June 5, 2024

Cody Kurowski
Alpine Master Builders
33105 Meadow Creek Drive
Steamboat Springs, Colorado 80487

Re: Geotechnical Subsurface Exploration
Proposed Wiemers Residence
Lot 41, Alpine Mountain Ranch
Routt County, Colorado
Western Slope Geotech Project No. 24-1031

Dear Cody,

Western Slope Geotech, Inc. (WSG) has completed the geotechnical subsurface exploration you requested for the proposed Wiemers residence to be constructed within Lot 41 of the Alpine Mountain Ranch Subdivision, Routt County, Colorado. The site is also known as 33170 Meadow Creek Drive. The results of our subsurface exploration, laboratory testing and pertinent geotechnical engineering recommendations are outlined in this report.

PURPOSE AND SCOPE OF WORK

The purpose of this exploration and associated reporting is to provide geotechnical design and construction recommendations for the proposed residential structure and other site improvements. WSG's scope of work included field exploration, laboratory testing and the preparation of this report summarizing the data obtained and outlining our recommendations for foundation design and construction and support of floor slabs and exterior flatwork. The conclusions and recommendations outlined in this report are based on our assumptions regarding proposed construction, results of subsurface exploration, laboratory testing and WSG's experience with subsurface conditions and similar construction in this area.

PROPOSED CONSTRUCTION

Based on review of the site provided, WSG assumes proposed construction will generally consist of a one to two-story wood framed structure over a full-depth walkout basement and with an attached garage. Slab-on-grade floor systems are assumed to be preferred for the residence lower level and garage and will be constructed from near existing site grades up to 10 feet below existing site grades.

Site grading to develop finished grades for the driveway and around the structure could include unretained cuts and fills up to approximately 6 feet in height.

Foundation loads for the structure are expected to be relatively light, with continuous wall loads less than 3 kips per lineal foot and individual column loads less than 50 kips. If the assumed construction and loading conditions vary substantially from those assumed, WSG should be contacted to reevaluate the recommendations in this report.

SITE DESCRIPTION

The project site is located off the south side of Meadow Creek Drive in the Alpine Mountain Ranch Subdivision, Routt County, Colorado. The property generally consists of approximately 5 acres of vacant, undisturbed rural land. The proposed building site was generally located in the central portion of the property and was located in an aspen forest also vegetated with grass, weeds and deciduous brush.

Building site topography appeared variable and generally sloped strongly to moderately steeply down to the north on the order of 15 to 20 percent. Based on review of the site plan provided, it appears that a maximum elevation difference of approximately 16 feet is present across the proposed building site.

FIELD EXPLORATION AND SUBSURFACE CONDITIONS

WSG's field exploration program consisted of the observation of two (2) exploratory test pits across the building site. The test pits were advanced to obtain information about the subsurface profile, groundwater conditions and obtain material samples for laboratory testing. Approximate test pit locations are shown on Figure 1.

Subsurface conditions encountered in the test and profile pits were variable and generally consisted of a layer of topsoil and organics overlying natural lean clay and sandstone-

claystone bedrock of the Browns Park Formation to the maximum depth explored, 8½ feet below existing ground surface. Graphic logs of the exploratory test pits and associated legend and notes are shown on Figure 2.

Topsoil and organics were encountered at the ground surface in both test pits and was estimated at approximately 24 inches in thickness.

Lean clay was encountered beneath the topsoil in both test pits. The clay was very sandy to sand and clay, low plastic, stiff to medium dense, fine to coarse grained and slightly gravelly, moist and light brown. Samples of the clay classified as CL and SC-Cl soils in accordance with the Unified Soil Classification System (USCS).

Sandstone-claystone bedrock was encountered beneath the lean clay in test pit 1 at a depth of approximately 6½ feet. The sandstone-claystone was low plastic, weathered, fine grained, non-cemented, moist and light brown. A sample of the bedrock classified as a CL soil in accordance with the USCS.

Swell-consolidation tests conducted on samples of the lean clay and bedrock material indicated both materials tested displayed low swell potentials under wetting and constant (1,000 psf) loading conditions. Swell-consolidation test results are presented on Figures 3 and 4 and summarized according to risk category on Table A below. Laboratory test results are also summarized on Table 1.

Table A

Slab Performance Risk Category	Representative Percent Swell (500 psf Surcharge)	Representative Percent Swell (1,000 psf Surcharge)	Lean Clay	Sandstone-Claystone
Low	0 to <3	0 to <2	1	1
Moderate	3 to <5	2 to <4	0	0
High	5 to <8	4 to <6	0	0
Very High	>8	>6	0	0

Groundwater seepage was not encountered in the test pits at the time of excavation. Groundwater levels will vary seasonally and over time based on weather and surface runoff conditions, site development, landscape irrigation practices and other hydrologic

conditions. Perched and/or trapped groundwater conditions may also be encountered at times throughout the year. Perched water is commonly encountered in soils overlying less permeable soil layers and/or bedrock.

