NorthWest Colorado Consultants, Inc.
Geotechnical / Environmental Engineering • Materials Testing

June 24, 2024

Ken Finch
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Clark, CO 80428

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Job Number: 24-13336

Subject: Subsoil and Foundation Investigation, Proposed Finch ADU, 27200 Golden View Trail, Routt County, Colorado.

Ken,

This report presents the results of the Subsoil and Foundation Investigation for your proposed residence to be constructed at 27200 Golden View Trail (Lot 4 Steamboat Lake Subdivision) in Routt County, Colorado. The approximate location of the project site is shown in Figure #1.

NWCC, Inc.'s (NWCC) scope of work included obtaining data from cursory observations made at the site, the logging of one test pit, the sampling of the probable foundation soils and the laboratory testing of the samples obtained. This report presents recommendations for economically feasible and safe type foundations, as well as allowable soil pressures and other design and construction considerations that are advisable, but not necessarily routine to quality design and building practices.

Proposed Construction: NWCC understands an Accessory Dwelling Unit (ADU) will be constructed at the site. Plans for the proposed ADU were not available at the time of investigation. However, NWCC assumes that the walkout lower level of the ADU will be constructed with a concrete slab-on-grade floor system placed slightly above to 8 feet below the existing ground surface (bgs).

For design purposes, we have assumed that the building loads will be light to moderate typical of this type of residential construction. If loadings or conditions are significantly different from those above, NWCC should be notified to reevaluate the recommendations in this report.

Site Conditions: The proposed building site is situated north of Miners Dream Dr. and east of County Road 129 in Routt County, Colorado. The site consists of an existing shed, barn, garage and residence at the time of our field investigation. Vegetation at the building site consists of grasses, weeds, sagebrush and deciduous bushes.

Topography at the site slopes moderately to strongly down to the south. An elevation difference of approximately 5 to 8 feet exists across the building site.

Subsurface Conditions: To investigate the subsurface conditions at the proposed building site, one test pit was excavated on May 23, 2024, with a MFC B85 backhoe provided by the client. The test pit was excavated deeper on June 21, 2024. The approximate test pit location is shown in Figure #2.

The subsurface conditions encountered generally consisted of a layer of existing clay fill materials that extended to the maximum depth excavated, 7 feet below the existing ground surface (bgs). A graphic log of the test pit, along with the associated Legend and Notes, is presented in Figure #3.

It should be noted that NWCC did not observe the underlying natural soils in the test pit. We have assumed the soil conditions will be similar to those encountered at adjacent sites, and that natural sands and clays, and/or sandstone bedrock will be encountered beneath the fill materials.

The clay ill materials were sandy to gravelly with roots, low plastic, fine to coarse grained with occasional cobbles, loose to medium stiff, moist and dark brown to brown.

Based on anticipated geologic site conditions, NWCC recommends a **Site Class C** be used for the foundation designs in accordance with Table 20.3-1 in Chapter 20 of ASCE 7.

Groundwater seepage was not encountered in the test pit at the time of excavation. It should be noted that the groundwater conditions at the site can be expected to fluctuate with changes in precipitation and runoff.

Foundation Recommendations: Based on the soils encountered in the test pit, our experience with adjacent sites, and our understanding of the proposed construction, NWCC believes an economically feasible type of foundation system is spread footings or individual pads with grade beams founded on the natural sands and clays and/or sandstone bedrock, or on properly compacted structural fill placed over the natural sands and clays or bedrock after all of the existing fill materials are removed.

The design and construction details presented below should be observed if a shallow foundation system is opted for. The precautions and recommendations itemized below will not prevent movement of the foundations if the underlying sands and clays or bedrock materials become wetted and swell. However, they should reduce the amount of differential movement beneath the foundation system. Differential movements on the order of 1 to 2 inches could still occur if the clays or bedrock materials undergo moisture changes. The owner must be willing to accept the risk of foundation movement associated with placing shallow foundations on expansive soils or bedrock materials.

1) Footings placed on the natural sands and clays, or bedrock, or properly compacted structural fill material placed on the natural sands and clays or bedrock should be designed using an allowable soil bearing pressure of 3,000 psf. A minimum dead load pressure of at least 600 psf should be used to reduce the risk of foundation movement associated with expansive soils or bedrock materials.

2) Footings or pad sizes should be computed using the above soil pressures and placed on the natural undisturbed sands and clays or sandstone bedrock or structural fill found below the fill materials, or on properly compacted structural fill materials.

3) Any topsoil and organic materials, existing fill materials or loose or soft natural soils encountered within the foundation excavations should be removed and the excavations extended to competent natural sands and clays or bedrock materials prior to concrete or structural fill placement.

