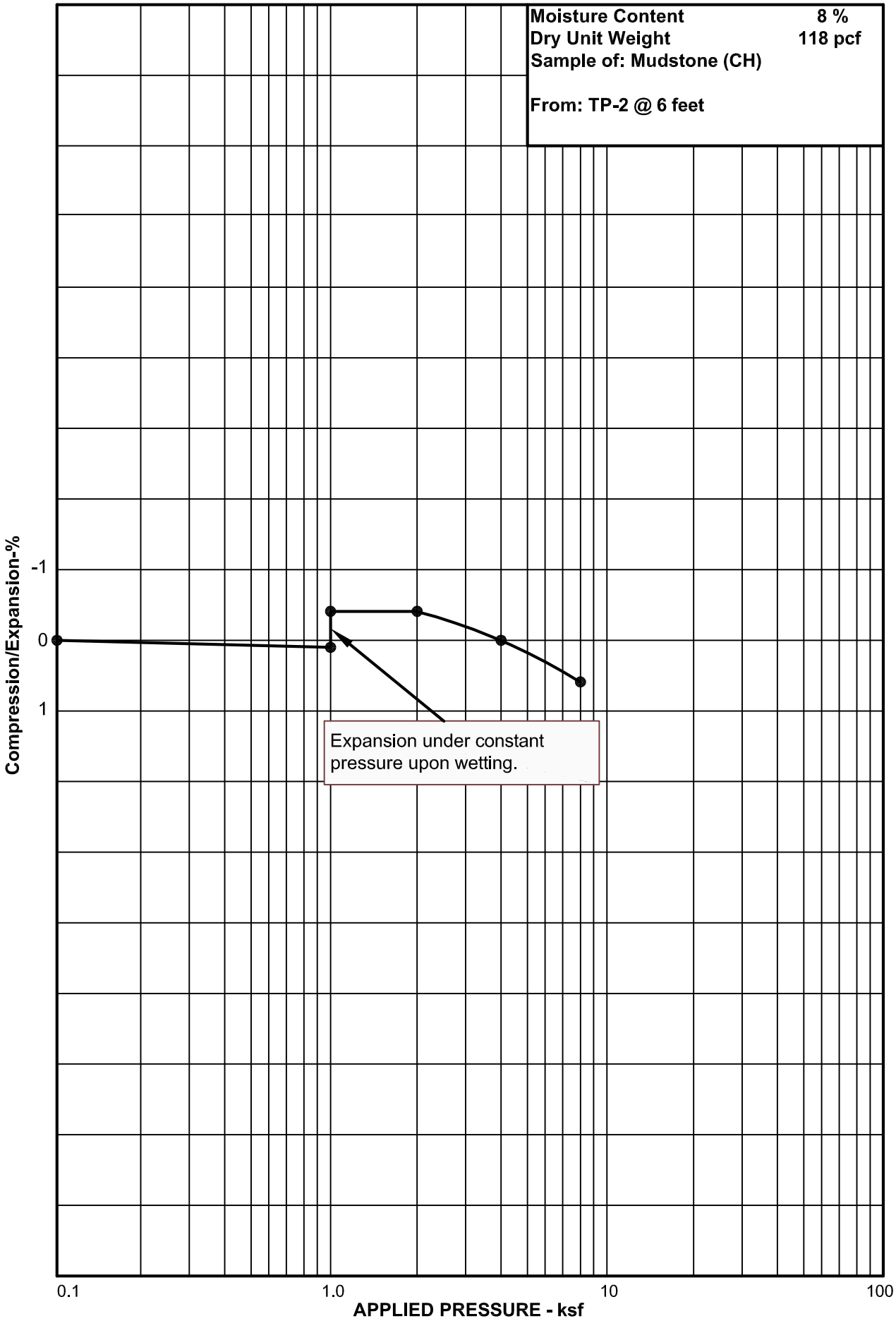
Project No. 2180295 **CONSOLIDATION TEST RESULTS** **Figure 6**

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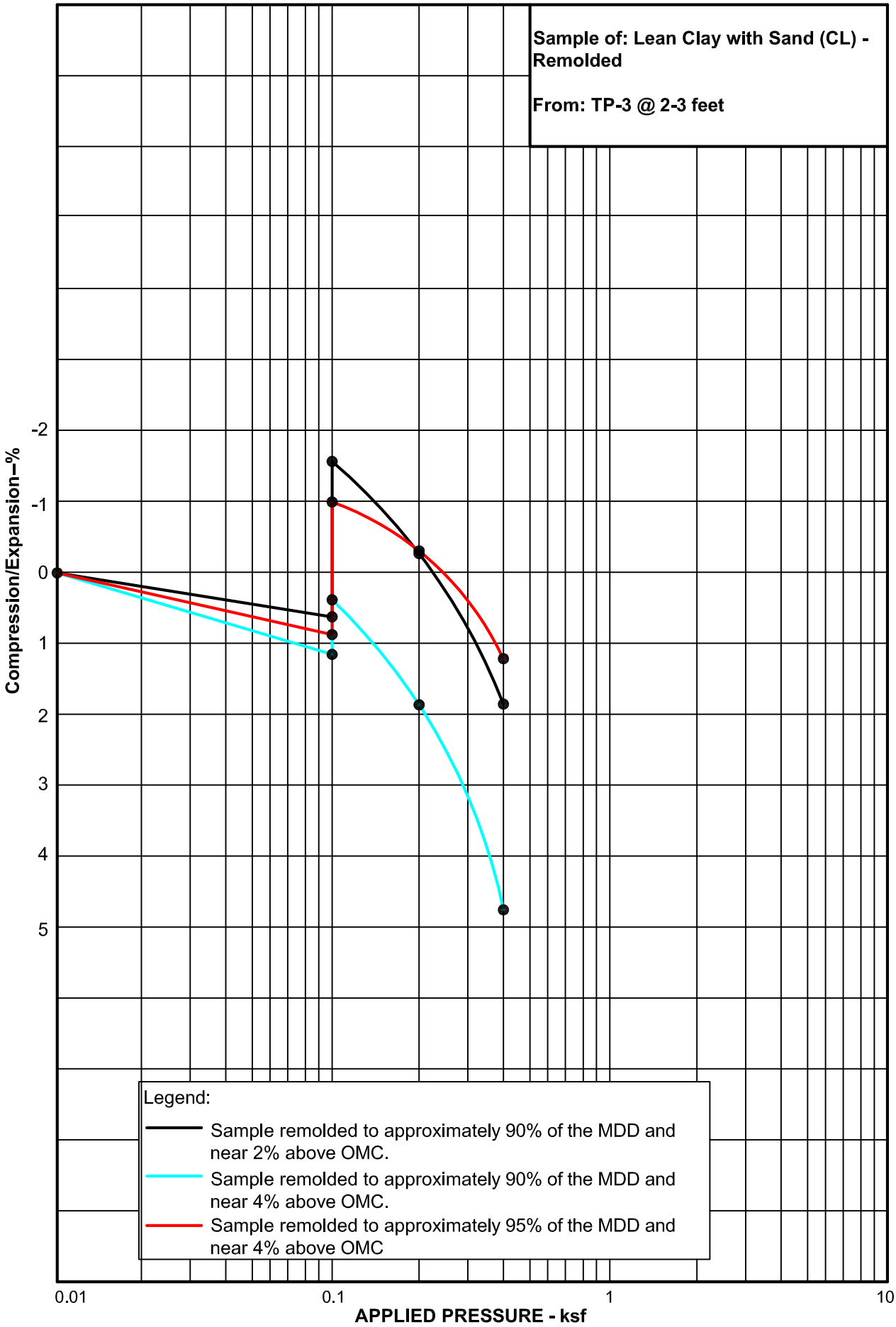
Project No. 2180295 **CONSOLIDATION TEST RESULTS** **Figure 7**

Applied Geotechnical Engineering Consultants, Inc.



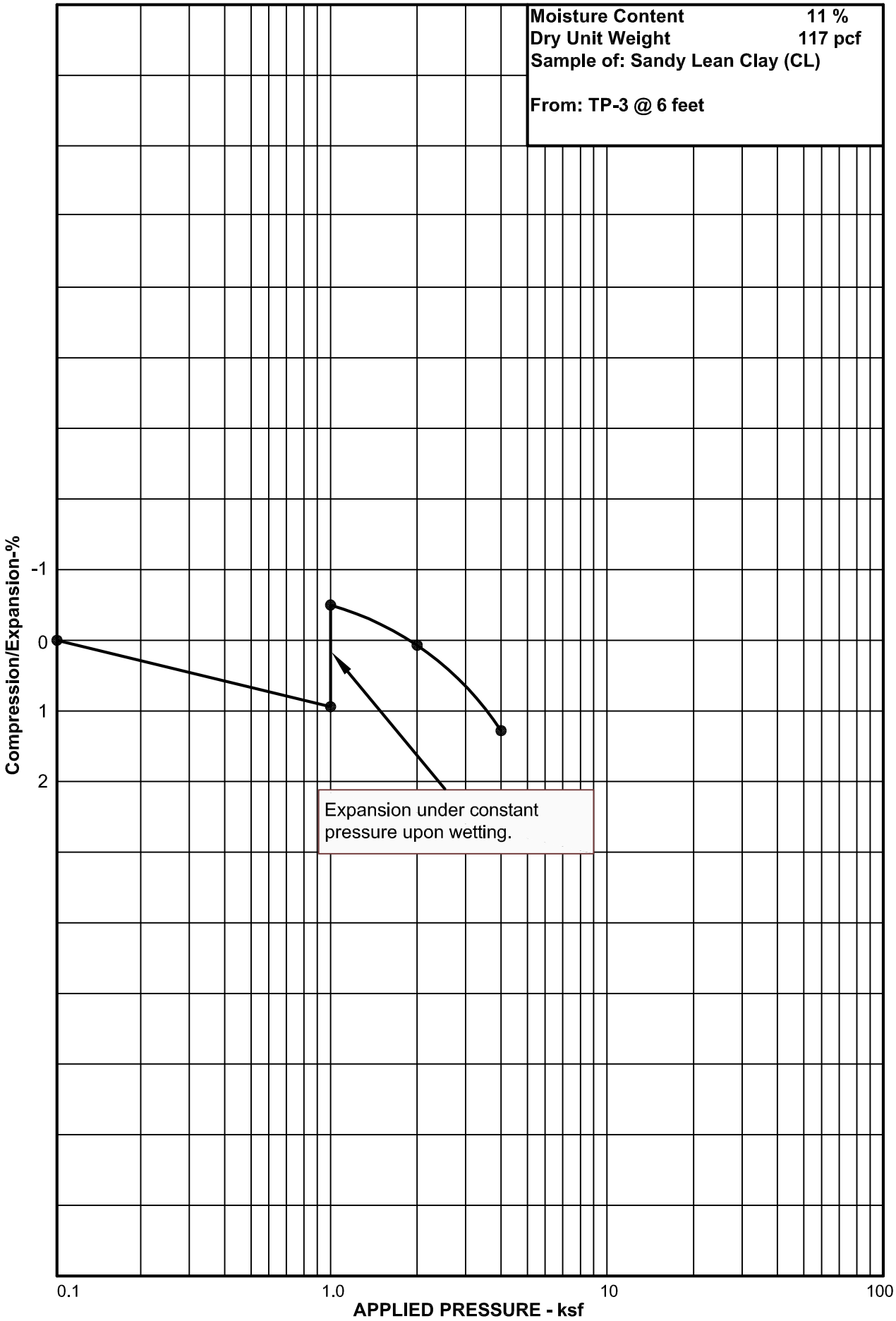
Project No. 2180295 **CONSOLIDATION TEST RESULTS** **Figure 8**

Applied Geotechnical Engineering Consultants, Inc.



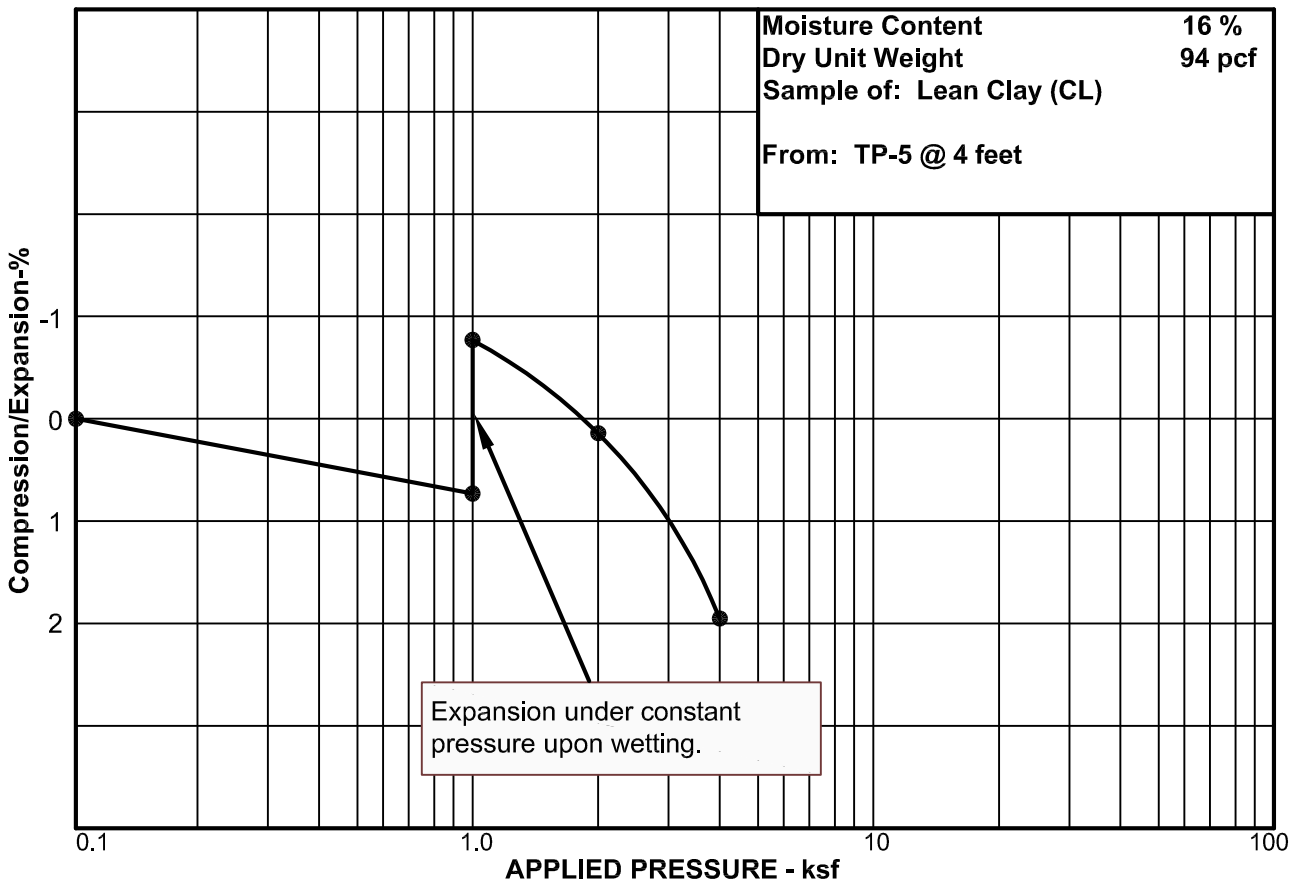
Project No. 2180295 **CONSOLIDATION TEST RESULTS** **Figure 9**

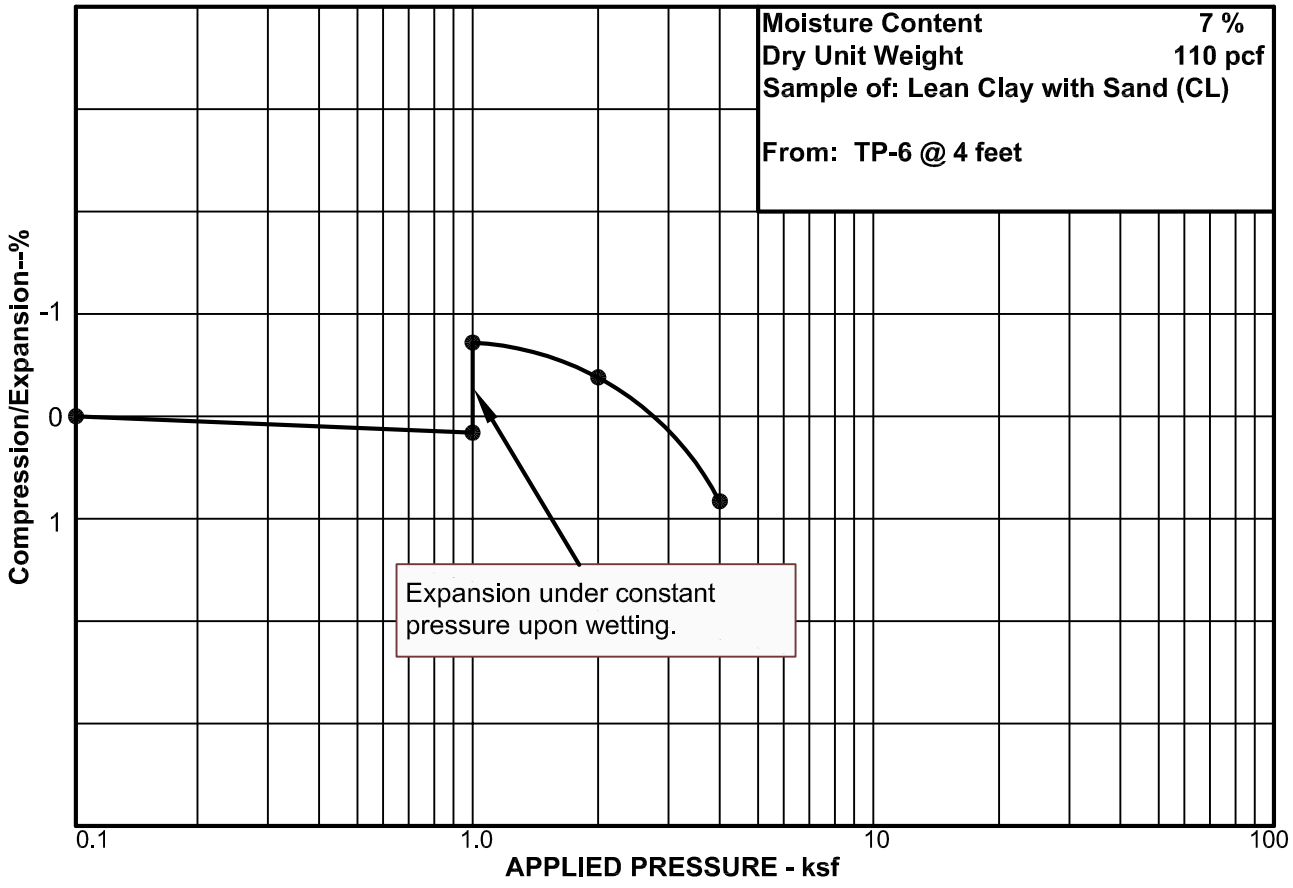
Applied Geotechnical Engineering Consultants, Inc.



Project No. 2180295 **CONSOLIDATION TEST RESULTS** **Figure 10**

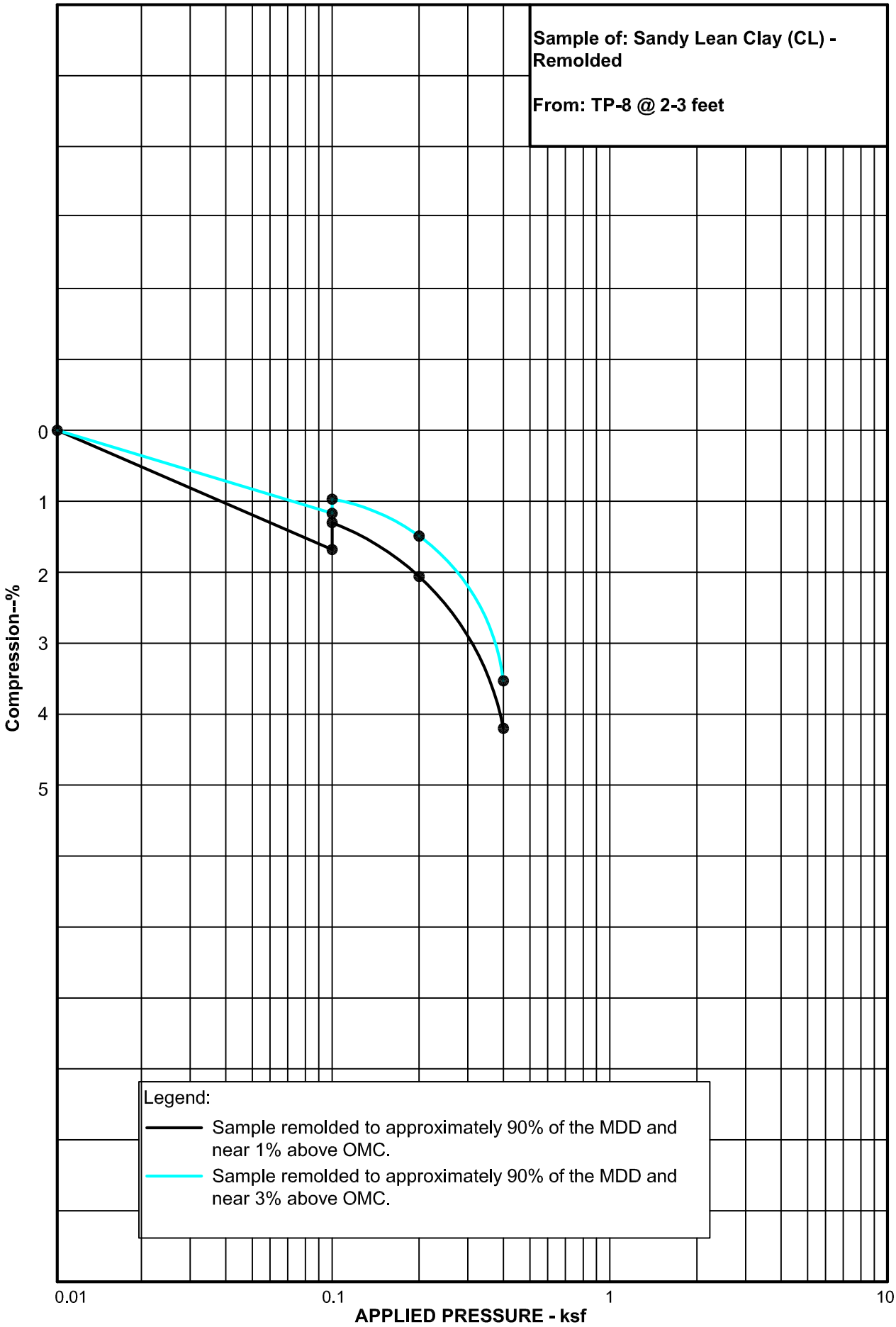
Applied Geotechnical Engineering Consultants, Inc.





Project No. 2180295 **CONSOLIDATION TEST RESULTS** **Figure 11**

Applied Geotechnical Engineering Consultants, Inc.

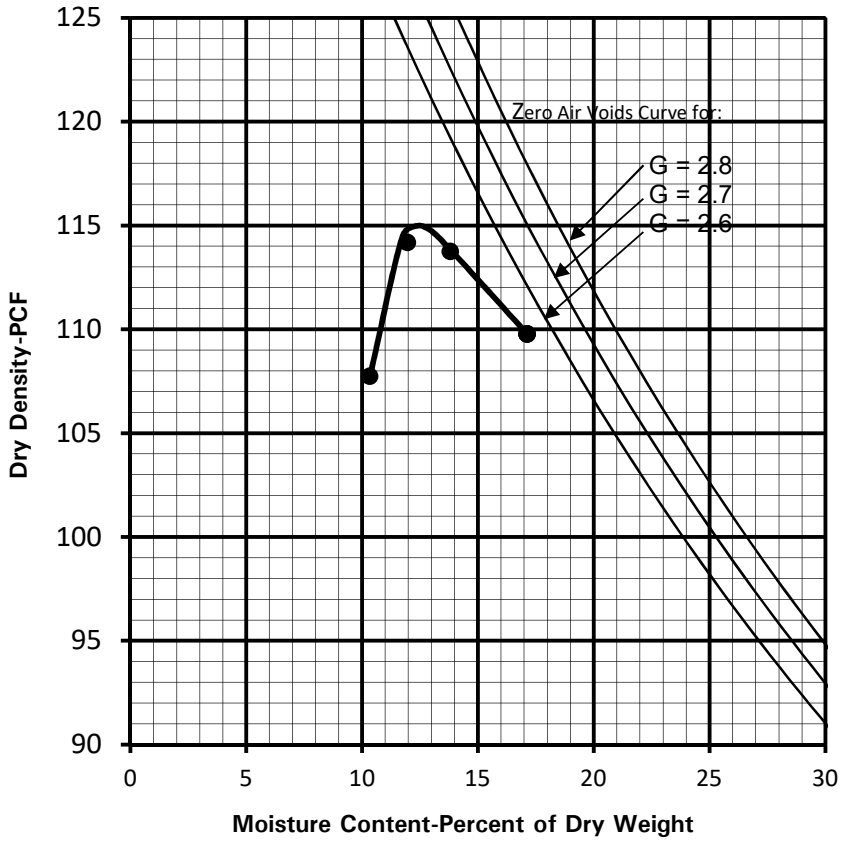


Project No. 2180295 **CONSOLIDATION TEST RESULTS** **Figure 12**

AGEC

Applied GeoTech

Project: 300 West (Tech Ridge South Access Road)



Sample Date:	8/14/18
Sample No.	180815G
Maximum Dry Density:	115.0
Optimum Moisture:	12.5
Atterberg Limits	
Liquid Limit:	45%
Plasticity Index:	24%
Gradation	
Gravel:	0%
Sand:	15%
Silt & Clay:	85%

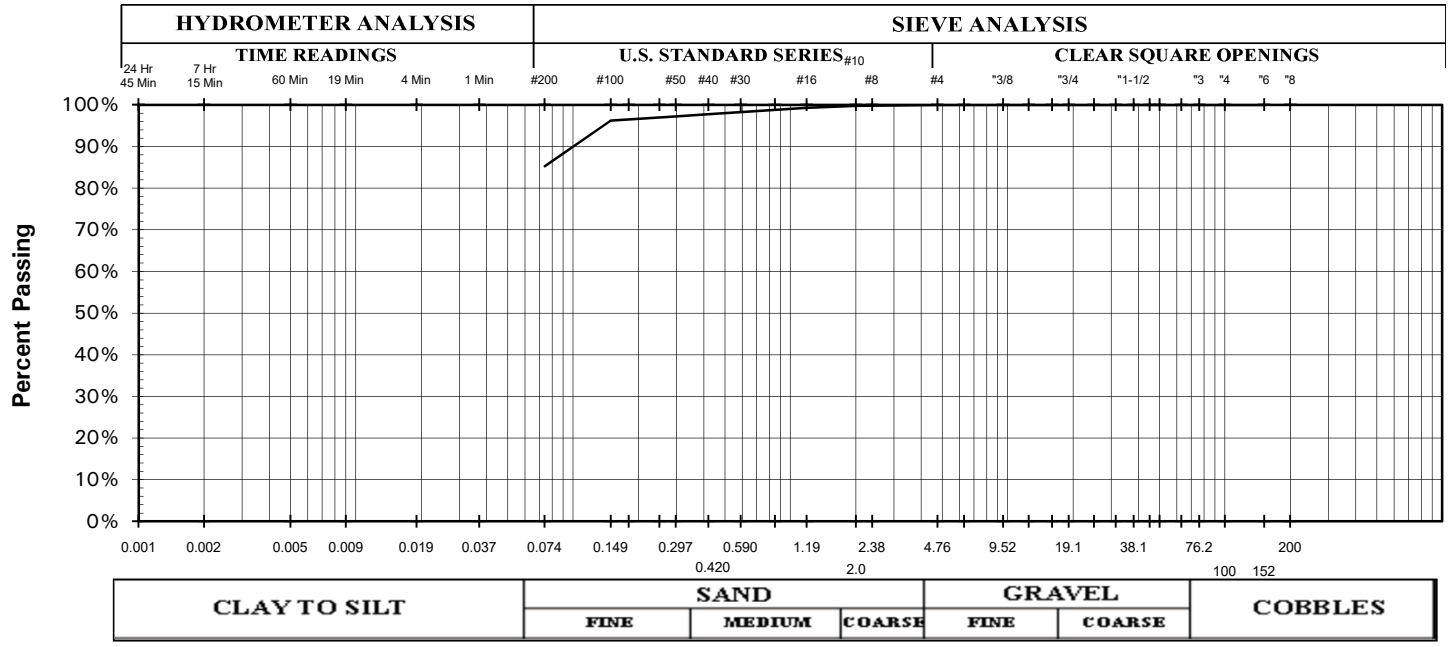
Moisture - Density Relationship Test Procedure: ASTM D-1557 B

Reviewed By: BI

Sample Description: Mudstone - lean clay (CL)

AASHTO Classification: A-7-6

Sample Location: TP-2 @ 2-3'



GRADATION AND MOISTURE-DENSITY RELATIONSHIP RESULTS

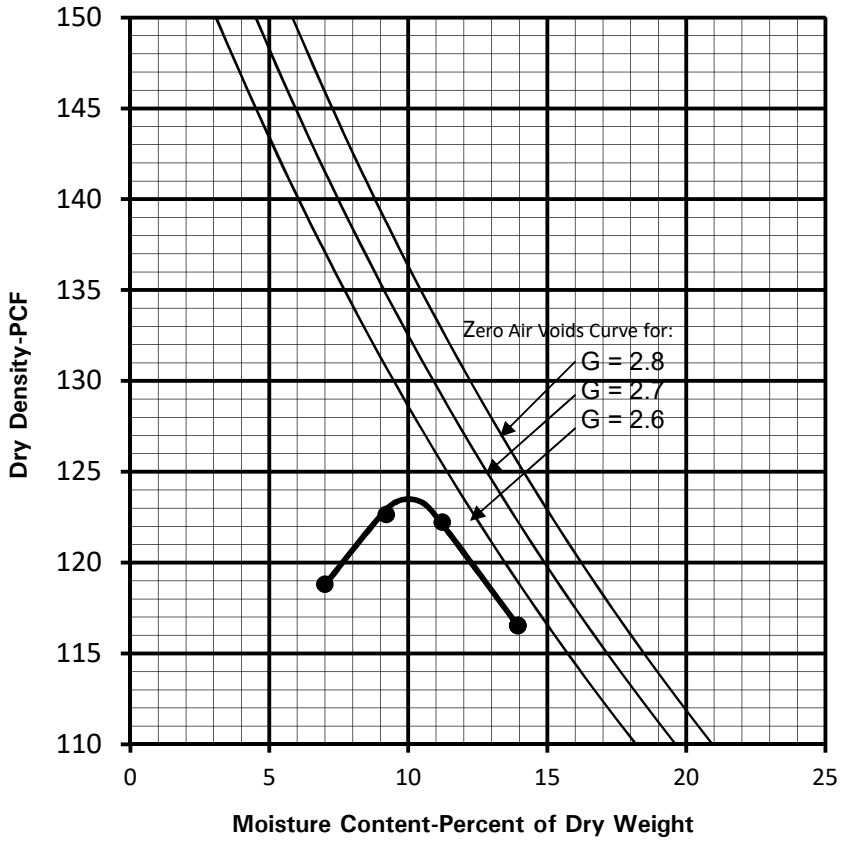
Project No.: 2180295

Figure: 13

AGEC

Applied GeoTech

Project: 300 West (Tech Ridge South Access Road)



Sample Date:	8/14/18
Sample No.	180816A
Maximum Dry Density:	123.5
Optimum Moisture:	10.0
Atterberg Limits	
Liquid Limit:	36%
Plasticity Index:	24%
Gradation	
Gravel:	0%
Sand:	27%
Silt & Clay:	73%

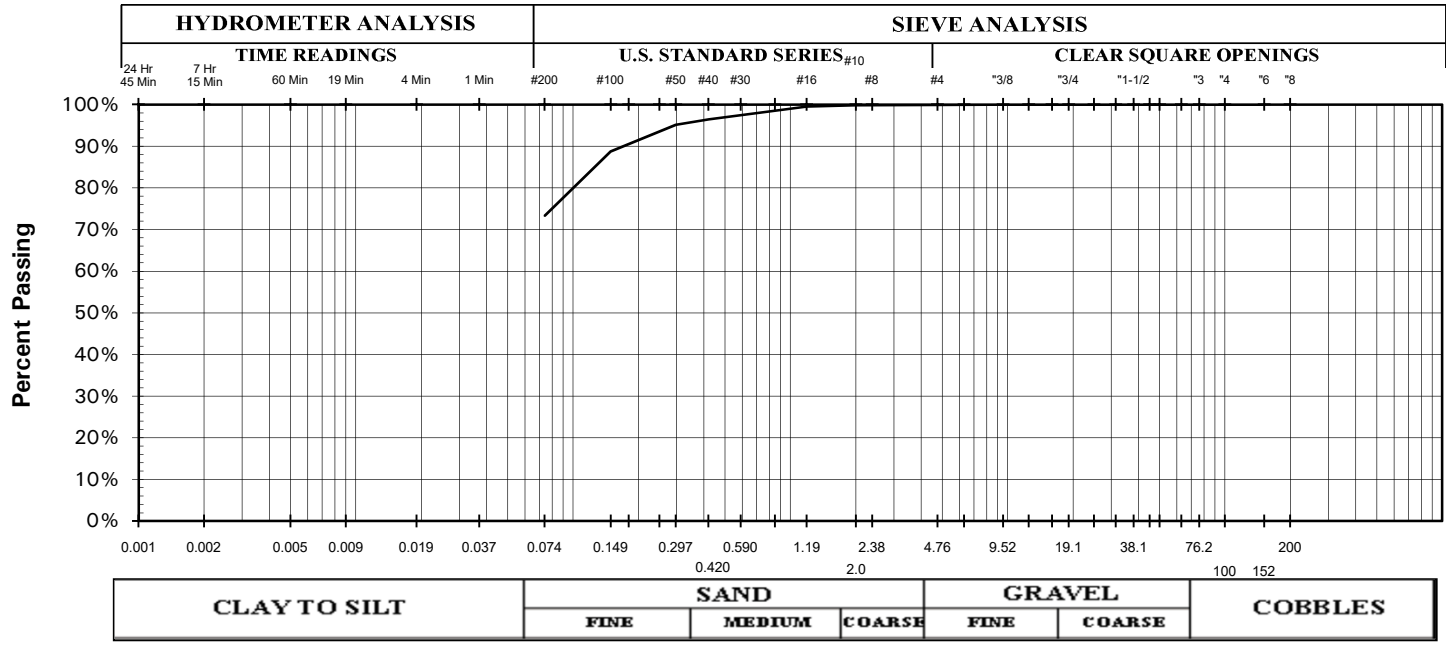
Moisture - Density Relationship Test Procedure: ASTM D-1557 B

Reviewed By: BI

USCS Classification: lean clay with sand (CL)

AASHTO Classification: A-6

Sample Location: TP-3 @ 2-3'



GRADATION AND MOISTURE-DENSITY RELATIONSHIP RESULTS

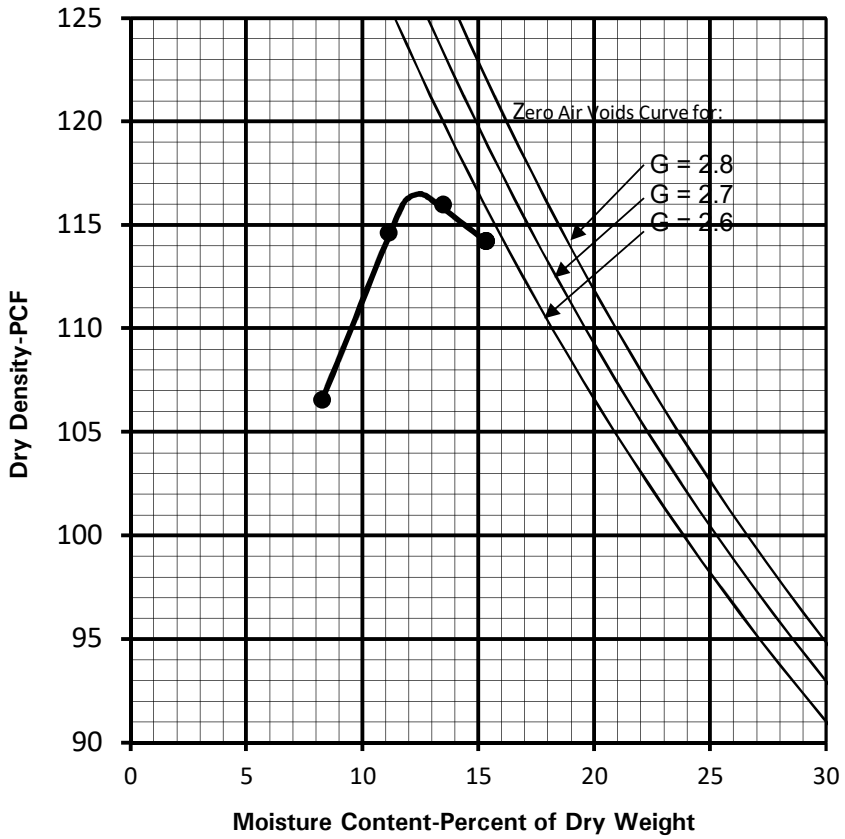
Project No.: 2180295

Figure: 14

AGEC

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Project: 300 West (Tech Ridge South Access Road)



Sample Date:	8/14/18
Sample No.	180816b
Maximum Dry Density:	116.5
Optimum Moisture:	12.5
Atterberg Limits	
Liquid Limit:	37%
Plasticity Index:	20%
Gradation	
Gravel:	12%
Sand:	22%
Silt & Clay:	66%

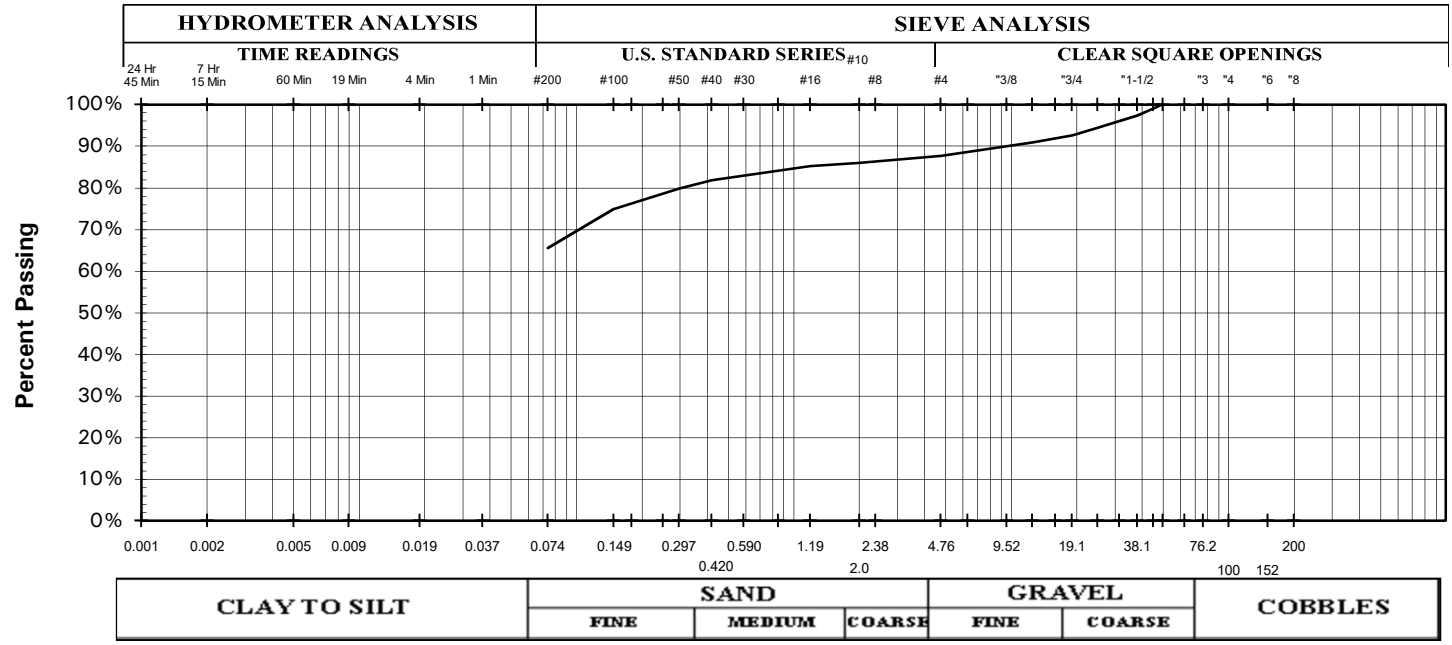
Moisture - Density Relationship Test Procedure: ASTM D-1557 B

Reviewed By: BI

Sample Description: sandy lean clay (CL)

AASHTO Classification: A-6

Sample Location: TP-8 @ 2-3'



GRADATION AND MOISTURE-DENSITY RELATIONSHIP RESULTS

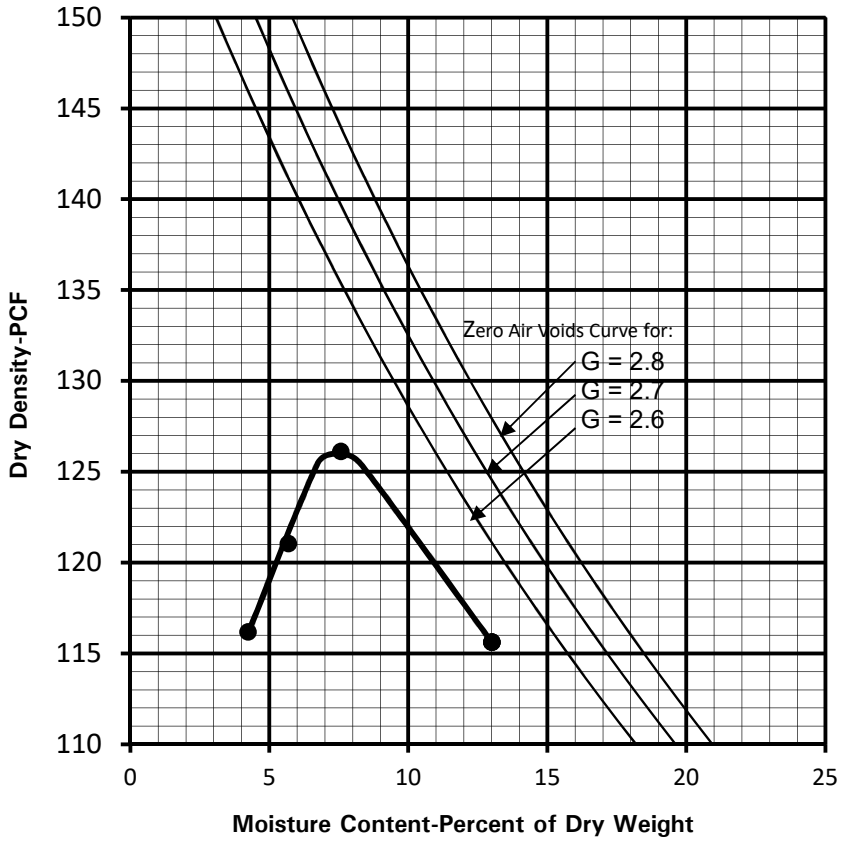
Project No.: 2180295

Figure: 15

AGEC

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Project: 300 West (Tech Ridge South Access Road)



Sample Date:	8/14/18
Sample No.	180816E
Maximum Dry Density:	126.0
Optimum Moisture:	7.5

Atterberg Limits

Liquid Limit:	
Plasticity Index:	Non-Plastic

Gradation

Gravel:	2%
Sand:	63%
Silt & Clay:	35%

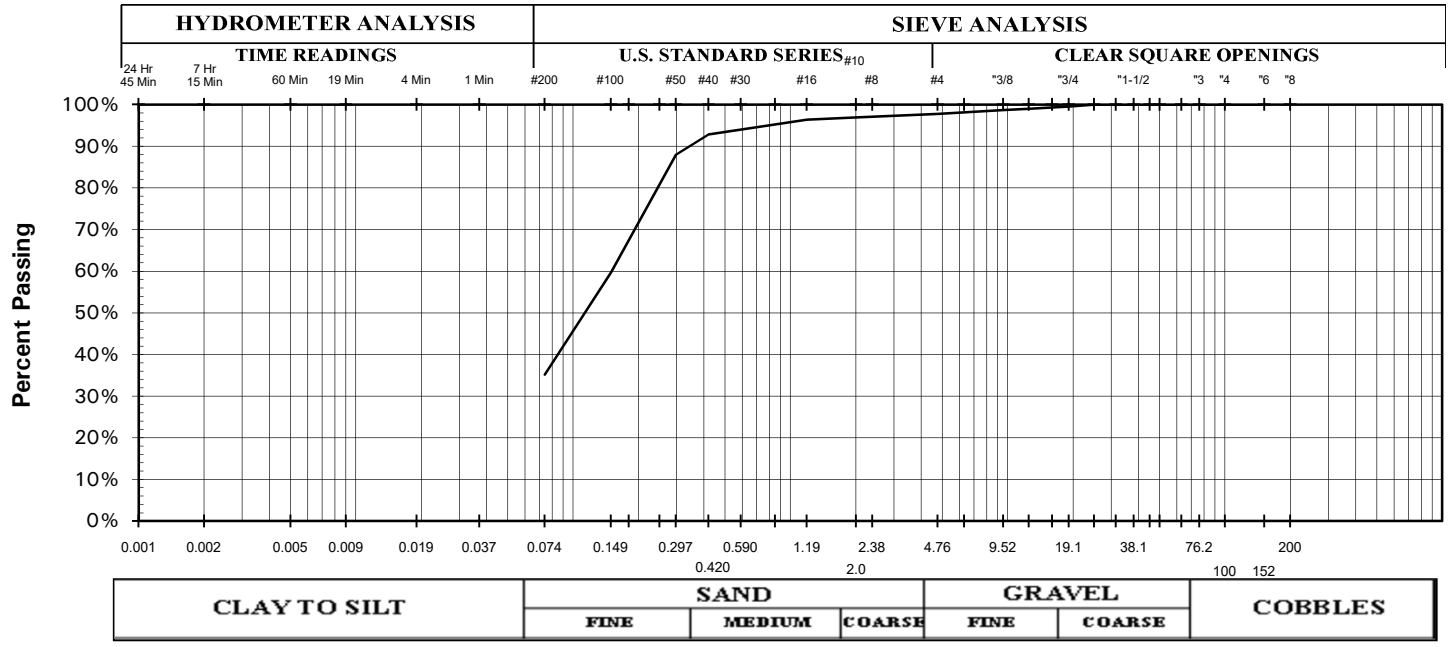
Moisture - Density Relationship Test Procedure: ASTM D-1557 B

Reviewed By: BI

USCS Classification: silty sand (SM)

AASHTO Classification: A-4

Sample Location: TP-10 @ 2-3'



GRADATION AND MOISTURE-DENSITY RELATIONSHIP RESULTS

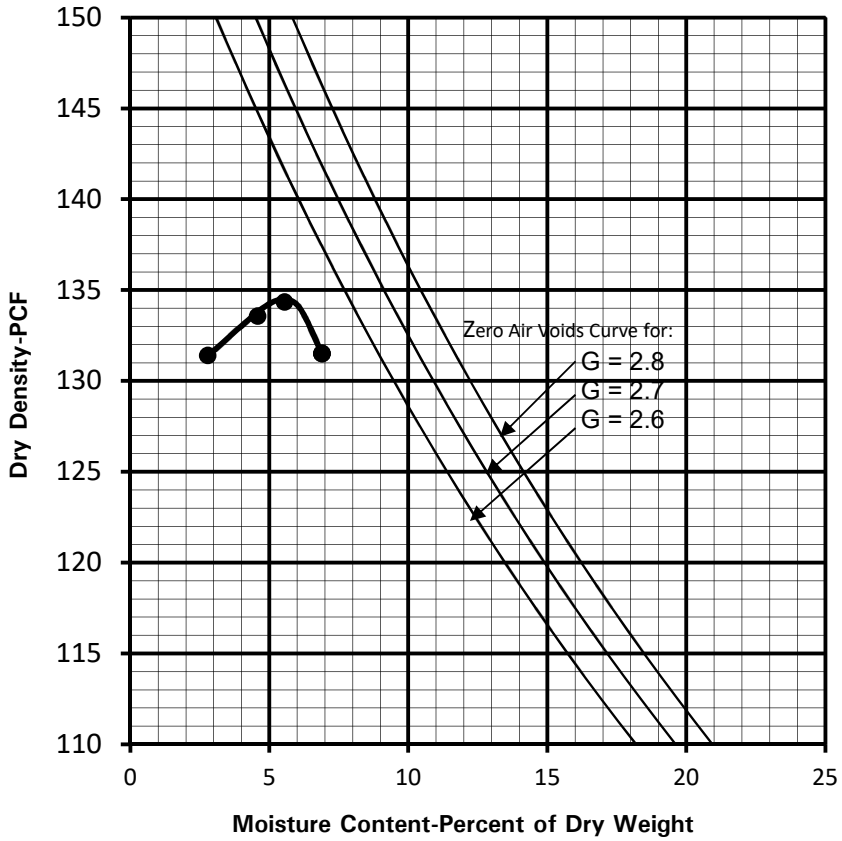
Project No.: 2180295

Figure: 16

AGEC

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Project: 300 West



Sample Date:	8/14/18
Sample No.	180816F
Maximum Dry Density:	134.5
Optimum Moisture:	5.5

Atterberg Limits

Liquid Limit:	
Plasticity Index:	Non-Plastic

Gradation

Gravel:	68%
Sand:	16%
Silt & Clay:	16%

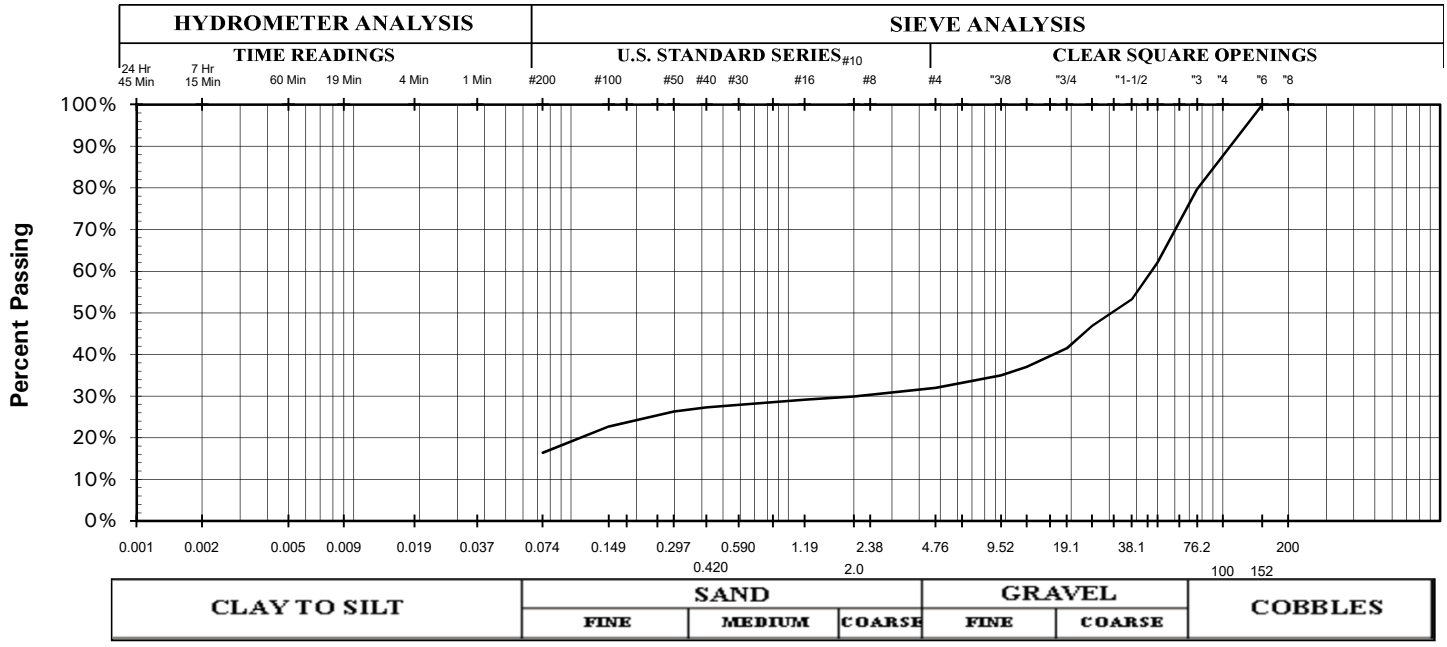
Moisture - Density Relationship Test Procedure: ASTM D-1557 B

Reviewed By: TT

USCS Classification: silty gravel with sand (GM) *Rock Corrected*

AASHTO Classification: A-1-b

Sample Location: TP-11 @ 0-1'

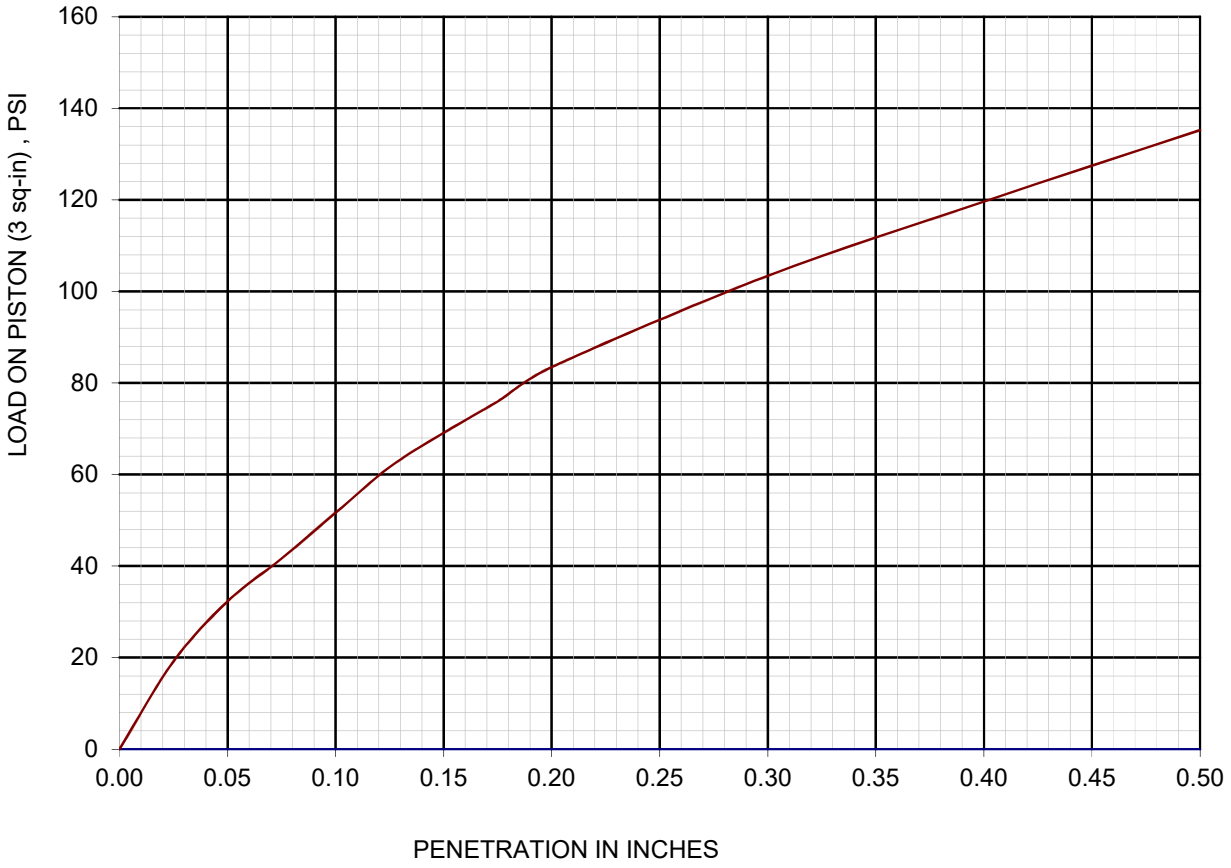


GRADATION AND MOISTURE-DENSITY RELATIONSHIP RESULTS

Project No.: 2180295

Figure: 17

AGEC
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Project 300 West **Sample Location** TP-2 @ 2-3'

Sample Classification (CL) lean clay - purple mudstone **AGEC Sample ID No.** A-082718

Method of sample preparation: Remolded to approximately 90% of the maximum dry density at the optimum moisture content +2 as per ASTM D-1557

Sample penetration after soaking for 96 hours

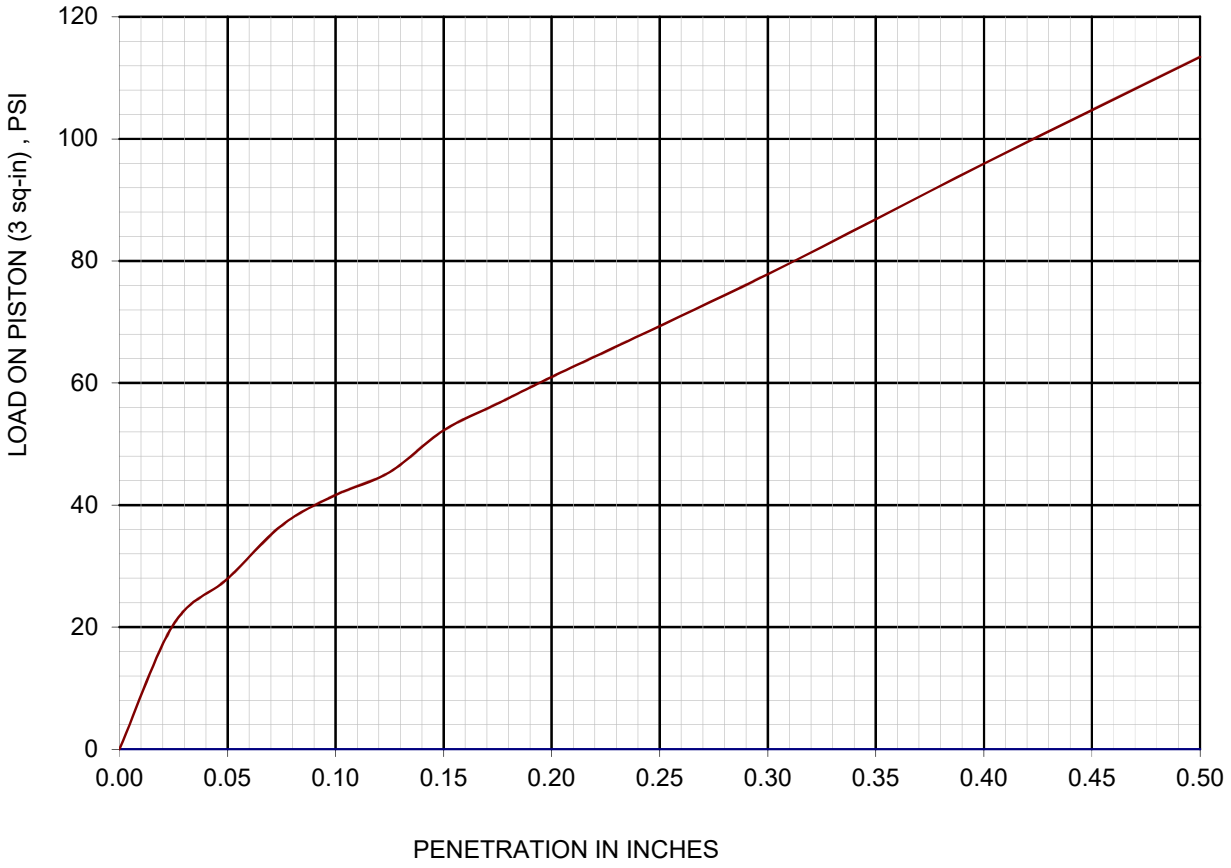
Dry Density:	as molded	103.0	pcf	**Moisture Content:**	as molded	14.1	percent
	after soaking	98.1	pcf		top 1-inch after soaking	26.0	percent
Swell:	after soaking	4.1	percent		average after soaking	25.3	percent

Comments CBR value taken at 0.2 inch penetration

Bearing Ratio of Sample, CBR = **6** percent **Surcharge** 30 lb

Proj. No. 2180295 **CALIFORNIA BEARING RATIO TEST RESULTS** Figure 18

AGEC
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Project 300 West **Sample Location** TP-3 @ 2-3'

Sample Classification (CL) lean clay with sand **AGEC Sample ID No.** B-082718

Method of sample preparation: Remolded to approximately 90% of the maximum dry density at the optimum moisture content +2% as per ASTM D-1557

Sample penetration after soaking for 96 hours

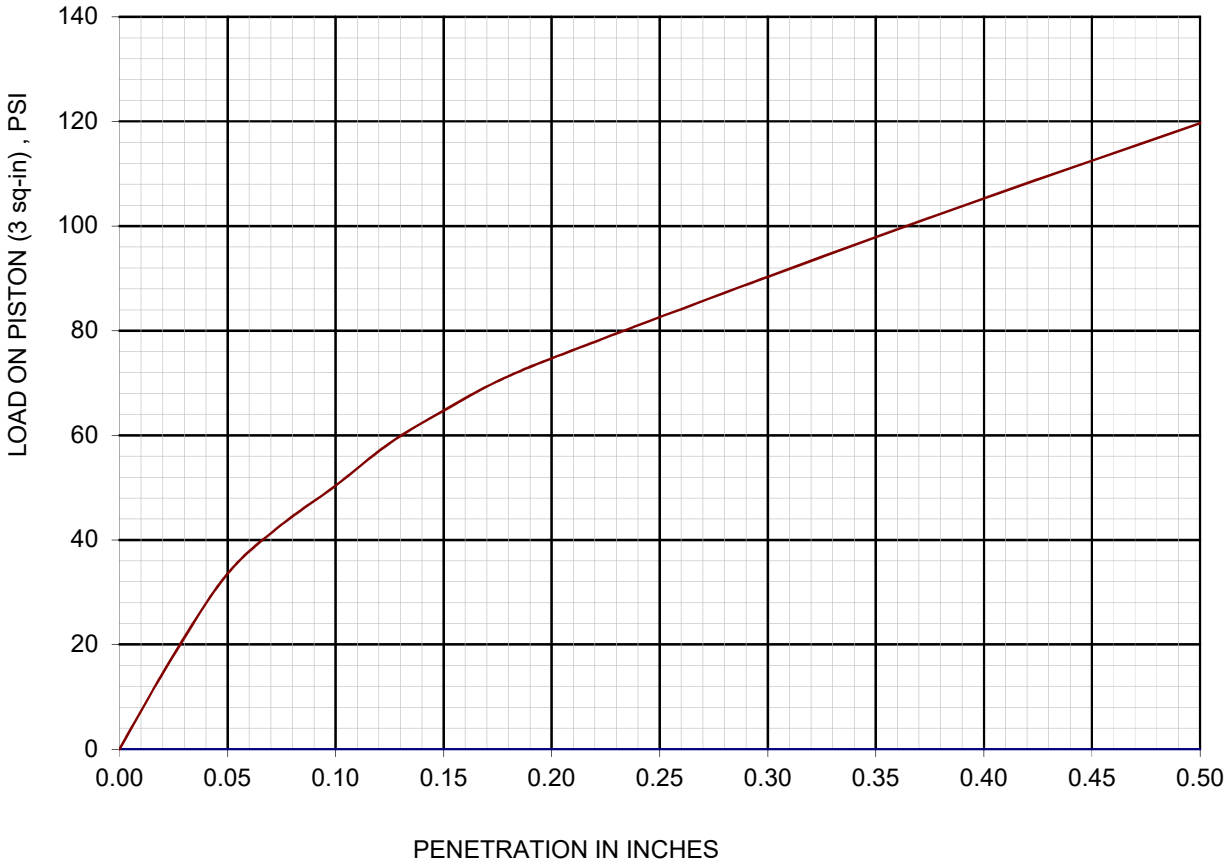
Dry Density:	as molded	113.6	pcf	**Moisture Content:**	as molded	12.0	percent
	after soaking	108.6	pcf		top 1-inch after soaking	23.1	percent
Swell:	after soaking	1.3	percent		average after soaking	20.0	percent

Comments CBR value taken at 0.2 inch penetration

Bearing Ratio of Sample, CBR = **4** percent **Surcharge** 30 lb

Proj. No. 2180295 **CALIFORNIA BEARING RATIO TEST RESULTS** Figure 19

AGEC
Applied GeoTech



Project 300 West **Sample Location** TP-8 @ 2-3'

Sample Classification (CL) sandy lean clay **AGEC Sample ID No.** C-082718

Method of sample preparation: Remolded to approximately 90% of the maximum dry density at the optimum moisture content +2% as per ASTM D-1557

Sample penetration after soaking for 96 hours

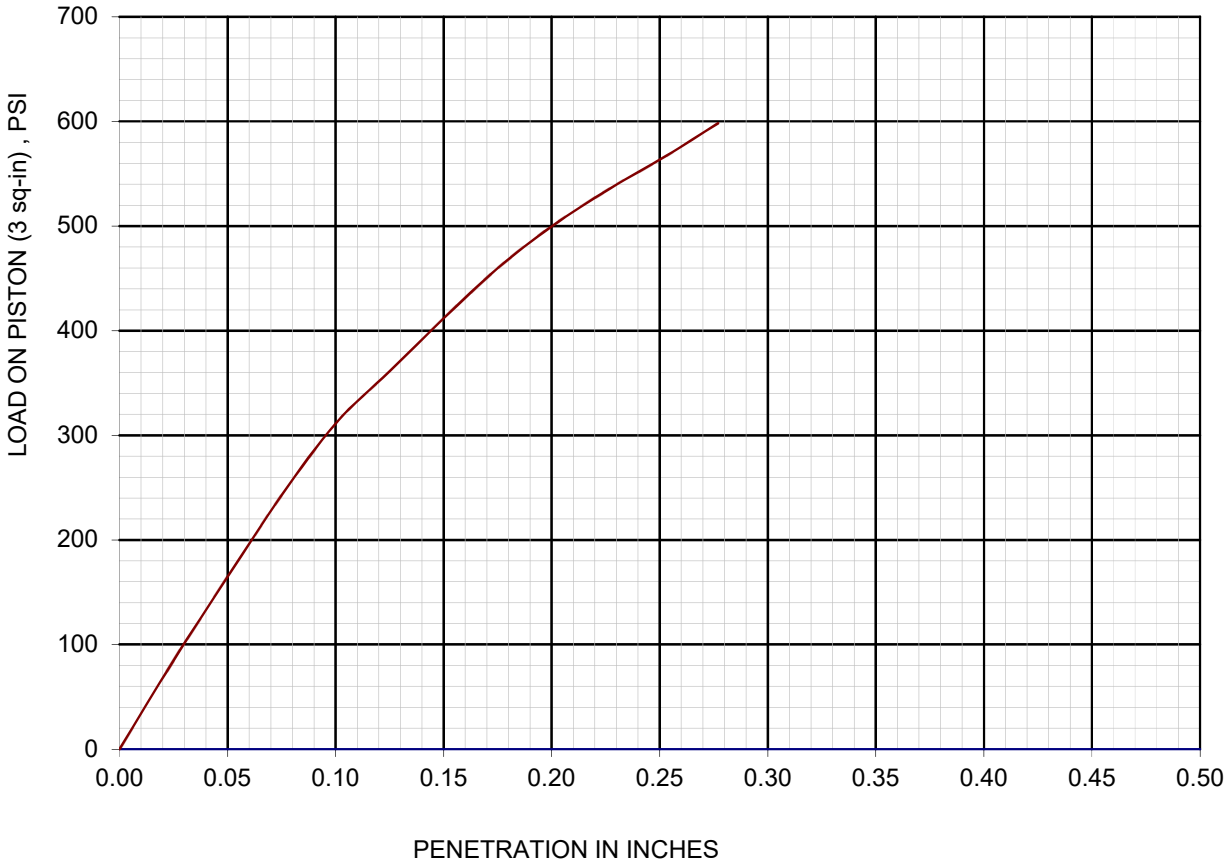
Dry Density:	as molded	104.5	pcf	**Moisture Content:**	as molded	14.5	percent
	after soaking	104.1	pcf		top 1-inch after soaking	21.7	percent
Swell:	after soaking	1.5	percent		average after soaking	18.9	percent

Comments CBR value taken at 0.2 inch penetration

Bearing Ratio of Sample, CBR = **5** percent **Surcharge** 30 lb

Proj. No. 2180295 **CALIFORNIA BEARING RATIO TEST RESULTS** Figure 20

AGEC
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Project 300 West **Sample Location** TP-10 @ 2-3'

Sample Classification (SM) Silty sand **AGEC Sample ID No.** D-082718

Method of sample preparation: Remolded to approximately 95% of the maximum dry density at the optimum moisture content as per ASTM D-1557

Sample penetration after soaking for 96 hours

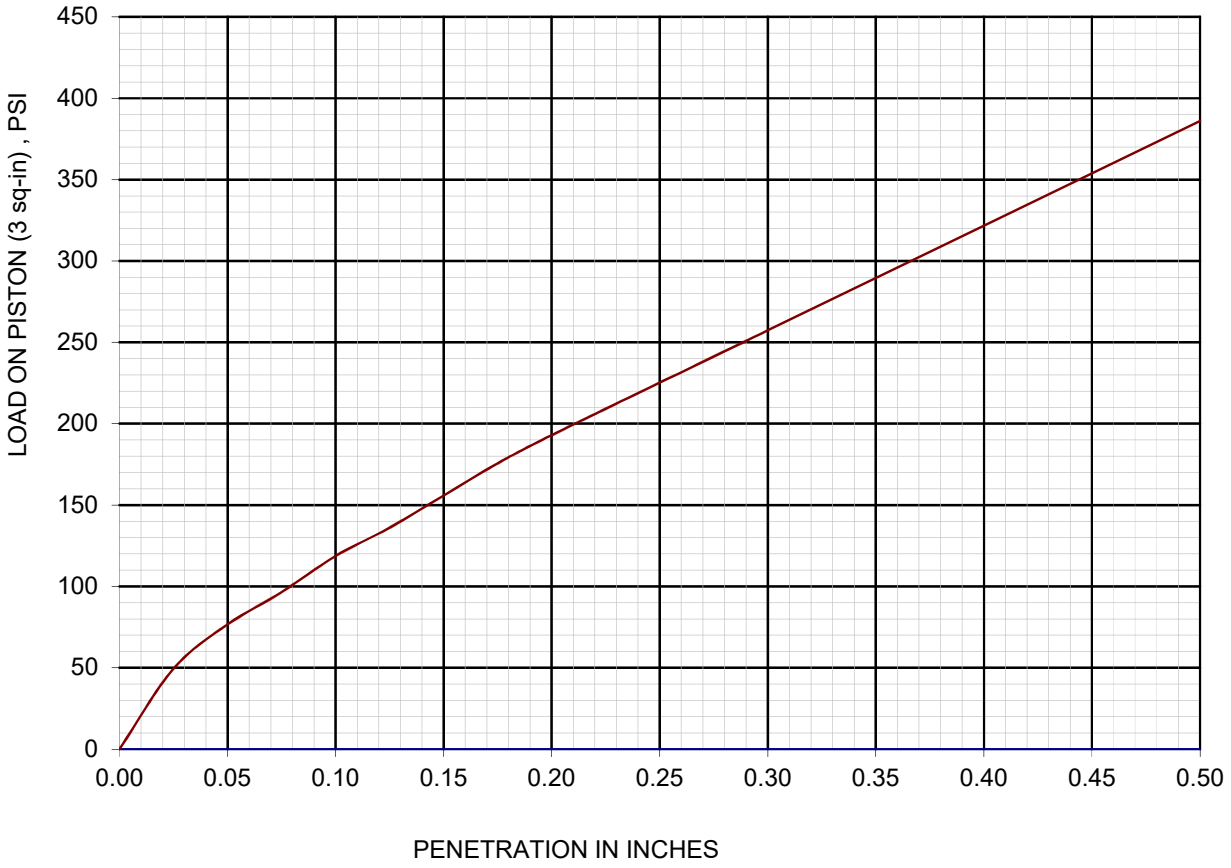
Dry Density:	as molded	122.2	pcf	**Moisture Content:**	as molded	7.4	percent
	after soaking	123.0	pcf		top 1-inch after soaking	10.3	percent
Swell:	after soaking	0.2	percent		average after soaking	10.5	percent

Comments CBR value taken at 0.2 inch penetration

Bearing Ratio of Sample, CBR = **33** percent **Surcharge** 10 lb

Proj. No. 2180295 **CALIFORNIA BEARING RATIO TEST RESULTS** Figure 21

AGEC
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Project 300 West **Sample Location** TP-11 @ 0-1'

Sample Classification Silty sand w/gravel - Basalt **AGEC Sample ID No.** E-082718

Method of sample preparation: Remolded to approximately 95% of the maximum dry density at the optimum moisture content as per ASTM D-1557

Sample penetration after soaking for 96 hours

Dry Density:	as molded	127.1	pcf	**Moisture Content:**	as molded	5.1	percent
	after soaking	122.6	pcf		top 1-inch after soaking	18.8	percent
Swell:	after soaking	1.6	percent		average after soaking	16.7	percent

Comments CBR value taken at 0.2 inch penetration

Bearing Ratio of Sample, CBR = 13 percent **Surcharge** 30 lb

Proj. No. 2180295 **CALIFORNIA BEARING RATIO TEST RESULTS** Figure 22

Applied Geotechnical Engineering Consultants, Inc.

Table 1 - Summary of Laboratory Test Results

Tech Ridge South Access Road

Project No. 2180295

Sample Location				Gradation			Atterberg Limits		Moisture-Density Relationship			
Test Pit No.	Depth (ft)	Natural Moisture Content (%)	Natural Dry Density (pcf)	Gravel (%)	Sand (%)	Silt/Clay (%)	Liquid Limit (%)	Plastic Index (%)	Maximum Dry Density (pcf)	Optimum Moisture Content (%)	California Bearing Ratio (%)	Soil Type
TP-1	4	7	124			63	31	19				Sandy Lean Clay (CL)
TP-1	6	7	123			62	27	14				Sandy Lean Clay (CL)
TP-1	13	15	96			84	44	29				Mudstone
TP-2	2	7				71	35	19				Mudstone
TP-2	2-3			0	15	85	45	24	115.0	12.5	6	Mudstone
TP-2	6	8	118			90	52	30				Mudstone
TP-3	2-3			0	27	73	36	24	123.5	10.0	4	Lean Clay with Sand (CL)
TP-3	6	11	117			69	47	35				Sandy Lean Clay (CL)
TP-4	2	11										Silty Gravel with Sand (GM)
TP-4	4	8	108			36						Silty Sand (SM)
TP-4	6	17	101			81						Silt with Sand (ML)
TP-5	2	9	93				39	27				Lean Clay (CL)
TP-5	4	16	94			96	48	33				Lean Clay (CL)
TP-5	6	14				92	36	22				Lean Clay (CL)
TP-6	4	7	110			83	29	18				Lean Clay with Sand (CL)

Applied Geotechnical Engineering Consultants, Inc.

Table 1 - Summary of Laboratory Test Results

Tech Ridge South Access Road

Project No. 2180295

Sample Location				Gradation			Atterberg Limits		Moisture-Density Relationship			
Test Pit No.	Depth (ft)	Natural Moisture Content (%)	Natural Dry Density (pcf)	Gravel (%)	Sand (%)	Silt/Clay (%)	Liquid Limit (%)	Plastic Index (%)	Maximum Dry Density (pcf)	Optimum Moisture Content (%)	California Bearing Ratio (%)	Soil Type
TP-6	6	6	112			94		NP				Silt (ML)
TP-7	3½					81	37	21				Lean Clay with Sand (CL)
TP-8	2	9		3	26	71	41	25				Lean Clay with Sand (CL)
TP-8	2-3			12	22	66	37	20	116.5	12.5	5	Sandy Lean Clay (ML)
TP-8	4	5				77	30	20				Lean Clay with Sand (CL)
TP-10	2	3	88			48						Silty Sand (SM)
TP-10	2-3			2	63	35		NP	126.0	7.5	33	Silty Sand (SM)
TP-10	4	1				6						Well Graded Sand with Silt (SW-SM)
TP-10	9½	10				59	59	37				Mudstone
TP-10	14½					99	52	39				Mudstone
TP-11	0-1			68	16	16		NP	134.5	5.5	13	Silty Gravel with Sand (GM)
TP-15	4					96	77	35				Shale Bedrock
TP-16	10½	5	110			71						Mudstone

NEW INFORMATION

AGEC
Applied GeoTech

September 7, 2023

Tech Ridge, LLC
475 South Donlee Dr.
S. George, Utah 84770

C/O: Alliance Consulting, Craig Coates

email: ccoates@allianceconsulting.us

Subject: Rockery-faced Slope Design and Slope Stability
Tech Ridge Southeast Slope
St. George, Utah
AGEC Project No. 2230248

References:
1. "Geotechnical Investigation, Tech Ridge South Access Road", prepared by AGEC under Project No. 2180295, dated October 19, 2018.
2. "Southeast Walls Exhibits Overall and Sheets 1-5", prepared by Alliance Consulting under Project No. 4488, dated June 14, 2023.

Applied Geotechnical Engineering Consultants, Inc. (AGEC) was requested to provide geotechnical recommendations and slope stability evaluation for construction of a rockery-faced slope and the pad grading for the above referenced project in St. George, Utah as shown on Figure 1. We understand it is planned that the property be graded level from the existing upper summit area by adding a rock wall and backfilling the area level behind the wall.

SITE CONDITIONS

The site is located at the south east end of the Tech Ridge Development. The project area includes the east edge of the ridge which slopes down to the east at slopes ranging from 10 percent up to 70 percent. The hillside below the project site continues to slope down to the east and south. The site slope generally becomes less steep to the west as it approaches the upper ridge where the topography becomes relatively flat. The sloping topography consists of hummocky terrain associated with historical landslide areas. Photos taken near the upper summit of the slope are shown below.



Photos 1 and 2: Southeast end of Tech Ridge Summit viewing to the south (top) and to the north (bottom)

PROPOSED CONSTRUCTION

As part of the future development of the east side access road, it is planned to extend the east edge of the slope with additional fill. A two-tiered rockery-faced slope is planned to face the east edge of the extended slope as shown on Figure 2. A paved biking/walking path is planned to be constructed near the top of the rockery-faced slope.

SUBSURFACE CONDITIONS

On May 18 and 19, 2023, AGEC drilled six exploratory borings at the approximate locations shown on Figure 2. The borings were drilled with a rubber tire ATV mounted drill rig using 8-inch hollow stem augers to drill through the overburden soil and fractured basalt rock. In 4 of the drilled borings, we extended the drilling through the basalt caprock to determine the thickness. The drilling extending through the basalt was accomplished using a tri-cone bit with air to remove cuttings.

Subsurface soil conditions encountered within the borings generally consists of shallow deposits of silty sand, overlying basalt caprock further underlain by silty sand and lean clay. The basalt caprock was encountered at 1 to 2 feet below the surface and it extended a varied amount of approximately 17 to 31 feet. Descriptions of the soil/rock types encountered follow:

Silty Sand - The silty sand is loose (near-surface) to dense (below basalt caprock), dry to slightly moist, contains occasional layers of sandy silt, occasional gravel, and small roots (above basalt caprock). The silty sand is light brown to brown to red-brown in color.

Basalt Caprock - The basalt caprock is hard, dry, and dark gray to black in color.

Lean Clay - The lean clay is stiff, slightly moist, red-brown.

SUBSURFACE WATER

Subsurface water was not encountered during the drilling of the borings as shown in Figure 3. We do not anticipate groundwater will be present or observed during excavation procedures. Fluctuation in groundwater level may occur over time. An evaluation of such fluctuations is beyond the scope of this report.

SLOPE STABILITY ANALYSIS: HILLSIDE

The underlying basalt bedrock will support the trail and its retaining system. The thickness of the basalt was found to vary from 17 to 31 feet. Two of our borings were not extended through the basalt, therefore the thickness of the basalt at those locations is not known.

Our global stability analysis of the hillside is based on subsurface soil information and strength characteristics that have been developed by AGEC during our involvement of the overall stability of the east Blackridge slope in addition to several individual project investigations on the slope.

Two profiles were evaluated in this analysis. One on the north side and the other on the south side of the retaining wall/trail system.

The vertical profiles for both the north and south ends of the trail system consists of basalt overlying undisturbed mudstone. A large area of landslide deposits extend from the edge of the basalt down the slope.

The general slope of the north profile is approximately 6.3:1 (horizontal to vertical) with a 3.0:1 slope on the south profile.

Calculations indicate that the factor of safety for the proposed trail system and retaining walls exceed the minimum 1.5 factor of safety for static conditions. Static factors of safety drop to 1.0 - 1.2 downslope and east of the basalt cap, within the landslide deposits.

The factor of safety under seismic conditions are calculated to be less than 1.0. A deformation analysis indicates that approximately 4 inches of displacement could be experienced should there be a major seismic event with an exceedance probability of 2 percent in a 50-year period.

Specific measures should be taken in design and construction to collect and divert water away from the slope. The stability of the slope could be significantly compromised with the addition of even a small amount of water different than what the slope has experienced in the past.

SLOPE STABILITY ANALYSIS: ROCKERY-FACED SLOPES

AGEC conducted a slope stability analysis to assist in providing recommendations to construct the proposed rockery-faced slope as requested. Stability analysis of the proposed rockery-faced slope was evaluated by selecting a representative cross section. The selected cross-section was analyzed in the proposed geometry to determine whether factors of safety meet generally accepted standards in the field of geotechnical engineering. The following is a list of items considered in our analysis:

A. Slope Profiles

The slope cross-sections were selected by reviewing the grading plan and cross-sections prepared for the site by Alliance Consulting.

B. Soil and Bedrock Strengths

Soil and bedrock strengths used in our analysis are based on the following:

1. Soil properties and descriptions observed in the geotechnical report,
2. Our experience with similar materials in the area, and
3. Naval Facilities Engineering Command (NAVFAC) 7.2.

The following table summarizes soil and bedrock strengths used in our engineering analysis:

Soil Type	Material Unit Weight	Cohesion - c (psf)	Friction Angle - ϕ (degrees)
Boulder Facing (Basalt)*	135	10,000	37
Fill	125	0	36
Basalt	135	Hoek and Brown	Hoek and Brown

* Anisotropic Function - strength parameters vary

C. Analysis and Stability

Based on the proposed slope and rockery facing geometry, our analysis indicates factors of safety exceed those generally accepted to meet the current industry standard of practice.

Our seismic analysis has incorporated an adjusted horizontal ground acceleration of 0.13g (based on an event with a 2 percent probability of exceedance on a 50 year period).

RECOMMENDATIONS

The construction of the rockery-faced slope should follow the recommendations provided on Figures 5 - 6. In addition, the following recommendations are provided and should be implemented during construction of the proposed rockery-faced slopes:

A. Site Grading and Rockery Slope Construction

1. Subgrade Preparation

Prior to placing fill, the exposed subgrade should be scarified, moisture conditioned and properly compacted. The subgrade should be tested to verify compaction prior to placing fill. If the exposed subgrade consists of undisturbed basalt, scarification and compaction is not necessary provided loose, disturbed soil or basalt rock is removed.

2. Excavation/Earthwork

We anticipate excavation of the on site soils may be accomplished with conventional excavation equipment. Excavations which extend into hard basalt will require the use of heavy duty excavation equipment such as a ripper tooth or a rock hammer. Blasting may be necessary on the basalt if the rock does not contain significant fractures.

3. Material Suitability

Imported backfill and site grading/structural fill should meet the following criteria:

Area	Fill Type	Recommendations
Building Pad/Rockery backfill	Structural fill	**-200** <50%, **LL<30** Maximum size = 3 inches Solubility < 1%
Backfill	Crushed rock fill	**-200** <10% Maximum size = 6 inches Solubility < 1%

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

The on-site soils free of organics, debris and oversized particles as listed above are suitable for use as rockery backfill, pool support fill and below areas which will support decking. The onsite bedrock which is excavated from the site may be used as backfill provided it is processed such that the maximum particle size is 6 inches. The rockfill will be most suitable if placed as backfill directly behind boulders. If the processed bedrock is open graded, filter fabric may be necessary behind the rockfill to reduce the potential for migration of adjacent soil fines.

Performance of the rockery-faced slope may be increased by importing a select aggregate granular backfill (behind the rockery in the geogrid reinforced zone) such as road base.

4. Compaction

Compaction of fill materials placed at the site should equal or exceed the following percentages:

Area	Compaction
Subgrade	90%
Rockery-faced Slope Backfill	95%
Pool Support and Decking	95%

Fill placed at the site should be tested frequently to verify proper compaction. Fill tested should be compared to the maximum dry density as determined by ASTM D-1557. Fill should be placed in lift thicknesses which are appropriate

to the type of compaction equipment used. Typically, loose lift thicknesses of 8 to 10 inches are appropriate for heavy equipment. Lift thicknesses should be reduced to 4 inches for hand compaction equipment. Fill should be properly moisture conditioned to within 2 percentage points of the optimum moisture content as determined by ASTM D-1557 prior to placement.

Further, we recommend using hand compaction equipment within 3 feet of the interior edge of the boulders.

5. Geosynthetic Reinforcement and Filter Fabric Placement

Figures 5 - 6 should be referenced for the geogrid type, spacing, lengths and filter fabric placement during construction. The following should be implemented when placing the geosynthetic reinforcement (geogrid):

a. The geogrid should be placed on a smooth subgrade free of humps or loose soil.

b. The geogrid should be placed with the primary strength direction perpendicular to the face of the slope. The geogrid may not be spliced in the primary strength direction.

c. The geogrid should not be trafficked with track-mounted equipment. At least 12 inches of soil should be placed over the geogrid prior to trafficking.

d. The geogrid should be stretched taught and free of wrinkles prior to placing fill. This is critical to the proper performance of the reinforced slope. We recommend the geogrid be staked in place and fill should be spread from the back of the excavation toward the face of the slope to reduce wrinkles.

e. Backfill should be properly compacted as recommended in the compaction section of this report. Appropriate reinforcing of the backfill relies on the interaction between the geogrid and the fill placed, which is dependant on compaction of the fill.

f. The filter fabric placed behind the boulder facing is critical and should be placed as shown on Figures 5 - 6.

6. Rockery Facing

a. The rockery-faced slope should be constructed in conformance with the recommendations provided on Figures 5 - 6.

b. The base boulder size should be at least ⅓ the height of the rockery facing for each tier and be embedded at least 1 foot.

c. Base boulders should be supported on a properly prepared subgrade as indicated in the Subgrade Preparation section of this report.

d. Boulders should be stacked such that they interlock and no steeper than ¼:1 (horizontal:vertical).

e. Boulders should be angular, rectangular ledge rock. They should have a flat stacking surface and decrease in size as they are stacked. Rounded boulders should not be used. Boulders should consist of durable material resistant to weathering. Boulders should typically range from 2 to 5 feet in size. We recommend basalt boulders, hard sandstone or hard limestone. Soft sandstone boulders (typically the Navajo or Kayenta (Red to orange color) Sandstone) are much more susceptible to weathering and degradation and should not be used.

f. The total exposed height of the proposed rockery-faced slopes should not exceed 24 feet.

7. Drainage Behind Boulder Facing

Desert landscaping (which requires no water) should be utilized adjacent, above and within 8 feet of the rockery facing. Wetting of the fill behind the boulders may increase the risk of fill densification, increase pressures on the boulder facing and can reduce long term stability of the slope.

Wetting of the backfill and rockery facing can also result in "salt weathering" of the boulders which will degrade and reduce the life of the boulders. Red sandstone in the area has shown to be highly susceptible to salt weathering and should not be used. More resistant boulders such as basalt would be less susceptible to salt weathering.

Drainage of surface water away from the boulder facing should also be maintained to reduce potential wetting of backfill from behind the boulders. It is also critical that roof water be captured and directed to the curb and gutter or off-site. A drainage swale, lined with an impermeable membrane, is recommended behind the rockery facing to collect and divert water away from the rockery slope and discharge offsite.

B. **Foundation Setback**

Foundations supporting structures (above the rockery) should be set back from the interior edge of a rockery facing or horizontal distance equal to or greater than the total height of the upper tier of facing.

C. **Summary Report**

The items recommended within this report and on Figures 5 - 6 should be observed and tested by AGEC in order to provide a summary report.

D. **Geotechnical Recommendation Review**

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

Geotechnical recommendations provided in the previously referenced report should also be followed and implemented if applicable to the project.

LIMITATIONS

This letter has been prepared in accordance with generally accepted soil and foundation engineering practices in the area for the use of the client for design purposes. The conclusions and recommendations included within the letter are based on the information obtained from review of the referenced report, site observations and conditions, the proposed construction, engineering analysis and our experience in the area. Variations in the subsurface conditions may not become evident until additional exploration or excavation is conducted. If the subsurface soil or groundwater conditions are found to be different from what is described in this letter or referenced geotechnical investigation, we should be notified to reevaluate the recommendations given.

If you have questions or require further assistance, please call.
Sincerely,

APPLIED GEOTECHNICAL ENGINEERING CONSULTANTS, INC.



Jake Erickson, P.E.

James E. Nordquist, P.E.

Reviewed by: G. Wayne Rogers, P.E.