ANALYSIS AND RECOMMENDATIONS

General

Based on our understanding regarding proposed construction and subsurface conditions encountered in the test pits, it appears that both natural lean clay and sandstone-claystone bedrock will likely be encountered at potential foundation bearing depths. Based on laboratory test results and WSG's experience with similar conditions and materials, WSG believes both the natural clay and bedrock materials will provide suitable bearing for shallow (spread footing) foundation systems.

Based on swell-consolidation testing and WSG's experience with similar materials in this area, the lean clay and bedrock materials will also display low swell potentials under loading and wetting conditions and certain design and construction considerations should be implemented to reduce potential differential foundation and slab movement associated with expansive soils.

It is WSG's opinion that total and differential foundation movements should be within limits indicated below provided the design, construction and maintenance recommendations contained herein are observed.

Foundations

Based on our understanding of proposed construction, WSG believes the proposed structure can be supported by continuous spread footing and isolated pad foundations bearing on natural, undisturbed lean clay and/or sandstone-claystone bedrock and should be designed and constructed as outlined below:

1. WSG recommends foundation footings be placed directly on undisturbed natural lean clay and/or sandstone-claystone bedrock and designed using a maximum net allowable soil bearing pressure of 3,000 psf. As a precaution and to resist uplift forces from expansive soils and bedrock, WSG recommends all footings be designed to maintain a minimum dead load pressure of 650 psf.

2. All excavations for footings and floor slabs should be graded to drain to prevent the accumulation of water beneath foundation and floor slab areas.
3. Footings exposed to freezing or frost conditions should be designed with adequate soil cover to prevent freezing. A cover depth of 48 inches is recognized by the local building authority as the minimum value for frost protection.
4. WSG recommends continuous footings have a minimum width of 12 inches and isolated pad foundations have a minimum width of 24 inches in order to facilitate construction and reduce the potential for development of eccentrically loaded conditions.
5. Foundation walls and grade beams should be designed to span an unsupported distance of 10 feet or the distance between pads.
6. Foundation resistance to lateral loads can be developed by passive pressure against footings and walls and sliding resistance between footings and floor slabs and the underlying soils. WSG recommends passive pressures be computed using an equivalent fluid pressure value of 250 pcf and friction resistance be calculated using a coefficient of friction of 0.30 times structural dead loads. The recommended passive equivalent fluid pressure value and coefficient of friction do not include a factor of safety.
7. WSG should be retained to observe foundation excavations to verify the subsurface conditions are consistent with those assumed.

WSG estimates total and differential movement of foundations designed and constructed as outlined above and resulting from the assumed structural loads will be 1-inch or less.

Interior Building Floor Slabs

WSG assumes concrete slab-on-grade floor systems are preferred for the residence lower level and garage floor system. WSG believes natural clay and bedrock materials could provide adequate support for floor slabs, however, certain mitigation measures are recommended to reduce the potential for movement of floor slabs subsequent to construction.

WSG recommends the underslab areas be overexcavated and slabs bear on a minimum of 1-foot of structural backfill. The structural fill and surcharge loads placed on the

underlying soils by the structural fill mat would reduce the potential for total and differential movement of the supported slab. The structural fill would also assist in distributing movement in the event that some swelling of the materials underlying the structural fill occurs.

WSG believes slab-on-grade construction can be used for the lower level and garage floor systems, provided the risk of differential slab movement is recognized and the design and construction precautions outlined below are observed.

1. Floor slabs should be designed and constructed as floating slabs, separated from foundation walls, columns, and plumbing intrusions by the use of cellotex or another approved material.

2. Interior partition walls should not bear on floor slabs but should be hung from interior framing and constructed with a slip joint at the wall-to-slab connection. The slip joint should provide for a minimum of 1½ inches of vertical movement.

3. Floor slabs should be constructed with control joints located a maximum of 12 feet on center to control natural, unavoidable cracking associated with concrete shrinkage that commonly occurs during curing. Control joint locations should be carefully selected to intersect slab intrusions, corners, and other locations where shrinkage cracking is common.

4. Underslab subgrade (natural soils or fill) areas should be graded to drain to the building perimeter to prevent the accumulation of water.

5. Topsoil and/or organic material should be completely removed from below all floor slab areas. WSG recommends at least 1-foot of the lean clay and/or bedrock materials be removed and replaced with properly compacted Low Volume Change (LVC) soils to mitigate expansive soil and bedrock effects on floor slabs. After stripping and completing all cuts and prior to placement of any fill or floor slab concrete, WSG recommends the exposed subgrade be scarified to a depth of 6-inches, moisture conditioned to within +/-2% of optimum moisture content and compacted to at least 95% of the maximum standard Proctor density.

   Fill material used to bring underslab areas to grade should consist of approved imported non-expansive materials and compacted to at least 95% of the maximum standard Proctor density within ±2% of optimum moisture content (ASTM D698).