4) Any fill materials placed beneath the footings should be a non-expansive granular soil approved by this office. Fill materials placed under the footings should be uniformly placed in 6 to 8 inch loose lifts and compacted to at least 100% of the maximum standard Proctor density and within 2% of the optimum moisture content determined in accordance with ASTM D-698. Structural fill materials should extend out from the edge of the footings on a 1(horizontal) to 1(vertical) or flatter slope.

5) Foundation walls should be designed and reinforced to span an unsupported distance of 10 feet or the length between pads, whichever is greater.

6) Footings or pads should be placed well enough below final backfill grades to protect them from frost heave. Forty-eight (48) inches is typical for this location considering normal snow cover and other winter factors.

7) Based on experience, we estimate the total settlement for footings and pads designed and constructed as discussed in this section will be approximately 1 inch. Additional bearing capacity values, along with the associated settlements, are presented in Figure #4.

8) Care should be taken when excavating the foundations to avoid disturbing the supporting materials. Hand excavation or careful backhoe soil removal may be required in excavating the last few inches.

9) The client must retain NWCC to observe the foundation excavations when they are near completion to identify the bearing soils and confirm the recommendations in this report, as well as test the structural fill materials placed beneath the foundations for compaction

Alternate Foundation Recommendations: If the client is not willing to accept the risk of foundation movement that could occur if the sands and clays or bedrock materials become wetted, then we recommend the foundation system for the residence and garage consist of straight-shaft skin friction/end bearing piers drilled into the underlying sandstone bedrock. Foundation movement should be within tolerable limits if the following design and construction precautions are observed.

1) A minimum pier diameter of 12 inches, a minimum pier length of 15 feet and a minimum bedrock penetration of 6 feet are recommended. A maximum pier length to diameter ratio of 25 is also recommended.

2) Piers should be designed using allowable skin friction value of 900 psf for the portion of pier drilled into the natural clays and 3,000 psf for the portion of the pier drilled into the sandstone bedrock. The upper 5 feet of pier penetration should be neglected in skin-friction calculations. A drill rig of sufficient size, type and operating condition should be used so the bottom of the piers can be cleaned out properly and minimum length requirements can be met. If the bottoms of piers are properly cleaned and approved by an engineer from this office, then an allowable end bearing pressure of 30,000 psf may be used in the design.

3) Piers should be reinforced their full length with at least one #5 reinforcing rod for each 16 inches of pier perimeter.

5) Piers should be properly cleaned and dewatered prior to steel and concrete placement. Concrete should not be placed in more than 3 inches of water unless the tremie or pump methods are used to place the concrete.

6) A 4-inch void should be provided beneath grade beams to prevent expansive soils from exerting uplift forces on grade beams and to concentrate pier loadings. A void should also be provided beneath the necessary pier caps.

7) We strongly recommend that at least one test hole or test pier be drilled at the building site prior to starting the pier drilling operations. The test holes/piers should be drilled to evaluate the deeper subsoil/bedrock conditions and verify the recommendations given above.

8) A representative of NWCC must observe the test hole/pier drilling operations.

Floor Slabs: The on-site soils, apart from the existing fill materials containing organics or debris, are capable of supporting slab-on-grade construction. However, floor slabs present a difficult problem where swelling materials are present near floor slab elevation because sufficient dead load cannot be imposed on them to resist the uplift pressure generated when the materials are wetted and expand. Based on the moisture-volume change characteristics of the sands and clays

and bedrock materials assumed at this site, we believe slab-on-grade construction may be used, provided the risk of distress resulting from slab movement is recognized and special design precautions are followed.

The following measures must be taken to reduce damage which could result from movement should the underslab soils or bedrock materials be subjected to moisture changes.

1) Floor slabs must be separated from all bearing walls; columns and their foundation supports with a positive slip joint. NWCC recommends the use of ½-inch thick cellotex or impregnated felt.

2) Interior non-bearing partition walls resting on the floor slabs must be provided with a slip joint, preferably at the bottom, so in the event the floor slab moves, this movement is not transmitted to the upper structure. This detail is also important for wallboard and doorframes and is shown in Figure #5.

3) A minimum 6-inch gravel layer must be provided beneath all floor slabs to act as a capillary break and to help distribute pressures. Prior to placing the gravel, excavation should be shaped so that if water does get under the slab, it will flow to the low point of the excavation. In addition, any topsoil and organic materials should be removed prior to placement of the underslab gravels or new structural fill materials.

4) Floor slabs must be provided with control joints placed a maximum of 10 to 12 feet on center in each direction, depending on slab configurations, to help control shrinkage cracking. The locations of the joints should be carefully checked to assure that natural, unavoidable cracking will be controlled. Depth of the control joints should be a minimum of ¼ the thickness of the slab.

5) Underslab soils must be kept as close as possible to their in-situ moisture content. Excessive wetting or drying of these soils prior to placement of floor slab could result in differential movement after slabs are constructed.