JE/sd P:\2023 Project Files\2230200\2230248 - GT- Tech Ridge SE SLOPE\2230248.Rockery Wall Letter.wpd



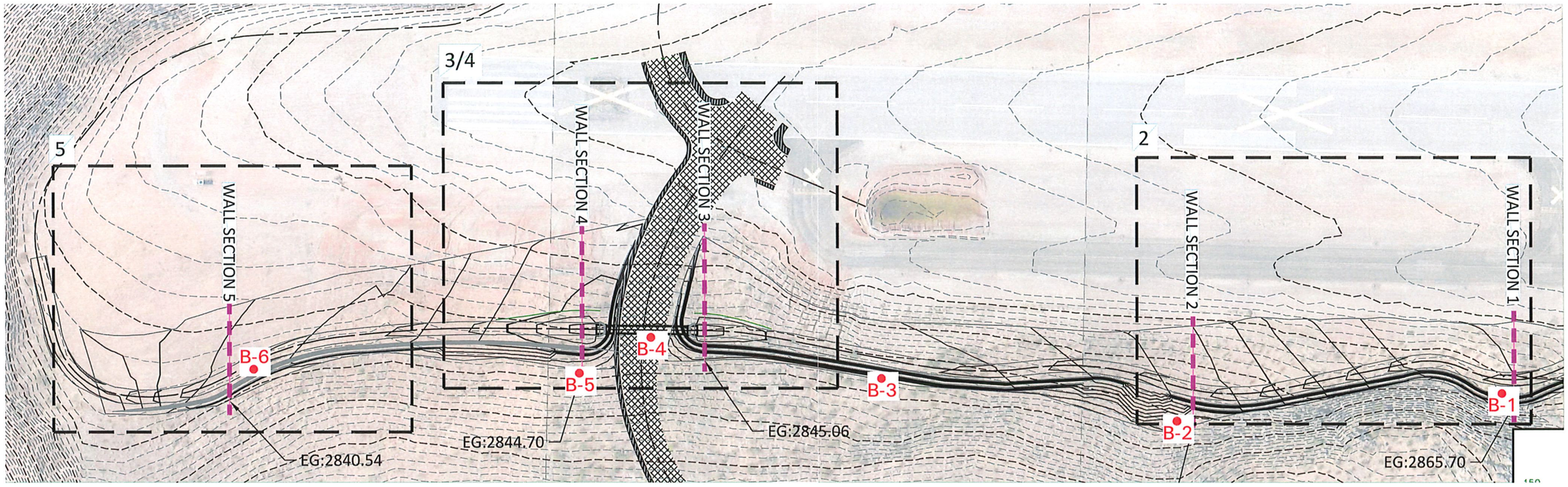
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Not to Scale

TECH RIDGE SOUTHEAST SLOPE
ST. GEORGE, UTAH

2230248	AGEC	Vicinity Map	Figure 1

TECH RIDGE SOUTHEAST SLOPE
ST. GEORGE, UTAH

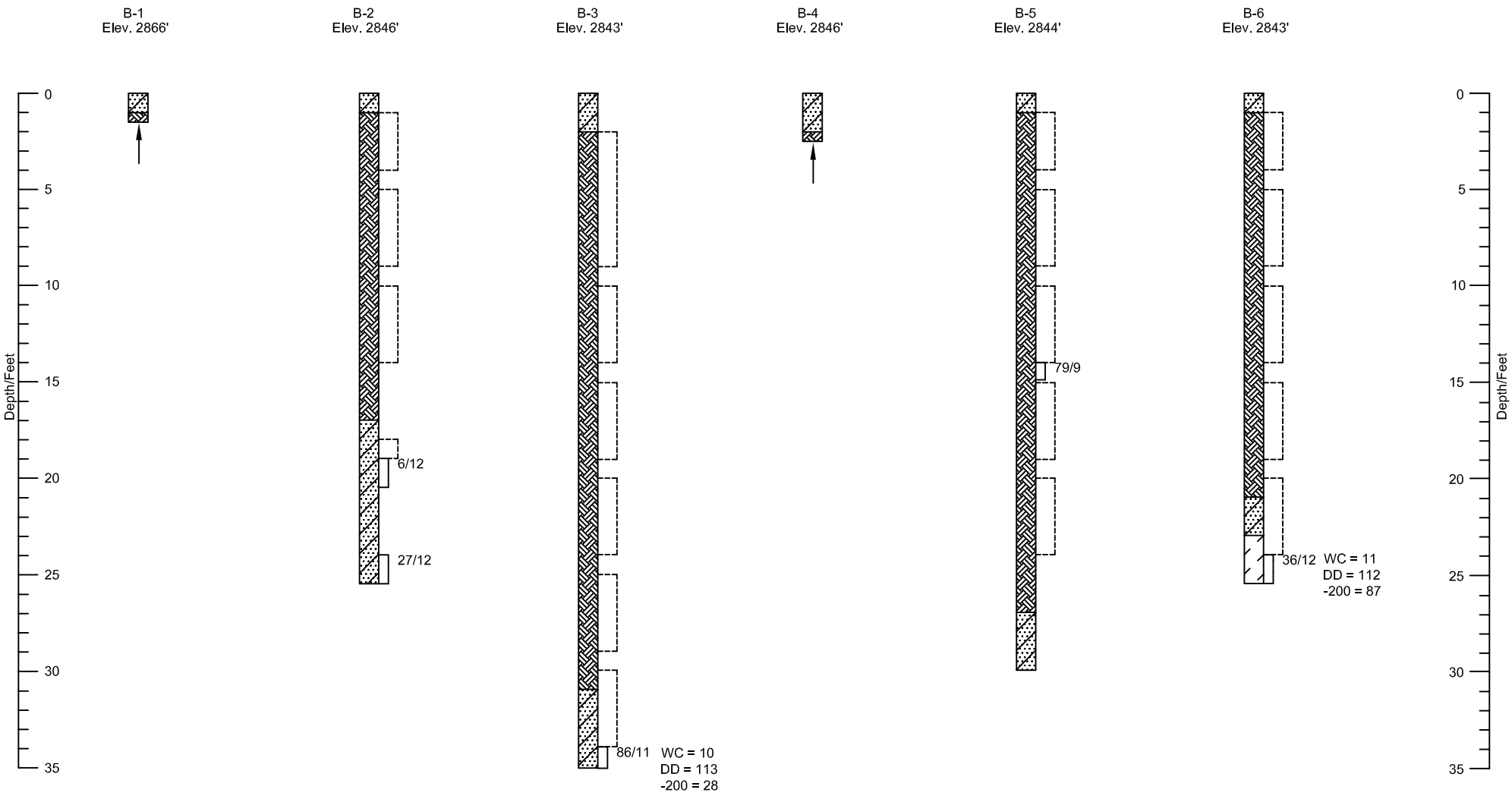


● Approximate boring location

N

0 150 300 feet

2230248	AGEC	Site Plan and Boring Locations	Figure 2



2230248 | AGEC | Logs of Exploratory Borings | Figure 3

LEGEND:



Silty Sand (SM); loose to dense, dry to slightly moist, contains occasional layers of sandy silt, occasional gravel, small roots (upper 12"), light brown to brown to red-brown.



Basalt Caprock; hard, dry, dark grey to black.



Lean Clay (CL); stiff, slightly moist, red-brown.



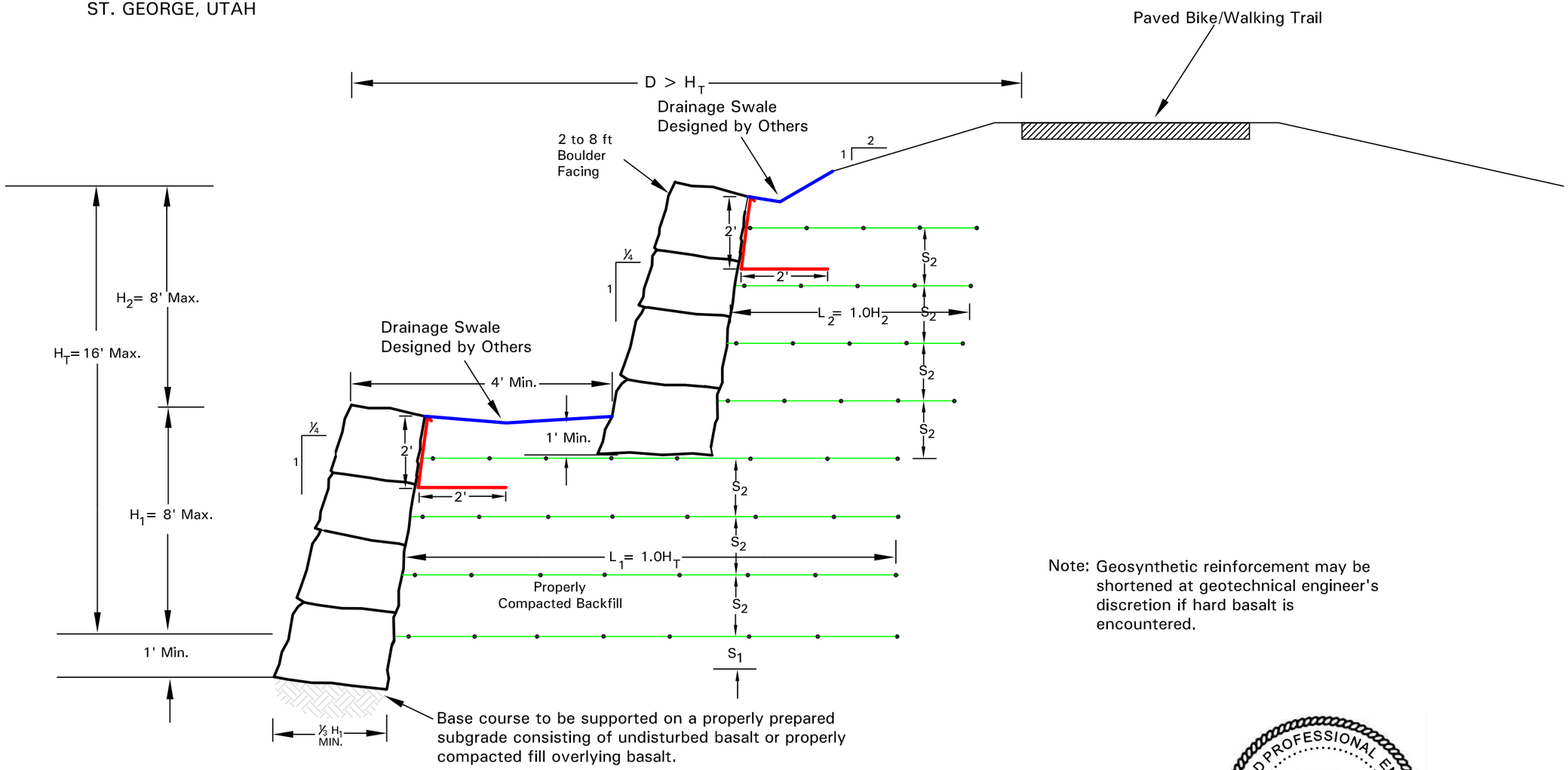
10/12 California drive sample taken. The symbol 10/12 indicates that 10 blows from a 140 pound hammer falling 30 inches were required to drive the sampler 12 inches.

Indicates practical backhoe refusal on basalt caprock.

NOTES:

1. The borings were drilled on May 18, 2023 with a rubber tire ATV mounted drill rig equipped with 8-inch hollow stem augers.
2. The locations of the borings were approximated with a KMZ file using a handheld GPS device as shown on Figure 2.
3. The elevations of the borings were interpolated from contours on the site plan as shown on Figure 2.
4. The boring locations and elevations should be considered accurate only to the degree implied by the method used.
5. The lines between the materials shown on the boring logs represent the approximate boundaries between material types and the transitions may be gradual.
6. Water level readings shown on the logs were made at the time and under the conditions indicated. Fluctuations in the water level may occur with time.
7. WC = water content (%);
   DD = dry density (pcf);
   -200 = percent passing No. 200 sieve.

TECH RIDGE, SOUTHEAST SLOPE
ST. GEORGE, UTAH



Key:

- Mirafi 140N Filter Fabric
- 10 Mil. PVC Liner
- Geosynthetic Reinforcment

Note: Geosynthetic reinforcement may be shortened at geotechnical engineer's discretion if hard basalt is encountered.

LICENSED PROFESSIONAL ENGINEER
9/8/23
JACOB C. ERICKSON
No. 10196083
STATE OF UTAH

By: Jake Erickson, P.E.

2230248	AGEC	TWO TIERED ROCKERY FACED REINFORCED FILL SLOPE	Figure 5

TECH RIDGE, SOUTHEAST SLOPE
ST. GEORGE, UTAH

A. **Boulder Placement/Construction:**

1. Boulders should be angular, rectangular ledge rock. Boulders should have a flat stacking surface and decrease in size as they are stacked.
2. Base rock size = ⅓-½H ; Minimum rock size 24 inches and/or 200 pounds.
3. Boulders should consist of durable material resistant to weathering. Typically 2 to 5 feet in size. Suitable sources in Washington County - Basalt, tan (Shinarump) sandstone, some limestone from Fort Pearce area.
4. Minimum **embedment** = 1 foot unless deeper embedment is shown on drawing.
5. Minimum **batter** ¼:1 (Horizontal to Vertical).
6. The slope/boulder subgrade should be properly prepared/compacted as directed by the geotechnical engineer prior to placing of fill or boulders.
7. Landscaping and associated irrigation systems are not recommended. Wetting of the backfill may result in settling or reduced stability. Block walls or fences may settle if placed in the backfill zone.

B. **Fill:**

1. Backfill should have a maximum size of 3", -200 < 30% and LL < 30%.
2. Refer to geotechnical investigation (AGEC Project No. 2180295) for approved low permeable fill criteria.
3. Each lift of backfill should be properly compacted. Hand compaction should be used within 3 feet of boulder facing. 4 inch lifts should be used for hand compaction equipment. Lift thickness may be increased to 8 inches for rubber tire or roller compaction.

C. **Construction Observation:**

1. Pre-construction meeting with Engineer, Owner and Contractor.
2. Observation of construction should be completed so that the quality of construction can be documented and modifications can be made if conditions require.
3. Backfill placed behind boulders and in reinforced areas should be tested frequently to verify compaction is at least 95% of the maximum dry density as determined by ASTM D-1557. We recommend a testing frequency of approximately every 1 foot of fill placed staggered approximately every 50 lineal feet. If the fill is not properly compacted, the stability of the slope will be reduced.
4. Backfill should be placed in 6 to 8-inch loose lifts prior to compacting. Proper moisture conditioning should be conducted in the backfill material before compacting.
5. A representative of AGEC should observe/verify placement of the geogrid, filter fabric and strip drains.

D. **Geosynthetics:**

1. The filter fabric may consist of Mirafi 140N, non-woven filter fabric or equivalent.
2. **Geosynthetic reinforcement** should be placed continuously in the primary strength direction. It may not be spliced in the primary strength direction.
3. The geogrid should be stretched by hand until taut and free of wrinkles. Individual lengths of the geosynthetic reinforcement should be overlapped at least 1 foot.
4. Where rockery wall forms an outside corner, geogrid should be placed in both directions with a minimum of 4" of backfill between the overlapping layers of geogrid.
5. The following table should be referred to for geosynthetic grid length: (See Figure 1)

Geosynthetic Reinforcement Schedule ¼:1 (H:V) Slope

Boulder Faced Fill Slope Height (ft)	Geosynthetic Reinforcement Required	Approved * Geosynthetic Reinforcement	Geosynthetic Vertical Spacing (ft)		Grid Lengths (ft)	
			S_1	S_2	L_1	L_2
$H_T \leq 3$	No	NA	NA	NA	See Detail	See Detail
$3 < H_T \leq 16$	Yes	Miragrid 5XT	1	2		

* Approved Equivalents - Tensar UX1500HS = Miragrid 5XT = WG6



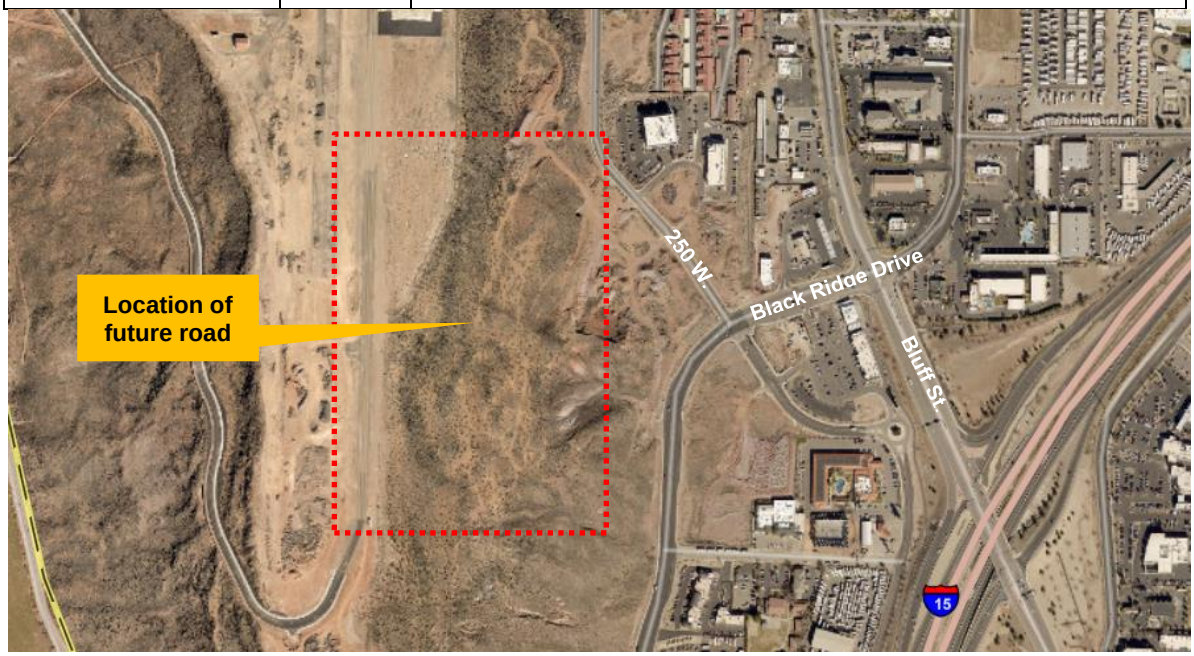
By: Jake Erickson, P.E.

St.George
Community Development

ITEM 2
Hillside Permit

HILLSIDE REVIEW BOARD AGENDA REPORT: **11/01/2023**

Tech Ridge Southeast Access Road Hillside Development Permit (Case No. 2023-HS-003)		
Request:	Consider a Hillside Development Permit to construct the southeast access road from 250 West St. to the Tech Ridge Development.	
Applicant:	City of St. George	
Representative:	Mike Bradshaw	
Location:	250 West Street at approximately 1170 South	
General Plan:	COM (Commercial), OS (Open Space), and MDR (Medium Density Residential)	
Existing Zoning:	R-1-10 (Single Family Residential 10,000sf) and PD-MU (Planned Development Mixed use)	
Surrounding Zoning:	North	PD-MU and R-1-10
	South	PD-MU and R-1-10
	East	PD-C
	West	OS, PD-MU



BACKGROUND

This is a request to obtain a hillside development permit to be able to construct the southeast access road from 250 West Street to the Tech Ridge development.

EXHIBITS PROVIDED

1. Exhibit A – Maps
   "Exhibit A" in the packet shows the general plan land use map and the zoning map.

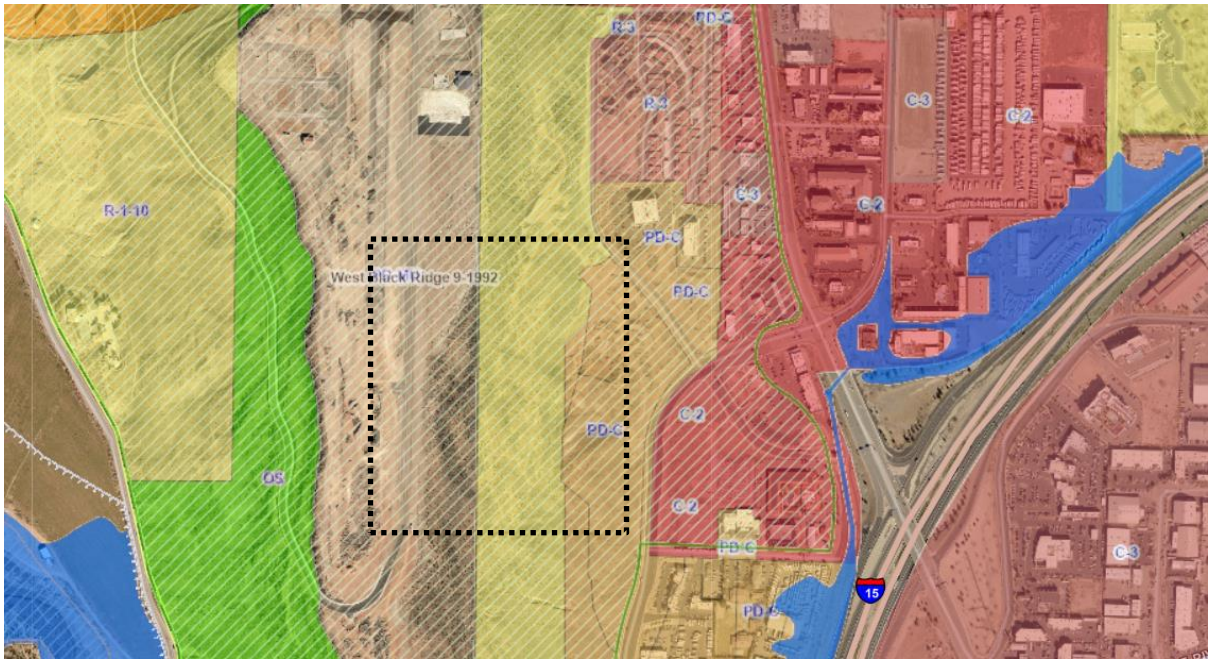
2. Exhibit B – Applicable Ordinances
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3. Exhibit C – Tech Ridge East Access Road Hillside Protection Plan
   "Exhibit C" in the packet shows the location of the east access road along with grading and slope analysis.

4. Exhibit D – Geotechnical Report
   "Exhibit D" in the packet shows the Geotech report for this proposal.

Exhibit A
MAPS

General Plan - COM



Zoning - R-1-10

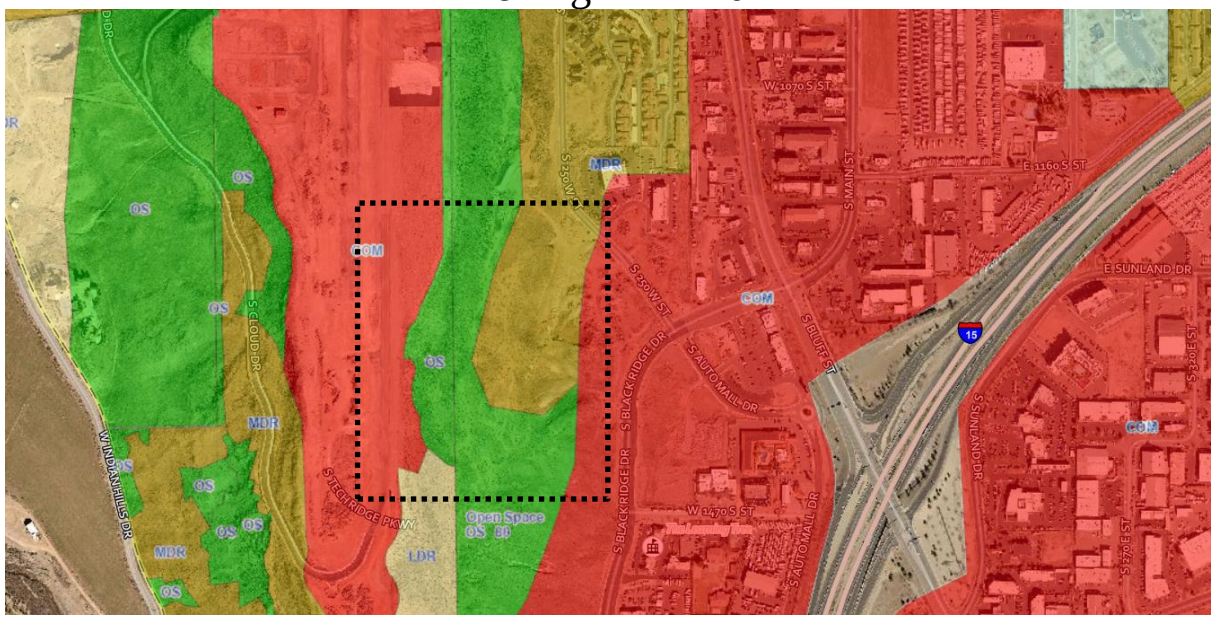


Exhibit B
APPLICABLE ORDINANCES

I. 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%).

F. The applicant may:

1. Transfer all development density from steeper slope categories (sending areas), to areas within the development with natural slopes of twenty percent (20%) or less (receiving areas); and

2. Develop additional bonus density, calculated from each slope category, as follows:

a. Natural slopes twenty percent (20%) or less transferred on a one-to-one (1:1) unit basis; plus

b. One (1) additional density unit for each density unit transferred from natural slopes of twenty-one percent (21%) to thirty percent (30%); plus

c. Two (2) additional density units for each density unit transferred from natural slopes of thirty-one percent (31%) to forty percent (40%).

3. Unit calculation for the receiving area shall be based on the requirements of the sending area zone.

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

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

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

J. Disturbance standards do not apply to the city for limited city facilities: trails, parks, and utilities. (Ord. 2019-10-002, 10-10-2019)

II. 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. (Ord. 2019-10-002, 10-10-2019)

III. Street Design

The following standards apply to public and private streets within the zone:

A. Street Grades: The maximum allowed street grade is fifteen percent (15%).

B. Intersections: Roads shall intersect at ninety-degree (90°) angles.

C. Intersection Spacing: Intersections should be spaced far enough apart so that the traffic stopped to make left turns at one intersection does not interfere with traffic movements at the adjacent intersections.

1. On low-volume streets such as access roads to minor collectors or minor collectors to minor collectors, the minimum spacing distance is one hundred twenty-five feet (125');

2. For minor collectors to major collectors, the minimum spacing distance is two hundred fifty feet (250').

D. Design Speed: The design of geometric features such as horizontal and vertical alignment will depend on the design speed selected for each street. The design speed is primarily determined by the street function and classification and is the maximum speed for safe and comfortable operation of a vehicle. Other than a major collector, all streets in hillside areas are classified as low speed streets (thirty-five (35) miles per hour or less).

Street Design Classification	Design Speed	Posted Speed
Minor collector	30	30
Local road	25 – 30	25
Hillside local	25	25
Hillside access	25	25

E. Clear Sight Distance at Intersections: Adequate, clear sight distance is required at intersections, as follows:

Posted Speed of Higher Order Road	Minimum Y	Desired Y
20	210	240
25	260	300
30	310	380
35	365	475

F. Vertical Curves and Intersection Relationship: The vertical alignment of residential streets shall comply with latest editions of AASHTO geometric design of highways and streets. See table below for listing of pertinent design criteria:

Design Speed	Crest "K" Value	Sag "K" Value
Minimum Length of Vertical Curves		
20	10	20
25	20	30
30	30	40
35	40	50

L = KA (for minimum sight distance on a vertical curve).

L = Length of vertical curve for proper sight distance.

A = Algebraic difference in grade.

Vertical alignment with the intersection is also of special nature, and design alternatives may be required. As a guideline, the approach area where vehicles stop while waiting to enter an intersection shall not exceed four (4%) to five percent (5%) from the gutter line of the street being intersected for a distance of fifty feet (50'), though a range of fifty feet (50') to one hundred feet (100') is more desirable. This applies to all intersections, except those intersections where both intersecting streets are minor collectors. The landing area for a minor collector shall be designed for a grade of two percent (2%) to three percent (3%) for a distance of one hundred feet (100').

G. Safe Stopping Sight Distance: The minimum sight distance to be provided before a stop is required is included in the table below:

Design Speed	Computed	Recommended Distance	Add-On for 15% Grade
20	106.7	125	20
25	146.5	150	36
30	195.7	200	64
35	248.4	250	95

H. Horizontal Curves: The minimum centerline radius for horizontal curves on low-speed residential streets is:

Street Classification or Speed	Curve Radius in Feet
Minimum Centerline Radius	
Private streets	50 – 100
20 mph	100 – 150
25 mph	185
30 mph	310

I. Street Cross-Section Standards: The requirements for street cross-section configurations are based on the following factors:

1. Traffic capacity;

2. Design speed;

3. Projected traffic;

4. Designs to reduce scarring.

J. Alternate road cross sections, such as grade separated streets, may be used if applicable safety and traffic standards are met.

K. Elimination of sidewalk on one side of the road may be approved when elimination of one (1) sidewalk can appreciably reduce the amount of hillside disturbance. Other considerations may also warrant its elimination. When one (1) sidewalk is eliminated, the remaining sidewalk shall be increased by one foot (1') in width.

L. The following table sets forth the requirements for street standards for single-family residential development.

Maximum Grade	Street Classification	Width ROW	Width TBC	Pavement Width	Width Sidewalk	ADT
Street Cross-Section Standards for Single-Family Residential						
12%	Minor collector	60'	50'	45'	5'	1,500 – 3,500
15%	Local road	50'	40'	35'	4'	750 – 1,500
15%	Hillside local	45'	35'	30'	4'	150 – 750
15%	Hillside access	41'	31'	26'	4'	0 – 150

(Ord. 2019-10-002, 10-10-2019)

IV. Additional Design Standards

1. *Retaining walls shall be colored to blend into the surrounding natural geology.*

2. *Retaining wall height is limited to the heights set forth in chapter 18 of this title and the standards for rock wall construction.*

3. *Building exterior colors shall be earth tone and blend with the surrounding natural landscape.*

4. *In residential zones, "no disturbance" areas shall be held as the "common area" of a project. Common areas shall be owned and maintained by the homeowners' association or may be deeded to the city when accepted by the city.*

5. *In nonresidential zones, any "no disturbance" area shall be identified on the final site plan or final plat.*

6. *Any required no disturbance area shall be identified on the ground with temporary fencing or other approved means to prevent accidental disturbance of the area during construction and such fencing shall be installed prior to issuance of a grading permit.*

7. *The building site shall be located on the flattest portion of the parcel.*

8. *No structure shall extend over any natural ridgeline. The structure shall be in contact with the ground at all edges. (Ord. 2019-10-002, 10-10-2019)*

Exhibit C

TECH RIDGE EAST ACCESS ROAD HILLSIDE PROTECTION PLAN

Exhibit D
GEOTECHNICAL REPORT

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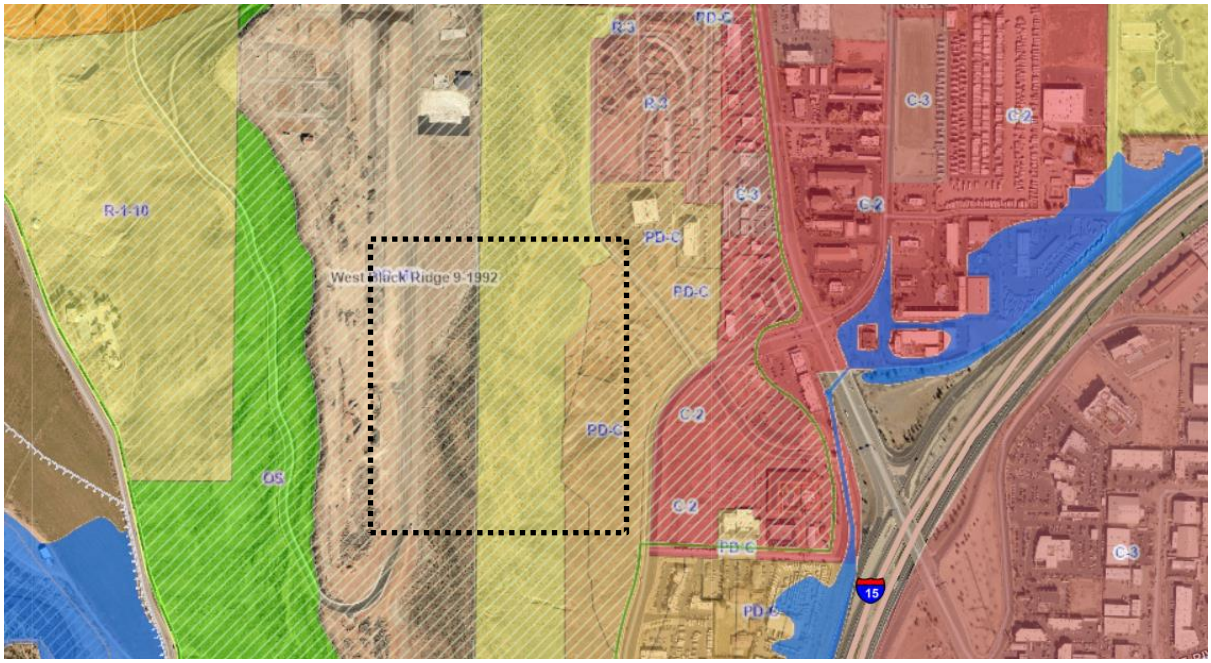
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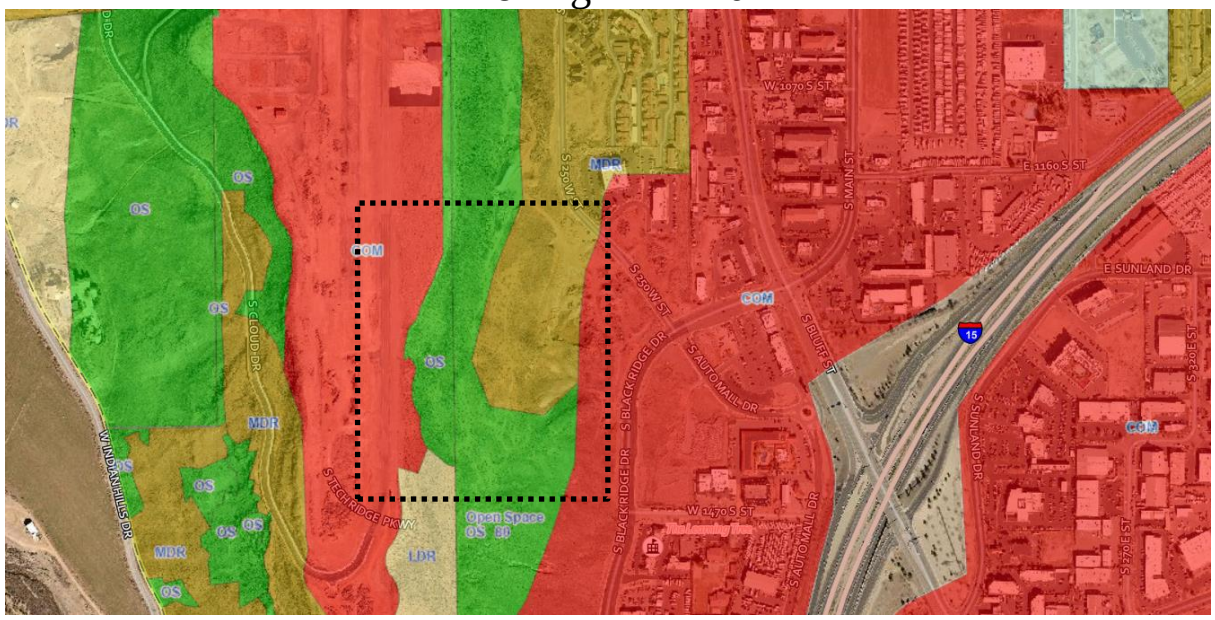


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5. *In nonresidential zones, any "no disturbance" area shall be identified on the final site plan or final plat.*

6. *Any required no disturbance area shall be identified on the ground with temporary fencing or other approved means to prevent accidental disturbance of the area during construction and such fencing shall be installed prior to issuance of a grading permit.*

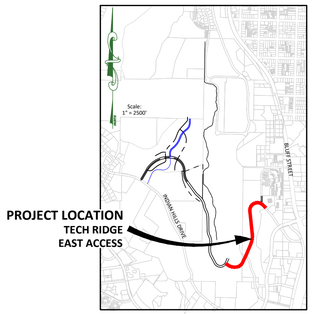
7. *The building site shall be located on the flattest portion of the parcel.*

8. *No structure shall extend over any natural ridgeline. The structure shall be in contact with the ground at all edges. (Ord. 2019-10-002, 10-10-2019)*

Exhibit C

TECH RIDGE EAST ACCESS ROAD HILLSIDE PROTECTION PLAN

TECH RIDGE EAST ACCESS ROAD
HILLSIDE APPLICATION
FOR
TECH RIDGE DEVELOPMENT, LLC
LOCATED IN
CITY OF ST. GEORGE, WASHINGTON COUNTY, UT



VICINITY MAP

SHEET INDEX	
SHEET NO.	DESCRIPTION
C1.0	COVER SHEET
C1.1	SHEET LAYOUT
C1.2	EXISTING GRADE SLOPE ANALYSIS
C1.3	OVERALL CUT AND FILL
C2.0- C2.9	EAST ACCESS ROAD GRADING

CALL 811 BEFORE YOU DIG
811
SAFE DIGGING PARTNER
BLUE STAKES OF UTAH

DEVELOPER

CITY OF ST. GEORGE
ATT: MR. CAMERON CUTLER
175 W 200 N
ST. GEORGE, UT 84770
EMAIL: CAMERON.CUTLER@SGCITY.ORG

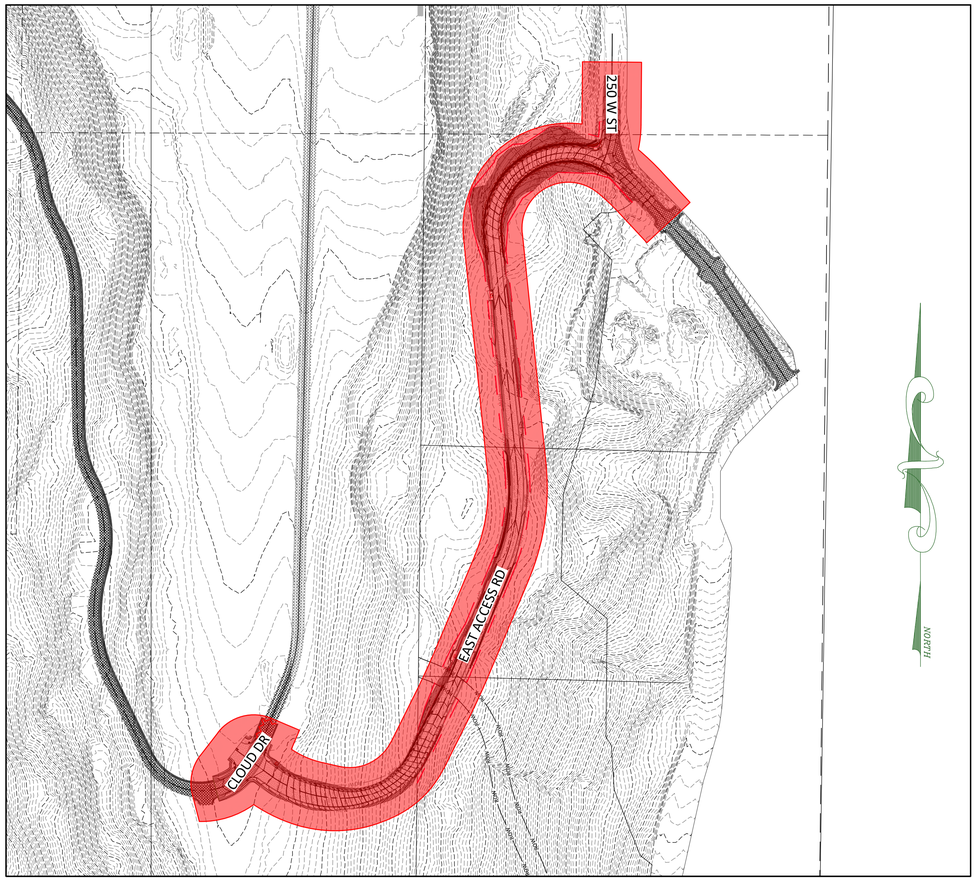
ENGINEER

ALLIANCE CONSULTING
2303 N. CORAL CANYON BLVD. SUITE 201
WASHINGTON, UT 84780-0577
PHONE: (435) 673-8060
FAX: (435) 673-8065
ENGINEER: MR. DELOSS HAMMON P.E.
CONTACT: MR. MIKE BRADSHAW
EMAIL: mwb@allianceconsulting.us

GEOTECHNICAL REPORTS:

The contractor is responsible to read and fully understand the Geotech report and to coordinate with the geotechnical engineer throughout the grading process to ensure that the report's recommendations are implemented from the beginning to the end of the projects construction. The owner will contract with the geotechnical engineer for their representatives to be on site throughout the grading process to ensure full compliance with the geotechnical report's recommendations. Refer to following reports.

1. Applied GeoTech Geotechnical Investigation, Tech Ridge South Access Road, Project No. 2180295, 12-6-2022d: Oct 19, 2018



GRAPHIC SCALE

250 0 125 250 500

(IN FEET)
1 inch = 250 ft.
If Printed 11x17 use Half Scale

GENERAL NOTES:

1. Unless shown otherwise on these plans, all construction shall conform to the codes and ordinances of St. George City, the State of Utah Administrative Codes, "The International Plumbing Code", and the "International Building Code" latest editions as administered by St. George City.
2. The Contractor shall be responsible for the location of and protection of all existing underground utilities and overhead power line during construction.
3. The Benchmark for this Project is the South 1/4 of Section 36, Township 42 South, Range 16 West Salt Lake Base and Meridian - St. George HCN #181 - Elevation: 2667.70
3. Existing contour and finish contour interval is 2 feet.
4. Any necessary design modifications shall be approved by the design engineer.
5. All grading to be within ±0.1' of proposed elevation.
6. Project shall install an information sign on site before construction begins. This sign shall have a minimum size, placement location and content information with the company name, phone & permit number.
7. A mandatory pre-construction meeting shall be required on all projects prior to any grubbing, grading, or construction activities. The permit holder shall be required to notify all Development Services inspectors.
8. Projects shall submit a dust control plan with details on equipment scheduling and reporting of dust control activities.
9. Follow Appendix J standards found in the IBC.
10. All work materials shall meet City of St. George standards.
11. The Developer will Maintain the Temporary Detention Basin until Decommission.

CONSTRUCTION NOTES:

1. All excavations and grading shall be in accordance with the requirements of the City of St. George [phone:435-627-4000], of the "International Building Code", 2018 edition, and the specifications and requirements included in the Tech Ridge Grading Recommendations...
1. All excavation, grading, and fill operations within the building area should be observed by the Field Engineer to verify subsoil conditions and determine adequacy of site preparation, suitability of fill materials and compliance with compaction requirements.
2. The Contractor shall provide suitable equipment to control dust and air pollution caused by construction operations. The Contractor shall also provide suitable mud and dirt containment to maintain clean conditions on the work site, access roadways, and adjacent properties.
3. Project shall submit a Dust Control Plan with details on equipment, scheduling and reporting of dust control activities.
4. Contractor is responsible and required to obtain their own UPDES/NOI permits.
5. It is the contractors responsibility to identify all and any SWPPP requirements.
6. Prior to and during compaction operations, all backfill material shall have the required moisture content uniform throughout each layer.
7. All Rip-Rap rock shall be approved by owner.
8. Contractor must coordinate with other Contractors working in areas.
9. Contractor must protect existing facilities.
10. All rock walls are to match in color and composition with the native basalt lava rock. Rock to be stained black.

Date: 12-30-2022

REVISIONS

No.	Date	by	Description
		ARL	

File Name
East Access Hillside Application.dwg

ALLIANCE CONSULTING
A PLANNING AND ENGINEERING FIRM

UTAH
2303 N CORAL CANYON BLVD
SUITE 201,
WASHINGTON, UT 84780
435-673-8060

NORTH DAKOTA
621 26th STREET W.
WILLISTON, ND 58801
701-572-8100

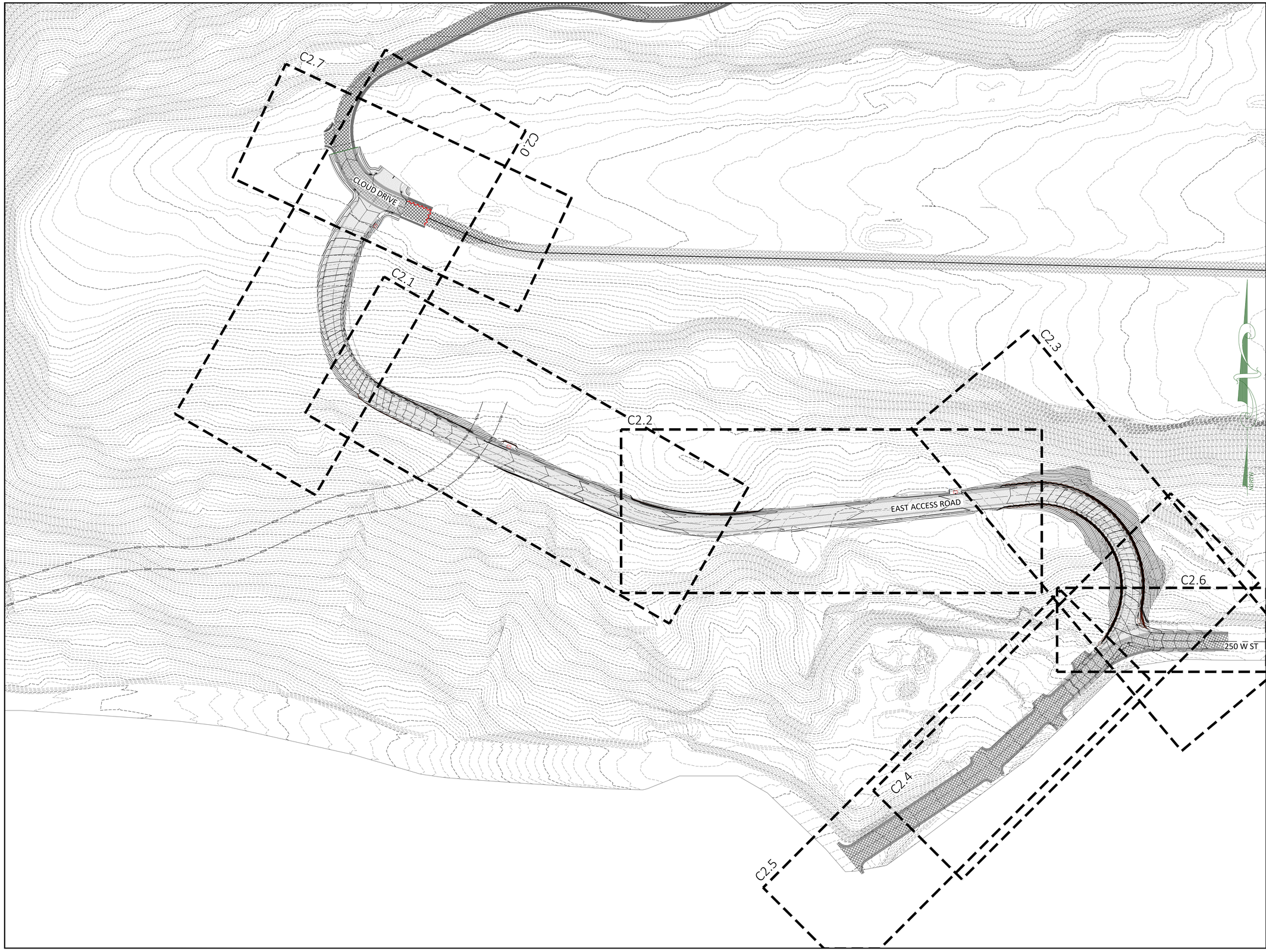
TECH RIDGE EAST ACCESS ROAD HILLSIDE PROTECTION PLAN
FOR
CITY OF ST. GEORGE
LOCATED IN SEC 36
T 42 SOUTH, R 16 WEST SLB&M
CITY OF ST. GEORGE, WASHINGTON COUNTY, UT

NOT FOR CONSTRUCTION REVIEW ONLY

Drawn By: ARL	Scale: 1"=250'
Client No. 4568	Project No. 4568-21

Drawing Sheet
C1.0

Sheet 1 of 14 Sheets



Date:
12-30-2022

REVISIONS

No.	Date	by	Description
		ARL	

File Name
East Access Hillside Application.dwg

GRAPHIC SCALE
120 0 60 120 240
(IN FEET)
1 inch = 120 ft.
If Printed 11x17 use Half Scale

ALLIANCE CONSULTING
A PLANNING AND ENGINEERING FIRM

UTAH
2303 N CORAL CANYON BLVD
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WASHINGTON, UT 84780
435-673-8060

NORTH DAKOTA
621 26th STREET W.
WILLISTON, ND 58801
701-572-8100

TECH RIDGE
EAST ACCESS ROAD
HILLSIDE SHEET LAYOUT

FOR

CITY OF ST. GEORGE

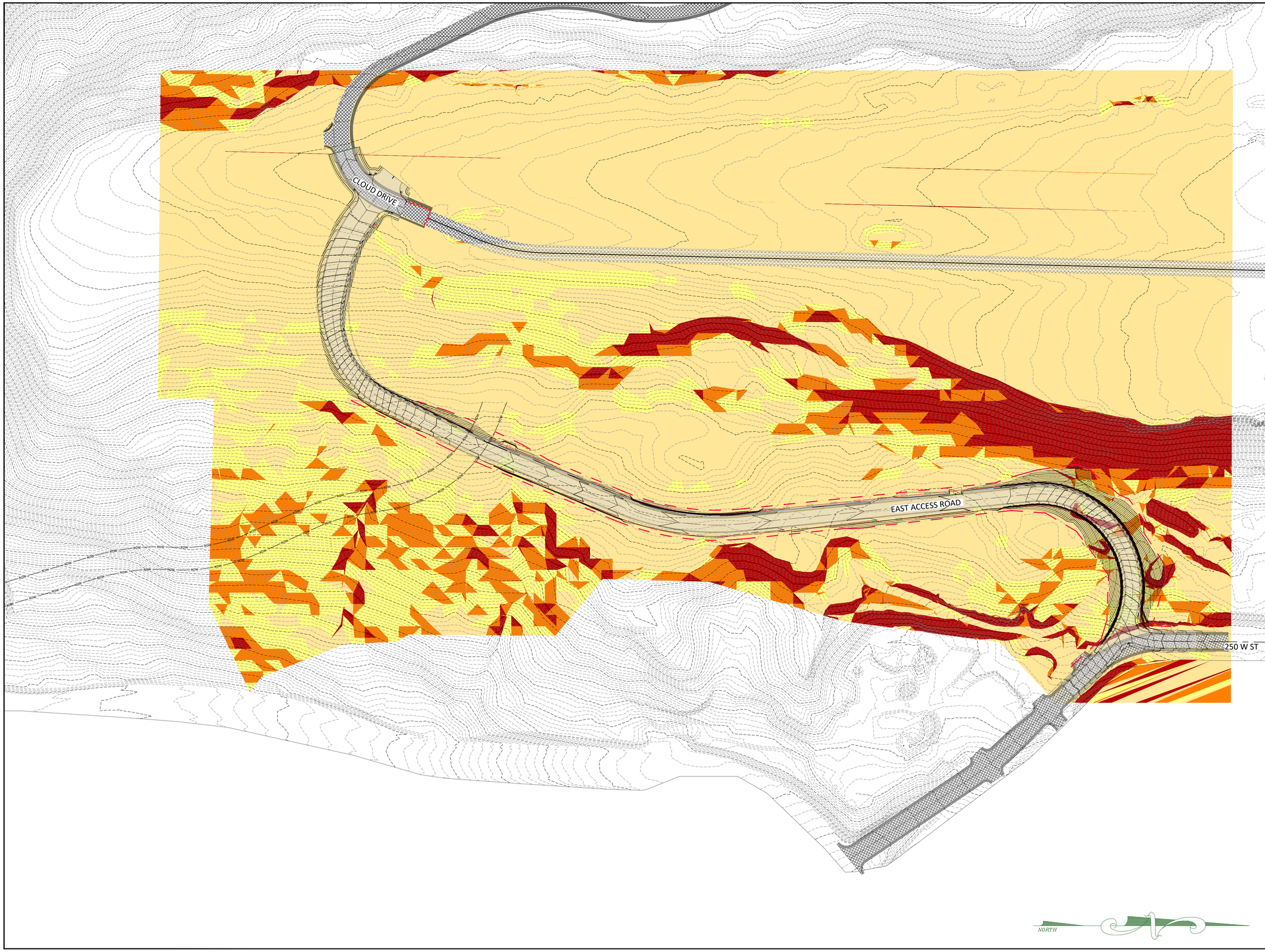
LOCATED IN SEC 36
T 42 SOUTH, R 16 WEST SLB&M
CITY OF ST. GEORGE, WASHINGTON COUNTY, UT

NOT FOR CONSTRUCTION
REVIEW ONLY

Drawn By: ARL	Scale: 1"=120'
Client No. 4568	Project No. 4568

Drawing Sheet
C1.1

Sheet 2 of 14 Sheets



Date:
12-30-2022

REVISIONS

No.	Date	by	Description
		ARL	

File Name
East Access Hillside Application.dwg

SLOPE ANALYSIS LEGEND

- 0% to 20%
- 20% to 40%
- 40% to 60%
- 60% +

GRAPHIC SCALE

120 0 60 120 240

(IN FEET)
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A PLANNING AND ENGINEERING FIRM

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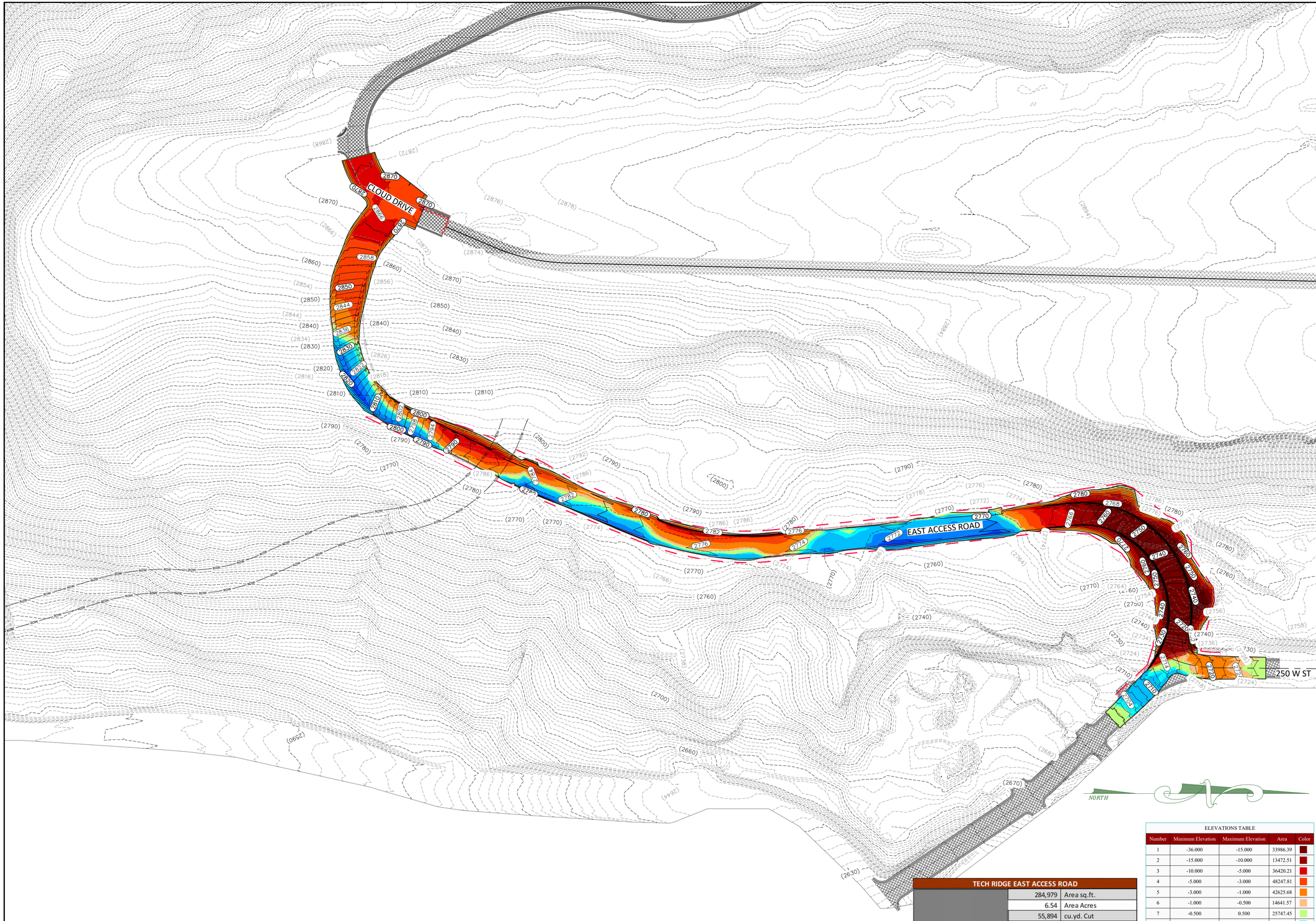
TECH RIDGE
EAST ACCESS ROAD
HILLSIDE SLOPE ANALYSIS
FOR
CITY OF ST. GEORGE
LOCATED IN SEC 36
T 42 SOUTH, R 16 WEST SLB&M
CITY OF ST. GEORGE, WASHINGTON COUNTY, UT

NOT FOR CONSTRUCTION
REVIEW ONLY

Drawn By:	Scale:
ARL	1"=120'
Client No.	Project No.
4568	4568

Drawing Sheet
C1.2

Sheet 3 of 14 Sheets



TECH RIDGE EAST ACCESS ROAD		
	284,979	Area sq.ft.
	6.54	Area Acres
	55,894	cu.yd. Cut
	6,316	cu.yd. Fill
Shrinkage 15%	947	cu.yd. Shrinkage
Total	**(50,525.40)**	**cu.yd. Material Export**

Cut and Fill volumes shown are based on Digital Terrain Modeling computations. Shrinkage volumes shown are estimated. These volumes are approximate based on the information provided.

ELEVATIONS TABLE

Number	Minimum Elevation	Maximum Elevation	Area	Color
1	-36.000	-15.000	33986.39	
2	-15.000	-10.000	13472.51	
3	-10.000	-5.000	36420.21	
4	-5.000	-3.000	48247.81	
5	-3.000	-1.000	42625.68	
6	-1.000	-0.500	14641.57	
7	-0.500	0.500	25747.45	
8	0.500	1.000	11792.38	
9	1.000	3.000	35077.70	
10	3.000	5.000	20122.57	
11	5.000	7.000	2817.70	
12	7.000	10.000	0.00	
13	10.000	20.000	0.00	

Date: 12-30-2022

REVISIONS

No.	Date	by	Description
		ARL	

File Name
East Access Hillside Application.dwg

LEGEND

- EXISTING ASPHALT
- PROPOSED ASPHALT
- EXISTING CONCRETE
- PROPOSED CONCRETE
- 30" CURB & GUTTER
- SLOPE EASEMENT
- EXISTING CONTOUR
- DESIGN CONTOUR

GRAPHIC SCALE

120 0 60 120 240

(IN FEET)
1 inch = 120 ft.
If Printed 11x17 use Half Scale

ALLIANCE CONSULTING
A PLANNING AND ENGINEERING FIRM

UTAH
2303 N CORAL CANYON BLVD
SUITE 201,
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435-673-8060

NORTH DAKOTA
621 26th STREET W.
WILLISTON, ND 58801
701-572-8100

TECH RIDGE
EAST ACCESS ROAD
HILLSIDE CUT/FILL

FOR

CITY OF ST. GEORGE

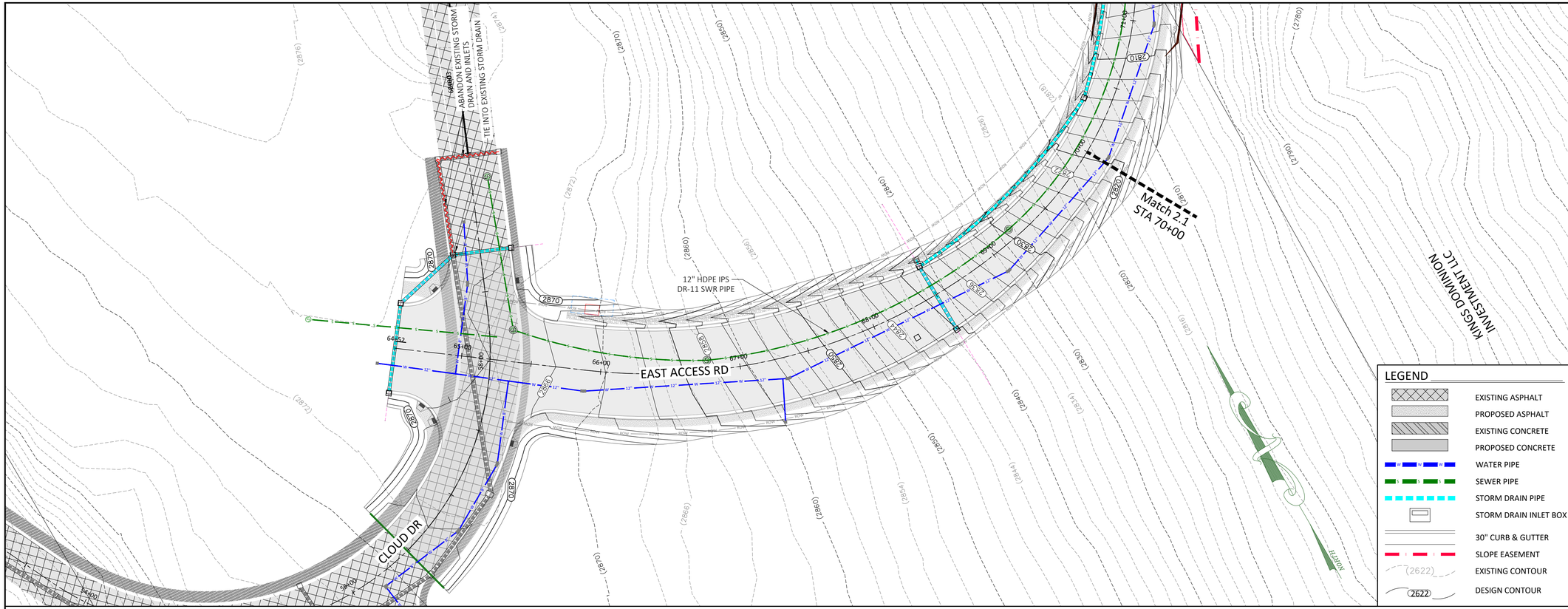
LOCATED IN SEC 36
T 42 SOUTH, R 16 WEST SLB&M
CITY OF ST. GEORGE, WASHINGTON COUNTY, UT

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REVIEW ONLY

Drawn By:	Scale:
ARL	1"=120'
Client No. 4568	Project No. 4568

Drawing Sheet
C1.3

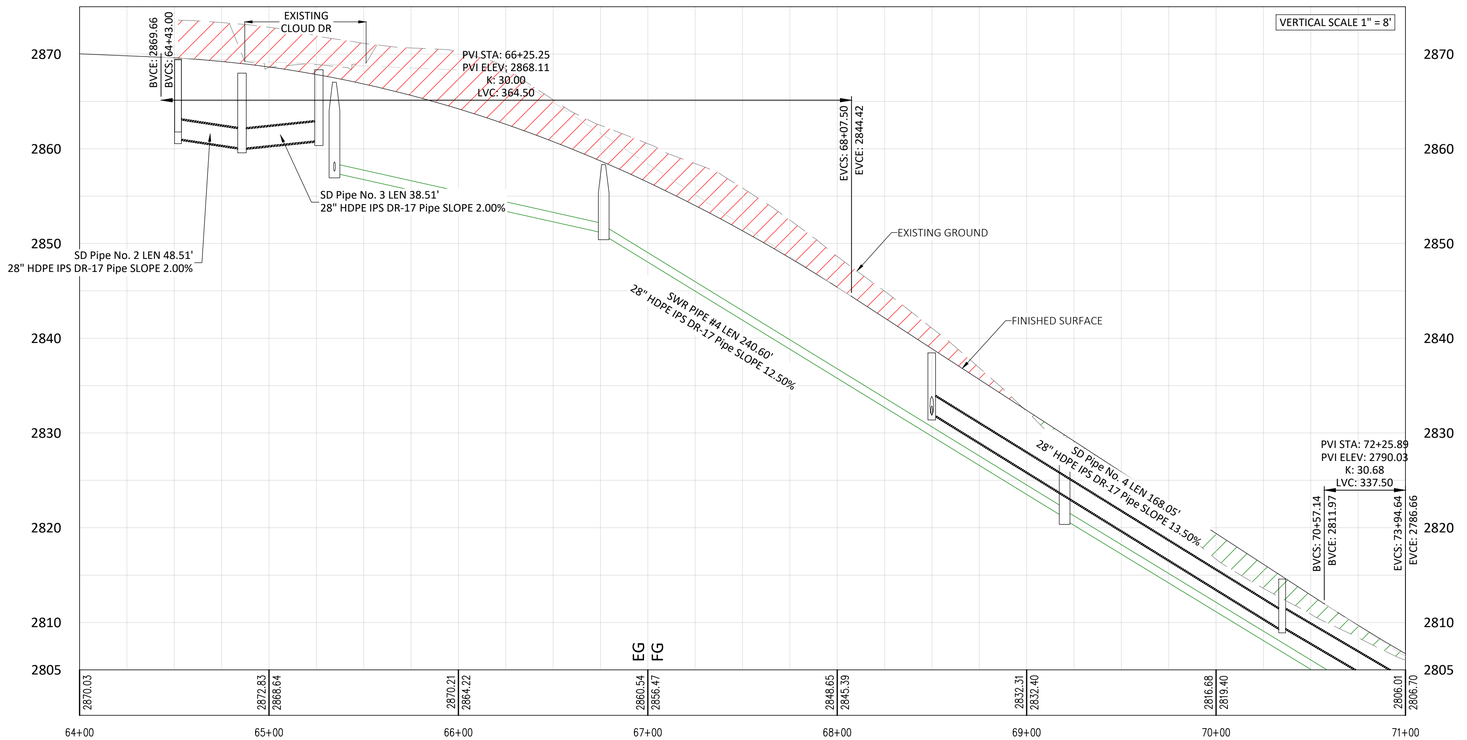
Sheet 3 of 14 Sheets



LEGEND

- EXISTING ASPHALT
- PROPOSED ASPHALT
- EXISTING CONCRETE
- PROPOSED CONCRETE
- WATER PIPE
- SEWER PIPE
- STORM DRAIN PIPE
- STORM DRAIN INLET BOX
- 30" CURB & GUTTER
- SLOPE EASEMENT
- (2622) EXISTING CONTOUR
- 2622 DESIGN CONTOUR

East Access REV 4



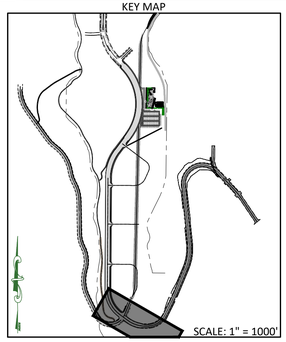
Date: 12-30-2022

REVISIONS

No.	Date	by	Description

File Name
East Access Hillside Application.dwg

KEY MAP



GRAPHIC SCALE

40 0 20 40 80

(IN FEET)
1 inch = 40 ft.
If Printed 11x17 use Half Scale

ALLIANCE CONSULTING
A PLANNING AND ENGINEERING FIRM

UTAH
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TECH RIDGE
EAST ACCESS
GRADING

FOR

CITY OF ST. GEORGE

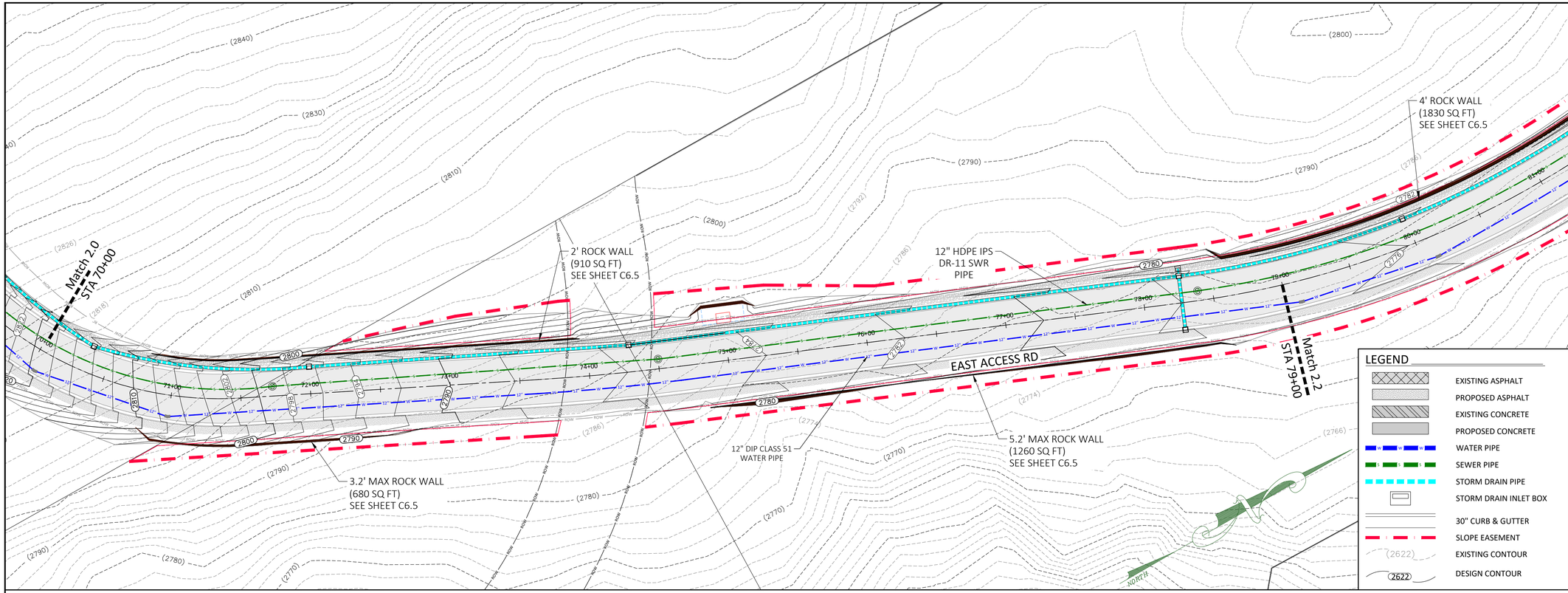
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T 42 SOUTH, R 15 WEST SLB&M
CITY OF ST. GEORGE, WASHINGTON COUNTY, UT

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Drawn By:	Scale:
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Client No. 4568-21	Project No. 4568-21

Drawing Sheet
C2.0

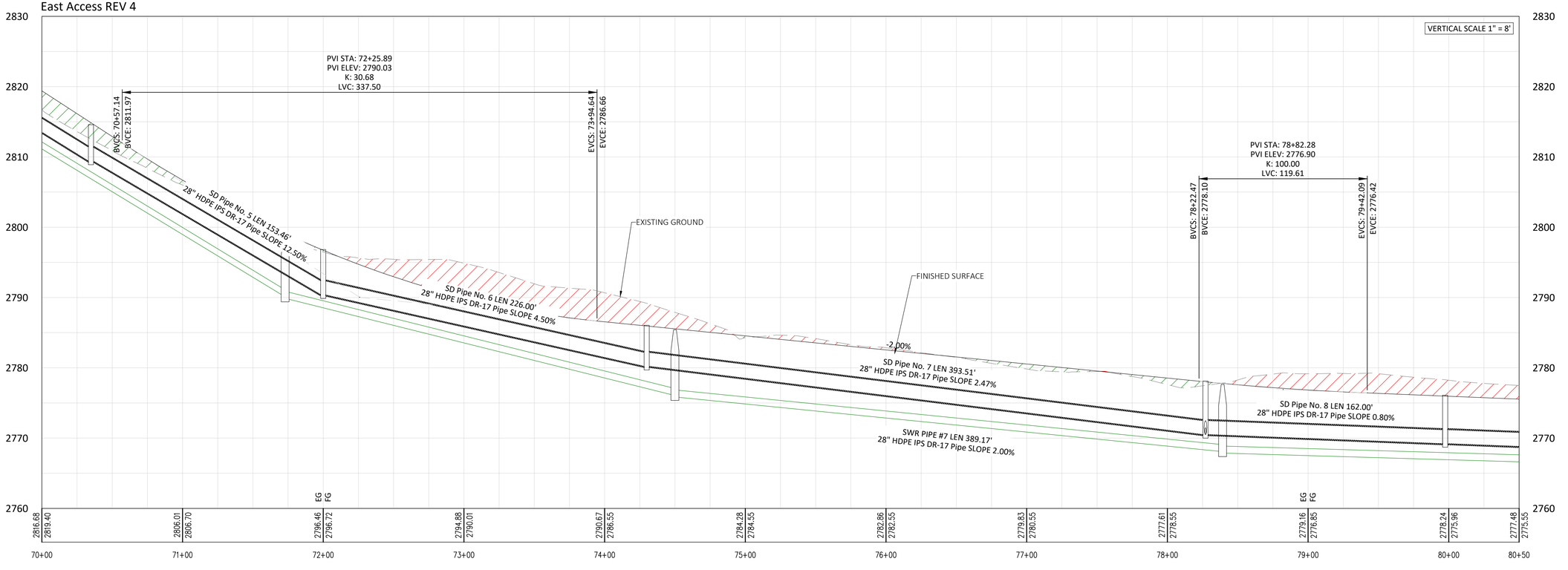
Sheet 5 of 14 Sheets



LEGEND

- EXISTING ASPHALT
- PROPOSED ASPHALT
- EXISTING CONCRETE
- PROPOSED CONCRETE
- WATER PIPE
- SEWER PIPE
- STORM DRAIN PIPE
- STORM DRAIN INLET BOX
- 30" CURB & GUTTER
- SLOPE EASEMENT
- EXISTING CONTOUR
- DESIGN CONTOUR

East Access REV 4



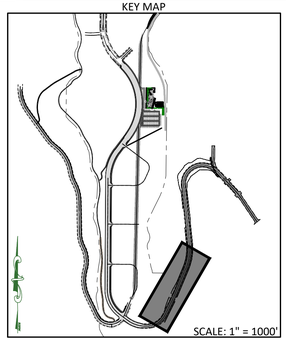
Date: 12-30-2022

REVISIONS

No.	Date	by	Description

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East Access Hillside Application.dwg

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TECH RIDGE
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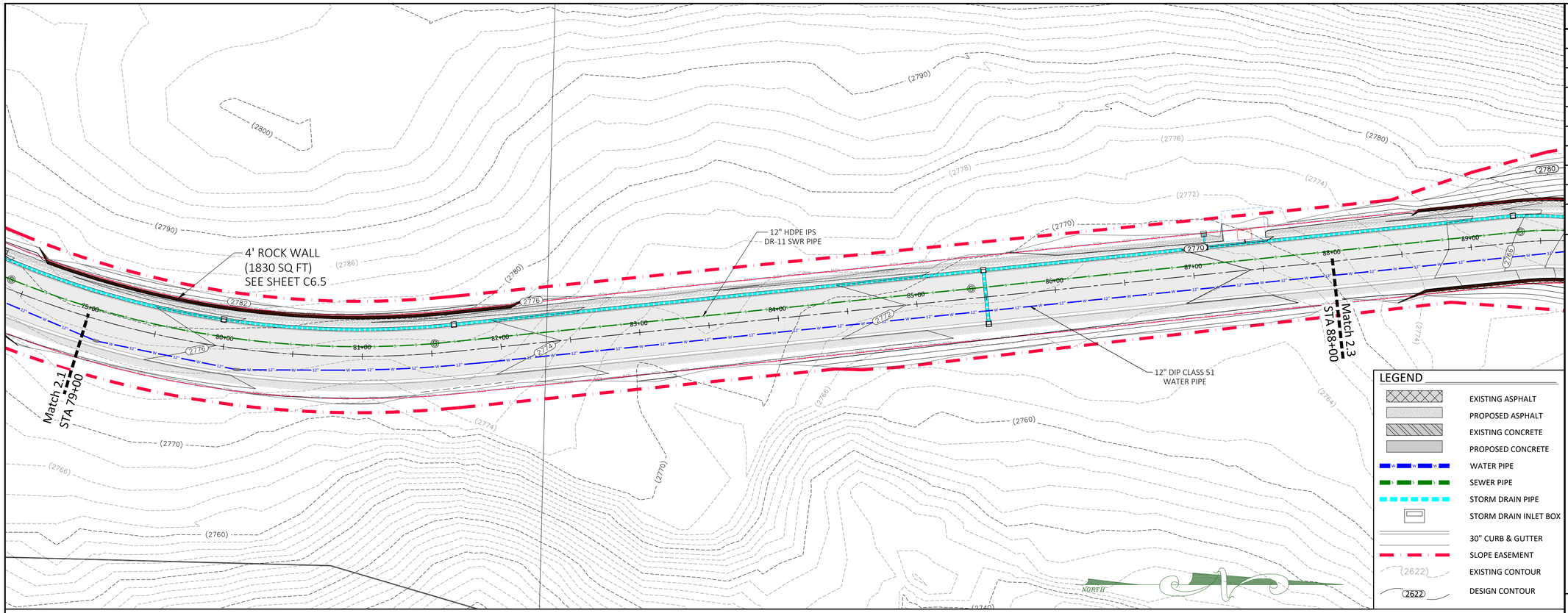
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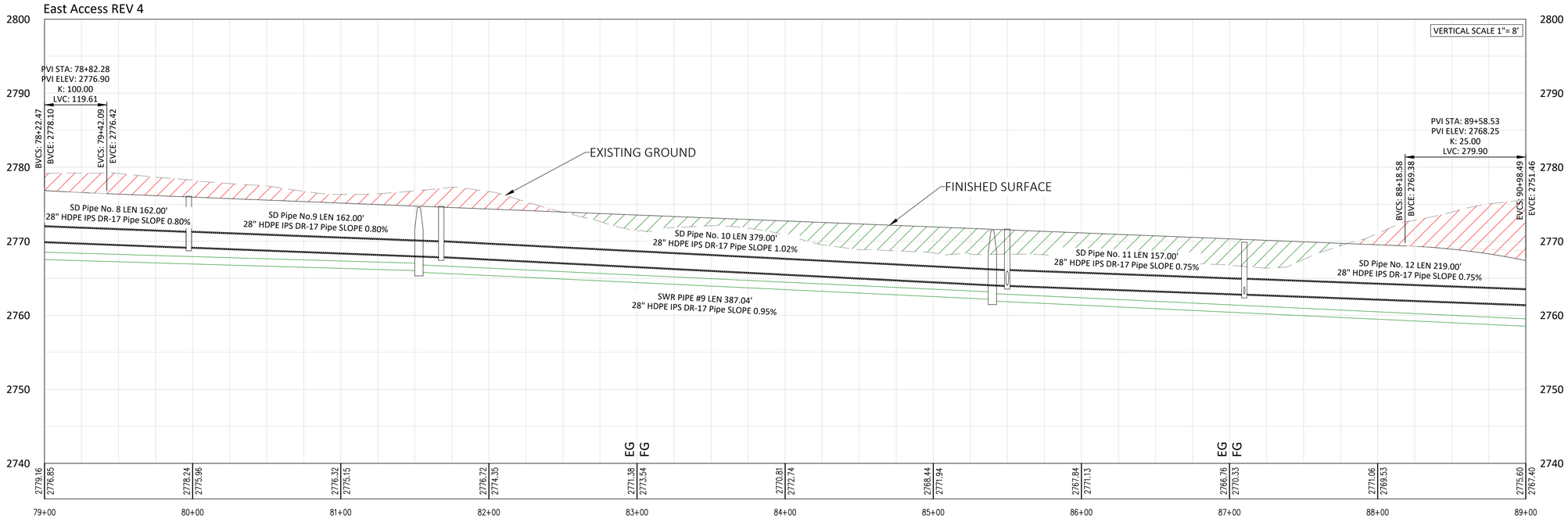
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Client No. 4568-21	Project No. 4568-21

Drawing Sheet
C2.1

Sheet 6 of 14 Sheets





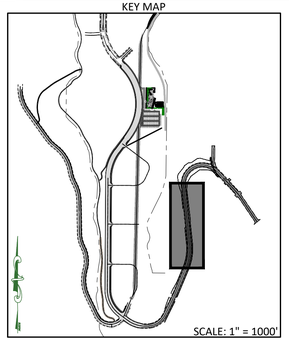
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REVISIONS

No.	Date	by	Description

File Name
East Access Hillside Application.dwg

KEY MAP



GRAPHIC SCALE

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(IN FEET)
1 inch = 40 ft.
If Printed 11x17 use Half Scale

ALLIANCE CONSULTING
A PLANNING AND ENGINEERING FIRM

UTAH
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435-673-8060

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701-572-8100

TECH RIDGE
EAST ACCESS
GRADING

FOR

CITY OF ST. GEORGE

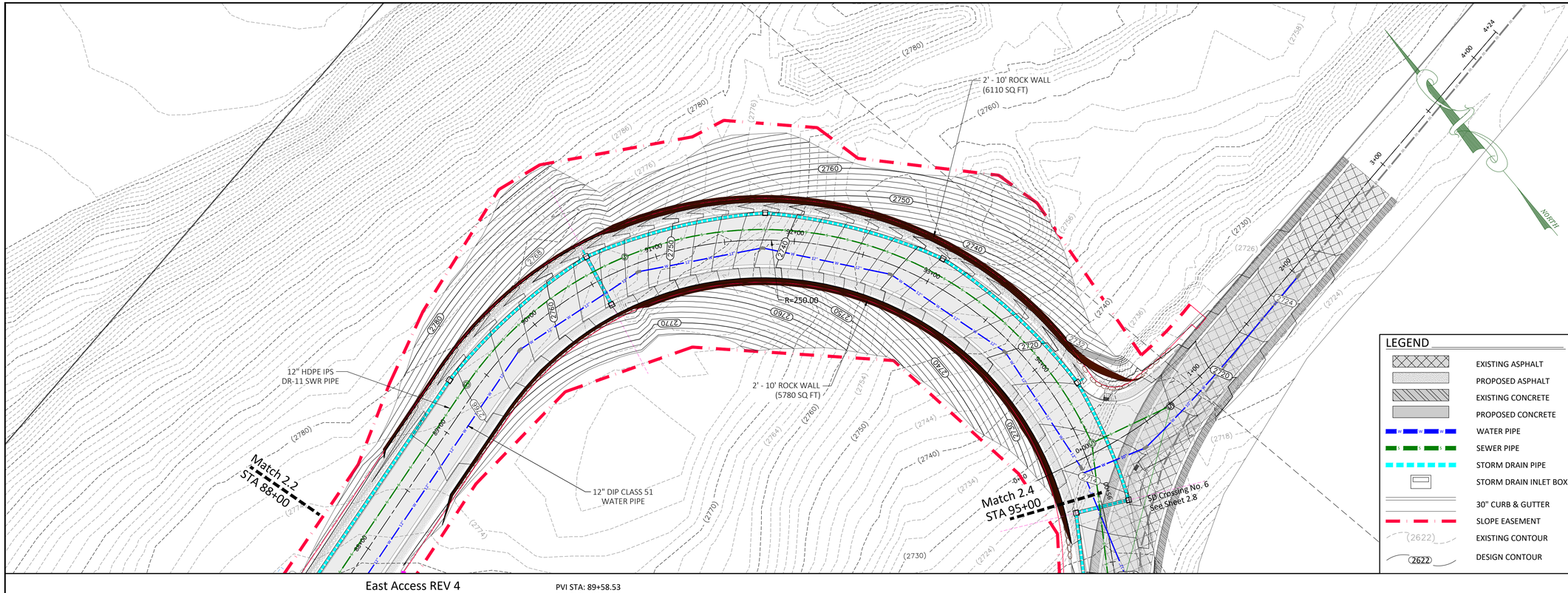
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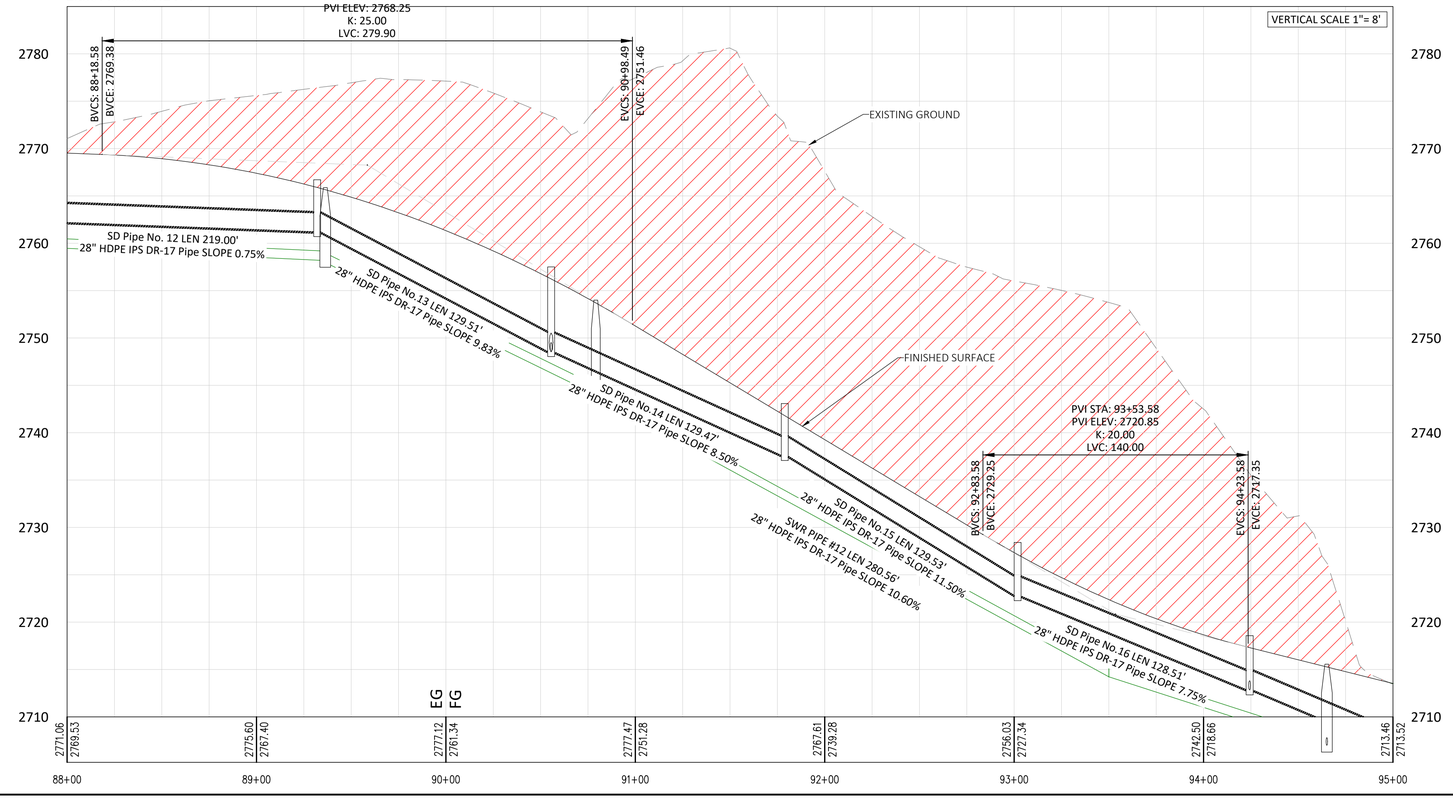
NOT FOR
CONSTRUCTION
REVIEW ONLY

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Client No.	Project No.
4568-21	4568-21

Drawing Sheet
C2.2

Sheet 7 of 14 Sheets





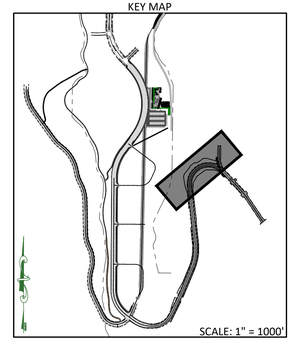
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REVISIONS

No.	Date	by	Description

File Name
East Access Hillside Application.dwg

KEY MAP



GRAPHIC SCALE

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(IN FEET)
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ALLIANCE CONSULTING
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TECH RIDGE
EAST ACCESS
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CITY OF ST. GEORGE

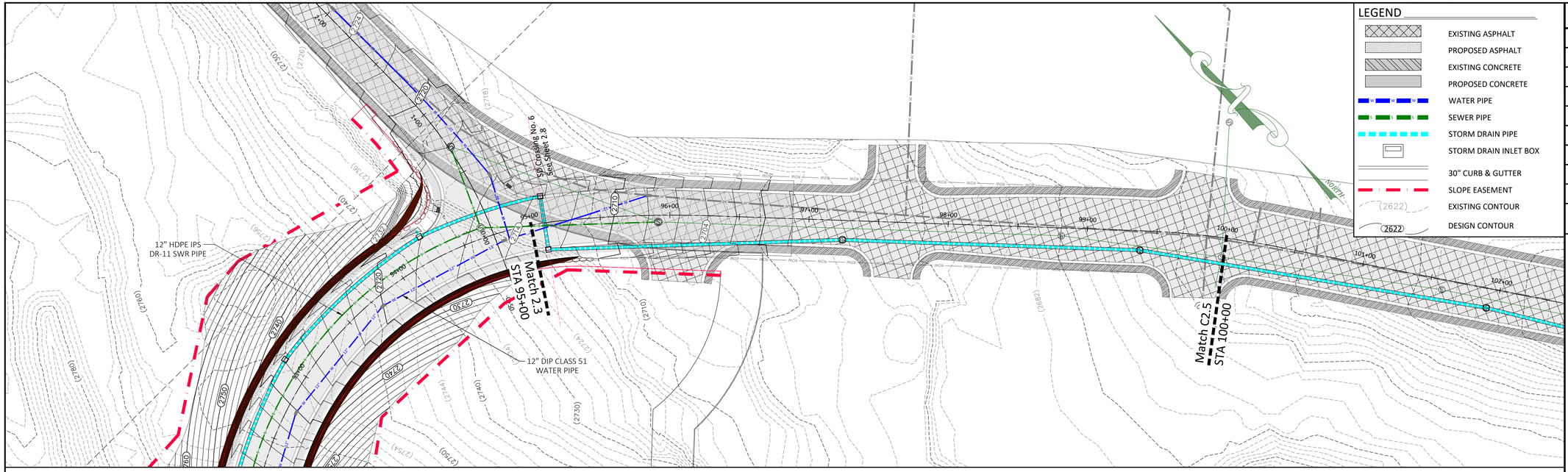
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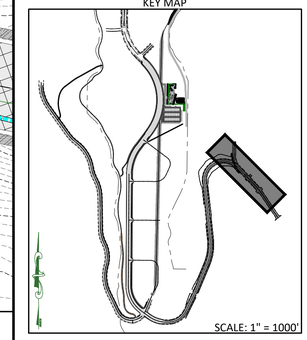
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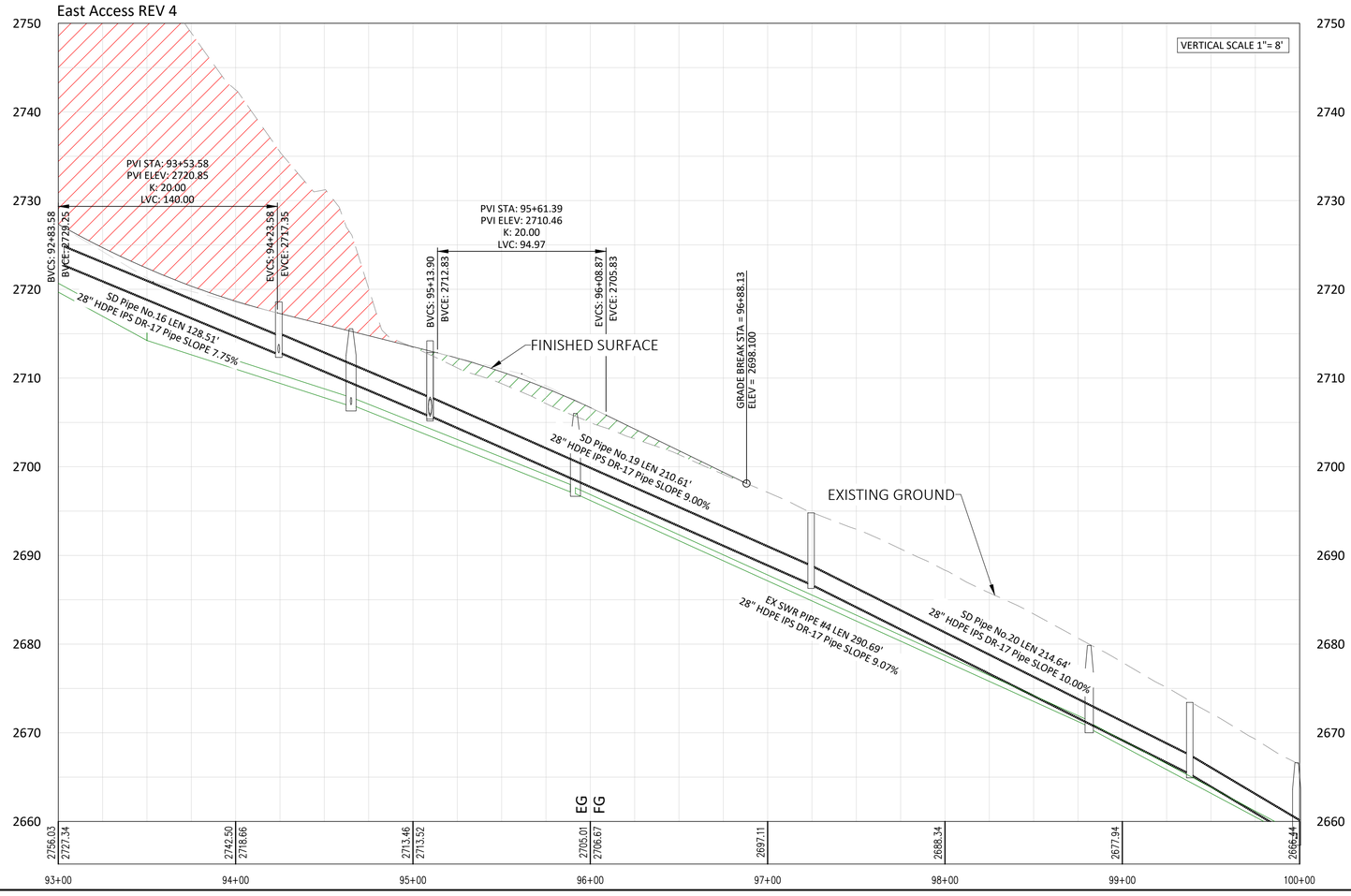
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ARL	1" = 40"
Client No. 4568-21	Project No. 4568-21