6. Floor slabs should be underlain by a minimum 6-inch layer of free draining gravel. The gravel layer will help provide uniform support and aid in underslab drainage.

Inherent risks exist when building in areas of expansive soils and bedrock. The overexcavation/backfill procedures outlined above will reduce, but not eliminate the potential for movement of floor slab subsequent to construction. The natural soils and bedrock below the structural backfill zone can experience volume change with variation in moisture content, causing some floor slab movement. Based upon the swell potential of the underlying soils, and depending on the actual depth of wetting experienced, we anticipate slab heave on the order of 1 inch or more could occur over time if deep wetting of the site occurs, even if overexcavation/backfill procedures are performed. If this amount of movement and cracking of the floor slab cannot be tolerated, a structural flooring system should be employed.

Perimeter Drainage Systems

WSG recommends a perimeter drainage system be installed at all perimeter foundations of the structure. Properly constructed perimeter drainage systems enhance site drainage, help reduce the potential for development of hydrostatic pressures behind the below-grade walls and reduce the potential for water infiltration beneath footings and into underslab and crawl space areas. WSG also recommends interior drainage systems for crawl spaces areas to allow for collection and discharge of water accumulation within crawl space areas.

A perimeter drainage system should generally consist of a 4-inch diameter perforated PVC drainpipe covered by a minimum of twelve (12) inches of free-draining gravel and covered with filter fabric (Mirafi 140N or equivalent) to prevent intrusion of fines. The high point of the drainpipe should be placed at approximate footing grade around the perimeter foundation footings, constructed with a minimum 1% slope to a daylighted outfall. Multiple daylights should be considered for larger, more complex structures. For building areas with at-grade floor slabs, minimum drainage system burial depths of 24-inches may be suitable. Care should be taken during drain installation to avoid disturbing those soils providing support to the footing bearing soils extending down at an approximate 1(H) to 1(V) slope from the bottom edges of the footings. Daylighted outfalls should be protected from small animal intrusion and backflow. WSG can provide perimeter and interior crawl space drainage system design and details upon request and after building plans are available.

Lateral Earth Pressures and Foundation Backfill

Lateral Earth Pressures: Foundation walls should be designed to resist lateral pressures associated with foundation backfill materials and existing site soils. Materials affecting lateral pressures are located within the area extending from the base of the foundation wall upward at an approximate 1(H) to 1(V) angle. Recommended lateral earth pressure design values to be used in foundation wall design are provided in Table B shown below. All values presented assume drained conditions (no hydrostatic loads) and sufficient wall deflection is achieved for activation of active earth pressure conditions.

Table B

Design Pressure Condition	Equivalent Fluid Pressure (pcf)
Active	45
At-Rest	55
Passive	250

Variables that affect active lateral earth pressures include but are not limited to the classification and swell potential of the backfill soils, backfill compaction and geometry, wetting of the backfill soils, surcharge loads and point loads developed in the backfill materials. The recommended equivalent fluid pressure values do not include a factor of safety or an allowance for hydrostatic loading. Use of expansive soil backfill, excessive compaction of the wall backfill, or surcharge loads placed adjacent to the foundation walls can add to the lateral earth pressures causing the equivalent fluid pressure values used in design to be exceeded.

Foundation Backfill: Backfill placed adjacent to below-grade walls should consist of LVC potential and relatively impervious soils free from organic matter, debris and other objectionable materials. The on-site clay and bedrock materials could be suitable for use as wall backfill but may require processing and moisture conditioning prior to placement. Imported LVC soils would also be suitable for foundation backfill but should be approved by WSG prior to use. WSG recommends foundation backfill soils be uniformly placed in maximum 9-inch loose lifts, moisture conditioned to within +/-2 percent of optimum

moisture content and compacted to at least 95 percent of the maximum standard Proctor dry density (ASTM D698) for imported LVC soils.

Foundation wall backfill operations should be conducted only after proper bracing and support is provided. Structural engineer approval is recommended. Excessive lateral stresses resulting in displacement, distress and damage to foundation walls can occur when insufficient bracing is in place or heavy mechanical compaction equipment is used. WSG recommends compaction of unbalanced foundation wall backfill soils be completed using light mechanical or hand compaction equipment.

Exterior Flatwork

Any topsoil/vegetation should be stripped/removed from proposed flatwork areas prior to fill or concrete placement. WSG recommends the exposed subgrade be scarified to a depth of 6-inches, moisture conditioned to within +/-2% of optimum moisture content and compacted to at least 95% of the maximum standard Proctor density. WSG recommends fill supporting flatwork consist of approved granular materials, processed and moisture conditioned on-site clay or bedrock materials uniformly placed in 9-inch loose lifts, moisture conditioned and compacted to the values indicated above with a limited risk of post-construction movement. All fill materials should be approved by WSG prior to use.