6) If fills are required to bring the underslab soils to the desired grade, the fill should consist of non-expansive, granular materials. The fill should be uniformly placed and compacted in 6 to 8-inch loose lifts to at least 95% of the maximum standard Proctor density at or near the optimum moisture content, as determined by ASTM D-698.

7) Due to the variability and expansive potential of the existing fill materials, NWCC recommends a minimum of 3 feet of the existing fill materials be removed and replacing with a well-compacted, non-expansive fill materials. If this is done or if fills are required to bring underslab areas to the desired grade, the fill should consist of non-expansive, granular materials. Fill should be uniformly placed and compacted in 6 to 8-inch lifts to

at least 95% of the maximum standard Proctor density at or near the optimum moisture content, as determined by ASTM D-698.

The above precautions and recommendations will not prevent floor slab movement in the event the sands and clays or bedrock materials beneath the floor slabs undergo moisture changes. However, they should reduce the amount of damage if such movement occurs. The only way to eliminate the risk of all floor slab movement is to construct a structural floor over a well-vented crawl space or void form materials.

Underdrain System: Any floor levels or crawlspace areas constructed below the existing or finished ground surfaces and the foundations should be protected by underdrain systems to help reduce the problems associated with surface and subsurface drainage during high runoff periods.

Localized perched water or runoff can infiltrate the lower levels of the structure at the foundation levels. This water can be one of the primary causes of differential foundation and slab movement. Excessive moisture in crawlspace areas or lower levels can also lead to rotting and mildewing of wooden structural members and the formation of mold and mold spores. Formation of mold and mold spores could have detrimental effects on the air quality in these areas, which in turn can lead to potential adverse health effects.

Drains should be located around the entire perimeter of the lower levels and be placed and at least 12 inches below any floor slab or crawlspace levels and at least 6 inches below the bottom of the footings, void forms and foundation walls. NWCC recommends the use of perforated PVC pipe for the drainpipe, which meets or exceeds ASTM D-3034/SDR 35 requirements, to minimize potential for pipe crushing during backfill operations. Holes in the drainpipe should be oriented down between 4 o'clock and 8 o'clock to promote rapid runoff of water. Drainpipe should have at least 12 inches of free draining gravels placed along the sides and top of the pipe. Gravels should be protected from contamination by a filter covering of Mirafi 140N subsurface drainage fabric or an equivalent product. Drain should have a minimum slope of 1/8 inch per foot and be daylighted at positive outfalls protected from freezing, or be led to sumps from which water can be pumped. The use of interior laterals, multiple daylights or sumps may be required for the proposed structure. Caution should be taken when backfilling so as not to damage or disturb the installed underdrain. NWCC recommends the drainage system include a cleanout every 100 feet, be protected against intrusion by animals at outfalls and be tested prior to backfilling. NWCC also recommends the client retain our firm to observe the underdrain systems during construction to verify that they are being installed in accordance with recommendations provided in this report and observe a flow test prior to backfilling the system.

In addition, NWCC recommends an impervious barrier be constructed to keep water from infiltrating under the footings or foundation walls. Barrier should be constructed of an impervious material, which is approved by this office and placed below the perimeter drain and up against the sides of the foundation walls. A typical perimeter/underdrain detail is shown in Figure #6.

Placement of an impervious membrane and/or properly compacted clays in crawl space areas to the top of the footings or at least 12 inches above the bottom of the foundation walls should help reduce the moisture problems in these areas.

Foundation Walls and Retaining Structures: Foundation walls and retaining structures, which are laterally supported and can be expected to undergo only a moderate amount of deflection, may be designed for a lateral earth pressure computed on the basis of an equivalent fluid unit weight of 45 pcf for imported, free draining granular backfill and 55 pcf for the on-site soils and bedrock materials.

Cantilevered retaining structures on the site can be expected to deflect sufficiently to mobilize the full active earth pressure condition. Therefore, cantilevered structures may be designed for a lateral earth pressure computed based on an equivalent fluid unit weight of 35 pcf for imported, free draining granular backfill and 45 pcf for the on-site soils and bedrock materials.

Foundation walls and retaining structures should be designed for appropriate hydrostatic and surcharge pressures such as adjacent buildings, traffic and construction materials. An upward sloping backfill and/or natural slope will also significantly increase the earth pressures on foundation walls and retaining structures and the structural engineer should carefully evaluate these additional lateral loads when designing the foundation and retaining walls.

The lateral resistance of retaining wall foundations placed on undisturbed natural soils at the site will be a combination of the sliding resistance of the footings on the foundation materials and the passive pressure against the sides of the footings. Sliding friction can be taken as 0.4 times the vertical dead load. Passive pressure against the sides of the footing can be calculated using an equivalent fluid pressure of 250 pcf. The fill placed against the sides of the footings to resist lateral loads should be compacted to at least 100% of the maximum standard Proctor density and near the optimum moisture content.

