GEOTECHNICAL INVESTIGATION REPORT

Prepared for:

Five County Association of Governements
Attn: Bryan Thiriot
P.O. Box 1550
St. George, Utah 84771

April 25, 2023

Five County AOG Storage Building - Revised

Prepared by:

795 East Factory Drive
St. George, UT 84790

Landmark Project No: 230112

March 31, 2023

Five County Association of Governments
Attn: Bryan Thiriot
P.O. Box 1550
St. George, Utah 84771

Subject: Geotechnical Investigation Report - Revised
Five County AOG Storage Building
St. George, Utah
Landmark Project No.: 230112

Bryan:

As requested, we have completed our Geotechnical Investigation for the above noted project. Our geotechnical recommendations, along with our field and laboratory data are presented in this report.

Our field investigation for this project consisted of the excavation of two test pits proximate to the proposed structure. The test pits extended to depths of 10.0 to 10.5 feet below the ground surface. The soil in the test pits consisted of loose clayey sand fill underlain by silty clay and sand. Groundwater was not encountered in the test pits at the time of our investigation. Site grading and general foundation recommendations are detailed in Section 5.0 of this report. Foundation recommendations are provided in Section 6.0 of this report. The on-site sandy and silty soils, free from organics and other debris are suitable for use as structural fill.

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

Sincerely,

LANDMARK TESTING AND ENGINEERING

Steven Wells, P.E.
Geotechnical Manager

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ST. GEORGE, UTAH

1.0 INTRODUCTION

This report presents the results of Landmark Testing & Engineering's geotechnical investigation for a storage building located to the north of the existing Five County AOG building at 1070 West 1600 North in the Tonaquint Center in St. George, Utah. Figure 1 is a Vicinity Map showing the project location relative to surrounding features. Figure 2 is a Site Map showing the proposed project layout and the approximate location of the test pits completed for this investigation.

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

2.0 PROPOSED CONSTRUCTION

We understand that a single-story storage building will be constructed on the project site. The building will be slab on grade construction. We anticipate that structural loads for the storage building will range from 1,500 to 2,000 pounds per lineal foot. Any significant changes to the anticipated development should be reviewed by Landmark to evaluate the continued applicability of the recommendations contained in this report.

3.0 SITE SETTING

3.1 SURFACE CONDITIONS

The project site is located to the north of the existing AOG building in the Tonaquint Center. The project site is bounded by the existing building to the south, a parking lot to the east, desert landscaping to the west and dry wash to the north.

The project site is covered in desert landscaping with abundant gravel and occasional desert plants. The project site is relatively level. The wash to the north is approximately 10 feet deep with slopes of approximately 2 horizontal to 1 vertical (2H:1V).

3.2 GEOLOGIC SETTING

According to the Utah Geological Survey, the soils on the project site are mapped old river and stream deposits (Holocene to middle Pleistocene, Qat), classified as, "stratified, moderately to well-sorted alluvial gravel, sand, silt, and minor clay that forms level to gently sloping terraces above modern drainages."[1] Soils encountered in the test pits consisted of loose, clayey sand underlain by clayey silt. The soils were consistent with the geologic mapping.

3.3 GEOLOGIC HAZARDS

Fault Rupture

The trace of the Washington Fault is approximately 6 miles to the east of the site. The trace of the Hurricane Fault is located approximately 16.5 miles east of the project site. The most recent

1 Interactive Geologic Map Portal, Retrieved March 30, 2023, from Utah Geological Survey, https://geology.utah.gov/apps/intgeomap

movement of the Washington and Hurricane Fault lines is mapped as Quaternary, which classifies the faults as active. Strong ground motion associated with movement along the Washington Fault, Hurricane Fault, or other faults associated with the Intermountain Seismic Belt is possible, however, the potential for surface fault rupture is considered low.

Liquefaction

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

The project site is mapped by the Utah Geological Survey as being in a very high liquefaction hazard area.[3] Soils encountered throughout the test pits consisted of loose clayey sand underlain by clayey silt with a relatively high fines content. These soils are typically not very susceptible to liquefaction. Additionally, groundwater was not encountered at the time of our investigation. Therefore, the potential for liquefaction is considered low. However, a liquefaction assessment is beyond the scope of this report.