Subgrade soils expected to receive exterior flatwork concrete should be evaluated closely evaluated immediately prior to concrete placement. If areas of disturbed, wet and softened, or dry subgrade soils are encountered at that time, reworking of those materials or removal/ replacement procedures may be required.

Drainage

Positive drainage is imperative for satisfactory long-term performance of the proposed building foundations, floor slabs and associated site improvements. WSG recommends positive drainage be developed away from the structure during construction and maintained throughout the life of the site improvements. Twelve (12) inches of fall in the first 10 feet away from the building is recommended. Flatter slopes could be considered in hardscape areas. If some settlement of the backfill soils occurs adjacent to the building, the original grade and associated positive drainage outlined above should be immediately restored.

Care should be taken in the planning of landscaping to avoid features which could result in the fluctuation of the moisture content of the foundation bearing and/or flatwork subgrade soils. We recommend watering systems be placed a minimum of 5 feet away from the perimeter of the structure and be designed to discharge away from all site improvements. Gutter systems should be considered to help reduce the potential for water ponding adjacent to the residence, with the gutter downspouts, roof drains or scuppers extended to discharge a minimum of 5 feet away from structural, flatwork and pavement elements. Water which is allowed to pond adjacent to the site improvements can result in unsatisfactory performance of those improvements over time. The use of area drain inlets and subsurface piping is recommended to aid in rapid runoff of surface water from areas of concentrated drainage and/or limited surface runoff capability.

SITE GRADING

Based on WSG's assumptions regarding site grading, WSG assumes unretained cuts and fills of up to approximately 6 feet in height could be constructed for site and driveway development. Based on proposed construction, WSG recommends the following:

1. Unretained cuts and fills should be constructed to a 2(H) to 1(V) or flatter slope configuration. Flatter slopes are often desirable to help facilitate revegetation efforts and reduce shallow slope failures commonly experienced by new cuts.

2. Areas to receive fills should be stripped of organics prior to fill placement, scarified to at least 12 inches, moisture conditioned and uniformly compacted prior to fill placement. Fills should be properly benched into hillsides exceeding 25 percent.

   Fill materials supporting driveways or other settlement-sensitive landscaping features should consist of approved materials. These fills should be uniformly placed and compacted in 9-inch loose lifts to at least 95% of the maximum standard Proctor density within +/-2% of optimum moisture content for on-site materials and +/-2% for LVC or granular imported materials (ASTM D698).

3. Proper drainage should be provided and maintained around all cuts, fills, buildings, and driveway surfaces. Special attention should be given to channeling or routing drainage around and away from site fills and retaining structures. Excessive or uncontrolled surface and subsurface drainage could lead to erosion and poor site fill performance and/or slope failure.

4. All disturbed areas should be protected from erosion by revegetation or other appropriate methods. Areas of concentrated drainage should be protected by the use of rip rap or other appropriate methods.

5. Construction safety is the sole responsibility of the contractor. The contractor is responsible for determining the appropriate OSHA slope criteria for the soils conditions encountered and implementing it during construction. The contractor shall be responsible for all means, methods, techniques, sequencing, and operations during construction. All excavation activities should meet minimum OSHA, state or local trenching and excavation safety standards.

GENERAL COMMENTS

This report was prepared based upon the data obtained from the completed site exploration, engineering analysis and WSG's experience with similar construction in this area. The subsurface conditions encountered during this investigation provide an indication of subsurface conditions at the test pit locations only. Variations in subsurface conditions can occur relatively short distances away. This report does not reflect any variations which may occur across the site or away from the test pit locations. If variations in the subsurface conditions anticipated become evident, the geotechnical engineer should be notified immediately so that further evaluation can be completed and when warranted, alternative recommendations provided.

The scope of services for this project does not include either specifically or by implication any biological or environmental assessment of the site or identification or prevention of pollutants or hazardous materials or conditions. Other studies should be completed if concerns over the potential of such contamination or pollution exist.

WSG should be retained to review the plans and specifications so that comments can be made regarding the interpretation and implementation of our geotechnical recommendations in the design and specifications. WSG should also be retained to provide testing and observation services during construction to help evaluate compliance with project plans and specifications.

This report has been prepared for the exclusive use of our client for specific application to the project discussed and has been prepared in accordance with the generally accepted standard of care for the profession. No warranties express or implied, are made. The

conclusions and recommendations contained in this report should not be considered valid if any changes in the nature, design or location of the project as outlined in this report are planned, unless those changes are reviewed, and the conclusions of this report modified and verified in writing by the geotechnical engineer.

Western Slope Geotech appreciates the opportunity to be of service to you on this project. If you have any questions concerning the enclosed information or if we can be of further service to you in any way, please do not hesitate to contact us.

Very Truly Yours,
Western Slope Geotech, Inc.