NWCC recommends imported granular soils for backfilling foundation walls and retaining structures because their use results in lower lateral earth pressures. Imported granular materials should be placed to within 2 to 3 feet of the ground surface, be free draining and have less than 5 percent passing the No. 200 sieve. Granular soils behind foundation and retaining walls should be sloped from the base of the wall at an angle of at least 45 degrees from the vertical. Upper 2 to 3 feet of fill should be a relatively impervious soil or pavement structure to prevent surface water infiltration into the backfill.

Wall backfill should be carefully placed in uniform lifts and compacted to at least 95 percent of the maximum standard Proctor density and near the optimum moisture content. Care should be taken not to overcompact the backfill since this could cause excessive lateral pressure on the walls. Some settlement of deep foundation wall backfill materials will occur even if the material is placed correctly.

Surface Drainage: Proper surface drainage at this site is of paramount importance for minimizing the infiltration of surface drainage into the wall backfill and bearing soils, which could result in increased wall pressures, differential foundation and slab movement. The following drainage precautions should be observed during construction and at all times after the structures have been completed:

1) Ground surface surrounding the structures should be sloped (minimum of 1.0 inch per foot) to drain away from the structures in all directions to a minimum of 10 feet. Ponding must be avoided. If necessary, raising the top of foundation walls to achieve a better surface grade is advisable.

2) Non-structural backfill placed around the structures should be compacted to at least 95% of the maximum standard Proctor density at or near the optimum moisture content in order to minimize future settlement of the fill. The backfill should be placed immediately after the braced foundation walls are able to structurally support the fill. Puddling or sluicing must be avoided.

3) Top 2 to 3 feet of soil placed within 10 feet of the foundations should be impervious in nature to minimize infiltration of surface water into the wall backfill.

4) Roof downspouts and drains should discharge well beyond the limits of all backfill. Roof overhangs, which project two to three feet beyond the foundation, should be considered if gutters are not used.

5) Landscaping, which requires excessive watering and lawn sprinkler heads, should be located a minimum of 10 feet from the foundation walls of the structures.

6) Plastic membranes should not be used to cover the ground surface adjacent to foundation walls.

Limitations: The recommendations provided in this report are based on the soils and bedrock materials encountered at nearby sites and assumed to be on this site, and NWCC's understanding of the proposed construction. We believe that this information gives a high degree of reliability for anticipating the behavior of the proposed structures; however, our recommendations are professional opinions and cannot control nature, nor can they assure the soils profiles beneath those or adjacent to those observed. No warranties expressed or implied are given on the content of this report. NWCC must be called to the site when the foundation excavations are completed and the natural soils are exposed so that the recommendations provided in this report can be confirmed.

We have assumed that swelling soils and bedrock materials will be encountered beneath the fill materials. These soils and bedrock materials are stable at their natural moisture content but can shrink or swell with changes in moisture. The behavior of expansive soils and bedrock materials

is not fully understood. The swell or consolidation potential of any site can change erratically both in lateral and vertical extent. Moisture changes also occur erratically, resulting in conditions which cannot always be predicted. Recommendations presented in this report are based on the current state of the art for foundations and floor slabs on expansive soils and bedrock materials.

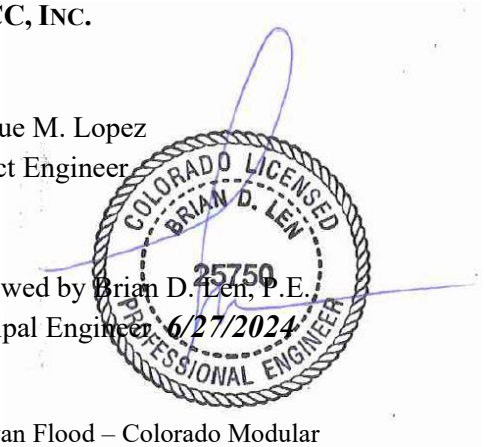
As noted previously, the owner and any future owners must be made aware there is a risk in construction on these types of soil and bedrock materials. Performance of the structures will depend on following the recommendations and in proper maintenance after construction is complete. As water is the main cause for volume change in the soils, it is necessary that the changes in moisture content be kept to a minimum. This requires judicious irrigation and providing positive surface drainage away from the structures. Any distress noted in the structures should be brought to the attention of NWCC.

This report is based on the investigation at the described site and on the specific anticipated construction as stated herein. If either of these conditions is changed, the results would also most likely change. Therefore, NWCC strongly recommends that our firm be contacted prior to finalizing the construction plans so that we can verify that our recommendations are being properly incorporated into the construction plans.

Man-made or natural changes in the conditions of a property can also occur over a period of time. In addition, changes in requirements due to state of the art knowledge and/or legislation may occur. As a result, the findings of this report may become invalid due to these changes; therefore, this report is subject to review and not considered valid after a period of 3 years or if conditions as stated above are altered.