Flooding

The project site is mapped by the Utah Geological Survey as located in a high flood hazard area described as, "High flood hazard in stream channels, flood plains, and low terraces along normally dry ephemeral streams (smaller drainage basins [less than 5 mi ^{2}]) that are periodically inundated by flash floods and debris flows during cloudburst or thunderstorms, young deltaic deposits that periodically flood due to shallow groundwater and streamflow, and slot canyons containing perennial streams that are periodically inundated by flash floods and debris flows during cloudburst storms in their smaller drainage basins."

We have been informed by the client that in the time since the UGS provided the hazard map, the channel to the north of the project site has been constructed. This was done in an attempt to redirect surface water from the vicinity.

The project site is mapped by FEMA as being within an area of minimal flood hazard.[4] The project site is mapped as having less than a 1 percent annual chance flood with a depth less than 1 foot.

3.4 SEISMICITY

Seismicity at the site was determined using the Structural Engineers Association (SEA), OSHPD Seismic Design Maps website. The following values are presented to assist with seismic design.

2 Coduto, Donald P. (1999), Geotechnical Engineering: Principles and Practices, Prentice Hall, Upper Saddle River, NJ
3 Utah Geological Hazards Portal, Retrieved March 30, 2023, from Utah Geological Survey, https://geology.utah.gov/apps/jay/tests/hazards/
4 https://www.fema.gov/flood-maps/national-flood-hazard-layer, Retrieved April 25, 2023

- Latitude = 37.08188 North, Longitude = 113.60607 West
- Site Class = D (Stiff Soil), based on ASCE 7-16 (Table 20.3.1) as referenced in 2021 IBC 1613.2

Period (sec)	Sa (g)	Site Class
0.2	S_S = 0.497	B/C
1.0	S_1 = 0.162	B/C
0.2	S_{DS} = 0.465	D
1.0	S_{D1} = 0.246	D

(2016 ASCE-7-16, SEA, Structural Engineers Association, https://seismicmaps.org/)

As per section 20.1 of ASCE 7-16, "The soil shall be classified in accordance with Table 20.3-1 and section 20.3 based on the upper 100 feet of the site profile." However, section 20.1 continues, "Where site specific data are not available to a depth of 100 feet, appropriate soil properties are permitted to be estimated by the registered design professional preparing the soil investigation report based on known geologic conditions." Based on our engineering experience in the area, mapped geology and the soils encountered in the test pits, it is the opinion of Landmark Testing and Engineering that the soils on site classify as Site Class D.

4.0 INVESTIGATION

4.1 FIELD INVESTIGATION

To investigate the subsurface soil conditions, two test pits were excavated proximate to the proposed structure. The locations of the test pits relative to the proposed layout of the project are shown on the Site Plan, Figure 2.

Test pit TP-1 was moved approximately 10 feet to the south to where it is shown on the Site Map on Figure 2 after a gravel drain wrapped in geofabric was encountered at a depth of approximately 1 foot.

The upper 3.5 feet of soil in the relocated test pit TP-1 consisted of loose clayey sand fill. The sand was underlain by native silty clay from 3.5 to 9 feet. The clay was underlain by loose to medium dense silty sand poorly graded sand to the bottom of the test pit at 10.5 feet.

Loose clayey sand fill was encountered in the upper 5.5 feet of test pit TP-2. The sand was underlain by soft to medium stiff silty clay to the bottom of the test pit at 10 feet.

Groundwater was not encountered in either of the test pits at the time of our investigation. For a detailed description of the subsurface soil and groundwater conditions encountered in the test pits, please see the test pit logs on Figures 3 and 4. A key to the symbols and soil classifications used on the logs is presented on Figure 5.

4.2 LABORATORY TESTING

Samples from the test pits were taken to our St. George, Utah laboratory for testing. Tests performed on the samples included mechanical sieve analyses and Atterberg Limits tests to aid in soil classification, consolidation tests to aid in excavation recommendations, and a modified Proctor test was performed to aid in construction observation. Laboratory test results are shown on the test pit logs on Figures 3 and 4.

The mechanical sieve analyses and Atterberg Limits tests classify the samples from test pits TP-1 at 4 feet and TP-2 at 5.5 feet as silty clay. The moisture contents of the samples were shown to be 10.5 and 8.8 percent, respectively.

Consolidation tests were performed on samples of clayey sand fill from test pits TP-1 at 1 foot and TP-2 at 3 feet. The samples collapsed and 1.0 and 0.3 percent when wetted under a load of 1,000 psf showing a low collapse potential. The samples were shown to compress up to 11.5 to 12.5 percent, showing that the fill soils are highly compressible. The consolidation curves are shown on Figures 6 and 7.