Harold Schlicht, P.E.
Principal Engineer

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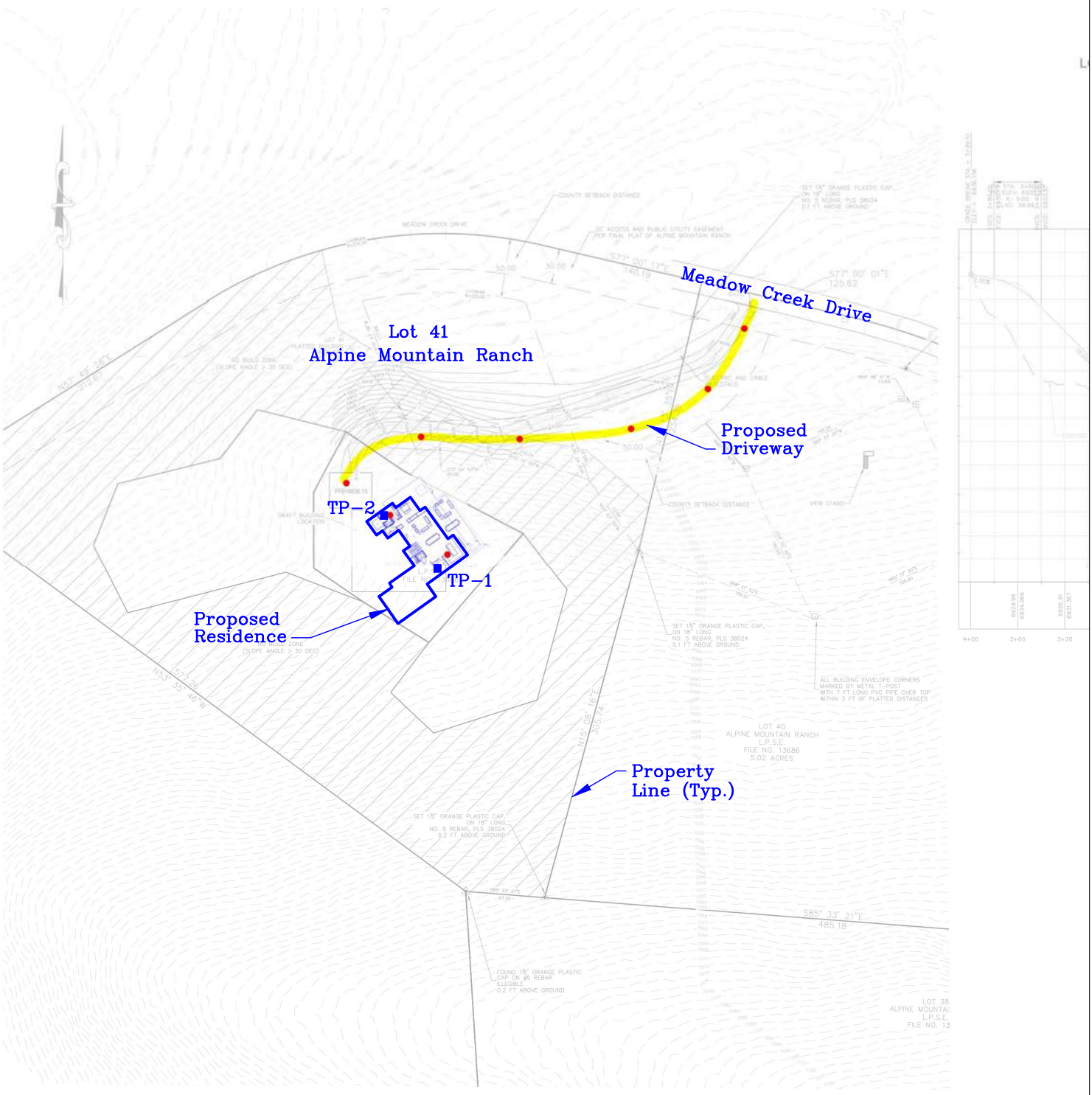
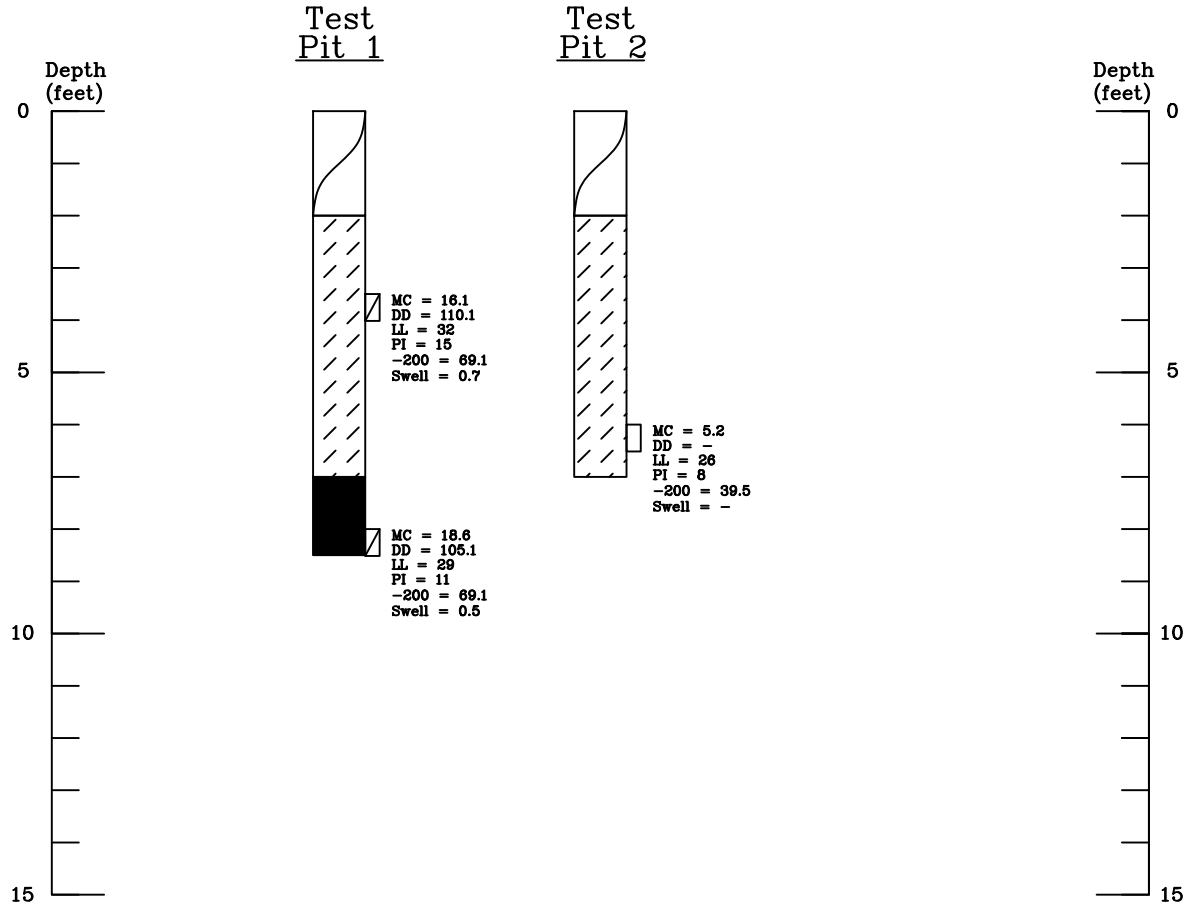
No Scale