Drawing Sheet
C2.3

Sheet 8 of 14 Sheets







LEGEND

- EXISTING ASPHALT
- PROPOSED ASPHALT
- EXISTING CONCRETE
- PROPOSED CONCRETE
- WATER PIPE
- SEWER PIPE
- STORM DRAIN PIPE
- STORM DRAIN INLET BOX
- 30" CURB & GUTTER
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- (2622) EXISTING CONTOUR
- 2622 DESIGN CONTOUR

Date: 12-30-2022

REVISIONS

No.	Date	by	Description

File Name
East Access Hillside Application.dwg

KEY MAP

GRAPHIC SCALE
40 0 20 40 80
(IN FEET)
1 inch = 40 ft.
If Printed 11x17 use Half Scale

ALLIANCE CONSULTING
A PLANNING AND ENGINEERING FIRM

UTAH
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435-673-8060

NORTH DAKOTA
621 26th STREET W.
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701-572-8100

TECH RIDGE
EAST ACCESS
GRADING

FOR

CITY OF ST. GEORGE

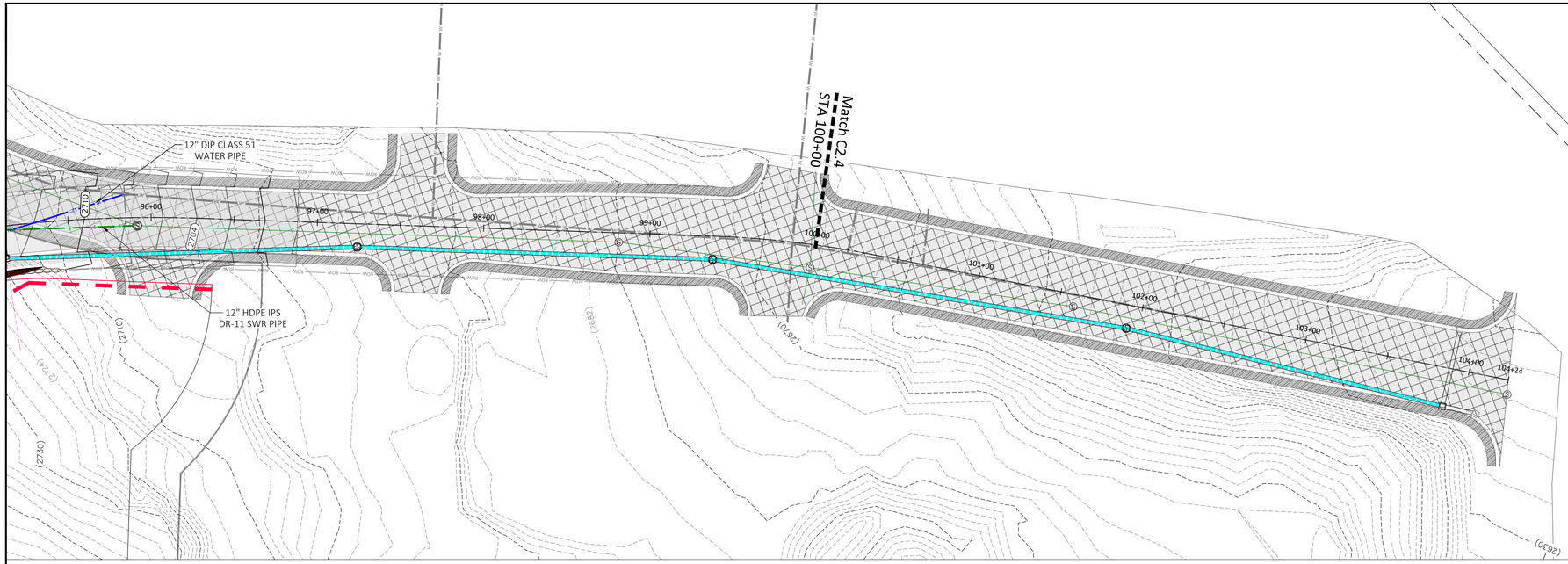
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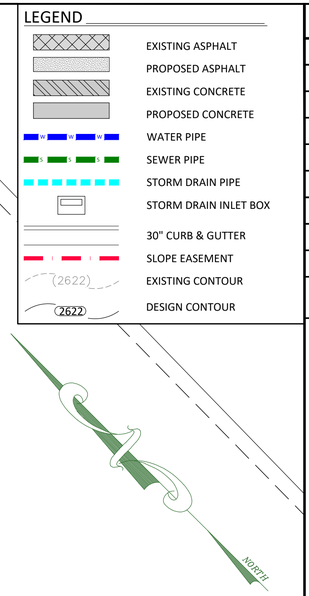
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Client No. 4568-21	Project No. 4568-21

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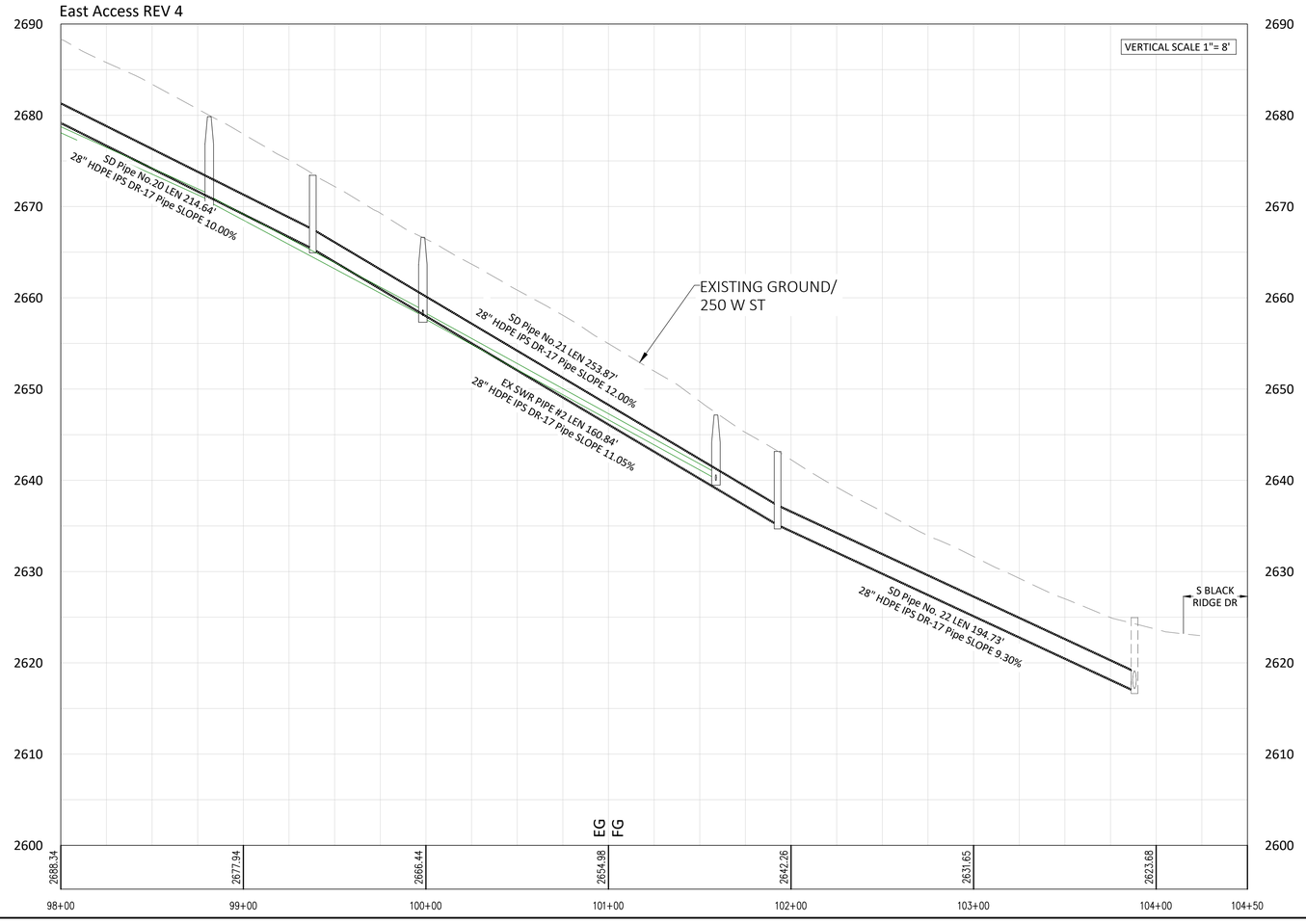
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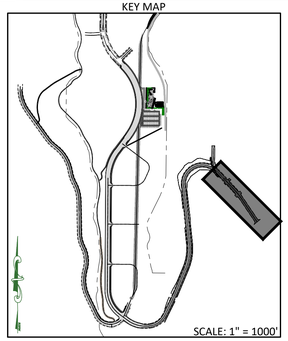
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- STORM DRAIN PIPE
- STORM DRAIN INLET BOX
- 30" CURB & GUTTER
- SLOPE EASEMENT
- EXISTING CONTOUR (2622)
- DESIGN CONTOUR 2622



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KEY MAP



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(IN FEET)
1 inch = 40 ft.
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EAST ACCESS
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FOR

CITY OF ST. GEORGE

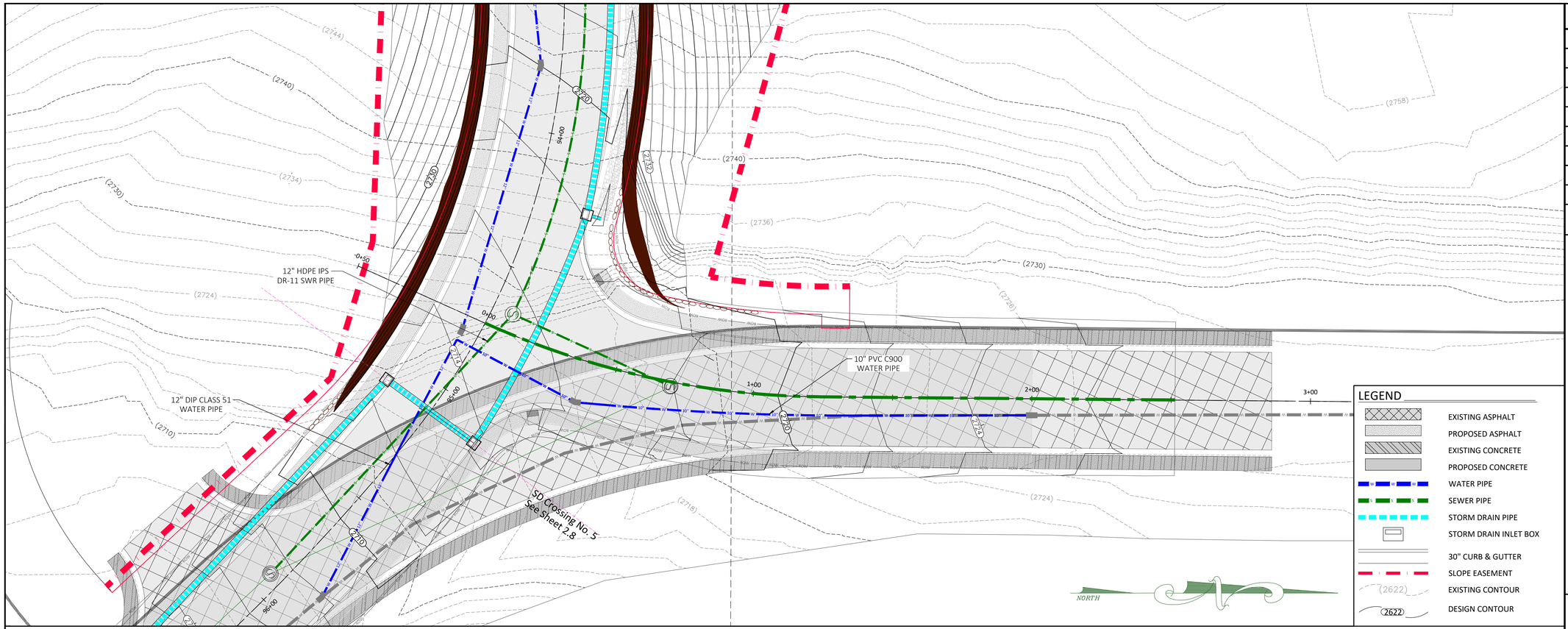
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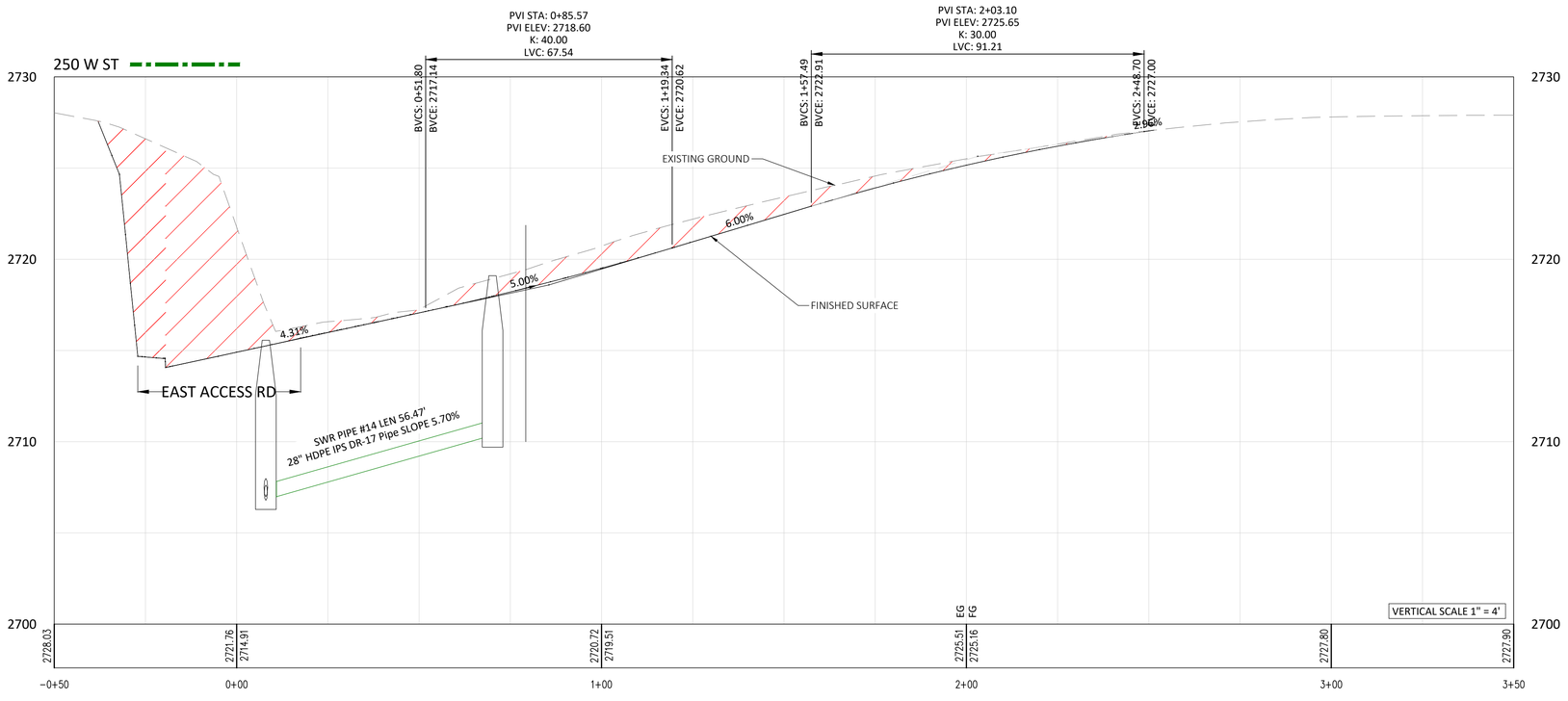
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- EXISTING CONCRETE
- PROPOSED CONCRETE
- WATER PIPE
- SEWER PIPE
- STORM DRAIN PIPE
- STORM DRAIN INLET BOX
- 30" CURB & GUTTER
- SLOPE EASEMENT
- (2622) EXISTING CONTOUR
- 2622 DESIGN CONTOUR



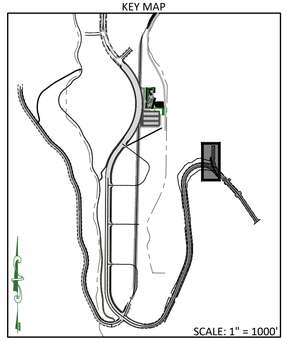
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KEY MAP



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GRAPHIC SCALE

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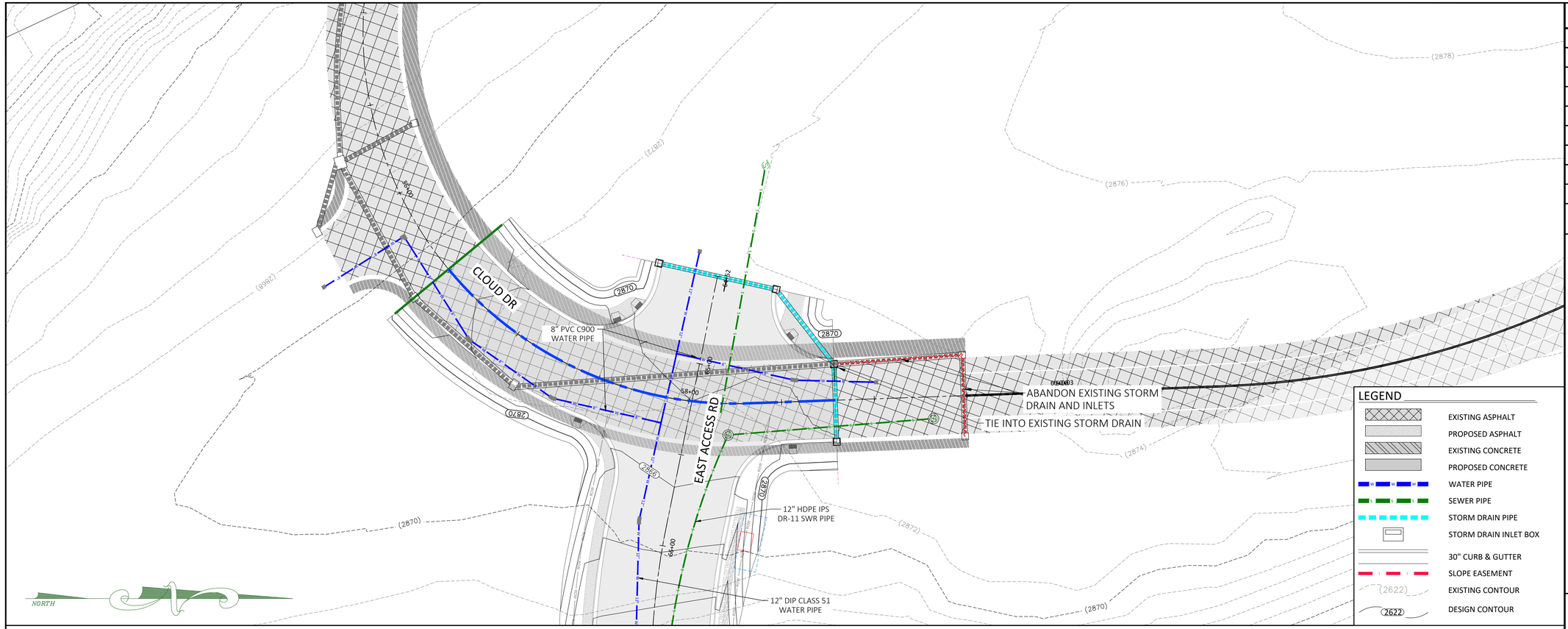
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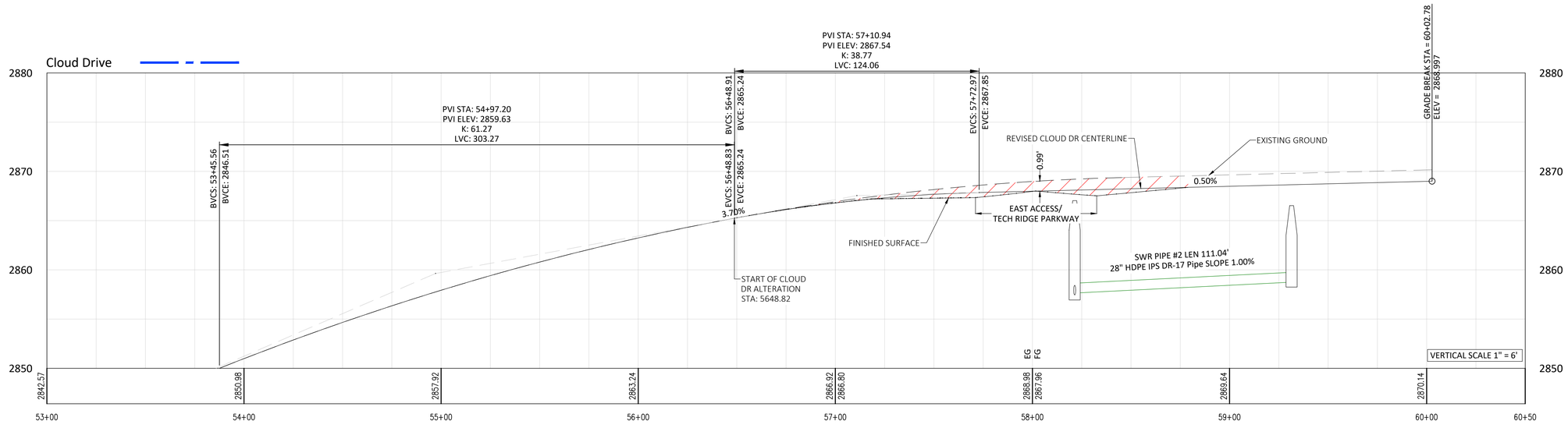
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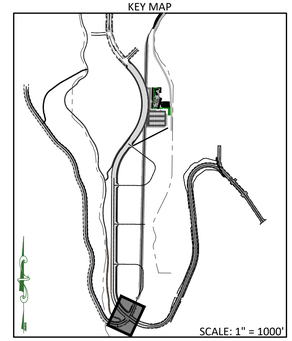
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KEY MAP



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CLOUD DRIVE
ALTERATION

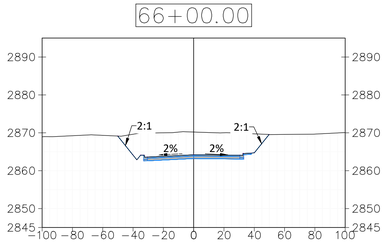
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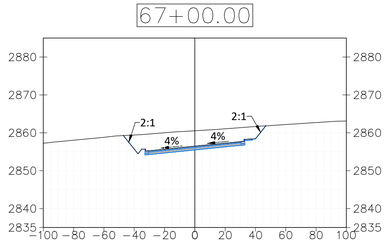
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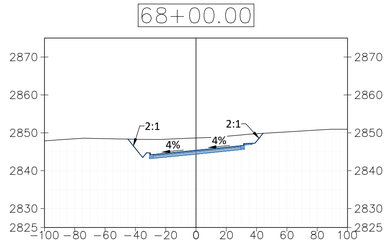
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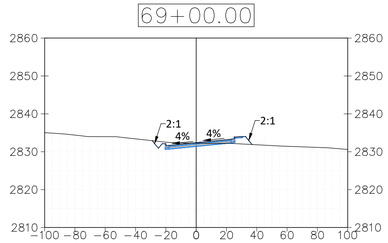
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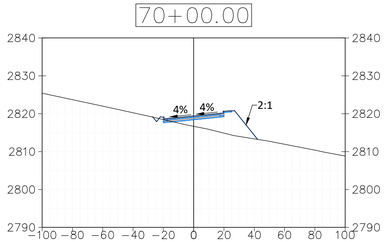
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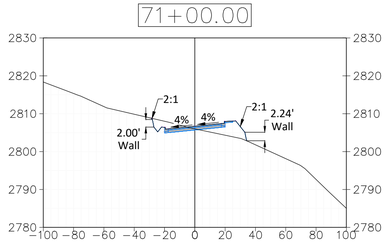


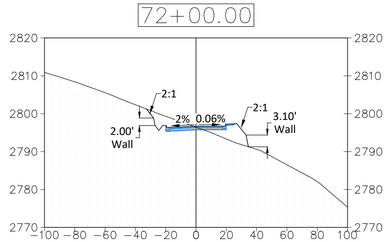


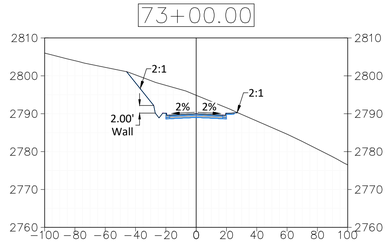


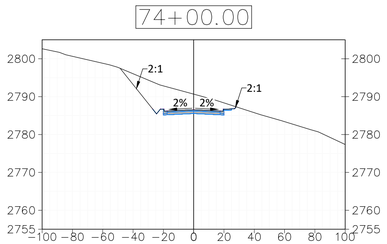


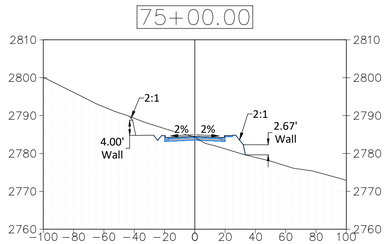


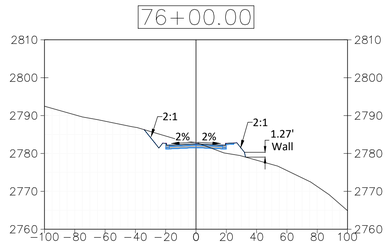


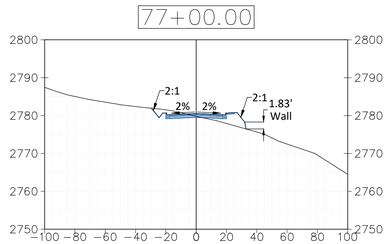


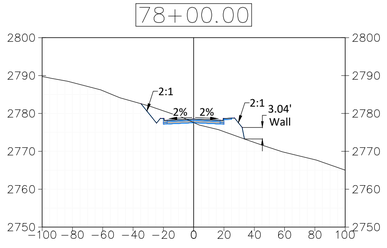


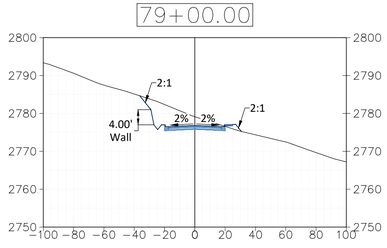


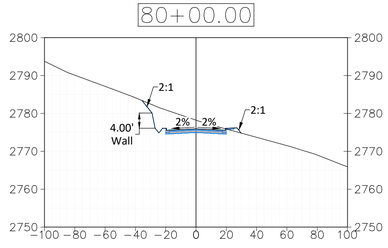


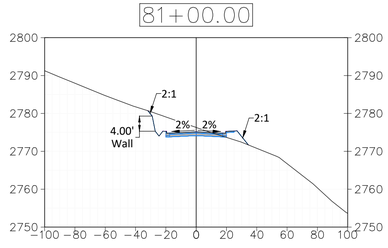












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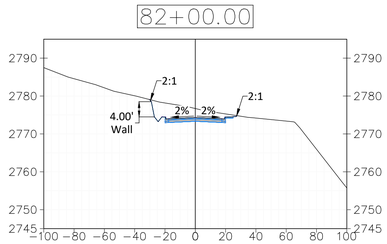
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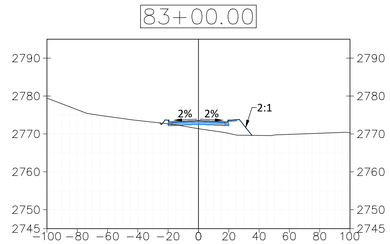
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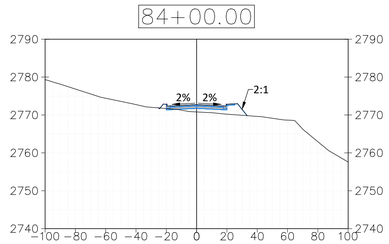
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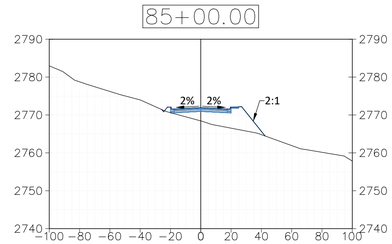
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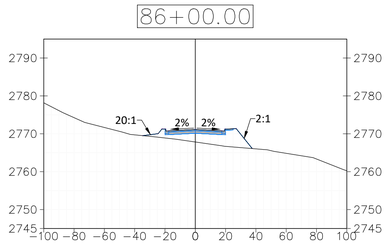
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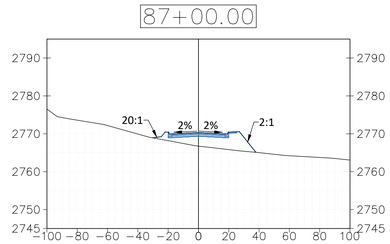


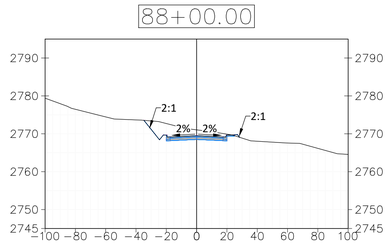


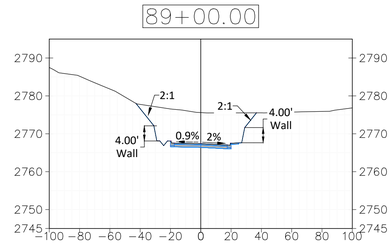


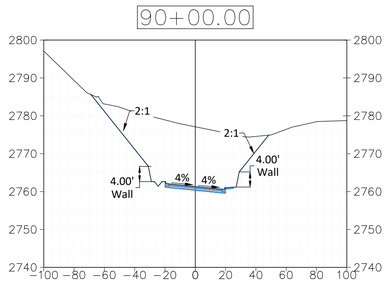


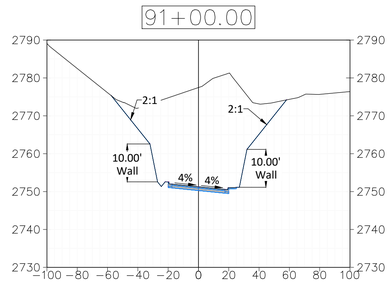


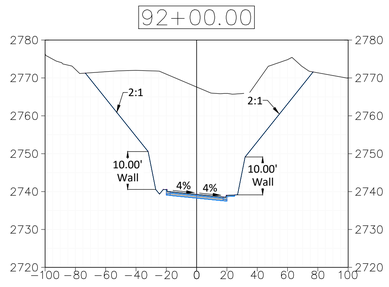


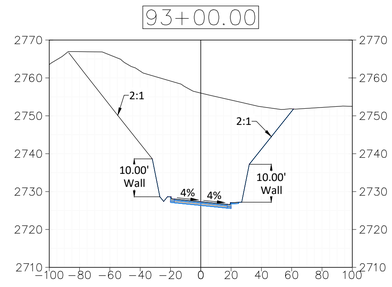


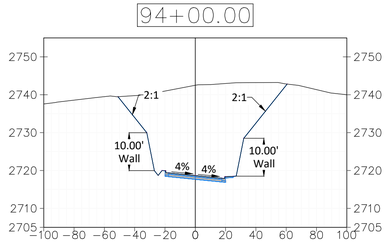


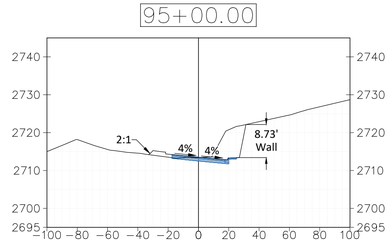


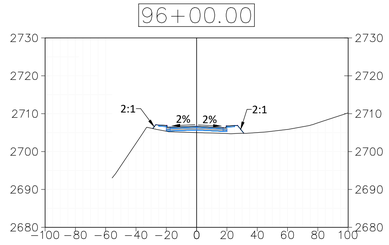


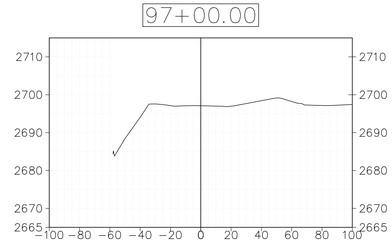












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TECH RIDGE
EAST ACCESS
GRADING

FOR

CITY OF ST. GEORGE

LOCATED IN SEC 36
T 42 SOUTH, R 15 WEST SLB&M
CITY OF ST. GEORGE, WASHINGTON COUNTY, UT

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Sheet 14 of 14 Sheets

Exhibit D
GEOTECHNICAL REPORT

AGEC
Applied GeoTech

GEOTECHNICAL INVESTIGATION

TECH RIDGE SOUTH ACCESS ROAD
ST. GEORGE, UTAH

PREPARED FOR:

TECH RIDGE, LLC
446 SOUTH MALL DRIVE
ST. GEORGE, UTAH 84790

ATTENTION: ISAAC BARLOW

PROJECT NO. 2180295 **OCTOBER 19, 2018**

1420 South 270 East • St. George, Utah 84790 • (435) 673-6850 • FAX (435) 673-1044

TABLE OF CONTENTS

SUMMARY . . . . . Page 1

SCOPE OF WORK . . . . . Page 3

SITE CONDITIONS . . . . . Page 4

PROPOSED CONSTRUCTION . . . . . Page 4

GEOLOGY AND GEOLOGIC HAZARDS . . . . . Page 5

ROADWAY SUBSURFACE CONDITIONS . . . . . Page 6

ROADWAY SUBSURFACE WATER . . . . . Page 11

EAST SLOPE STABILITY . . . . . Page 11

ROADWAY RECOMMENDATIONS . . . . . Page 15
- A. Site Grading . . . . . Page 16
- B. Soil Corrosion . . . . . Page 23
- C. Pavement Analysis and Design . . . . . Page 23
- D. Pavement Support, Section, and Materials . . . . . Page 24
- E. Drainage and Maintenance . . . . . Page 26
- F. Construction Materials Observation and Testing . . . . . Page 27
- G. Geotechnical Recommendation Review . . . . . Page 27

LIMITATIONS . . . . . Page 28

REFERENCES . . . . . Page 29

FIGURES AND TABLE

Vicinity and Geologic Map	Figure 1
Test Pit Locations	Figures 2
Logs of Test Pits	Figures 3-4
Legend and Notes of Test Pits	Figure 5
Consolidation Test Results	Figures 6-12
Gradation/Soil Class. & Moisture Density Relationship Test Results	Figures 13-17
California Bearing Ratio Test Results	Figures 18-22
Summary of Laboratory Test Results	Table 1

SUMMARY

A. East Slope Stability

1. Much of the proposed roadway crosses historical landslide deposits.

2. An evaluation of the east slope stability was included in the scope of this investigation.

3. Based on the available information obtained from previous investigations, inclinometer measurements, and past performance of the slope, it is apparent that the east slope for this project is currently maintaining its stability.

   Using the information available from our subsurface exploration, the laboratory test results along with our experience in the area, it is our professional opinion that the stability of the east slope is marginal. Even with the lack of apparent movement, small changes in the slope configuration and/or weakening of the material in the slope could trigger future movement.

   The strength of the slope will be adversely impacted by water infiltration. Therefore, we recommend strict drainage recommendations be followed to reduce the risk of future slope instability.

B. Roadway

If construction of the roadway is to proceed, the following information and recommendations apply.

1. A variety of soil and bedrock types were encountered in the test pits. Lean clay, silt, silty sand, well graded sand with silt, silty gravel with sand, basalt, mudstone, and shale bedrock were encountered. Practical excavator refusal was encountered on stiff clay, boulders, basalt and shale bedrock

2. Potentially expansive mudstone, potentially expansive lean clay and potentially collapsible silty sand were encountered in the test pits.

3. Subsurface water was not encountered in the excavated test pits to the maximum depths investigated. Fluctuation in groundwater level may occur over time. An evaluation of such fluctuations is beyond the scope of this report.

4. The on-site granular soils such as the silty gravel with sand (GM), silty sand (SM), and well graded sand with silt (SW-SM) free of organics, debris, and material greater than 6 inches in size, are suitable for use as site grading fill. Oversized rocks (greater than 6 inches and smaller than 12 inches) may be used as fill at depths greater than 3 feet below finished subgrade. The oversized rock should be placed so that rock to rock contact is minimized to reduce potential for nesting and voids.

5. The on-site fine grained soils range between non-plastic silt to highly plastic mudstone. The silt and portions of the lean clay observed in test pits TP-7 and TP-8 are suitable for use as low permeable fill above expansive subgrade. The mudstone and expansive lean clay similar to that encountered in test pits TP-1, should not be used as fill within 6 feet of the finished roadway subgrade elevation.

6. Consolidation testing of remolded samples of mudstone and lean clay indicate the material remains expansive upon processing and adding moisture. However, the laboratory tests also indicate the expansion potential of the processed and remolded mudstone and lean clay can be reduced with moisture contents of 4 to 6 percent above the optimum moisture content and a compaction of approximately 90 percent of the modified proctor value (ASTM D-1557). Conversely, remolded samples with moisture contents below 4 percent and compaction near or above 95% will likely exhibit higher expansive properties.

7. The proposed roadway may be supported on a properly prepared subgrade as recommended in the Subgrade Preparation section of this report.

   The on-site, potentially expansive mudstone and expansive lean clay should be overexcavated to an appropriate depth beneath the proposed roadway. Overexcavation depths may be determined from the information provided in the Subgrade Preparation section of this report.

   Areas which expose near surface loose, dry, potentially collapsible silty sand should be overexcavated prior to placing fill as recommended in the Subgrade Preparations section of this report.

   Drainage recommendations are also provided in this report to reduce the risk of the underlying expansive subgrade.

   Moisture conditioning and compaction criteria are also included in this report. The calculated asphalt, untreated base course, and borrow thickness vary depending on subgrade and traffic loading.

8. The information provided in this summary should not be used independent of that provided within the body of this report.

SCOPE OF WORK

This report presents the results of a geotechnical investigation for the proposed south access road construction project to Tech Ridge located in St. George, Utah as shown on Figures 1 and 2. The geotechnical investigation includes access from the east and west sides of Tech Ridge. AGEC was requested to perform the following tasks:

1. Conduct a subsurface investigation to determine the subsurface conditions. The subsurface investigation included the excavation of 21 test pits along the roadway alignment. The first 13 test pits which include the west access road (TP-1 through TP-11) and a portion of the east access road (TP-12 and TP-13) were excavated with a track mounted excavator (CAT 336E) equipped with a 30-inch wide bucket. A ripper tooth attachment was also used to loosen boulders encountered during test pit excavations.

2. Log the subsurface soil profile and obtain samples of the subsurface soils to conduct laboratory testing.

3. Conduct a laboratory testing program on the subsurface soils to determine their engineering characteristics and determine the support value of the subsurface soil.

4. Prepare a report which presents the subsurface conditions encountered and recommendations for the geotechnical aspects of the project including slope stability of the eastern facing slope. Our conclusions and recommendations are based on the subsurface investigation, the results of laboratory testing and our engineering analysis.

This report was prepared in accordance with our "Proposal for Professional Geotechnical Services" dated, April 30, 2018.

SITE CONDITIONS

The existing site topography consists of sloping hillsides and relatively flat areas. A dry wash runs through the west side access from the north to the south. The majority of the hillside along the proposed alignment have been mapped geologically as ancient landslide deposits and consists of undulating hummocky terrain with relatively gently benches and steeper sloping areas. Existing vegetation across the site consists of sparse, low brush. Basalt boulders are also exposed at the surface across the site. Various dirt roads traverse the sides of both hill slopes.

PROPOSED CONSTRUCTION

The proposed project consists of constructing a 2 lane roadway to the west and a 4 lane roadway to the east near the south end of Tech Ridge. Detailed roadway cross-sections and grading plans for the east access road were not provided for the preparation of this report.

Based on a review of the plan and profile sheet (dated 03/28/2018) prepared by Alliance Consulting for the west access road, we anticipate cuts of up to 9 feet and fills on the order of 19 feet will be required to grade the proposed roadway. The grading plan also indicates a 12-foot by 12-foot underpass will be constructed over the existing drainage. A flexible pavement section is proposed for the project and we anticipate the project will include curb, gutter and sidewalk.

The Average Daily Traffic (ADT) provided by Alliance Consulting includes 2,500 to 5,000 vehicles for the west access and approximately 15,000 vehicles for the east access road. These ADT values correspond to a Traffic Index of 6 for the west side access road and 7 for the east side as provided by the City of St. George Design Criteria.

GEOLOGY AND GEOLOGIC HAZARDS

Geologic conditions at the site were evaluated by a review of geologic literature and aerial photographs. Aerial photographs used during the investigation were downloaded from the Utah Geological Survey website. They have photograph numbers of 810941 AM-4-1 and 2 and a photograph date of October 23, 1981.

A. Geologic Literature Review

The site is located in the transition zone of the Basin and Range, and Colorado Plateau provinces. Hayden and Willis (2011) map the area to be underlain by the Moenave and Chinle Formations (See Figure 1). The bedrock dips gently down to the north. The bedrock is capped by the Cedar Bench lava flow at the top of the hill. Alluvial and colluvial sediments overlie the bedrock at the northwest end of the road alignment. Landslide deposits are mapped for the south and central portions of the road alignment. A geologist from AGEC visited on September 12, 2018. The geology of the area was found to be consistent with mapping by Hayden and Willis (2011).

Geologic hazards mapped by Lund and others (2008) are mostly limited to landslide and rockfall. Rockfall is not generally a hazard for the road for the current condition of the hillside but could become a hazard depending on how cut slopes are developed for the road. Similarly, landslide is not currently a significant hazard on the slope in its present condition, but could be a concern with added water or steepened slopes. This will be addressed in the geotechnical study for the project.

B. Aerial Photograph Review

Based on review of aerial photographs of the site, faulting and debris flow are not potential hazards at the site. The area of landslide deposits appears to be similar to that mapped by Hayden and Willis (2011). Lineations formed in the landslide deposits and likely representative of intermediate landslide scarps are shown on Figure 1.

C. Seismicity

The property is located in the Intermountain Seismic Zone, which consists of an area of relatively high historical seismic activity. The most intense seismic ground shaking at the site is expected to originate from the Washington fault zone. The Washington fault zone is considered capable of producing earthquakes on the order of 7 to 7.5 magnitude and can result in significant seismic ground shaking at the site. The US Geological Survey data indicate that a peak ground acceleration in bedrock of 0.24g can be expected to have a 2 percent probability of being exceeded in a 50-year time period at this site (IBC, 2015). The St George fault zone may also add to the seismic hazard in the area, although there is no evidence that the fault displaces Holocene sediments, suggesting the fault may not be active. The St George Fault is not included in the Quaternary Fault and Fold Database (Utah Geological Survey, 2018).

ROADWAY SUBSURFACE CONDITIONS

On August 8 and 9, 2018, an engineer from AGEC visited the site and observed the excavation of 13 test pits at the approximate locations shown on Figure 2. The 8 additional test pits (TP-14 to TP-21) were excavated during a previous geotechnical investigation by AGEC in August of 1998. The subsurface profile observed within the excavated test pits at the site is highly variable and consists of lean clay, silt, silty sand with gravel, well graded sand with silt, silty gravel with sand, basalt, mudstone bedrock, and shale bedrock.

Potentially expansive mudstone was encountered in test pits TP-1, TP-2, TP-10, TP-14, and TP-15 as shown on Figures 3-5. Expansive lean clay was encountered in test pits TP-1, TP-3, TP-5, TP-6, TP-7, TP-8, TP-14, TP-16 and TP-20. The shale bedrock encountered in test pits TP-16, TP-19, and TP-21 may also contain expansive layers. The dry loose nature of the near surface silty sand with gravel encountered in test pit TP-10 indicates the material is potentially collapsible if exposed to water.

Practical excavator refusal was encountered on stiff clay and boulders in test pits TP-3, TP-7, TP-8 and TP-20. Practical excavator refusal on basalt was encountered in test pits TP-11, TP-12, TP-13, and TP-17 with refusal on shale bedrock encountered in test pit TP-19. The maximum depth investigated in the test pits was 19 feet.

Detailed descriptions of the bedrock and soil types observed follow.

Lean Clay - The lean clay is medium stiff to very stiff, moist, medium plastic, contains varied amounts of sand, gravel, and boulders (1 to 4 feet in size). The lean clay varies from red-brown to brown with white mottles in color.

Laboratory tests conducted on samples of the lean clay indicate in-place moisture contents ranging from 5 to 16 percent, in-place dry densities ranging from 93 to 124 pounds per cubic foot (pcf), gravel contents (percent retained on the No. 4 sieve) ranging from 0 to 12 percent, and fines contents (percent passing the No. 200 sieve) ranging from 62 to 96 percent. Atterberg Limits tests conducted on samples of the lean clay indicated liquid limits ranging from 27 to 48 percent and plasticity indices ranging from 14 to 35 percent.

Moisture-Density relationship (ASTM D-1557) tests conducted on samples of the lean clay from test pits TP-3 and TP-8 indicate maximum dry densities (MDD) ranging from 116.5 pcf to 123.5 pcf and optimum moisture contents (OMC) ranging from 10.0 to 12.5 percent. California Bearing Ratio (CBR) tests conducted on remolded samples of the lean clay indicate CBR values ranging from 4 to 5 percent. The samples were remolded to near 90 percent of the maximum dry density (ASTM D-1557) and approximately 2% above the optimum moisture content.

One-dimensional consolidation tests conducted on samples of the native lean clay indicate it is slightly moisture sensitive when wetted under a constant pressure of approximately 1,000 pounds per square foot (psf). Swell potentials of 1 to 1½ percent and swell pressures ranging from 2,650 psf to 3,500 psf were measured in the laboratory testing.

Remolded one-dimensional consolidation tests conducted on samples of the lean clay indicate moisture conditioned and remolded samples are still expansive when wetted. The remolded one-dimensional consolidation results indicate a reduction in expansion potential with an increase moisture content during processing.

Silt - The silt is medium stiff to stiff, slightly moist to moist, contains various amount of sand, and is reddish brown in color.

Laboratory tests conducted on samples of the silt indicate in-place moisture contents ranging from 6 to 17 percent, in-place dry densities ranging from 101 to 112 pcf, and a fines content ranging from 81 to 94 percent. Atterberg Limits tests conducted on samples of the silt indicate it is non-plastic.

Silty Sand - The silty sand is loose to medium dense, dry, fine to medium grained, contains occasional gravel, cobbles, and boulders and ranges in color from light reddish brown to brown in color.

Laboratory tests conducted on samples of the silty sand indicate in-place moisture contents ranging from 3 to 8 percent, in-place dry densities ranging from 88 to 108 pcf, a gravel content of 2 percent, and fines contents ranging from 35 to 48 percent. The relatively low dry density and moisture content of the near surface silty sand indicates it is potentially collapsible.

A Moisture-Density relationship (ASTM D-1557) test indicates the silty sand has a maximum dry density of 126.0 pcf and an optimum moisture content of 7.5 percent.

Well Graded Sand with Silt - The well graded sand with silt is medium dense, dry, contains gravel, and brown in color.

Laboratory tests conducted on samples of the silty to clayey gravel with sand indicate an in-place moisture content of 1 percent, and a fines content of 6 percent.

Silty Gravel with Sand - The silty gravel with sand is medium dense to dense, dry to moist, and light brown to brown in color.

Laboratory tests conducted on the silty gravel with sand from test pit TP-4 indicate an in-place moisture content of 11 percent.

Basalt - The basaltic rock is moderately hard to very hard, dry, highly fractured to less fractured, and black in color.

A Moisture-Density relationship (ASTM D-1557) test indicates the fractured basalt with silt and sand has a maximum dry density of 134.5 pcf and an optimum moisture content of 5.5 percent.

Mudstone - The mudstone, known locally as “blue clay” is soft to moderately hard, dry to moist, medium to highly plastic, and grey to purple in color.

Laboratory tests conducted on samples of the mudstone indicate in-place moisture contents ranging from 7 to 15 percent, in-place dry densities ranging from 96 to 118 pcf, and fines contents ranging from 59 to 99 percent. Atterberg Limits tests conducted on samples of the mudstone indicate liquid limits ranging from 35 to 76 percent and plasticity indexes ranging from 19 to 39 percent.

A Moisture-Density relationship (ASTM D-1557) test indicates the mudstone has a maximum dry density of 115.0 pcf and an optimum moisture content of 12.5 percent. A CBR test conducted on a remolded sample of the mudstone indicates a CBR value of 6 percent. The sample was remolded to near 90 percent of the maximum dry density (ASTM D-1557) and approximately 2 percent above the optimum moisture content.

One-dimensional consolidation tests conducted on natural samples of the mudstone indicate it is moisture sensitive (expansive) when wetted under a constant pressure of approximately 1,000 psf. Swell potentials of ½ to 1 percent with swell pressures of 2,170 to 4,000 psf were measured in the laboratory testing.

Remolded one-dimensional consolidation tests conducted on samples of the mudstone indicate moisture conditioned and remolded samples are still expansive when wetted. The remolded one-dimensional consolidation results indicate a reduction in expansion potential with an increase moisture content during processing.

Shale Bedrock - The shale bedrock is soft to hard, dry to slightly moist, interbedded with layers of siltstone and claystone, and dark brown to dark red in color.

Laboratory tests conducted on a sample of the shale bedrock indicate an in-place moisture content of 5 percent, an in-place dry density of 110 pcf, and a fines content of 71 percent.

The Logs, Legend and Notes of Test Pits are shown on Figures 3-5. The results of laboratory testing are also shown on Figures 3 and 4 and are summarized in the Summary of Laboratory Test Results, Table 1. The One-dimensional Consolidation Test Results are shown graphically on Figures 6-12. The Gradation/Soil Classification and Moisture-Density Relationship Test Results are shown graphically on Figures 13-17. The California Bearing Ratio Test Results are shown graphically on Figures 18-22.

ROADWAY SUBSURFACE WATER

Groundwater was not encountered during the subsurface investigation to the maximum depth investigated, approximately 19 feet. Fluctuations in the groundwater level may occur over time. An evaluation of such fluctuations is beyond the scope of this report.

EAST SLOPE STABILITY

AGEC previously investigated the subsurface conditions of the east facing slope by drilling five borings to depths varying from 110 to 250 feet. Inclinometer casings were installed at each of the five locations along with an adjacent boring to facilitate measurements of the groundwater level.

Our findings of the stability analysis are presented without the boring logs, laboratory test results, inclinometer measurements, and our calculations as stipulated in our agreement for this project.

Existing Conditions

As indicated on Figure 1, portions of both arms of the access road are located on landslide deposits. In addition to verifying the geologic mapping presented on Figure 1, the east hillside stability has been evaluated. Site conditions that reflect the material behavior and characteristics of the landslide include:

1. The hummocky nature of the ground surface along with the lineations associated with each of the landslide slumps .

2. Landslide masses will often reach equilibrium at a slope angle close to the internal material strengths. The ground surface slopes from 8 to 18 degrees (3 to 7:1 horizontal to vertical) which are consistent with the internal friction values obtained from our earlier studies and from samples tested in the laboratory.

Contributing Factors

In addition to the surface geology, the following items contribute to the status of the slope stability.

1. The bedding planes in the area generally slope down to the northeast at an angle of approximately 7 to 8 degrees.

2. The weakest clay sample tested from explorations conducted on the east slope has been found to have a residual coefficient of friction of 7.5 degrees. This angle closely matches the dip of the bedding plane. With this strength and bedding plane combination, slippage would occur on 7.5 degree downward slope if the interface strength is less than 7.5 degrees or slippage would also occur if there are areas or zones where the dip angle of the bedding plane is steeper than the 7.5 degrees.

3. Investigation into landslide movements on the east slope indicate a relatively thick deposit that contains layers of this potentially weak clay. Measurements indicate that the hillside movement occurs at multiple depths indicating similar strength characteristics throughout the deposit.

4. Groundwater was encountered in each of the deep borings.

Status of Movement

Inclinometers were installed at five locations to depths of 92 to 258 feet on the east hillside in 2007. Inclinometer Measurements were obtained in 2008, 2011 and April 4, 2018. The 2018 measurements on 4 of the 5 inclinometers are within the accuracy of the equipment indicating no measurable movement.

The inclinometer located immediately west of the vacant restaurant, located at 1090 South Bluff Street, was measured before 2011. Displacement was measured at multiple depths.

Geotechnical Testing Services (GTS) installed an inclinometer on a berm placed behind the restaurant. We understand that recent measurements by GTS indicate lateral movement of approximately 0.7 inches in the last 5 years.

Anticipated Performance

With the lack of measured movement in the 4 inclinometers over the past 10½ years along with the lack of surficial evidence of movement, it is apparent that the portion of the slope for this project is currently maintaining its stability. Using the information available from our subsurface exploration, the laboratory test results along with our experience in the area, it is our professional opinion that the stability of the slope is marginal even with the lack of apparent movement.

With these conditions, small changes in the slope configuration or weakening of the material strengths in the slope could trigger future movement.

As stated in the 1996 Transportation Research Board, Special Report 247, (entitled Landslides, Investigation and Mitigation), "…old landslides are often barely stable, and they may not have significant resistance to new loadings or other changed conditions that tend to reduce their stability. Changing natural drainage patterns on the surfaces of old landslides may significantly influence their stability and cause unwanted movements. Thus, the decision to construct transportation facilities over ancient landslides must be carefully investigated and appropriate consideration given to remedial measures and long-term stability".

It is important to recognize that marginal stability of the slope indicates that:

1. A calculated factor of safety using the parameters selected to characterize the materials in the slope and the existing configuration is near 1.0 and will not meet the standard acceptable level of at least 1.5.

2. Changes in the internal conditions and/or surficial geometry modifications may improve or reduce the ability of the slope to maintain its stability. It may not be practical to quantify with confidence the impact that internal changes may have provided.

3. It is a matter of time before more movement on the slope occurs. Determining a location and/or timing of such an event is not possible with the information currently available.

4. A seismic event could introduce sufficient lateral load to initiate slope movement.

Mitigation

If the decision is made to continue with construction of the roadway on the landslides, we recommend the following items be seriously considered:

1. Introduction of moisture into the subgrade should be minimized if not eliminated. This could be accomplished by:

    a. Collecting and transporting surface drainage off of the slope in watertight catch basins and piping. This is not standard storm drainage procedures therefore, this would require specific attention to verify that the improvements are watertight.

    b. Water ways should be lined to prevent seepage into the ground.

    c. Measures need to be taken to eliminate the potential for water to pond on the slope.

    d. No water bearing utilities should be installed within the landslide area.

2. Cut and fill slopes need to be minimized. Overall impact of potential grade changes should be evaluated and the consequence of the change found to be acceptable before proceeding.

3. Water entering the ground in all areas above the slope (within the Tech Ridge area) should be reduced and ideally eliminated. Some, if not all, of the methods described above should be considered within the Tech Ridge area.

ROADWAY RECOMMENDATIONS

The following recommendations are provided with the assumption that all stakeholders recognize and accept the risk of landslide movement. The recommendations are based on the proposed construction, information obtained from the field and laboratory testing, engineering analysis, and our experience in the area.

A. Site Grading

Based on the subsurface conditions and the proposed grading provided by Alliance Consulting, the following recommendations are provided:

1. Subgrade Preparation

a. *General Subgrade Preparation*: Prior to conducting site grading, vegetation and soil containing significant amounts of roots and organics should be removed. Loose/disturbed soil, debris, deleterious material, previously placed fill, and undiscovered fill should be removed to the full depth.

b. *Expansive Mudstone and Lean Clay Subgrade Areas*: To reduce the potential for wetting and subsequent swelling of the expansive subgrade supporting the proposed roadway, we recommend the expansive mudstone and lean clay areas be overexcavated to remove a portion of the expansive material and it replace with properly compacted, low permeable fill. The low permeable fill is intended to provide a less permeable zone which reduces the potential for infiltration of water to the underlying expansive mudstone and lean clay. If the natural moisture content of the expansive mudstone and lean clay is maintained, distress to the asphalt/sidewalk and curb will be reduced.

Prior to placing the low permeable fill and subsequent to overexcavation, the exposed subgrade should be scarified a minimum of 8 inches, moisture conditioned to 4 to 6 percentage points above the optimum moisture content and compacted to 90 percent of the maximum dry density as determined by ASTM D-1557.

We recommend overexcavation and replacement of the expansive mudstone and lean clay be performed to provide a low permeable zone above expansive materials and reduce the risk of wetting and potential heave. The surface heave estimates are provided in the following table. The estimates are based on an assumed active zone (wetted depth) of 10 feet. The heave estimates should be used to assist in determining the depth of overexcavation and replacement desired based on the associated risk of surface heave.

Depth to Expansive Soil Below Finished Subgrade Elevation (feet)	Estimated Potential Surface Heave (inches)
0	3 to 4½
2	2½ to 4
4	2 to 3
6	1 to 2½

c. *Sand, and Gravel Areas (All Other Subgrades Encountered)*: Subsequent to grubbing and prior to placing fill, base course, or asphalt pavement, the exposed subgrade beneath pavement and fill slope areas should be scarified to a depth of 8 inches, moisture conditioned and properly compacted to at least 95 percent of the maximum dry density as determined by ASTM D-1557.

If the exposed subgrade consists of loose, dry silty sand or silty gravel (potentially collapsible soils), we recommend this soil be overexcavated to remove the full depth of this material. An engineer from AGEC should observe the exposed subgrade to provide guidance regarding the subgrade preparation in these areas.

d. *Potentially Soft Subgrade (Encountered in Area of TP-4):* Potentially soft subgrade conditions may be encountered near TP-4 resulting from heavy equipment and very moist subgrade conditions observed in the test pit. If soft/pumping conditions are encountered subgrade stabilization may be implemented using overexcavation to remove the soft soils or by implementing gravel and geosynthetic reinforcement may be necessary. Additional details may be provided upon request.

2. Excavation/Earthwork

The on-site soils and soft mudstone bedrock may be excavated with conventional excavation equipment. Excavations extending into large boulders, potential cemented zones, basalt and hard shale bedrock will likely require the use of heavy excavation equipment such as a trackhoe equipped with rock teeth or a single ripper tooth. A rock hammer may also be necessary to excavate portions of the basalt or shale bedrock. Difficulty may be particularly evident in confined excavations.

3. Grading Slopes

Review of the grading plan for the west side access road indicates existing slopes along the road alignment of the project will be excavated and cut to construct the roadway. We also anticipate grading along the east side access road will require cuts into hillside. Our experience with soil cut and fill slopes in the area has shown soils will tend to erode over time to their natural angle of repose. The following table provides recommendations for guidance of cut slopes based on the observed onsite soils:

Expected Soil Condition	Grading Recommendations (Horizontal:Vertical)
Basalt	½:1
Lean Clay	¾ :1
Silty Sand and gravel	1:1
Shale and Mudstone Bedrock	½ :1 (if faced) or 1½ :1 (if not faced)

Mudstone and clay slopes cut steeper than 1½ :1 would remain stable, but will dessicate, and likely ravel naturally to approximately a 1½ :1 slope. This process will require long term maintenance to remove the accumulated soils deposited at the toe of the slope. If this process is not acceptable, steep slopes may be flattened or faced to provide protection from weathering and erosion. Stacked rockery facing or reinforced gunnite facing anchored with soil nails may be considered to protect steeper cut slopes. Design and recommendations associated with reinforced/stabilized cut slopes are beyond the scope of AGEC's services.

Additionally, several existing cut slopes are part of a larger ancient landslide deposit. This analysis does not address the potential development, re-activation or stabilization of larger scale slope movement as could be possible due to the site being part of the larger landslide deposit.

We recommend fill slopes constructed with onsite soil not exceed a 2:1 (horizontal:vertical) slope. Fill slopes should be graded by overbuilding and then cutting them back to the desired grade to provide a compacted slope face. Fill placed on existing slopes steeper than 4:1 (horizontal to vertical) should be placed using a benching procedure to "key" the fill into the existing slope. Benches should be of sufficient width to extend fill placement through loose/surficial soils or to meet the criteria given in the following table, whichever is greater.

Approximate Slope Grade (Horizontal:Vertical)	Bench Width (feet)
1:1	2
2:1	4
3:1	6
4:1	8

4. Materials

The on-site granular soils such as the silty gravel with sand (GM), silty sand (SM), and well graded sand with silt (SW-SM) free of organics, debris, and material greater than 6 inches in size, are suitable for use as site grading fill. Oversized rocks (greater than 6 inches and smaller than 12 inches) may be used as fill at depths greater than 3 feet below finished subgrade. The oversized rock should be placed so that rock to rock contact is avoided to reduce potential voids and nesting of rocks.

The on-site fine grained soils range between non-plastic silt to low to medium plastic lean clay and highly plastic mudstone. The silt and portions of the lean clay observed in test pits TP-7 and TP-8 are suitable for use as low permeable fill above expansive subgrade. The on-site expansive soils (mudstone and lean clay) free of organics may be used as site grading fill in areas not supporting the roadway. The mudstone and the expansive lean clay should not be used as fill within 6 feet of the finished roadway subgrade elevation without accepting potential surface heave risks.

Listed below are the materials recommended for fill.

Area	Fill Type	Soil Type
Roadway	Untreated Base Course	CBR > 70%, **200** < 12% Maximum size: 1 inch
Roadway	Site Grading and Embankment Fill	**-200** < 35%, **LL** < 30% Maximum size: 4 inches Solubility < 1%

-200 = Percent Passing the No. 200 Sieve

LL = Liquid Limit

The potential impact of the expansive characteristics of the underlying expansive mudstone and lean clay can be reduced by protecting the expansive material from becoming wet. Placement of relatively low permeable fill above the expansive soil/bedrock can help reduce the possibility of water coming in contact with the expansive material.

Low permeable fill used to replace removed expansive soil should meet at least one of the following options:

Option No.	Liquid Limit (%)	Percent Passing the No. 200 Sieve
1	50+	15-20
2	30-50	20-40
3	0-30	30-100

Based on the above criteria, we anticipate some of the on-site soils will be suitable for use as low permeable fill. Mixing of onsite soils (lean clay and mudstone) with non-expansive fill may be necessary to produce low permeable fill meeting the above requirements. If mixing will be considered, AGEC should be contacted to conduct additional laboratory testing to determine mixing/blending recommendations.

5. Compaction

Compaction of fill materials placed at the site should meet the following moisture content criteria and equal or exceed the following compaction criteria:

Area	Moisture Content	Percent Compaction
Low Permeable Fill	+2% to +4% above OMC	90%
Subgrade - Expansive Materials	+4% to +6% above OMC	90%
Subgrade - Non-expansive Materials	± 2% of OMC	90%
Roadway Fill - Expansive Materials	+4% to+ 6% above OMC	90%
Roadway Fill - Non-expansive Materials	± 2% of OMC	95%
Roadway Base Course	± 2% of OMC	95%

OMC = Optimum moisture content

Fill tested should be compared to the maximum dry density as determined by ASTM D-1557. Soils placed as site grading fill should be moisture conditioned to the above recommendations. Soil at the site was generally below the optimum moisture content and will require moisture conditioning prior to placement to achieve the required compaction.

It is critical that the low permeable fill is moisture conditioned over the optimum moisture content (as recommended) to provide the low permeable properties necessary for the application. If the low permeable fill is placed dry of the optimum moisture content, the permeability or infiltration rate of water will be higher.

Fill should be placed in lift thicknesses which do not exceed the capacity of the compaction equipment used. Generally 6 inch loose lifts are appropriate for heavy rubber-tire compaction equipment. Lift thickness should be reduced to 4 inches for hand compaction equipment. Fill placed at the site should be tested frequently to verify proper compaction.

B. Soil Corrosion

Our experience has shown the on-site soils, bedrock and many import soils may contain sulfates in sufficient concentration to be corrosive to concrete. Therefore, we recommend concrete elements that will be exposed to the on-site soils be designed in accordance with provisions provided in the American Concrete Institute Manual of Concrete Practice (ACI) 318-14 Chapter 19. Tables 19.3.1.1 and 19.3.2.1 of ACI 318-14 should be referenced for design of concrete elements utilizing a Sulfate Exposure Class of S2.

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

C. Pavement Analysis and Design

The following pavement design criteria were used in our pavement design based on the UDOT Pavement Management and Pavement Design Manual dated November, 1998 and updated March, 2008.

- A 20 year design life with ADT values of 2,500 to 5,000 for the west access road and 15,000 for the east access road were provided by Alliance Consulting. These traffic conditions correspond to a Major Collector (TI = 6) for the west access roadway and a Minor Arterial (TI = 7) for the east access roadway according to the St. George City Design Specifications.
- A Standard Deviation of 0.45.
- Initial and Terminal Serviceabilities of 4.2 and 2.5, respectively.
- A Reliability of 90 percent.
- CBR values of 4 and 10 percent for varying on-site soil types.
- A Subgrade Resilient Modulus of 1500*CBR value.
- A Untreated Base Course Resilient Modulus of 27,000 psi.
- A Granular Borrow Resilient Modulus of 15,000 psi.
- Layer Coefficients of 0.4, 0.1, and 0.08 for the hot mix asphalt, untreated base course, and the granular borrow, respectively.
- A Drainage Coefficient of 1 for the untreated base course and the granular borrow.

D. Pavement Support, Section, and Materials

Based on the subsurface conditions encountered, UDOT/AASHTO Design methods, and a 20-year design life, the following recommendations are given. Although the following pavement sections are based on a 20 year design life, the life span of the pavement may be shorter if not properly maintained, drained, and due to the presence of expansive materials, and landslide deposits below the roadway on some portions of the project.

1. Subgrade Support

The subgrade should be prepared as outlined in the Site Grading section of this report. We anticipate the subgrade materials at the site will generally consist of lean clay, mudstone, silty sand and gravel, and silty gravel with sand.

AGEC measured CBR values ranging from 4 to 33 percent from remolded samples of the on-site soils obtained from the test pit excavations. For the purpose of this report, a CBR value of 4 was used for design of pavement supported over the mudstone and lean clay and a CBR value of 10 was used for the design of pavement supported over the remaining subgrade soils encountered at the site.

2. Pavement Thickness

Refer to the following tables for pavement section thicknesses.

East Access Roadway (TI = 7)

Subgrade Type	CBR Value	Asphalt Thickness (in)	Base Course Thickness (in)
Mudstone and Lean Clay	4	4	12
Other Soils	10	3½	8

West Access Roadway (TI = 6)

Subgrade Type	CBR Value	Asphalt Thickness (in)	Base Course Thickness (in)
Mudstone and Lean Clay	4	3½	8
Other Soils	10	3	6

3. Pavement Materials

The pavement materials should meet St. George City specifications for gradation and quality. The pavement thicknesses indicated above assume that the base course is a high quality material with a CBR of at least 50 percent and the asphaltic concrete has a minimum Marshal stability of 1,800 pounds.

Other materials may be considered for use in the pavement section. The use of other materials may result in other pavement material thicknesses.

E. Drainage and Maintenance

The collection and diversion of drainage away from the pavement surface is extremely important to the satisfactory performance and life span of the pavement section and the slope stability. Proper drainage and precautions presented in the stability section should be provided.

Due to the moisture sensitivity of the on-site mudstone and portions of the lean clay, it is critical that infiltration of water be minimized to reduce the potential for future movement of pavement and utilities. Maintaining natural soil moisture conditions of the moisture sensitive soil and bedrock reduces potential for expansion of underlying soil/bedrock and subsequent heave. To reduce infiltration, we recommend the following:

1. Maintain positive site drainage during and following construction. Ponding of water should be eliminated.

2. Surface drainage of streets should be maintained by providing sufficient crown/grade in the road to direct flows into the curb/gutter systems or off of roadway improvements in areas not including curb and gutter. Positive flow of the gutters should be provided and maintained.

3. Seams and joints in the asphalt and concrete should be properly sealed to reduce infiltration of water to the underlying expansive soil/bedrock.

4. Maintenance should be provided to maintain asphalt cracks which may occur over time.

F. Construction Materials Observation and Testing

Construction materials observation and testing should meet St. George City testing requirements. We also recommend the following be conducted during the construction of the roadway.

1. Verify that the subgrade is properly prepared prior to placing fill and the recommended overexcavation depths are achieved to expose the underlying competent basalt.

2. Observe the placement and conduct compaction testing on each foot of site grading fill placed in roadway areas and within utility trenches.

3. Conduct materials testing on road-base, concrete, and asphalt in accordance with St. George City standards.

G. Geotechnical Recommendation Review

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

LIMITATIONS

This report has been prepared in accordance with generally accepted soil engineering practices in the area for design purposes. The conclusions and recommendations included within the report are based on the information obtained from the borings drilled and the test pits excavated at the locations indicated on the site plan, the results of laboratory testing, the referenced documents and our experience in the area. Variations in the subsurface conditions may not become evident until additional exploration or excavation is conducted. If the subsurface soil or groundwater conditions are found to be different from what is described in this report, we should be notified to reevaluate the recommendations given.

Sincerely,

APPLIED GEOTECHNICAL ENGINEERING CONSULTANTS, INC.





Jake Erickson, P.E.

James E. Nordquist, P.E.

Reviewed by Arnold DeCastro, P.E.

JE/sd P:\2018 Project Files\2180200\2180295 Tech Ridge Access Road(s)\2180295 Report.wpd

References

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

International Building Code, 2015; International Code Council, Falls Church, Virginia.

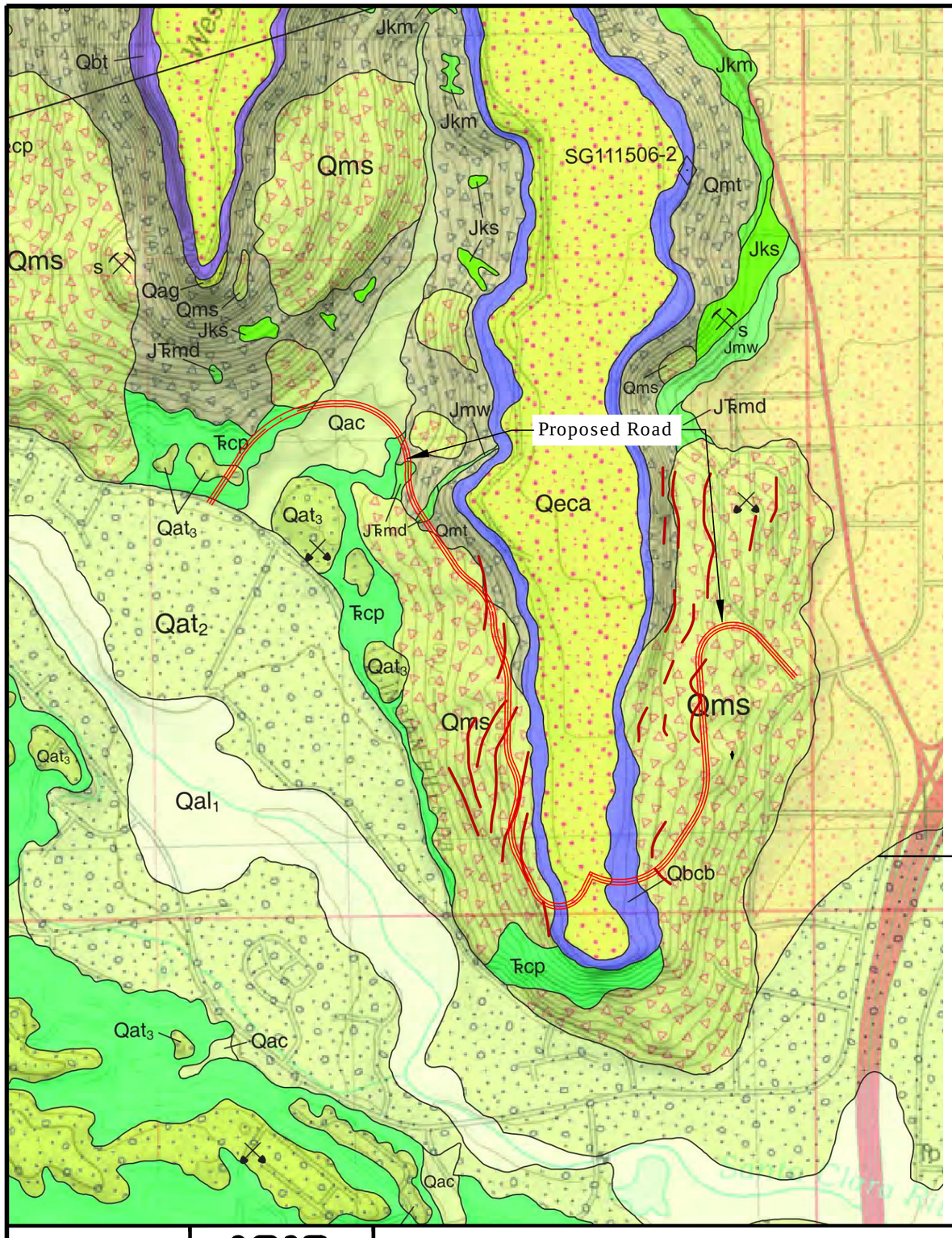
Lund, W.R., Knudsen, T.R., Vice, G.S. and Shaw, L.M., 2008; Geologic hazards and adverse conditions, St George-Hurricane metropolitan areas, Wasatch County, Utah, Utah Geological Survey Special Study 127.

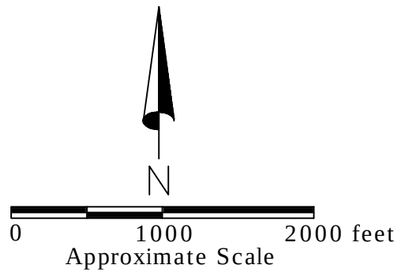
Utah Geological Survey, 2018; Utah Quaternary Fault and Fold Database, http://geology.utah.gov/resources/data-databases/qfaults/ Accessed September 24, 2018.

"Pavement Management and Pavement Design Manual", Utah Department of Transportation, November 1998, updated March 2008.

"Landslide-Hazard Map for the St. George-Hurricane Metropolitan Area", Utah Geological Survey, 2008.

"St. George Geologic Map Overlay", Utah Geological Survey, 2013.





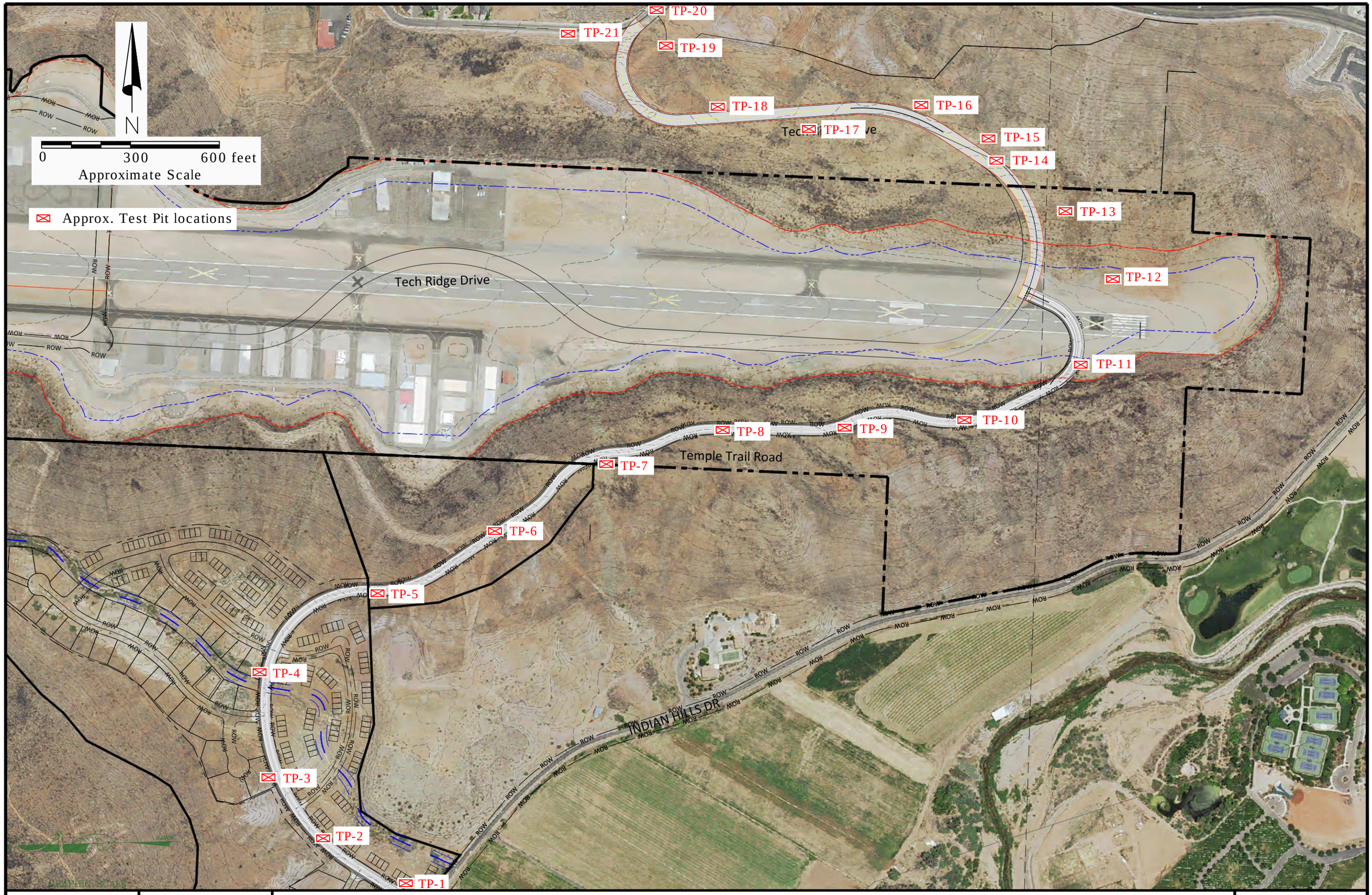
Explanation of Symbols and Geologic Units in Area of Proposed Road

Qal_1	-	Stream alluvium (Holocene)
Qac	-	Mixed alluvial and colluvial deposits (Holocene to upper Pleistocene)
Qeca	-	Eolian and alluvial deposits (Holocene to lower Pleistocene)
Qat_2	-	Alluvial-terrace deposits (Holocene)
Qat_3	-	Alluvial-terrace deposits (late Pleistocene)
Qmt	-	Talus deposits (Holocene to upper Pleistocene)
Qms	-	Landslide deposits (Holocene to middle Pleistocene)
Qbcb	-	Cedar Bench lava flow (lower Pleistocene)
Jmw	-	Whitmore Point Member of the Moenave Formation (Lower Jurassic)
JTrmd	-	Dinosaur Canyon Member of the Moenave Formation (Lower Jurassic)
Trcp	-	Petrified Forest Member of the Chinle Formation (Upper Triassic)
		Lineation within the landslide deposits
		Approximate location of proposed access roads

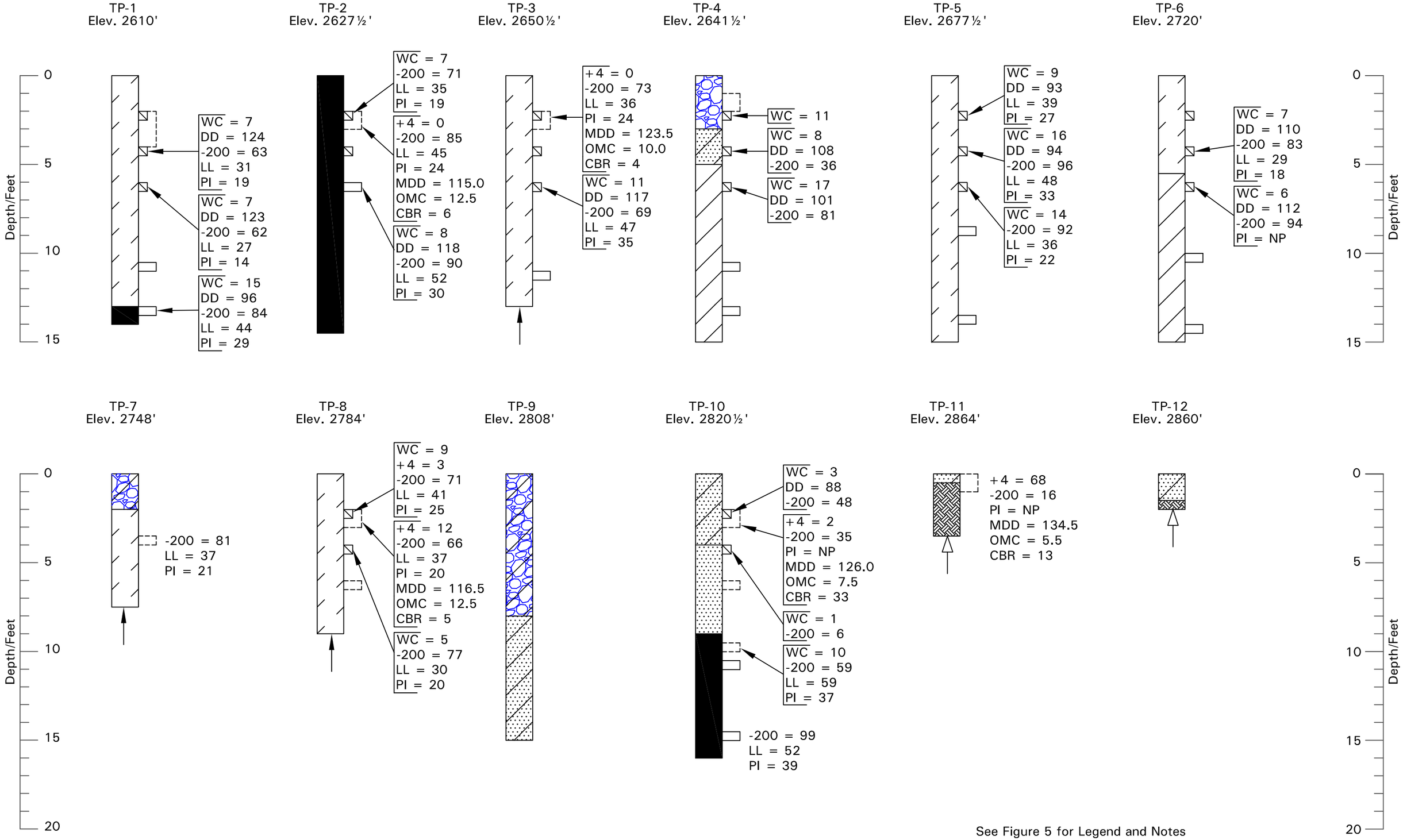
TECH RIDGE SOUTH ACCESS ROAD
ST. GEORGE, UTAH

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

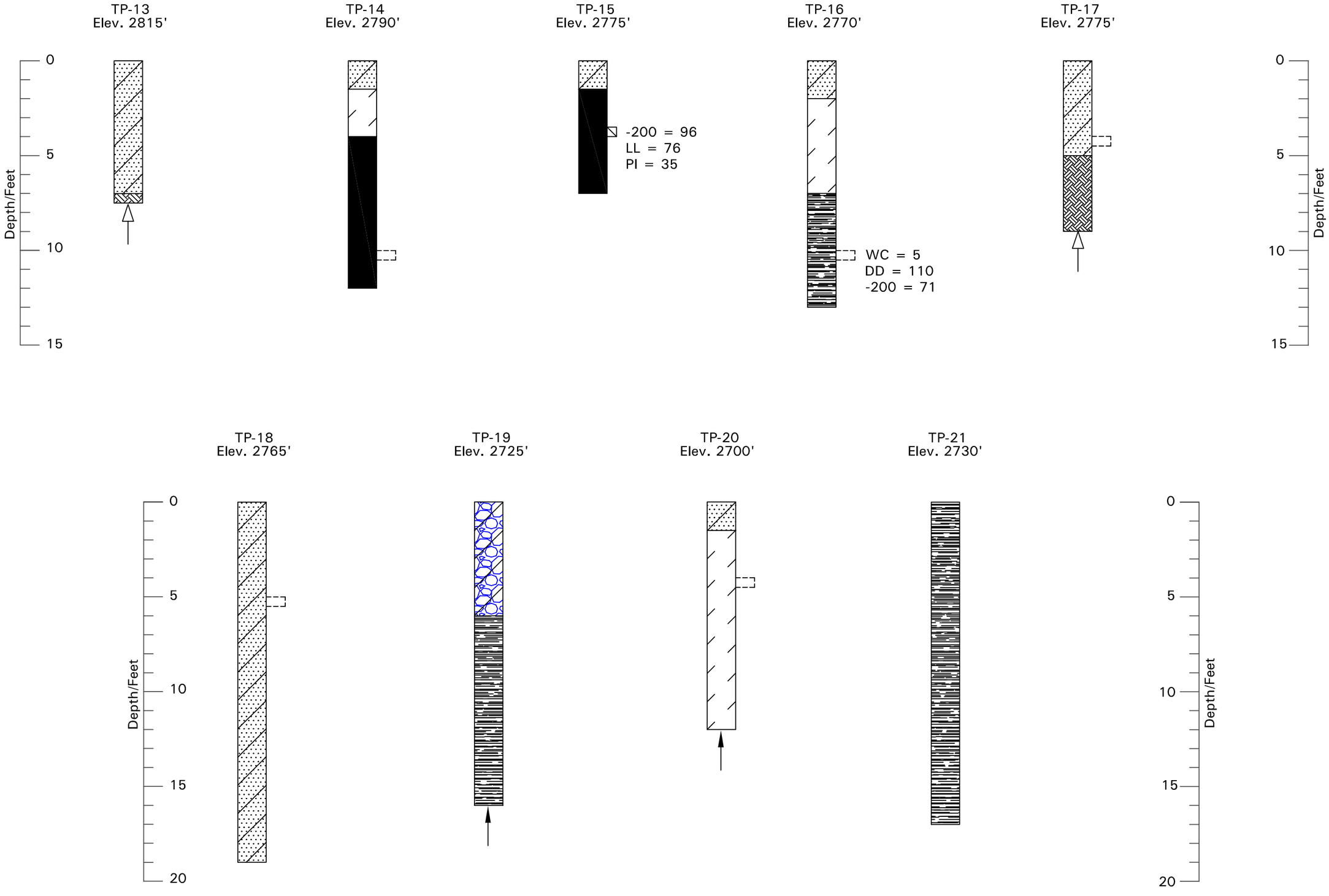
2180295	AGEC	Vicinity and Geologic Map	Figure 1



2180295	AGEC	Test Pit Locations	Figure 2



See Figure 5 for Legend and Notes



See Figure 5 for Legend and Notes

LEGEND:

Lean Clay (CL); medium stiff to very stiff, moist, medium plastic, contains varied amounts of sand, gravel, and boulders (1 to 4 feet in size), red-brown to brown with white mottles.

Silt (ML); medium stiff to stiff, slightly moist to moist, contains various amounts of sand, reddish brown.

Silty Sand (SM); loose to medium dense, dry, fine to medium grained, contains occasional gravel, cobbles and boulders (1 to 4 feet in size), light reddish brown to brown.

Well Graded Sand with Silt (SW-SM); medium dense, dry, contains gravel, brown.

Silty Gravel with Sand (GM); medium dense to dense, dry to moist, light brown to brown.

Basalt; moderately hard to very hard, dry, highly fractured near surface, black.

Mudstone; soft to moderately hard, dry to moist, medium to highly plastic, grey to purple.

Shale Bedrock; soft to hard, dry to slightly moist, interbedded with layers of siltstone and claystone, dark brown to dark red.

Indicates relatively undisturbed hand drive sample taken.

Indicates relatively undisturbed block sample taken.

Indicates disturbed sample taken.

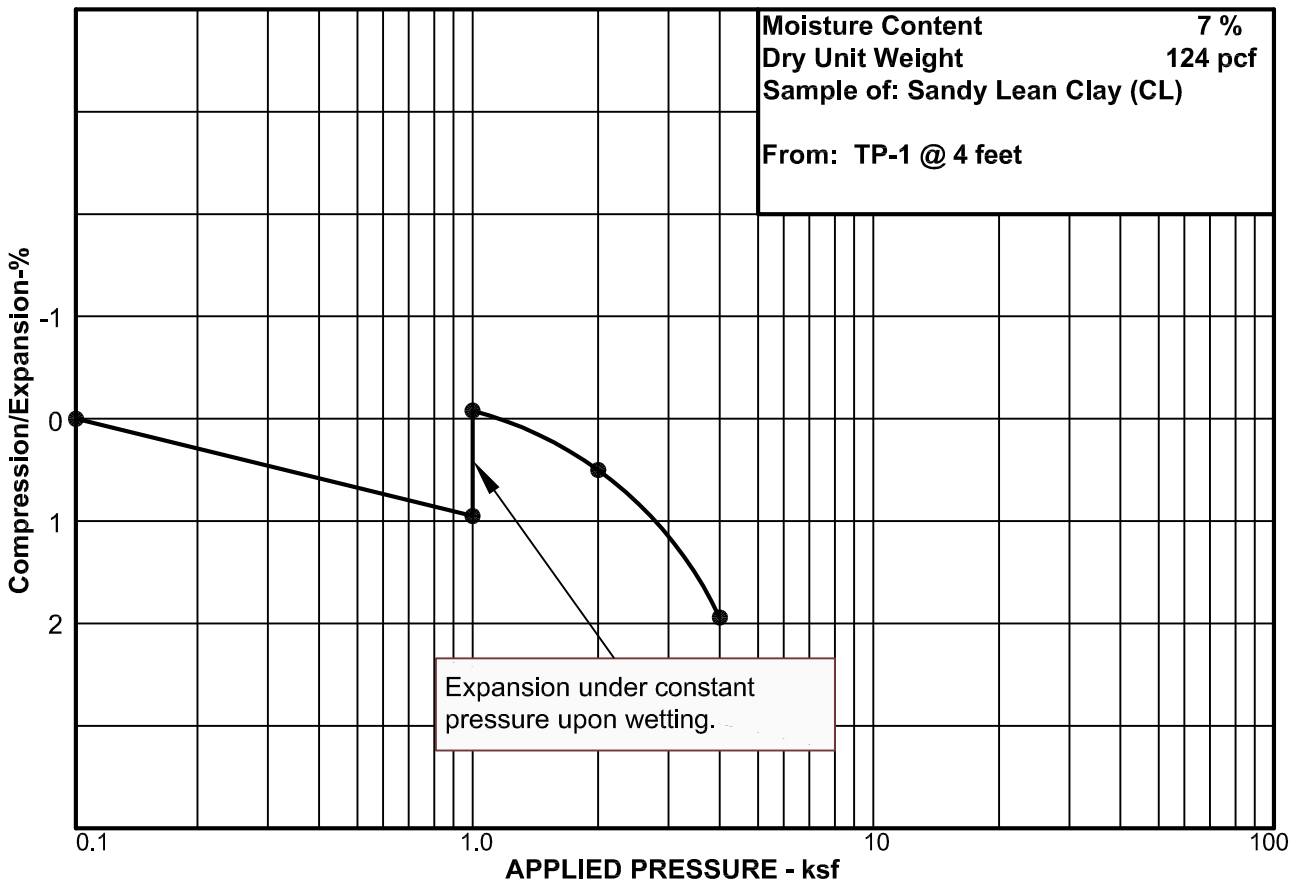
Indicates practical backhoe refusal on stiff clay and boulders or shale bedrock.