It is the responsibility of the owner or their representative to ensure the information in this report is incorporated into the plans and/or specifications and construction of the project. If you have any questions regarding this report or if NWCC may be of further service, please do not hesitate to contact us.

Sincerely,
NWCC, INC.



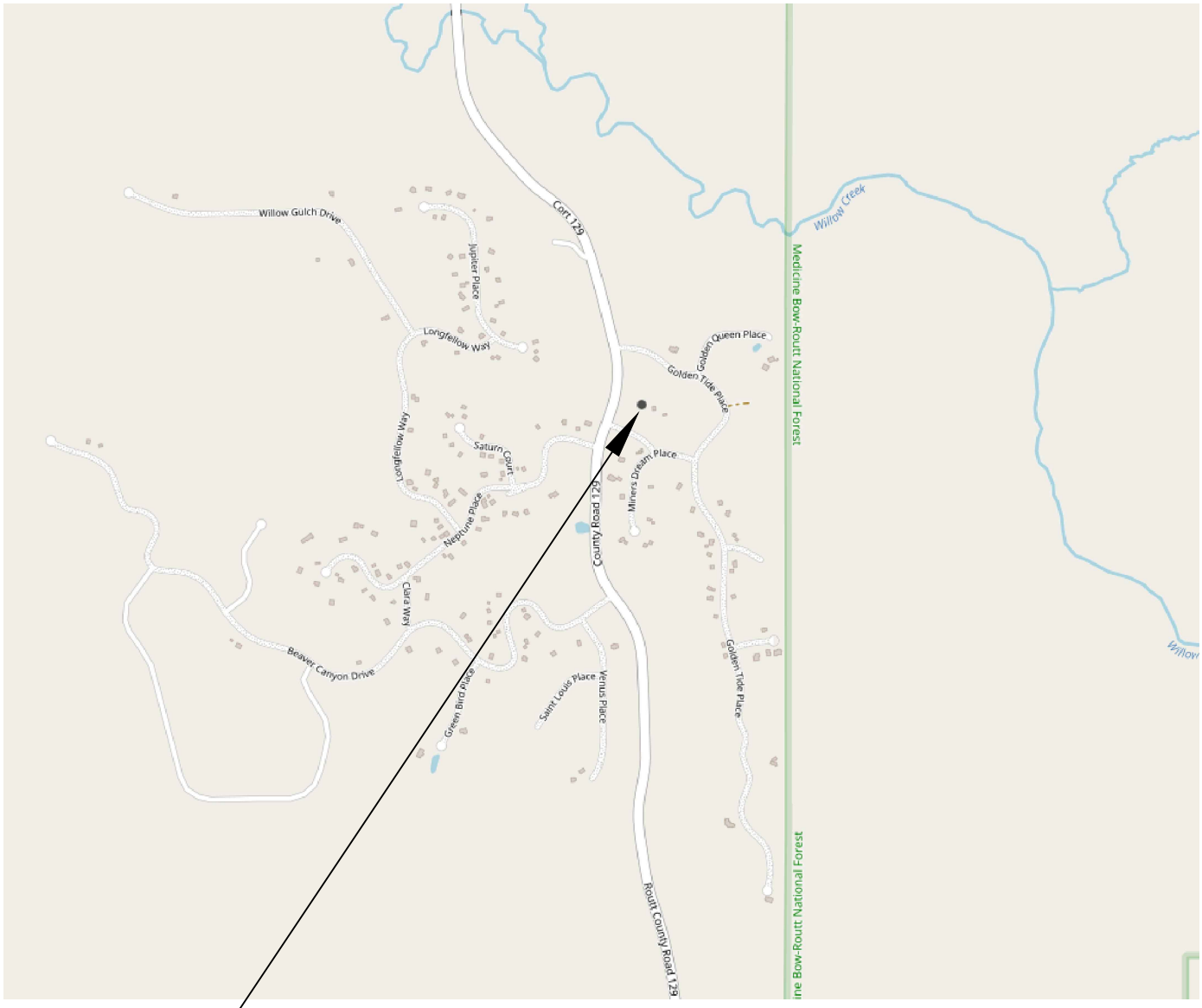
Enrique M. Lopez
Project Engineer

Reviewed by Brian D. Len, P.E.
Principal Engineer ***6/27/2024***

cc: Ryan Flood – Colorado Modular

N

NOT TO SCALE



PROJECT SITE

Title: VICINITY MAP		**Date:** 6/10/24	NWCC North West Colorado Consultants, Inc. Geotechnical / Environmental Engineering • Materials Testing
Job Name: Proposed Finch ADU		**Job No.** 24-13336	(970)879-7888 • Fax (970)879-7891 2580 Copper Ridge Drive Steamboat Springs, Colorado 80487
Location: 27200 Golden View Trail, Routt County, Colorado		**Figure** #1	