A modified Proctor test was performed on a bulk sample of the clayey sand fill from test pit TP-2. The sample was shown to have a maximum dry density of 123.9 pcf at an optimum moisture content of 9.9 percent.

4.3 CONCLUSIONS

Our field observations and experience in the area, including laboratory testing of soils on a lot to the southwest, indicate that the soils on site consisted of loose with a low to moderate collapse potential and are moderately to highly compressible. We recommend that loose, compressible, near surface soils be excavated prior to construction. General recommendations for the earthwork and the foundation system are outlined in Sections 5.0 and 6.0 of this report.

5.0 SITE GRADING AND EARTHWORK

5.1 GENERAL GRADING

We anticipate that grubbing the upper 3 to 6-inches of soil will be sufficient to remove the majority of the roots. Once the building pad areas have been cleared and grubbed, we recommend that the loose clayey sand soils be excavated. We anticipate that the excavation will extend to depths of 3.5 to 5.5 feet below the ground surface.

The excavations are expected to extend to the bottom of the gravel drain. We recommend that the drain be removed as part of the excavation process. Where soft and wet soils are encountered in the drain area we recommend that the excavation extend to firm and dry soil. It is unknown at this time how much deeper, if at all, the excavation in the drain area will need to extend than the surrounding area.

Once the excavations are complete, we recommend that the silty clay in the upper 8-inches of the bottom of the excavations be scarified, moisture conditioned to within 2 percent of the optimum

moisture content and compacted to a minimum of 90 percent of the maximum dry density as determined by ASTM D-1557.

The excavated sands are suitable for use as structural fill and may be replaced according to structural fill recommendations as subsequently outlined, provided the soil is free of organics, and other deleterious materials, including rocks large than 6-inches in dimension. However, the material may have a tight moisture band and care will need to be exercised to ensure adequate moisture conditioning and compaction.

We anticipate a loss in volume upon compaction of the on-site soils of 10-15 percent. We recommend that imported, granular fill, if required to bring the building pad up to the desired elevation, be placed in the upper portion of the building pad area. Imported fill should meet the subsequent specifications.

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

5.2 FILL PLACEMENT AND COMPACTION

All fill to be placed for support of footings and slabs-on-grade should be considered structural fill. Imported, granular fill, if required, should be well-graded, non-expansive, and free of organics and all deleterious materials. Soils used for granular, imported, structural fill should meet the following specifications and preferably would classify as gravel.

GRADATION	PERCENT PASSING
3- inch	100
1 ½ -inch	80-100
No. 200 sieve	10-25

ATTERBERG LIMITS	
Liquid Limit	30 or less
Plasticity Index	9 or less

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

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

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

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

5.3 LIGHTLY LOADED ELEMENTS

Exterior concrete slabs on grade (miscellaneous concrete flatwork) should be established on a minimum of 8-inches of scarified and recompacted on-site fill soils. Sidewalks and curbs and gutters in the public right of way will need to be underlain by approved road base as per Kanab City standards. Structural fill, including road base, should be compacted to a minimum of 95 percent of the maximum dry density as determined by ASTM D-1557.

5.4 CUT AND FILL SLOPES

We anticipate that permanent cuts and fills will be minimal. It is recommended that permanent cut or fill slopes in on-site silty sand be maintained at a slope of one vertical to two horizontal (1V:2H) or flatter unless structurally retained.

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

6.0 FOUNDATION & CONSTRUCTION CONSIDERATIONS

The following recommendations apply to conventional strip and spot footings. Footings should be established on structurally placed soils as indicated in section 5.0. Foundation excavations should be visually observed and tested by qualified personnel prior to placement of reinforcing steel or concrete. Additional foundation recommendations are subsequently presented.