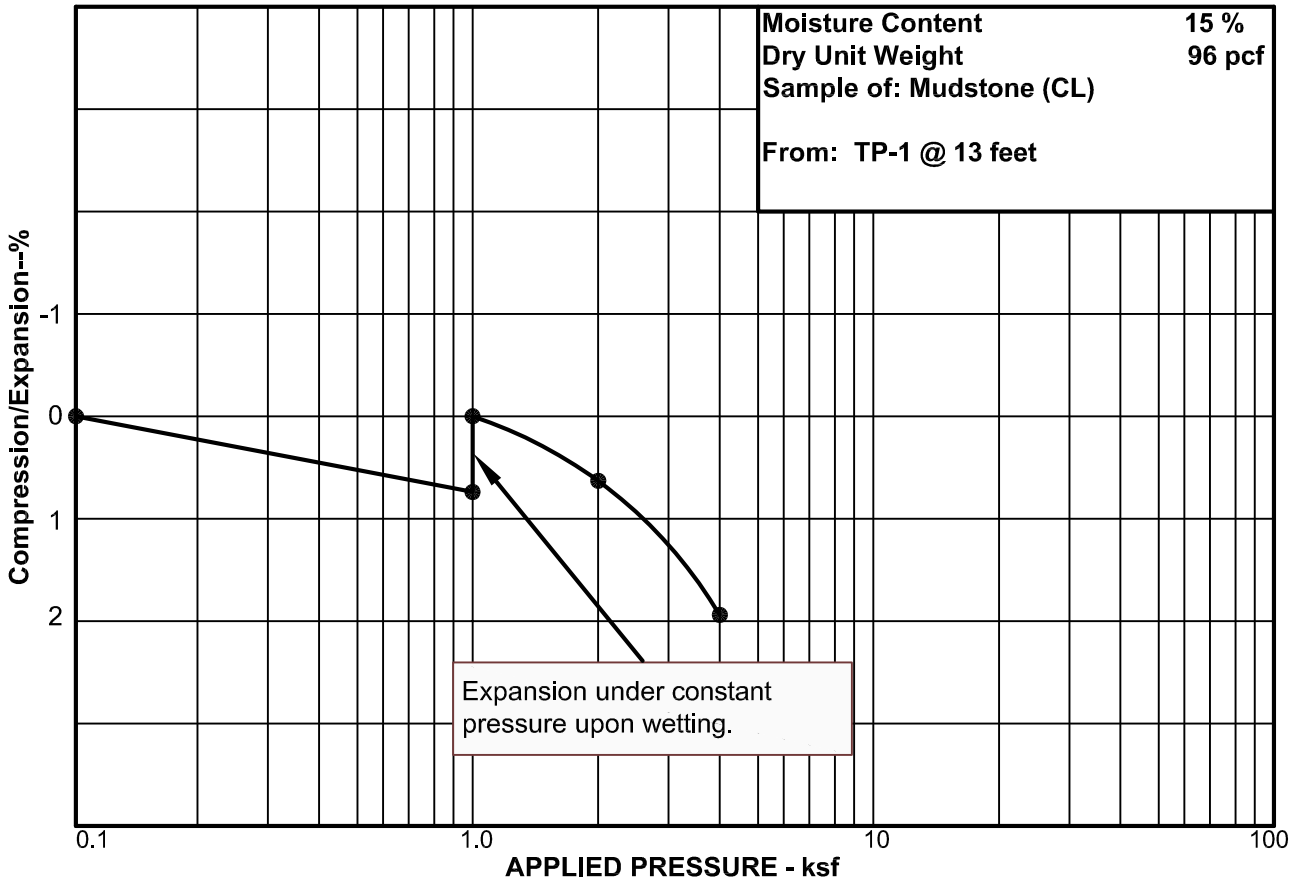
Indicates practical backhoe refusal on basalt.

NOTES:

1. Test pits TP-1 through TP-13 were excavated on August 8 and 9, 2018 and test pits TP-14 through TP-21 were excavated on August of 1998 with a trackhoe.
2. The locations and elevations of test pits TP-1 through TP-11 were measured using roadway centerline stakes, which were located using GPS by others.
3. The locations of test pits TP-12 through TP-21 were located by pacing from features shown on Figure 2. The elevations of test pits TP-12 through TP-21 were interpolated between contours shown on Figure 2.
4. The test pit locations and elevations should be considered accurate only to the degree implied by the method used.
5. The lines between the materials shown on the test pit logs represent the approximate boundaries between material types and the transitions may be gradual.
6. Free water was not encountered in the test pits at the time of excavation.
7. WC = water content (%);
   DD = dry density (pcf);
   +4 = percent retained on the No. 4 sieve;
   -200 = percent passing No. 200 sieve;
   LL = liquid limit (%);
   PI = plasticity index (%);
   NP = non-plastic;
   MDD = maximum dry density (pcf);
   OMC = optimum moisture content (%);
   CBR = california bearing ratio (%).

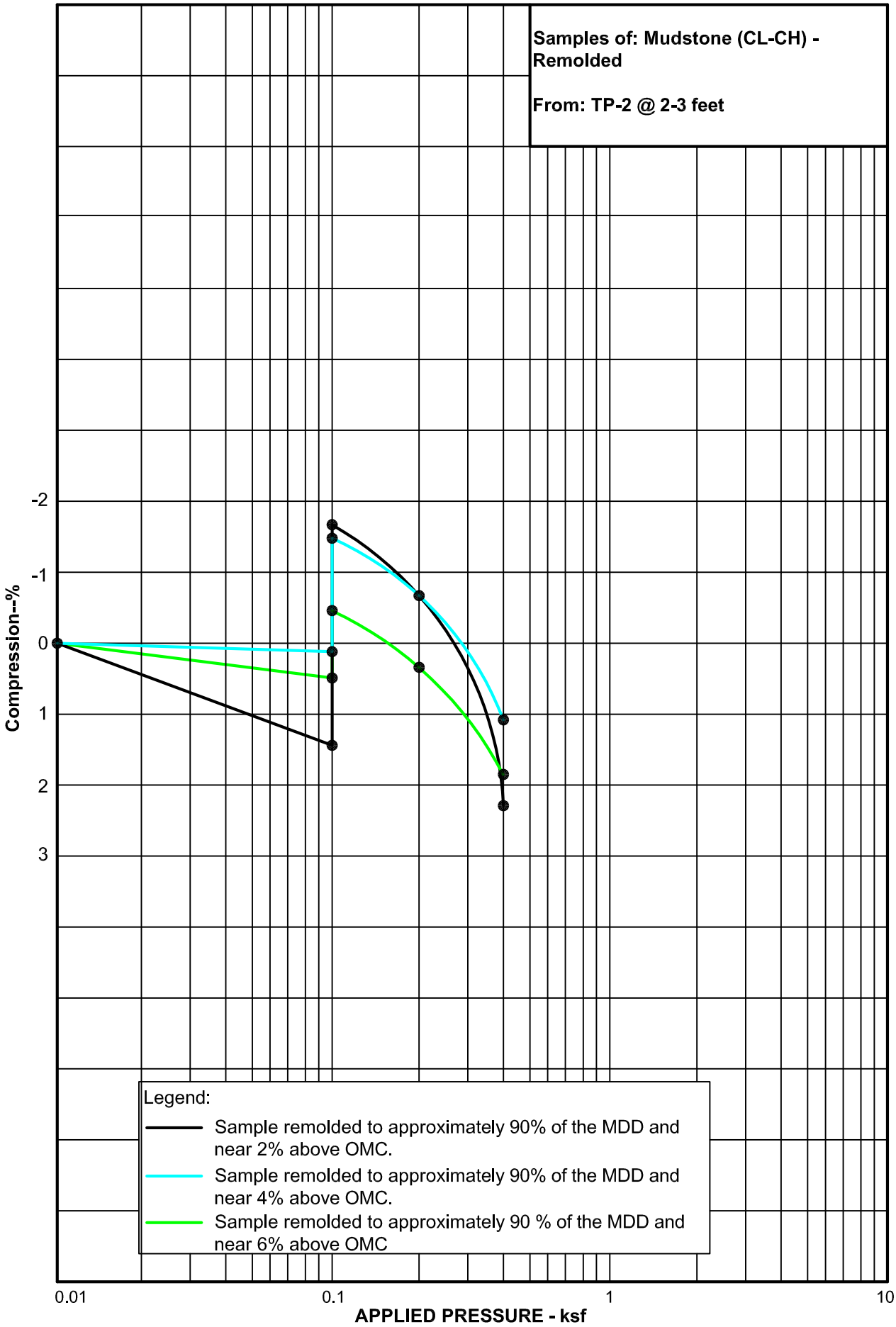
Applied Geotechnical Engineering Consultants, Inc.





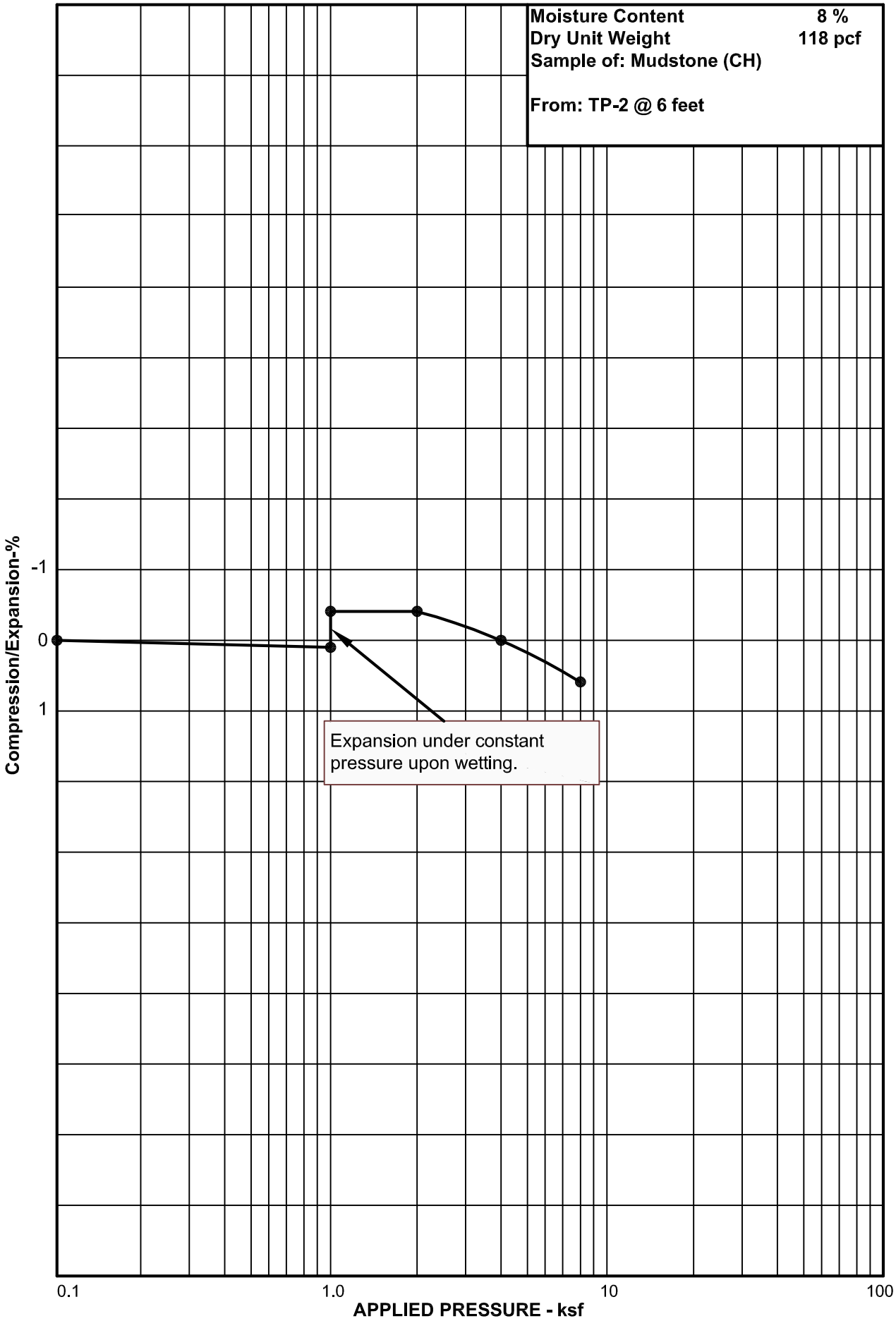
Project No. 2180295 **CONSOLIDATION TEST RESULTS** **Figure 6**

Applied Geotechnical Engineering Consultants, Inc.



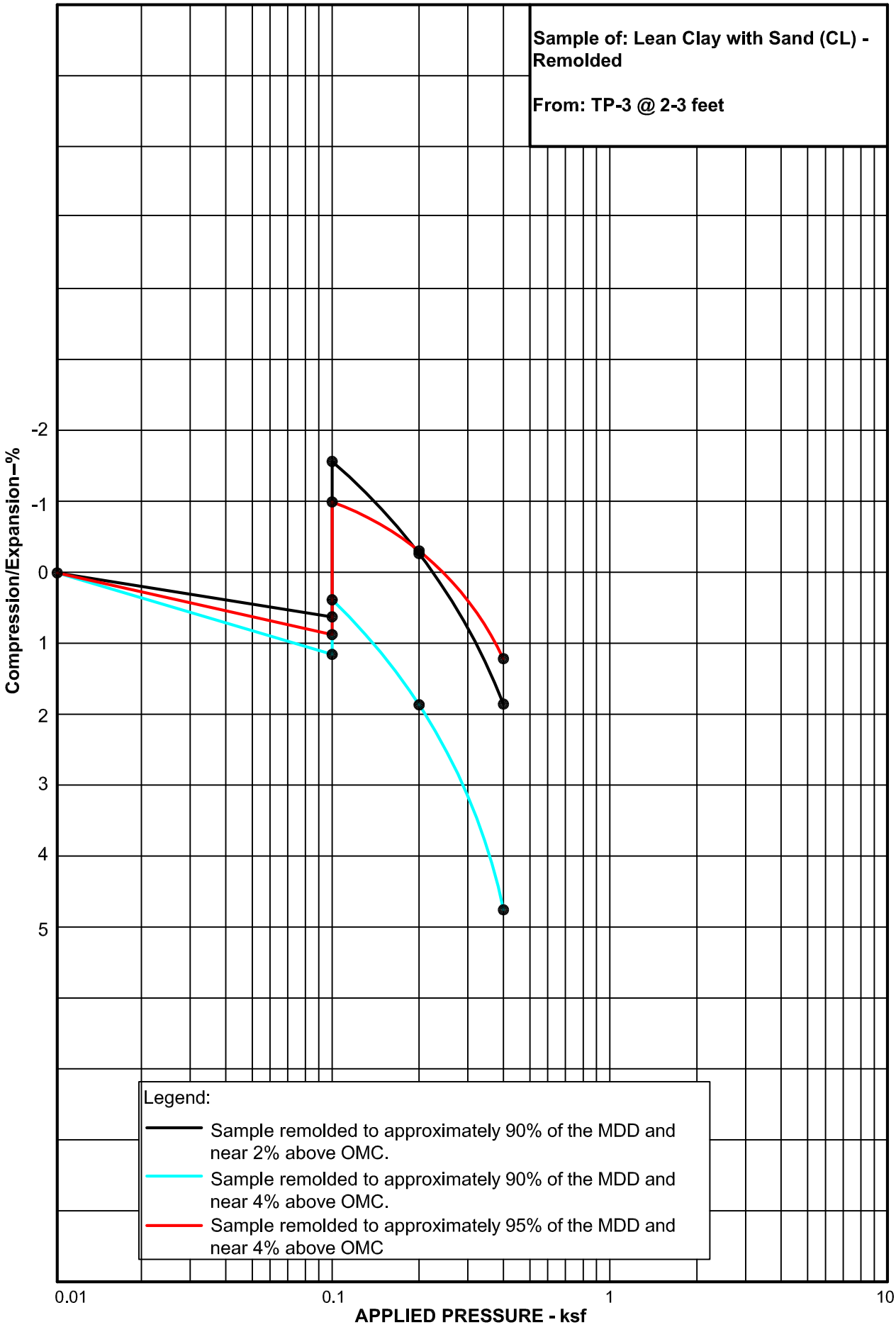
Project No. 2180295 **CONSOLIDATION TEST RESULTS** **Figure 7**

Applied Geotechnical Engineering Consultants, Inc.



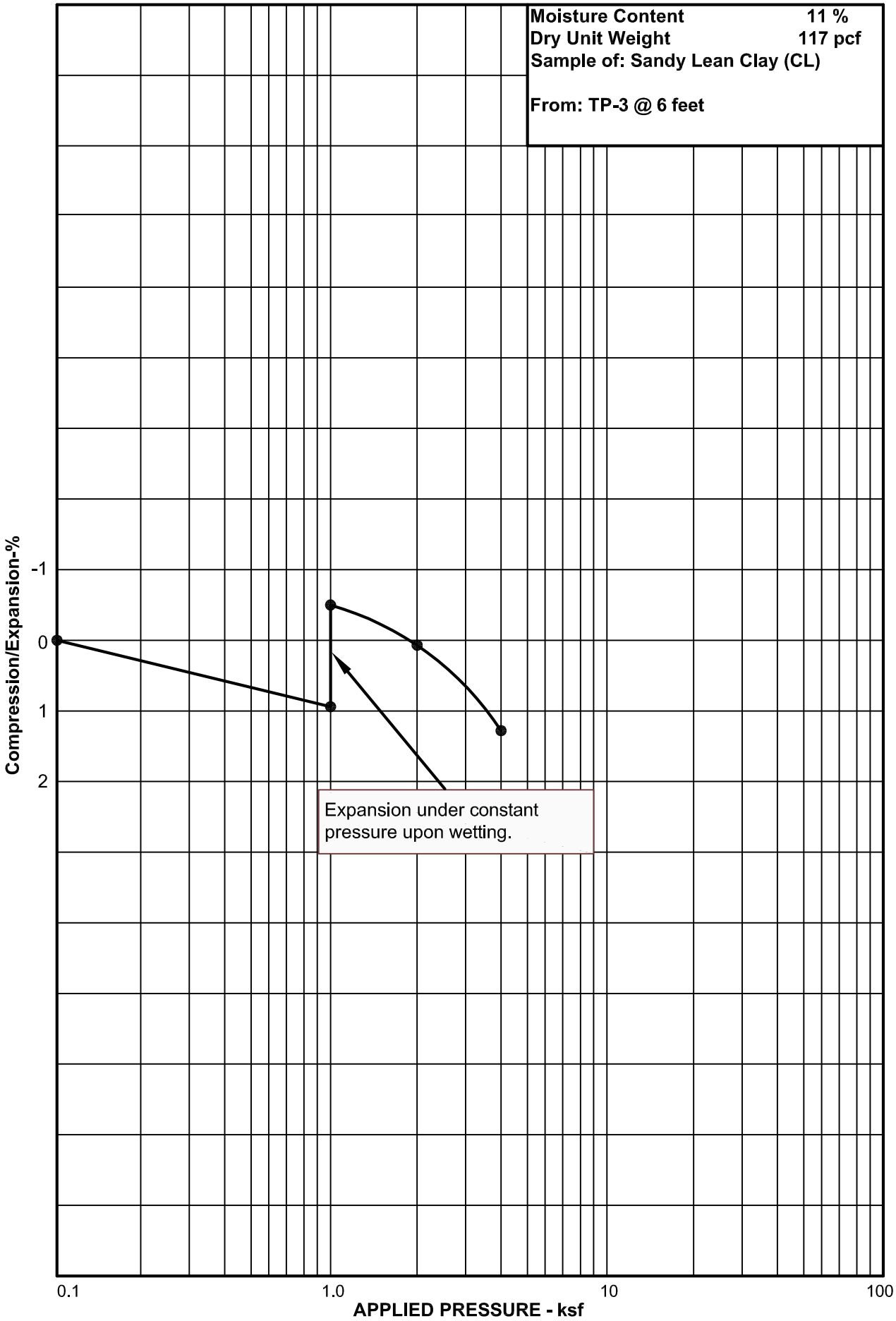
Project No. 2180295 **CONSOLIDATION TEST RESULTS** **Figure 8**

Applied Geotechnical Engineering Consultants, Inc.



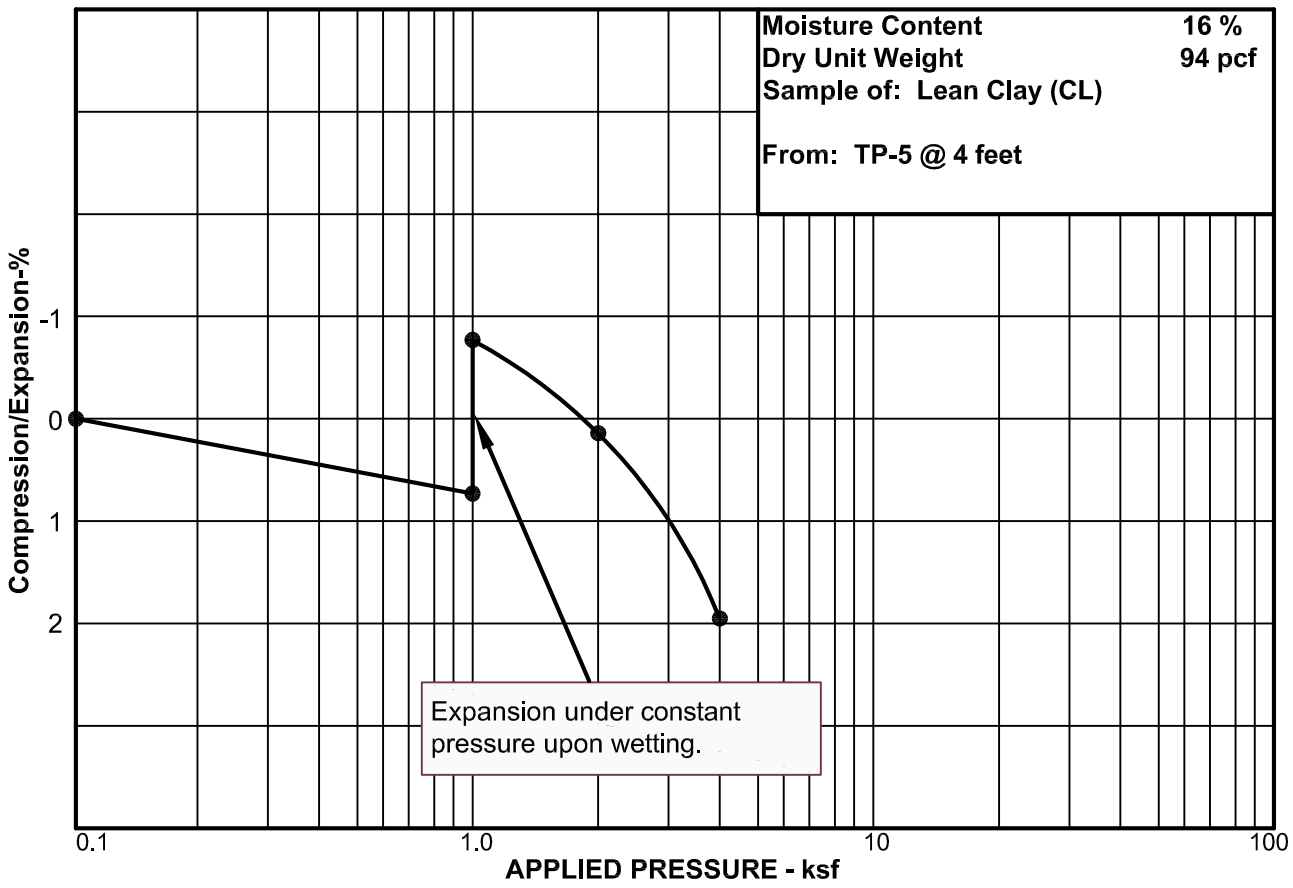
Project No. 2180295 **CONSOLIDATION TEST RESULTS** **Figure 9**

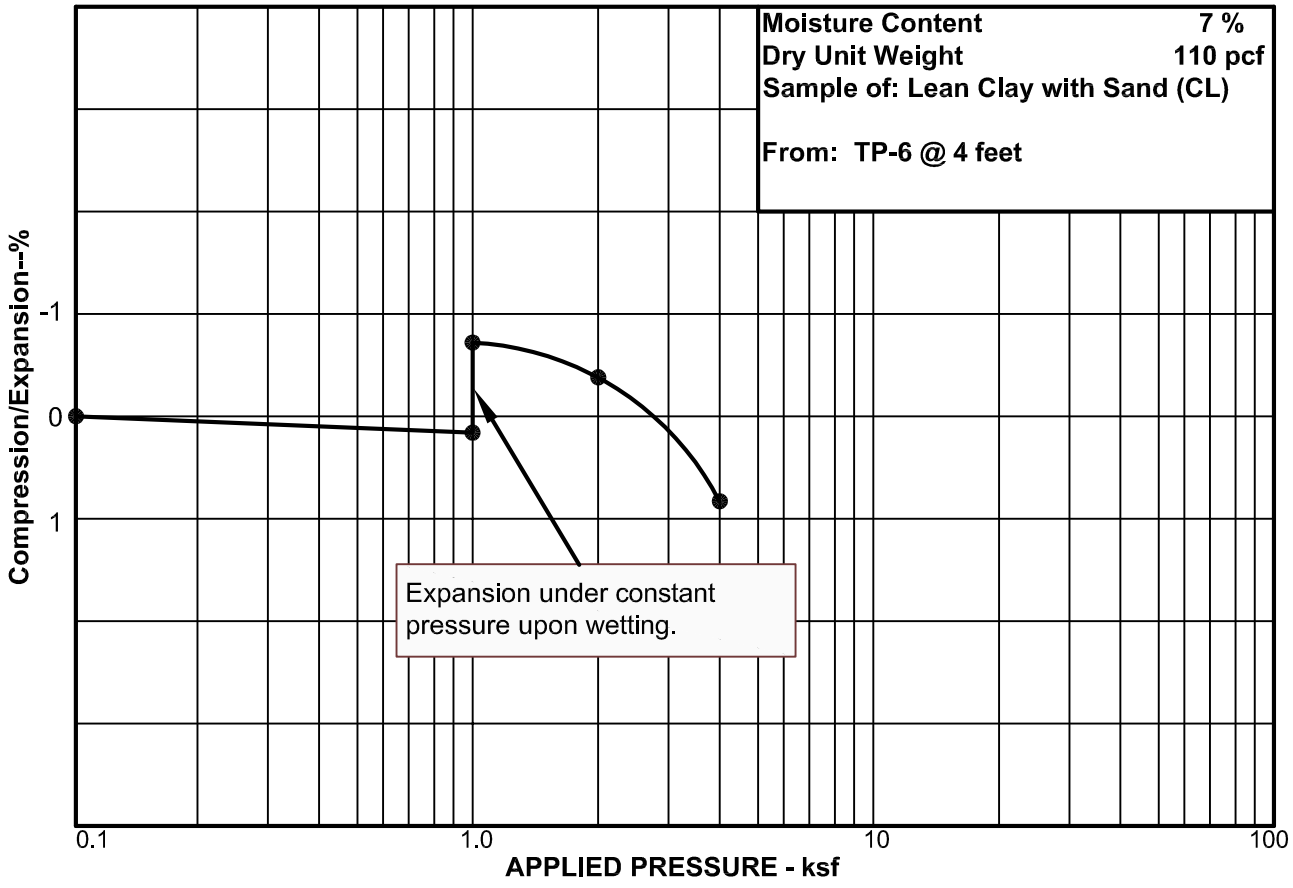
Applied Geotechnical Engineering Consultants, Inc.



Project No. 2180295 **CONSOLIDATION TEST RESULTS** **Figure 10**

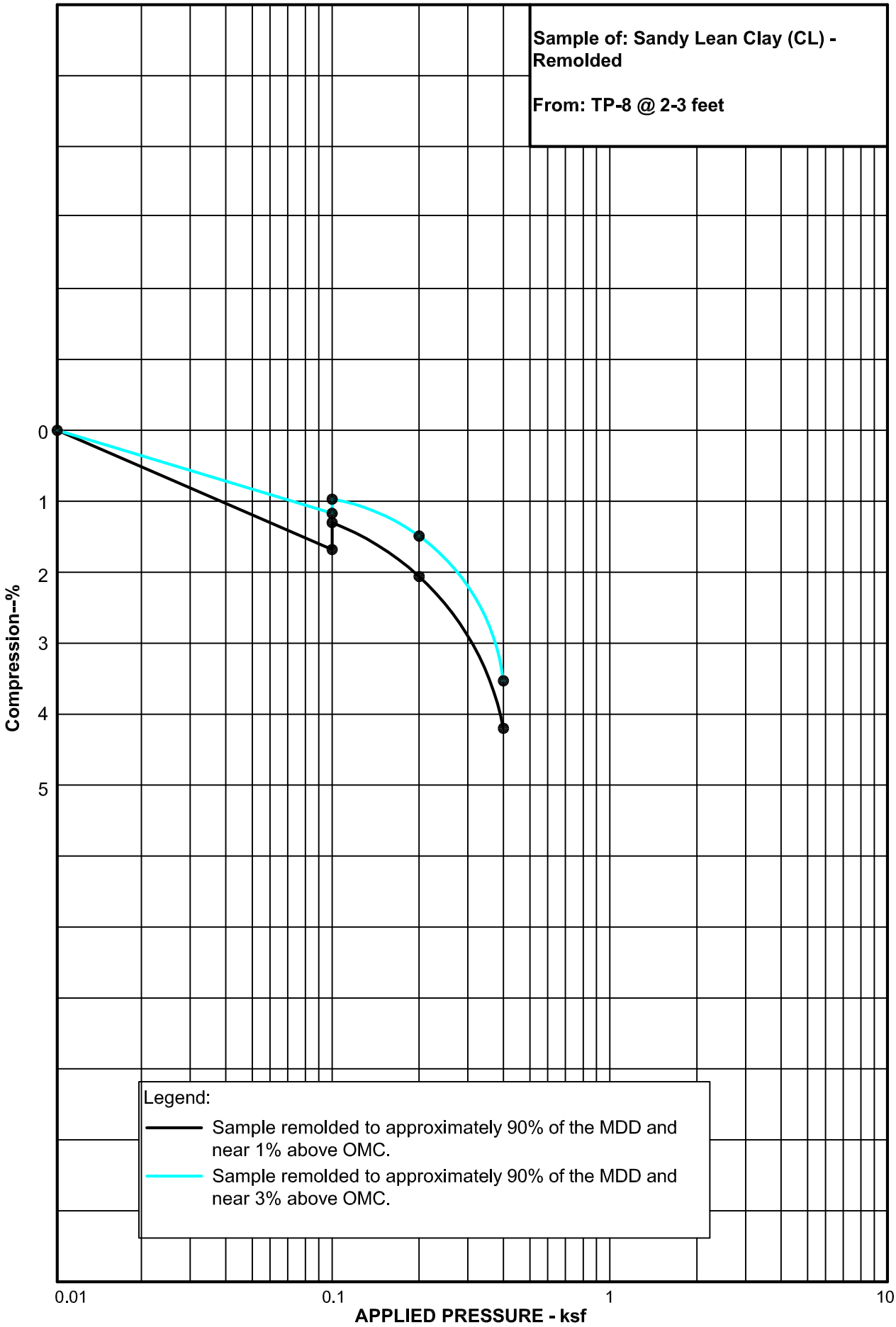
Applied Geotechnical Engineering Consultants, Inc.





Project No. 2180295 **CONSOLIDATION TEST RESULTS** **Figure 11**

Applied Geotechnical Engineering Consultants, Inc.

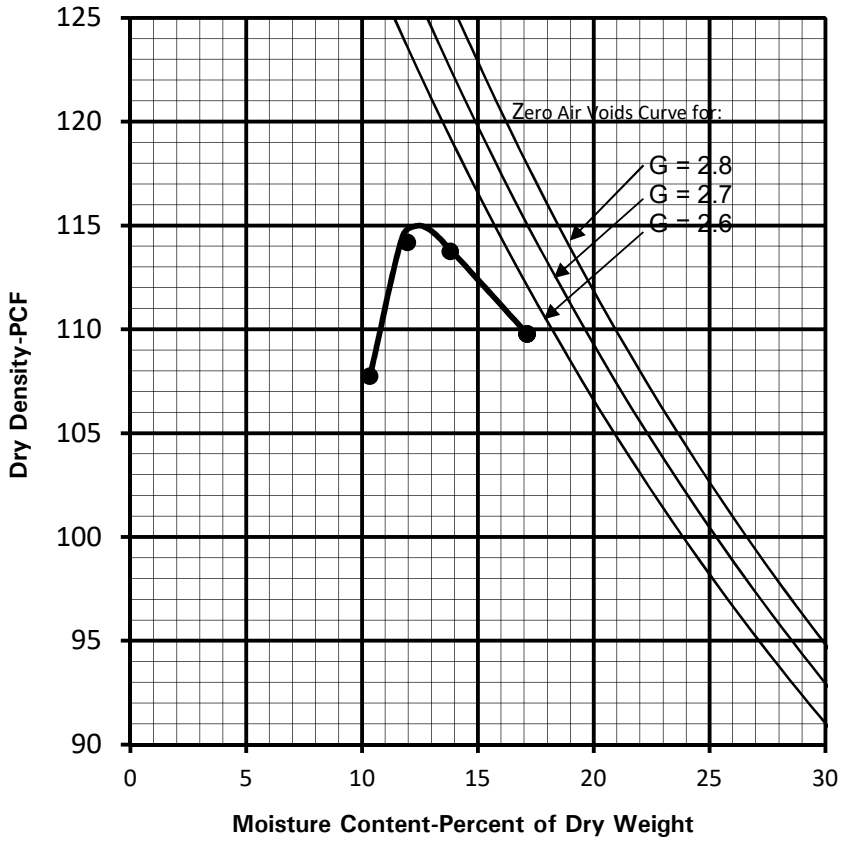


Project No. 2180295 **CONSOLIDATION TEST RESULTS** **Figure 12**

AGEC

Applied GeoTech

Project: 300 West (Tech Ridge South Access Road)



Sample Date:	8/14/18
Sample No.	180815G
Maximum Dry Density:	115.0
Optimum Moisture:	12.5
Atterberg Limits	
Liquid Limit:	45%
Plasticity Index:	24%
Gradation	
Gravel:	0%
Sand:	15%
Silt & Clay:	85%

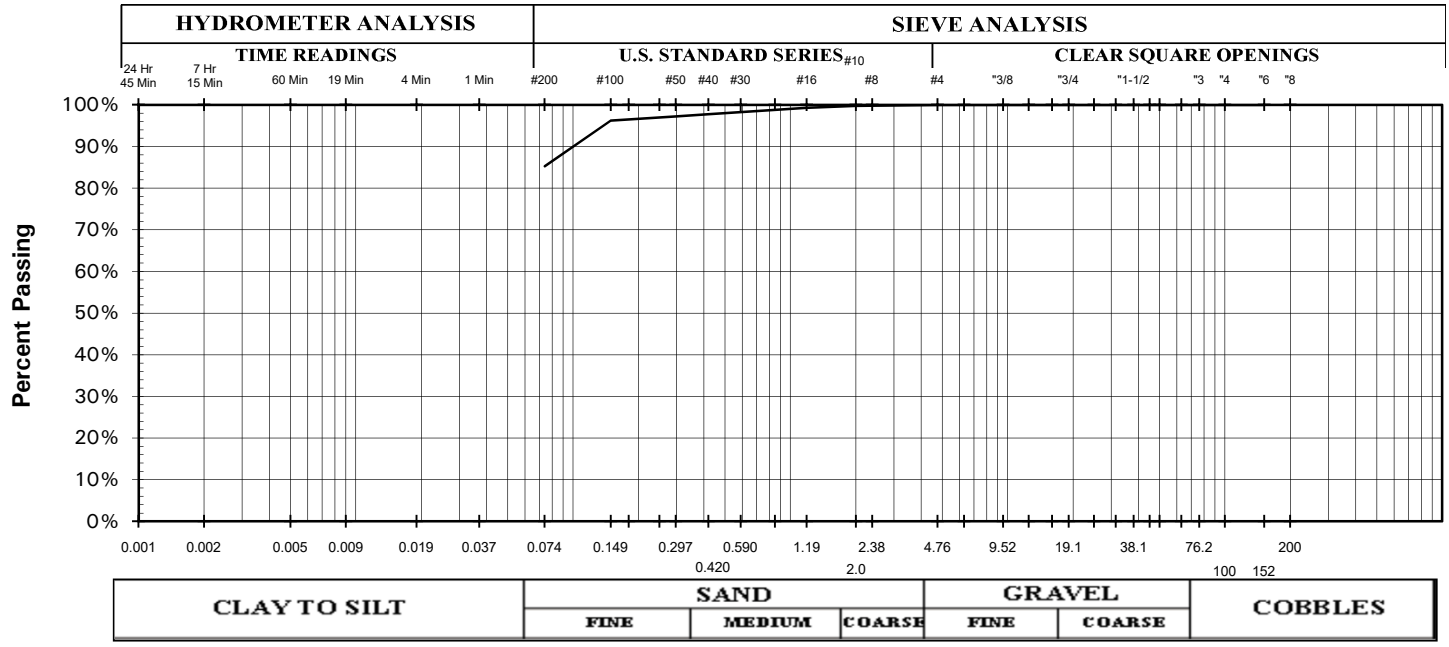
Moisture - Density Relationship Test Procedure: ASTM D-1557 B

Reviewed By: BI

Sample Description: Mudstone - lean clay (CL)

AASHTO Classification: A-7-6

Sample Location: TP-2 @ 2-3'



GRADATION AND MOISTURE-DENSITY RELATIONSHIP RESULTS

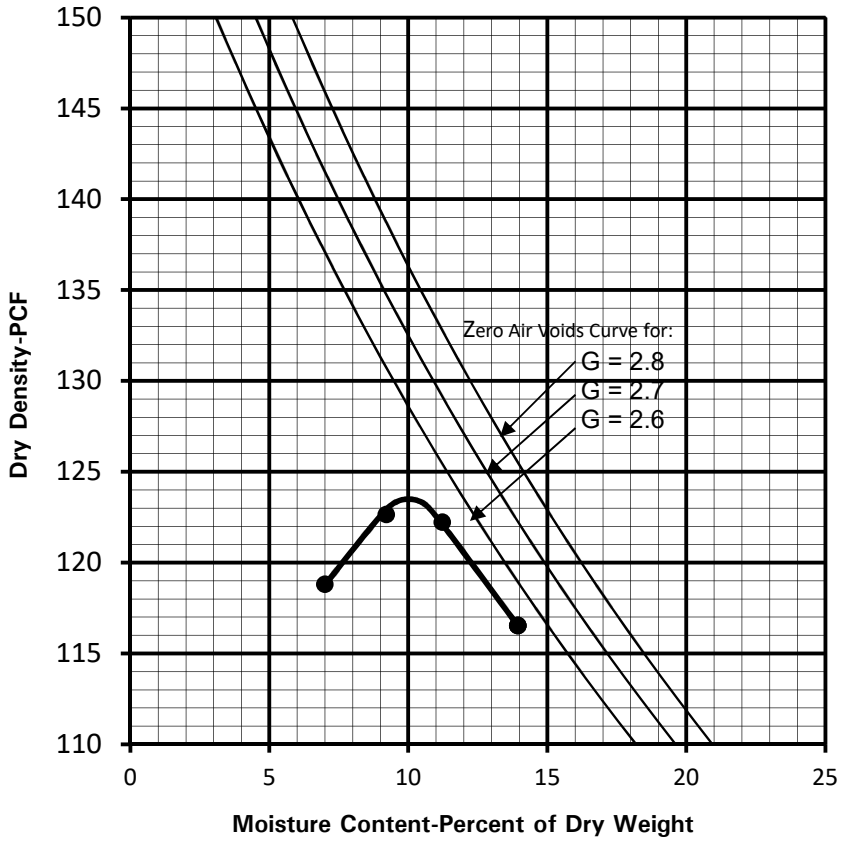
Project No.: 2180295

Figure: 13

AGEC

Applied GeoTech

Project: 300 West (Tech Ridge South Access Road)



Sample Date:	8/14/18
Sample No.	180816A
Maximum Dry Density:	123.5
Optimum Moisture:	10.0
Atterberg Limits	
Liquid Limit:	36%
Plasticity Index:	24%
Gradation	
Gravel:	0%
Sand:	27%
Silt & Clay:	73%

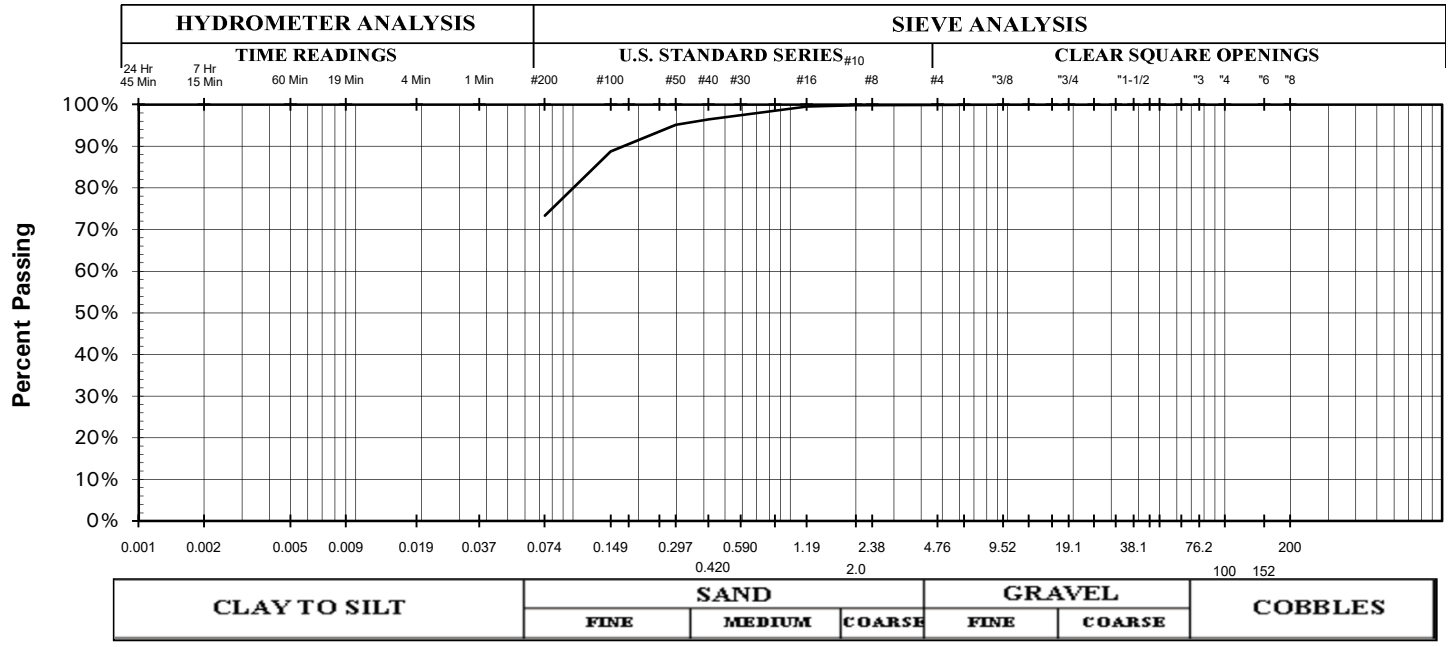
Moisture - Density Relationship Test Procedure: ASTM D-1557 B

Reviewed By: BI

USCS Classification: lean clay with sand (CL)

AASHTO Classification: A-6

Sample Location: TP-3 @ 2-3'



GRADATION AND MOISTURE-DENSITY RELATIONSHIP RESULTS

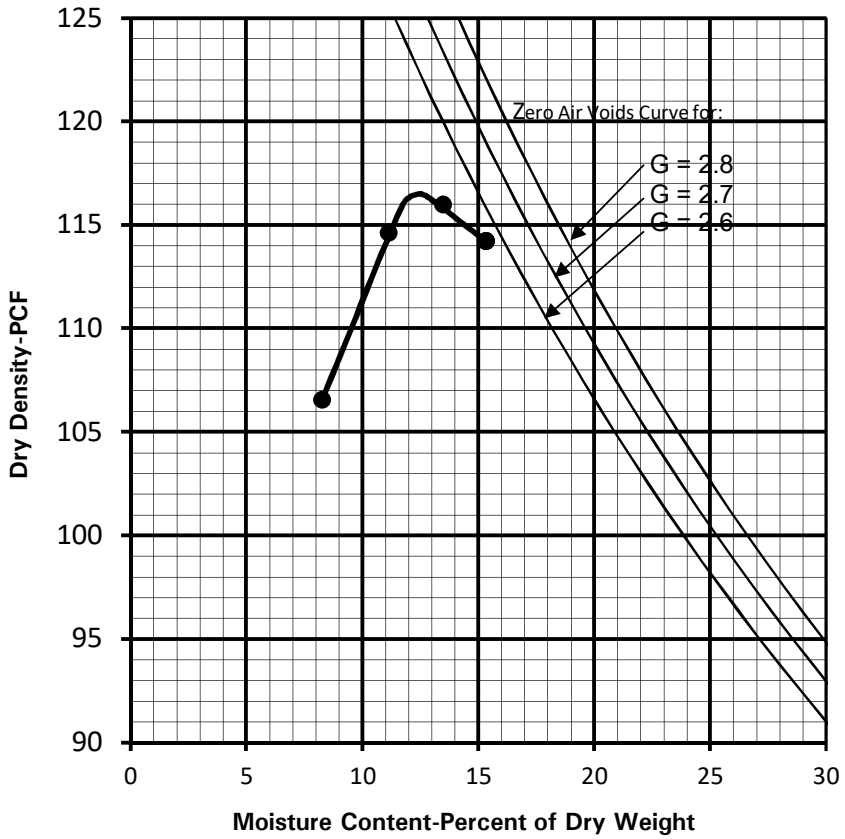
Project No.: 2180295

Figure: 14

AGEC

Applied GeoTech

Project: 300 West (Tech Ridge South Access Road)



Sample Date:	8/14/18
Sample No.	180816b
Maximum Dry Density:	116.5
Optimum Moisture:	12.5
Atterberg Limits	
Liquid Limit:	37%
Plasticity Index:	20%
Gradation	
Gravel:	12%
Sand:	22%
Silt & Clay:	66%

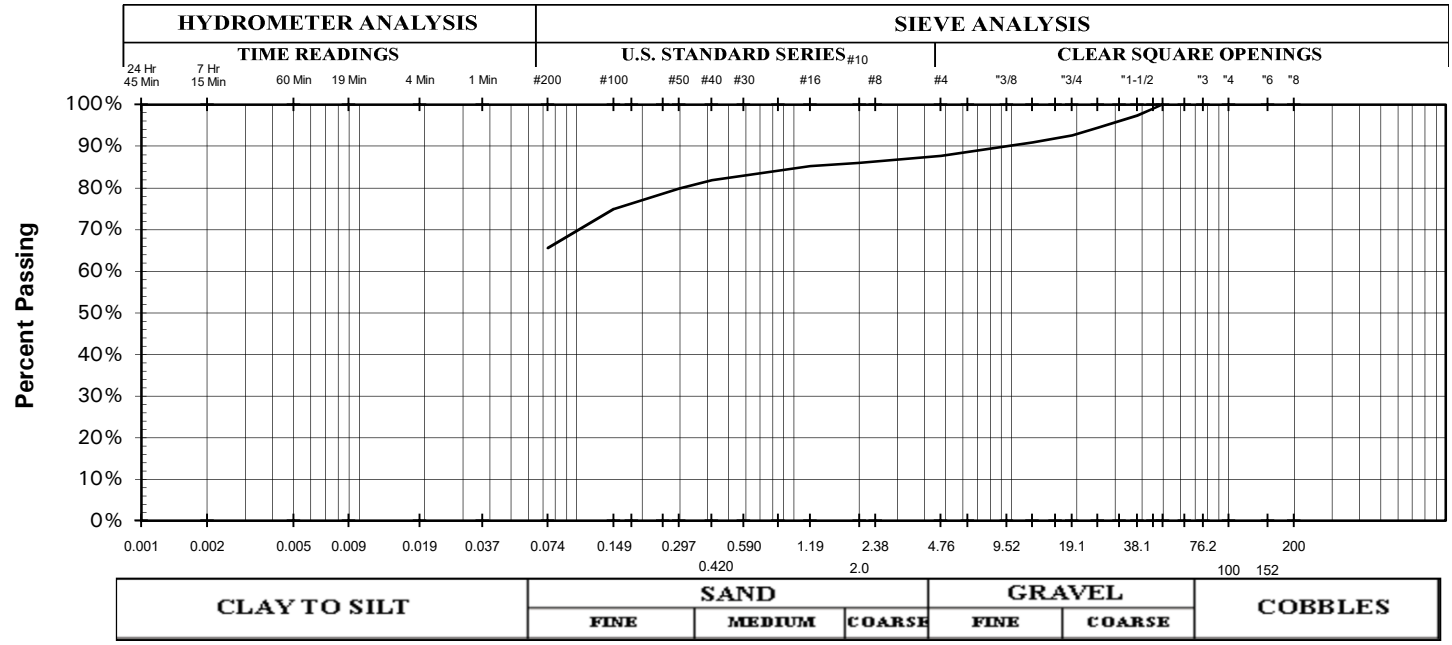
Moisture - Density Relationship Test Procedure: ASTM D-1557 B

Reviewed By: BI

Sample Description: sandy lean clay (CL)

AASHTO Classification: A-6

Sample Location: TP-8 @ 2-3'



GRADATION AND MOISTURE-DENSITY RELATIONSHIP RESULTS

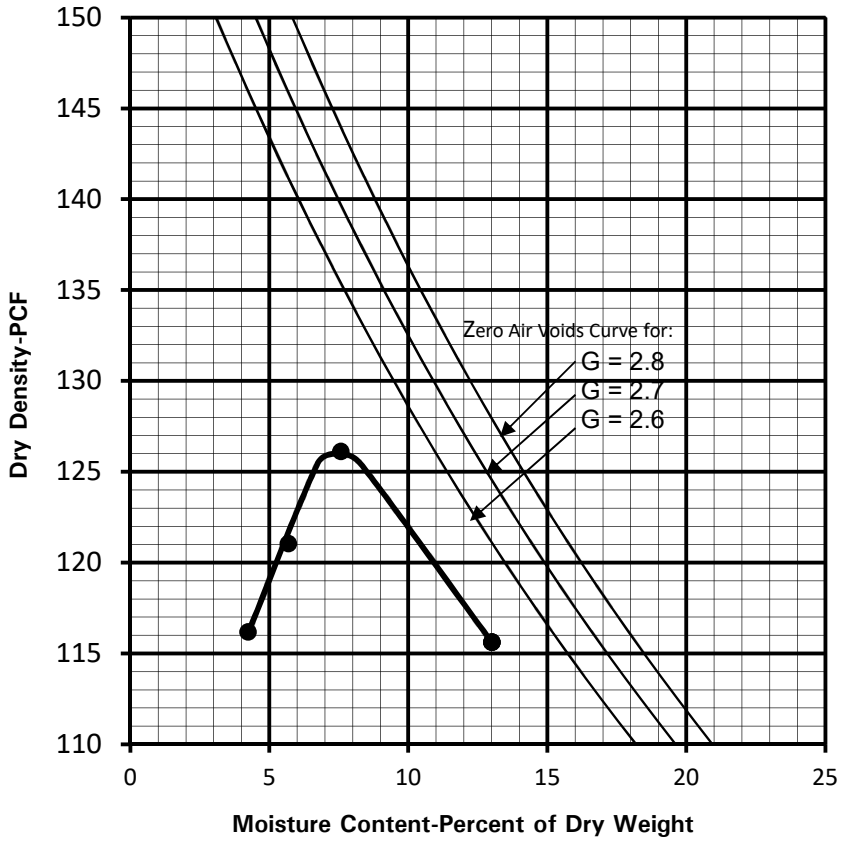
Project No.: 2180295

Figure: 15

AGEC

Applied GeoTech

Project: 300 West (Tech Ridge South Access Road)



Sample Date:	8/14/18
Sample No.	180816E
Maximum Dry Density:	126.0
Optimum Moisture:	7.5

Atterberg Limits

Liquid Limit:	
Plasticity Index:	Non-Plastic

Gradation

Gravel:	2%
Sand:	63%
Silt & Clay:	35%

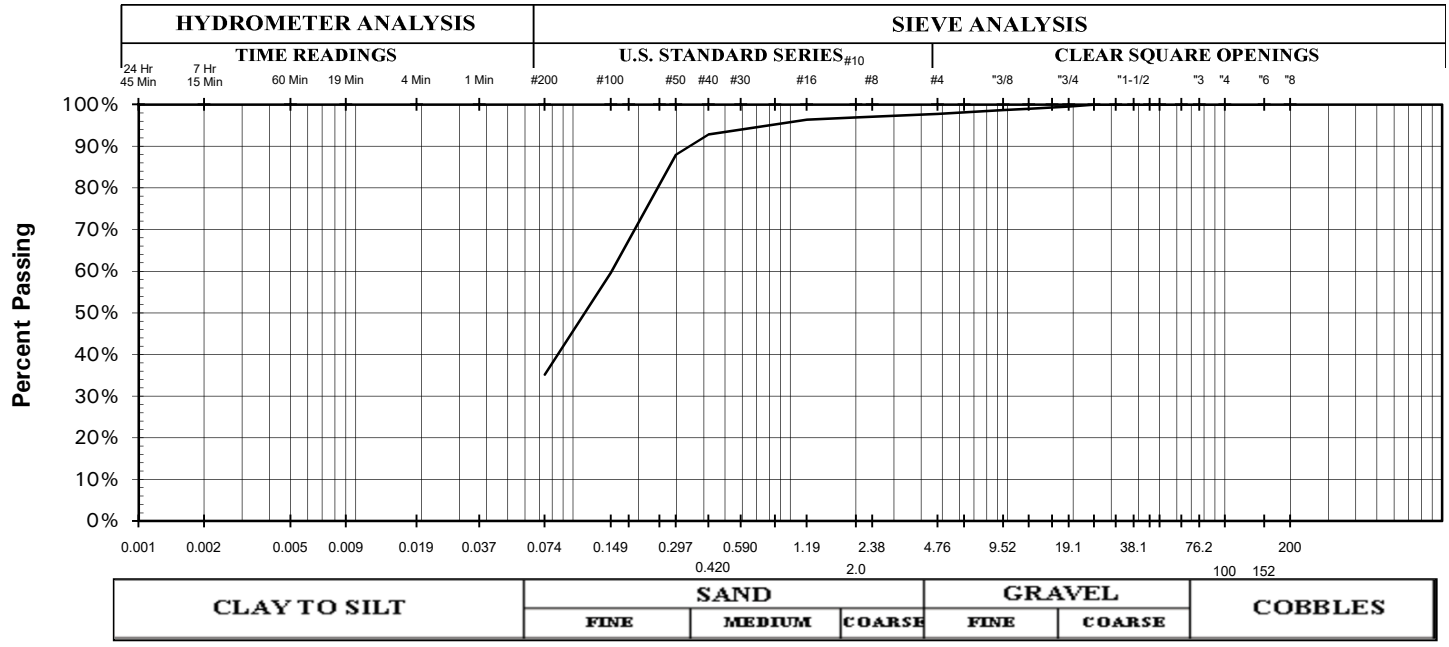
Moisture - Density Relationship Test Procedure: ASTM D-1557 B

Reviewed By: BI

USCS Classification: silty sand (SM)

AASHTO Classification: A-4

Sample Location: TP-10 @ 2-3'



GRADATION AND MOISTURE-DENSITY RELATIONSHIP RESULTS

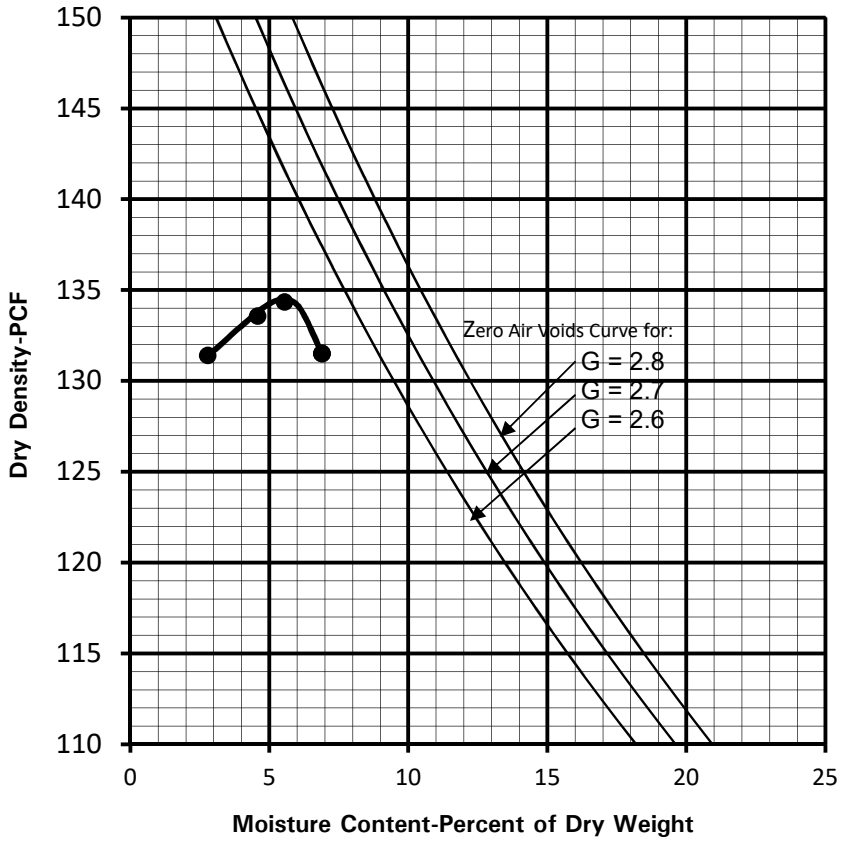
Project No.: 2180295

Figure: 16

AGEC

Applied GeoTech

Project: 300 West



Sample Date:	8/14/18
Sample No.	180816F
Maximum Dry Density:	134.5
Optimum Moisture:	5.5

Atterberg Limits

Liquid Limit:	
Plasticity Index:	Non-Plastic

Gradation

Gravel:	68%
Sand:	16%
Silt & Clay:	16%

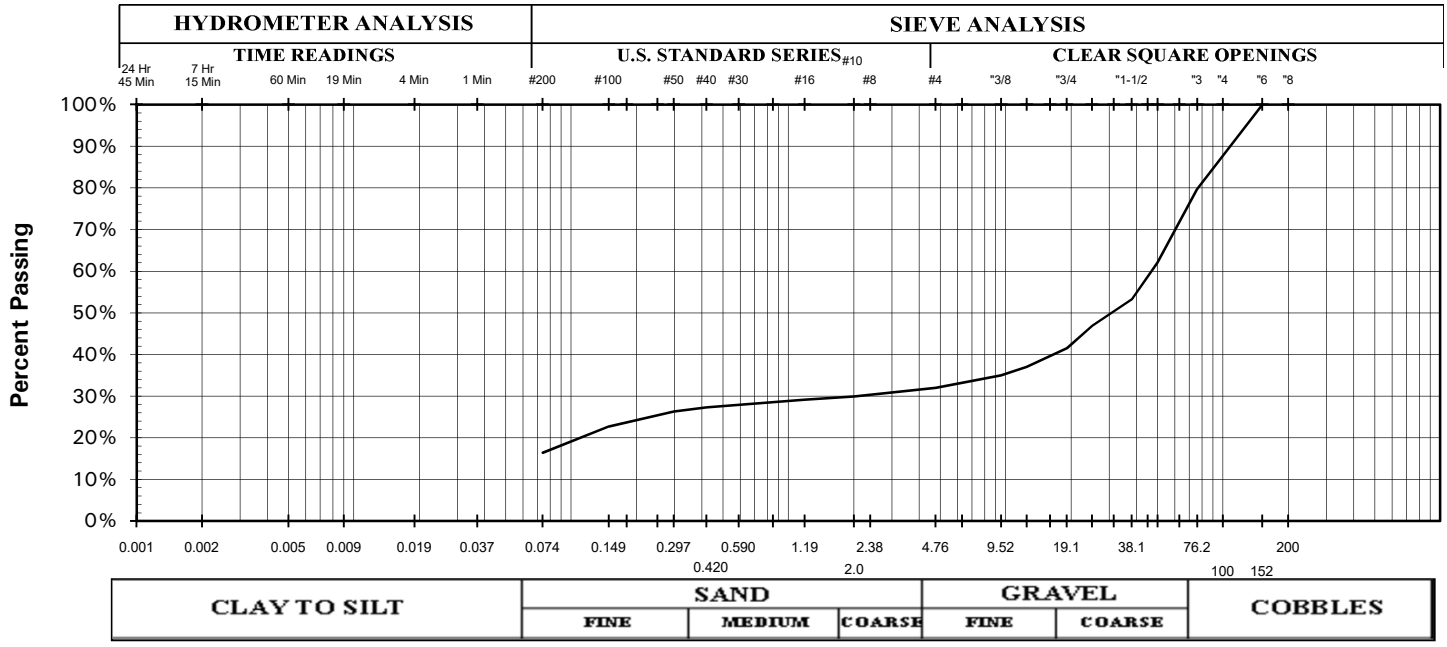
Moisture - Density Relationship Test Procedure: ASTM D-1557 B

Reviewed By: TT

USCS Classification: silty gravel with sand (GM) *Rock Corrected*

AASHTO Classification: A-1-b

Sample Location: TP-11 @ 0-1'

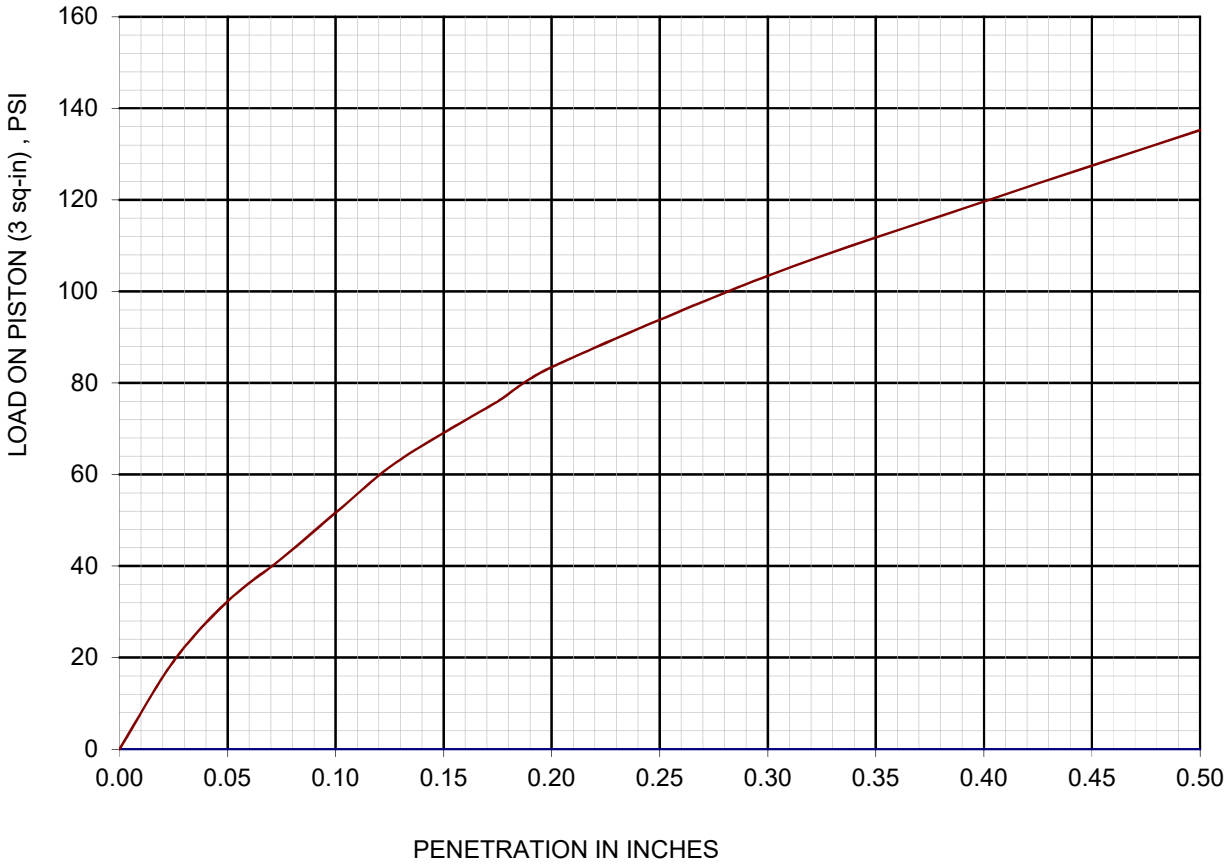


GRADATION AND MOISTURE-DENSITY RELATIONSHIP RESULTS

Project No.: 2180295

Figure: 17

AGEC
Applied GeoTech



Project 300 West **Sample Location** TP-2 @ 2-3'

Sample Classification (CL) lean clay - purple mudstone **AGEC Sample ID No.** A-082718

Method of sample preparation: Remolded to approximately 90% of the maximum dry density at the optimum moisture content +2 as per ASTM D-1557

Sample penetration after soaking for 96 hours

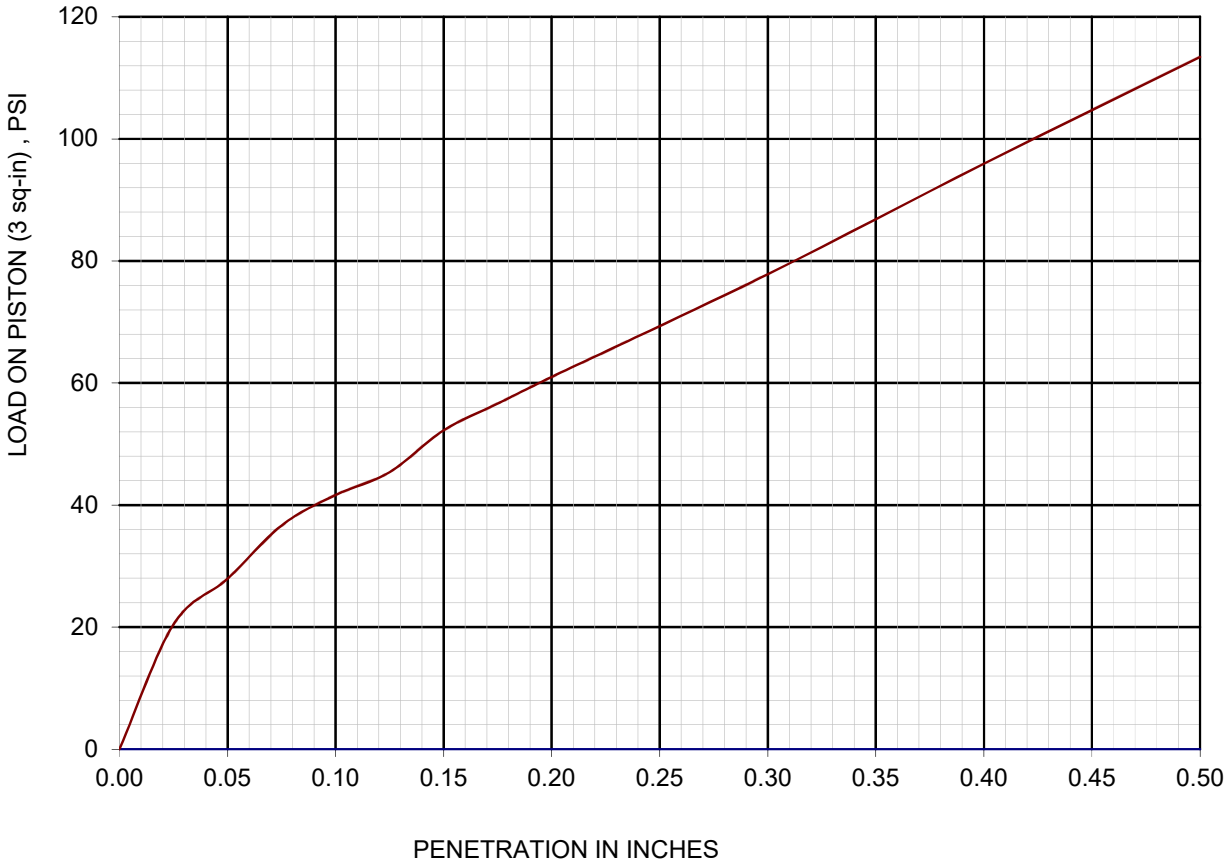
Dry Density:	as molded	103.0	pcf	**Moisture Content:**	as molded	14.1	percent
	after soaking	98.1	pcf		top 1-inch after soaking	26.0	percent
Swell:	after soaking	4.1	percent		average after soaking	25.3	percent

Comments CBR value taken at 0.2 inch penetration

Bearing Ratio of Sample, CBR = **6** percent **Surcharge** 30 lb

Proj. No. 2180295 **CALIFORNIA BEARING RATIO TEST RESULTS** Figure 18

AGEC
Applied GeoTech



Project 300 West **Sample Location** TP-3 @ 2-3'

Sample Classification (CL) lean clay with sand **AGEC Sample ID No.** B-082718

Method of sample preparation: Remolded to approximately 90% of the maximum dry density at the optimum moisture content +2% as per ASTM D-1557

Sample penetration after soaking for 96 hours

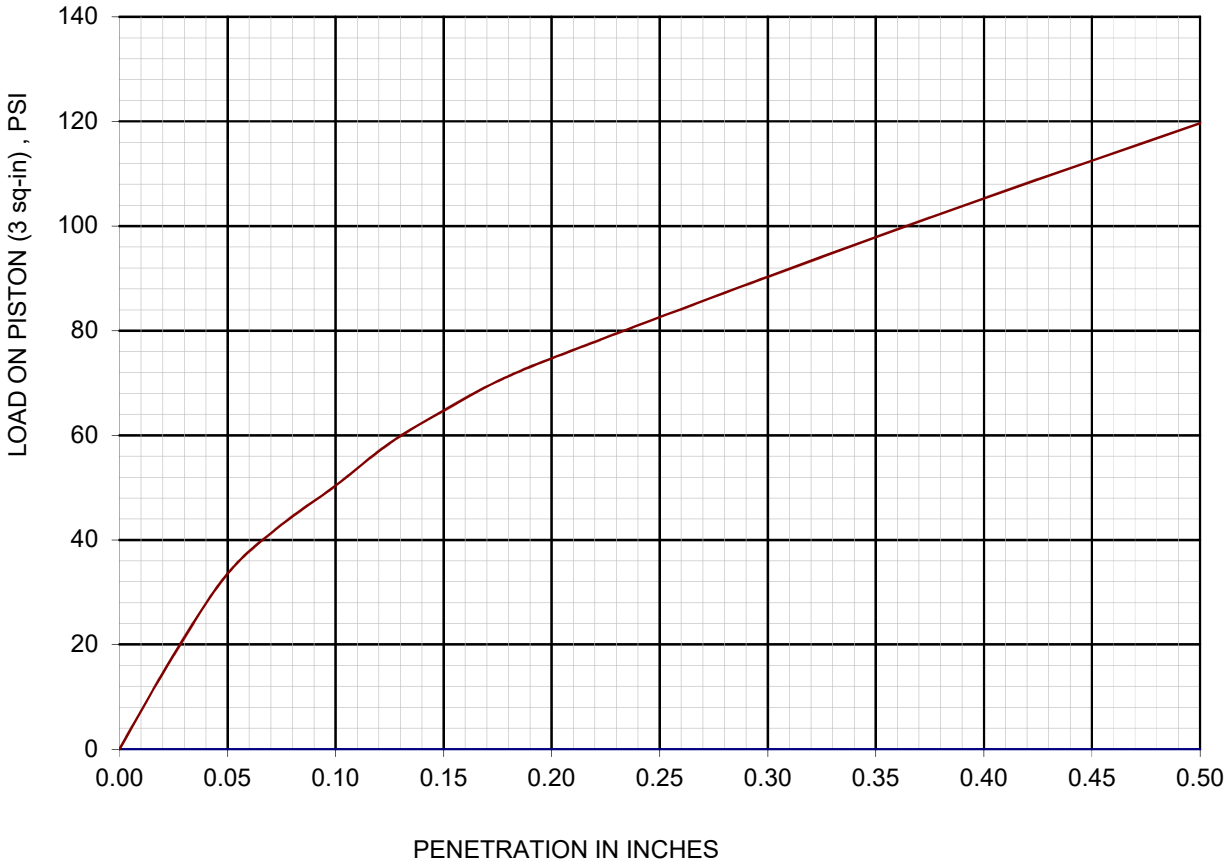
Dry Density:	as molded	113.6	pcf	**Moisture Content:**	as molded	12.0	percent
	after soaking	108.6	pcf		top 1-inch after soaking	23.1	percent
Swell:	after soaking	1.3	percent		average after soaking	20.0	percent

Comments CBR value taken at 0.2 inch penetration

Bearing Ratio of Sample, CBR = **4** percent **Surcharge** 30 lb

Proj. No. 2180295 **CALIFORNIA BEARING RATIO TEST RESULTS** Figure 19

AGEC
Applied GeoTech



Project 300 West **Sample Location** TP-8 @ 2-3'

Sample Classification (CL) sandy lean clay **AGEC Sample ID No.** C-082718

Method of sample preparation: Remolded to approximately 90% of the maximum dry density at the optimum moisture content +2% as per ASTM D-1557

Sample penetration after soaking for 96 hours

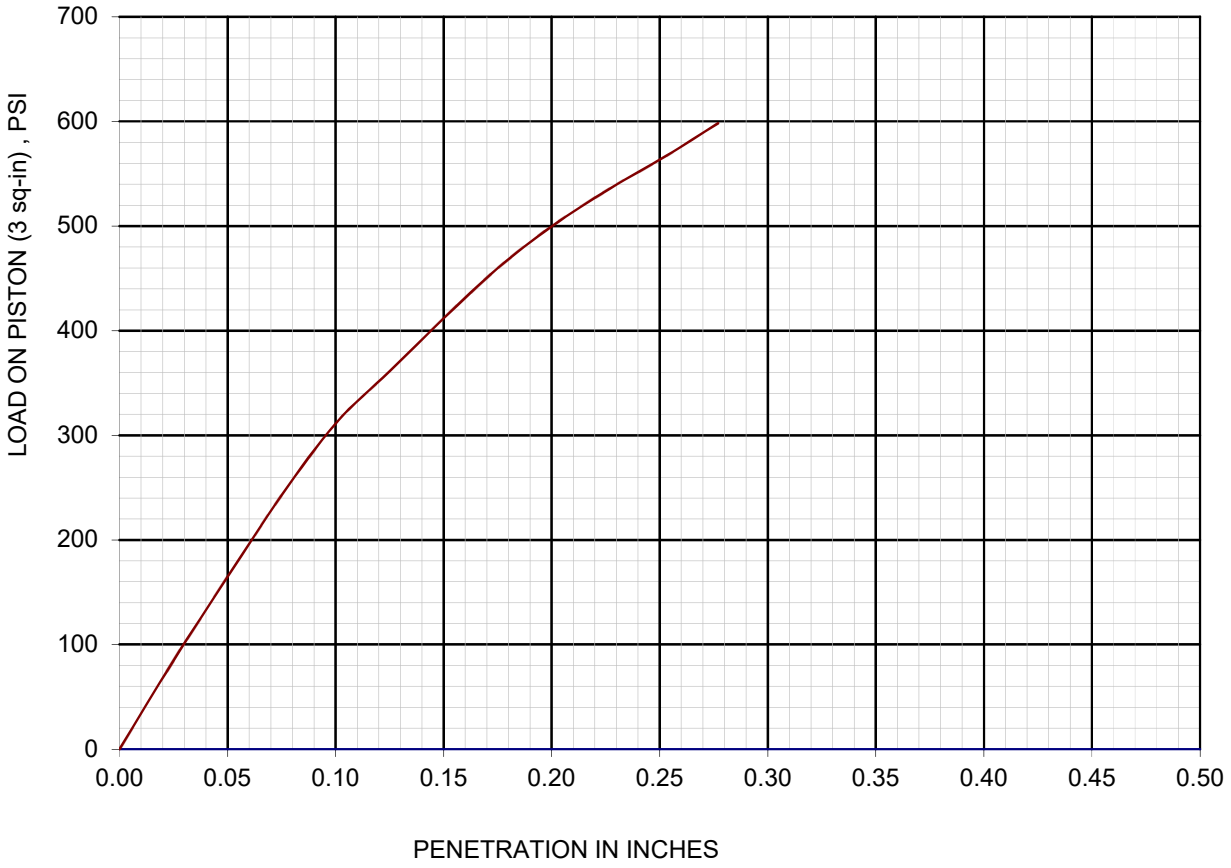
Dry Density:	as molded	104.5	pcf	**Moisture Content:**	as molded	14.5	percent
	after soaking	104.1	pcf		top 1-inch after soaking	21.7	percent
Swell:	after soaking	1.5	percent		average after soaking	18.9	percent

Comments CBR value taken at 0.2 inch penetration

Bearing Ratio of Sample, CBR = **5** percent **Surcharge** 30 lb

Proj. No. 2180295 **CALIFORNIA BEARING RATIO TEST RESULTS** Figure 20

AGEC
Applied GeoTech



Project 300 West **Sample Location** TP-10 @ 2-3'

Sample Classification (SM) Silty sand **AGEC Sample ID No.** D-082718

Method of sample preparation: Remolded to approximately 95% of the maximum dry density at the optimum moisture content as per ASTM D-1557

Sample penetration after soaking for 96 hours

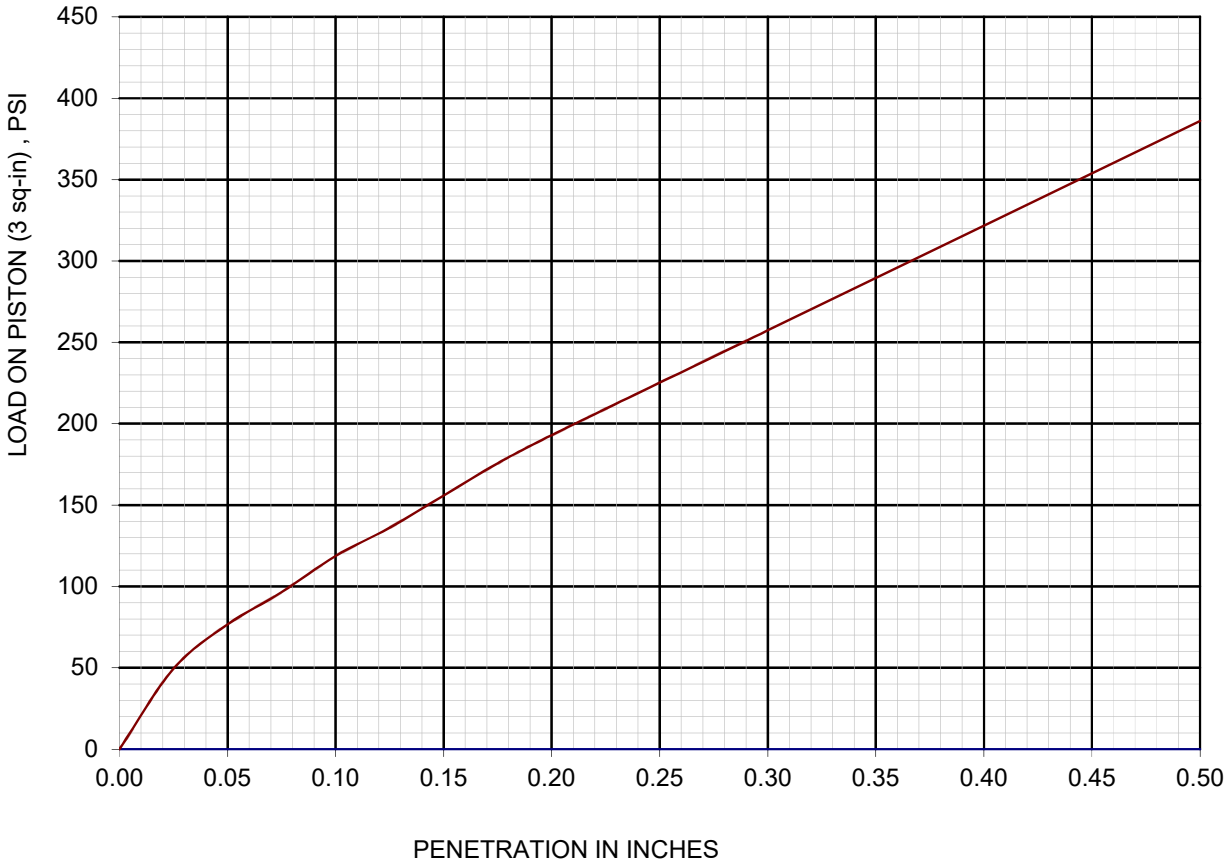
Dry Density:	as molded	122.2	pcf	**Moisture Content:**	as molded	7.4	percent
	after soaking	123.0	pcf		top 1-inch after soaking	10.3	percent
Swell:	after soaking	0.2	percent		average after soaking	10.5	percent

Comments CBR value taken at 0.2 inch penetration

Bearing Ratio of Sample, CBR = **33** percent **Surcharge** 10 lb

Proj. No. 2180295 **CALIFORNIA BEARING RATIO TEST RESULTS** Figure 21

AGEC
Applied GeoTech



Project 300 West **Sample Location** TP-11 @ 0-1'

Sample Classification Silty sand w/gravel - Basalt **AGEC Sample ID No.** E-082718

Method of sample preparation: Remolded to approximately 95% of the maximum dry density at the optimum moisture content as per ASTM D-1557

Sample penetration after soaking for 96 hours

Dry Density:	as molded	127.1	pcf	**Moisture Content:**	as molded	5.1	percent
	after soaking	122.6	pcf		top 1-inch after soaking	18.8	percent
Swell:	after soaking	1.6	percent		average after soaking	16.7	percent

Comments CBR value taken at 0.2 inch penetration

Bearing Ratio of Sample, CBR = 13 percent **Surcharge** 30 lb

Proj. No. 2180295 **CALIFORNIA BEARING RATIO TEST RESULTS** Figure 22

Applied Geotechnical Engineering Consultants, Inc.

Table 1 - Summary of Laboratory Test Results

Tech Ridge South Access Road

Project No. 2180295

Sample Location				Gradation			Atterberg Limits		Moisture-Density Relationship			
Test Pit No.	Depth (ft)	Natural Moisture Content (%)	Natural Dry Density (pcf)	Gravel (%)	Sand (%)	Silt/Clay (%)	Liquid Limit (%)	Plastic Index (%)	Maximum Dry Density (pcf)	Optimum Moisture Content (%)	California Bearing Ratio (%)	Soil Type
TP-1	4	7	124			63	31	19				Sandy Lean Clay (CL)
TP-1	6	7	123			62	27	14				Sandy Lean Clay (CL)
TP-1	13	15	96			84	44	29				Mudstone
TP-2	2	7				71	35	19				Mudstone
TP-2	2-3			0	15	85	45	24	115.0	12.5	6	Mudstone
TP-2	6	8	118			90	52	30				Mudstone
TP-3	2-3			0	27	73	36	24	123.5	10.0	4	Lean Clay with Sand (CL)
TP-3	6	11	117			69	47	35				Sandy Lean Clay (CL)
TP-4	2	11										Silty Gravel with Sand (GM)
TP-4	4	8	108			36						Silty Sand (SM)
TP-4	6	17	101			81						Silt with Sand (ML)
TP-5	2	9	93				39	27				Lean Clay (CL)
TP-5	4	16	94			96	48	33				Lean Clay (CL)
TP-5	6	14				92	36	22				Lean Clay (CL)
TP-6	4	7	110			83	29	18				Lean Clay with Sand (CL)

Applied Geotechnical Engineering Consultants, Inc.

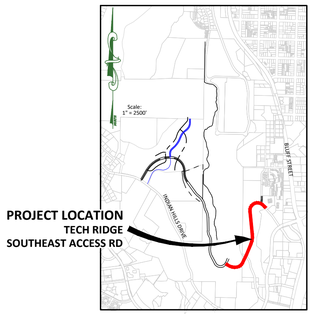
Table 1 - Summary of Laboratory Test Results

Tech Ridge South Access Road

Project No. 2180295

Sample Location				Gradation			Atterberg Limits		Moisture-Density Relationship			
Test Pit No.	Depth (ft)	Natural Moisture Content (%)	Natural Dry Density (pcf)	Gravel (%)	Sand (%)	Silt/Clay (%)	Liquid Limit (%)	Plastic Index (%)	Maximum Dry Density (pcf)	Optimum Moisture Content (%)	California Bearing Ratio (%)	Soil Type
TP-6	6	6	112			94		NP				Silt (ML)
TP-7	3½					81	37	21				Lean Clay with Sand (CL)
TP-8	2	9		3	26	71	41	25				Lean Clay with Sand (CL)
TP-8	2-3			12	22	66	37	20	116.5	12.5	5	Sandy Lean Clay (ML)
TP-8	4	5				77	30	20				Lean Clay with Sand (CL)
TP-10	2	3	88			48						Silty Sand (SM)
TP-10	2-3			2	63	35		NP	126.0	7.5	33	Silty Sand (SM)
TP-10	4	1				6						Well Graded Sand with Silt (SW-SM)
TP-10	9½	10				59	59	37				Mudstone
TP-10	14½					99	52	39				Mudstone
TP-11	0-1			68	16	16		NP	134.5	5.5	13	Silty Gravel with Sand (GM)
TP-15	4					96	77	35				Shale Bedrock
TP-16	10½	5	110			71						Mudstone

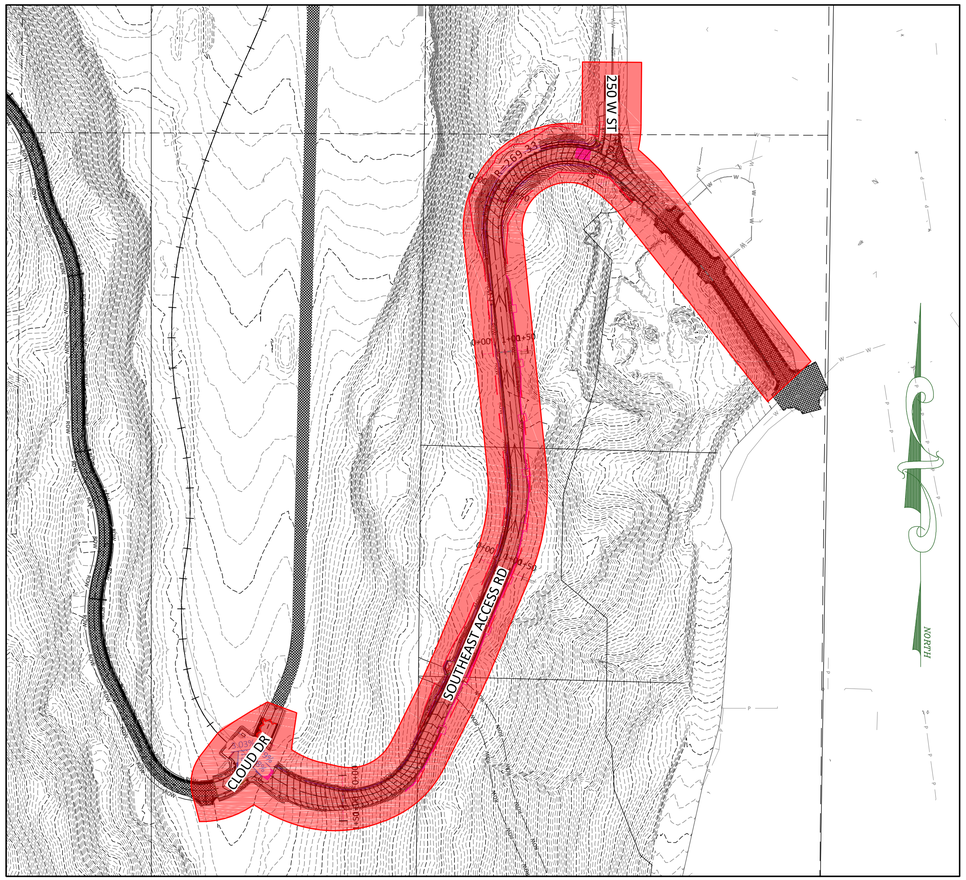
NEW INFORMATION



VICINITY MAP

SOUTHEAST ACCESS ROAD
@ TECH RIDGE
FOR
CITY OF ST. GEORGE
LOCATED IN
CITY OF ST. GEORGE, WASHINGTON COUNTY, UT

SHEET INDEX	
SHEET NO.	DESCRIPTION
C1.0	COVER SHEET
C1.1	GRADING AND STORM DRAIN OVERALL
C1.2	GRADING OVERALL CUT AND FILL
C1.3	DUST AND SWPPP/EROSIN CONTROL PLAN
C1.4 - C1.5	DEMOLITION PLAN
C2.0 - C2.5	SOUTHEAST ACCESS RD PLAN AND PROFILE
C2.6	250 W STREET ALTERATION PLAN AND PROFILE
C2.7	CLOUD DRIVE ALTERATION PLAN AND PROFILE
C2.8	STORM DRAIN CROSSINGS
C2.9 - C2.10	SOUTHEAST ACCESS RD CROSS SECTIONS
C3.0	SEWER AND WATER OVERALL
C3.1 - C3.4	SWR AND WTR PLAN AND PROFILE
C4.0	POWER AND GAS OVERALL
C4.1 - C4.4	SOUTHEAST ACCESS RD POWER AND GAS
C5.0	PAVING OVERALL
C5.1 - C5.4	ROAD SECTIONS
C5.5 - C5.7	SOUTHEAST ACCESS RD PAVING
C6.0 - C6.5	DETAILS



GRAPHIC SCALE

250 0 125 250 500

(IN FEET)
1 inch = 250 ft.
If Printed 11x17 use Half Scale

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CITY

CITY OF ST. GEORGE
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175 W 200 N
ST. GEORGE, UT 84770
EMAIL: CAMERON.CUTLER@SGCITY.ORG

ENGINEER

ALLIANCE CONSULTING
2303 N. CORAL CANYON BLVD. SUITE 201
WASHINGTON, UT 84780-0577
PHONE: (435) 673-8060
FAX: (435) 673-8065
ENGINEER: MR. DELOSS HAMMON P.E.
CONTACT: MR. CRAIG COATS
EMAIL: ccoats@allianceconsulting.us

GEOTECHNICAL REPORTS:

The contractor is responsible to read and fully understand the Geotech report and to coordinate with the geotechnical engineer throughout the grading process to ensure that the report's recommendations are implemented from the beginning to the end of the projects construction. The owner will contract with the geotechnical engineer for their representatives to be on site throughout the grading process to ensure full compliance with the geotechnical report's recommendations. Refer to following reports.