SITE PLAN/LOCATION OF TEST PITS

Project Name: Proposed Weimers Residence	WESTERN SLOPE GEOTECH STEAMBOAT SPRINGS COLORADO	
Location: Lot 41, Alpine Mountain Ranch, Routt County, CO	Project No.: 24-1031	Drawn/Checked:HS
	Date: 6/5/24	Figure No.: 1



Legend:

TOPSOIL/ORGANICS.

LEAN CLAY: Very sandy to sand and clay, low plastic, stiff to medium dense, fine to coarse grained and slightly gravelly, moist and light brown.

SANDSTONE–CLAYSTONE: Low plastic, weathered, fine grained, non–cemented, moist and light brown.

Hand Drive Sample – California liner.

Small disturbed bag sample.

Notes:

1) Test pits were excavated on 5/24/24 with a Bobcat E55 trackhoe.

2) Locations of test pits were determined by pacing from existing and proposed features as shown on the site plan provided and staked in the field.

3) Test pit elevations were not determined and logs are drawn to the depths explored.

4) Lines between materials types are approximate and transitions may be gradual.

5) Groundwater measurements were made at the time of excavation and levels may vary.

MC = Natural Moisture Content (%)
DD = Natural Dry Density (pcf)
LL = Liquid Limit
PI = Plasticity Index
-200 = Percent Passing No. 200 Sieve
Swell = Percent Swell Under 500 or 1,000 psf surcharge