DESCRIPTION	VALUE
Foundation Type	Continuous or spread footings
Bearing Material	Structurally placed on-site soils
Allowable Bearing Capacity	2,000 psf on structurally placed soil

DESCRIPTION	VALUE
Minimum embedment depth below finished grade	1.0 feet (for frost and confinement)
Minimum footing width	12 inches (continuous) for single-story 18-inches for two stories 24-inches (isolated spread)
Total estimated settlement	1-inch
Total differential settlement	less than 3/4 inch

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

7.0 FLOOR SLABS

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

Concrete slabs should be designed using rebar reinforcement and frequent crack control joints to help control normal shrinkage and stress cracking. Concrete placement and curing should meet ACI[5] requirements including following hot or cold weather placement recommendations, when appropriate. If a moisture-sensitive floor covering will be installed, we recommend that a vapor barrier be installed beneath the concrete slab. The moisture sensitivity of floor finishes, anticipated project conditions, and the potential effects of slab curling and cracking should be considered in determining if the barrier should be placed directly beneath the slab or beneath the free-draining gravel (see ACI 302.IR-96 for more information regarding vapor barrier location). If the vapor barrier is installed directly beneath the slab, measures should be taken to minimize excessive slab curl such as reduced joint spacing and use of a low shrinkage (low water-cement ratio) mix.

8.0 LATERAL EARTH PRESSURES

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

[5] American Concrete Institute

Case Evaluated	Soil Type	Value
Active	On-site sands	36 psf/ft
		55 psf/ft (with seismic)
At-Rest	On-site sands	55 psf/ft
Passive	On-site sands	384 psf/ft
		332 psf/ft (with seismic)
Coefficient of friction tan(φ*0.6) where φ = 32°	On-site sands	0.35

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

9.0 MOISTURE CONTROL

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

1. The ground surface should be graded to drain surface water away from the structure in all directions. A minimum grade of 5% (IBC 1803.3) in the first 10 feet is recommended. Impervious surfaces such as concrete walkways adjacent to the structure are effective in reducing the potential for water migration beneath foundations and slabs and should be considered in design. Impervious surfaces such as concrete within 10 feet of the building foundation should be sloped a minimum of 2% away from the building.

2. Xeriscape (landscaping that eliminates the need for supplemental irrigation of plants) is recommended within 5-feet of the building foundations. Bubblers, although more efficient than sprinkler irrigation, still have a significant potential of introducing excessive water into the ground and saturating foundation soils. Bubblers are not recommended in the 5-foot buffer zone area. As an alternative, sealed bottom planter boxes may be used.

3. Grass should not be placed within 5-feet of the foundation. Grass, if planted, should have a minimum slope of 5% away from the foundation.

4. Roof runoff should be collected, and downspouts should be designed to discharge collected water a minimum of 10 feet beyond the building footprint.

5. Inadequate compaction of utility trench backfill provides a conduit for water migration. All utility trenches within the building footprint and extending 5 feet beyond the footprint should be backfilled with structural fill similar to that approved for the foundations. Backfill adjacent to structures should be compacted to at least 90 percent of the maximum dry density as determined by ASTM D-1557 and the minimum slope requirements should be followed. Backfill beneath structures should be compacted to at least 95% of the maximum dry density.

6. Grading should be such that surface water is directed away from all cut and fill slopes and collected only in channels protected against erosion. Water should not be allowed to pond on-site.

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

10.0 SOIL CORROSIVITY

Soils in the area have been shown to be moderately corrosive to concrete and metal structures. It is recommended that all concrete in contact with or within 6 inches of native soils be designed in accordance with ACI 318, Table 19.3.1.1 for Exposure Category S1. Buried pipes should be plastic (PVC or HDPE) instead of metal, where possible.

11.0 FOUNDATION REVIEW AND TESTING

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

12.0 LIMITATIONS

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

this report, Landmark should be made aware of the changes. Landmark will provide written verification that the recommendations and conclusions remain valid or that modifications are required.

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

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

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

LANDMARK TESTING & ENGINEERING

Kent Nelson, P.E.
Project Engineer

Reviewed by:

Hugo Angeles, E.I.T.
Geotechnical Field Manager

LANDMARK TESTING & ENGINEERING	VICINITY MAP PROJECT NUMBER 230112	Figure 1

LANDMARK TESTING & ENGINEERING	SITE MAP PROJECT NUMBER 230112	Figure 2

TEST PIT NUMBER TP-1

DATE STARTED 3/6/23 **COMPLETED** 3/6/23 **EXCAVATION COMPANY** Trever Jensen **ELEVATION**

LOGGED BY Dave Baldazzi **CHECKED BY** Kent Nelson **EXCAVATION METHOD** Bobcat 341 Mini-ex