1. Applied GeoTech Geotechnical Investigation, Tech Ridge South Access Road, Project No. 2180295, Dated: Oct 19, 2018
2. Applied GeoTech Geotechnical Investigation, Updated Tech Ridge South Access Road Report, Project No. 2230249, Dated: Sept. 08, 2023

GENERAL NOTES:

1. Unless shown otherwise on these plans, all construction shall conform to the codes and ordinances of St. George City, the State of Utah Administrative Codes, "The International Plumbing Code", and the "International Building Code" latest editions as administered by St. George City.
2. The Contractor shall be responsible for the location of and protection of all existing underground utilities and overhead power line during construction.
3. The Benchmark for this Project is the South 1/4 of Section 36, Township 42 South, Range 16 West Salt Lake Base and Meridian - St. George HCN #181 - Elevation: 2667.70
3. Existing contour and finish contour interval is 2 feet.
4. Any necessary design modifications shall be approved by the design engineer.
5. All grading to be within ±0.1' of proposed elevation.
6. Project shall install an information sign on site before construction begins. This sign shall have a minimum size, placement location and content information with the company name, phone & permit number.
7. A mandatory pre-construction meeting shall be required on all projects prior to any grubbing, grading, or construction activities. The permit holder shall be required to notify all Development Services inspectors.
8. Projects shall submit a dust control plan with details on equipment scheduling and reporting of dust control activities.
9. Follow Appendix J standards found in the IBC.
10. All work materials shall meet City of St. George standards.
11. The Developer will Maintain the Temporary Detention Basin until Decommission.

CONSTRUCTION NOTES:

1. All excavations and grading shall be in accordance with the requirements of the City of St. George [phone:435-627-4000], of the "International Building Code", 2018 edition, and the specifications and requirements included in the Tech Ridge Grading Recommendations...
1. All excavation, grading, and fill operations within the building area should be observed by the Field Engineer to verify subsoil conditions and determine adequacy of site preparation, suitability of fill materials and compliance with compaction requirements.
2. The Contractor shall provide suitable equipment to control dust and air pollution caused by construction operations. The Contractor shall also provide suitable mud and dirt containment to maintain clean conditions on the work site, access roadways, and adjacent properties.
3. Project shall submit a Dust Control Plan with details on equipment, scheduling and reporting of dust control activities.
4. Contractor is responsible and required to obtain their own UPDES/NOI permits.
5. It is the contractors responsibility to identify all and any SWPPP requirements.
6. Prior to and during compaction operations, all backfill material shall have the required moisture content uniform throughout each layer.
7. All Rip-Rap rock shall be approved by owner.
8. Contractor must coordinate with other Contractors working in areas.
9. Contractor must protect existing facilities.
10. All rock walls are to match in color and composition with the native basalt lava rock. Rock to be stained black.
11. HDPE pipe to be stubbed a minimum of 6" inside Manholes and Grouted.
12. Clay material on-site to be mitigated per Geotechnical Reports.

Date: 10-19-2023

REVISIONS

No.	Date	by	Description

File Name
East Access OPT 2.dwg

ALLIANCE CONSULTING
A PLANNING AND ENGINEERING FIRM

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SUITE 201,
WASHINGTON, UT 84780
435-673-8060

NORTH DAKOTA
621 26th STREET W.
WILLISTON, ND 58801
701-572-8100

SOUTHEAST ACCESS ROAD
AT TECH RIDGE
COVER
FOR
CITY OF ST. GEORGE
LOCATED IN SEC 36
T 42 SOUTH, R 15 WEST SLB&M
CITY OF ST. GEORGE, WASHINGTON COUNTY, UT

NOT FOR CONSTRUCTION
REVIEW ONLY

Drawn By:	Scale:
AZ	1" = 250'
Client No. 4568-21	Project No. 4568-21

Drawing Sheet
C1.0

Sheet 1 of 41 Sheets

LEGEND

- EXISTING ASPHALT
- PROPOSED ASPHALT
- EXISTING CONCRETE
- PROPOSED CONCRETE
- STORM DRAIN PIPE
- STORM DRAIN INLET BOX
- 30" CURB & GUTTER
- SLOPE EASEMENT
- EXISTING CONTOUR
- DESIGN CONTOUR
- PROPOSED WALLS
- STORM DRAIN FLOW DIRECTION

SOUTHEAST ACCESS ROAD GRADING		
Southeast Access Road Finished Grade	292,350	Sq.Ft.
	6.71	Acres
Existing Grade to Finish Grade	46,011	CY. Cut (-)
	6,547	CY. Fill (+)
Hardscape Areas		
Roadways (4" Asphalt/12" Base)	138,775	Sq.Ft.
	6,836	Cu.yd.
Sidewalk (4" Concrete/4" Base)	20,455	Sq.Ft.
	505	Cu.yd.
Total	**7,341**	Cu.yd.
Existing Grade to Subgrade		
Existing Grade to Subgrade	**53,352**	CY. Cut (-)
	6,547	CY. Fill (+)
Shrinkage 15%	**982**	CY Shrinkage (+)
TOTAL	**45,823**	**CY. Material Export**

Cut and Fill volumes shown are based on Digital Terrain Modeling computations. Shrinkage volumes shown are estimated. These volumes are approximate based on the information provided.

CLOUD DR

SOUTHEAST ACCESS RD

250 WEST STREET

2'-4' ROCK WALL (2,000 SQ FT)

6' ROCK WALL (550 SQ FT)

6' ROCK WALL (2,555 SQ FT)

3.2' MAX ROCK WALL (760 SQ FT)

5.2' MAX ROCK WALL (1,900 SQ FT)

2' - 6' ROCK WALL

2' - 8' UPPER ROCK WALL (3,300 SQ FT)

2' - 8' LOWER ROCK WALL (6,550 SQ FT)

2' - 8' LOWER ROCK WALL (7,000 SQ FT)

2' - 8' UPPER ROCK WALL (3,000 SQ FT)

4' - 8' ROCK WALL

6'-8' ROCK WALL

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CITY OF ST. GEORGE

NORTH

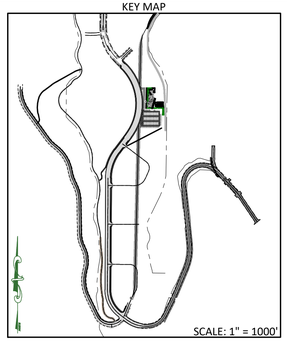
Date: 10-19-2023

REVISIONS

No.	Date	by	Description

File Name: East Access OPT 2.dwg

KEY MAP



SCALE: 1" = 1000'

GRAPHIC SCALE

100 0 50 100 200

(IN FEET)

1 inch = 100 ft.

If Printed 11x17 use Half Scale

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701-572-8100

SOUTHEAST ACCESS ROAD AT TECH RIDGE GRADING AND SD OVERALL

FOR

CITY OF ST. GEORGE

LOCATED IN SEC 36

T 42 SOUTH, R 15 WEST SLB&M

CITY OF ST. GEORGE, WASHINGTON COUNTY, UT

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Drawn By: AZ	Scale: 1"=100'
Client No. 4568-21	Project No. 4568-21

Drawing Sheet

C1.1

Sheet 2 of 41 Sheets

LEGEND

- EXISTING ASPHALT
- PROPOSED ASPHALT
- EXISTING CONCRETE
- PROPOSED CONCRETE
- STORM DRAIN PIPE
- STORM DRAIN INLET BOX
- 30" CURB & GUTTER
- SLOPE EASEMENT
- EXISTING CONTOUR
- DESIGN CONTOUR
- PROPOSED WALLS

ELEVATIONS TABLE

Number	Minimum Elevation	Maximum Elevation	Area	Color
1	-37.200	-10.000	46630.00	
2	-10.000	-8.000	6526.71	
3	-8.000	-6.000	11732.62	
4	-6.000	-4.000	46604.60	
5	-4.000	-2.000	37328.96	
6	-2.000	-1.000	24629.53	
7	-1.000	0.000	28576.84	
8	0.000	1.000	23380.94	
9	1.000	2.000	21466.97	
10	2.000	4.000	25701.79	
11	4.000	6.000	10488.10	
12	6.000	8.000	405.82	

SOUTHEAST ACCESS ROAD GRADING		
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CITY OF ST. GEORGE

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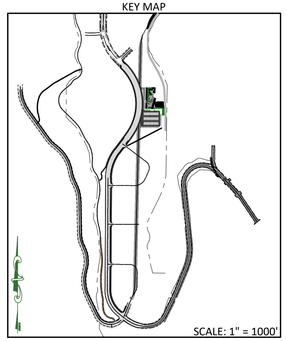
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REVISIONS

No.	Date	by	Description

File Name: East Access OPT 2.dwg

KEY MAP



SCALE: 1" = 1000'

GRAPHIC SCALE

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(IN FEET)
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SOUTHEAST ACCESS ROAD AT TECH RIDGE GRADING CUT/FILL

FOR

CITY OF ST. GEORGE

LOCATED IN SEC 36
T 42 SOUTH, R 15 WEST SLB&M
CITY OF ST. GEORGE, WASHINGTON COUNTY, UT

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AZ	1"=100'
Client No. 4568-21	Project No. 4568-21

Drawing Sheet

C1.2

Sheet 3 of 41 Sheets

LEGEND

- SILT FENCE (LEN: 1800 FT)
- SLOPE EASEMENT
- TRACKING PAD

DISTURBED AREA - 281,804 SQ FT
6.47 Acres

DUST CONTROL NOTES

THESE DUST CONTROL MEASURES MUST BE OBSERVED AT ALL TIMES:

1. Apply water by means of trucks, hoses and/or sprinklers at sufficient frequency and quantity, prior to conducting, during and after earthmoving activities.
2. Pre-apply water to the depth of the proposed cuts, or equipment penetration.
3. Apply water as necessary and prior to expected wind events.
4. Operate haul vehicles appropriately in order to minimize fugitive dust and apply water as necessary during loading operations.

DISTURBED SURFACE AREAS OR INACTIVE CONSTRUCTION SITES:

1. When active construction operations have ceased, apply water at sufficient frequency and quantity to develop a surface crust and prior to expected wind events
2. Install fence barrier and /or "no trespassing" signs to prevent access to disturbed suffice areas.

CLOUD DR

SOUTHEAST ACCESS RD

SOUTHEAST ACCESS RD

W 250 ST

TRACKING PAD
SEE DETAIL A/C6.0

TRACKING PAD
SEE DETAIL A/C6.0

SILT FENCE
SEE DETAIL C/C6.0

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CITY OF ST. GEORGE

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NORTH

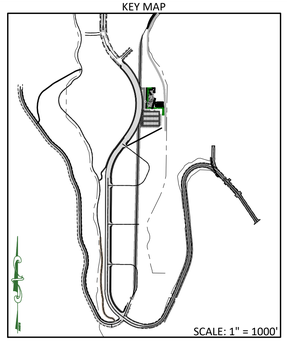
Date: 10-19-2023

REVISIONS

No.	Date	by	Description

File Name
East Access OPT 2.dwg

KEY MAP



SCALE: 1" = 1000'

GRAPHIC SCALE

100 0 50 100 200

(IN FEET)
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DUST AND SWPPP/ EROSION CONTROL PLAN

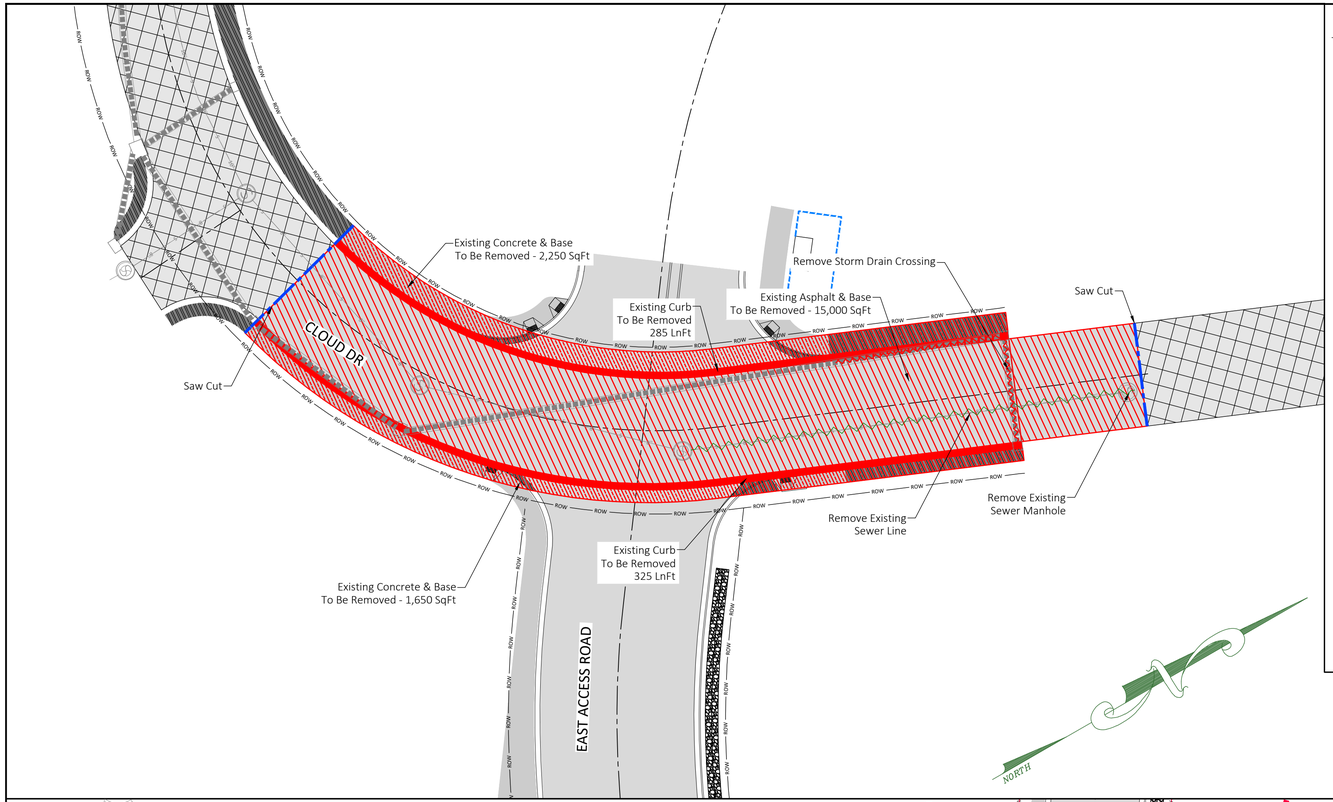
FOR
CITY OF ST. GEORGE
LOCATED IN SEC 36
T 42 SOUTH, R 15 WEST SLB&M
CITY OF ST. GEORGE, WASHINGTON COUNTY, UT

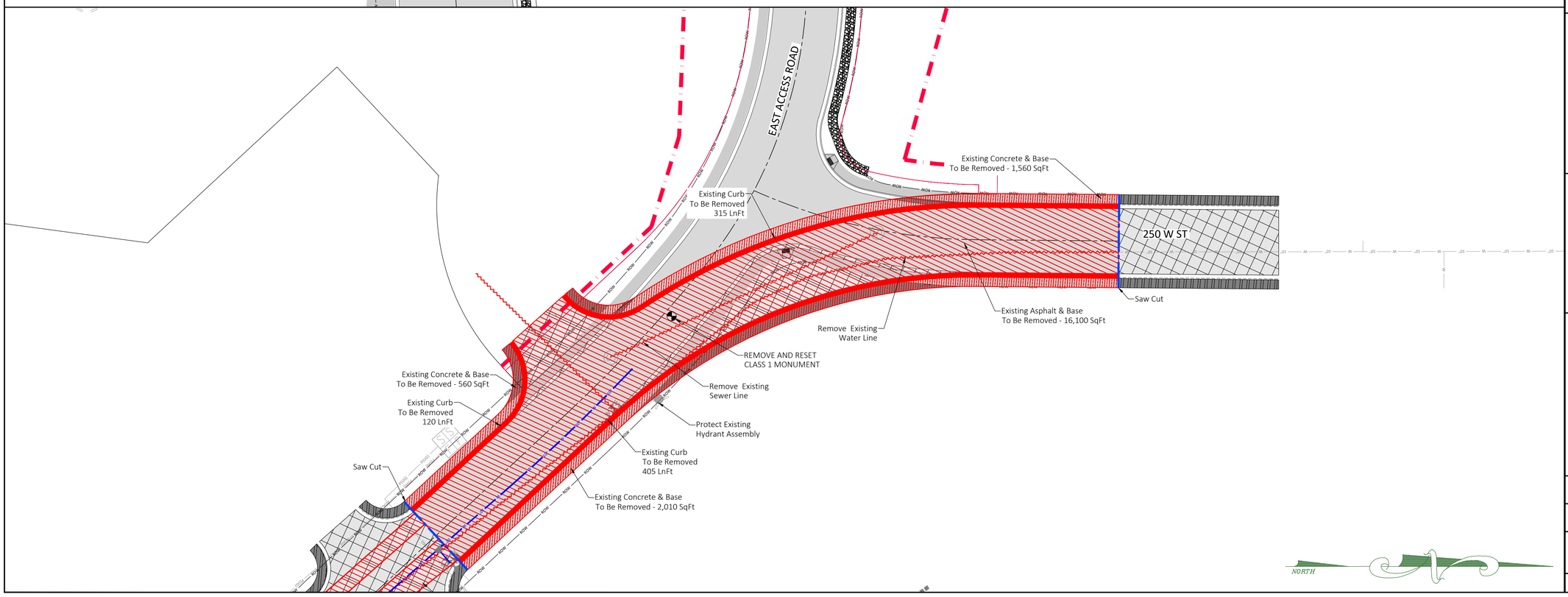
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Drawn By:	Scale:
AZ	1"=100'
Client No. 4568-21	Project No. 4568-21

Drawing Sheet
C1.3

Sheet 4 of 41 Sheets





LEGEND

- EXISTING STORM SEWER
- EXISTING SEWER LINE
- EXISTING WATER LINE
- EXISTING UNDERGROUND POWER
- EXISTING GAS LINE

EXISTING

- FIRE HYDRANTS
- WATER VALVES
- SANITARY SEWER MANHOLES
- EXISTING ELECTRICAL BOX
- EXISTING HARDSCAPE
- EXISTING CONCRETE
- REMOVE EXISTING ASPHALT 33,740 SQ FT TOTAL
- REMOVE EXISTING CONCRETE 8,595 SQ FT TOTAL
- EXISTING CURB AND GUTTER
- REMOVE EXISTING CURB AND GUTTER 1,565 LN FT TOTAL
- SAW CUT - 220 LN FT TOTAL
- SLOPE EASEMENT
- REMOVE SEWER LINE 336 LN FT TOTAL
- REMOVE WATER LINE 558 LN FT TOTAL

DEMOLITION NOTES:

1. Demolition shall include removal of all Foundations, Footings, Cables, Wires, Pipes, Roots, Etc. Associated with all surface or subsurface items subject to demolition. All items subject to demolition shall be hauled to a landfill approved by the Engineer. Bidders shall satisfy themselves of all work involved in the removal of all items subject to demolition. Submission of a bid shall constitute incontrovertible evidence that bidder understands and has included in his bid all items affecting cost, progress or performance of the work.
2. Edges of Asphalt or Concrete subject to removal shall be saw cut vertically through the entire depth of the pavement structure.
3. Removal and replacement of existing concrete curb and sidewalk at curb stops shall be limited to two segments defined by existing control joints. The contractor is responsible to protect adjacent concrete curb and sidewalk during construction. Any adjacent curb or sidewalk segments damaged during construction will be replaced at the sole expense of the Contractor, with no adjustment in price.

DUST CONTROL NOTES

THESE DUST CONTROL MEASURES MUST BE OBSERVED AT ALL TIMES:

1. Apply water by means of trucks, hoses and/or sprinklers at sufficient frequency and quantity, prior to conducting, during and after earthmoving activities.
2. Pre-apply water to the depth of the proposed cuts, or equipment penetration.
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4. Operate haul vehicles appropriately in order to minimize fugitive dust and apply water as necessary during loading operations.

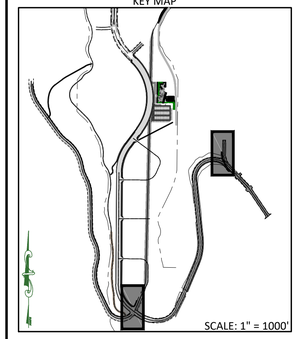
Date: 10-19-2023

REVISIONS

No.	Date	by	Description

File Name
East Access Demo OPT 2.dwg

KEY MAP



GRAPHIC SCALE

30 0 15 30 60

(IN FEET)
1 inch = 30 ft.
If Printed 11x17 use Half Scale

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A PLANNING AND ENGINEERING FIRM

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435-673-8060

NORTH DAKOTA
621 26th STREET W.
WILLISTON, ND 58801
701-572-8100

CLOUD DRIVE AND 250 WEST STREET DEMOLITION

FOR

CITY OF ST. GEORGE

LOCATED IN SEC 36
T 42 SOUTH, R 15 WEST SLB&M
CITY OF ST. GEORGE, WASHINGTON COUNTY, UT

NOT FOR CONSTRUCTION REVIEW ONLY

Drawn By: AZ	Scale: 1"=30'
Client No. 4568-21	Project No. 4568-21

Drawing Sheet
C1.4

Sheet 5 of 41 Sheets

LEGEND

- EXISTING STORM SEWER
- EXISTING SEWER LINE
- EXISTING WATER LINE
- EXISTING UNDERGROUND POWER
- EXISTING GAS LINE

EXISTING

- FIRE HYDRANTS
- WATER VALVES
- SANITARY SEWER MANHOLES
- EXISTING ELECTRICAL BOX
- EXISTING HARDSCAPE
- EXISTING CONCRETE
- REMOVE EXISTING ASPHALT 33,740 SQ FT TOTAL
- REMOVE EXISTING CONCRETE 8,595 SQ FT TOTAL
- EXISTING CURB AND GUTTER
- REMOVE EXISTING CURB AND GUTTER 1,565 LN FT TOTAL
- SAW CUT - 220 LN FT TOTAL
- SLOPE EASEMENT
- ABANDONED SEWER LINE 336 LN FT TOTAL
- ABANDONED WATER LINE 558 LN FT TOTAL

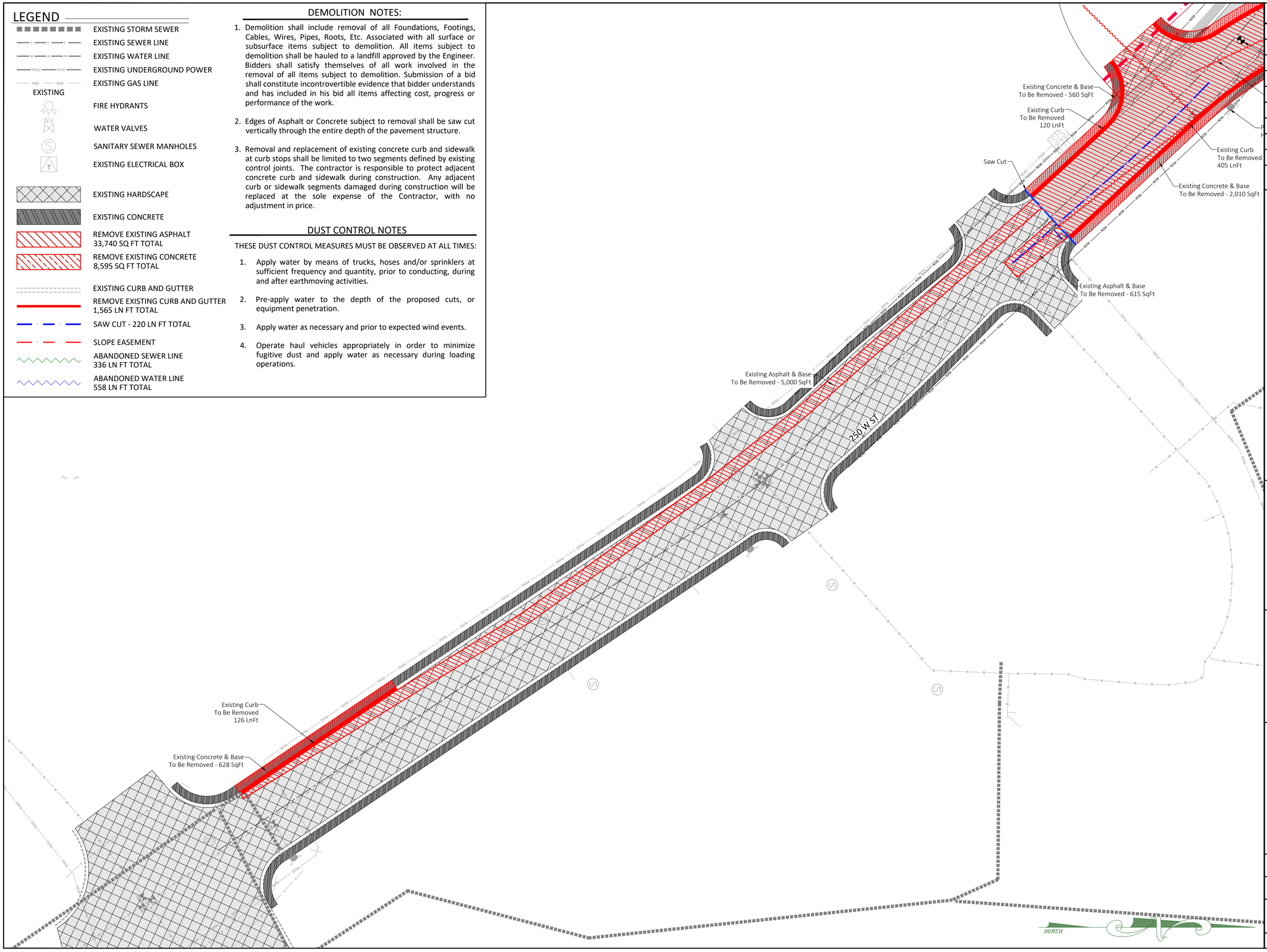
DEMOLITION NOTES:

1. Demolition shall include removal of all Foundations, Footings, Cables, Wires, Pipes, Roots, Etc. Associated with all surface or subsurface items subject to demolition. All items subject to demolition shall be hauled to a landfill approved by the Engineer. Bidders shall satisfy themselves of all work involved in the removal of all items subject to demolition. Submission of a bid shall constitute incontrovertible evidence that bidder understands and has included in his bid all items affecting cost, progress or performance of the work.
2. Edges of Asphalt or Concrete subject to removal shall be saw cut vertically through the entire depth of the pavement structure.
3. Removal and replacement of existing concrete curb and sidewalk at curb stops shall be limited to two segments defined by existing control joints. The contractor is responsible to protect adjacent concrete curb and sidewalk during construction. Any adjacent curb or sidewalk segments damaged during construction will be replaced at the sole expense of the Contractor, with no adjustment in price.

DUST CONTROL NOTES

THESE DUST CONTROL MEASURES MUST BE OBSERVED AT ALL TIMES:

1. Apply water by means of trucks, hoses and/or sprinklers at sufficient frequency and quantity, prior to conducting, during and after earthmoving activities.
2. Pre-apply water to the depth of the proposed cuts, or equipment penetration.
3. Apply water as necessary and prior to expected wind events.
4. Operate haul vehicles appropriately in order to minimize fugitive dust and apply water as necessary during loading operations.



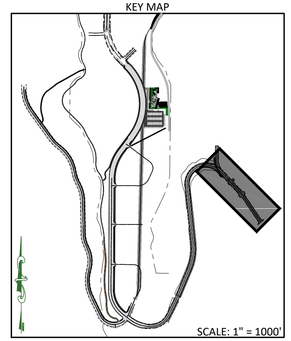
Date: 10-19-2023

REVISIONS

No.	Date	by	Description

File Name
East Access Demo OPT 2.dwg

KEY MAP



GRAPHIC SCALE

30 0 15 30 60

(IN FEET)
1 inch = 30 ft.
If Printed 11x17 use Half Scale

ALLIANCE CONSULTING
A PLANNING AND ENGINEERING FIRM

UTAH
2303 N CORAL CANYON BLVD
SUITE 201,
WASHINGTON, UT 84780
435-673-8060

NORTH DAKOTA
621 26th STREET W.
WILLISTON, ND 58801
701-572-8100

EAST ACCESS DEMOLITION

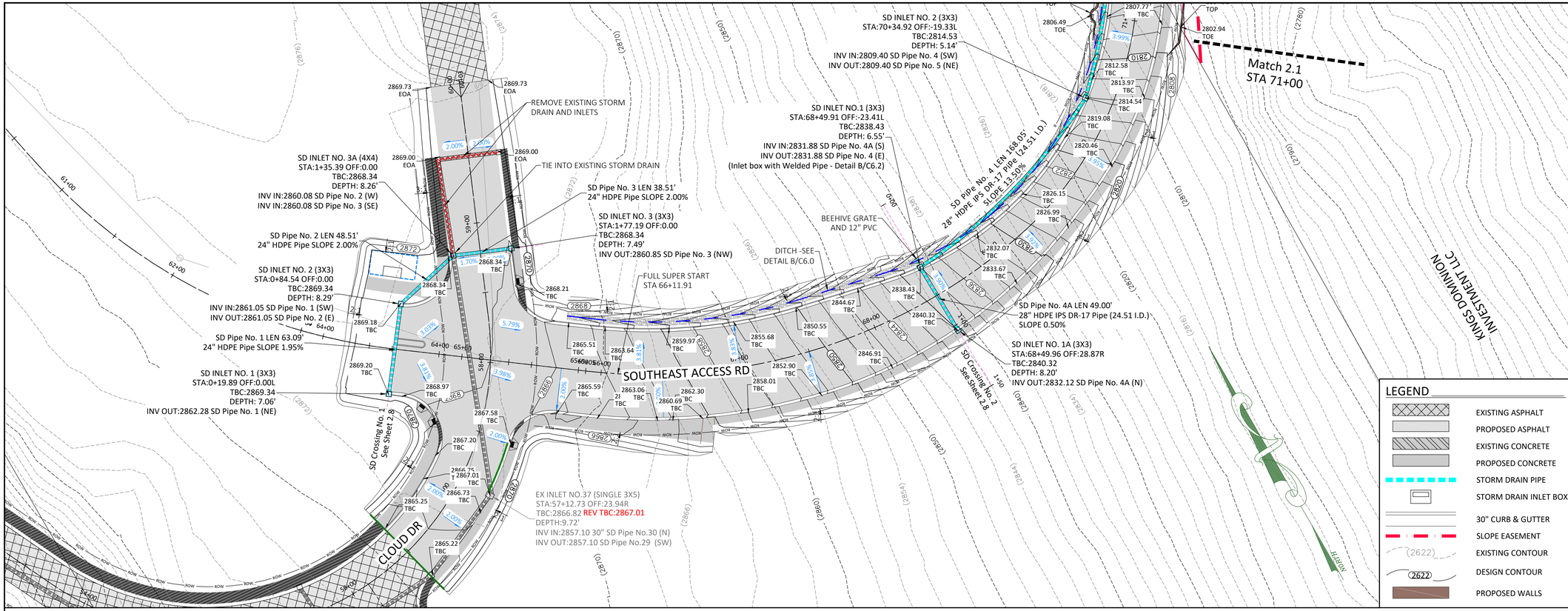
FOR
CITY OF ST. GEORGE
LOCATED IN SEC 36
T 42 SOUTH, R 15 WEST SLB&M
CITY OF ST. GEORGE, WASHINGTON COUNTY, UT

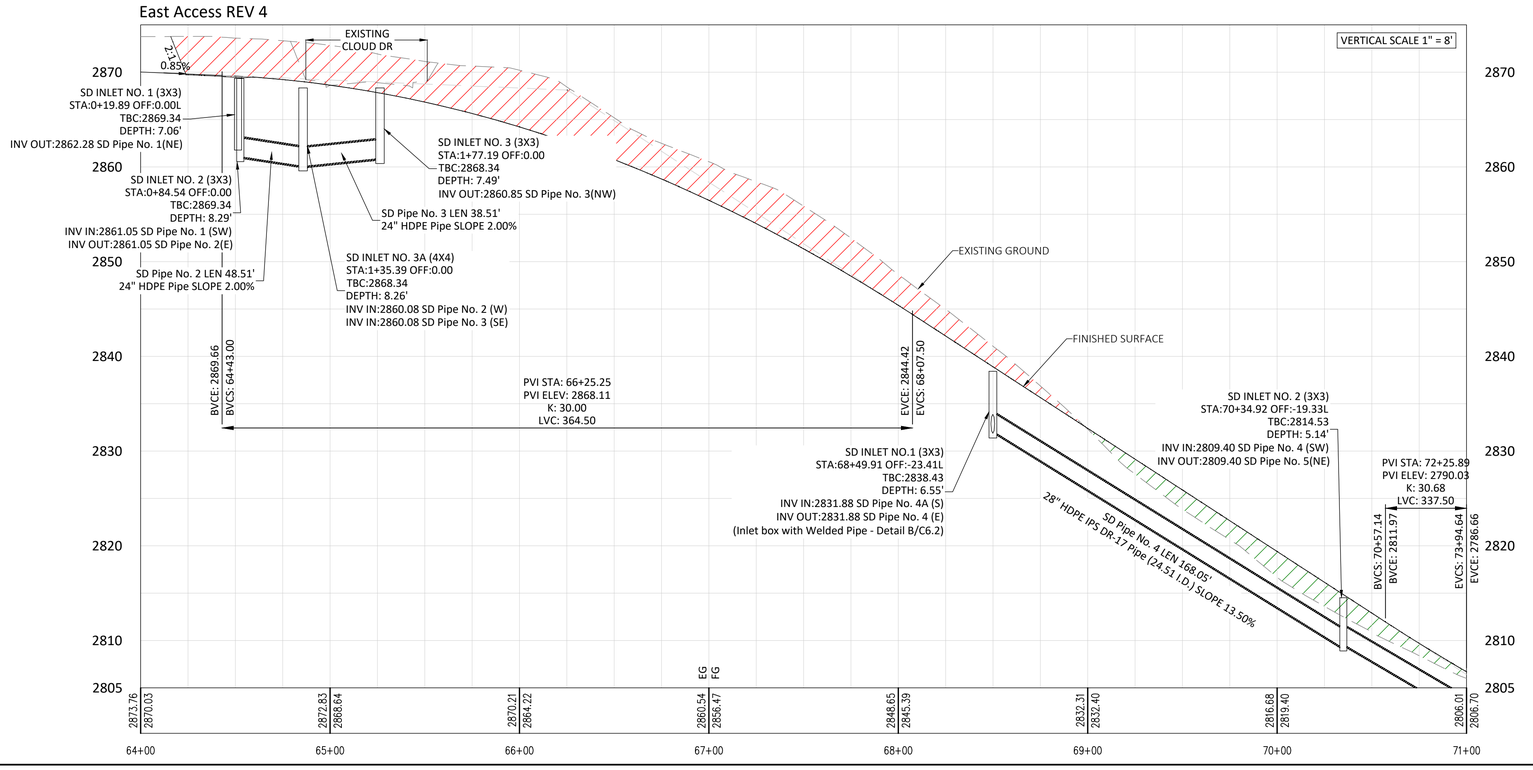
NOT FOR CONSTRUCTION
REVIEW ONLY

Drawn By: AZ	Scale: 1"=30'
Client No. 4568-21	Project No. 4568-21

Drawing Sheet
C1.5

Sheet 6 of 41 Sheets





LEGEND

- EXISTING ASPHALT
- PROPOSED ASPHALT
- EXISTING CONCRETE
- PROPOSED CONCRETE
- STORM DRAIN PIPE
- STORM DRAIN INLET BOX
- 30" CURB & GUTTER
- SLOPE EASEMENT
- (2622) EXISTING CONTOUR
- 2622 DESIGN CONTOUR
- PROPOSED WALLS

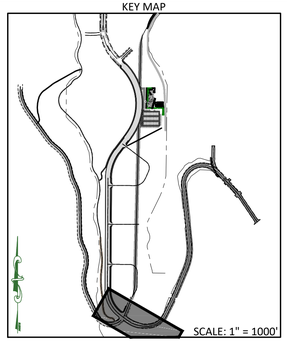
Date: 10-19-2023

REVISIONS

No.	Date	by	Description

File Name: East Access OPT 2.dwg

KEY MAP



GRAPHIC SCALE

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(IN FEET)
1 inch = 40 ft.
If Printed 11x17 use Half Scale

ALLIANCE CONSULTING
A PLANNING AND ENGINEERING FIRM

UTAH
2303 N CORAL CANYON BLVD
SUITE 201,
WASHINGTON, UT 84780
435-673-8060

NORTH DAKOTA
621 26th STREET W.
WILLISTON, ND 58801
701-572-8100

SOUTHEAST ACCESS ROAD GRADING AND STORM DRAIN PLAN AND PROFILE

FOR

CITY OF ST. GEORGE

LOCATED IN SEC 36
T 42 SOUTH, R 15 WEST SLB&M
CITY OF ST. GEORGE, WASHINGTON COUNTY, UT

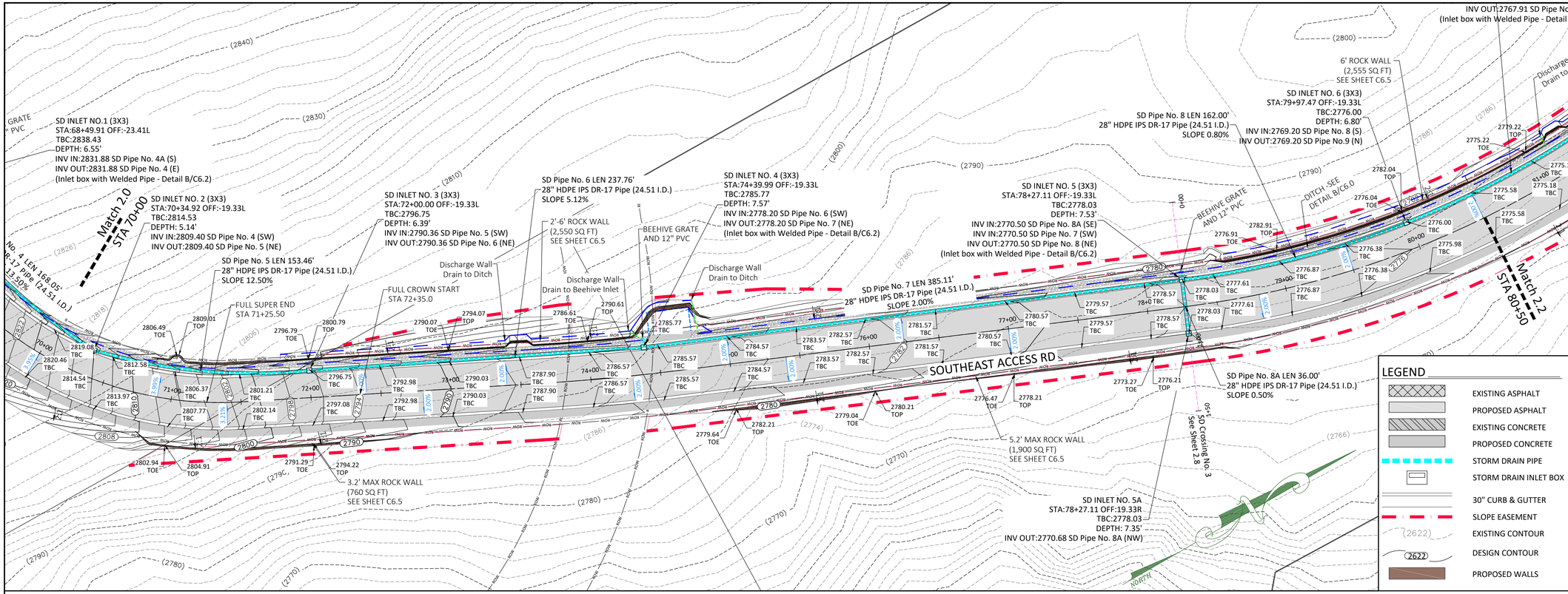
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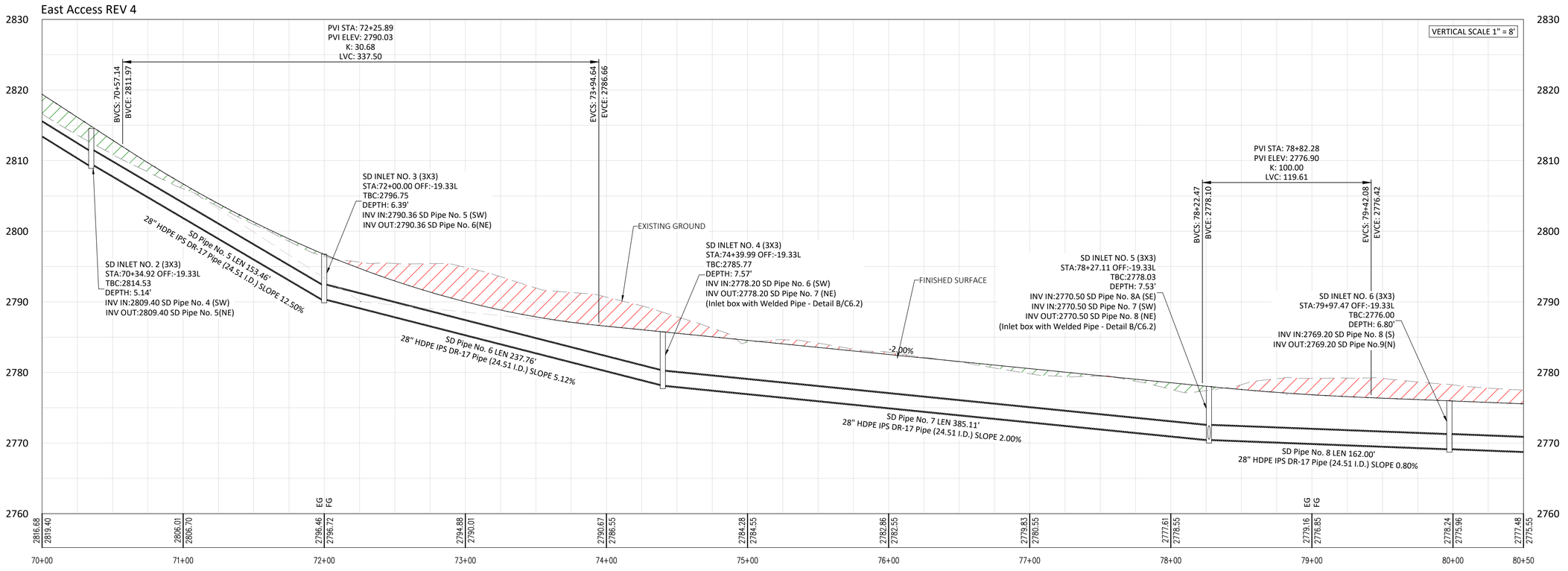
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Client No. 4568-21	Project No. 4568-21

Drawing Sheet

C2.0

Sheet 7 of 41 Sheets





Date: 10-19-2023

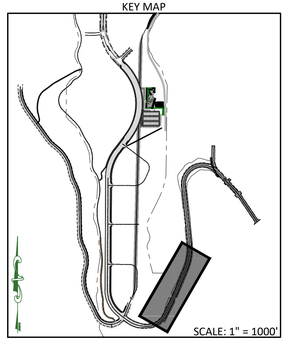
REVISIONS

No.	Date	by	Description

File Name

East Access OPT 2.dwg

KEY MAP



GRAPHIC SCALE

40 0 20 40 80

(IN FEET)
1 inch = 40 ft.
If Printed 11x17 use Half Scale

ALLIANCE CONSULTING
A PLANNING AND ENGINEERING FIRM

UTAH
2303 N CORAL CANYON BLVD
SUITE 201,
WASHINGTON, UT 84780
435-673-8060

NORTH DAKOTA
621 26th STREET W.
WILLISTON, ND 58801
701-572-8100

SOUTHEAST ACCESS ROAD GRADING AND STORM DRAIN PLAN AND PROFILE

FOR

CITY OF ST. GEORGE

LOCATED IN SEC 36
T 42 SOUTH, R 15 WEST SLB&M
CITY OF ST. GEORGE, WASHINGTON COUNTY, UT

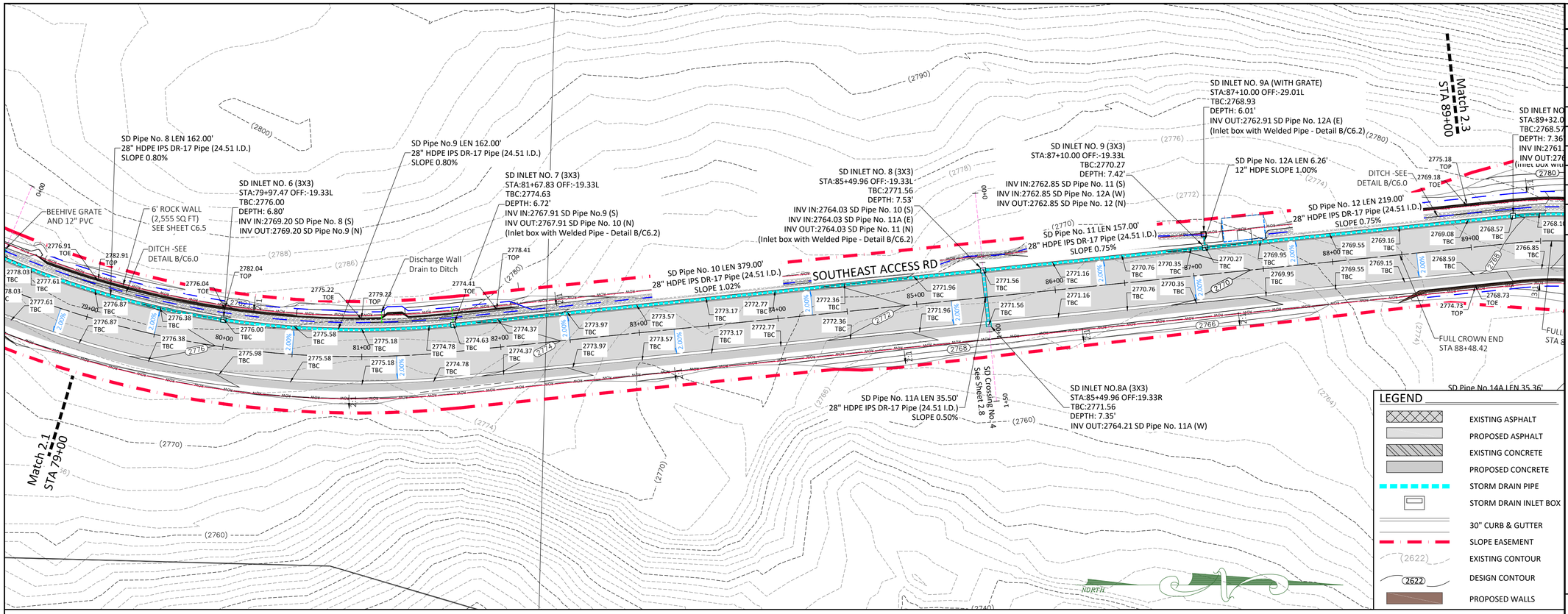
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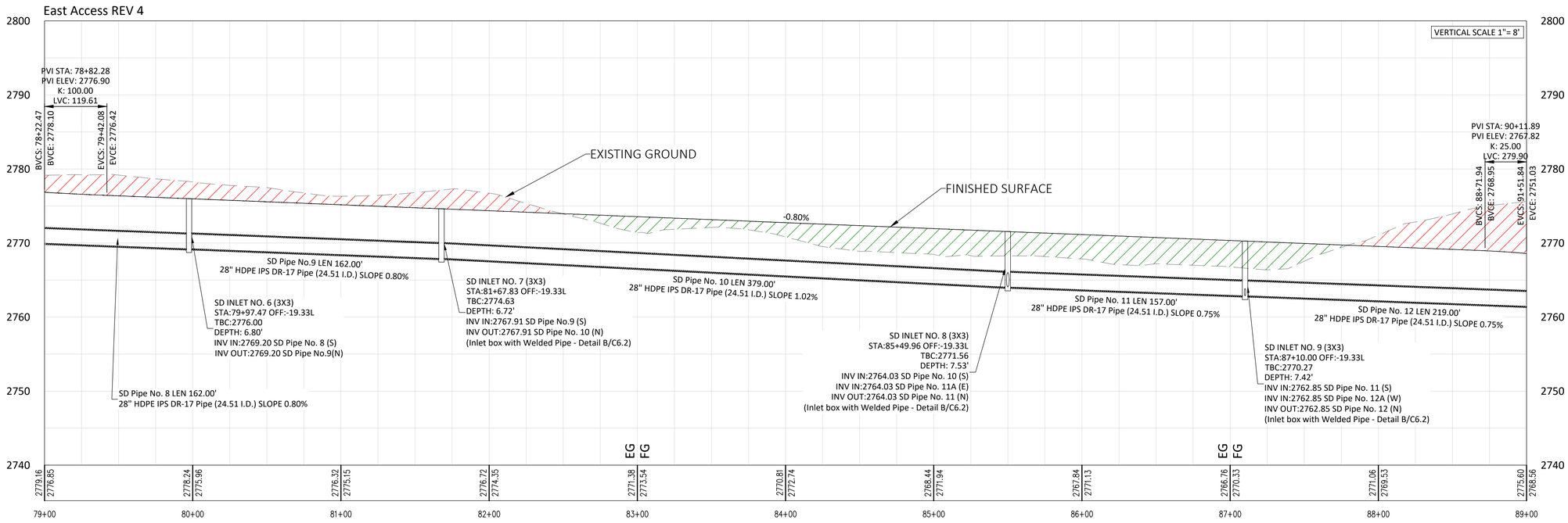
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Client No. 4568-21	Project No. 4568-21

Drawing Sheet

C2.1

Sheet 8 of 41 Sheets





Date:
10-19-2023

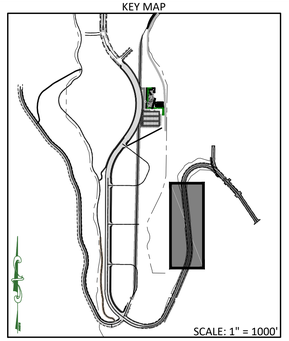
REVISIONS

No.	Date	by	Description

File Name

East Access OPT 2.dwg

KEY MAP



SCALE: 1" = 1000'

GRAPHIC SCALE

40 0 20 40 80

(IN FEET)

1 inch = 40 ft.

If Printed 11x17 use Half Scale

LEGEND

- EXISTING ASPHALT
- PROPOSED ASPHALT
- EXISTING CONCRETE
- PROPOSED CONCRETE
- STORM DRAIN PIPE
- STORM DRAIN INLET BOX
- 30" CURB & GUTTER
- SLOPE EASEMENT
- EXISTING CONTOUR (2622)
- DESIGN CONTOUR 2622
- PROPOSED WALLS

ALLIANCE CONSULTING
A PLANNING AND ENGINEERING FIRM

UTAH
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SUITE 201,
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701-572-8100

SOUTHEAST ACCESS ROAD GRADING AND STORM DRAIN PLAN AND PROFILE

FOR

CITY OF ST. GEORGE

LOCATED IN SEC 36

T 42 SOUTH, R 15 WEST SLB&M

CITY OF ST. GEORGE, WASHINGTON COUNTY, UT

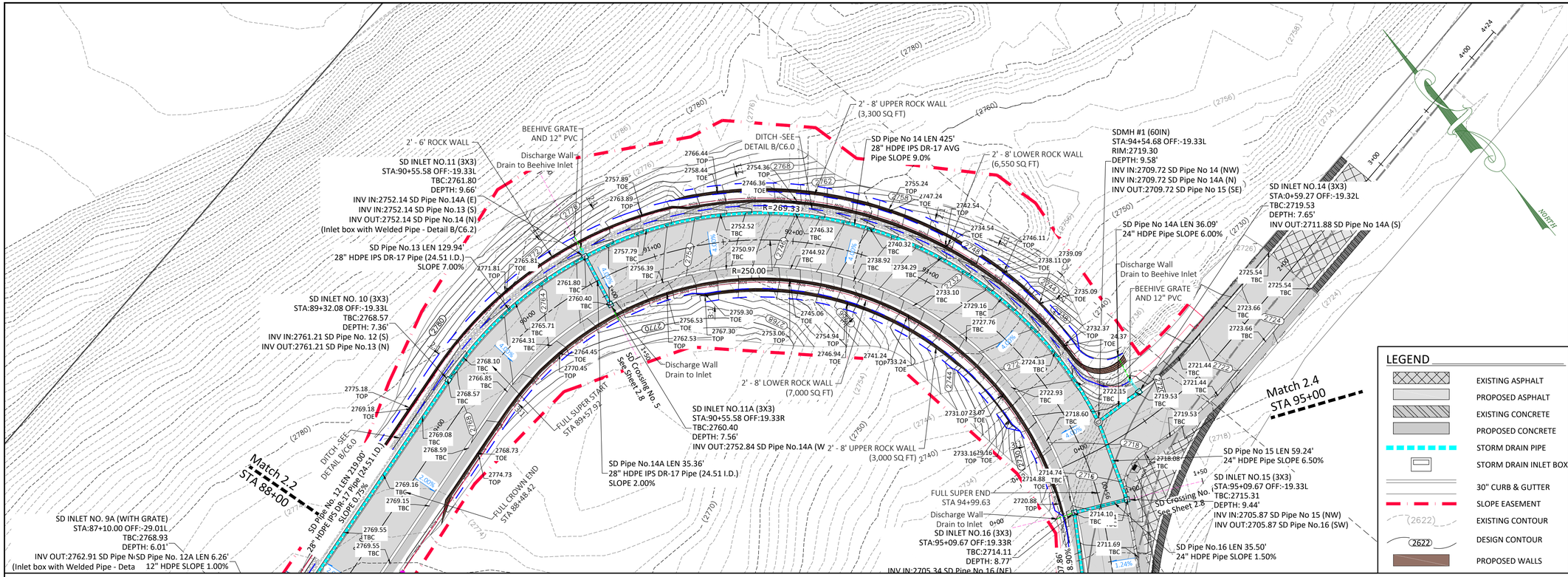
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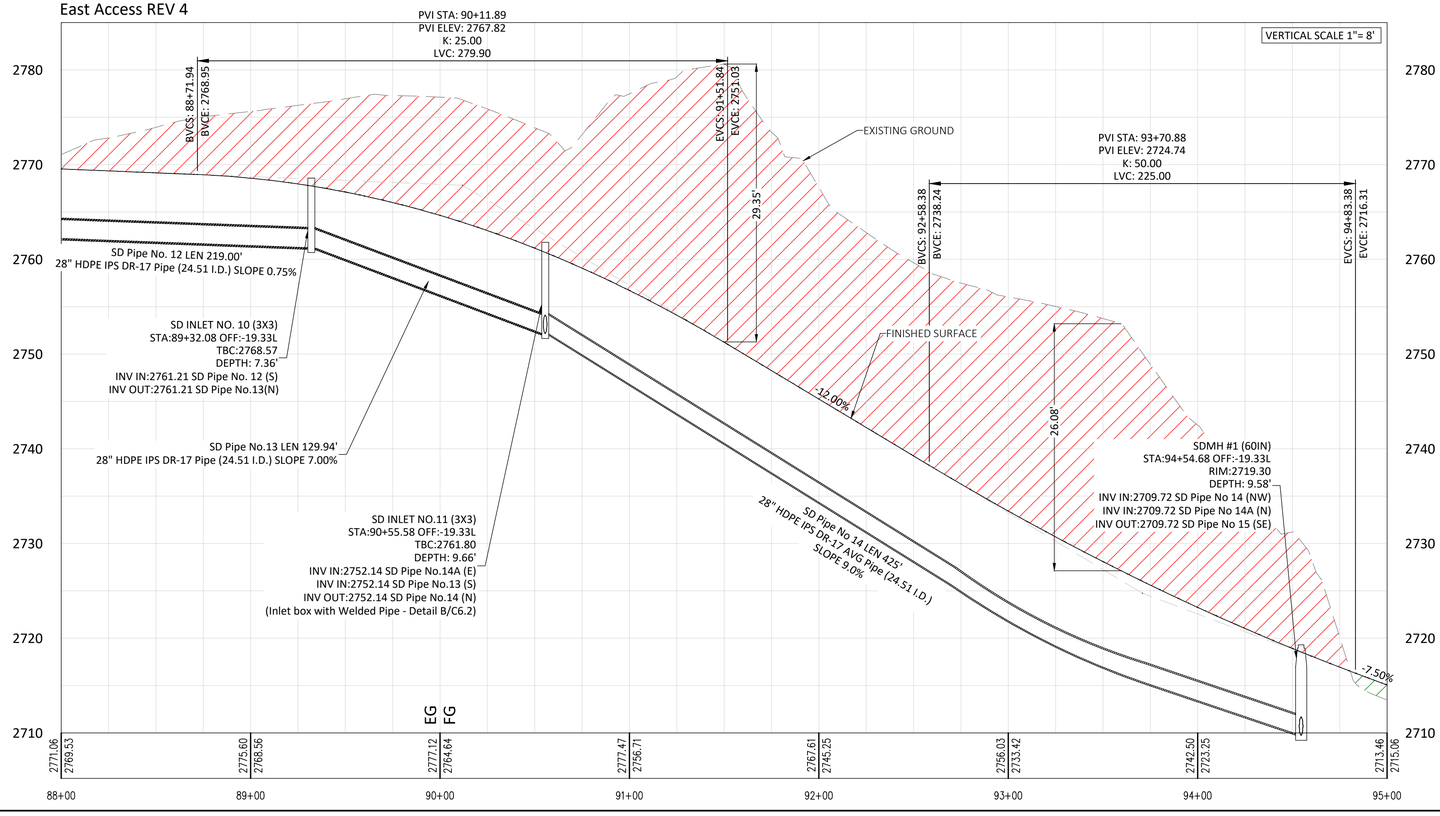
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Client No. 4568-21	Project No. 4568-21

Drawing Sheet

C2.2

Sheet 9 of 41 Sheets





Date: 10-19-2023

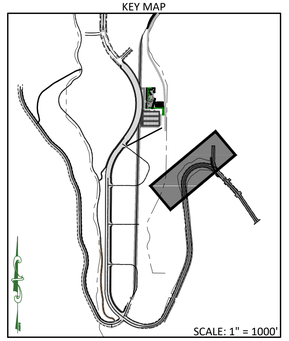
REVISIONS

No.	Date	by	Description

File Name

East Access OPT 2.dwg

KEY MAP



GRAPHIC SCALE

40 0 20 40 80

(IN FEET)
1 inch = 40 ft.
If Printed 11x17 use Half Scale

ALLIANCE CONSULTING
A PLANNING AND ENGINEERING FIRM

UTAH
2303 N CORAL CANYON BLVD
SUITE 201,
WASHINGTON, UT 84780
435-673-8060

NORTH DAKOTA
621 26th STREET W.
WILLISTON, ND 58801
701-572-8100

SOUTHEAST ACCESS ROAD GRADING AND STORM DRAIN PLAN AND PROFILE

FOR

CITY OF ST. GEORGE

LOCATED IN SEC 36

T 42 SOUTH, R 15 WEST SLB&M

CITY OF ST. GEORGE, WASHINGTON COUNTY, UT

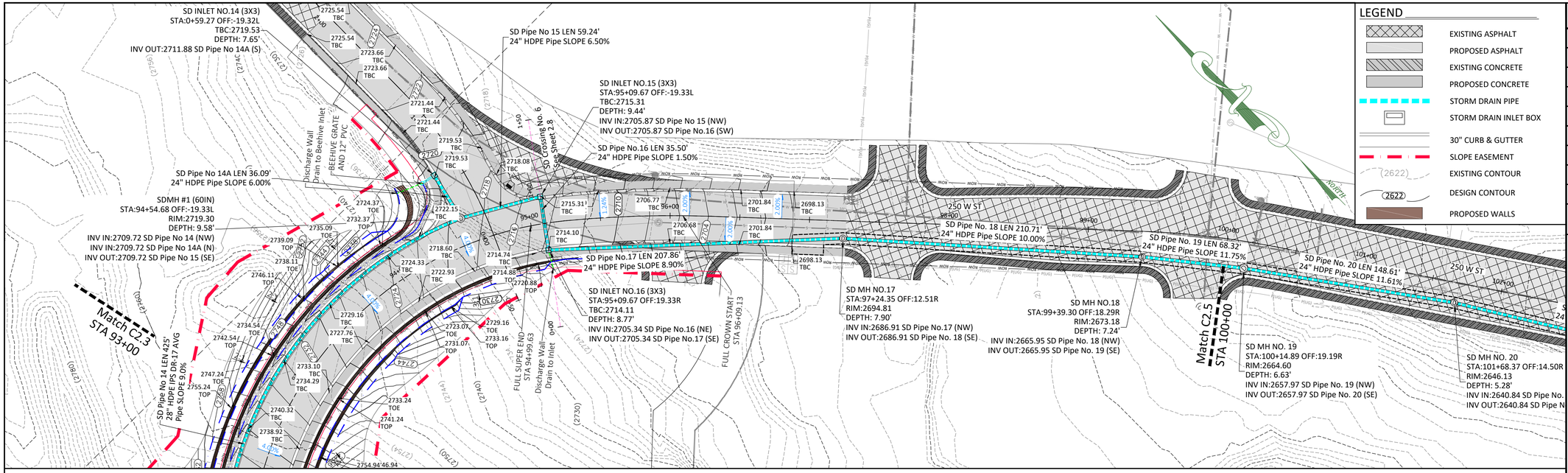
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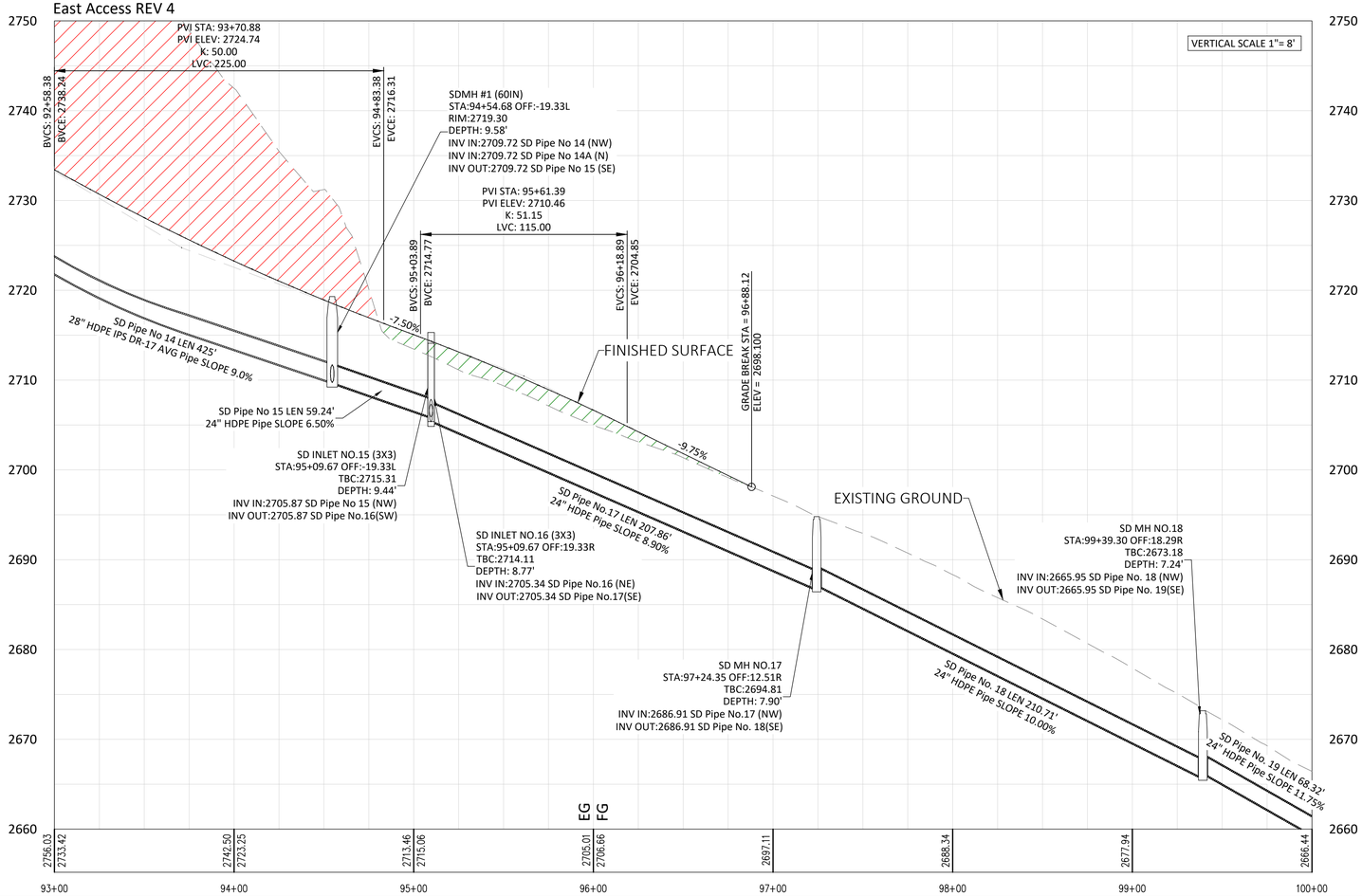
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Client No.	Project No.
4568-21	4568-21

Drawing Sheet

C2.3

Sheet 10 of 41 Sheets





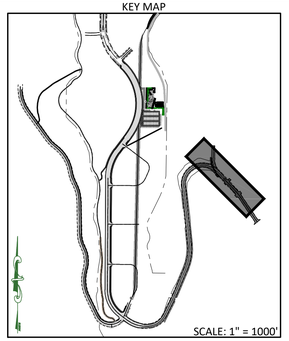
Date: 10-19-2023

REVISIONS

No.	Date	by	Description

File Name
East Access OPT 2.dwg

KEY MAP



GRAPHIC SCALE

40 0 20 40 80

(IN FEET)
1 inch = 40 ft.
If Printed 11x17 use Half Scale

ALLIANCE CONSULTING
A PLANNING AND ENGINEERING FIRM

UTAH
2303 N CORAL CANYON BLVD
SUITE 201,
WASHINGTON, UT 84780
435-673-8060

NORTH DAKOTA
621 26th STREET W.
WILLISTON, ND 58801
701-572-8100

SOUTHEAST ACCESS ROAD GRADING AND STORM DRAIN PLAN AND PROFILE

FOR
CITY OF ST. GEORGE
LOCATED IN SEC 36
T 42 SOUTH, R 15 WEST SLB&M
CITY OF ST. GEORGE, WASHINGTON COUNTY, UT

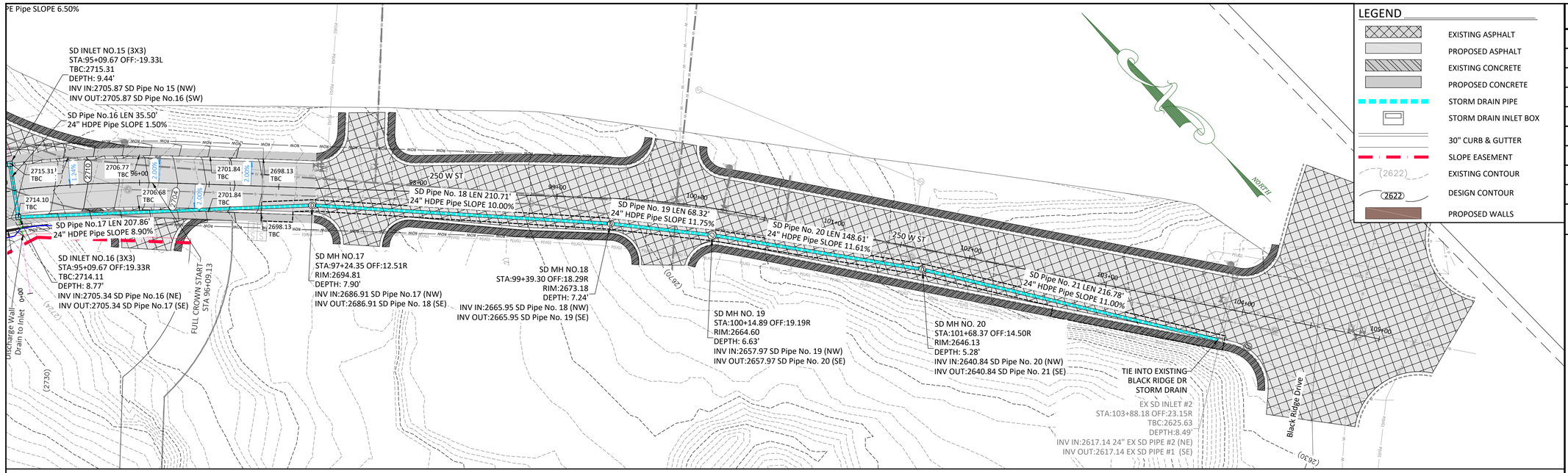
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Client No. 4568-21	Project No. 4568-21

Drawing Sheet
C2.4

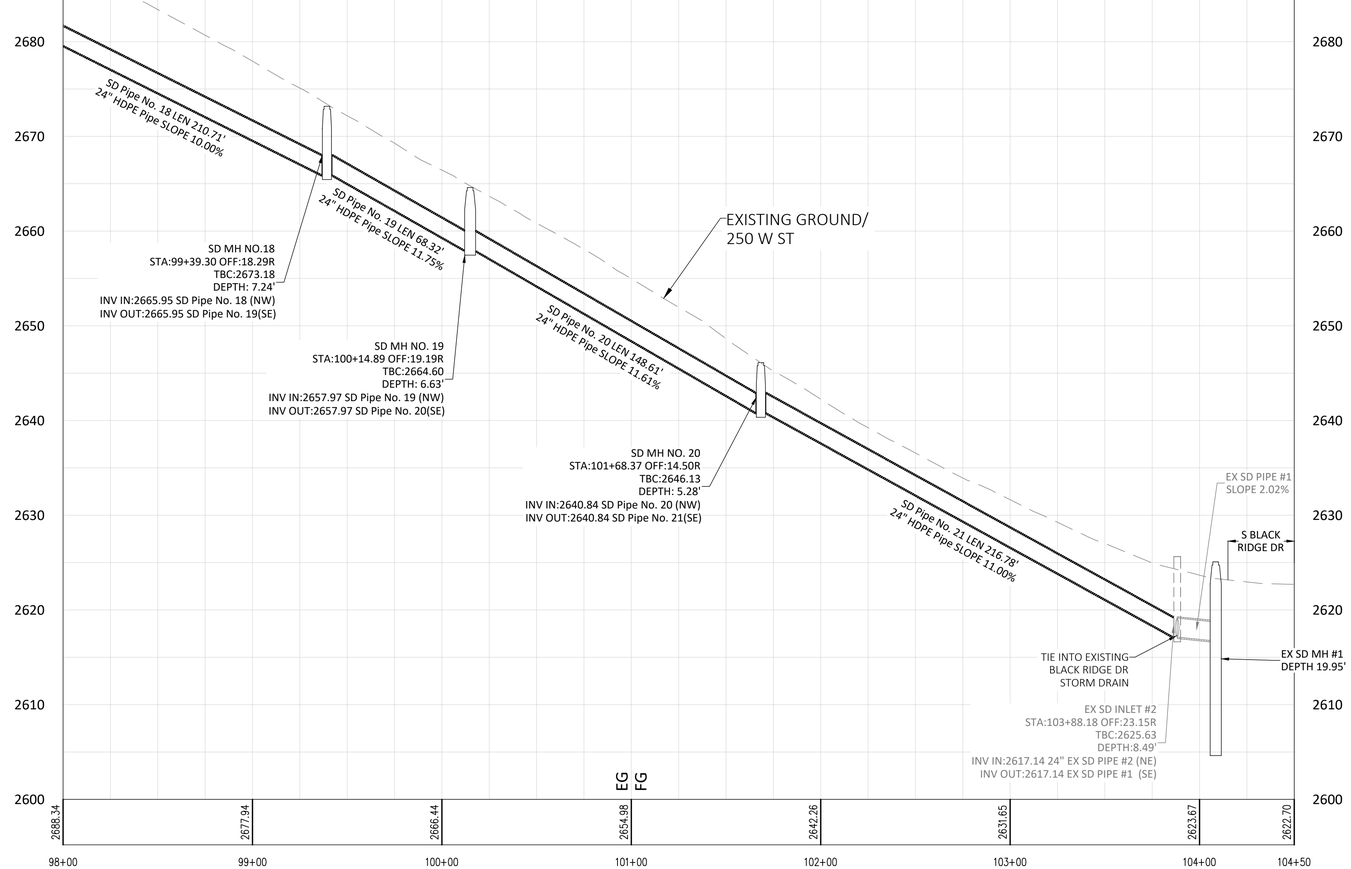
Sheet 11 of 41 Sheets

PE Pipe SLOPE 6.50%



LEGEND

- EXISTING ASPHALT
- PROPOSED ASPHALT
- EXISTING CONCRETE
- PROPOSED CONCRETE
- STORM DRAIN PIPE
- STORM DRAIN INLET BOX
- 30" CURB & GUTTER
- SLOPE EASEMENT
- EXISTING CONTOUR (2622)
- DESIGN CONTOUR 2622
- PROPOSED WALLS



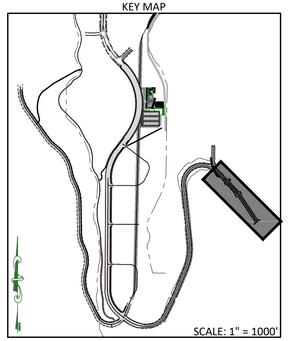
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REVISIONS

No.	Date	by	Description

File Name
East Access OPT 2.dwg

KEY MAP



GRAPHIC SCALE

40 0 20 40 80

(IN FEET)
1 inch = 40 ft.
If Printed 11x17 use Half Scale

ALLIANCE CONSULTING
A PLANNING AND ENGINEERING FIRM

UTAH
2303 N CORAL CANYON BLVD
SUITE 201,
WASHINGTON, UT 84780
435-673-8060

NORTH DAKOTA
621 26th STREET W.
WILLISTON, ND 58801
701-572-8100

SOUTHEAST ACCESS ROAD GRADING AND STORM DRAIN PLAN AND PROFILE

FOR

CITY OF ST. GEORGE

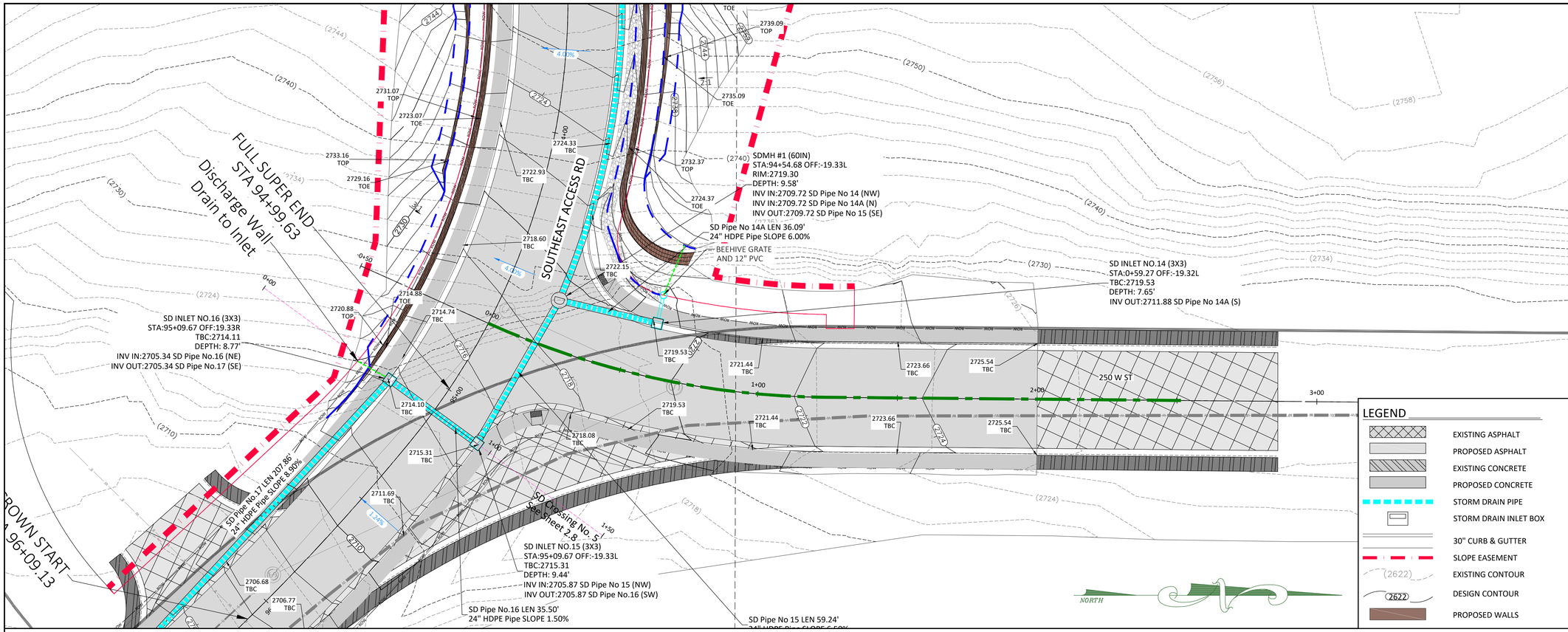
LOCATED IN SEC 36
T 42 SOUTH, R 15 WEST SLB&M
CITY OF ST. GEORGE, WASHINGTON COUNTY, UT

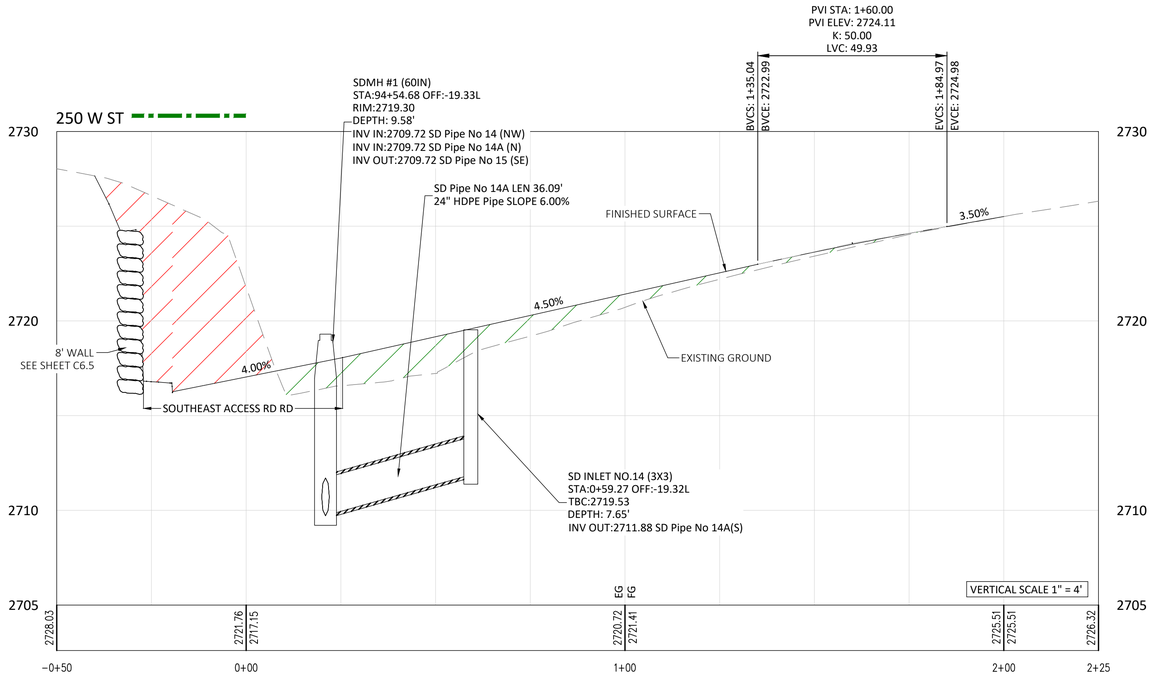
NOT FOR CONSTRUCTION REVIEW ONLY

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AZ	1" = 40"
Client No. 4568-21	Project No. 4568-21

Drawing Sheet
C2.5

Sheet 12 of 41 Sheets





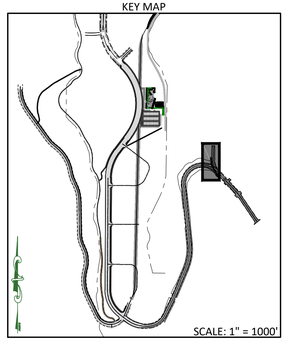
Date: 10-19-2023

REVISIONS

No.	Date	by	Description

File Name
East Access OPT 2.dwg

KEY MAP



GRAPHIC SCALE

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(IN FEET)
1 inch = 20 ft.
If Printed 11x17 use Half Scale

ALLIANCE CONSULTING
A PLANNING AND ENGINEERING FIRM

UTAH
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SUITE 201,
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435-673-8060

NORTH DAKOTA
621 26th STREET W.
WILLISTON, ND 58801
701-572-8100

250 WEST STREET ALTERATION PLAN AND PROFILE

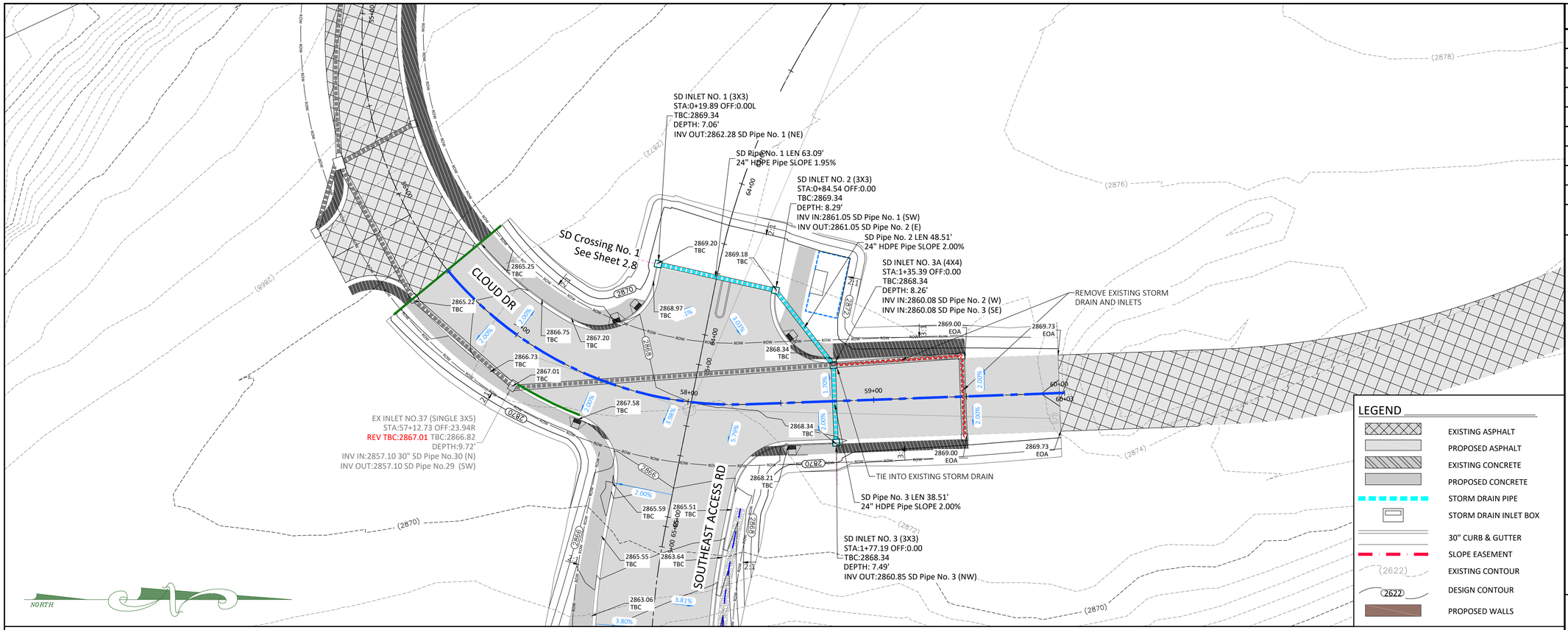
FOR
CITY OF ST. GEORGE
LOCATED IN SEC 36
T 42 SOUTH, R 15 WEST SLB&M
CITY OF ST. GEORGE, WASHINGTON COUNTY, UT

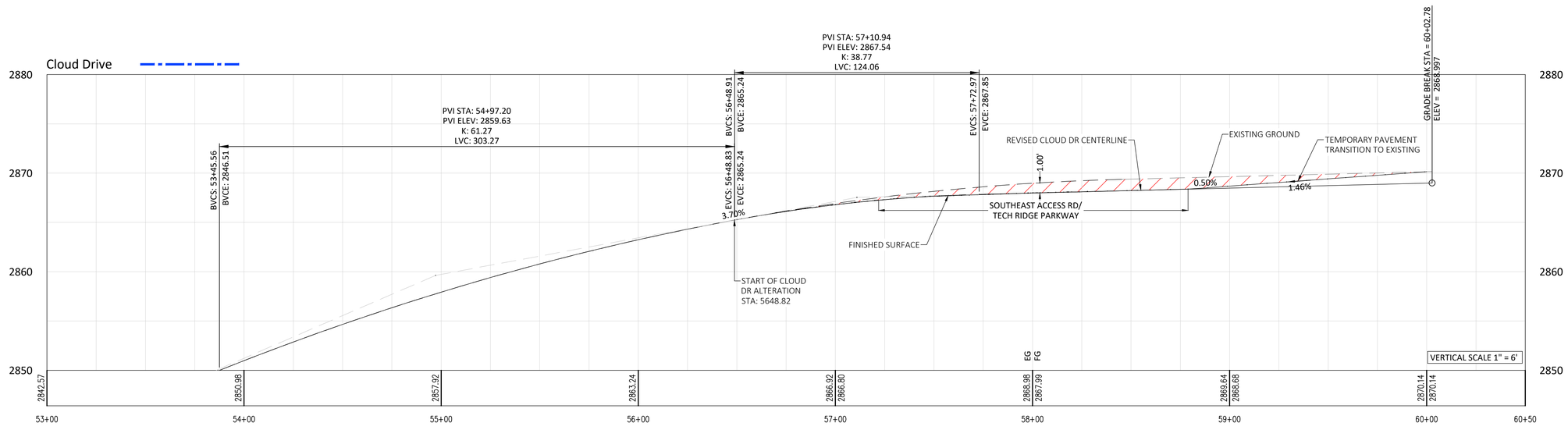
NOT FOR CONSTRUCTION REVIEW ONLY

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Client No. 4568-21	Project No. 4568-21

Drawing Sheet
C2.6

Sheet 13 of 41 Sheets





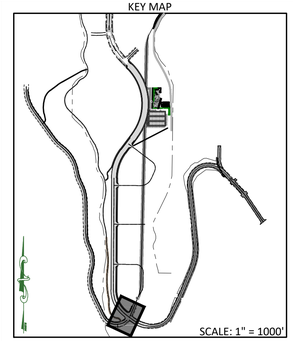
Date: 10-19-2023

REVISIONS

No.	Date	by	Description

File Name: East Access OPT 2.dwg

KEY MAP



GRAPHIC SCALE

30 0 15 30 60

(IN FEET)

1 inch = 30 ft.