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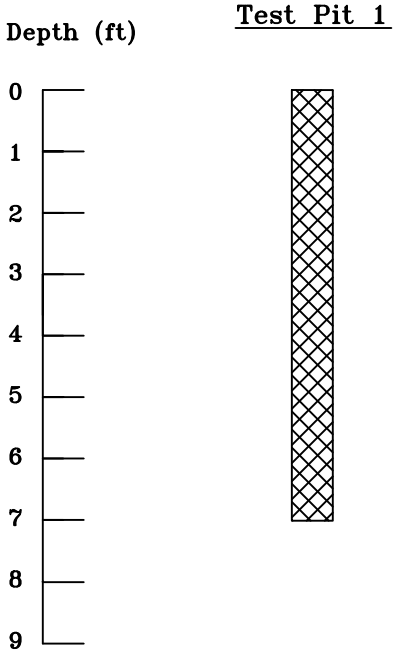
NOT TO SCALE

Title: SITE PLAN–LOCATION OF TEST PIT		**Date:** 6/10/24	NWCC North West Colorado Consultants, Inc. Geotechnical / Environmental Engineering • Materials Testing
Job Name: Proposed Finch ADU		**Job No.** 24–13336	(970)879-7888 • Fax (970)879-7891 2580 Copper Ridge Drive Steamboat Springs, Colorado 80487
Location: 27200 Golden View Trail, Routt County, Colorado		**Figure** #2	

Test Pit 1



LEGEND:

CLAY FILL: Sandy to gravelly with roots, low plastic, fine to coarse grained with occasional cobbles, loose to medium dense, moist and dark brown to brown.

NOTES:

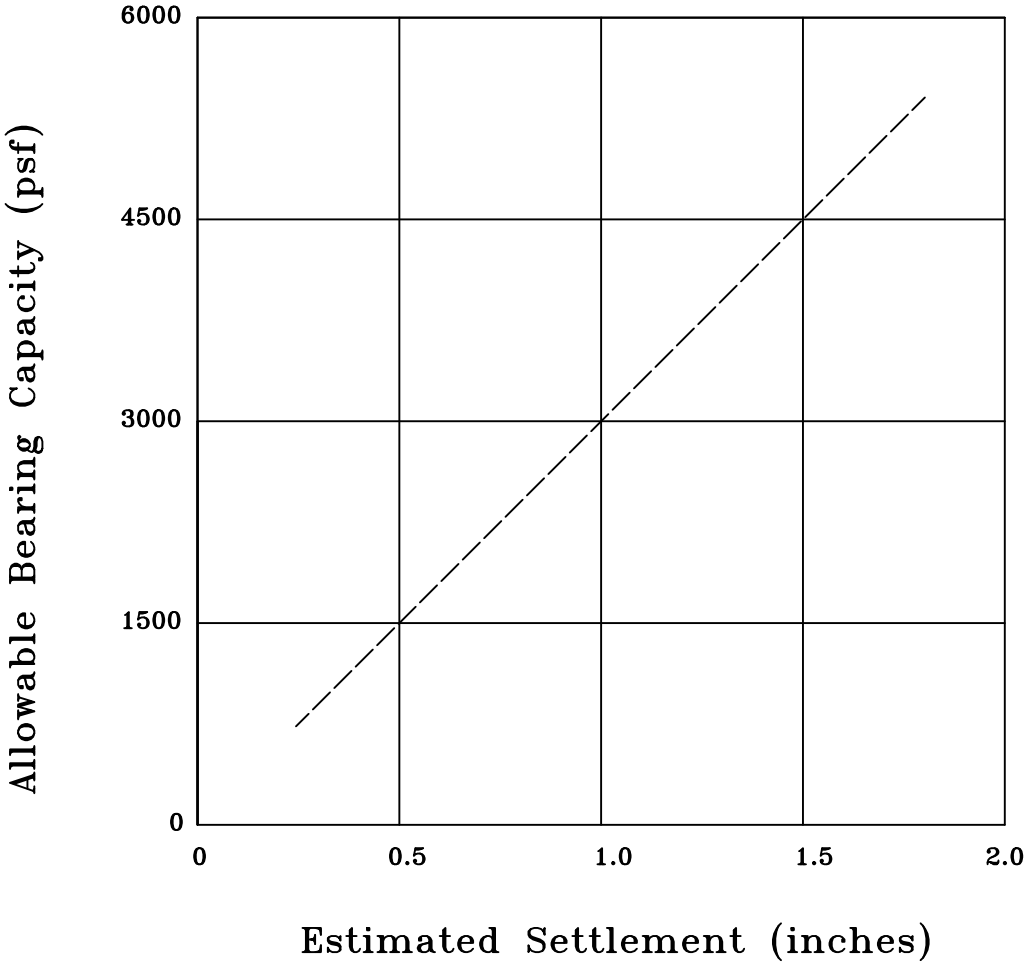
1) Test pit was excavated on May 23 and June 21, 2024 with a MFC B85 backhoe.