NOTES

DEPTH (ft)	GRAPHIC LOG	SAMPLE TYPE NUMBER	MATERIAL DESCRIPTION	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	MECHANICAL GRADATION: GRAVEL (%)	MECHANICAL GRADATION: SAND (%)	MECHANICAL GRADATION: FINES (%)	Other Tests
0		1	FILL: CLAYEY SAND (SC), loose, slightly moist, fine grained, roots less than 1-inch in diameter to a depth of 1 foot, pinholes, brown	97.7	15.2						1% Collapse @ 1000 psf
5		2	SILTY CLAY (CL-ML), soft to medium stiff, slightly moist, fine grained, pinholes, brown		10.5	21	6	6	34	60	
10		3	SILTY SAND (SM), loose to medium dense, slightly moist, brown								
			Grades to fine to coarse grained sand								
			POORLY GRADED GRADED GRAVEL (GW), loose to medium dense, slightly moist, brown								

Bottom of test pit at 10.5 feet.

TEST PIT NUMBER TP-2

DATE STARTED 3/6/23 **COMPLETED** 3/6/23 **EXCAVATION COMPANY** Trever Jensen **ELEVATION**

LOGGED BY Dave Baldazzi **CHECKED BY** Kent Nelson **EXCAVATION METHOD** Bobcat 341 Mini-ex

NOTES

DEPTH (ft)	GRAPHIC LOG	SAMPLE TYPE NUMBER	MATERIAL DESCRIPTION	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	MECHANICAL GRADATION: GRAVEL (%)	MECHANICAL GRADATION: SAND (%)	MECHANICAL GRADATION: FINES (%)	Other Tests
0		1	FILL: CLAYEY SAND (SC), loose, slightly moist, fine grained, roots less than 1/4-inch in diameter to a depth of 1 foot, scattered pinholes, brown	98.6	16.0						Modified Proctor 123.9 pcf @ 9.9% 0.3% Collapse @ 1000 psf
		R 2									
		3									
5		4	SILTY CLAY (CL-ML), loose, dry, fine grained, brown		8.8			0	16	84	
10											

Bottom of test pit at 10.0 feet.

LANDMARK TESTING & ENGINEERING

Landmark Testing & Engineering
795 East Factory Drive
St. George, UT 84790
Telephone: 435-986-0566
Fax: 435-986-0568

PROJECT NAME Five County AOG Storage Building

CLIENT 5 County Association of Governments

PROJECT NUMBER 230112

PROJECT LOCATION St. George, UT

Figure No. 3

UNIFIED SOIL CLASSIFICATION SYSTEM

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

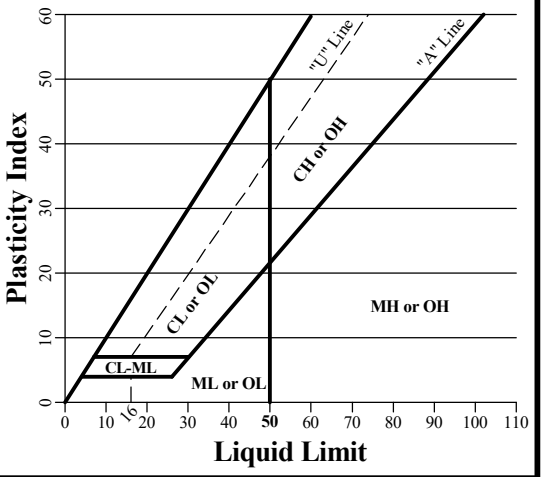
GRAIN SIZE CHART

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

SAMPLES

- Relatively Undisturbed Sample
- Block Sample
- Bag Sample
- Auger Cuttings
- B — Bucket Sample
- Core
- No Recovery

PLASTICITY CURVE



LANDMARK TESTING & ENGINEERING

Landmark Testing & Engineering
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PROJECT NAME Five County AOG Storage Building

CLIENT 5 County Association of Governments

PROJECT NUMBER 230112

PROJECT LOCATION St. George, UT

Figure No. 5

LANDMARK TESTING & ENGINEERING

CONSOLIDATION REPORT

Client: 5 County Association of Governements
P.O Box 1550
St. George, UT 84771

Date of Report: 3/16/2023
Reviewed By: Z. Girsberger
Lab#: 23SG1093

Project: Five County AOG Storage Building **Project #:** 230112
Location: St George **Sampled By:** D. Baldazzi **Date:** 3/6/2023
Type of Sample: ML **Tested By:** J. Bracken **Date:** 3/10/2023
Location of Sample: Test Pit 1 at 1' **Authorized By:** Client **Date:** 3/6/2023