If Printed 11x17 use Half Scale

ALLIANCE CONSULTING
A PLANNING AND ENGINEERING FIRM

UTAH
2303 N CORAL CANYON BLVD
SUITE 201,
WASHINGTON, UT 84780
435-673-8060

NORTH DAKOTA
621 26th STREET W.
WILLISTON, ND 58801
701-572-8100

CLOUD DRIVE ALTERATION GRADING PLAN AND PROFILE

FOR

CITY OF ST. GEORGE

LOCATED IN SEC 36
T 42 SOUTH, R 15 WEST SLB&M
CITY OF ST. GEORGE, WASHINGTON COUNTY, UT

NOT FOR CONSTRUCTION REVIEW ONLY

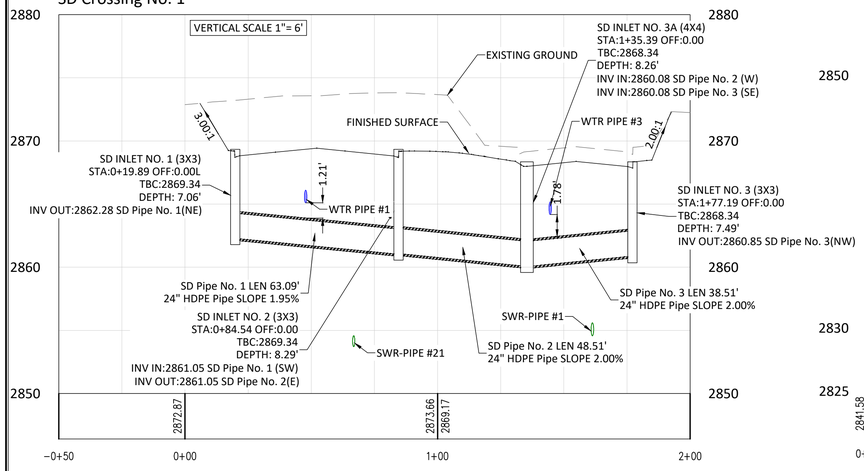
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Client No. 4568-21	Project No. 4568-21

Drawing Sheet

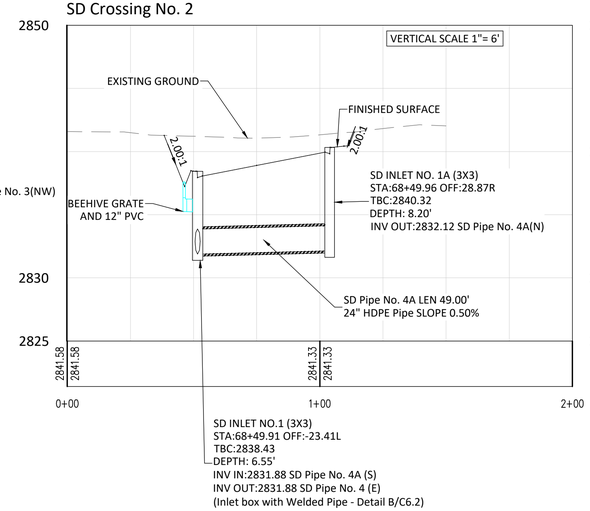
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Sheet 14 of 41 Sheets

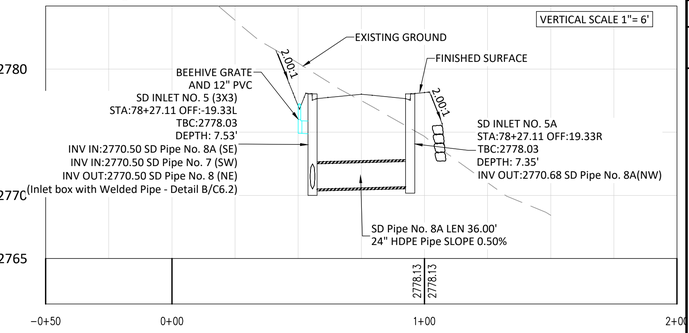
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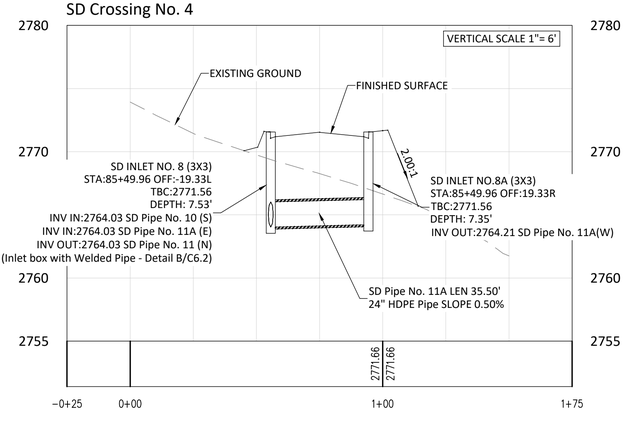
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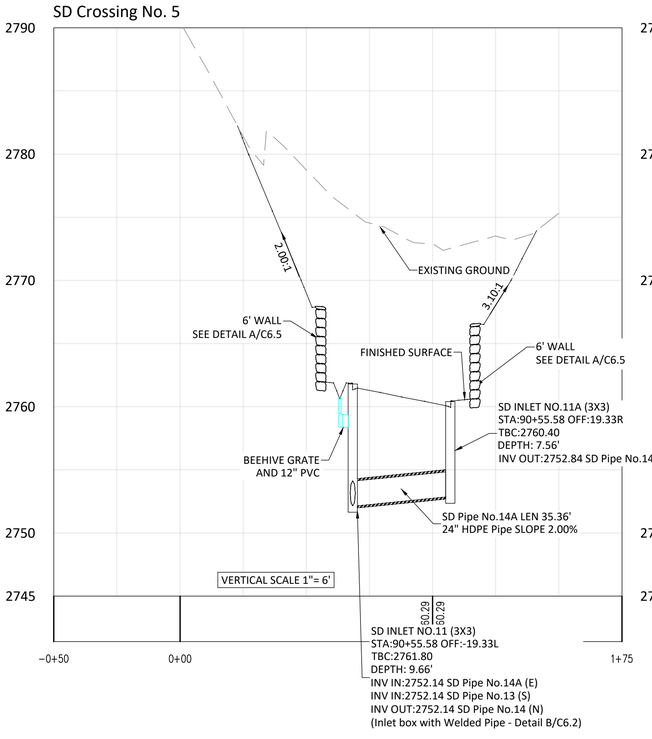
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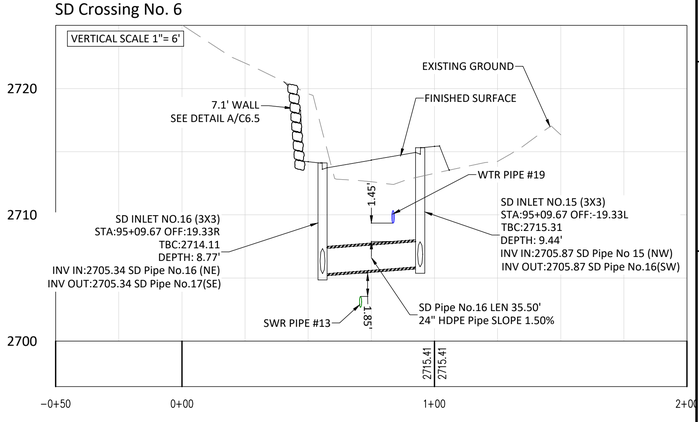
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SD Crossing No. 5



SD Crossing No. 6



Date: 10-19-2023

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No.	Date	by	Description

File Name: East Access OPT 2.dwg

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UTAH
2303 N CORAL CANYON BLVD
SUITE 201,
WASHINGTON, UT 84780
435-673-8060

NORTH DAKOTA
621 26th STREET W.
WILLISTON, ND 58801
701-572-8100

SOUTHEAST ACCESS RD
STORM DRAIN CROSSINGS

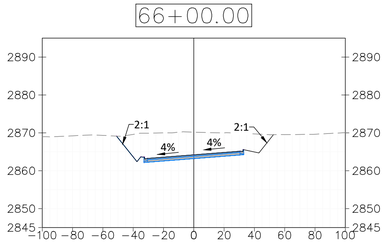
FOR
CITY OF ST. GEORGE
LOCATED IN SEC 36
T 42 SOUTH, R 15 WEST SLB&M
CITY OF ST. GEORGE, WASHINGTON COUNTY, UT

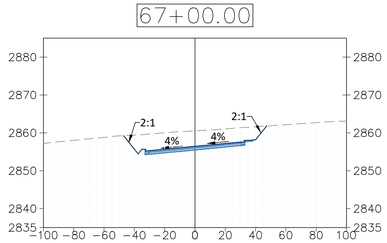
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REVIEW ONLY

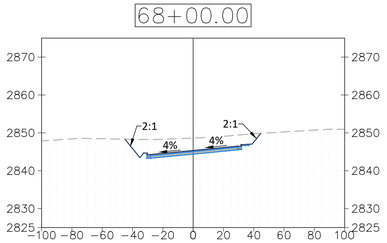
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Client No. 4568-21	Project No. 4568-21

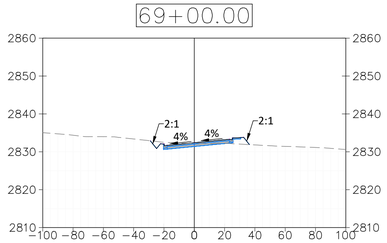
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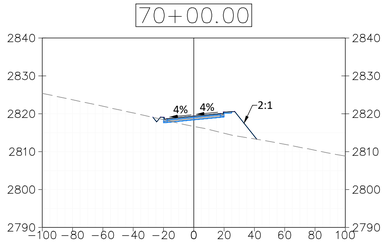
Sheet 15 of 41 Sheets

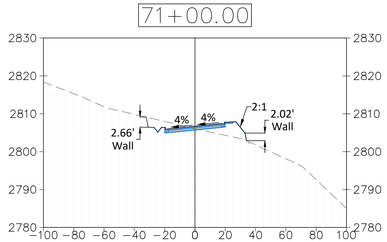


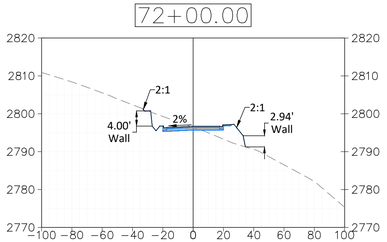


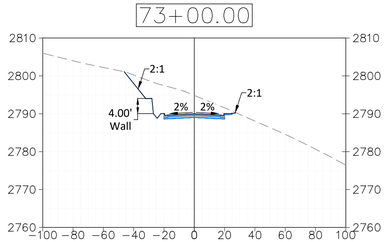


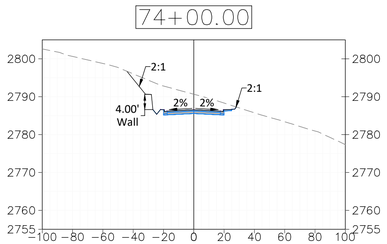


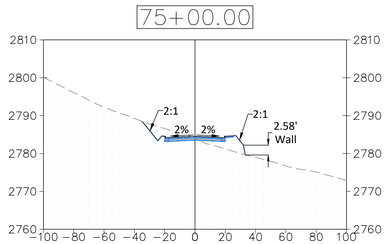


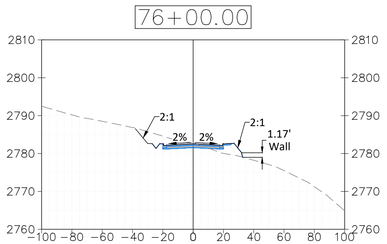


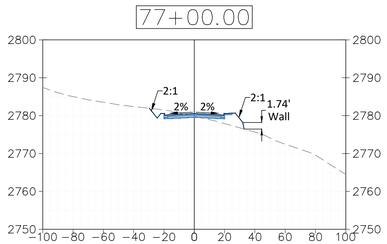


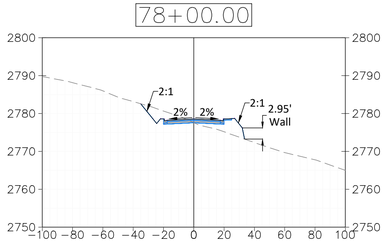


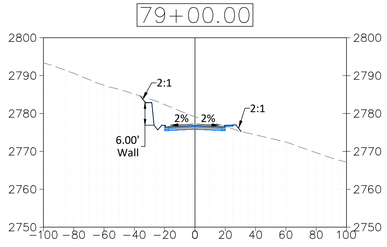


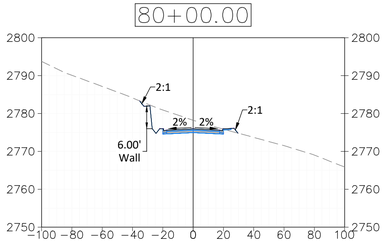


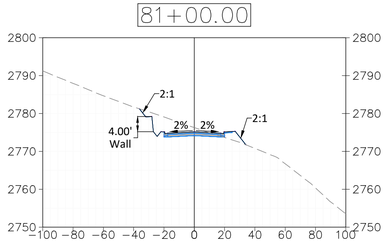












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621 26th STREET W.
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701-572-8100

SOUTHEAST ACCESS GRADING CROSS SECTIONS

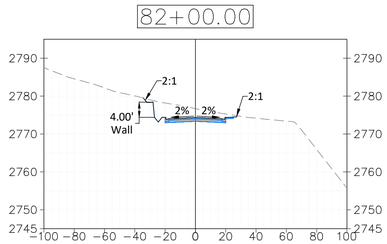
FOR
CITY OF ST. GEORGE
LOCATED IN SEC 36
T 42 SOUTH, R 15 WEST SLB&M
CITY OF ST. GEORGE, WASHINGTON COUNTY, UT

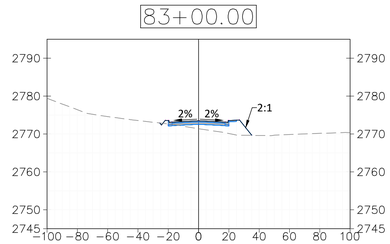
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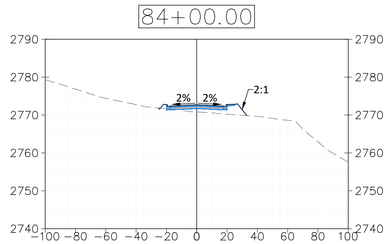
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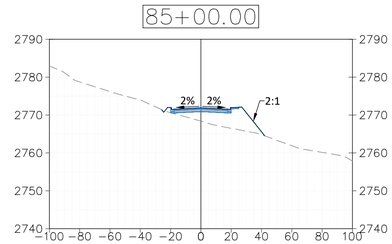
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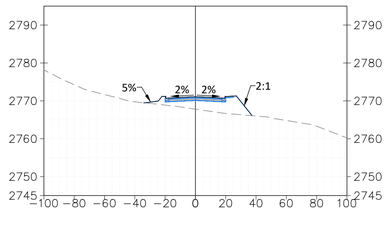
Sheet 16 of 41 Sheets

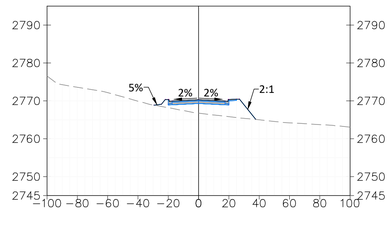


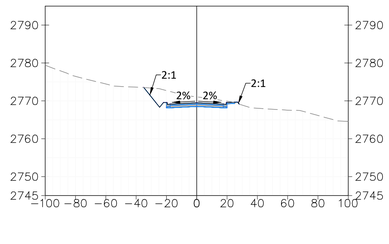


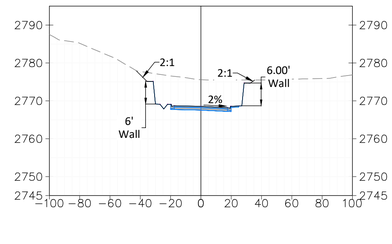


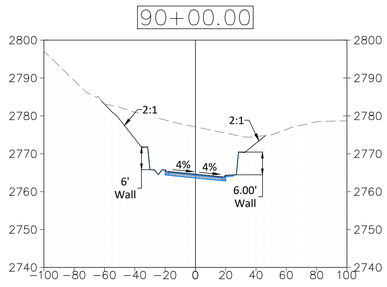


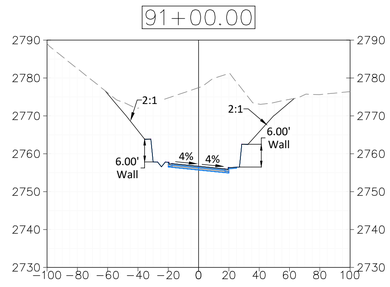


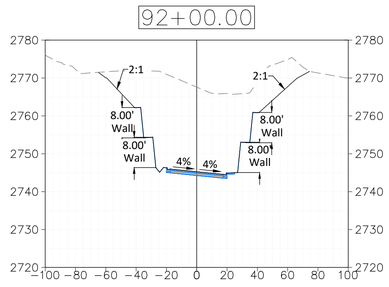


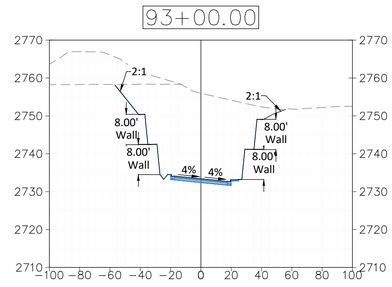


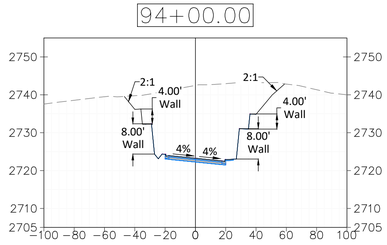


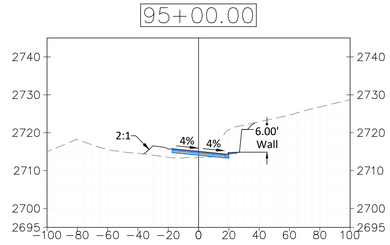


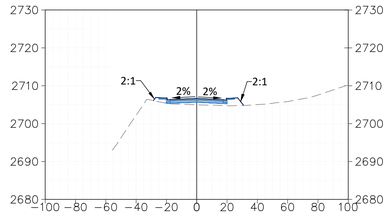


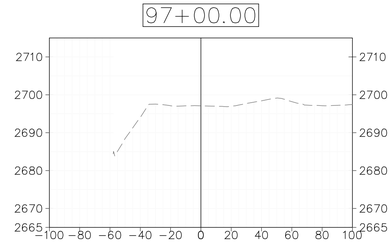












Date:
10-19-2023

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No.	Date	by	Description

File Name
East Access OPT 2.dwg

ALLIANCE CONSULTING
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UTAH
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621 26th STREET W.
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SOUTHEAST ACCESS RD GRADING CROSS SECTIONS

FOR
CITY OF ST. GEORGE
LOCATED IN SEC 36
T 42 SOUTH, R 15 WEST SLB&M
CITY OF ST. GEORGE, WASHINGTON COUNTY, UT

NOT FOR CONSTRUCTION REVIEW ONLY

Drawn By:	Scale:
AZ	NONE
Client No. 4568-21	Project No. 4568-21

Drawing Sheet
C2.10

Sheet 17 of 41 Sheets

CITY OF ST. GEORGE WATER NOTES:

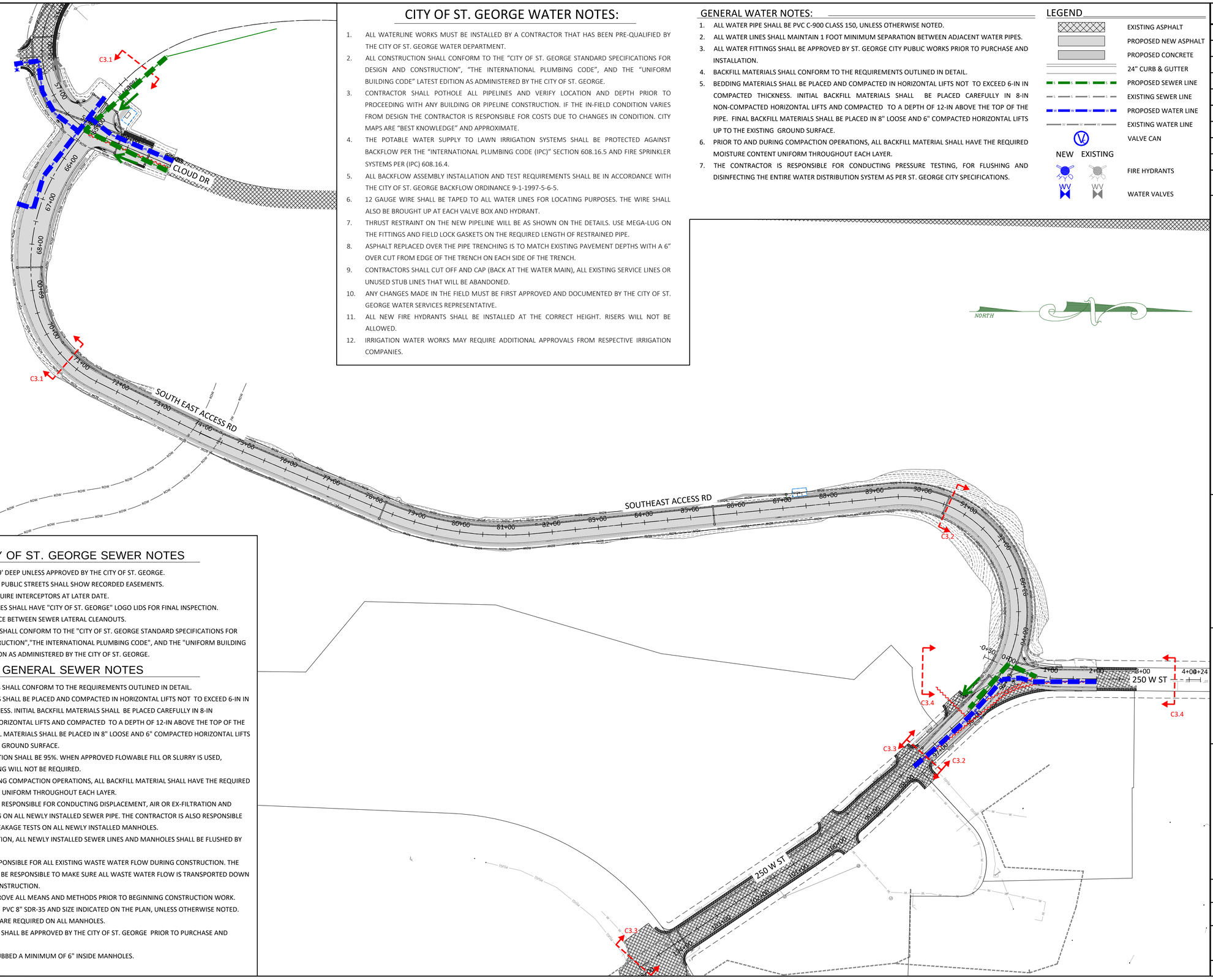
1. ALL WATERLINE WORKS MUST BE INSTALLED BY A CONTRACTOR THAT HAS BEEN PRE-QUALIFIED BY THE CITY OF ST. GEORGE WATER DEPARTMENT.
2. ALL CONSTRUCTION SHALL CONFORM TO THE "CITY OF ST. GEORGE STANDARD SPECIFICATIONS FOR DESIGN AND CONSTRUCTION", "THE INTERNATIONAL PLUMBING CODE", AND THE "UNIFORM BUILDING CODE" LATEST EDITION AS ADMINISTERED BY THE CITY OF ST. GEORGE.
3. CONTRACTOR SHALL POTHOLE ALL PIPELINES AND VERIFY LOCATION AND DEPTH PRIOR TO PROCEEDING WITH ANY BUILDING OR PIPELINE CONSTRUCTION. IF THE IN-FIELD CONDITION VARIES FROM DESIGN THE CONTRACTOR IS RESPONSIBLE FOR COSTS DUE TO CHANGES IN CONDITION. CITY MAPS ARE "BEST KNOWLEDGE" AND APPROXIMATE.
4. THE POTABLE WATER SUPPLY TO LAWN IRRIGATION SYSTEMS SHALL BE PROTECTED AGAINST BACKFLOW PER THE "INTERNATIONAL PLUMBING CODE (IPC)" SECTION 608.16.5 AND FIRE SPRINKLER SYSTEMS PER (IPC) 608.16.4.
5. ALL BACKFLOW ASSEMBLY INSTALLATION AND TEST REQUIREMENTS SHALL BE IN ACCORDANCE WITH THE CITY OF ST. GEORGE BACKFLOW ORDINANCE 9-1-1997-5-6-5.
6. 12 GAUGE WIRE SHALL BE TAPED TO ALL WATER LINES FOR LOCATING PURPOSES. THE WIRE SHALL ALSO BE BROUGHT UP AT EACH VALVE BOX AND HYDRANT.
7. THRUST RESTRAINT ON THE NEW PIPELINE WILL BE AS SHOWN ON THE DETAILS. USE MEGA-LUG ON THE FITTINGS AND FIELD LOCK GASKETS ON THE REQUIRED LENGTH OF RESTRAINED PIPE.
8. ASPHALT REPLACED OVER THE PIPE TRENCHING IS TO MATCH EXISTING PAVEMENT DEPTHS WITH A 6" OVER CUT FROM EDGE OF THE TRENCH ON EACH SIDE OF THE TRENCH.
9. CONTRACTORS SHALL CUT OFF AND CAP (BACK AT THE WATER MAIN), ALL EXISTING SERVICE LINES OR UNUSED STUB LINES THAT WILL BE ABANDONED.
10. ANY CHANGES MADE IN THE FIELD MUST BE FIRST APPROVED AND DOCUMENTED BY THE CITY OF ST. GEORGE WATER SERVICES REPRESENTATIVE.
11. ALL NEW FIRE HYDRANTS SHALL BE INSTALLED AT THE CORRECT HEIGHT. RISERS WILL NOT BE ALLOWED.
12. IRRIGATION WATER WORKS MAY REQUIRE ADDITIONAL APPROVALS FROM RESPECTIVE IRRIGATION COMPANIES.

GENERAL WATER NOTES:

1. ALL WATER PIPE SHALL BE PVC C-900 CLASS 150, UNLESS OTHERWISE NOTED.
2. ALL WATER LINES SHALL MAINTAIN 1 FOOT MINIMUM SEPARATION BETWEEN ADJACENT WATER PIPES.
3. ALL WATER FITTINGS SHALL BE APPROVED BY ST. GEORGE CITY PUBLIC WORKS PRIOR TO PURCHASE AND INSTALLATION.
4. BACKFILL MATERIALS SHALL CONFORM TO THE REQUIREMENTS OUTLINED IN DETAIL.
5. BEDDING MATERIALS SHALL BE PLACED AND COMPACTED IN HORIZONTAL LIFTS NOT TO EXCEED 6-IN IN COMPACTED THICKNESS. INITIAL BACKFILL MATERIALS SHALL BE PLACED CAREFULLY IN 8-IN NON-COMPACTED HORIZONTAL LIFTS AND COMPACTED TO A DEPTH OF 12-IN ABOVE THE TOP OF THE PIPE. FINAL BACKFILL MATERIALS SHALL BE PLACED IN 8" LOOSE AND 6" COMPACTED HORIZONTAL LIFTS UP TO THE EXISTING GROUND SURFACE.
6. PRIOR TO AND DURING COMPACTION OPERATIONS, ALL BACKFILL MATERIAL SHALL HAVE THE REQUIRED MOISTURE CONTENT UNIFORM THROUGHOUT EACH LAYER.
7. THE CONTRACTOR IS RESPONSIBLE FOR CONDUCTING PRESSURE TESTING, FOR FLUSHING AND DISINFECTING THE ENTIRE WATER DISTRIBUTION SYSTEM AS PER ST. GEORGE CITY SPECIFICATIONS.

LEGEND

NEW	EXISTING	
		EXISTING ASPHALT
		PROPOSED NEW ASPHALT
		PROPOSED CONCRETE
		24" CURB & GUTTER
S	S	PROPOSED SEWER LINE
S	S	EXISTING SEWER LINE
W	W	PROPOSED WATER LINE
W	W	EXISTING WATER LINE
V	V	VALVE CAN
		FIRE HYDRANTS
WV	WV	WATER VALVES



CITY OF ST. GEORGE SEWER NOTES

1. NO SEWERS UNDER 9' DEEP UNLESS APPROVED BY THE CITY OF ST. GEORGE.
2. ANY SEWERS NOT IN PUBLIC STREETS SHALL SHOW RECORDED EASEMENTS.
3. BUILDINGS MAY REQUIRE INTERCEPTORS AT LATER DATE.
4. ALL SEWER MANHOLES SHALL HAVE "CITY OF ST. GEORGE" LOGO LIDS FOR FINAL INSPECTION.
5. 100' MAXIMUM SPACE BETWEEN SEWER LATERAL CLEANOUTS.
6. ALL CONSTRUCTION SHALL CONFORM TO THE "CITY OF ST. GEORGE STANDARD SPECIFICATIONS FOR DESIGN AND CONSTRUCTION","THE INTERNATIONAL PLUMBING CODE", AND THE "UNIFORM BUILDING CODE" LATEST EDITION AS ADMINISTERED BY THE CITY OF ST. GEORGE.

GENERAL SEWER NOTES

1. BACKFILL MATERIALS SHALL CONFORM TO THE REQUIREMENTS OUTLINED IN DETAIL.
2. BEDDING MATERIALS SHALL BE PLACED AND COMPACTED IN HORIZONTAL LIFTS NOT TO EXCEED 6-IN IN COMPACTED THICKNESS. INITIAL BACKFILL MATERIALS SHALL BE PLACED CAREFULLY IN 8-IN NON-COMPACTED HORIZONTAL LIFTS AND COMPACTED TO A DEPTH OF 12-IN ABOVE THE TOP OF THE PIPE. FINAL BACKFILL MATERIALS SHALL BE PLACED IN 8" LOOSE AND 6" COMPACTED HORIZONTAL LIFTS UP TO THE EXISTING GROUND SURFACE.
3. MINIMUM COMPACTION SHALL BE 95%. WHEN APPROVED FLOWABLE FILL OR SLURRY IS USED, COMPACTION TESTING WILL NOT BE REQUIRED.
4. PRIOR TO AND DURING COMPACTION OPERATIONS, ALL BACKFILL MATERIAL SHALL HAVE THE REQUIRED MOISTURE CONTENT UNIFORM THROUGHOUT EACH LAYER.
5. THE CONTRACTOR IS RESPONSIBLE FOR CONDUCTING DISPLACEMENT, AIR OR EX-FILTRATION AND DEFLECTION TESTING ON ALL NEWLY INSTALLED SEWER PIPE. THE CONTRACTOR IS ALSO RESPONSIBLE FOR CONDUCTING LEAKAGE TESTS ON ALL NEWLY INSTALLED MANHOLES.
6. FOLLOWING INSPECTION, ALL NEWLY INSTALLED SEWER LINES AND MANHOLES SHALL BE FLUSHED BY THE CONTRACTOR.
7. CONTRACTOR IS RESPONSIBLE FOR ALL EXISTING WASTE WATER FLOW DURING CONSTRUCTION. THE CONTRACTOR SHALL BE RESPONSIBLE TO MAKE SURE ALL WASTE WATER FLOW IS TRANSPORTED DOWN STREAM DURING CONSTRUCTION.
8. THE CITY MUST APPROVE ALL MEANS AND METHODS PRIOR TO BEGINNING CONSTRUCTION WORK.
9. ALL SEWER PIPE ARE PVC 8" SDR-35 AND SIZE INDICATED ON THE PLAN, UNLESS OTHERWISE NOTED.
10. CONCRETE COLLARS ARE REQUIRED ON ALL MANHOLES.
11. ALL SEWER FITTINGS SHALL BE APPROVED BY THE CITY OF ST. GEORGE PRIOR TO PURCHASE AND INSTALLATION.
12. HDPE PIPE TO BE STUBBED A MINIMUM OF 6" INSIDE MANHOLES.

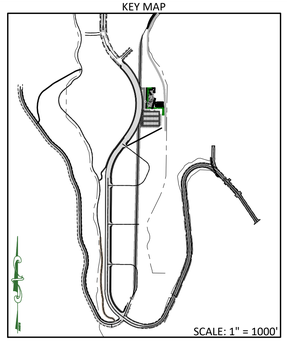
Date: 10-19-2023

REVISIONS

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East Access SWR & WTR OPT 2.dwg

KEY MAP



GRAPHIC SCALE

100 0 50 100 200

(IN FEET)
1 inch = 100 ft.
If Printed 11x17 use Half Scale

ALLIANCE CONSULTING
A PLANNING AND ENGINEERING FIRM

UTAH
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SOUTHEAST ACCESS RD
AT TECH RIDGE
SEWER AND WATER OVERALL

FOR

CITY OF ST. GEORGE

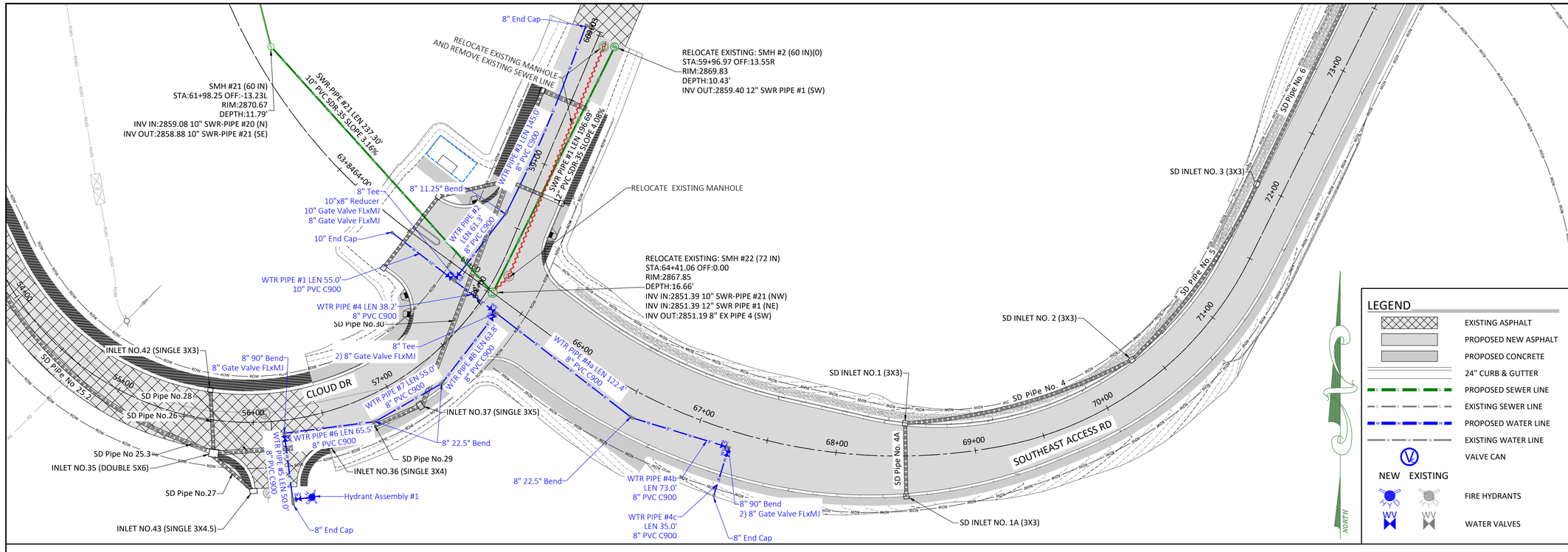
LOCATED IN SEC 36
TOWNSHIP 42 NORTH, RANGE 15 WEST SLB&M
CITY OF ST. GEORGE, WASHINGTON COUNTY, UT

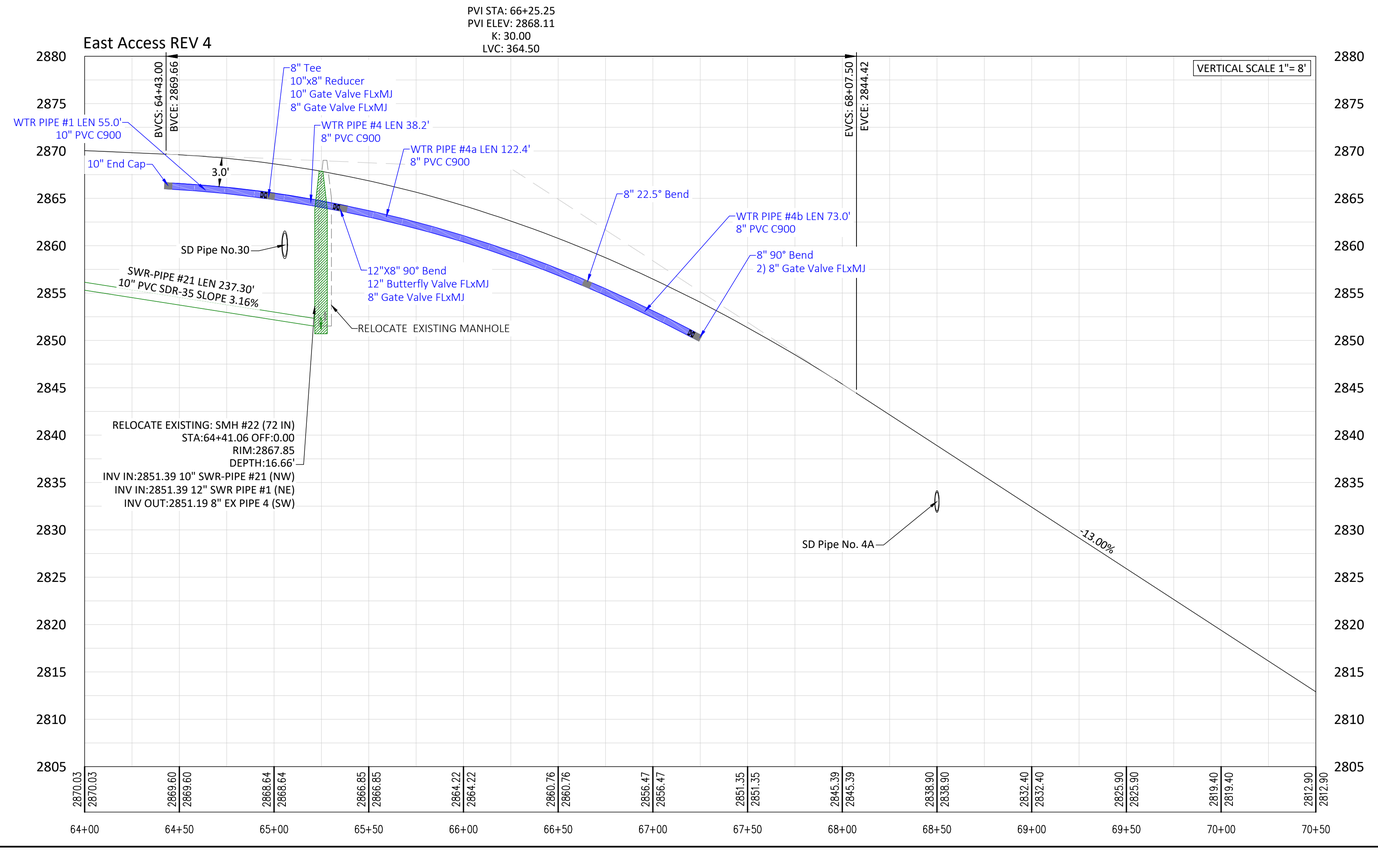
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Client No. 4568	Project No. 4568

Drawing Sheet
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Sheet 18 of 41 Sheets





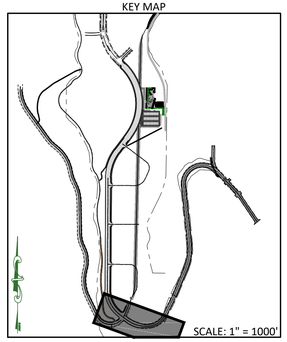
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REVISIONS

No.	Date	by	Description

File Name
East Access SWR & WTR OPT 2.dwg

KEY MAP



GRAPHIC SCALE

40 0 20 40 80

(IN FEET)
1 inch = 40 ft.
If Printed 11x17 use Half Scale

ALLIANCE CONSULTING
A PLANNING AND ENGINEERING FIRM

UTAH
2303 N CORAL CANYON BLVD
SUITE 201,
WASHINGTON, UT 84780
435-673-8060

NORTH DAKOTA
621 26th STREET W.
WILLISTON, ND 58801
701-572-8100

SOUTHEAST ACCESS RD
SEWER AND WATER
PLAN AND PROFILE

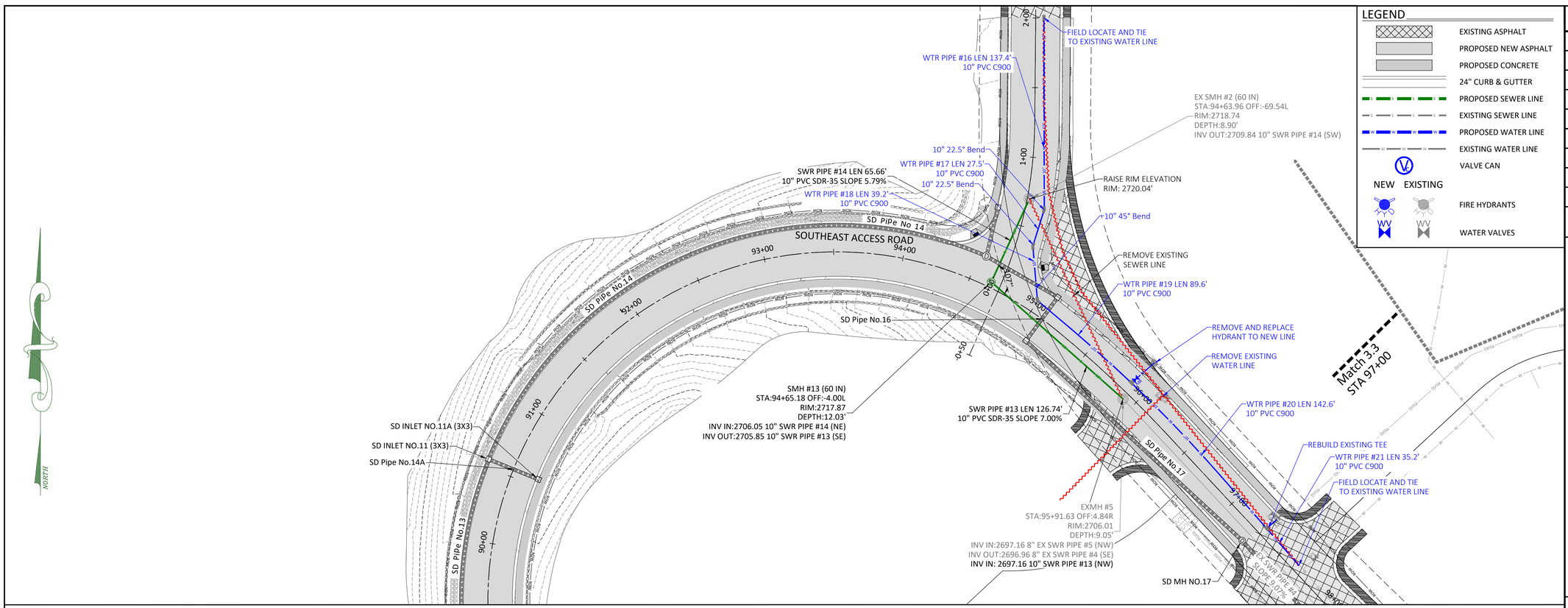
FOR
CITY OF ST. GEORGE
LOCATED IN SEC 36
TOWNSHIP 42 NORTH, RANGE 15 WEST SLB&M
CITY OF ST. GEORGE, WASHINGTON COUNTY, UT

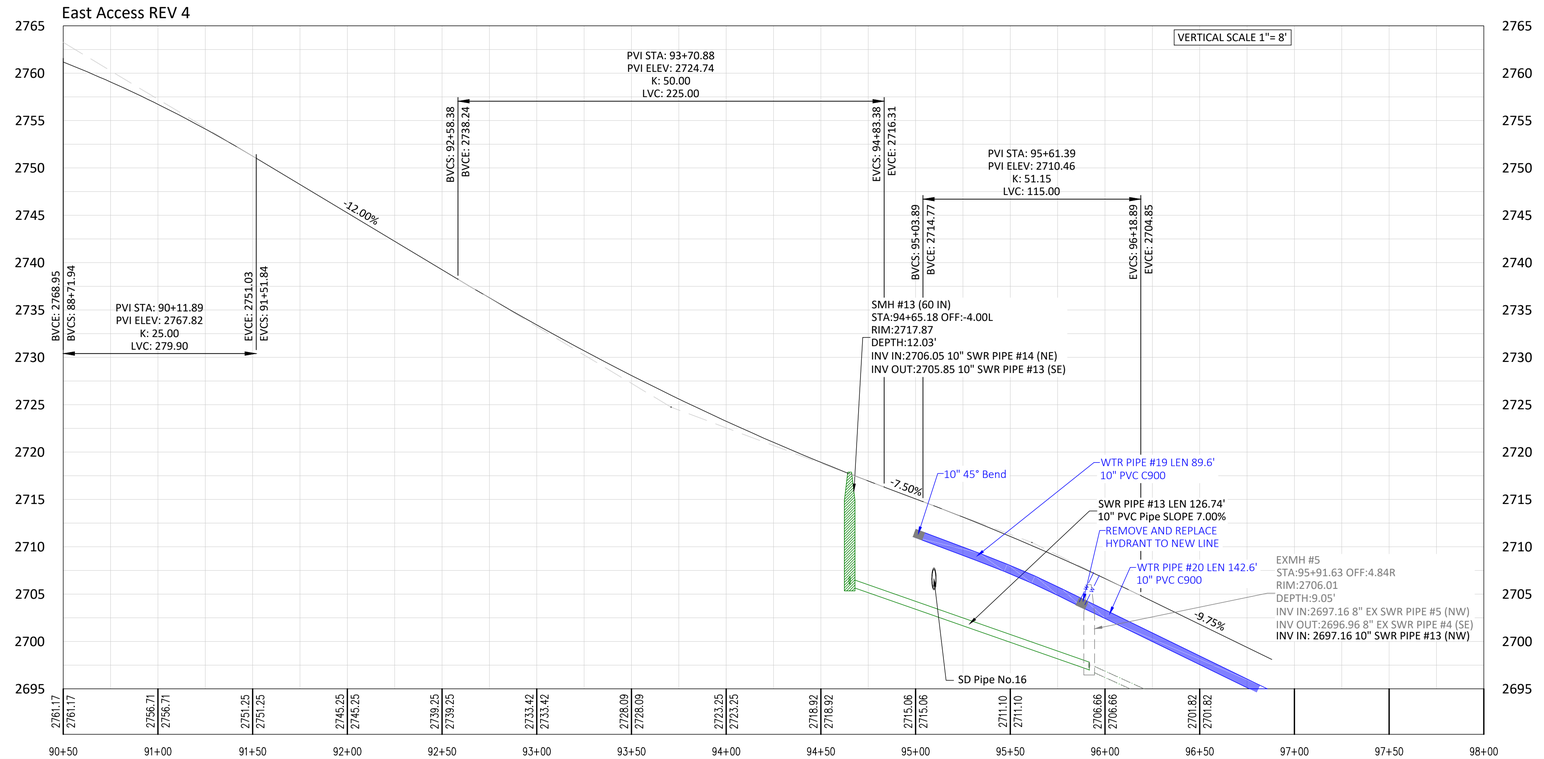
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AZ	1"= 40'
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Sheet 19 of 41 Sheets





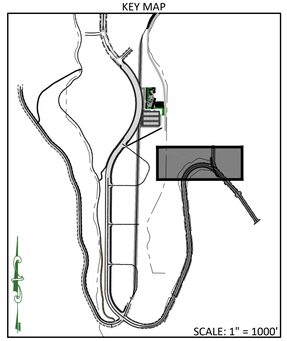
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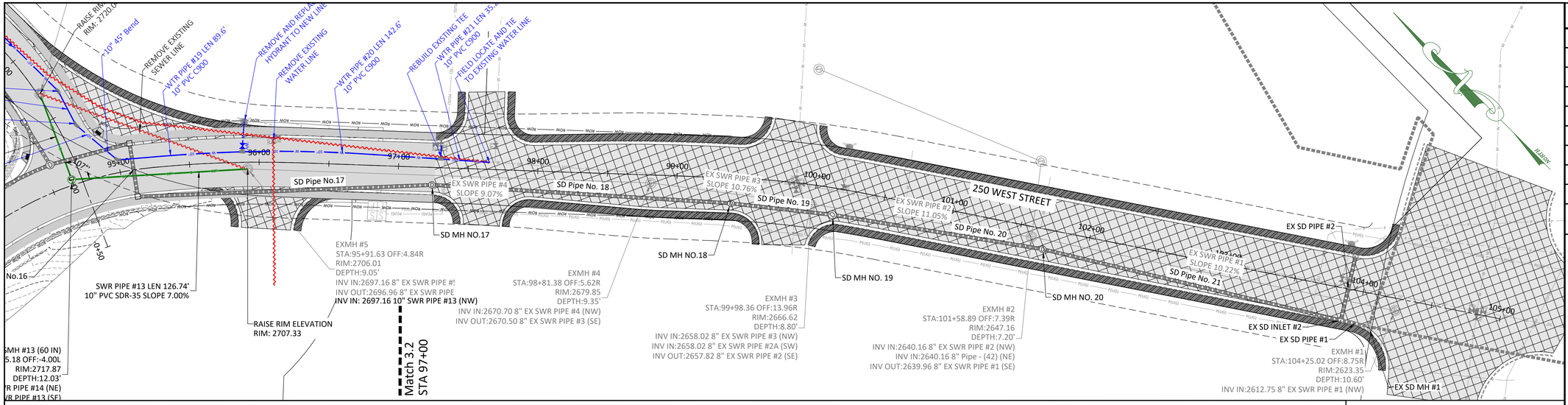
SOUTHEAST ACCESS RD
SEWER AND WATER
PLAN AND PROFILE
FOR
CITY OF ST. GEORGE
LOCATED IN SEC 36
TOWNSHIP 42 NORTH, RANGE 15 WEST SLB&M
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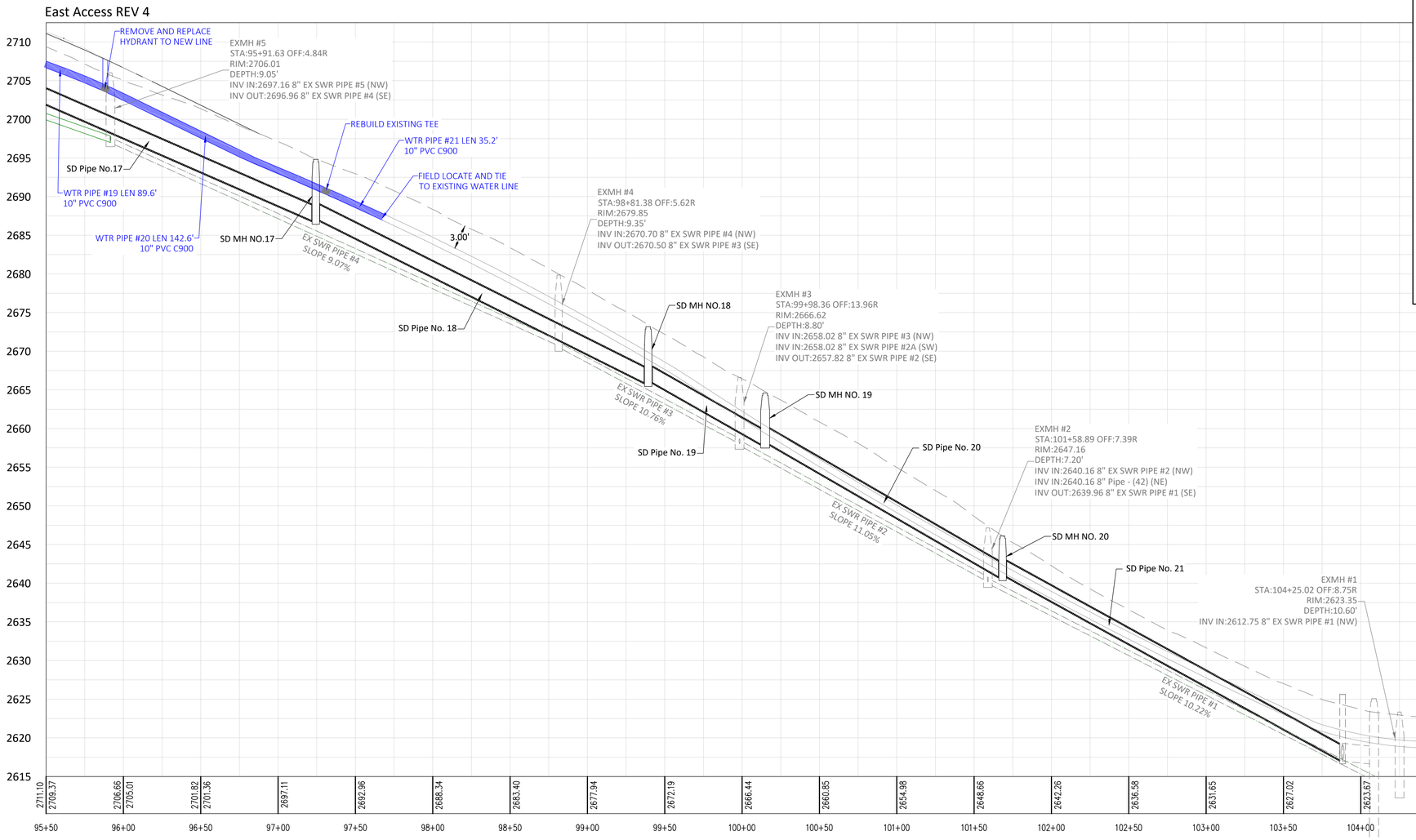
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AZ	1"=40'
Client No. 4568	Project No. 4568

Drawing Sheet
C3.2

Sheet 20 of 41 Sheets





LEGEND

- EXISTING ASPHALT
- PROPOSED NEW ASPHALT
- PROPOSED CONCRETE
- 24" CURB & GUTTER
- PROPOSED SEWER LINE
- EXISTING SEWER LINE
- PROPOSED WATER LINE
- EXISTING WATER LINE
- VALVE CAN
- NEW / EXISTING FIRE HYDRANTS
- NEW / EXISTING WATER VALVES

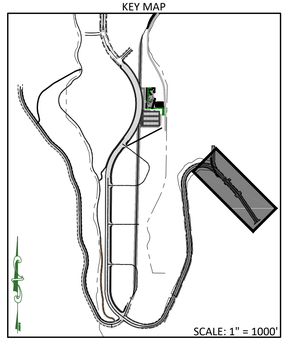
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SOUTHEAST ACCESS RD
SEWER AND WATER
PLAN AND PROFILE

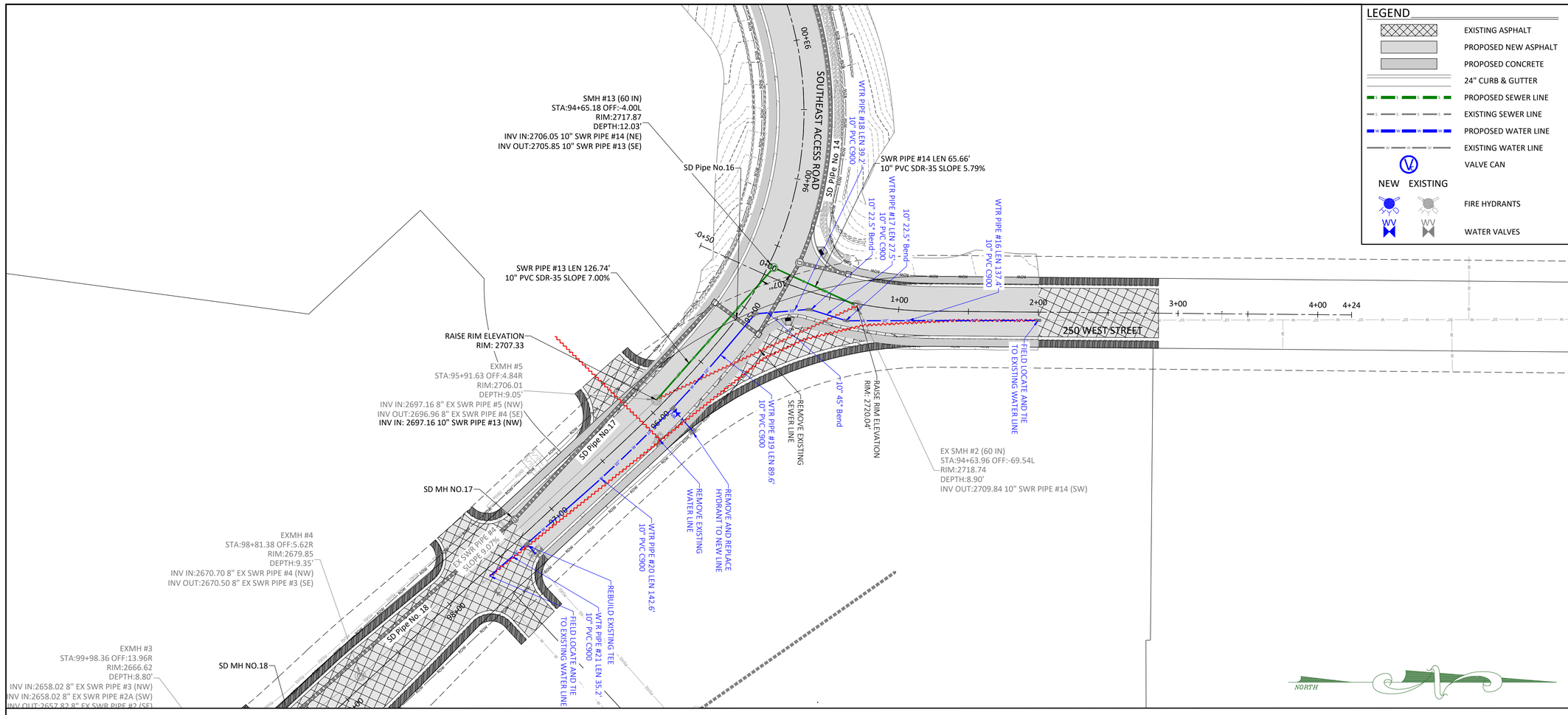
FOR
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LOCATED IN SEC 36
TOWNSHIP 42 NORTH, RANGE 15 WEST SLB&M
CITY OF ST. GEORGE, WASHINGTON COUNTY, UT

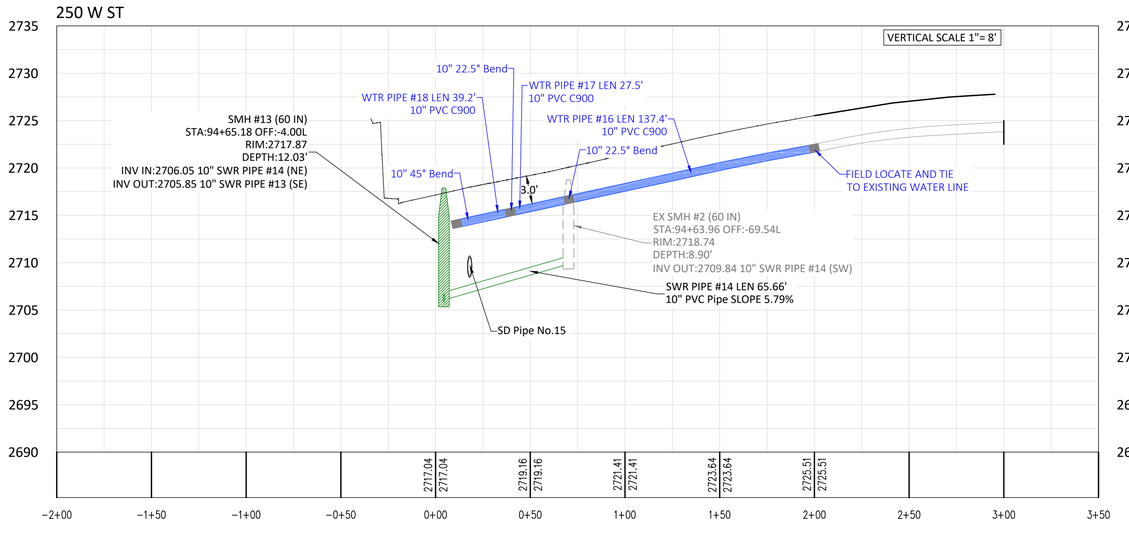
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Drawing Sheet
C3.3

Sheet 21 of 41 Sheets





LEGEND

- EXISTING ASPHALT
- PROPOSED NEW ASPHALT
- PROPOSED CONCRETE
- 24" CURB & GUTTER
- PROPOSED SEWER LINE
- EXISTING SEWER LINE
- PROPOSED WATER LINE
- EXISTING WATER LINE
- VALVE CAN
- NEW / EXISTING
- FIRE HYDRANTS
- WATER VALVES

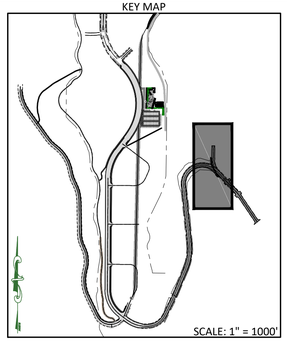
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SOUTHEAST ACCESS RD SEWER AND WATER PLAN AND PROFILE

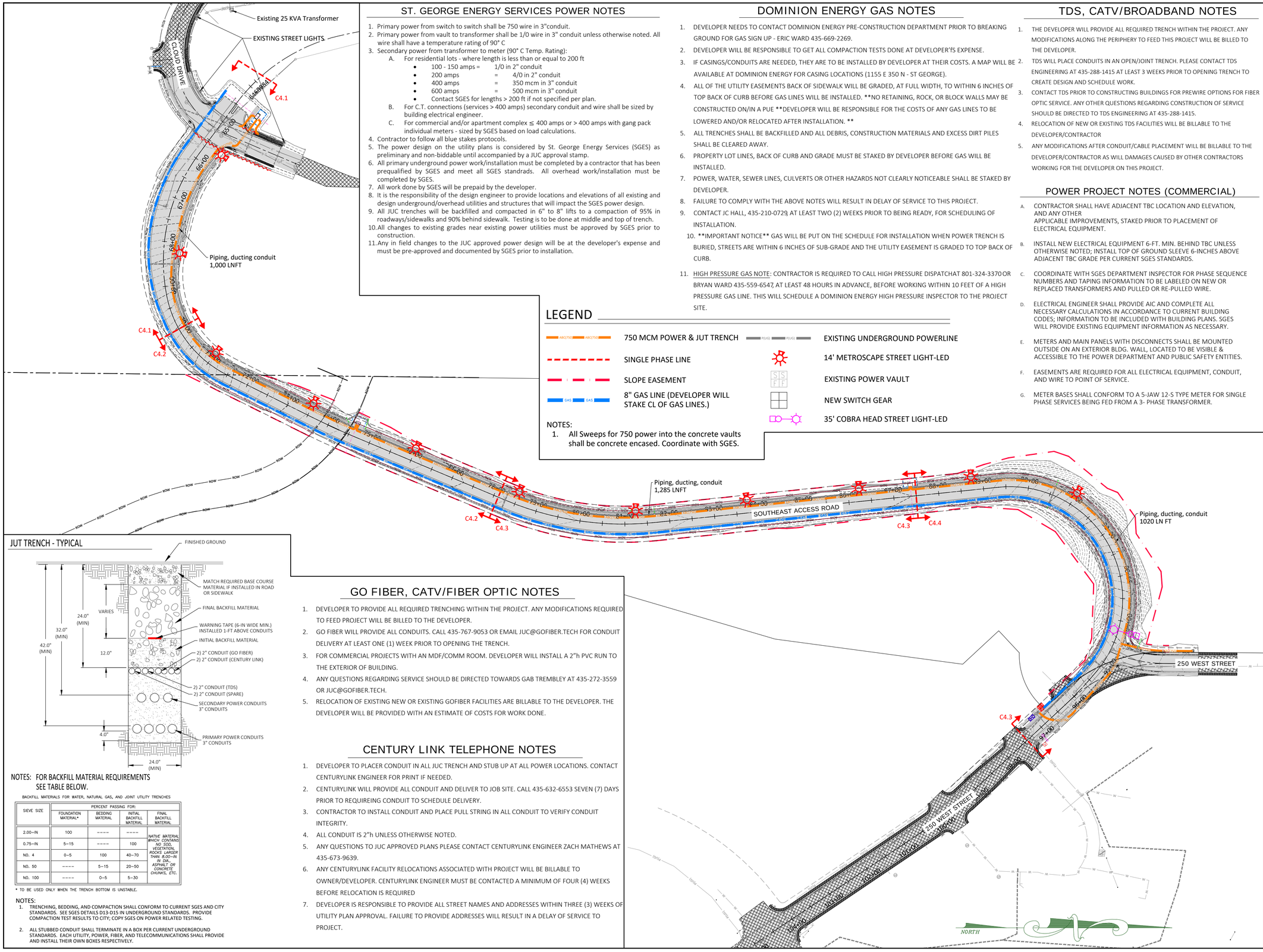
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TOWNSHIP 42 NORTH, RANGE 15 WEST SLB&M
CITY OF ST. GEORGE, WASHINGTON COUNTY, UT

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C3.4

Sheet 22 of 41 Sheets



ST. GEORGE ENERGY SERVICES POWER NOTES

1. Primary power from switch to switch shall be 750 wire in 3"conduit.
2. Primary power from vault to transformer shall be 1/0 wire in 3" conduit unless otherwise noted. All wire shall have a temperature rating of 90° C
3. Secondary power from transformer to meter (90° C Temp. Rating):
   - A. For residential lots - where length is less than or equal to 200 ft
     - 100 - 150 amps = 1/0 in 2" conduit
     - 200 amps = 4/0 in 2" conduit
     - 400 amps = 350 mcm in 3" conduit
     - 600 amps = 500 mcm in 3" conduit
     - Contact SGES for lengths > 200 ft if not specified per plan.
   - B. For C.T. connections (services > 400 amps) secondary conduit and wire shall be sized by building electrical engineer.
   - C. For commercial and/or apartment complex ≤ 400 amps or > 400 amps with gang pack individual meters - sized by SGES based on load calculations.
4. Contractor to follow all blue stakes protocols.
5. The power design on the utility plans is considered by St. George Energy Services (SGES) as preliminary and non-biddable until accompanied by a JUC approval stamp.
6. All primary underground power work/installation must be completed by a contractor that has been prequalified by SGES and meet all SGES standrads. All overhead work/installation must be completed by SGES.
7. All work done by SGES will be prepaid by the developer.
8. It is the responsibility of the design engineer to provide locations and elevations of all existing and design underground/overhead utilities and structures that will impact the SGES power design.
9. All JUC trenches will be backfilled and compacted in 6" to 8" lifts to a compaction of 95% in roadways/sidewalks and 90% behind sidewalk. Testing is to be done at middle and top of trench.
10. All changes to existing grades near existing power utilities must be approved by SGES prior to construction.
11. Any in field changes to the JUC approved power design will be at the developer's expense and must be pre-approved and documented by SGES prior to installation.

DOMINION ENERGY GAS NOTES

1. DEVELOPER NEEDS TO CONTACT DOMINION ENERGY PRE-CONSTRUCTION DEPARTMENT PRIOR TO BREAKING GROUND FOR GAS SIGN UP - ERIC WARD 435-669-2269.
2. DEVELOPER WILL BE RESPONSIBLE TO GET ALL COMPACTION TESTS DONE AT DEVELOPER'fS EXPENSE.
3. IF CASINGS/CONDUITS ARE NEEDED, THEY ARE TO BE INSTALLED BY DEVELOPER AT THEIR COSTS. A MAP WILL BE AVAILABLE AT DOMINION ENERGY FOR CASING LOCATIONS (1155 E 350 N - ST GEORGE).
4. ALL OF THE UTILITY EASEMENTS BACK OF SIDEWALK WILL BE GRADED, AT FULL WIDTH, TO WITHIN 6 INCHES OF TOP BACK OF CURB BEFORE GAS LINES WILL BE INSTALLED. **NO RETAINING, ROCK, OR BLOCK WALLS MAY BE CONSTRUCTED ON/IN A PUE **DEVELOPER WILL BE RESPONSIBLE FOR THE COSTS OF ANY GAS LINES TO BE LOWERED AND/OR RELOCATED AFTER INSTALLATION. **
5. ALL TRENCHES SHALL BE BACKFILLED AND ALL DEBRIS, CONSTRUCTION MATERIALS AND EXCESS DIRT PILES SHALL BE CLEARED AWAY.
6. PROPERTY LOT LINES, BACK OF CURB AND GRADE MUST BE STAKED BY DEVELOPER BEFORE GAS WILL BE INSTALLED.
7. POWER, WATER, SEWER LINES, CULVERTS OR OTHER HAZARDS NOT CLEARLY NOTICEABLE SHALL BE STAKED BY DEVELOPER.
8. FAILURE TO COMPLY WITH THE ABOVE NOTES WILL RESULT IN DELAY OF SERVICE TO THIS PROJECT.
9. CONTACT JC HALL, 435-210-0729, AT LEAST TWO (2) WEEKS PRIOR TO BEING READY, FOR SCHEDULING OF INSTALLATION.
10. **IMPORTANT NOTICE** GAS WILL BE PUT ON THE SCHEDULE FOR INSTALLATION WHEN POWER TRENCH IS BURIED, STREETS ARE WITHIN 6 INCHES OF SUB-GRADE AND THE UTILITY EASEMENT IS GRADED TO TOP BACK OF CURB.
11. HIGH PRESSURE GAS NOTE: CONTRACTOR IS REQUIRED TO CALL HIGH PRESSURE DISPATCHAT 801-324-3370 OR BRYAN WARD 435-559-6547, AT LEAST 48 HOURS IN ADVANCE, BEFORE WORKING WITHIN 10 FEET OF A HIGH PRESSURE GAS LINE. THIS WILL SCHEDULE A DOMINION ENERGY HIGH PRESSURE INSPECTOR TO THE PROJECT SITE.

TDS, CATV/BROADBAND NOTES

1. THE DEVELOPER WILL PROVIDE ALL REQUIRED TRENCH WITHIN THE PROJECT. ANY MODIFICATIONS ALONG THE PERIPHERY TO FEED THIS PROJECT WILL BE BILLED TO THE DEVELOPER.
2. TDS WILL PLACE CONDUITS IN AN OPEN/JOINT TRENCH. PLEASE CONTACT TDS ENGINEERING AT 435-288-1415 AT LEAST 3 WEEKS PRIOR TO OPENING TRENCH TO CREATE DESIGN AND SCHEDULE WORK.
3. CONTACT TDS PRIOR TO CONSTRUCTING BUILDINGS FOR PREWIRE OPTIONS FOR FIBER OPTIC SERVICE. ANY OTHER QUESTIONS REGARDING CONSTRUCTION OF SERVICE SHOULD BE DIRECTED TO TDS ENGINEERING AT 435-288-1415.
4. RELOCATION OF NEW OR EXISTING TDS FACILITIES WILL BE BILLABLE TO THE DEVELOPER/CONTRACTOR
5. ANY MODIFICATIONS AFTER CONDUIT/CABLE PLACEMENT WILL BE BILLABLE TO THE DEVELOPER/CONTRACTOR AS WILL DAMAGES CAUSED BY OTHER CONTRACTORS WORKING FOR THE DEVELOPER ON THIS PROJECT.

POWER PROJECT NOTES (COMMERCIAL)

A. CONTRACTOR SHALL HAVE ADJACENT TBC LOCATION AND ELEVATION, AND ANY OTHER APPLICABLE IMPROVEMENTS, STAKED PRIOR TO PLACEMENT OF ELECTRICAL EQUIPMENT.

B. INSTALL NEW ELECTRICAL EQUIPMENT 6-FT. MIN. BEHIND TBC UNLESS OTHERWISE NOTED; INSTALL TOP OF GROUND SLEEVE 6-INCHES ABOVE ADJACENT TBC GRADE PER CURRENT SGES STANDARDS.

C. COORDINATE WITH SGES DEPARTMENT INSPECTOR FOR PHASE SEQUENCE NUMBERS AND TAPING INFORMATION TO BE LABELED ON NEW OR REPLACED TRANSFORMERS AND PULLED OR RE-PULLED WIRE.

D. ELECTRICAL ENGINEER SHALL PROVIDE AIC AND COMPLETE ALL NECESSARY CALCULATIONS IN ACCORDANCE TO CURRENT BUILDING CODES; INFORMATION TO BE INCLUDED WITH BUILDING PLANS. SGES WILL PROVIDE EXISTING EQUIPMENT INFORMATION AS NECESSARY.

E. METERS AND MAIN PANELS WITH DISCONNECTS SHALL BE MOUNTED OUTSIDE ON AN EXTERIOR BLDG. WALL, LOCATED TO BE VISIBLE & ACCESSIBLE TO THE POWER DEPARTMENT AND PUBLIC SAFETY ENTITIES.

F. EASEMENTS ARE REQUIRED FOR ALL ELECTRICAL EQUIPMENT, CONDUIT, AND WIRE TO POINT OF SERVICE.

G. METER BASES SHALL CONFORM TO A 5-JAW 12-S TYPE METER FOR SINGLE PHASE SERVICES BEING FED FROM A 3- PHASE TRANSFORMER.

LEGEND

- 750 MCM POWER & JUT TRENCH
- SINGLE PHASE LINE
- SLOPE EASEMENT
- 8" GAS LINE (DEVELOPER WILL STAKE CL OF GAS LINES.)
- EXISTING UNDERGROUND POWERLINE
- 14' METROSCAPE STREET LIGHT-LED
- EXISTING POWER VAULT
- NEW SWITCH GEAR
- 35' COBRA HEAD STREET LIGHT-LED

NOTES:
1. All Sweeps for 750 power into the concrete vaults shall be concrete encased. Coordinate with SGES.

JUT TRENCH - TYPICAL

NOTES: FOR BACKFILL MATERIAL REQUIREMENTS SEE TABLE BELOW.

BACKFILL MATERIALS FOR WATER, NATURAL GAS, AND JOINT UTILITY TRENCHES

SIEVE SIZE	PERCENT PASSING FOR: FOUNDATION MATERIAL*	BEDDING MATERIAL	INITIAL BACKFILL MATERIAL	FINAL BACKFILL MATERIAL
2.00–IN	100	----	----	NATIVE MATERIAL WHICH CONTAINS NO SOD, VEGETATION, ROCKS LARGER THAN 8.00–IN IN DIA., ASPHALT OR CONCRETE CHUNKS, ETC.
0.75–IN	5–15	----	100	
NO. 4	0–5	100	40–70	
NO. 50	----	5–15	20–50	
NO. 100	----	0–5	5–30	

* TO BE USED ONLY WHEN THE TRENCH BOTTOM IS UNSTABLE.

NOTES:
1. TRENCHING, BEDDING, AND COMPACTION SHALL CONFORM TO CURRENT SGES AND CITY STANDARDS. SEE SGES DETAILS D13-D15 IN UNDERGROUND STANDARDS. PROVIDE COMPACTION TEST RESULTS TO CITY; COPY SGES ON POWER RELATED TESTING.
2. ALL STUBBED CONDUIT SHALL TERMINATE IN A BOX PER CURRENT UNDERGROUND STANDARDS. EACH UTILITY, POWER, FIBER, AND TELECOMMUNICATIONS SHALL PROVIDE AND INSTALL THEIR OWN BOXES RESPECTIVELY.

GO FIBER, CATV/FIBER OPTIC NOTES

1. DEVELOPER TO PROVIDE ALL REQUIRED TRENCHING WITHIN THE PROJECT. ANY MODIFICATIONS REQUIRED TO FEED PROJECT WILL BE BILLED TO THE DEVELOPER.
2. GO FIBER WILL PROVIDE ALL CONDUITS. CALL 435-767-9053 OR EMAIL JUC@GOFIBER.TECH FOR CONDUIT DELIVERY AT LEAST ONE (1) WEEK PRIOR TO OPENING THE TRENCH.
3. FOR COMMERCIAL PROJECTS WITH AN MDF/COMM ROOM. DEVELOPER WILL INSTALL A 2"h PVC RUN TO THE EXTERIOR OF BUILDING.
4. ANY QUESTIONS REGARDING SERVICE SHOULD BE DIRECTED TOWARDS GAB TREMBLEY AT 435-272-3559 OR JUC@GOFIBER.TECH.
5. RELOCATION OF EXISTING NEW OR EXISTING GOFIBER FACILITIES ARE BILLABLE TO THE DEVELOPER. THE DEVELOPER WILL BE PROVIDED WITH AN ESTIMATE OF COSTS FOR WORK DONE.

CENTURY LINK TELEPHONE NOTES

1. DEVELOPER TO PLACER CONDUIT IN ALL JUC TRENCH AND STUB UP AT ALL POWER LOCATIONS. CONTACT CENTURYLINK ENGINEER FOR PRINT IF NEEDED.
2. CENTURYLINK WILL PROVIDE ALL CONDUIT AND DELIVER TO JOB SITE. CALL 435-632-6553 SEVEN (7) DAYS PRIOR TO REQUIREING CONDUIT TO SCHEDULE DELIVERY.
3. CONTRACTOR TO INSTALL CONDUIT AND PLACE PULL STRING IN ALL CONDUIT TO VERIFY CONDUIT INTEGRITY.
4. ALL CONDUIT IS 2"h UNLESS OTHERWISE NOTED.
5. ANY QUESTIONS TO JUC APPROVED PLANS PLEASE CONTACT CENTURYLINK ENGINEER ZACH MATHEWS AT 435-673-9639.
6. ANY CENTURYLINK FACILITY RELOCATIONS ASSOCIATED WITH PROJECT WILL BE BILLABLE TO OWNER/DEVELOPER. CENTURYLINK ENGINEER MUST BE CONTACTED A MINIMUM OF FOUR (4) WEEKS BEFORE RELOCATION IS REQUIRED
7. DEVELOPER IS RESPONSIBLE TO PROVIDE ALL STREET NAMES AND ADDRESSES WITHIN THREE (3) WEEKS OF UTILITY PLAN APPROVAL. FAILURE TO PROVIDE ADDRESSES WILL RESULT IN A DELAY OF SERVICE TO PROJECT.

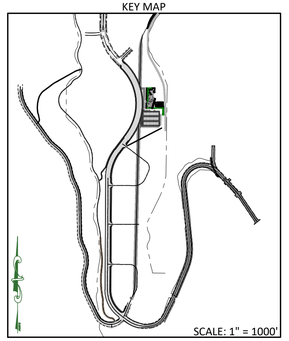
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KEY MAP



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100 0 50 100 200
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SOUTHEAST ACCESS ROAD
AT TECH RIDGE
POWER AND GAS OVERALL

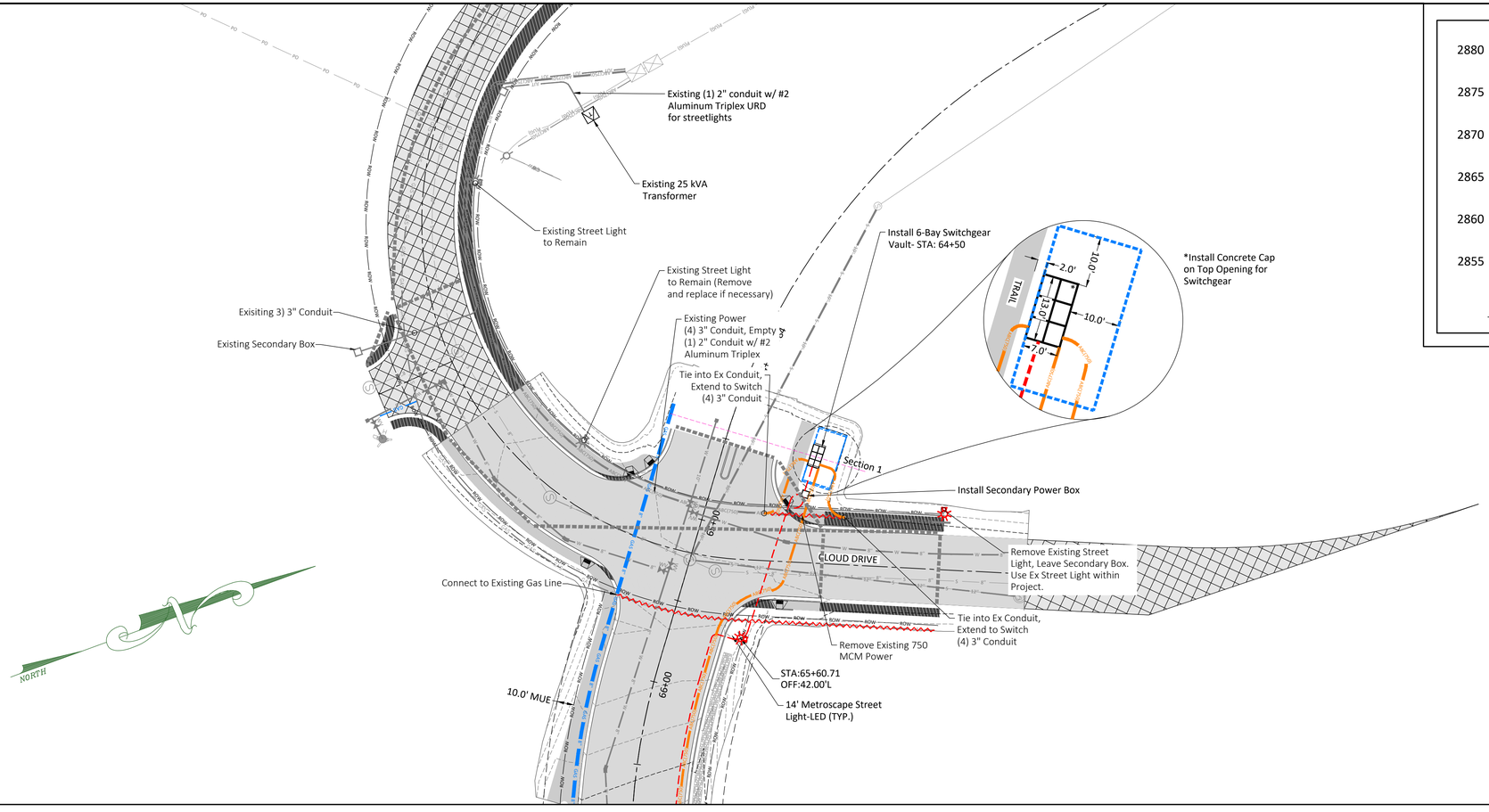
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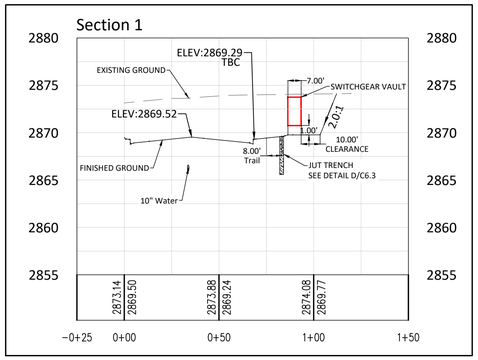
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Sheet 23 of 41 Sheets



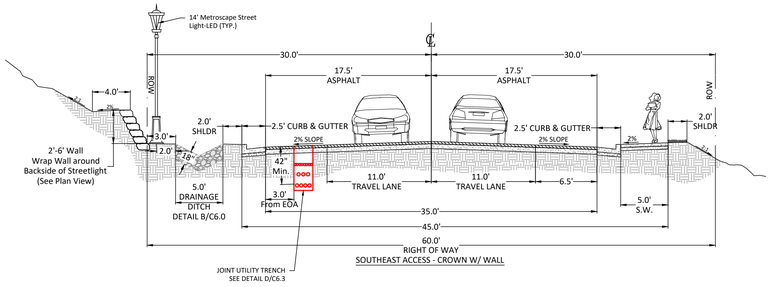


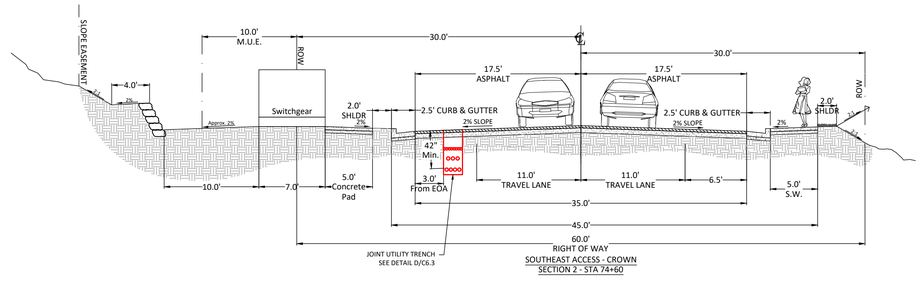
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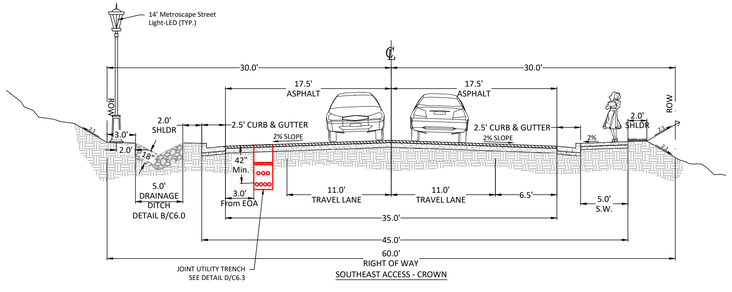
- (4) 3" EMPTY CONDUITS
- (1) 2" Conduit w/ #2 Aluminum Triplex
- SLOPE EASEMENT
- 8" GAS LINE (DEVELOPER WILL STAKE CL OF GAS LINES.)
- EXISTING UNDERGROUND POWERLINE
- 14' METROSCAPE STREET LIGHT-LED
- EXISTING POWER VAULT
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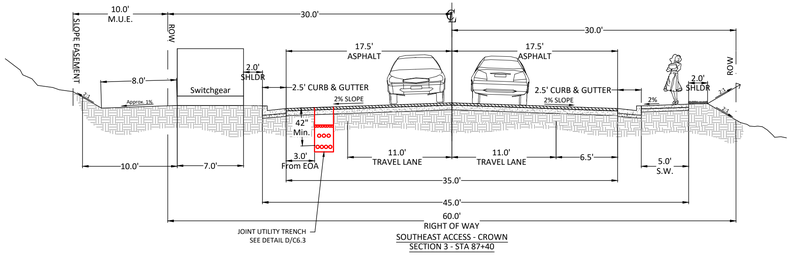
NOTES:

1. See Detail D/C6.3 for typical Joint Utility Trench Detail
2. All Sweeps for 750 power into the concrete vaults shall be concrete encased. Coordinate with SGES.









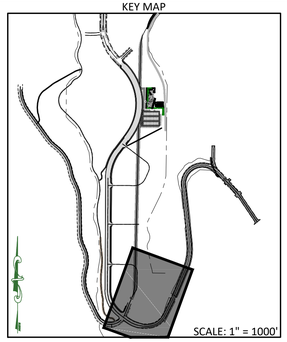
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SOUTHEAST ACCESS ROAD POWER AND GAS

FOR

CITY OF ST. GEORGE

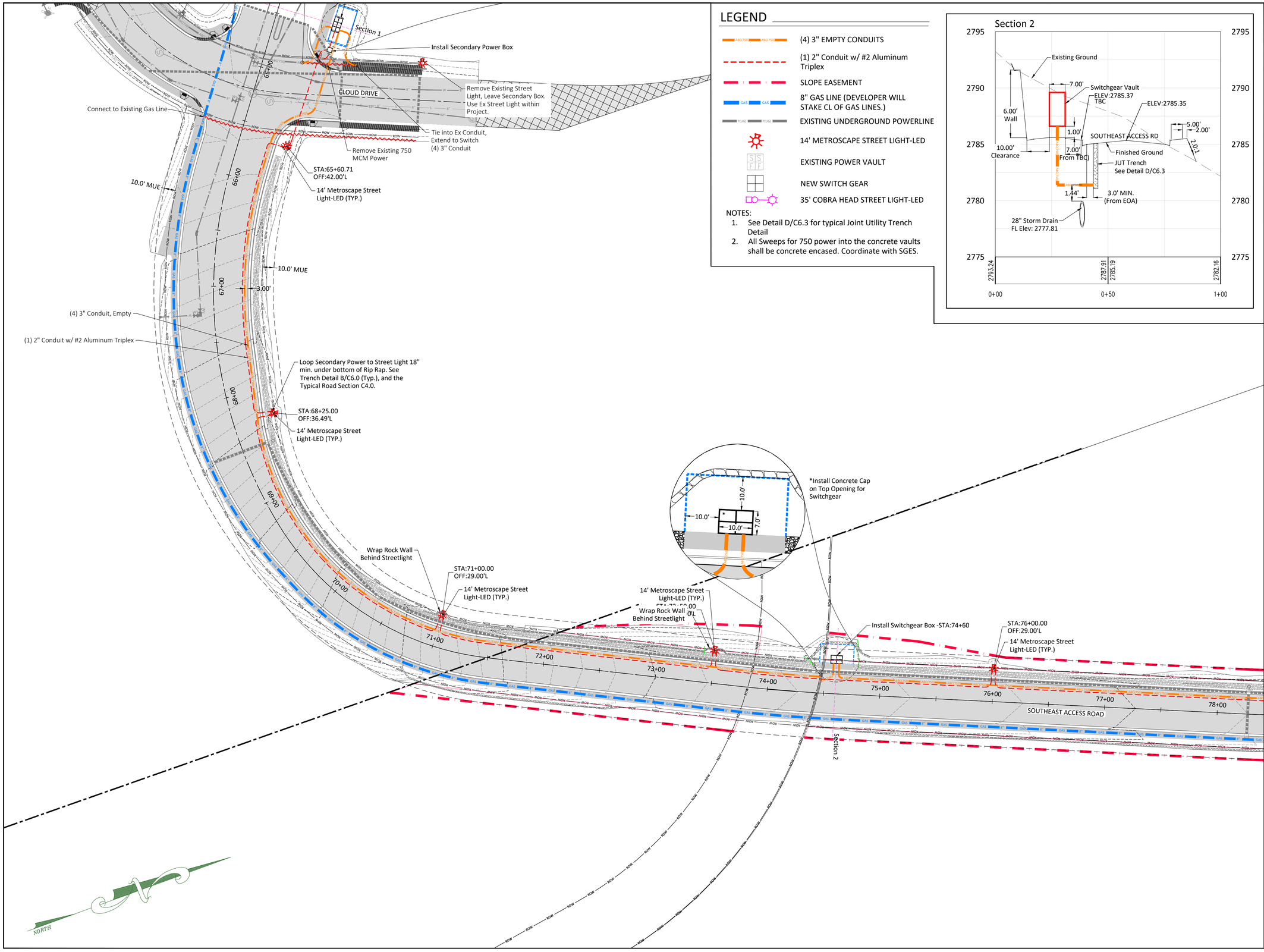
LOCATED IN SEC 36
TOWNSHIP 24 SOUTH, RANGE 15 WEST SLB&M
CITY OF ST. GEORGE, WASHINGTON COUNTY, UT

NOT FOR CONSTRUCTION REVIEW ONLY

Drawn By:	Scale:
AZ	1"=40'
Client No. 4568	Project No. 4568

Drawing Sheet
C4.1

Sheet 24 of 41 Sheets



LEGEND

- (4) 3" EMPTY CONDUITS
- (1) 2" Conduit w/ #2 Aluminum Triplex
- SLOPE EASEMENT
- 8" GAS LINE (DEVELOPER WILL STAKE CL OF GAS LINES.)
- EXISTING UNDERGROUND POWERLINE
- 14' METROSCAPE STREET LIGHT-LED
- EXISTING POWER VAULT
- NEW SWITCH GEAR
- 35' COBRA HEAD STREET LIGHT-LED

NOTES:

1. See Detail D/C6.3 for typical Joint Utility Trench Detail
2. All Sweeps for 750 power into the concrete vaults shall be concrete encased. Coordinate with SGES.