2) Test pit location was determined by pacing from existing topographic features at the site.

3) Elevation of the test pit was not measured and the log is drawn to the depth investigated.

4) The lines between materials shown on the test pit log represent the approximate boundaries between material types and transitions may be gradual.

Title: LOGS, LEGEND AND NOTES	Date: 6/10/24	NWCC North West Colorado Consultants, Inc Geotechnical / Environmental Engineering • Materials Testing
Job Name: Proposed Finch ADU	Job No. 24-13336	(970)879-7888 • Fax (970)879-7891 2580 Copper Ridge Drive Steamboat Springs, Colorado 80487
Location: 27200 Golden View Trail, Routt County, Colorado	Figure #3	



Note: These values are based on footing widths of 1 to 4 feet. If the footing width is to be greater than 4 feet in width, then we should be notified to re-evaluate these recommendations.

Title: BEARING CAPACITY CHART		**Date:** 6/10/24	
Job Name: Proposed Finch ADU		**Job No.** 24-13336	
Location: 27200 Golden View Trail, Routt County, Colorado		**Figure** #4	

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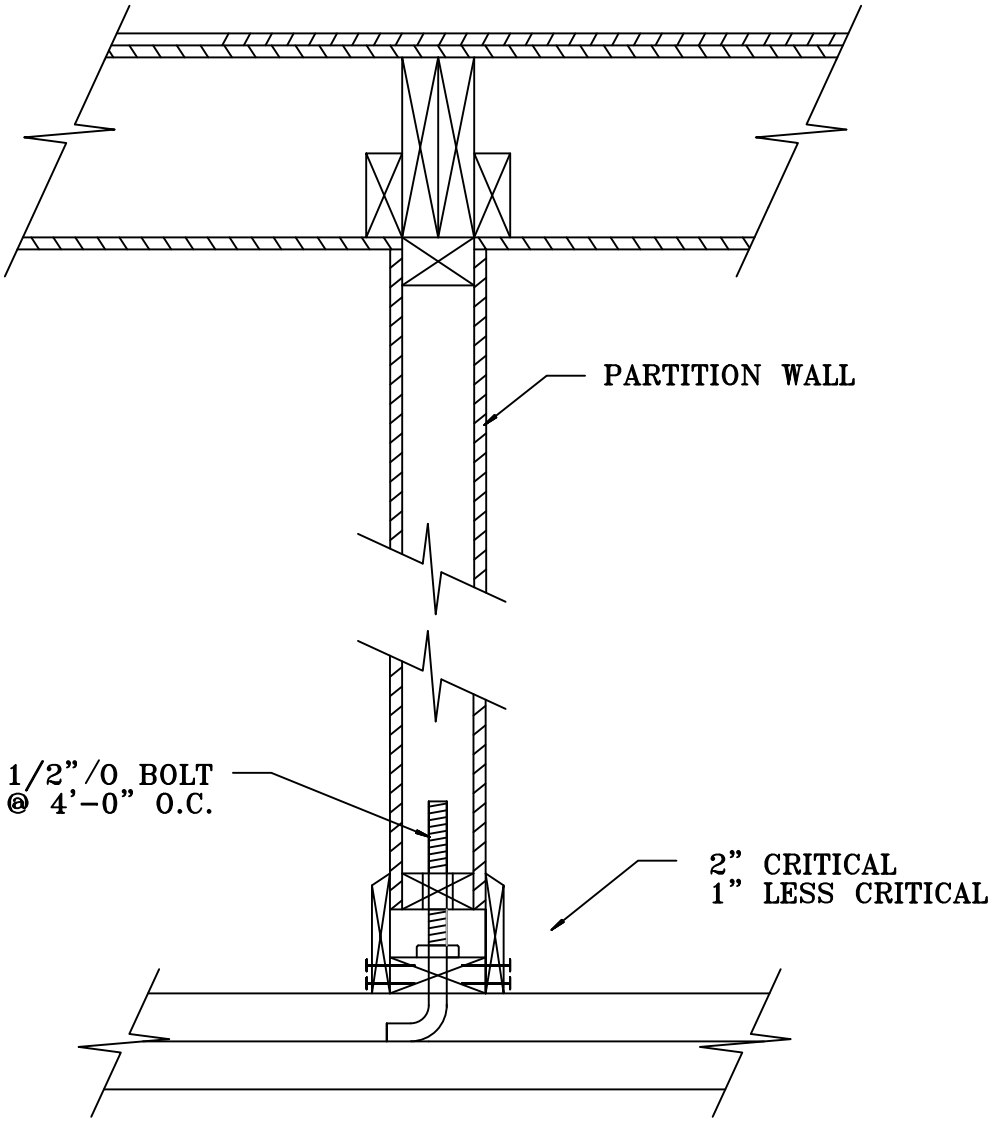
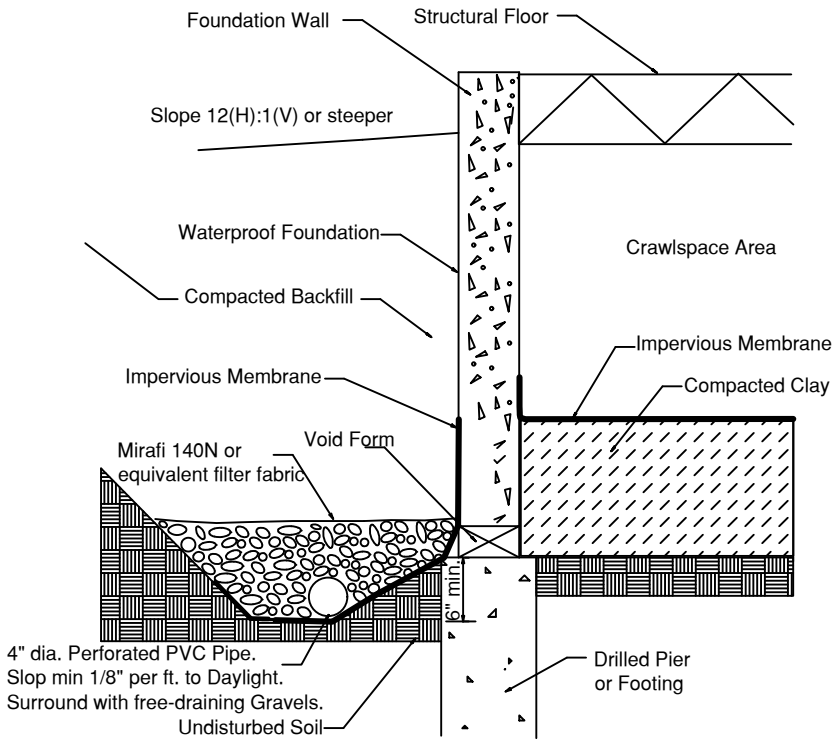
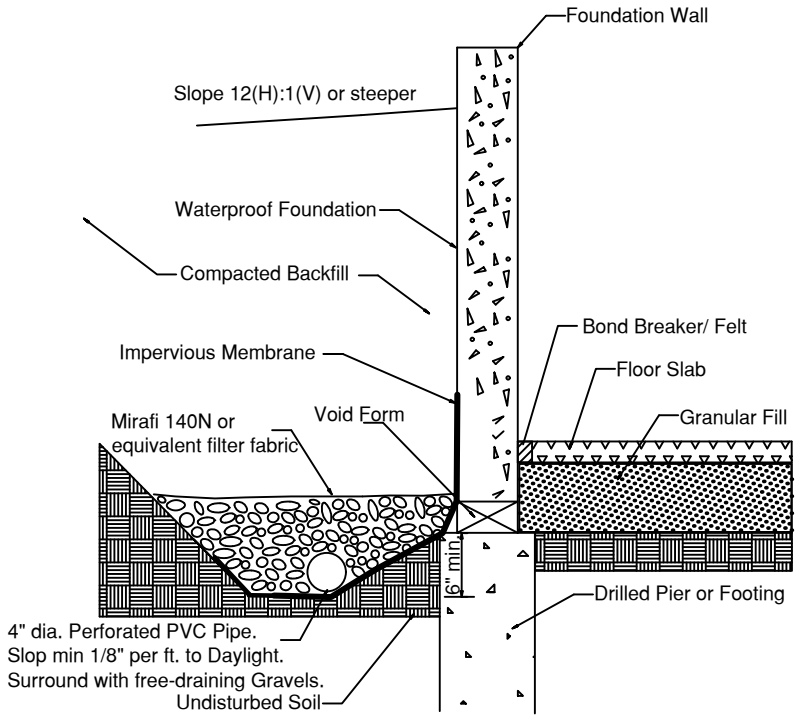


Title: HUNG PARTITION WALL DETAIL	**Date:** 6/10/24	NWCC North West Colorado Consultants, Inc.
Job Name: Proposed Finch ADU	**Job No.** 24-13336	Geotechnical / Environmental Engineering • Materials Testing
Location: 27200 Golden View Trail, Routt County, Colorado	**Figure** #5	(970)879-7888 • Fax (970)879-7891 2580 Copper Ridge Drive Steamboat Springs, Colorado 80487



Crawlspace Area



Lower Level with
Floor Slab

Title: PERIMETER/UNDERDRAIN DETAIL	**Date:** 6/10/24	NWCC North West Colorado Consultants, Inc.
Job Name: Proposed Finch ADU	**Job No.** 24-13336	Geotechnical / Environmental Engineering • Materials Testing
Location: 27200 Golden View Trail, Routt County, Colorado	**Figure** #6	(970)879-7888 • Fax (970)879-7891 2580 Copper Ridge Drive Steamboat Springs, Colorado 80487