COLLAPSE/SWELL CURVE

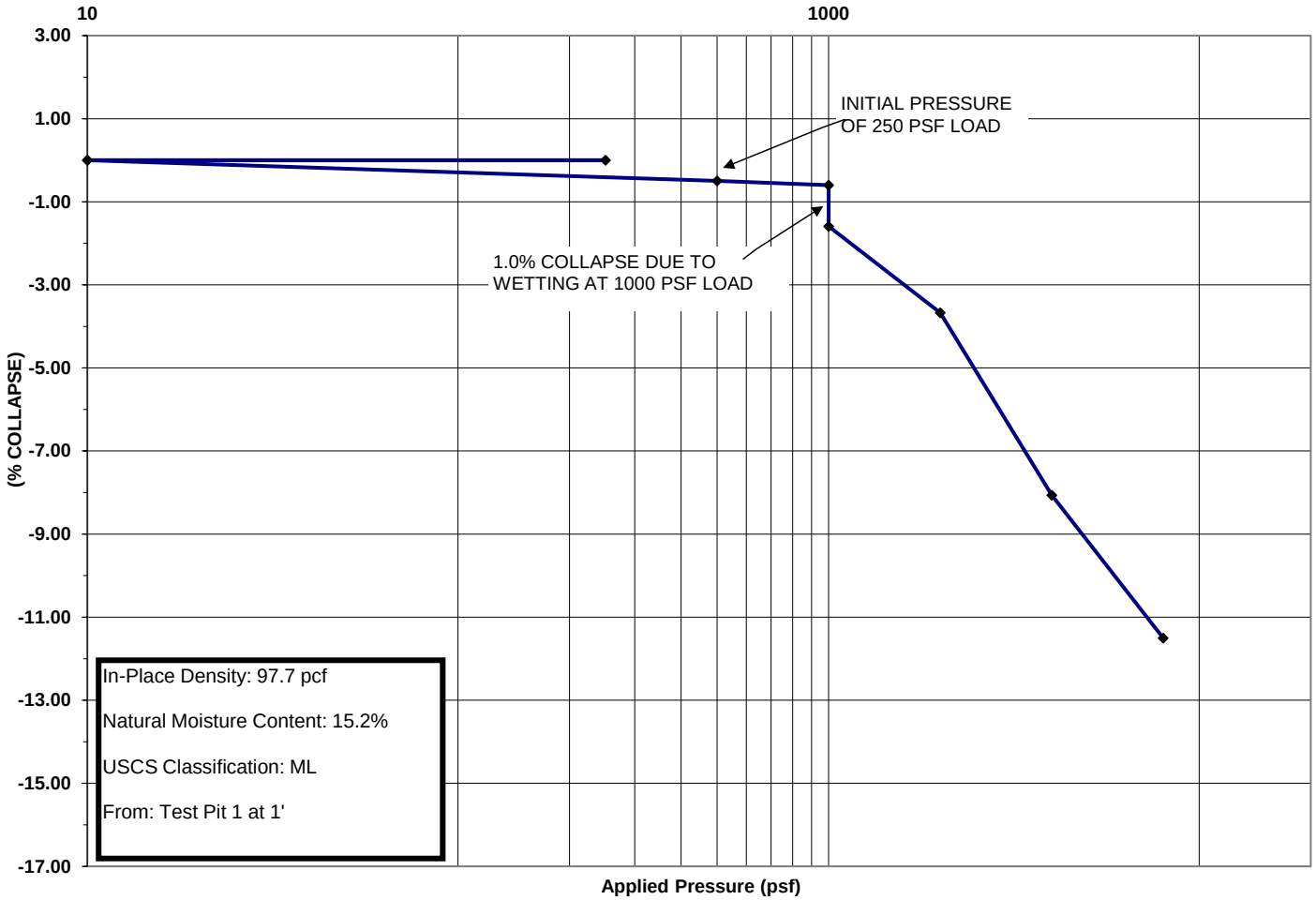

Figure 6

LANDMARK TESTING & ENGINEERING

CONSOLIDATION REPORT

Client: 5 County Association of Governements
P.O Box 1550
St. George, UT 84771

Date of Report: 3/16/2023
Reviewed By: Z. Girsberger
Lab#: 23SG1096

Project: Five County AOG Storage Building **Project #:** 230112
Location: St George **Sampled By:** D. Baldazzi **Date:** 3/6/2023
Type of Sample: ML **Tested By:** J. Bracken **Date:** 3/10/2023
Location of Sample: Test Pit 2 at 3' **Authorized By:** Client **Date:** 3/6/2023