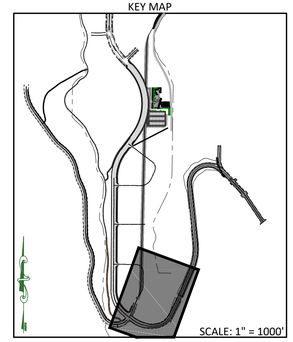
Date: 10-19-2023

REVISIONS

No.	Date	by	Description

File Name
East Access Pwr & Gas OPT 2.dwg

KEY MAP



GRAPHIC SCALE

40 0 20 40 80

(IN FEET)
1 inch = 40 ft.
If Printed 11x17 use Half Scale

ALLIANCE CONSULTING
A PLANNING AND ENGINEERING FIRM

UTAH
2303 N CORAL CANYON BLVD
SUITE 201,
WASHINGTON, UT 84780
435-673-8060

NORTH DAKOTA
621 26th STREET W.
WILLISTON, ND 58801
701-572-8100

SOUTHEAST ACCESS ROAD POWER AND GAS

FOR

CITY OF ST. GEORGE

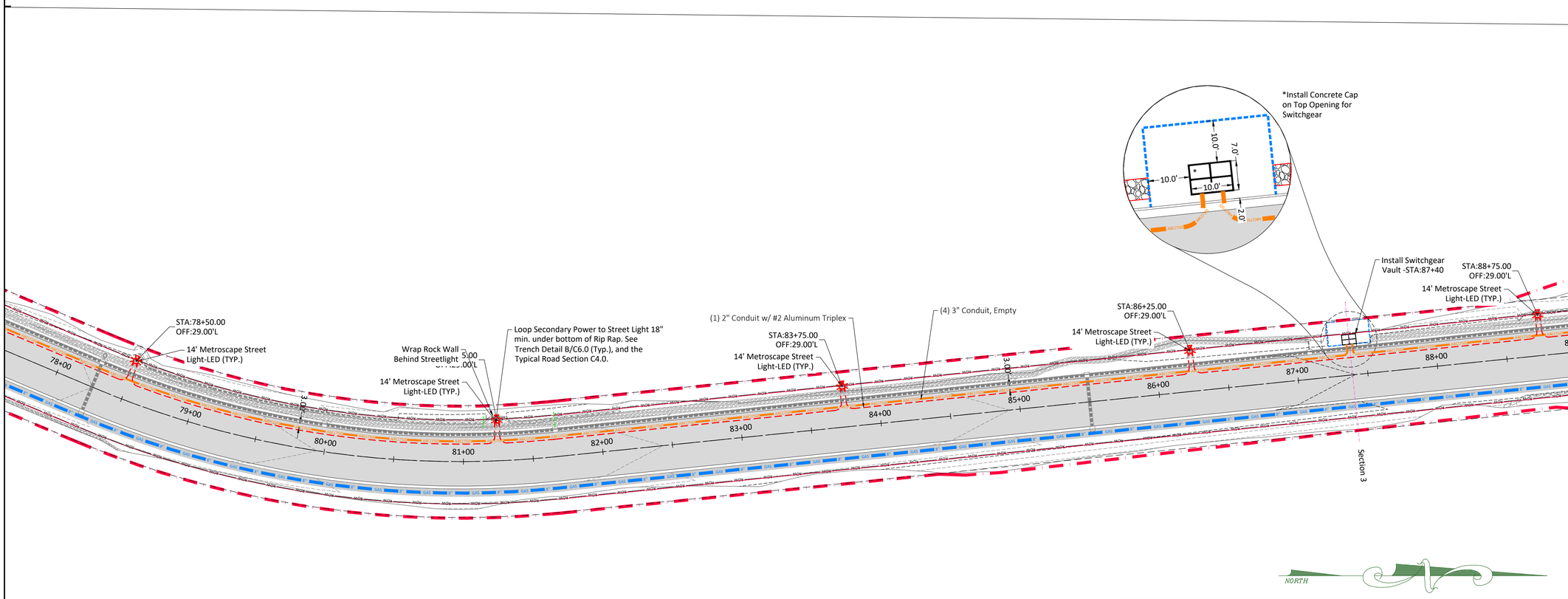
LOCATED IN SEC 36
TOWNSHIP 24 SOUTH, RANGE 15 WEST SLB&M
CITY OF ST. GEORGE, WASHINGTON COUNTY, UT

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Drawn By:	Scale:
AZ	1"=40'
Client No. 4568	Project No. 4568

Drawing Sheet
C4.2

Sheet 25 of 41 Sheets

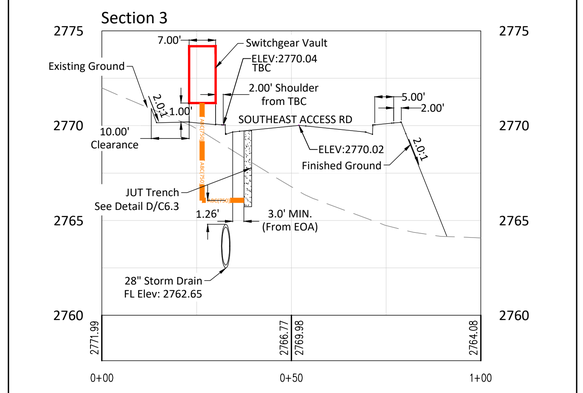


LEGEND

- (4) 3" EMPTY CONDUITS
- (1) 2" Conduit w/ #2 Aluminum Triplex
- SLOPE EASEMENT
- 8" GAS LINE (DEVELOPER WILL STAKE CL OF GAS LINES.)
- EXISTING UNDERGROUND POWERLINE
- 14' METROSCAPE STREET LIGHT-LED
- EXISTING POWER VAULT
- NEW SWITCH GEAR
- 35' COBRA HEAD STREET LIGHT-LED

NOTES:

1. See Detail D/C6.3 for typical Joint Utility Trench Detail
2. All Sweeps for 750 power into the concrete vaults shall be concrete encased. Coordinate with SGES.



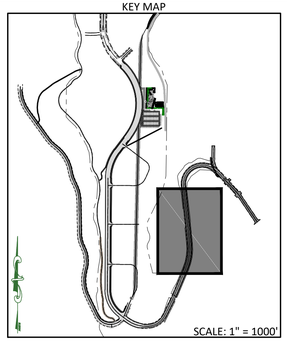
Date: 10-19-2023

REVISIONS

No.	Date	by	Description

File Name
East Access Pwr & Gas OPT 2.dwg

KEY MAP



GRAPHIC SCALE

40 0 20 40 80

(IN FEET)
1 inch = 40 ft.
If Printed 11x17 use Half Scale

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NORTH DAKOTA
621 26th STREET W.
WILLISTON, ND 58801
701-572-8100

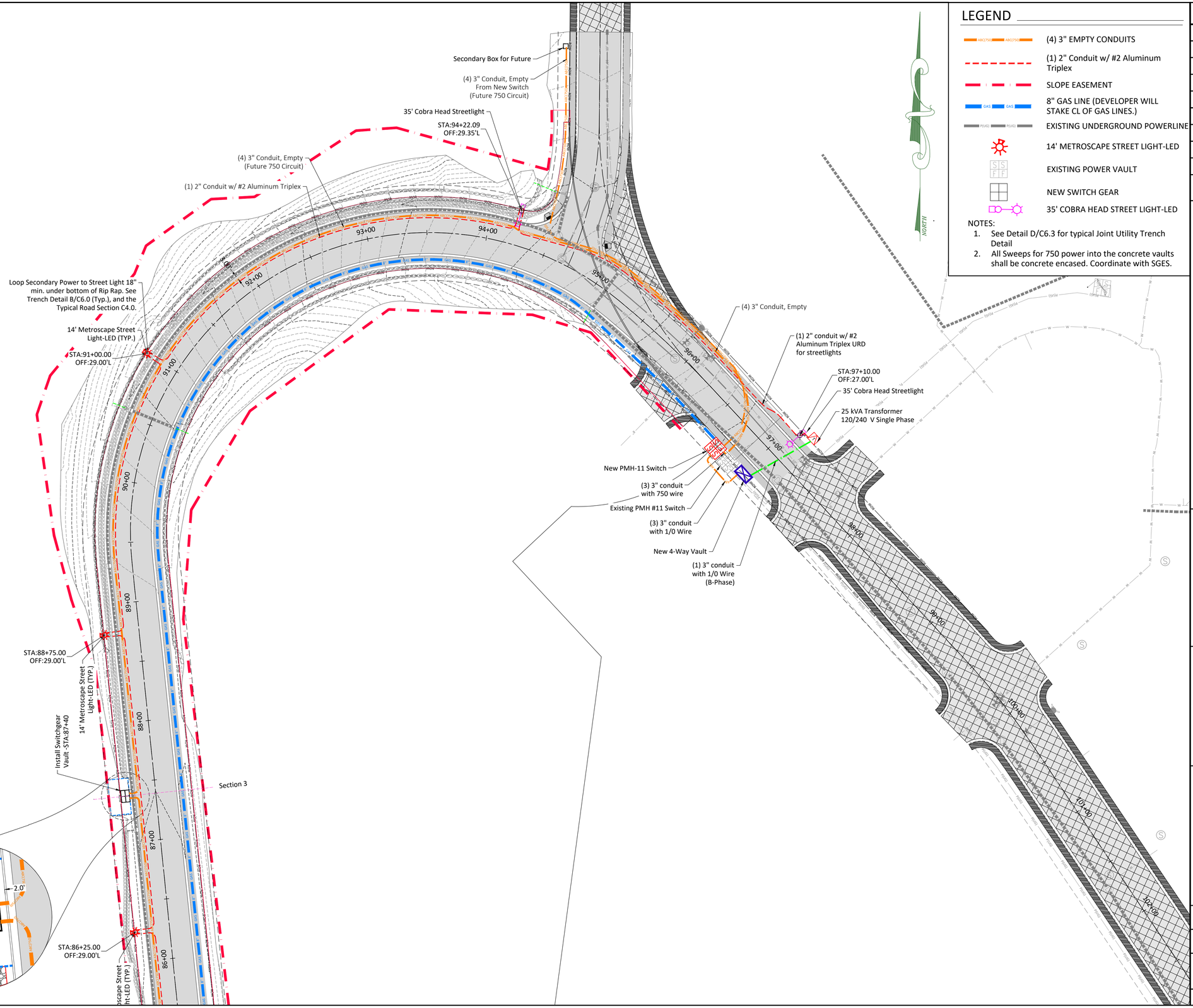
SOUTHEAST ACCESS ROAD
POWER AND GAS
FOR
CITY OF ST. GEORGE
LOCATED IN SEC 36
TOWNSHIP 24 SOUTH, RANGE 15 WEST SLB&M
CITY OF ST. GEORGE, WASHINGTON COUNTY, UT

NOT FOR CONSTRUCTION REVIEW ONLY

Drawn By:	Scale:
AZ	1"=40'
Client No.	Project No.
4568	4568

Drawing Sheet
C4.3

Sheet 26 of 41 Sheets



LEGEND

- (4) 3" EMPTY CONDUITS
- (1) 2" Conduit w/ #2 Aluminum Triplex
- SLOPE EASEMENT
- 8" GAS LINE (DEVELOPER WILL STAKE CL OF GAS LINES.)
- EXISTING UNDERGROUND POWERLINE
- 14' METROSCAPE STREET LIGHT-LED
- EXISTING POWER VAULT
- NEW SWITCH GEAR
- 35' COBRA HEAD STREET LIGHT-LED

NOTES:

1. See Detail D/C6.3 for typical Joint Utility Trench Detail
2. All Sweeps for 750 power into the concrete vaults shall be concrete encased. Coordinate with SGES.

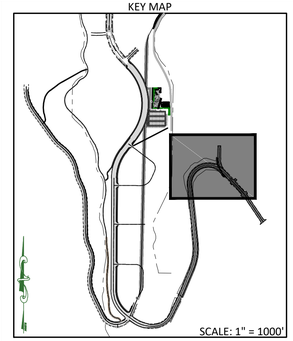
Date: 10-19-2023

REVISIONS

No.	Date	by	Description

File Name
East Access Pwr & Gas OPT 2.dwg

KEY MAP



GRAPHIC SCALE

40 0 20 40 80

(IN FEET)
1 inch = 40 ft.
If Printed 11x17 use Half Scale

ALLIANCE CONSULTING
A PLANNING AND ENGINEERING FIRM

UTAH
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701-572-8100

SOUTHEAST ACCESS ROAD POWER AND GAS

FOR

CITY OF ST. GEORGE

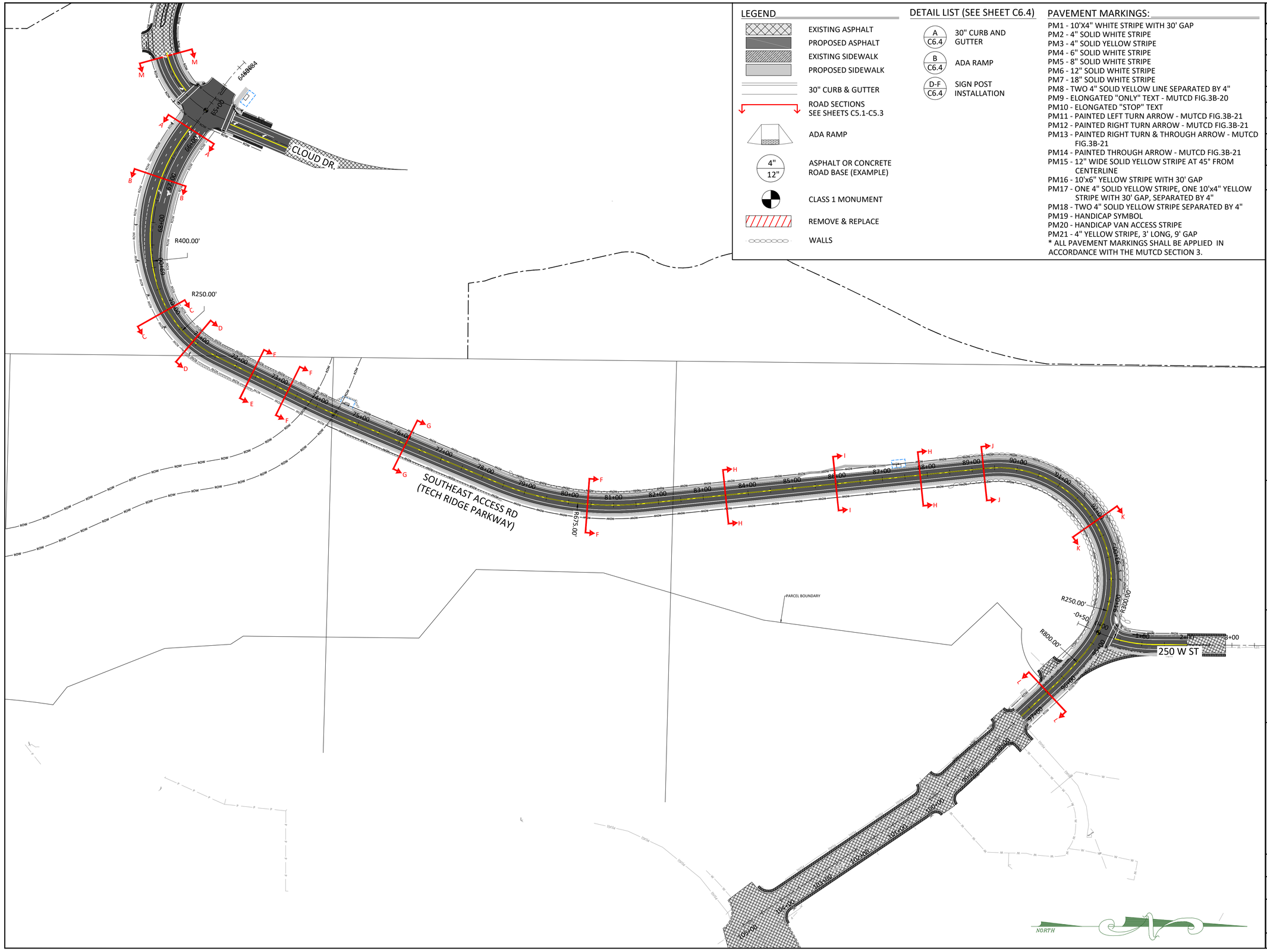
LOCATED IN SEC 36
TOWNSHIP 24 SOUTH, RANGE 15 WEST SLB&M
CITY OF ST. GEORGE, WASHINGTON COUNTY, UT

NOT FOR CONSTRUCTION REVIEW ONLY

Drawn By:	Scale:
AZ	1"=40'
Client No. 4568	Project No. 4568

Drawing Sheet
C4.4

Sheet 27 of 41 Sheets



LEGEND

- EXISTING ASPHALT
- PROPOSED ASPHALT
- EXISTING SIDEWALK
- PROPOSED SIDEWALK
- 30" CURB & GUTTER
- ROAD SECTIONS SEE SHEETS C5.1-C5.3
- ADA RAMP
- 4" / 12" ASPHALT OR CONCRETE ROAD BASE (EXAMPLE)
- CLASS 1 MONUMENT
- REMOVE & REPLACE
- WALLS

DETAIL LIST (SEE SHEET C6.4)

- A / C6.4 — 30" CURB AND GUTTER
- B / C6.4 — ADA RAMP
- D-F / C6.4 — SIGN POST INSTALLATION

PAVEMENT MARKINGS:

PM1 - 10'X4" WHITE STRIPE WITH 30' GAP
PM2 - 4" SOLID WHITE STRIPE
PM3 - 4" SOLID YELLOW STRIPE
PM4 - 6" SOLID WHITE STRIPE
PM5 - 8" SOLID WHITE STRIPE
PM6 - 12" SOLID WHITE STRIPE
PM7 - 18" SOLID WHITE STRIPE
PM8 - TWO 4" SOLID YELLOW LINE SEPARATED BY 4"
PM9 - ELONGATED "ONLY" TEXT - MUTCD FIG.3B-20
PM10 - ELONGATED "STOP" TEXT
PM11 - PAINTED LEFT TURN ARROW - MUTCD FIG.3B-21
PM12 - PAINTED RIGHT TURN ARROW - MUTCD FIG.3B-21
PM13 - PAINTED RIGHT TURN & THROUGH ARROW - MUTCD FIG.3B-21
PM14 - PAINTED THROUGH ARROW - MUTCD FIG.3B-21
PM15 - 12" WIDE SOLID YELLOW STRIPE AT 45° FROM CENTERLINE
PM16 - 10'x6" YELLOW STRIPE WITH 30' GAP
PM17 - ONE 4" SOLID YELLOW STRIPE, ONE 10'x4" YELLOW STRIPE WITH 30' GAP, SEPARATED BY 4"
PM18 - TWO 4" SOLID YELLOW STRIPE SEPARATED BY 4"
PM19 - HANDICAP SYMBOL
PM20 - HANDICAP VAN ACCESS STRIPE
PM21 - 4" YELLOW STRIPE, 3' LONG, 9' GAP
* ALL PAVEMENT MARKINGS SHALL BE APPLIED IN ACCORDANCE WITH THE MUTCD SECTION 3.

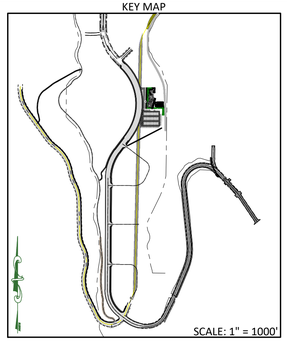
Date: 10-19-2023

REVISIONS

No.	Date	by	Description

File Name
East Access Paving OPT 2.dwg

KEY MAP



GRAPHIC SCALE

100 0 50 100 200

(IN FEET)
1 inch = 100 ft.
If Printed 11x17 use Half Scale

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621 26th STREET W.
WILLISTON, ND 58801
701-572-8100

SOUTHEAST ACCESS ROAD AT TECH RIDGE PAVING OVERALL

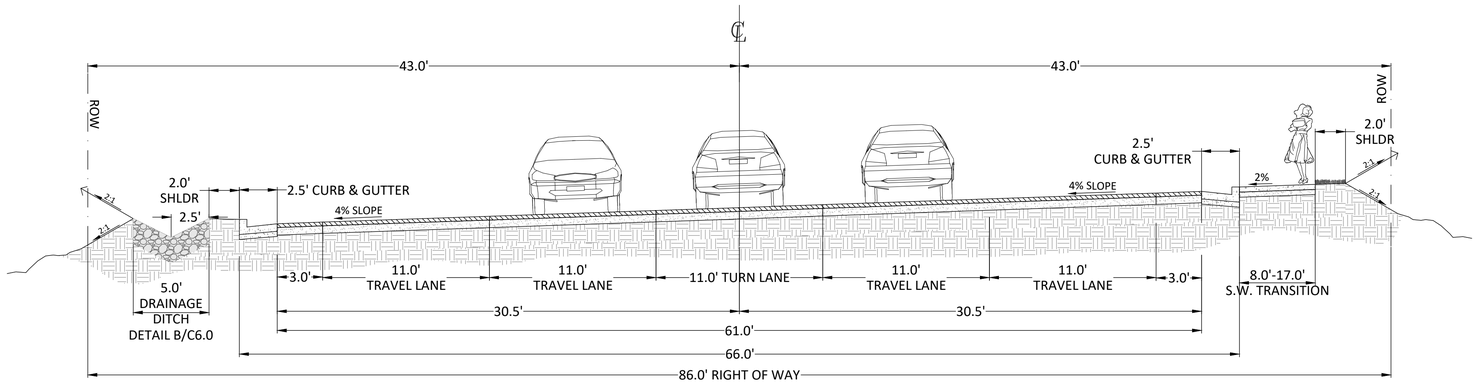
FOR
CITY OF ST. GEORGE
LOCATED IN
ST. GEORGE CITY
WASHINGTON COUNTY, UT

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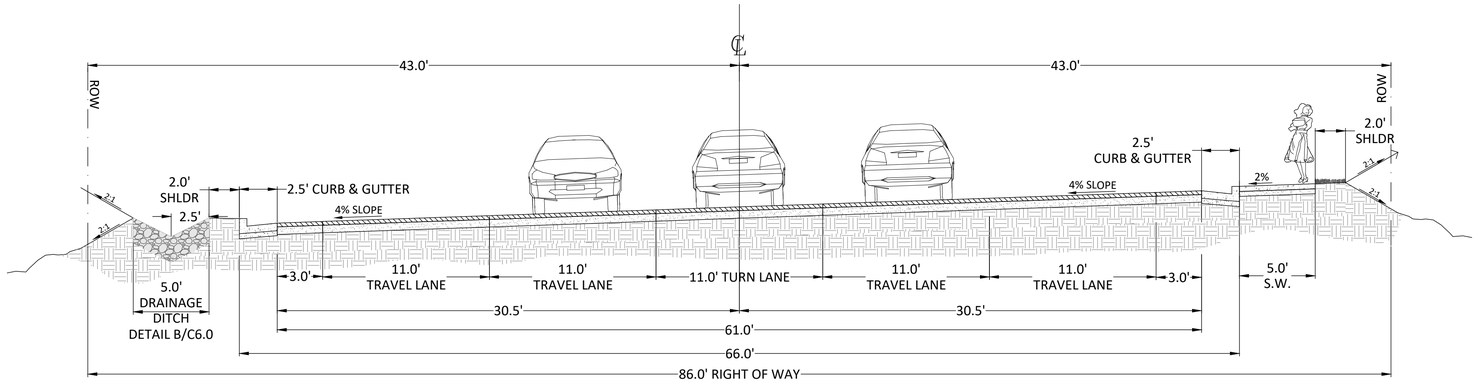
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Client No. 4568-21	Project No. 4568-21

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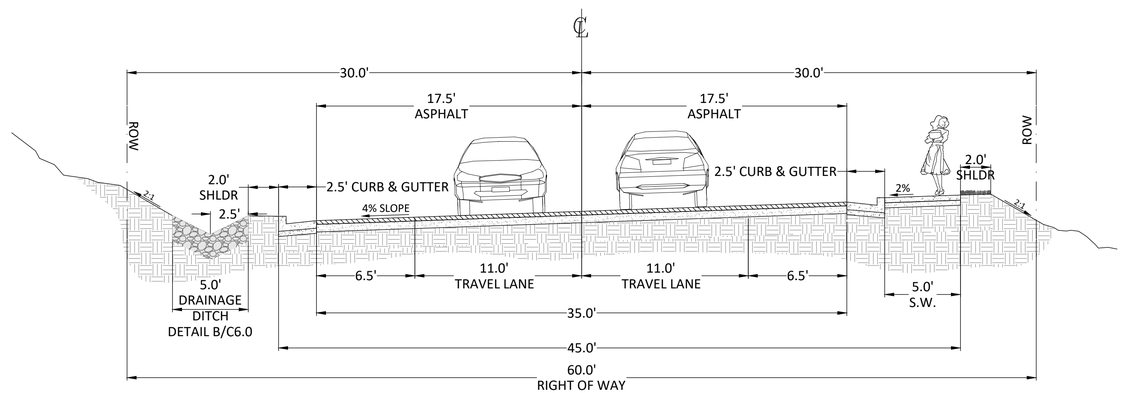
Sheet 28 of 41 Sheets



SOUTHEAST ACCESS - SUPER
SECTION A-A
STA 65+71.47 TO 66+75.0



SOUTHEAST ACCESS - SUPER
SECTION B-B
STA 66+75.0 TO 67+52.50



SOUTHEAST ACCESS-SUPER
SECTION C-C
STA 69+62+60 TO 70+80.0

Date: 10-19-2023

REVISIONS

No.	Date	by	Description

File Name
East Access Paving OPT 2.dwg

ALLIANCE CONSULTING
A PLANNING AND ENGINEERING FIRM

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NORTH DAKOTA
621 26th STREET W.
WILLISTON, ND 58801
701-572-8100

SOUTHEAST ACCESS ROAD CROSS-SECTIONS

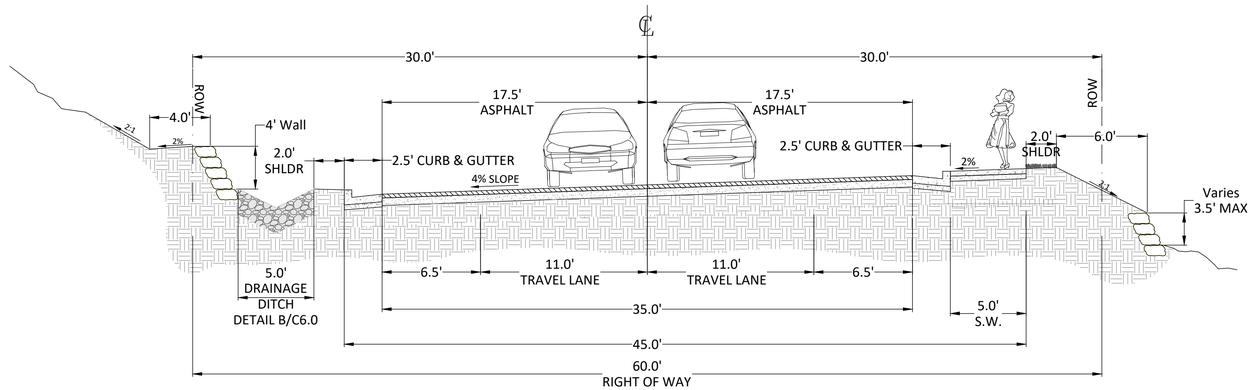
FOR
CITY OF ST. GEORGE
LOCATED IN
ST. GEORGE CITY
WASHINGTON COUNTY, UT

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REVIEW ONLY

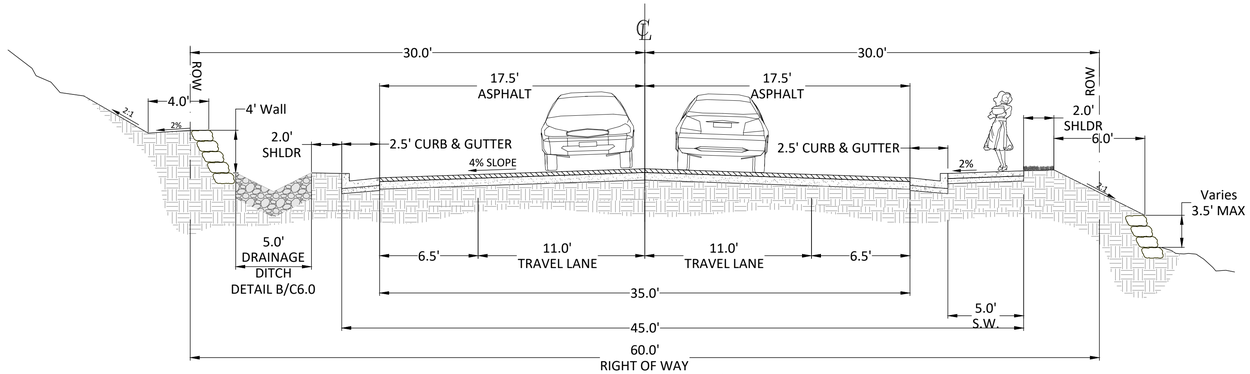
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Drawing Sheet
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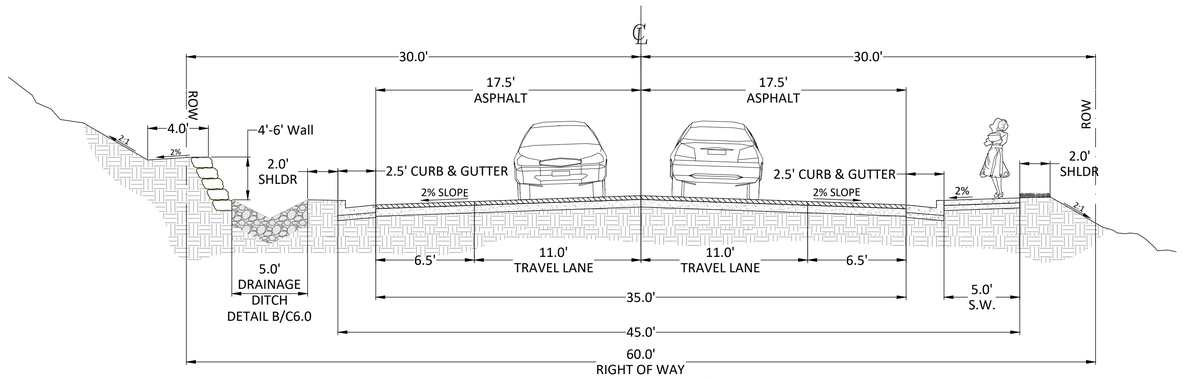
Sheet 29 of 41 Sheets



SOUTHEAST ACCESS - SUPER W/ WALLS
SECTION D-D
STA 70+80.0 TO 72+35.0



SOUTHEAST ACCESS - CROWN W/ WALLS
SECTION E-E
STA 72+35.0 TO 72+60.0



SOUTHEAST ACCESS - CROWN W/ WALL LEFT
SECTION F-F
STA 72+60.00 TO 74+44.90
STA 78+60.00 TO 82+15.50

Date: 10-19-2023

REVISIONS

No.	Date	by	Description

File Name
East Access Paving OPT 2.dwg

ALLIANCE CONSULTING
A PLANNING AND ENGINEERING FIRM

UTAH
2303 N CORAL CANYON BLVD
SUITE 201,
WASHINGTON, UT 84780
435-673-8060

NORTH DAKOTA
621 26th STREET W.
WILLISTON, ND 58801
701-572-8100

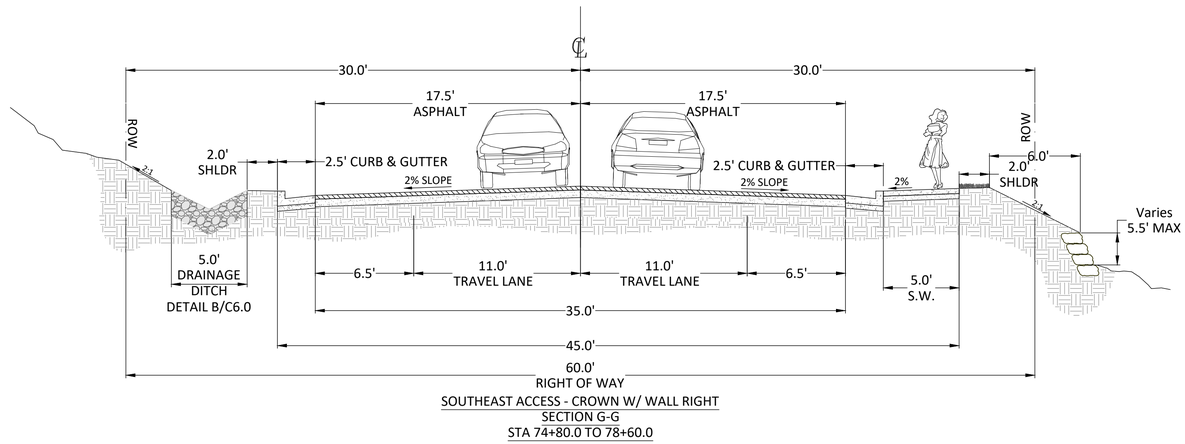
SOUTHEAST ACCESS ROAD
CROSS SECTIONS

FOR
CITY OF ST. GEORGE
LOCATED IN
ST. GEORGE CITY
WASHINGTON COUNTY, UT

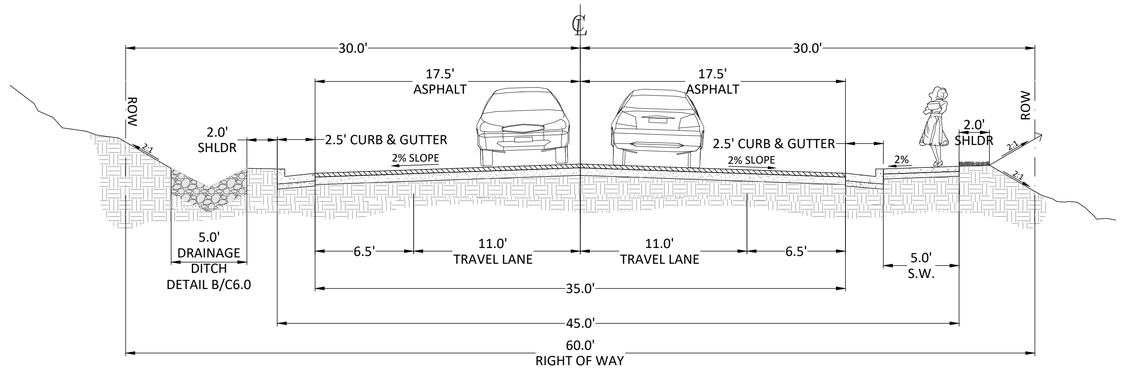
NOT FOR
CONSTRUCTION
REVIEW ONLY

Drawn By:	Scale:
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Client No. 4568-21	Project No. 4568-21

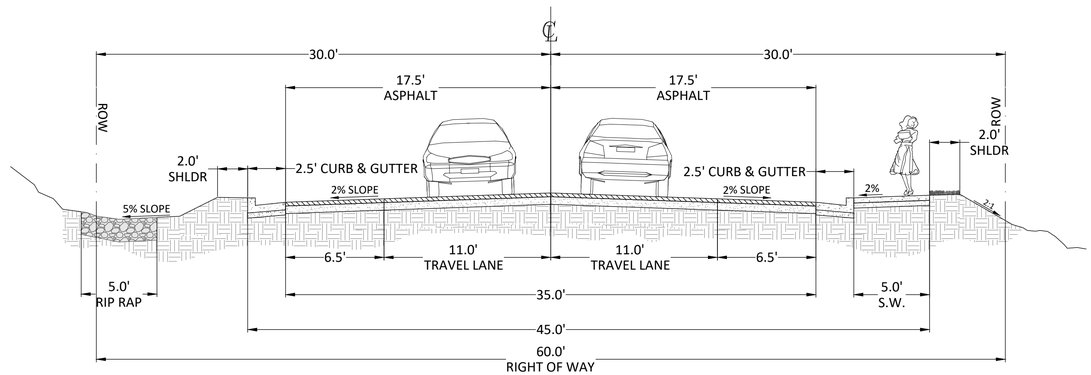
Drawing Sheet
C5.2



SOUTHEAST ACCESS - CROWN W/ WALL RIGHT
SECTION G-G
STA 74+80.0 TO 78+60.0



SOUTHEAST ACCESS - CROWN
SECTION H-H
STA 82+15.50 TO 85+10
STA 87+10.0 TO 88+48.42



SOUTHEAST ACCESS - CROWN
SECTION I-I
STA 85+10.0 TO 87+10.0

Date: 10-19-2023

REVISIONS

No.	Date	by	Description

File Name
East Access Paving OPT 2.dwg

ALLIANCE CONSULTING
A PLANNING AND ENGINEERING FIRM

UTAH
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SUITE 201,
WASHINGTON, UT 84780
435-673-8060

NORTH DAKOTA
621 26th STREET W.
WILLISTON, ND 58801
701-572-8100

SOUTHEAST ACCESS ROAD CROSS SECTIONS

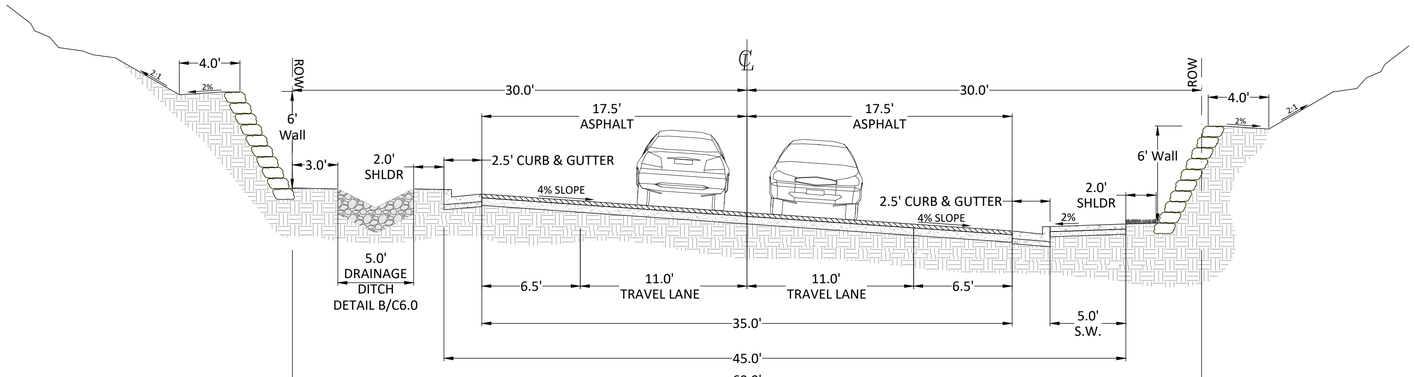
FOR
CITY OF ST. GEORGE
LOCATED IN
ST. GEORGE CITY
WASHINGTON COUNTY, UT

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REVIEW ONLY

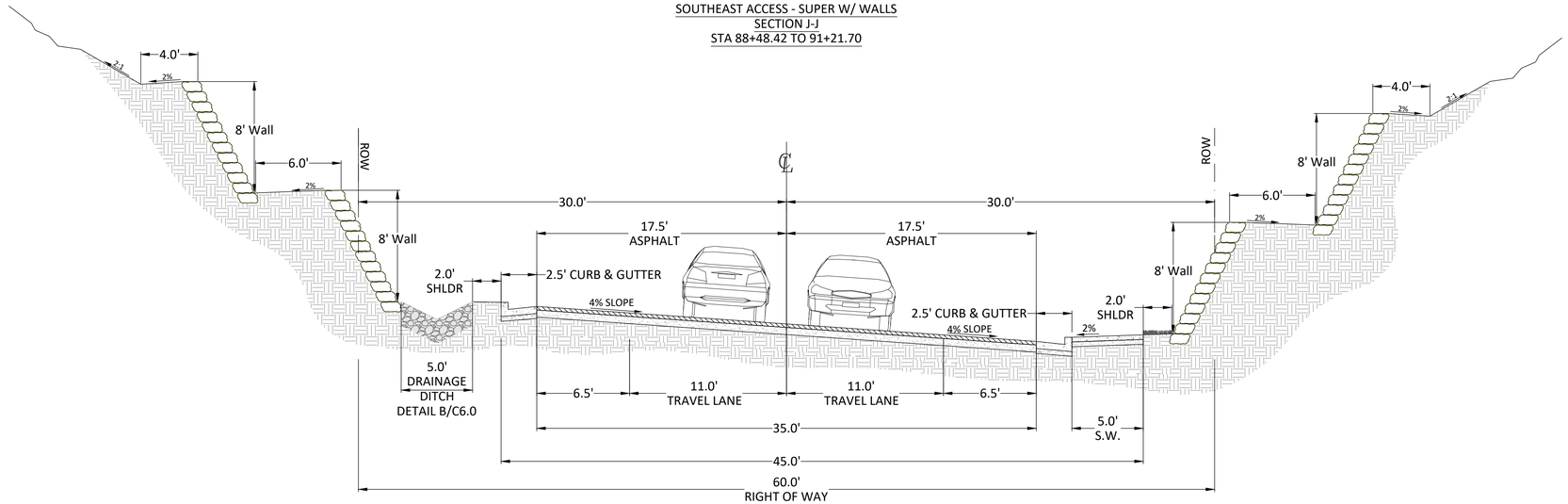
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Client No. 4568-21	Project No. 4568-21

Drawing Sheet
C5.3

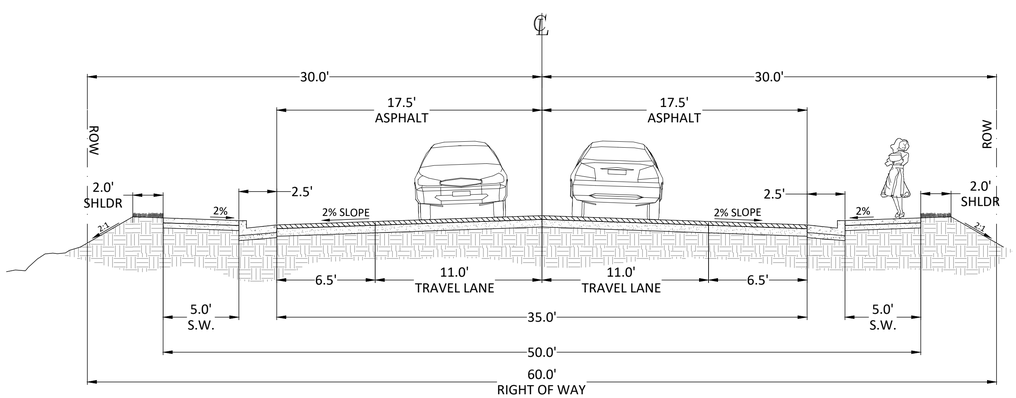
Sheet 31 of 41 Sheets



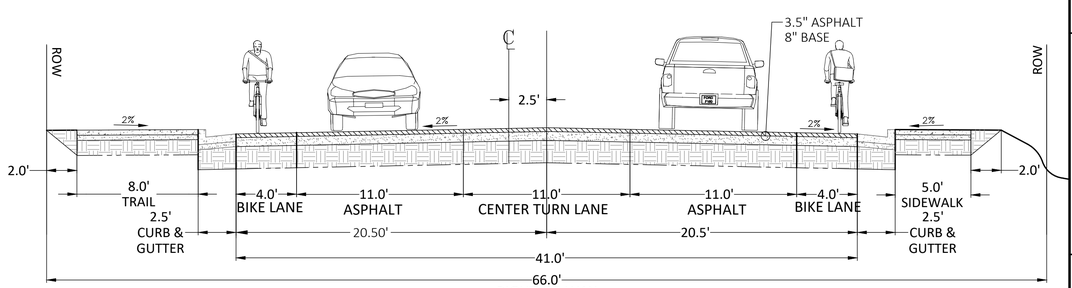
SOUTHEAST ACCESS - SUPER W/ WALLS
SECTION J-J
STA 88+48.42 TO 91+21.70



SOUTHEAST ACCESS - SUPER W/ 2 TIER WALLS
SECTION K-K
STA 91+21.70 TO 94+23.30



SOUTHEAST ACCESS - CROWN
SECTION L-L
STA 95+38.50 TO 97+26.00



CLOUD DRIVE - CROWN
SECTION M-M

Date: 10-19-2023

REVISIONS

No.	Date	by	Description

File Name
East Access Paving OPT 2.dwg

ALLIANCE CONSULTING
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NORTH DAKOTA
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WILLISTON, ND 58801
701-572-8100

SOUTHEAST ACCESS ROAD CROSS SECTIONS

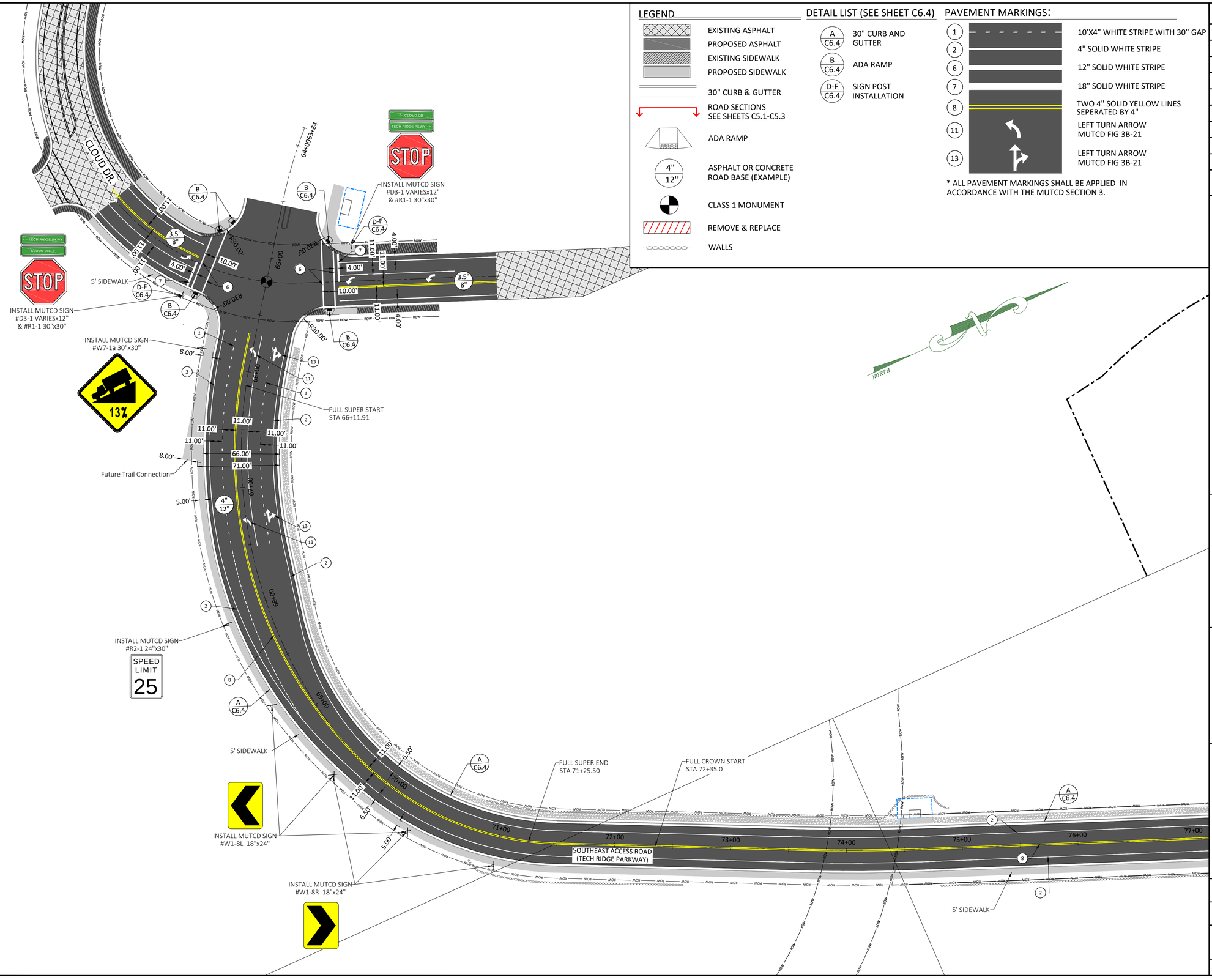
FOR
CITY OF ST. GEORGE
LOCATED IN
ST. GEORGE CITY
WASHINGTON COUNTY, UT

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Drawn By:	Scale:
AZ	NONE
Client No.	Project No.
4568-21	4568-21

Drawing Sheet
C5.4

Sheet 32 of 41 Sheets



LEGEND

- EXISTING ASPHALT
- PROPOSED ASPHALT
- EXISTING SIDEWALK
- PROPOSED SIDEWALK
- 30" CURB & GUTTER
- ROAD SECTIONS SEE SHEETS C5.1-C5.3
- ADA RAMP
- 4" / 12" ASPHALT OR CONCRETE ROAD BASE (EXAMPLE)
- CLASS 1 MONUMENT
- REMOVE & REPLACE
- WALLS

DETAIL LIST (SEE SHEET C6.4)

- A C6.4 — 30" CURB AND GUTTER
- B C6.4 — ADA RAMP
- D-F C6.4 — SIGN POST INSTALLATION

PAVEMENT MARKINGS:

- 1 — 10'X4" WHITE STRIPE WITH 30" GAP
- 2 — 4" SOLID WHITE STRIPE
- 6 — 12" SOLID WHITE STRIPE
- 7 — 18" SOLID WHITE STRIPE
- 8 — TWO 4" SOLID YELLOW LINES SEPERATED BY 4"
- 11 — LEFT TURN ARROW MUTCD FIG 3B-21
- 13 — LEFT TURN ARROW MUTCD FIG 3B-21

* ALL PAVEMENT MARKINGS SHALL BE APPLIED IN ACCORDANCE WITH THE MUTCD SECTION 3.

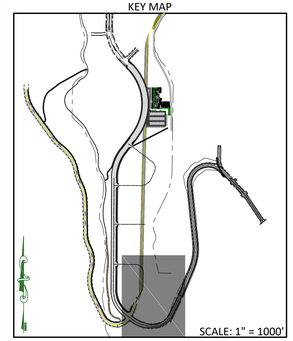
Date: 10-19-2023

REVISIONS

No.	Date	by	Description

File Name
East Access Paving OPT 2.dwg

KEY MAP



GRAPHIC SCALE

40 0 20 40 80

(IN FEET)
1 inch = 40 ft.
If Printed 11x17 use Half Scale

ALLIANCE CONSULTING
A PLANNING AND ENGINEERING FIRM

UTAH
2303 N CORAL CANYON BLVD
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621 26th STREET W.
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SOUTHEAST ACCESS ROAD PAVING

FOR
CITY OF ST. GEORGE
LOCATED IN
ST. GEORGE CITY
WASHINGTON COUNTY, UT

NOT FOR CONSTRUCTION REVIEW ONLY

Drawn By:	Scale:
AZ	1"=40'
Client No. 4568-21	Project No. 4568-21

Drawing Sheet
C5.5

Sheet 33 of 41 Sheets

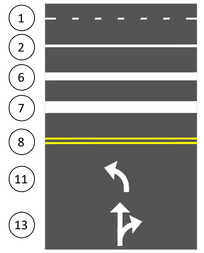
DETAIL LIST (SEE SHEET C6.4)

- A / C6.4 — 30" CURB AND GUTTER
- B / C6.4 — ADA RAMP
- D-F / C6.4 — SIGN POST INSTALLATION

LEGEND

- EXISTING ASPHALT
- PROPOSED ASPHALT
- EXISTING SIDEWALK
- PROPOSED SIDEWALK
- 30" CURB & GUTTER
- ROAD SECTIONS SEE SHEETS C5.1-C5.3
- ADA RAMP
- 4" / 12" — ASPHALT OR CONCRETE ROAD BASE (EXAMPLE)
- CLASS 1 MONUMENT
- REMOVE & REPLACE
- WALLS

PAVEMENT MARKINGS:



1. 10'X4" WHITE STRIPE WITH 30" GAP
2. 4" SOLID WHITE STRIPE
6. 12" SOLID WHITE STRIPE
7. 18" SOLID WHITE STRIPE
8. TWO 4" SOLID YELLOW LINES SEPERATED BY 4"
11. LEFT TURN ARROW MUTCD FIG 3B-21
13. LEFT TURN ARROW MUTCD FIG 3B-21

* ALL PAVEMENT MARKINGS SHALL BE APPLIED IN ACCORDANCE WITH THE MUTCD SECTION 3.



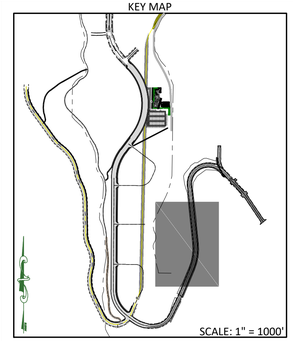
Date: 10-19-2023

REVISIONS

No.	Date	by	Description

File Name
East Access Paving OPT 2.dwg

KEY MAP



GRAPHIC SCALE

40 0 20 40 80

(IN FEET)
1 inch = 40 ft.
If Printed 11x17 use Half Scale

ALLIANCE CONSULTING
A PLANNING AND ENGINEERING FIRM

UTAH
2303 N CORAL CANYON BLVD
SUITE 201,
WASHINGTON, UT 84780
435-673-8060

NORTH DAKOTA
621 26th STREET W.
WILLISTON, ND 58801
701-572-8100

SOUTHEAST ACCESS ROAD PAVING

FOR
CITY OF ST. GEORGE
LOCATED IN
ST. GEORGE CITY
WASHINGTON COUNTY, UT

NOT FOR CONSTRUCTION REVIEW ONLY

Drawn By:	Scale:
AZ	1"=40'
Client No.	Project No.
4568-21	4568-21

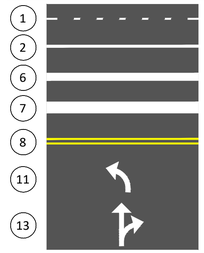
Drawing Sheet
C5.6

Sheet 34 of 41 Sheets

LEGEND

- EXISTING ASPHALT
- PROPOSED ASPHALT
- EXISTING SIDEWALK
- PROPOSED SIDEWALK
- 30" CURB & GUTTER
- ROAD SECTIONS SEE SHEETS C5.1-C5.3
- ADA RAMP
- 4" / 12" ASPHALT OR CONCRETE ROAD BASE (EXAMPLE)
- CLASS 1 MONUMENT
- REMOVE & REPLACE
- WALLS

PAVEMENT MARKINGS:

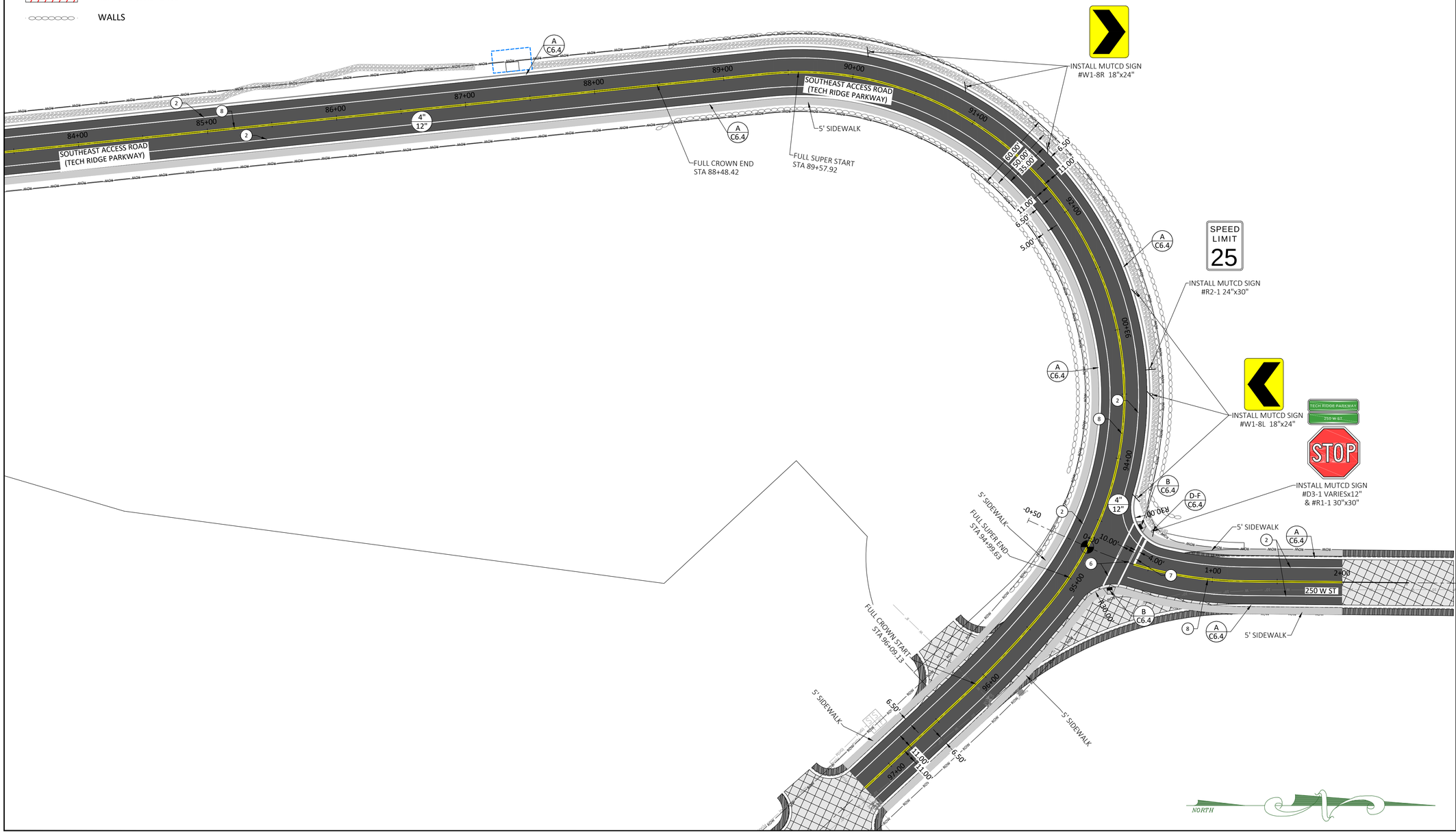


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13. LEFT TURN ARROW MUTCD FIG 3B-21

* ALL PAVEMENT MARKINGS SHALL BE APPLIED IN ACCORDANCE WITH THE MUTCD SECTION 3.

DETAIL LIST (SEE SHEET C6.4)

- A C6.4 — 30" CURB AND GUTTER
- B C6.4 — ADA RAMP
- D-F C6.4 — SIGN POST INSTALLATION



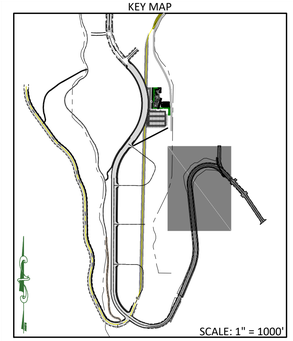
Date: 10-19-2023

REVISIONS

No.	Date	by	Description

File Name: East Access Paving OPT 2.dwg

KEY MAP



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SOUTHEAST ACCESS ROAD PAVING

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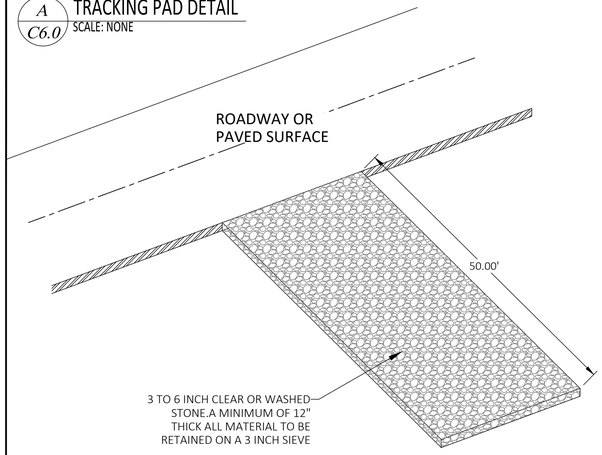
Drawn By:	Scale:
AZ	1"=40'
Client No. 4568-21	Project No. 4568-21

Drawing Sheet: C5.7

Sheet 35 of 41 Sheets

A C6.0 TRACKING PAD DETAIL

SCALE: NONE

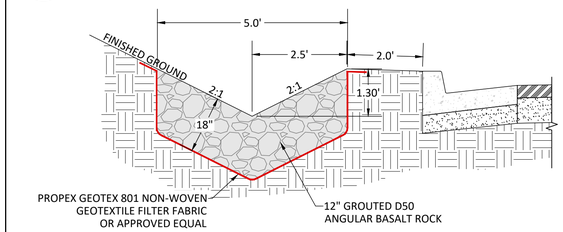


NOTES:

1. DIVERT FLOW AWAY FROM TRACKING PAD USING CULVERTS, SHALLOW TRENCH OR DIVERSION DAM.
2. ROCKS LODGED BETWEEN THE TIRES OF DUAL VEHICLES SHALL BE REMOVED PRIOR TO LEAVING THE SITE.
3. ON SITES WITH A HIGH WATER TABLE OR SATURATED SOILS. INSTALL A GEOTEXTILE FABRIC UNDER STONE TRACKING PAD.
4. THE ENTRANCE SHALL BE MAINTAINED IN A CONDITION THAT WILL PREVENT TRACKING OR FLOWING OF SEDIMENT ONTO PUBLIC RIGHT-OF-WAY. THIS MAY REQUIRE TOP DRESSING, REPAIR AND /OR CLEANOUT OF ANY MEASURES USED TO TRAP SEDIMENT.

B C6.0 RIP RAP DITCH DETAIL

SCALE: NONE



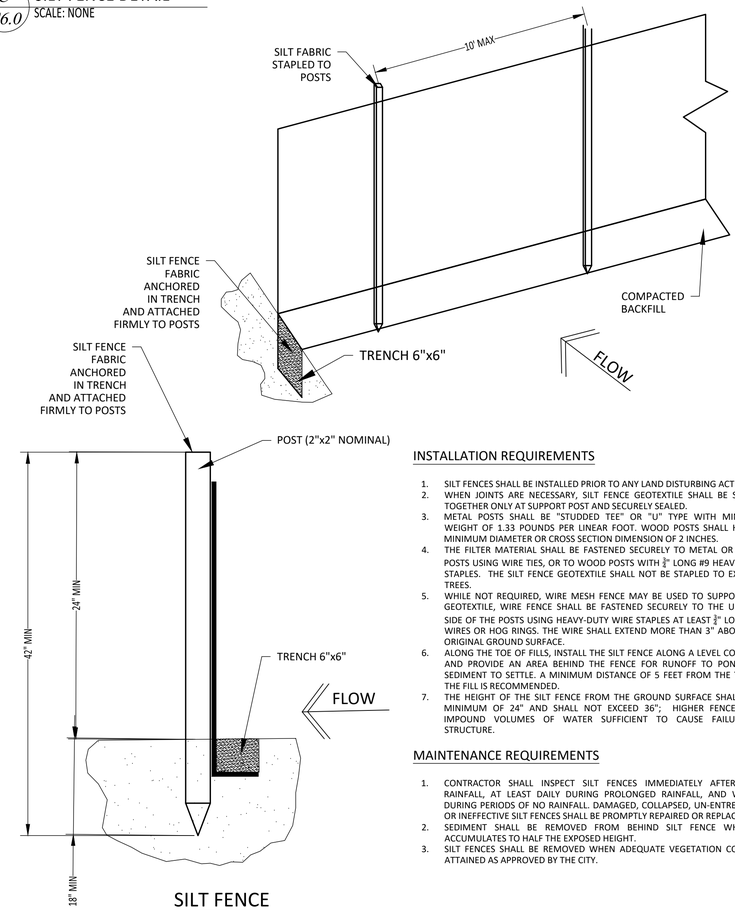
1. FILTER FABRIC SHALL BE PROPEX GEOTEX 801 WOVEN GEOTEXTILE OR AN APPROVED EQUAL. FABRIC SHALL BE PLACED AS SHOWN HEREON AND INSTALLED ACCORDING TO MANUFACTURER'S INSTRUCTIONS. CARE SHALL BE TAKEN TO PREVENT FABRIC FROM TEARING DURING ROCK PLACEMENT.
2. ROCK USED FOR HAND PLACED RIP-RAP SHALL BE HARD, DURABLE, ANGULAR IN SHAPE, AND FREE FROM CRACKS, OVERBURDEN, SHALE, AND ORGANIC MATTER. NEITHER BREADTH NOR THICKNESS OF A SINGLE STONE SHALL BE LESS THAN 1/3 ITS LENGTH AND ROUNDED STONES SHALL BE AVOIDED. ROCK HAVING A MINIMUM SPECIFIC GRAVITY OF 2.60 IS PREFERRED; HOWEVER, IN NO CASE SHOULD ROCK HAVE A SPECIFIC GRAVITY LESS THAN 2.50. CLASSIFICATION AND GRADATION FOR RIPRAP IS SHOWN IN THE ROCK GRADATION TABLE. ALL ROCK RIP-RAP SHALL BE INSPECTED BY THE ENGINEER PRIOR TO BACKFILLING.
3. RIP-RAP THICKNESS SHALL BE 2 X MAX. ROCK DIA.

ROCK GRADATION TABLE

Loose Riprap Gradations		Riprap D_{50}**				
Stone Diameter Range (ft)	Percent of Gradation Smaller Than	12"	14"	18"	24"	30"
1.5 D_{50} to 1.7D_{50}	100	18-20	21-24	27-31	36-41	45-51
1.2 D_{50} to 1.4D_{50}	85	14-17	17-20	22-25	29-34	36-42
1.0 D_{50} to 1.15D_{50}	50	12-14	14-16	18-21	24-28	30-35
0.4 D_{50} to 0.6D_{50}	15	5-7	6-9	7-11	10-15	12-18
0.1 D_{50}	10	1	1.5	2	2.5	3
*D50 = Nominal particle size						

C C6.0 SILT FENCE DETAIL

SCALE: NONE



SILT FENCE

INSTALLATION REQUIREMENTS

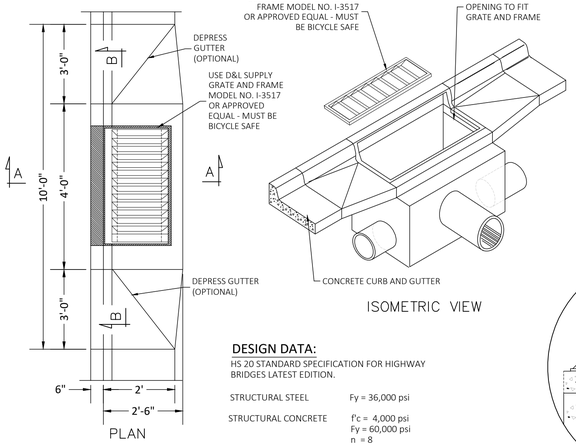
1. SILT FENCES SHALL BE INSTALLED PRIOR TO ANY LAND DISTURBING ACTIVITY.
2. WHEN JOINTS ARE NECESSARY, SILT FENCE GEOTEXTILE SHALL BE SPLICED TOGETHER ONLY AT SUPPORT POST AND SECURELY SEALED.
3. METAL POSTS SHALL BE "STUDDED TEE" OR "U" TYPE WITH MINIMUM WEIGHT OF 1.33 POUNDS PER LINEAR FOOT. WOOD POSTS SHALL HAVE A MINIMUM DIAMETER OR CROSS SECTION DIMENSION OF 2 INCHES.
4. THE FILTER MATERIAL SHALL BE FASTENED SECURELY TO METAL OR WOOD POSTS USING WIRE TIES, OR TO WOOD POSTS WITH $\frac{3}{4}$" LONG #9 HEAVY-DUTY STAPLES. THE SILT FENCE GEOTEXTILE SHALL NOT BE STAPLED TO EXISTING TREES.
5. WHILE NOT REQUIRED, WIRE MESH FENCE MAY BE USED TO SUPPORT THE GEOTEXTILE, WIRE FENCE SHALL BE FASTENED SECURELY TO THE UPSLOPE SIDE OF THE POSTS USING HEAVY-DUTY WIRE STAPLES AT LEAST $\frac{3}{4}$" LONG, TIE WIRES OR HOG RINGS. THE WIRE SHALL EXTEND MORE THAN 3" ABOVE THE ORIGINAL GROUND SURFACE.
6. ALONG THE TOE OF FILLS, INSTALL THE SILT FENCE ALONG A LEVEL CONTOUR AND PROVIDE AN AREA BEHIND THE FENCE FOR RUNOFF TO POND AND SEDIMENT TO SETTLE. A MINIMUM DISTANCE OF 5 FEET FROM THE TOE OF THE FILL IS RECOMMENDED.
7. THE HEIGHT OF THE SILT FENCE FROM THE GROUND SURFACE SHALL BE A MINIMUM OF 24" AND SHALL NOT EXCEED 36"; HIGHER FENCES MAY IMPOUND VOLUMES OF WATER SUFFICIENT TO CAUSE FAILURE OF STRUCTURE.

MAINTENANCE REQUIREMENTS

1. CONTRACTOR SHALL INSPECT SILT FENCES IMMEDIATELY AFTER EACH RAINFALL, AT LEAST DAILY DURING PROLONGED RAINFALL, AND WEEKLY DURING PERIODS OF NO RAINFALL. DAMAGED, COLLAPSED, UN-ENTRENCHED OR INEFFECTIVE SILT FENCES SHALL BE PROMPTLY REPAIRED OR REPLACED.
2. SEDIMENT SHALL BE REMOVED FROM BEHIND SILT FENCE WHEN IT ACCUMULATES TO HALF THE EXPOSED HEIGHT.
3. SILT FENCES SHALL BE REMOVED WHEN ADEQUATE VEGETATION COVER IS ATTAINED AS APPROVED BY THE CITY.

D C6.0 INLET BOX DETAIL

SCALE: NONE



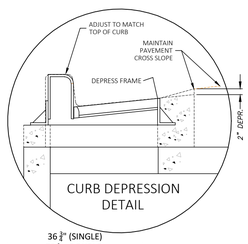
PLAN

ISOMETRIC VIEW

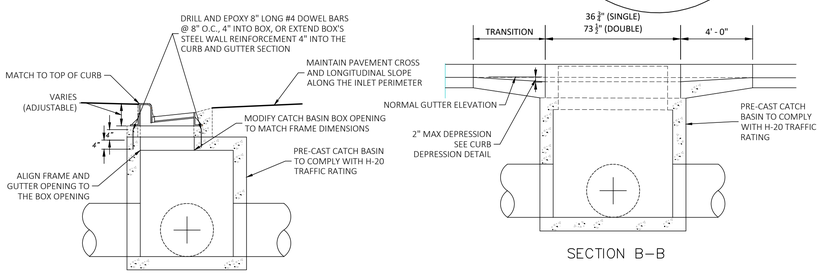
DESIGN DATA:

HS 20 STANDARD SPECIFICATION FOR HIGHWAY BRIDGES LATEST EDITION.

STRUCTURAL STEEL	Fy = 36,000 psi
STRUCTURAL CONCRETE	f'c = 4,000 psi Fy = 60,000 psi n = 8



CURB DEPRESSION
DETAIL



SECTION A–A

SECTION B–B

NOTES:

1. USE COATED DEFORMED REINFORCING STEEL BARS CONFORMING TO AASHTO M 284 OR M 111 AND M 31 GRADE 60 RESPECTIVELY.
2. FIELD CUT AND BEND REINFORCING STEEL AS NECESSARY TO CLEAR PIPES AND MAINTAIN 2" COVER. REPAIR ANY DAMAGE OR CUTS TO THE EPOXY COATING ON REINFORCING BARS.
3. USE CLASS AA (AE) CONCRETE.
4. USE TYPE II CEMENT (LOW ALKALI).
5. PROVIDE 2" CONCRETE COVER TO REINFORCING STEEL.
6. FOR NUMBER, LOCATION, AND SIZE OF PIPE SEE ROADWAY PLANS.
7. SEE PLANS FOR DEPRESSION DIMENSIONS.
8. PROVIDE 3/4" CHAMFER ON ALL EXPOSED CONCRETE CORNERS.
9. FOR GRATE AND FRAME USE D&L SUPPLY MODEL NO. I-3517 OR APPROVED EQUAL.

Date: 10-19-2023

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SOUTHEAST ACCESS ROAD
AT TECH RIDGE
DETAILS

FOR

CITY OF ST. GEORGE

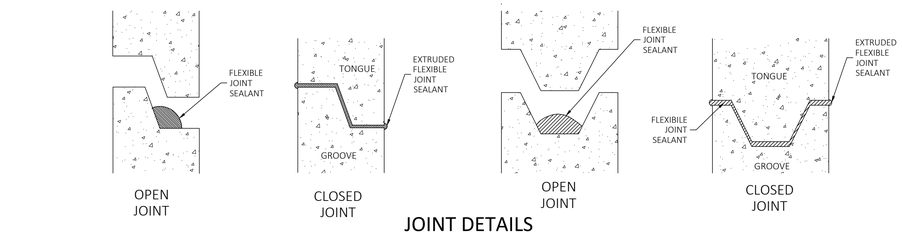
LOCATED IN SEC 36
T 42 SOUTH, R 15 WEST SLB&M
CITY OF ST. GEORGE, WASHINGTON COUNTY, UT

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CONSTRUCTION
REVIEW ONLY

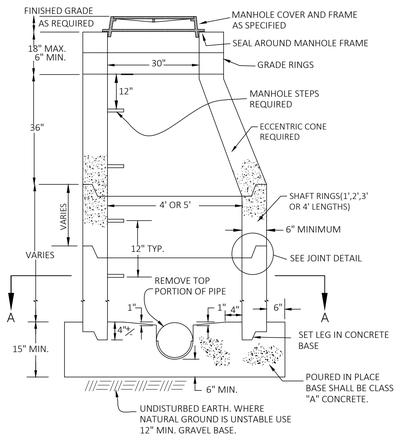
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Client No. 4568-21	Project No. 4568-21

Drawing Sheet
C6.0

Sheet 36 of 41 Sheets



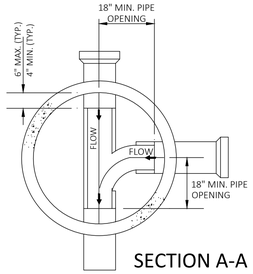
JOINT DETAILS



SECTION THRU CENTER

NOTES:

1. SEE DETAIL NO. 220 OF ST. GEORGE CITY SPECIFICATIONS FOR JUNCTION AND DROP MANHOLE DETAILS AND MANHOLES SIZES.
2. PRECAST BASE MAY BE USED BUT REQUIRES ADVANCED APPROVAL.
3. IF OPTIONAL JOINT IS USED ALL MANHOLE SECTIONS SHALL BE CLEARLY MARKED ON THE INSIDE AS TO THE MANUFACTURER AND TYPE OF JOINT BEING USED.



SECTION A-A

A C6.1 SEWER MANHOLE DETAIL

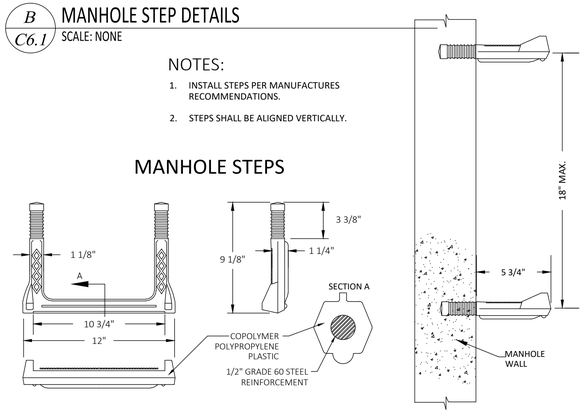
SCALE: NONE

B C6.1 MANHOLE STEP DETAILS

SCALE: NONE

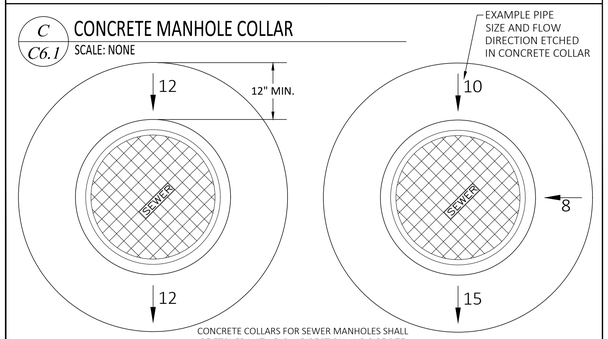
NOTES:

1. INSTALL STEPS PER MANUFACTURES RECOMMENDATIONS.
2. STEPS SHALL BE ALIGNED VERTICALLY.



C C6.1 CONCRETE MANHOLE COLLAR

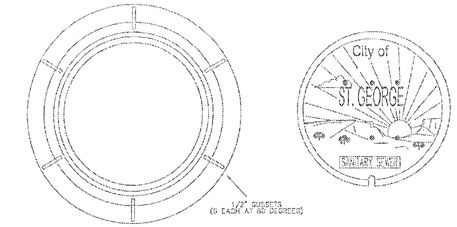
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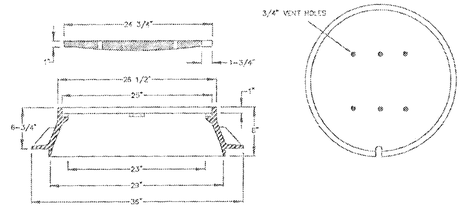


CONCRETE COLLARS FOR SEWER MANHOLES SHALL BE ETCHED WITH FLOW DIRECTION AND PIPE SIZE

D C6.1 MANHOLE FRAME AND COVER

SCALE: NONE





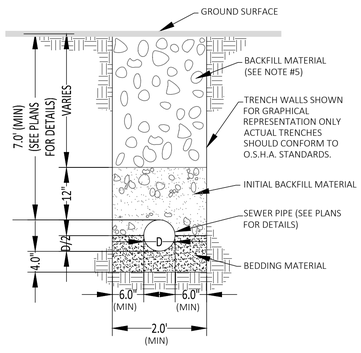
NOTES:
1.- USE D & L MODEL NO. A-1180 OR APPROVED EQUAL.
2.- MUST MEET HS-20 LOADING.

E C6.1 SEWER TRENCH DETAIL

SCALE: NONE

NOTES:

1. ALL EXCAVATIONS WITHIN THE PUBLIC RIGHT-OF-WAY REQUIRE AN ENCROACHMENT PERMIT FROM THE CITY ENCROACHMENT OFFICER.
2. MINIMUM THICKNESS OF ASPHALT AND BASE SHALL BE AS OUTLINED IN THE ROADWAY STRUCTURAL REQUIREMENTS. IN NO CASE SHALL THE THICKNESS BE LESS THAN THE EXISTING.
3. FOUNDATION MATERIAL SHALL BE USED WHEN TRENCH BOTTOM IS UNSTABLE.
4. ALL STATE HIGHWAY CROSSINGS SHALL BE APPROVED BY THE U.D.O.T. DISTRICT ENGINEER (U.D.O.T. PERMIT REQUIRED.)
5. MINIMUM COMPACTION SHALL BE 95%. WHEN APPROVED FLOWABLE FILL OR SLURRY IS USED, COMPACTION TESTING WILL NOT BE REQUIRED.
6. WHEN MATERIAL UNDER THE 6" OVER CUT SLUFFS OFF OR IS REMOVED, BASE SHALL BE COMPACTED TO THE BOTTOM LEVEL OF EXISTING ASPHALT. AN ADDITIONAL 6" IN WIDTH OF ASPHALT SHALL BE CUT, REMOVED AND REPLACED AS PART OF THE OVERALL PATCH.
7. WHERE ROAD SECTION HAS A DESIGNED GRANULAR SUB-BASE, IT SHALL BE REPLACED IN KIND OR WITH ROAD BASE GRAVEL.
8. IN GENERAL, STREET SURFACES LESS THAN 24 MONTHS OLD WILL NOT BE CUT. IF A CUT MUST BE MADE, ADDITIONAL MORE STRICT REQUIREMENTS MAY BE INVOKED. SEE ENCROACHMENT OFFICER.
9. 24 HOUR NOTICE REQUIRED ON ALL INSPECTIONS.
10. ALL TRENCH BACKFILL SHALL MEET MIN. COMPACTION REQUIREMENTS.
11. EXCLUDING EMERGENCY CLOSURES, ALL ROAD CLOSURES AND DETOURS REQUIRE 48 HOURS PRIOR NOTICE.



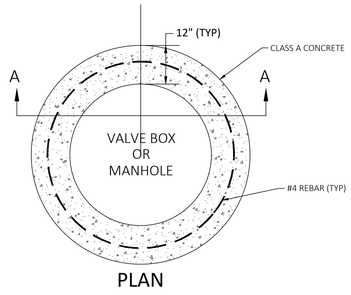
BACKFILL MATERIALS FOR SEWER TRENCHES

SIEVE SIZE	PERCENT PASSING FOR:			
	FOUNDATION MATERIAL*	BEDDING MATERIAL	INITIAL BACKFILL MATERIAL	FINAL BACKFILL MATERIAL
2.00-IN	100	----	----	NATIVE MATERIAL WHICH CONTAINS NO SOD, VEGETATION, ROCKS LARGER THAN 8.00-IN IN DIA., ASPHALT OR CONCRETE CHUNKS, ETC.
0.75-IN	5-15	----	100	
NO. 4	0-5	100	40-70	
NO. 50	----	5-15	20-50	
NO. 100	----	0-5	5-30	

* TO BE USED ONLY WHEN THE TRENCH BOTTOM IS UNSTABLE.

F C6.1 MANHOLE CONRETE COVER

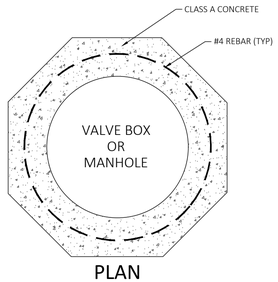
SCALE: NONE



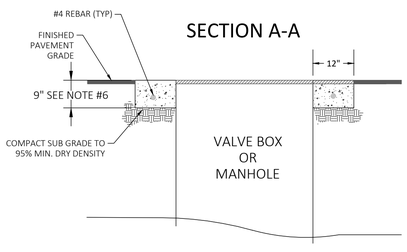
PLAN

NOTES:

1. MANHOLES, VALVE BOXES AND OTHER SIMILAR ITEMS SHALL BE ADJUSTED TO GRADE AFTER PAVING IS COMPLETE.
2. THE SURFACE OF THE ADJUSTED RING SHALL MATCH THE GRADE OF THE CONCRETE COLLAR. CONCRETE COLLAR SHALL BE 1/8" - 1/4" LOWER THAN ASPHALT.
3. ASPHALT SHALL BE CUT IN STRAIGHT VERTICAL LINES.
4. ADJUSTMENTS TO GRADE SHALL BE MADE WITH STANDARD RINGS OR EXTENSIONS OR AS APPROVED BY THE CITY REPRESENTATIVE.
5. ALL MANHOLES, VALVE BOXES AND OTHER SIMILAR ITEMS SHALL HAVE CONCRETE COLLAR AS REQUIRED UNLESS OTHERWISE APPROVED.
6. 9" THICK COLLARS SHALL BE REINFORCED. 12" THICK COLLARS DO NOT REQUIRE REINFORCEMENT.
7. MARK CONCRETE COLLAR ON WATER VALVE BOXES WITH ARROW INDICATING DIRECTION OF FLOW.
8. MANHOLE LID SHALL COMPLY WITH ST. GEORGE CITY STANDARDS.

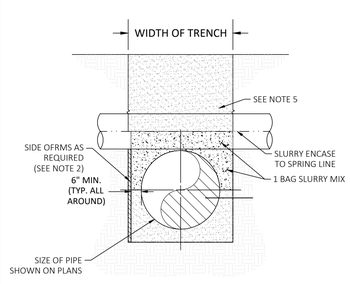


PLAN OPTIONAL



G C6.1 SLURRY ENCASEMENT

SCALE: NONE



END SECTION

NOTES:

1. THIS DETAIL SHALL BE REQUIRED WHEN NEW OR EXISTING PIPE INSTALLATIONS WILL BE SUBJECT TO DAMAGE ANYTIME IN THE FUTURE DUE TO LACK OF PROPER COVER OR WHEN MINIMUM SEPARATION BETWEEN CROSSING OR ADJACENT UTILITIES CAN NOT BE MAINTAINED, AS DETERMINED BY THE ENGINEER.
2. FOR PIPE OVER 18" I.D., WOOD, METAL, OR GYPSUM BOARD FORMS MUST BE USED TO FORM THE SIDES OF THE ENCASEMENT. GYPSUM BOARD FORMS MAY BE LEFT IN THE GROUND BELOW THE TOP OF THE ENCASEMENT. THIS SHALL BE OPTIONAL WITH POURING AGAINST TRENCH WALLS FOR ENCASEMENT OF 18" AND SMALLER PIPE.
3. FOR ALL SITUATIONS WHERE SIDE FORMS ARE USED, TRENCH WALLS SHALL BE OVER-EXCAVATED TO ALLOW SUFFICIENT ROOM TO OPERATE PROPER MECHANICAL COMPACTION EQUIPMENT.
4. SLURRY WHICH SPILLS BEYOND 12" FROM THE SIDES OF THE PIPE FOR ANY REASON SHALL BE REMOVED BACK TO THE PROPER LINE PRIOR TO BACKFILLING.
5. COVER TO BE APPROVED BY ENGINEER.
6. THE SLURRY ENCASEMENT SHALL HAVE A MINIMUM THICKNESS ON ALL SIDES OF 6"

Date: 10-19-2023

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WILLISTON, ND 58801
701-572-8100

SOUTHEAST ACCESS ROAD AT TECH RIDGE DETAILS

FOR

CITY OF ST. GEORGE

LOCATED IN SEC 36
T 42 SOUTH, R 15 WEST SLB&M
CITY OF ST. GEORGE, WASHINGTON COUNTY, UT

NOT FOR CONSTRUCTION REVIEW ONLY

Drawn By:	Scale:
AZ	NONE
Client No. 4568-21	Project No. 4568-21

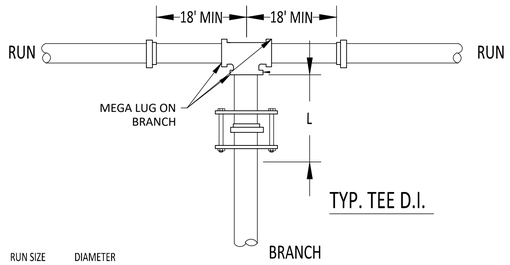
Drawing Sheet

C6.1

Sheet 37 of 41 Sheets

A C6.2 MECHANICAL JOINT DETAIL-D.I.

SCALE: NONE



TYP. TEE D.I.

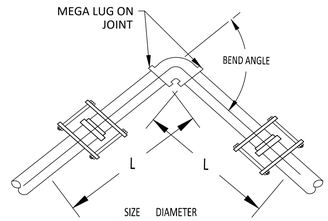
BRANCH

BRANCH SIZE \ RUN SIZE DIAMETER	4	6	8	10	12	14	16	18	20	24
4	*	*	*	*	*	*	*	*	*	*
6		*	*	*	*	*	*	*	*	*
8			*	*	*	*	*	*	*	*
10				10	2	*	*	*	*	*
12					19	12	4	*	*	*
14						28	22	15	8	*
16							37	31	26	13
18								46	41	30
20									55	45
24										72

* - FOR THIS CONDITION NEED ONLY RESTRAIN THE BRANCH OUTLET OF THE TEE.

RESTRAINED LENGTHS, "L" (IN FEET)

1. RESTRAIN THE TWO MECHANICAL JOINTS ON THE RUN SIDES OF THE TEE. THERE SHOULD BE A FULL 18' LENGTH OF PIPE INSTALLED ON EACH SIDE OF THE RUN.
2. ALL JOINTS WITHIN THE LENGTH "L" ON THE BRANCH MUST BE RESTRAINED. USE RETAINER GLAND AT MECHANICAL JOINTS AND HARDNESS ON PUSH-ON PIPE PER CITY SPECIFICATION.
3. FOR TEST PRESSURES AND LAYING CONDITIONS SEE SECTION ON GENERAL NOTES FOR USE OF RESTRAINED JOINT LENGTHS.

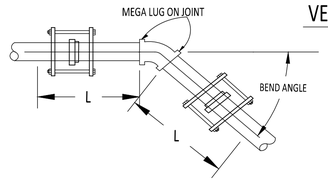


HORIZONTAL BEND FOR D.I.

1. ALL JOINTS WITHIN LENGTH "L" MUST BE RESTRAINED. USE RETAINER GLAND AT MECHANICAL JOINTS AND HARNESS WITH PUSH-ON PIPE PER CITY SPECIFICATION.
2. FOR TEST PRESSURES AND LAYING CONDITIONS SEE SECTION ON GENERAL NOTES FOR USE OF RESTRAINED JOINT LENGTHS.

BEND ANGLE \ SIZE DIAMETER	4	6	8	10	12	14	16	20
11.25	3	2	3	3	4	4	5	6
22.5	3	4	7	7	8	9	10	12
45	6	9	12	14	16	19	21	26
90	15	21	28	34	40	45	51	62

RESTRAINED LENGTHS, "L" (IN FEET)



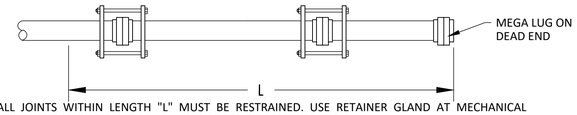
VERTICAL DOWN BEND D.I.

1. ALL JOINTS WITHIN LENGTH "L" MUST BE RESTRAINED. USE RETAINER GLAND AT MECHANICAL JOINTS AND HARNESS WITH PUSH-ON PIPE PER CITY SPECIFICATION.
2. FOR TEST PRESSURES AND LAYING CONDITIONS SEE SECTION ON GENERAL NOTES FOR USE OF RESTRAINED JOINT LENGTHS.

BEND ANGLE \ SIZE DIAMETER	4	6	8	10	12	14	16	20
11.25	3	5	7	8	8	10	11	13
22.5	6	10	11	14	16	18	22	25
45	14	18	24	28	33	38	43	53

RESTRAINED LENGTHS, "L" (IN FEET)

IN LINE VALVE/DEAD END ON D.I. PIPE



1. ALL JOINTS WITHIN LENGTH "L" MUST BE RESTRAINED. USE RETAINER GLAND AT MECHANICAL JOINTS AND HARNESS WITH PUSH-ON PIPE PER CITY SPECIFICATION.
2. FOR TEST PRESSURES AND LAYING CONDITIONS SEE SECTION ON GENERAL NOTES FOR USE OF RESTRAINED JOINT LENGTHS.

PIPE SIZE IN INCHES	4	6	8	10	12	14	16	18	20
	44	62	82	99	118	135	153	169	187

RESTRAINED LENGTHS, "L" (IN FEET)

RESTRAINED JOINT LENGTHS USAGE GENERAL NOTES

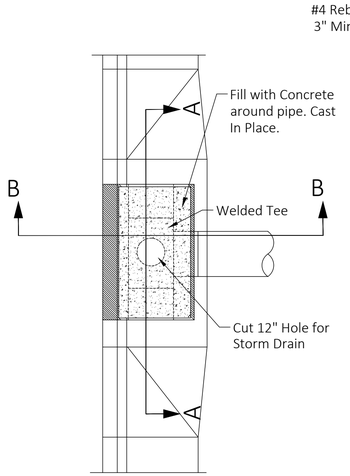
RESTRAINED LENGTH CALCULATIONS ARE BASED ON THE FOLLOWING DESIGN TYPICALLY USED WITH BACKFILL IN ST. GEORGE.

1. THREE (3) FEET MINIMUM DEPTH OF COVER.
2. A SAFETY FACTOR OF 1.5
3. SOIL TYPE SANDY CLAY
4. TYPE 5 TRENCH COMPACTION FROM FOUR (4) INCHES MINIMUM UNDER THE PIPE TO THE CENTER LINE OF THE PIPE, AND COMPACTED GRANULAR OR SELECTED MATERIAL FROM THE CENTER LINE OF THE PIPE TO THE TOPOF THE PIPE (90 PERCENT STANDARD PROCTOR DENSITY, AASHTO T-99).
5. 200 PSI TEST PRESSURES FOR FOUR (4) THROUGH SIXTEEN (16) INCH SIZE PIPES.

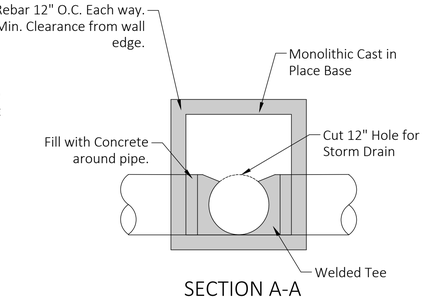
IF ACTUAL CONDITIONS DIFFER FROM THOSE LISTED ABOVE OR THE REQUIRED RESTRAINED LENGTH CANNOT BE MET, THE RESTRAINED JOINT LENGTH SHALL BE DETERMINED BY THE WATER ENGINEER.