LOGS, LEGEND & NOTES

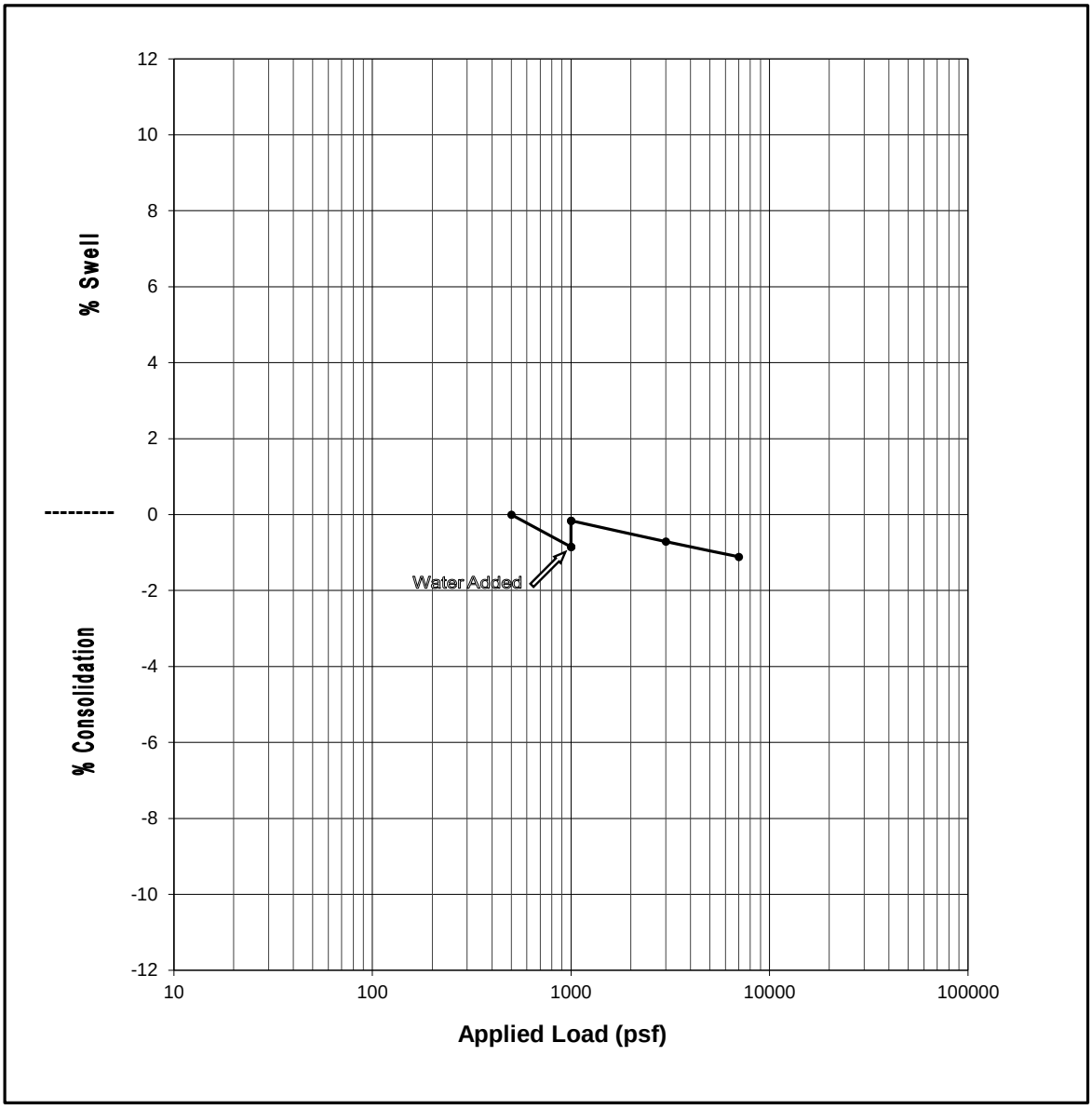
Project Name: Proposed Holmes Residence

Location: Lot 32, Big Valley Ranch, Filing IIA, Routt County, CO

WESTERN SLOPE GEOTECH STEAMBOAT SPRINGS COLORADO

Project No.: 24–1017	Drawn/Checked:HS/HS
Date: 6/3/24	Figure No. 2

SWELL/CONSOLIDATION TEST SUMMARY

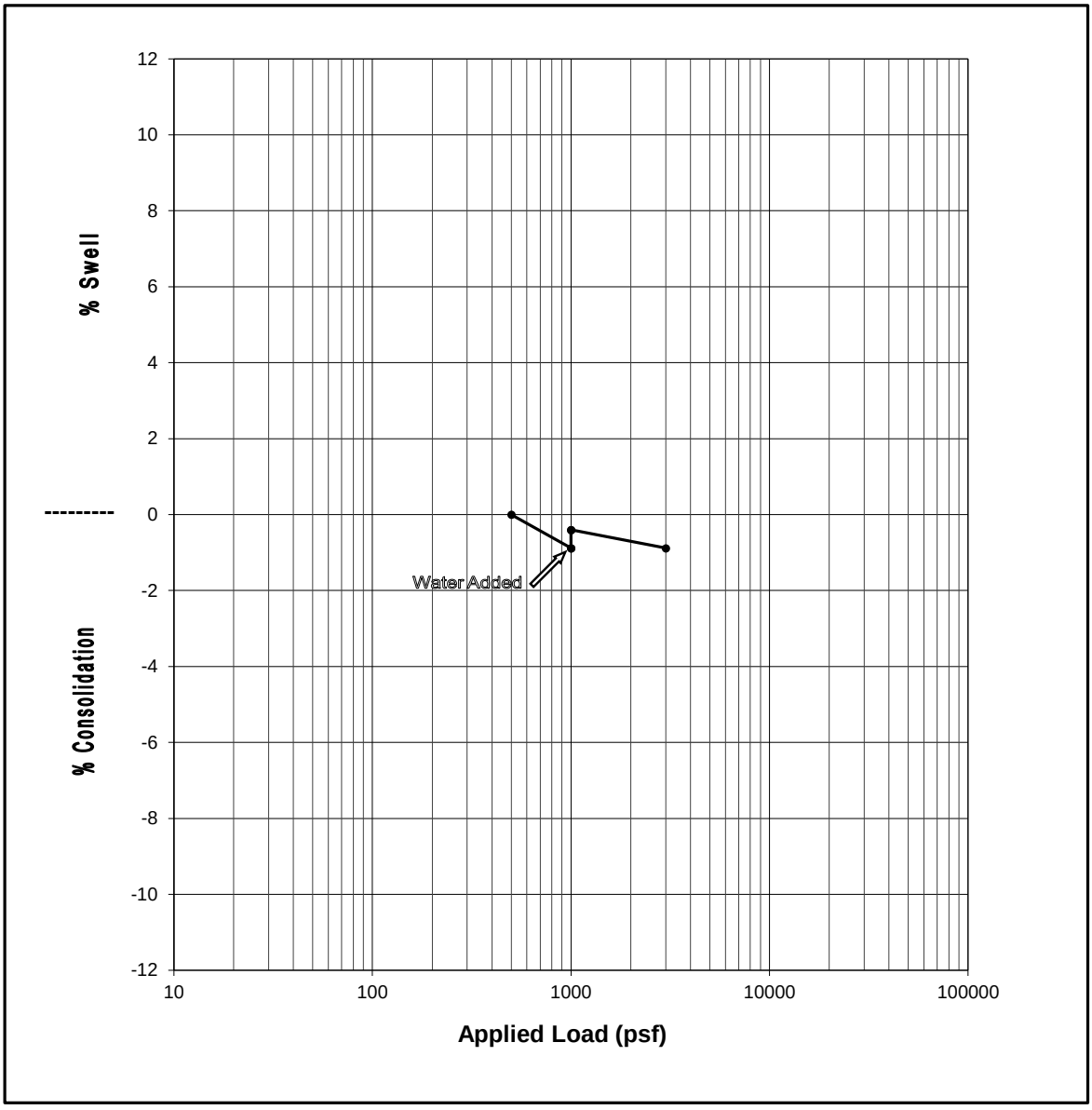


Sample ID: TP-1 @ 5 1/2'			
Sample Description: Gravelly, Sandy Lean Clay (CL)			
Initial Moisture	16.1%	Liquid Limit	32
Final Moisture	17.0%	Plasticity Index	15
% Swell @ 1000 psf	0.7%	% Passing #200	69.1%
Swell Pressure	4,000 psf	Dry Density	110,1 pcf

Project Name: Proposed Weimers Residence	Project No.: 24-1031
Location: Lot 41, Alpine Mountain Ranch, Routt County, CO	Date: 6/5/24
Drawn/Checked: HS/HS	Figure No. : 3

WESTERN SLOPE GEOTECH
STEAMBOAT SPRINGS COLORADO

SWELL/CONSOLIDATION TEST SUMMARY



Sample ID: TP-1 @ 8'			
Sample Description: Claystone (CL)			
Initial Moisture	18.6%	Liquid Limit	29