COLLAPSE/SWELL CURVE

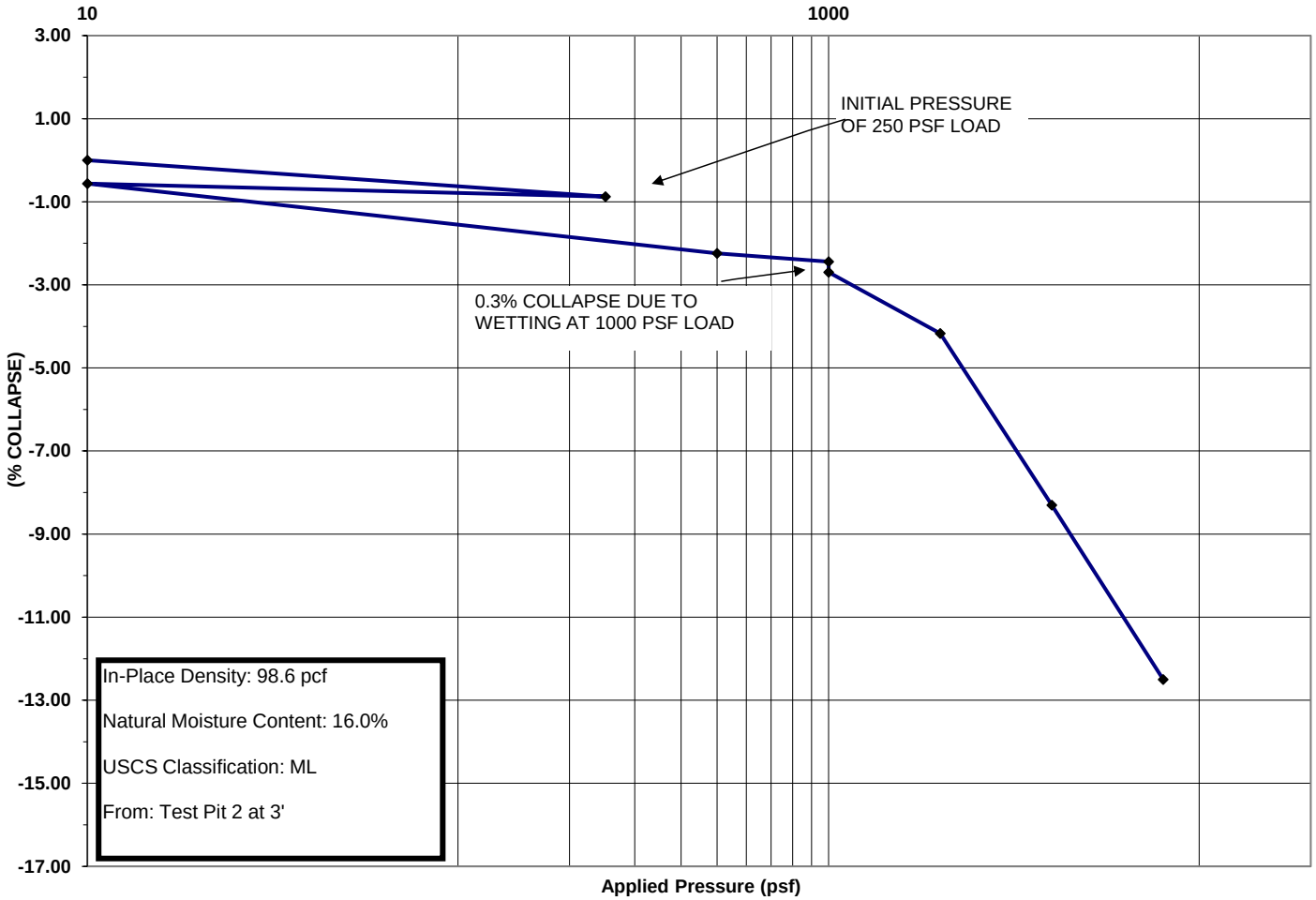

Figure 7