B C6.2 INLET BOX WITH WELDED PIPE

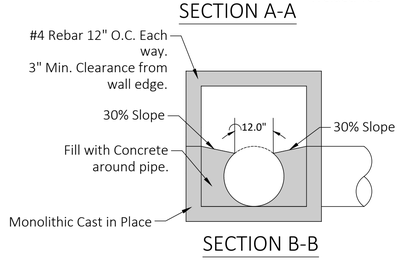
SCALE: NONE



PLAN VIEW



SECTION A-A



SECTION B-B

Date: 10-19-2023

REVISIONS

No.	Date	by	Description

File Name: East Access Details OPT 2.dwg

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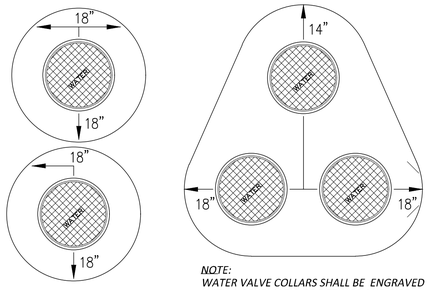
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Client No. 4568-21	Project No. 4568-21

Drawing Sheet: C6.2

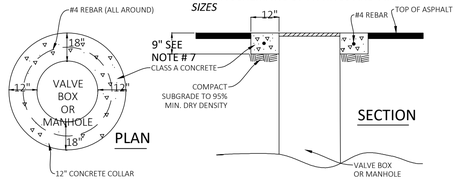
Sheet 38 of 41 Sheets

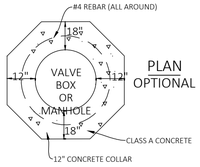
A C6.3 WATER VALVE CONC. COLLAR

SCALE: NONE



NOTE:
WATER VALVE COLLARS SHALL BE ENGRAVED WITH A SCHEMATIC OF FITTINGS AND PIPE SIZES



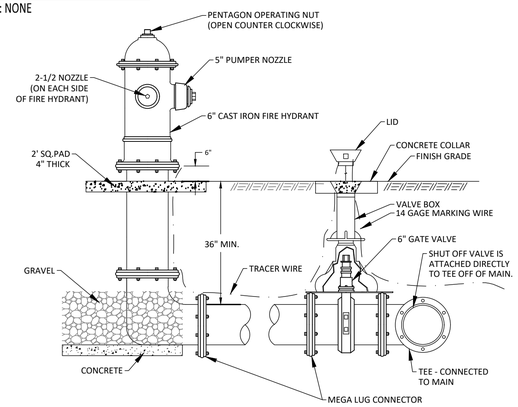


NOTES

1. MANHOLES, VALVE BOXES AND OTHER SIMILAR ITEMS SHALL BE ADJUSTED TO GRADE AFTER PAVING IS COMPLETE.
2. THE SURFACE OF THE ADJUSTED RIND SHALL MATCH THE GRADE OF THE CONCRETE COLLAR. CONCRETE COLLAR SHALL BE 1/8" - 1/4" LOWER THAN ASPHALT.
3. ASPHALT SHALL BE CUT IN STRAIGHT VERTICAL LINES.
4. ADJUSTMENTS TO GRADE SHALL BE MADE WITH STANDARD RINGS OR EXTENSIONS OR AS APPROVED BY THE CITY REPRESENTATIVE.
5. ALL MANHOLES, VALVE BOXES AND OTHER SIMILAR ITEMS SHALL HAVE CONCRETE COLLAR AS REQUIRED UNLESS OTHERWISE APPROVED.
6. 9" THICK COLLARS SHALL BE REINFORCED. 12" THICK COLLARS DO NOT REQUIRE REINFORCEMENT.
7. MARK CONCRETE COLLAR ON WATER VALVE BOXES WITH ARROW INDICATING DIRECTION OF FLOW AND LINE SIZE.

B C6.3 TYP. FIRE HYDRANT

SCALE: NONE

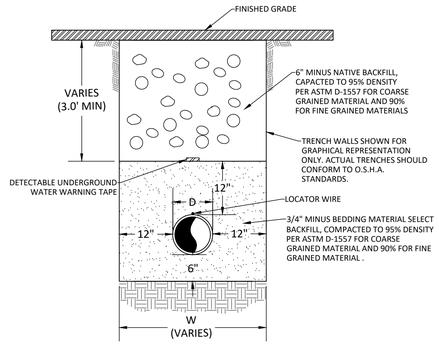


NOTES:

1. IN GENERAL, NO PART OF THE FIRE HYDRANT SHALL BE PLACED WITHIN 12" OF THE BACK OF THE SIDEWALK.
2. INSTALL TRACER WIRE FROM SHUT OFF VALVE TO HYDRANT.

C C6.3 WATER TRENCH DETAIL

SCALE: NONE

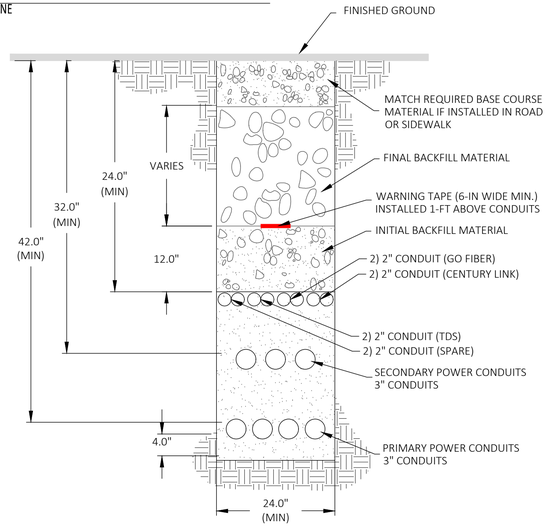


NOTES

1. ALL EXCAVATIONS WITHIN PUBLIC RIGHT-OF-WAY REQUIRE AN ENCROACHMENT PERMIT FROM THE CITY ENCROACHMENT OFFICER.
2. EXCLUDING EMERGENCY CLOSURES ALL ROAD CLOSURES AND DETOURS REQUIRE 48 HOURS PRIOR NOTICE.
3. ALL STATE HIGHWAY CROSSING SHALL BE APPROVED BY THE U.D.O.T. DISTRICT ENGINEER (U.D.O.T. PERMIT REQUIRED)
4. MINIMUM COMPACTION SHALL BE 95% WHEN APPROVED FLOWABLE FILL OR SLURRY IS USED COMPACTION TESTING WILL NOT BE REQUIRED.
5. MINIMUM THICKNESS OF ASPHALT AND BASE SHALL BE OUTLINED IN THE ROADWAY STRUCTURAL REQUIREMENTS. IN NO CASE SHALL THE THICKNESS BE LESS THAN THE EXISTING.
6. FOUNDATION MATERIAL SHALL BE USED WHEN TRENCH BOTTOM IS UNSTABLE.
7. WHERE ROAD SECTION HAS A DESIGNED GRANULAR SUB-BASE, IT SHALL BE REPLACED IN KIND OR WITH ROAD BASE GRAVEL.
8. IN GENERAL, STREET SURFACES LESS THAN 24 MONTHS OLD WILL NOT BE CUT. IF A CUT MUST BE MADE, ADDITIONAL, STRICTER REQUIREMENTS MAY BE INVOKED SEE ENCROACHMENT OFFICER.
9. 24 HOUR NOTICE REQUIRED ON ALL INSPECTIONS.
10. ALL TRENCH BACKFILL SHALL MEET MIN COMPACTION REQUIREMENTS.
11. ALL PIPE MATERIAL SHALLBE NSF 61 COMPLIANT FOR CULINARY WATER USE.

D C6.3 JUT TRENCH - TYPICAL

SCALE: NONE



NOTES: FOR BACKFILL MATERIAL REQUIREMENTS SEE TABLE BELOW.

BACKFILL MATERIALS FOR WATER, NATURAL GAS, AND JOINT UTILITY TRENCHES

SIEVE SIZE	PERCENT PASSING FOR:			
	FOUNDATION MATERIAL*	BEDDING MATERIAL	INITIAL BACKFILL MATERIAL	FINAL BACKFILL MATERIAL
2.00–IN	100	----	----	*NATIVE MATERIAL WHICH CONTAINS NO SOD, VEGETATION, ROCKS LARGER THAN 8.00–IN IN DIA., ASPHALT OR CONCRETE CHUNKS, ETC.*
0.75–IN	5–15	----	100	
NO. 4	0–5	100	40–70	
NO. 50	----	5–15	20–50	
NO. 100	----	0–5	5–30	

* TO BE USED ONLY WHEN THE TRENCH BOTTOM IS UNSTABLE.

NOTES:

1. TRENCHING, BEDDING, AND COMPACTION SHALL CONFORM TO CURRENT SGES AND CITY STANDARDS. SEE SGES DETAILS D13-D15 IN UNDERGROUND STANDARDS. PROVIDE COMPACTION TEST RESULTS TO CITY; COPY SGES ON POWER RELATED TESTING.
2. ALL STUBBED CONDUIT SHALL TERMINATE IN A BOX PER CURRENT UNDERGROUND STANDARDS. EACH UTILITY, POWER, FIBER, AND TELECOMMUNICATIONS SHALL PROVIDE AND INSTALL THEIR OWN BOXES RESPECTIVELY.

Date: 10-19-2023

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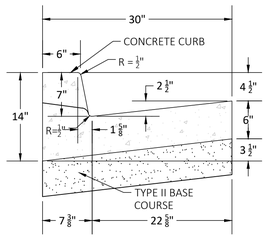
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Client No. 4568-21	Project No. 4568-21

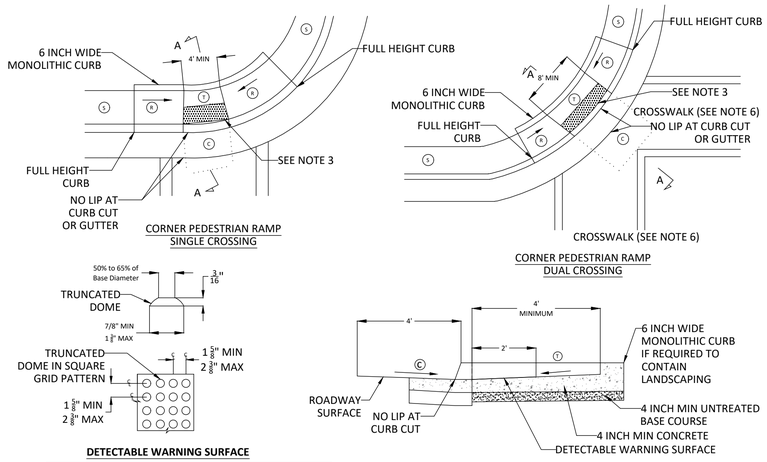
Drawing Sheet
C6.3

Sheet 39 of 41 Sheets

A C6.4 CURB & GUTTER
SCALE: NONE



B C6.4 ADA RAMP - CORNER
SCALE: NONE



SLOPE TABLE			
	ITEM	MAX. RUNNING SLOPE *	MAX. CROSS SLOPE *
T	TURNING SPACE	2%	2% (c)
R	RAMP	8.33% (a)	2% (c)
C	CLEAR SPACE	5% (b)	2% (c)
S	SIDEWALK	STREET GRADE	2%

* RUNNING SLOPE IS IN THE DIRECTION OF PEDESTRIAN TRAVEL. CROSS SLOPE IS PERPENDICULAR TO PEDESTRIAN TRAVEL

(a) LENGTH OF RUNNING SLOPE FOR PARALLEL RAMPS IS NOT REQUIRED TO EXCEED 15FT.

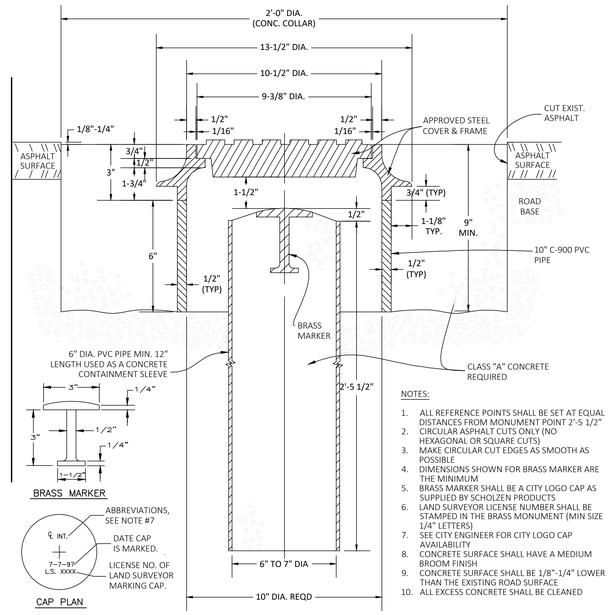
(b) MAINTAIN CONSISTENCY OF CLEAR SPACE RUNNING SLOPE ACROSS ENTIRE CURB CUT. WARP CUTTER PAN TO MEET REQUITED CLEAR SPACE SLOPE AT CURB CUT.

(c) DO NOT EXCEED THE ROADWAY PROFILE GRADE FOR THE CROSS SLOPE AT CROSSWALKS WITHOUT STOP OR YIELD CONTROL AND AT MID-BLOCK CROSSWALKS.

NOTES:

1. DIMENSIONS SHOWN IN THE SLOPE TABLE ON ARE NOT SUBJECT TO CONVENTIONAL INDUSTRY TOLERANCES. CONSTRUCT SIDEWALKS AND RAMPS SUCH THAT THE MAXIMUM OR MINIMUM VALUES ARE NOT EXCEEDED. WORK THAT EXCEEDS THOSE VALUES WILL NOT BE ACCEPTED.
2. PROVIDE DETECTABLE WARNING SURFACE FOR FULL WIDTH OF CURB CUT.
3. LOCATE DETECTABLE WARNING SURFACE SO THE CORNERS NEAREST THE STREET ARE WITHIN 1 INCH OF THE BACK OF CURB.
4. RAMP GRADE BREAK MUST BE PERPENDICULAR TO THE RUNNING SLOPE.
5. CLEAR SPACE AND TURNING SPACE SIZE: 4 FT MIN. X 4 FT MIN.
6. CROSSWALK DELINEATION IF REQUIRED ON PROJECT STRIPING PLAN.
7. ALL TRAIL ADA RAMPS SHALL HAVE AN 8' WIDE DETECTABLE WARNING SURFACE.

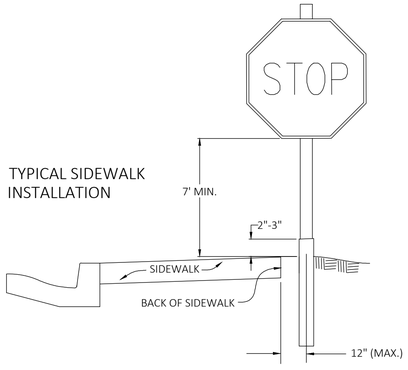
C C6.4 CLASS 1 STANDARD MONUMENT DETAIL
SCALE: NONE



NOTES:

1. ALL REFERENCE POINTS SHALL BE SET AT EQUAL DISTANCES FROM MONUMENT POINT 2'-5 1/2"
2. CIRCULAR ASPHALT CUTS ONLY (NO HEXAGONAL OR SQUARE CUTS)
3. MAKE CIRCULAR CUT EDGES AS SMOOTH AS POSSIBLE
4. DIMENSIONS SHOWN FOR BRASS MARKER ARE THE MINIMUM
5. BRASS MARKER SHALL BE A CITY LOGO CAP AS SUPPLIED BY SCHOLZEN PRODUCTS
6. LAND SURVEYOR LICENSE NUMBER SHALL BE STAMPED IN THE BRASS MONUMENT (MIN SIZE 1/4" LETTERS)
7. SEE CITY ENGINEER FOR CITY LOGO CAP AVAILABILITY
8. CONCRETE SURFACE SHALL HAVE A MEDIUM BROOM FINISH
9. CONCRETE SURFACE SHALL BE 1/8"-1/4" LOWER THAN THE EXISTING ROAD SURFACE
10. ALL EXCESS CONCRETE SHALL BE CLEANED

D C6.4 SIGN POST AND INSTALLATION DETAIL
SCALE: NONE



NOTES:

1- SIGNS SHALL BE PLACED IN CONFORMANCE WITH THE MANUAL ON UNIFORM TRAFFIC CONTROL DEVICES. (M.U.T.C.D.).

2- STREET NAME SIGNS SHALL BE REQUIRED ON ALL CITY STREETS.

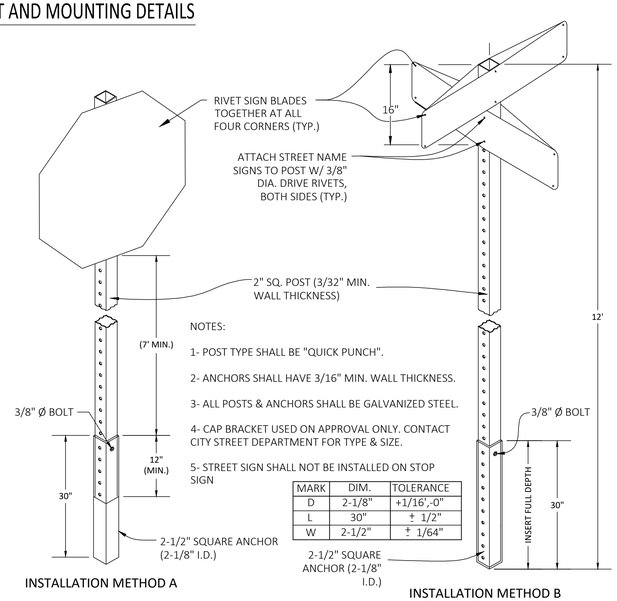
3- ALL POST COMPONENTS SHALL BE GALVANIZED STEEL.

4- STREET NAME SIGNS PLACED ABOVE STOP SIGN SHALL BE AS SHOWN IN DRAWING 110 (2 OF 2) OF THE ST. GEORGE CITY SPECIFICATIONS.

5- WHERE PLANTER STRIP LIES BETWEEN SIDEWALK AND CURB, SIGNS SHALL BE INSTALLED IN PLANTER STRIP AS PER M.U.T.C.D.

6- SIGNS SHALL BE PLACED TO BE CLEARLY VISIBLE. ALL OBSTRUCTIONS SUCH AS TREES, POLES, OTHER SIGNS, ETC, SHALL BE AVOIDED.

E C6.4 SIGN POST AND MOUNTING DETAILS
SCALE: NONE



NOTES:

1- POST TYPE SHALL BE "QUICK PUNCH".

2- ANCHORS SHALL HAVE 3/16" MIN. WALL THICKNESS.

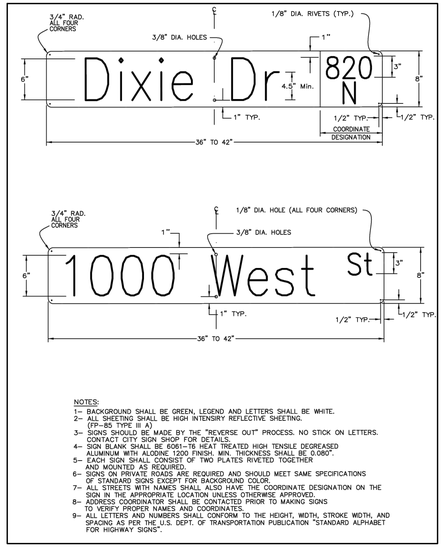
3- ALL POSTS & ANCHORS SHALL BE GALVANIZED STEEL.

4- CAP BRACKET USED ON APPROVAL ONLY. CONTACT CITY STREET DEPARTMENT FOR TYPE & SIZE.

5- STREET SIGN SHALL NOT BE INSTALLED ON STOP SIGN

MARK	DIM.	TOLERANCE
D	2-1/8"	+1/16',-0"
L	30"	± 1/2"
W	2-1/2"	± 1/64"

F C6.4 STANDARD STREET SIGN
SCALE: NONE



NOTES:

1- BACKGROUND SHALL BE GREEN, LEGEND AND LETTERS SHALL BE WHITE.
2- ALL SHEETING SHALL BE HIGH INTENSITY REFLECTIVE SHEETING. (FP-85 TYPE III A)
3- SIGNS SHOULD BE MADE BY THE "REVERSE OUT" PROCESS. NO STICK ON LETTERS. CONTACT CITY SIGN SHOP FOR DETAILS.
4- SIGN BLANK SHALL BE 6061-T6 HEAT TREATED HIGH TENSILE DEGREASED ALUMINUM WITH ALODINE 1200 FINISH. MIN. THICKNESS SHALL BE 0.080".
5- EACH SIGN SHALL CONSIST OF TWO PLATES RIVETED TOGETHER AND MOUNTED AS REQUIRED.
6- SIGNS ON PRIVATE ROADS ARE REQUIRED AND SHOULD MEET SAME SPECIFICATIONS OF STANDARD SIGNS EXCEPT FOR BACKGROUND COLOR.
7- ALL STREETS WITH NAMES SHALL ALSO HAVE THE COORDINATE DESIGNATION ON THE SIGN IN THE APPROPRIATE LOCATION UNLESS OTHERWISE APPROVED.
8- ADDRESS COORDINATOR SHALL BE CONTACTED PRIOR TO MAKING SIGNS TO VERIFY PROPER NAMES AND COORDINATES.
9- ALL LETTERS AND NUMBERS SHALL CONFORM TO THE HEIGHT, WIDTH, STROKE WIDTH, AND SPACING AS PER THE U.S. DEPT. OF TRANSPORTATION PUBLICATION "STANDARD ALPHABET FOR HIGHWAY SIGNS".

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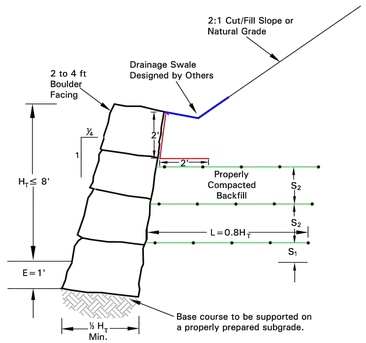
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AZ	NONE
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Drawing Sheet: C6.4

Sheet 40 of 41 Sheets

TECH RIDGE SOUTHEAST ACCESS ROAD
ST. GEORGE, UTAH



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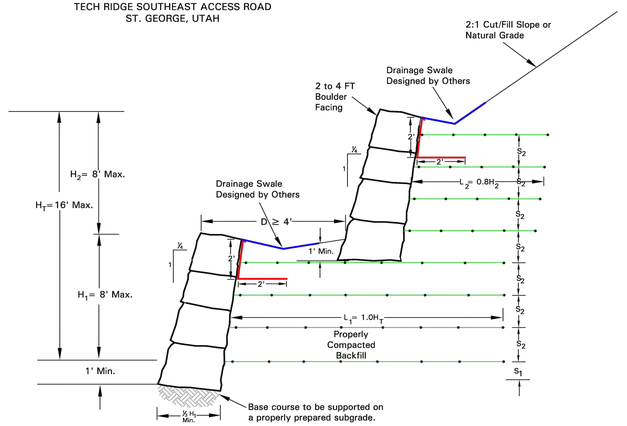
- Mirafi 140N Filter Fabric
- 10 Mil. PVC Liner or Concrete Lined Trench
- Geosynthetic Reinforcment



By: Jake Erickson, P.E.

2230249	AGEC	SINGLE TIERED ROCKERY FACED REINFORCED FILL SLOPE	Figure 3

TECH RIDGE SOUTHEAST ACCESS ROAD
ST. GEORGE, UTAH



Key:

- Mirafi 140N Filter Fabric
- 10 Mil. PVC Liner or Concrete Lined Trench
- Geosynthetic Reinforcment



By: Jake Erickson, P.E.

2230249	AGEC	TWO TIERED ROCKERY FACED REINFORCED FILL SLOPE	Figure 1

TECH RIDGE SOUTHEAST ACCESS ROAD
ST. GEORGE, UTAH

A. Boulder Placement/Construction:

1. Boulders should be angular, rectangular ledge rock. Boulders should have a flat stacking surface and decrease in size as they are stacked.
2. Base rock size = ½-⅓ H ; Minimum rock size 24 inches and/or 200 pounds.
3. Boulders should consist of durable material resistant to weathering. Typically 2 to 5 feet in size. Suitable sources in Washington County - Basalt, tan (Shinarump) sandstone, some limestone from Fort Pearce area.
4. Minimum **embedment** = 1 foot unless deeper embedment is shown on drawing.
5. Minimum **batter** ¼:1 (Horizontal to Vertical).
6. The slope/boulder subgrade should be properly prepared/compacted as directed by the geotechnical engineer prior to placing of fill or boulders.
7. Landscaping and associated irrigation systems are not recommended. Wetting of the backfill may result in settling or reduced stability. Block walls or fences may settle if placed in the backfill zone.

B. Fill:

1. Backfill should have a maximum size of 3", -200 < 30% and LL < 30%.
2. Refer to geotechnical investigation (AGEC Project No. 2180295) for approved low permeable fill criteria.
3. Each lift of backfill should be properly compacted. Hand compaction should be used within 3 feet of boulder facing. 4 inch lifts should be used for hand compaction equipment. Lift thickness may be increased to 8 inches for rubber tire or roller compaction.

C. Construction Observation:

1. Pre-construction meeting with Engineer, Owner and Contractor.
2. Observation of construction should be completed so that the quality of construction can be documented and modifications can be made if conditions require.
3. Backfill placed behind boulders and in reinforced areas should be tested frequently to verify compaction is at least 95% of the maximum dry density as determined by ASTM D-1557. We recommend a testing frequency of approximately every 1 foot of fill placed staggered approximately every 50 lineal feet. If the fill is not properly compacted, the stability of the slope will be reduced.
4. Backfill should be placed in 6 to 8-inch loose lifts prior to compacting. Proper moisture conditioning should be conducted in the backfill material before compacting.
5. A representative of AGEC should observe/verify placement of the geogrid, filter fabric and strip drains.

D. Geosynthetics:

1. The filter fabric may consist of Mirafi 140N, non-woven filter fabric or equivalent.
2. **Geosynthetic reinforcement** should be placed continuously in the primary strength direction. It may not be spliced in the primary strength direction.
3. The geogrid should be stretched by hand until taut and free of wrinkles. Individual lengths of the geosynthetic reinforcement should be overlapped at least 1 foot.
4. Where rockery wall forms an outside corner, geogrid should be placed in both directions with a minimum of 4" of backfill between the overlapping layers of geogrid.
5. The following table should be referred to for geosynthetic grid length: (See Figure 1)

Geosynthetic Reinforcement Schedule ¼:1 (H:V) Slope

Boulder Faced Fill Slope Height (ft)	Geosynthetic Reinforcement Required	Approved * Geosynthetic Reinforcement	Geosynthetic Vertical Spacing (ft)		Grid Lengths (ft)	
			S_1	S_2	L_1	L_2
$H_T \leq 3$	No	NA	NA	NA	See Detail	See Detail
$3 < H_T \leq 16$	Yes	Miragrid 5XT	1	2		

* Approved Equivalents - Tensar UX1500HS = Miragrid 5XT = WG6



By: Jake Erickson, P.E.

2230249	AGEC	Rockery Faced Slope Notes	Figure 4

NOTES:
1. All rock wall material is Basalt.

Date: 10-19-2023

REVISIONS

No.	Date	by	Description

File Name
East Access Details OPT 2.dwg

ALLIANCE CONSULTING
A PLANNING AND ENGINEERING FIRM

UTAH
2303 N CORAL CANYON BLVD
SUITE 201,
WASHINGTON, UT 84780
435-673-8060

NORTH DAKOTA
621 26th STREET W.
WILLISTON, ND 58801
701-572-8100

SOUTHEAST ACCESS ROAD
AT TECH RIDGE
DETAILS

FOR

CITY OF ST. GEORGE
LOCATED IN SEC 36
T 42 SOUTH, R 15 WEST SLB&M
CITY OF ST. GEORGE, WASHINGTON COUNTY, UT

NOT FOR CONSTRUCTION REVIEW ONLY

Drawn By: AZ	Scale: NONE
Client No. 4568-21	Project No. 4568-21

Drawing Sheet
C6.5

Sheet 41 of 41 Sheets

AGEC
Applied GeoTech

September 8, 2023

St. George City Public Works, Engineering Division
175 East 200 North
S. George, Utah 84770

Attention: Wes Jenkins
email: wes.jenkins@sgcity.org

Subject: Geotechnical Report Update Consultation
Tech Ridge Southeast Access Roadway
St. George, Utah
Project Nos. 22230249

REFERENCES

1. "Geotechnical Investigation, Tech Ridge South Access Road", prepared by AGEC under Project No. 2180295, dated October 19, 2018.

2. "Preliminary Construction Plans - Southeast Access Road, Sheets C1.1, C1.2, C1.3, C2.9, and C2.10", prepared by Alliance Consulting under Poject No. 4568-21, dated June 30, 2023.

AGEC was requested to provide and update to the referenced report above (Reference No. 1) and respond to items from the St. George City plan review. AGEC has reviewed the referenced report and concludes that the recommendations provided (Reference No. 1) still apply and should be used for design and construction. Additionally, we were informed that a change to include water bearing utilities such as waterline and storm drains has been added to the roadway construction.

Due to the existence of landslide deposits across the eastern slope (which the proposed roadway alignment traverses) and our analysis which indicates the eastern slope contains marginal stability, AGEC provided the following as mitigation for the landslide area:

Mitigation

If the decision is made to continue with construction of the roadway on the landslides, we recommend the following items be seriously considered:

1. *Introduction of moisture into the subgrade should be minimized if not eliminated. This could be accomplished by:*

a. Collecting and transporting surface drainage off the slope in watertight catch basins and piping. This is not standard storm drainage procedures therefore, this would require specific attention to verify that the improvements are watertight.

b. Water ways should be lined to prevent seepage into the ground.

c. Measures need to be taken to eliminate the potential for water to pond on the slope.

d. No water bearing utilities should be installed within the landslide area.

2. Cut and fill slopes need to be minimized. Overall impact of potential grade changes should be evaluated and the consequence of the change found to be acceptable before proceeding.

3. Water entering the ground in all areas above the slope (within the Tech Ridge area) should be reduced and ideally eliminated. Some, if not all, of the methods described above should be considered within the Tech Ridge area.

Due to the marginal stability of the landslide deposits, the long-term stability of the site largely depends on keeping the natural hillside topography and subsurface moisture conditions unchanged. The inclusion of water bearing utilities will likely increase the risk that future landslide movement could occur because of water infiltrating the subsurface soils and bedrock leading to weakened subsurface conditions.

St. George City should understand the risk associated with this project and plan accordingly. Frequent maintenance and inspection of the roadway drainage during and after heavy precipitation could be conducted to check for potential water ponding or infiltration issues so that repairs can be made to provide proper drainage.

Additionally, inspections of the storm drainpipes and basins could be done to check for leaks so that repairs can be made quickly to seal the leaks. Thorough inspections and testing should be provided during construction to check for any leaks prior to backfilling water bearing utilities.

Special attention to the backfill material and process should be conducted around the pipes to reduce potential damage to the pipes. We understand that fused HDPE pipe is planned to be used, which may experience lengthening/shortening under temperature fluctuations. Design and construction of the water and storm drain systems should consider the effects lengthening/shortening may have on the system to remain watertight. Unfortunately, waterline leaks on buried pipes are difficult to observe until a major failure occurs. Our experience indicates small leaks in underground water-bearing utilities will likely go unnoticed for a period, while the trenches transport water through them as a conduit. Consideration should be given to evaluating the cost of running the water bearing utilities along an alternate route outside the landslide vs. the future cost of repairs should landslide movement be triggered.

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

Sincerely,

APPLIED GEOTECHNICAL ENGINEERING CONSULTANTS, INC.



Jake Erickson, P.E.

Reviewed by: G. Wayne Rogers, P.E.
P:\2018 Project Files\2180200\2180295 Tech Ridge Access Road(s)\2180295 Geotech update letter.docx

AGEC
Applied GeoTech

September 8, 2023

St. George City Public Works, Engineering Division
175 East 200 North
S. George, Utah 84770

Attention: Wes Jenkins
email: wes.jenkins@sgcity.org

Subject: Rockery Faced Slope and Segmented Block Wall Design
Tech Ridge Southeast Access Road
St. George, Utah
AGEC Project No. 2230249

References:
1. "Geotechnical Investigation, Tech Ridge South Access Road", prepared by AGEC under Project No. 2180295, dated October 19, 2018.
2. "Preliminary Construction Plans - Southeast Access Road, Sheets C1.1, C1.2, C1.3, C2.9, and C2.10", prepared by Alliance Consulting under Poject No. 4568-21, dated 6-30-2023.

Applied Geotechnical Engineering Consultants, Inc. (AGEC) was requested to provide geotechnical recommendations and slope stability evaluation for construction of rockery faced slopes and/or segmented block walls for the above referenced project in St. George, Utah as shown on Figure 1.

SITE CONDITIONS

The site is located at the southeast end of the Tech Ridge Development. The top end of the site is characterized by black basalt rock, while the hillside below consists of hummocky terrain (consistent with landslide deposits) that slopes down to the east. The hillside is vegetated with native desert brush, grass, and weeds.

PROPOSED CONSTRUCTION

The project area includes the proposed alignment of the southeast access road which will connect at the south end of Tech Ridge Drive and curve northward down the eastern slope and curve back towards the east to connect to 250 West near the bottom of the new access road. Based on a review of the preliminary construction plans by Alliance Consulting, site

grading will include cuts on the order of 37 feet at the northeast end (typical cuts along the alignment will very from 0 to 8 feet), typical site fills will be on the order of 0 to 8 feet. Roadway cross sections indicate the cuts and fills will require a combination of 2:1 (H:V) cut and fill slopes, and rockery faced slopes or segmented concrete block walls. The rockery faced slopes/segmented block walls will vary in height up to 12 feet tall

SUBSURFACE CONDITIONS

The subsurface conditions encountered at the site (Reference No. 1) generally consist of silty sand, lean clay, and silty gravel overlying, mudstone bedrock, shale bedrock and basalt rock.

Test pit logs are provided in the referenced Geotechnical Investigation (Reference No. 1).

SUBSURFACE WATER

Subsurface water was not encountered during the excavation of the test pits as shown in Figure 3. We do not anticipate groundwater will be present or observed during excavation procedures. Fluctuation in groundwater level may occur over time. An evaluation of such fluctuations is beyond the scope of this report.

SLOPE STABILITY ANALYSIS: EASTERN SLOPE

The stability of the eastern slope was previously addressed in the referenced geotechnical investigation (Reference No. 1). Refer to the referenced report for the Eastern Slope Stability.

SLOPE STABILITY ANALYSIS: ROCKERY FACED SLOPES AND SEGMENTAL BLOCK WALLS

AGEC conducted a slope stability analysis to assist in providing recommendations to construct the proposed rockery faced slopes and segmental block retaining walls as requested. Stability analysis of the proposed rockery faced slopes and segemental block retaining walls was evaluated by selecting a representative cross section. The selected cross-section was analyzed in the proposed geometry to determine whether factors of safety meet generally accepted standards in the field of geotechnical engineering. The following is a list of items considered in our analysis:

A. **Slope Profiles**

The slope cross-sections were selected by reviewing the grading plan and cross-sections prepared for the site by Alliance Consulting.

B. **Soil and Bedrock Strengths**

Soil and bedrock strengths used in our analysis are based on the following:

1. Soil properties and descriptions observed in the geotechnical report,

2. Our experience with similar materials in the area, and

3. Naval Facilities Engineering Command (NAVFAC) 7.2.

The following table summarizes soil and bedrock strengths used in our engineering analysis:

Soil Type	Material Unit Weight	Cohesion - c (psf)	Friction Angle - ϕ (degrees)
Boulder Facing (Basalt)*	135	10,000	37
Fill	125	0	36
Concrete Blocks	145	500,000	38
Basalt	135	Hoek and Brown	Hoek and Brown

* Anisotropic Function - strength parameters vary

C. **Analysis and Stability**

Based on the proposed slope and rockery facing geometry, our analysis indicates factors of safety exceed those generally accepted to meet the current industry standard of practice.

Our seismic analysis has incorporated an adjusted horizontal ground acceleration of 0.13g (based on an event with a 2 percent probability of exceedance on a 50 year period).

RECOMMENDATIONS

The construction of the rockery faced slopes and/or segmented concrete block walls should follow the recommendations provided on Figures 1 - 6. In addition, the following recommendations are provided and should be implemented during construction of the proposed rockery faced slopes:

A. Site Grading and Rockery Slope Construction

1. Subgrade Preparation

Prior to placing fill, the exposed subgrade should be scarified, moisture conditioned and properly compacted. The subgrade should be tested to verify compaction prior to placing fill. If the exposed subgrade consists of undisturbed basalt, scarification and compaction is not necessary provided loose, disturbed soil or basalt rock is removed. A 6-inch layer of leveling gravel or compacted road-base is recommended below the concrete blocks.

2. Excavation/Earthwork

We anticipate excavation of the on site soils may be accomplished with conventional excavation equipment. Excavations which extend into hard basalt will require the use of heavy duty excavation equipment such as a ripper tooth or a rock hammer. Blasting may be necessary on the basalt if the rock does not contain significant fractures.

3. Material Suitability

Imported backfill and site grading/structural fill should meet the following criteria:

Area	Fill Type	Recommendations
Building Pad/Rockery backfill	Structural fill	**-200** < 50%, **LL < 30** Maximum size = 3 inches Solubility < 1%
Backfill	Crushed rock fill	**-200** < 10% Maximum size = 6 inches Solubility < 1%

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

The on-site granular soils free of organics, debris and oversized particles as listed above are suitable for use as rockery wall backfill and site grading. The onsite basalt rock which is excavated from the site may be used as rockfill provided it is processed such that the maximum particle size is 6 inches. The rockfill will be most suitable if placed as backfill directly behind boulders. If the processed bedrock is open graded, filter fabric may be necessary behind the rockfill to reduce the potential for migration of adjacent soil fines.

Performance of the rockery faced slope may be increased by importing a select aggregate granular backfill (behind the rockery in the geogrid reinforced zone) such as road base.

4. Compaction

Compaction of fill materials placed at the site should equal or exceed the following percentages:

Area	Compaction
Subgrade	90%
Rockery Faced Slope Backfill	95%

Fill placed at the site should be tested frequently to verify proper compaction. Fill tested should be compared to the maximum dry density as determined by ASTM D-1557. Fill should be placed in lift thicknesses which are appropriate to the type of compaction equipment used. Typically, loose lift thicknesses of 6 to 8 inches are appropriate for heavy equipment. Lift thicknesses should be reduced to 4 inches for hand compaction equipment. Fill should be properly moisture conditioned to within 2 percentage points of the optimum moisture content as determined by ASTM D-1557 prior to placement.

Further, we recommend using hand compaction equipment within 3 feet of the interior edge of the boulders.

5. Geosynthetic Reinforcement and Filter Fabric Placement

Figures 1 - 6 should be referenced for the geogrid type, spacing, lengths and filter fabric placement during construction. The following should be implemented when placing the geosynthetic reinforcement (geogrid):

a. The geogrid should be placed on a smooth subgrade free of humps or loose soil.

b. The geogrid should be placed with the primary strength direction perpendicular to the face of the slope. The geogrid may not be spliced in the primary strength direction.

c. The geogrid should not be trafficked with track-mounted equipment. At least 12 inches of soil should be placed over the geogrid prior to trafficking.

d. The geogrid should be stretched taught and free of wrinkles prior to placing fill. This is critical to the proper performance of the reinforced slope. We recommend the geogrid be staked in place and fill should be spread from the back of the excavation toward the face of the slope to reduce wrinkles.

e. Geogrid placed behind concrete blocks should be placed between each block and extend from the face to the appropriate length specified in the cross-sections provided.

f. Backfill should be properly compacted as recommended in the compaction section of this report. Appropriate reinforcing of the backfill relies on the interaction between the geogrid and the fill placed, which is dependant on compaction of the fill.

g. The filter fabric placed behind the boulder facing is critical and should be placed as shown on Figures 1 - 6.

6. Rockery Facing

a. The rockery faced slope should be constructed in conformance with the recommendations provided on Figures 1 - 6.

b. The base boulder size should be at least ⅓ the height of the rockery facing for each tier and be embedded at least 1 foot.

c. Base boulders should be supported on a properly prepared subgrade as indicated in the Subgrade Preparation section of this report.

d. Boulders should be stacked such that they interlock and no steeper than ¼:1 (horizontal:vertical).

e. Boulders should be angular, rectangular ledge rock. They should have a flat stacking surface and decrease in size as they are stacked. Rounded boulders should not be used. Boulders should consist of durable material resistant to weathering. Boulders should typically range from 2 to 5 feet in size. We recommend basalt boulders, hard sandstone or hard limestone. Soft sandstone boulders (typically the Navajo or Kayenta (Red to orange color) Sandstone) are much more susceptible to weathering and degradation and should not be used.

f. The total exposed height of the proposed rockery faced slopes should not exceed 16 feet.

7. Concrete Block Facing

a. The precast concrete block wall retaining system should be constructed in conformance with the recommendations provided on Figures 5 and 6.

b. The base blocks should be supported a 6 inch leveling course of gravel or base course underlain by bedrock.

c. Block facing should be stacked with a batter of at least 1:10 (horizontal:vertical).

d. Block facing should be manufactured with Type V sulfate resistant cement in accordance with Table 19.3.1.1 of ACI 318-19 using a sulfate expose category of "Severe, S2".

8. Drainage

Desert landscaping (which requires no water) should be utilized adjacent, above the rockery-faced slopes or segmental block walls. Wetting of the fill behind the boulders may increase the risk of fill densification, increase pressures on the boulder facing and can reduce long term stability of the slope.

Wetting of the backfill and rockery facing can also result in "salt weathering" of the boulders which will degrade and reduce the life of the boulders. Red sandstone in the area has shown to be highly susceptible to salt weathering and should not be used. More resistant boulders such as basalt would be less susceptible to salt weathering.

Drainage of surface water away from the boulder facing/concrete blocks should also be maintained to reduce potential wetting of backfill. It is also critical that surface water be captured and directed to the curb and gutter or off-site. A drainage swale, lined with an impermeable membrane, is recommended behind the rockery facing to collect and divert water away from the rockery slope and discharge offsite. Chimney drains behind concrete blocks are recommended to help reduce the risk of saturation of the backfill zone.

B. **Foundation Setback**

Foundations supporting structures (above the rockery faced slope or segmented block wall) should be set back from the interior edge of a rockery facing or horizontal distance greater than the total height of the slope/wall.

C. **Summary Report**

The items recommended within this report and on Figures 1 - 6 should be observed and tested by AGEC in order to provide a summary report.

D. **Geotechnical Recommendation Review**

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

Geotechnical recommendations provided in the previously referenced report should also be followed and implemented if applicable to the project.

LIMITATIONS

This letter has been prepared in accordance with generally accepted soil and foundation engineering practices in the area for the use of the client for design purposes. The conclusions and recommendations included within the letter are based on the information obtained from review of the referenced report, site observations and conditions, the proposed construction, engineering analysis and our experience in the area. Variations in the subsurface conditions may not become evident until additional exploration or excavation is conducted. If the subsurface soil or groundwater conditions are found to be different from what is described in this letter or referenced geotechnical investigation, we should be notified to reevaluate the recommendations given.

If you have questions or require further assistance, please call.
Sincerely,

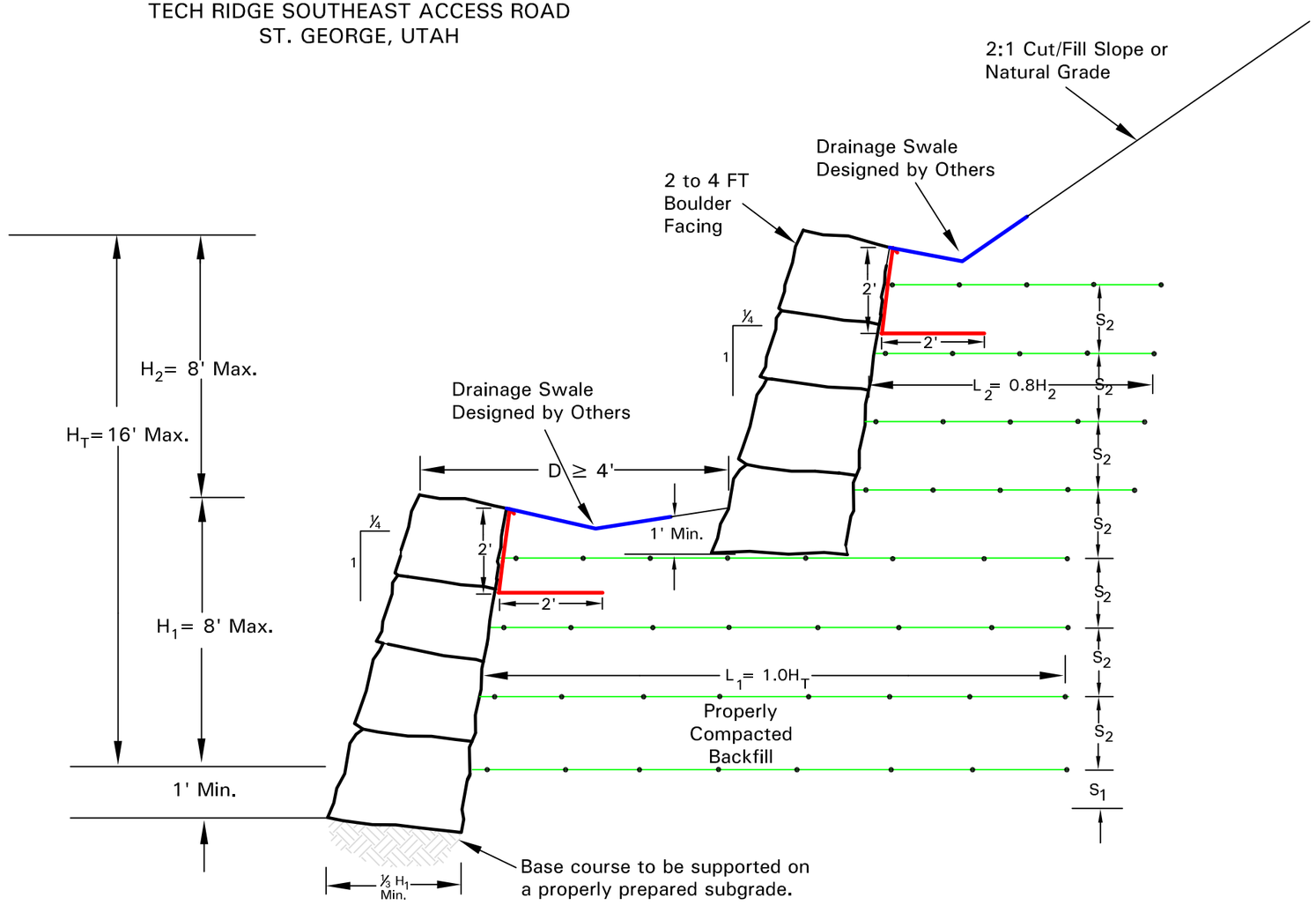
APPLIED GEOTECHNICAL ENGINEERING CONSULTANTS, INC.



Jake Erickson, P.E.

Reviewed by: G. Wayne Rogers, P.E.
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TECH RIDGE SOUTHEAST ACCESS ROAD
ST. GEORGE, UTAH



Key:

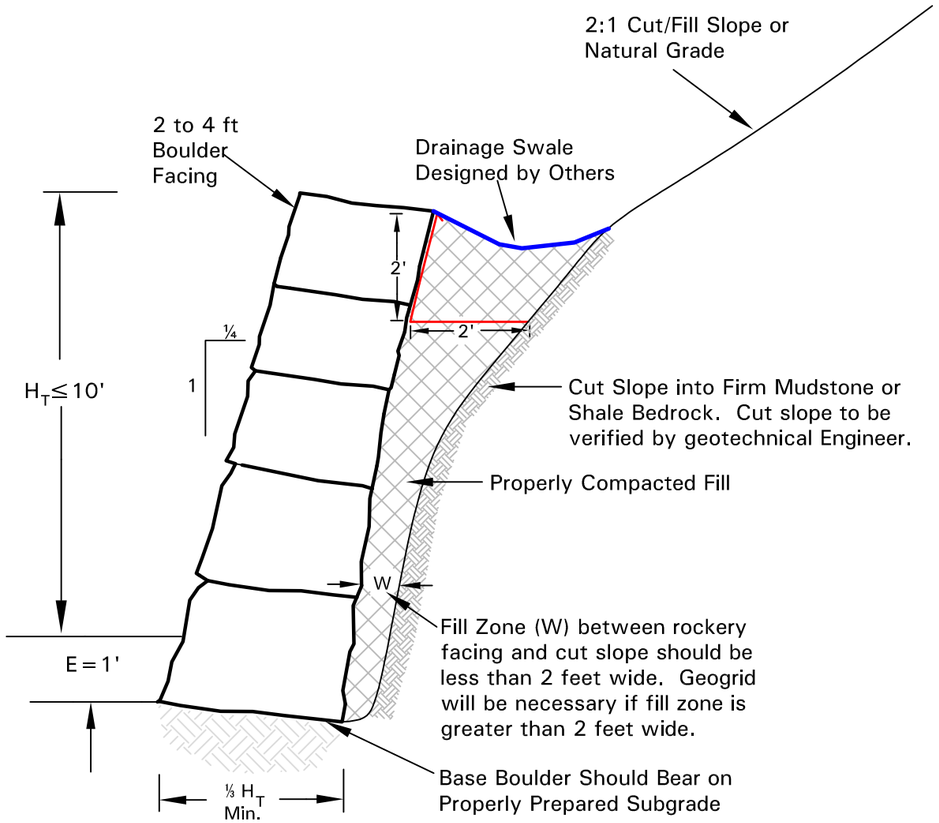
- Mirafi 140N Filter Fabric
- 10 Mil. PVC Liner or Concrete Lined Trench
- Geosynthetic Reinforcment

LICENSED PROFESSIONAL ENGINEER
9/8/23
JACOB C. ERICKSON
No. 10196083
STATE OF UTAH

By: Jake Erickson, P.E.

2230249	AGEC	TWO TIERED ROCKERY FACED REINFORCED FILL SLOPE	Figure 1

TECH RIDGE SOUTHEAST ACCESS ROAD
ST. GEORGE, UTAH



Key:

Mirafi 140N Filter Fabric

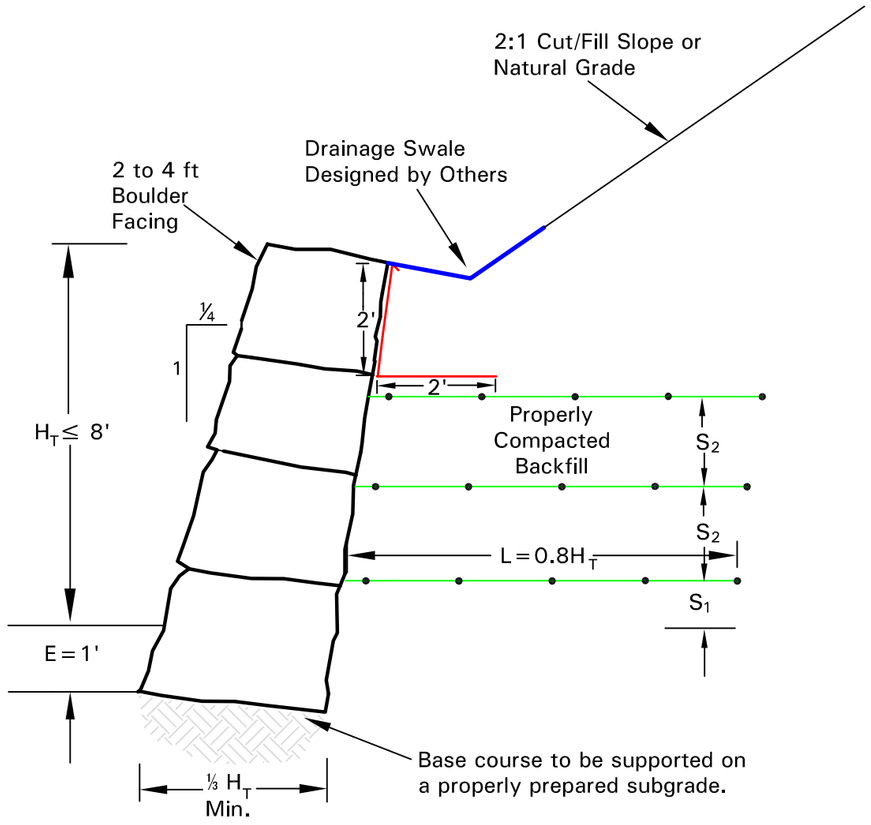
10 Mil. PVC Liner or Concrete Lined Trench

LICENSED PROFESSIONAL ENGINEER
9/8/23
JACOB C. ERICKSON
No. 10196083
STATE OF UTAH

By: Jake Erickson, P.E.

2230249	AGEC	Single Tier Rockery Faced Slope Design - Cut Face	Figure 2

TECH RIDGE SOUTHEAST ACCESS ROAD
ST. GEORGE, UTAH



Key:

- Mirafi 140N Filter Fabric
- 10 Mil. PVC Liner or Concrete Lined Trench
- Geosynthetic Reinforcment

LICENSED PROFESSIONAL ENGINEER
9/823
JACOB C. ERICKSON
No. 10196083
STATE OF UTAH

By: Jake Erickson, P.E.

2230249	AGEC	SINGLE TIERED ROCKERY FACED REINFORCED FILL SLOPE	Figure 3

TECH RIDGE SOUTHEAST ACCESS ROAD
ST. GEORGE, UTAH

A. **Boulder Placement/Construction:**

1. Boulders should be angular, rectangular ledge rock. Boulders should have a flat stacking surface and decrease in size as they are stacked.
2. Base rock size = ⅓-½H ; Minimum rock size 24 inches and/or 200 pounds.
3. Boulders should consist of durable material resistant to weathering. Typically 2 to 5 feet in size. Suitable sources in Washington County - Basalt, tan (Shinarump) sandstone, some limestone from Fort Pearce area.
4. Minimum **embedment** = 1 foot unless deeper embedment is shown on drawing.
5. Minimum **batter** ¼:1 (Horizontal to Vertical).
6. The slope/boulder subgrade should be properly prepared/compacted as directed by the geotechnical engineer prior to placing of fill or boulders.
7. Landscaping and associated irrigation systems are not recommended. Wetting of the backfill may result in settling or reduced stability. Block walls or fences may settle if placed in the backfill zone.

B. **Fill:**

1. Backfill should have a maximum size of 3", -200 < 30% and LL < 30%.
2. Refer to geotechnical investigation (AGEC Project No. 2180295) for approved low permeable fill criteria.
3. Each lift of backfill should be properly compacted. Hand compaction should be used within 3 feet of boulder facing. 4 inch lifts should be used for hand compaction equipment. Lift thickness may be increased to 8 inches for rubber tire or roller compaction.

C. **Construction Observation:**

1. Pre-construction meeting with Engineer, Owner and Contractor.
2. Observation of construction should be completed so that the quality of construction can be documented and modifications can be made if conditions require.
3. Backfill placed behind boulders and in reinforced areas should be tested frequently to verify compaction is at least 95% of the maximum dry density as determined by ASTM D-1557. We recommend a testing frequency of approximately every 1 foot of fill placed staggered approximately every 50 lineal feet. If the fill is not properly compacted, the stability of the slope will be reduced.
4. Backfill should be placed in 6 to 8-inch loose lifts prior to compacting. Proper moisture conditioning should be conducted in the backfill material before compacting.
5. A representative of AGEC should observe/verify placement of the geogrid, filter fabric and strip drains.

D. **Geosynthetics:**

1. The filter fabric may consist of Mirafi 140N, non-woven filter fabric or equivalent.
2. **Geosynthetic reinforcement** should be placed continuously in the primary strength direction. It may not be spliced in the primary strength direction.
3. The geogrid should be stretched by hand until taut and free of wrinkles. Individual lengths of the geosynthetic reinforcement should be overlapped at least 1 foot.
4. Where rockery wall forms an outside corner, geogrid should be placed in both directions with a minimum of 4" of backfill between the overlapping layers of geogrid.
5. The following table should be referred to for geosynthetic grid length: (See Figure 1)

Geosynthetic Reinforcement Schedule ¼:1 (H:V) Slope

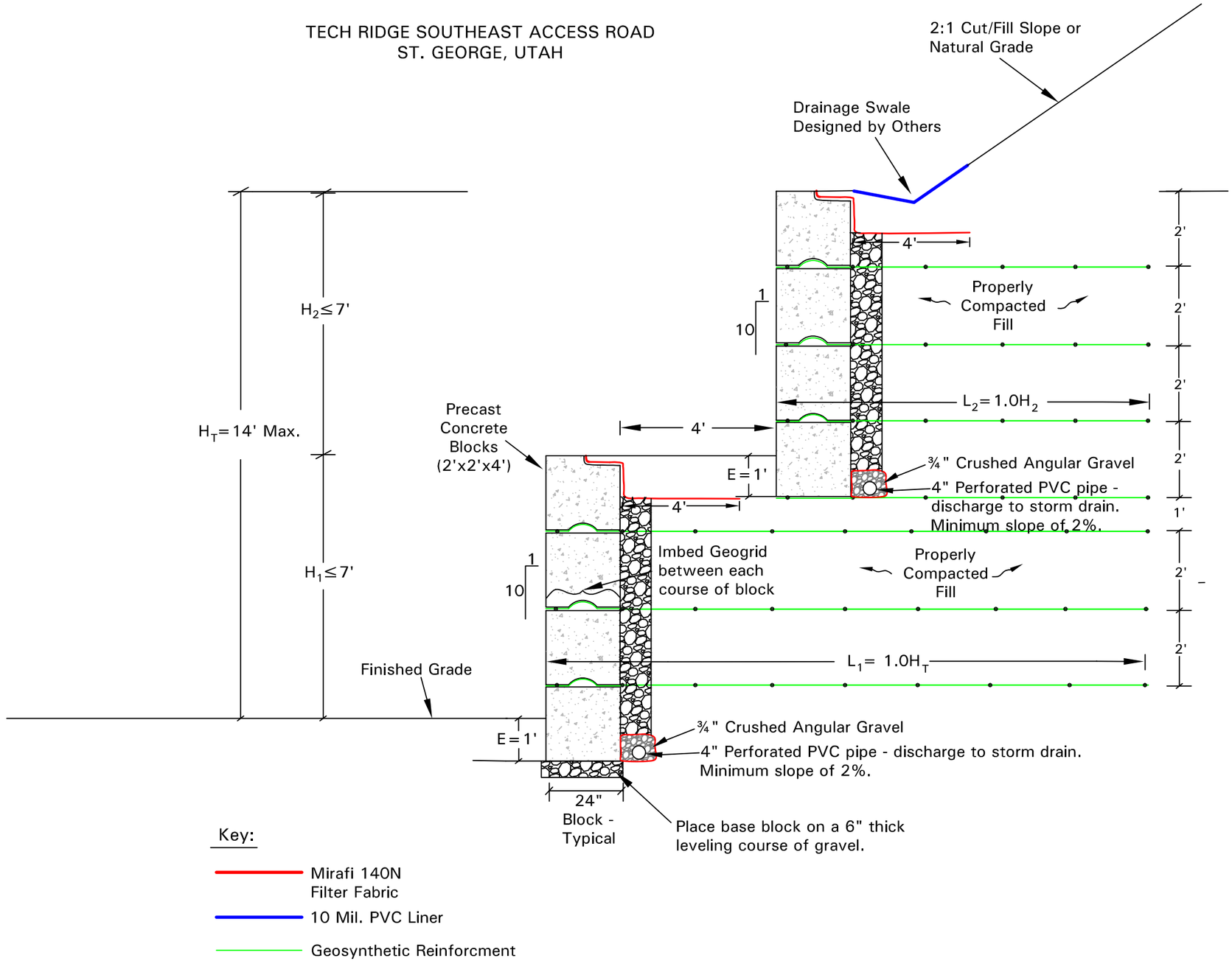
Boulder Faced Fill Slope Height (ft)	Geosynthetic Reinforcement Required	Approved * Geosynthetic Reinforcement	Geosynthetic Vertical Spacing (ft)		Grid Lengths (ft)	
			S_1	S_2	L_1	L_2
$H_T \leq 3$	No	NA	NA	NA	See Detail	See Detail
$3 < H_T \leq 16$	Yes	Miragrid 5XT	1	2		

* Approved Equivalents - Tensar UX1500HS = Miragrid 5XT = WG6

LICENSED PROFESSIONAL ENGINEER
9/8/23
JACOB C. ERICKSON
No. 10196083
STATE OF UTAH

By: Jake Erickson, P.E.

TECH RIDGE SOUTHEAST ACCESS ROAD
ST. GEORGE, UTAH



Key:

- Mirafi 140N Filter Fabric
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- Geosynthetic Reinforcment

LICENSED PROFESSIONAL ENGINEER
9/8/23
JACOB C. ERICKSON
No. 10196083
STATE OF UTAH

By: Jake Erickson, P.E.

2230249	AGEC	Two Tier Segmented Concrete Block Wall	Figure 5

A. CONSTRUCTION NOTES

1. Blocks should consist of at least 4,500 psi strength (28-day strength) concrete. Concrete type should meet or exceed requirements found in Table 4.2.1 of the ACI and be designed according to ACI 318-19 category for "S2" sulfate attack.
2. The base block should consists of a 2'x2'x4' and be placed on a level surface. Gravel or base course should be used as the leveling course.
3. Rigid improvements and structures should be setback from the top of the slope as recommended by the Geotechnical Engineer. Setbacks may vary depending on the size and type of structure being constructed.
4. The pre-cast concrete blocks should be stacked with a batter of at least 1 to 10 (Horizontal to Vertical).

B. GEOSYNTHETIC NOTES (REINFORCED SOIL SLOPE):

1. Geosynthetic reinforcement should be placed continuously in the primary strength direction. It may not be spliced in the primary strength direction. Geosynthetic should be overlapped a minimum of 12" on edges.
2. The placement of the geosynthetic should be observed by a representative of AGEC to verify the specified geosynthetic is being used and properly placed. It should be stretched by hand until taut and free of wrinkles.
3. The primary geosynthetic reinforcement placed behind the blocks should have a minimum long term design strength (LTDS) of 2,800lb/ft (5XT or equivalent).
4. Geogrid should be placed in between the stacked concrete blocks and carry through to the face.

Geosynthetic Reinforcement Schedule 1¼:1 (H:V) Slope

Segmented Block Wall Height (ft)	Geosynthetic Reinforcement Required	Geosynthetic Vertical Spacing (ft)	Primary Geosynthetic Grid Lengths (ft)	
		S	L_1	L_2
$4 \leq H_T \leq 10$	Yes	2'	$1.0H_T$	NA
$10 \leq H_T \leq 14$	Yes	2'	$1.0H_T$	$1.0H_2$

C. GRADING NOTES

1. Backfill should consist of granular material with a maximum particle size of 3", -200<30% and LL<30%.
2. Backfill should be placed and compacted in 6 to 8 inch lifts.
3. Backfill placed behind the blocks should be properly moisture conditioned and compacted to at least 95% of the maximum dry density as determined be ASTM D-1557. Care should be taken to compact the soil adjacent the block to avoid moving the block outward. AGEC should conduct compaction testing on each vertical foot of fill placed at least every 50 feet of wall length.
4. The subgrade below blocks should be properly prepared as directed by the geotechnical engineer prior to placing blocks or backfill. Underlying loose or disturbed soil should be removed its full depth and recompacted prior to placing the leveling course.
5. Fill placed behind the wall should be benched into firm bedrock or properly compacted fill per IBC 2021 Appendix J.

D. DRAINAGE NOTES

1. The surface above the wall and at the top of the slope should be graded to drain away from the face of the wall and slope. A drainage swale with PVC liner and/or concrete lined trench may be used to assist with proper drainage away from the slope.
2. A chimney drain should be installed behind the block wall to prevent saturation of the soil behind the wall. The drain should consist of a 4" perforated pipe covered in clean gravel and wrapped in filter fabric with a 1-foot gravel zone extending up the wall. Saturation of backfill behind the block wall may reduce long-term stability of the wall.



By: Jake Erickson, P.E.

AGEC
Applied GeoTech

September 7, 2023

Tech Ridge, LLC
475 South Donlee Dr.
S. George, Utah 84770

C/O: Alliance Consulting, Craig Coates

email: ccoates@allianceconsulting.us

Subject: Rockery-faced Slope Design and Slope Stability
Tech Ridge Southeast Slope
St. George, Utah
AGEC Project No. 2230248

References:
1. "Geotechnical Investigation, Tech Ridge South Access Road", prepared by AGEC under Project No. 2180295, dated October 19, 2018.
2. "Southeast Walls Exhibits Overall and Sheets 1-5", prepared by Alliance Consulting under Project No. 4488, dated June 14, 2023.

Applied Geotechnical Engineering Consultants, Inc. (AGEC) was requested to provide geotechnical recommendations and slope stability evaluation for construction of a rockery-faced slope and the pad grading for the above referenced project in St. George, Utah as shown on Figure 1. We understand it is planned that the property be graded level from the existing upper summit area by adding a rock wall and backfilling the area level behind the wall.

SITE CONDITIONS

The site is located at the south east end of the Tech Ridge Development. The project area includes the east edge of the ridge which slopes down to the east at slopes ranging from 10 percent up to 70 percent. The hillside below the project site continues to slope down to the east and south. The site slope generally becomes less steep to the west as it approaches the upper ridge where the topography becomes relatively flat. The sloping topography consists of hummocky terrain associated with historical landslide areas. Photos taken near the upper summit of the slope are shown below.



Photos 1 and 2: Southeast end of Tech Ridge Summit viewing to the south (top) and to the north (bottom)

PROPOSED CONSTRUCTION

As part of the future development of the east side access road, it is planned to extend the east edge of the slope with additional fill. A two-tiered rockery-faced slope is planned to face the east edge of the extended slope as shown on Figure 2. A paved biking/walking path is planned to be constructed near the top of the rockery-faced slope.

SUBSURFACE CONDITIONS

On May 18 and 19, 2023, AGEC drilled six exploratory borings at the approximate locations shown on Figure 2. The borings were drilled with a rubber tire ATV mounted drill rig using 8-inch hollow stem augers to drill through the overburden soil and fractured basalt rock. In 4 of the drilled borings, we extended the drilling through the basalt caprock to determine the thickness. The drilling extending through the basalt was accomplished using a tri-cone bit with air to remove cuttings.

Subsurface soil conditions encountered within the borings generally consists of shallow deposits of silty sand, overlying basalt caprock further underlain by silty sand and lean clay. The basalt caprock was encountered at 1 to 2 feet below the surface and it extended a varied amount of approximately 17 to 31 feet. Descriptions of the soil/rock types encountered follow:

Silty Sand - The silty sand is loose (near-surface) to dense (below basalt caprock), dry to slightly moist, contains occasional layers of sandy silt, occasional gravel, and small roots (above basalt caprock). The silty sand is light brown to brown to red-brown in color.

Basalt Caprock - The basalt caprock is hard, dry, and dark gray to black in color.

Lean Clay - The lean clay is stiff, slightly moist, red-brown.

SUBSURFACE WATER

Subsurface water was not encountered during the drilling of the borings as shown in Figure 3. We do not anticipate groundwater will be present or observed during excavation procedures. Fluctuation in groundwater level may occur over time. An evaluation of such fluctuations is beyond the scope of this report.

SLOPE STABILITY ANALYSIS: HILLSIDE

The underlying basalt bedrock will support the trail and its retaining system. The thickness of the basalt was found to vary from 17 to 31 feet. Two of our borings were not extended through the basalt, therefore the thickness of the basalt at those locations is not known.

Our global stability analysis of the hillside is based on subsurface soil information and strength characteristics that have been developed by AGEC during our involvement of the overall stability of the east Blackridge slope in addition to several individual project investigations on the slope.

Two profiles were evaluated in this analysis. One on the north side and the other on the south side of the retaining wall/trail system.

The vertical profiles for both the north and south ends of the trail system consists of basalt overlying undisturbed mudstone. A large area of landslide deposits extend from the edge of the basalt down the slope.

The general slope of the north profile is approximately 6.3:1 (horizontal to vertical) with a 3.0:1 slope on the south profile.

Calculations indicate that the factor of safety for the proposed trail system and retaining walls exceed the minimum 1.5 factor of safety for static conditions. Static factors of safety drop to 1.0 - 1.2 downslope and east of the basalt cap, within the landslide deposits.

The factor of safety under seismic conditions are calculated to be less than 1.0. A deformation analysis indicates that approximately 4 inches of displacement could be experienced should there be a major seismic event with an exceedance probability of 2 percent in a 50-year period.

Specific measures should be taken in design and construction to collect and divert water away from the slope. The stability of the slope could be significantly compromised with the addition of even a small amount of water different than what the slope has experienced in the past.

SLOPE STABILITY ANALYSIS: ROCKERY-FACED SLOPES

AGEC conducted a slope stability analysis to assist in providing recommendations to construct the proposed rockery-faced slope as requested. Stability analysis of the proposed rockery-faced slope was evaluated by selecting a representative cross section. The selected cross-section was analyzed in the proposed geometry to determine whether factors of safety meet generally accepted standards in the field of geotechnical engineering. The following is a list of items considered in our analysis:

A. Slope Profiles

The slope cross-sections were selected by reviewing the grading plan and cross-sections prepared for the site by Alliance Consulting.

B. Soil and Bedrock Strengths

Soil and bedrock strengths used in our analysis are based on the following:

1. Soil properties and descriptions observed in the geotechnical report,
2. Our experience with similar materials in the area, and
3. Naval Facilities Engineering Command (NAVFAC) 7.2.

The following table summarizes soil and bedrock strengths used in our engineering analysis:

Soil Type	Material Unit Weight	Cohesion - c (psf)	Friction Angle - ϕ (degrees)
Boulder Facing (Basalt)*	135	10,000	37
Fill	125	0	36
Basalt	135	Hoek and Brown	Hoek and Brown

* Anisotropic Function - strength parameters vary

C. Analysis and Stability

Based on the proposed slope and rockery facing geometry, our analysis indicates factors of safety exceed those generally accepted to meet the current industry standard of practice.

Our seismic analysis has incorporated an adjusted horizontal ground acceleration of 0.13g (based on an event with a 2 percent probability of exceedance on a 50 year period).

RECOMMENDATIONS

The construction of the rockery-faced slope should follow the recommendations provided on Figures 5 - 6. In addition, the following recommendations are provided and should be implemented during construction of the proposed rockery-faced slopes:

A. Site Grading and Rockery Slope Construction

1. Subgrade Preparation

Prior to placing fill, the exposed subgrade should be scarified, moisture conditioned and properly compacted. The subgrade should be tested to verify compaction prior to placing fill. If the exposed subgrade consists of undisturbed basalt, scarification and compaction is not necessary provided loose, disturbed soil or basalt rock is removed.

2. Excavation/Earthwork

We anticipate excavation of the on site soils may be accomplished with conventional excavation equipment. Excavations which extend into hard basalt will require the use of heavy duty excavation equipment such as a ripper tooth or a rock hammer. Blasting may be necessary on the basalt if the rock does not contain significant fractures.

3. Material Suitability

Imported backfill and site grading/structural fill should meet the following criteria:

Area	Fill Type	Recommendations
Building Pad/Rockery backfill	Structural fill	**-200** <50%, **LL<30** Maximum size = 3 inches Solubility < 1%
Backfill	Crushed rock fill	**-200** <10% Maximum size = 6 inches Solubility < 1%

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

The on-site soils free of organics, debris and oversized particles as listed above are suitable for use as rockery backfill, pool support fill and below areas which will support decking. The onsite bedrock which is excavated from the site may be used as backfill provided it is processed such that the maximum particle size is 6 inches. The rockfill will be most suitable if placed as backfill directly behind boulders. If the processed bedrock is open graded, filter fabric may be necessary behind the rockfill to reduce the potential for migration of adjacent soil fines.

Performance of the rockery-faced slope may be increased by importing a select aggregate granular backfill (behind the rockery in the geogrid reinforced zone) such as road base.

4. Compaction

Compaction of fill materials placed at the site should equal or exceed the following percentages:

Area	Compaction
Subgrade	90%
Rockery-faced Slope Backfill	95%
Pool Support and Decking	95%

Fill placed at the site should be tested frequently to verify proper compaction. Fill tested should be compared to the maximum dry density as determined by ASTM D-1557. Fill should be placed in lift thicknesses which are appropriate

to the type of compaction equipment used. Typically, loose lift thicknesses of 8 to 10 inches are appropriate for heavy equipment. Lift thicknesses should be reduced to 4 inches for hand compaction equipment. Fill should be properly moisture conditioned to within 2 percentage points of the optimum moisture content as determined by ASTM D-1557 prior to placement.

Further, we recommend using hand compaction equipment within 3 feet of the interior edge of the boulders.

5. Geosynthetic Reinforcement and Filter Fabric Placement

Figures 5 - 6 should be referenced for the geogrid type, spacing, lengths and filter fabric placement during construction. The following should be implemented when placing the geosynthetic reinforcement (geogrid):

a. The geogrid should be placed on a smooth subgrade free of humps or loose soil.

b. The geogrid should be placed with the primary strength direction perpendicular to the face of the slope. The geogrid may not be spliced in the primary strength direction.

c. The geogrid should not be trafficked with track-mounted equipment. At least 12 inches of soil should be placed over the geogrid prior to trafficking.

d. The geogrid should be stretched taught and free of wrinkles prior to placing fill. This is critical to the proper performance of the reinforced slope. We recommend the geogrid be staked in place and fill should be spread from the back of the excavation toward the face of the slope to reduce wrinkles.

e. Backfill should be properly compacted as recommended in the compaction section of this report. Appropriate reinforcing of the backfill relies on the interaction between the geogrid and the fill placed, which is dependant on compaction of the fill.

f. The filter fabric placed behind the boulder facing is critical and should be placed as shown on Figures 5 - 6.

6. Rockery Facing

a. The rockery-faced slope should be constructed in conformance with the recommendations provided on Figures 5 - 6.

b. The base boulder size should be at least ⅓ the height of the rockery facing for each tier and be embedded at least 1 foot.

c. Base boulders should be supported on a properly prepared subgrade as indicated in the Subgrade Preparation section of this report.

d. Boulders should be stacked such that they interlock and no steeper than ¼:1 (horizontal:vertical).

e. Boulders should be angular, rectangular ledge rock. They should have a flat stacking surface and decrease in size as they are stacked. Rounded boulders should not be used. Boulders should consist of durable material resistant to weathering. Boulders should typically range from 2 to 5 feet in size. We recommend basalt boulders, hard sandstone or hard limestone. Soft sandstone boulders (typically the Navajo or Kayenta (Red to orange color) Sandstone) are much more susceptible to weathering and degradation and should not be used.

f. The total exposed height of the proposed rockery-faced slopes should not exceed 24 feet.

7. Drainage Behind Boulder Facing

Desert landscaping (which requires no water) should be utilized adjacent, above and within 8 feet of the rockery facing. Wetting of the fill behind the boulders may increase the risk of fill densification, increase pressures on the boulder facing and can reduce long term stability of the slope.

Wetting of the backfill and rockery facing can also result in "salt weathering" of the boulders which will degrade and reduce the life of the boulders. Red sandstone in the area has shown to be highly susceptible to salt weathering and should not be used. More resistant boulders such as basalt would be less susceptible to salt weathering.

Drainage of surface water away from the boulder facing should also be maintained to reduce potential wetting of backfill from behind the boulders. It is also critical that roof water be captured and directed to the curb and gutter or off-site. A drainage swale, lined with an impermeable membrane, is recommended behind the rockery facing to collect and divert water away from the rockery slope and discharge offsite.

B. **Foundation Setback**

Foundations supporting structures (above the rockery) should be set back from the interior edge of a rockery facing or horizontal distance equal to or greater than the total height of the upper tier of facing.

C. **Summary Report**

The items recommended within this report and on Figures 5 - 6 should be observed and tested by AGEC in order to provide a summary report.

D. **Geotechnical Recommendation Review**

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

Geotechnical recommendations provided in the previously referenced report should also be followed and implemented if applicable to the project.

LIMITATIONS

This letter has been prepared in accordance with generally accepted soil and foundation engineering practices in the area for the use of the client for design purposes. The conclusions and recommendations included within the letter are based on the information obtained from review of the referenced report, site observations and conditions, the proposed construction, engineering analysis and our experience in the area. Variations in the subsurface conditions may not become evident until additional exploration or excavation is conducted. If the subsurface soil or groundwater conditions are found to be different from what is described in this letter or referenced geotechnical investigation, we should be notified to reevaluate the recommendations given.

If you have questions or require further assistance, please call.
Sincerely,

APPLIED GEOTECHNICAL ENGINEERING CONSULTANTS, INC.



Jake Erickson, P.E.

James E. Nordquist, P.E.

Reviewed by: G. Wayne Rogers, P.E.

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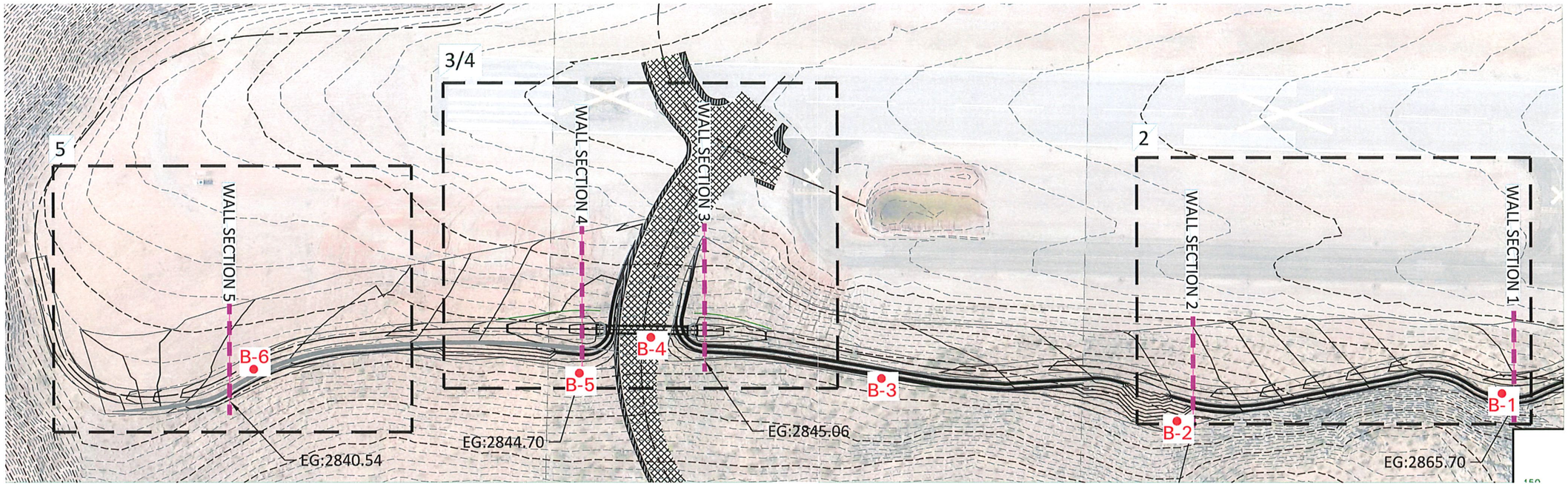
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Not to Scale

TECH RIDGE SOUTHEAST SLOPE
ST. GEORGE, UTAH

2230248	AGEC	Vicinity Map	Figure 1

TECH RIDGE SOUTHEAST SLOPE
ST. GEORGE, UTAH

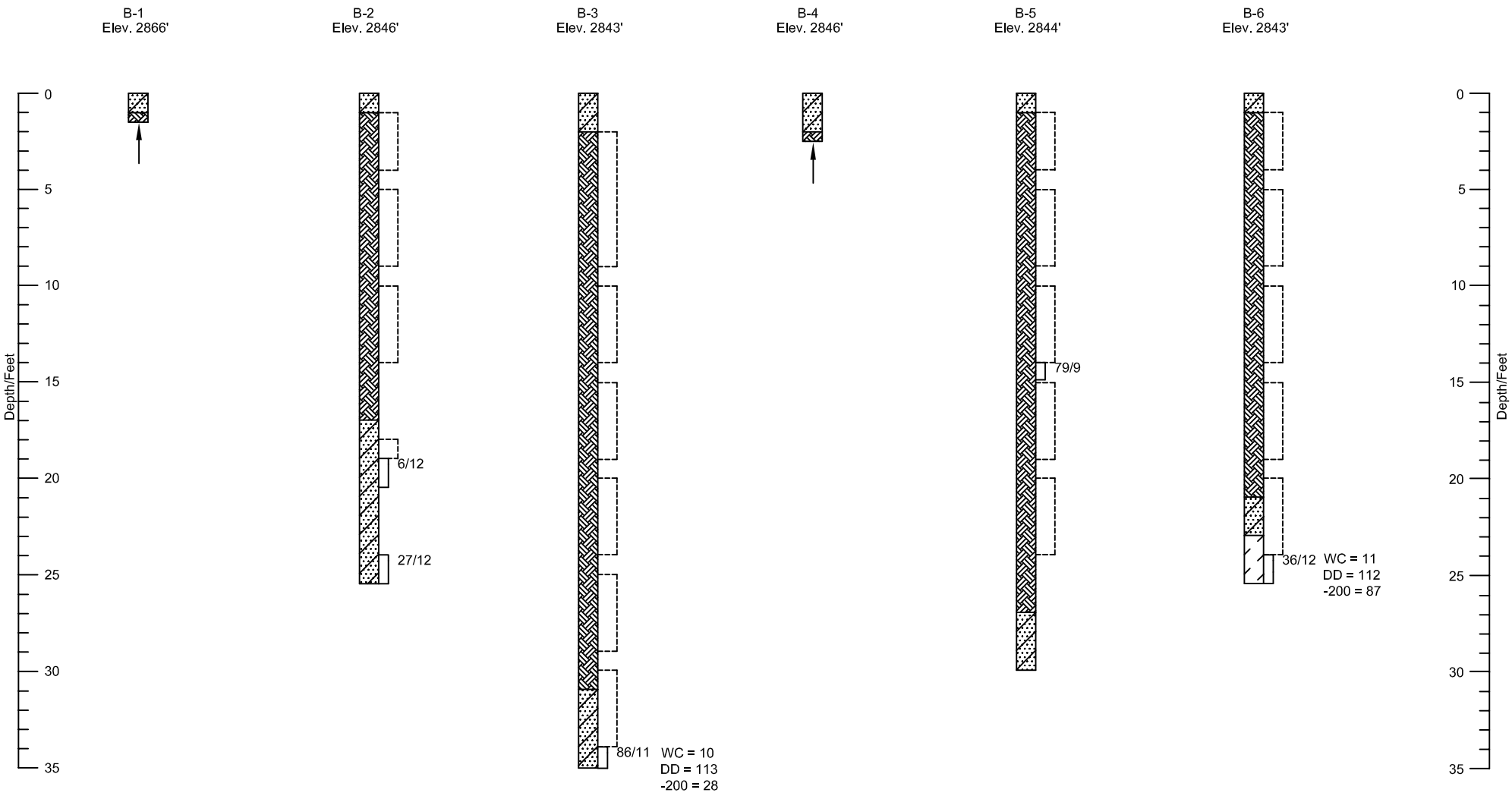


● Approximate boring location

N

0 150 300 feet

2230248	AGEC	Site Plan and Boring Locations	Figure 2



2230248 | AGEC | Logs of Exploratory Borings | Figure 3

LEGEND:



Silty Sand (SM); loose to dense, dry to slightly moist, contains occasional layers of sandy silt, occasional gravel, small roots (upper 12"), light brown to brown to red-brown.



Basalt Caprock; hard, dry, dark grey to black.



Lean Clay (CL); stiff, slightly moist, red-brown.



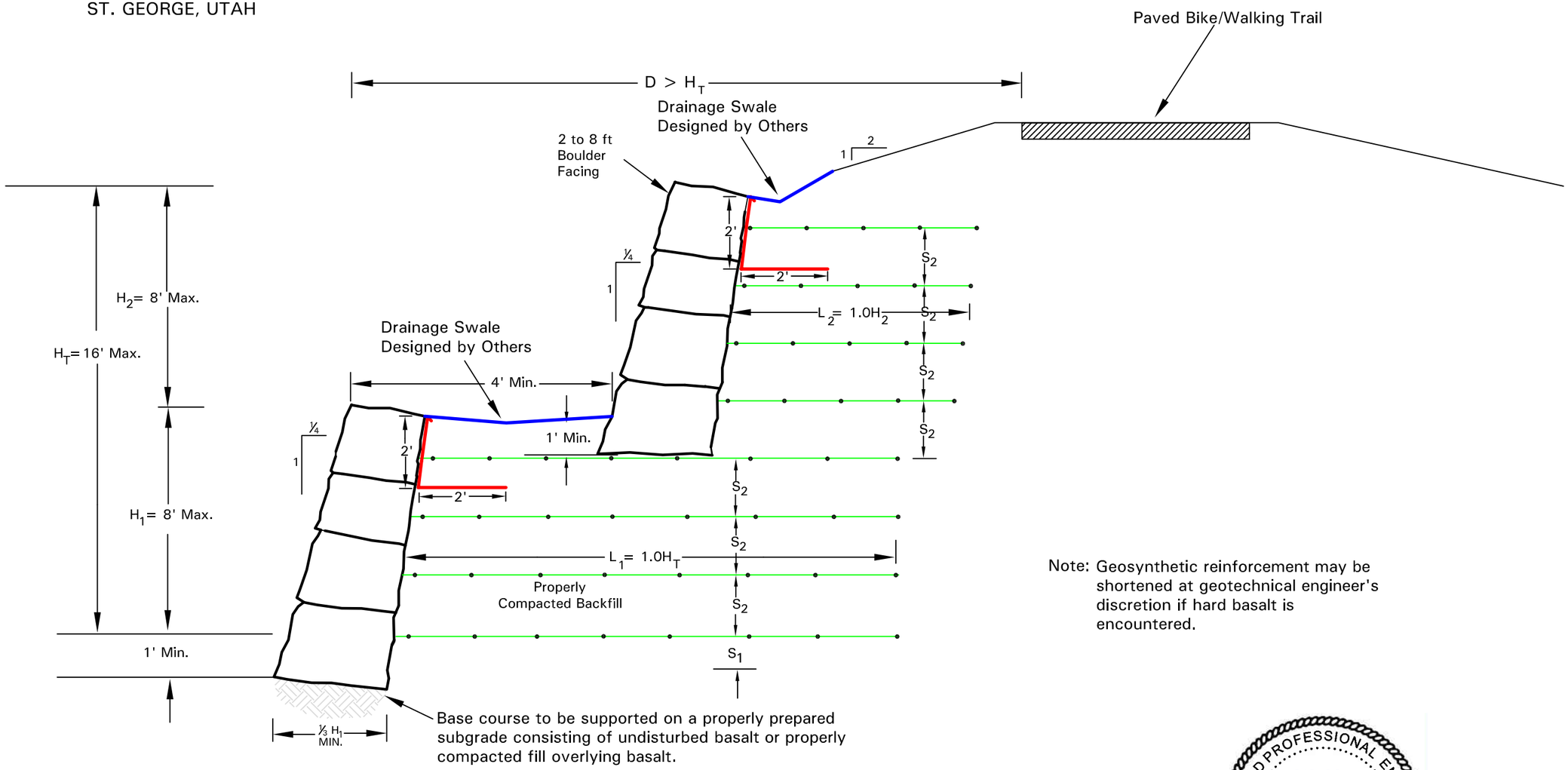
10/12 California drive sample taken. The symbol 10/12 indicates that 10 blows from a 140 pound hammer falling 30 inches were required to drive the sampler 12 inches.

Indicates practical backhoe refusal on basalt caprock.

NOTES:

1. The borings were drilled on May 18, 2023 with a rubber tire ATV mounted drill rig equipped with 8-inch hollow stem augers.
2. The locations of the borings were approximated with a KMZ file using a handheld GPS device as shown on Figure 2.
3. The elevations of the borings were interpolated from contours on the site plan as shown on Figure 2.
4. The boring locations and elevations should be considered accurate only to the degree implied by the method used.
5. The lines between the materials shown on the boring logs represent the approximate boundaries between material types and the transitions may be gradual.
6. Water level readings shown on the logs were made at the time and under the conditions indicated. Fluctuations in the water level may occur with time.
7. WC = water content (%);
   DD = dry density (pcf);
   -200 = percent passing No. 200 sieve.

TECH RIDGE, SOUTHEAST SLOPE
ST. GEORGE, UTAH



Key:

- Mirafi 140N Filter Fabric
- 10 Mil. PVC Liner
- Geosynthetic Reinforcment

Note: Geosynthetic reinforcement may be shortened at geotechnical engineer's discretion if hard basalt is encountered.

LICENSED PROFESSIONAL ENGINEER
9/8/23
JACOB C. ERICKSON
No. 10196083
STATE OF UTAH

By: Jake Erickson, P.E.

2230248	AGEC	TWO TIERED ROCKERY FACED REINFORCED FILL SLOPE	Figure 5

TECH RIDGE, SOUTHEAST SLOPE
ST. GEORGE, UTAH

A. **Boulder Placement/Construction:**

1. Boulders should be angular, rectangular ledge rock. Boulders should have a flat stacking surface and decrease in size as they are stacked.
2. Base rock size = ⅓-½H ; Minimum rock size 24 inches and/or 200 pounds.
3. Boulders should consist of durable material resistant to weathering. Typically 2 to 5 feet in size. Suitable sources in Washington County - Basalt, tan (Shinarump) sandstone, some limestone from Fort Pearce area.
4. Minimum **embedment** = 1 foot unless deeper embedment is shown on drawing.
5. Minimum **batter** ¼:1 (Horizontal to Vertical).
6. The slope/boulder subgrade should be properly prepared/compacted as directed by the geotechnical engineer prior to placing of fill or boulders.
7. Landscaping and associated irrigation systems are not recommended. Wetting of the backfill may result in settling or reduced stability. Block walls or fences may settle if placed in the backfill zone.

B. **Fill:**

1. Backfill should have a maximum size of 3", -200 < 30% and LL < 30%.
2. Refer to geotechnical investigation (AGEC Project No. 2180295) for approved low permeable fill criteria.
3. Each lift of backfill should be properly compacted. Hand compaction should be used within 3 feet of boulder facing. 4 inch lifts should be used for hand compaction equipment. Lift thickness may be increased to 8 inches for rubber tire or roller compaction.

C. **Construction Observation:**

1. Pre-construction meeting with Engineer, Owner and Contractor.
2. Observation of construction should be completed so that the quality of construction can be documented and modifications can be made if conditions require.
3. Backfill placed behind boulders and in reinforced areas should be tested frequently to verify compaction is at least 95% of the maximum dry density as determined by ASTM D-1557. We recommend a testing frequency of approximately every 1 foot of fill placed staggered approximately every 50 lineal feet. If the fill is not properly compacted, the stability of the slope will be reduced.
4. Backfill should be placed in 6 to 8-inch loose lifts prior to compacting. Proper moisture conditioning should be conducted in the backfill material before compacting.
5. A representative of AGEC should observe/verify placement of the geogrid, filter fabric and strip drains.

D. **Geosynthetics:**

1. The filter fabric may consist of Mirafi 140N, non-woven filter fabric or equivalent.
2. **Geosynthetic reinforcement** should be placed continuously in the primary strength direction. It may not be spliced in the primary strength direction.
3. The geogrid should be stretched by hand until taut and free of wrinkles. Individual lengths of the geosynthetic reinforcement should be overlapped at least 1 foot.
4. Where rockery wall forms an outside corner, geogrid should be placed in both directions with a minimum of 4" of backfill between the overlapping layers of geogrid.
5. The following table should be referred to for geosynthetic grid length: (See Figure 1)

Geosynthetic Reinforcement Schedule ¼:1 (H:V) Slope

Boulder Faced Fill Slope Height (ft)	Geosynthetic Reinforcement Required	Approved * Geosynthetic Reinforcement	Geosynthetic Vertical Spacing (ft)		Grid Lengths (ft)	
			S_1	S_2	L_1	L_2
$H_T \leq 3$	No	NA	NA	NA	See Detail	See Detail
$3 < H_T \leq 16$	Yes	Miragrid 5XT	1	2		

* Approved Equivalents - Tensar UX1500HS = Miragrid 5XT = WG6

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