Final Moisture	19.4%	Plasticity Index	11
% Swell @ 1000 psf	0.5%	% Passing #200	60.0%
Swell Pressure	3,000 psf	Dry Density	105.1 pcf

Project Name: Proposed Weimers Residence	Project No.: 24-1031
Location: Lot 41, Alpine Mountain Ranch, Routt County, CO	Date: 6/5/24
Drawn/Checked: HS/HS	Figure No. : 4

WESTERN SLOPE GEOTECH
STEAMBOAT SPRINGS COLORADO

Table 1
Summary of Laboratory Test Results

WESTERN SLOPE GEOTECH — STEAMBOAT SPRINGS COLORADO

Project No.: 24–1031

Test Hole/ Pit	Depth (ft)	Natural Moisture Content (%)	Dry Density (pcf)	Grain Size Analysis			Atterberg Limits		Swell Test Data		Soil or Bedrock Type	USCS Classification	AASHTO Classification
				Gravel (%)	Sand (%)	Silt/ Clay (%)	LL (%)	PI (%)	Swell(+) Consol.(–)	Swell Pressure (psf)			
TP–1	3 1/2	16.1	110.1	6	25	69	32	15	0.7	4000	Gravelly, Sandy Lean Clay	CL	
TP–1	8	18.6	105.1	2	38	60	29	11	0.5	3000	Claystone	CL	
TP–2	6–7	5.2	–	12	48	40	26	8	–	–	Gravelly Sand & Clay	SC–CL	