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

FOR REFERENCE - Already Submitted with DPVC-21-16 and DPVC-21-06

March 15, 2021

FV Basecamp, LLC
c/o May Riegler Properties
2201 Wisconsin Ave., Suite 200
Washington DC 20007

Attn: Gaby Riegler

Job Number: 20-11961

Subject: Supplemental Subsurface Investigation and Geotechnical Recommendations, Steamboat Basecamp, Lots 1 and 2, Worldwest Subdivision, Steamboat Springs, Colorado.

Gaby,

As requested, NWCC, Inc. (NWCC) has completed this Supplemental Subsurface Investigation and Geotechnical Recommendations report for the proposed Steamboat Basecamp to be constructed within Lots 1 and 2 of the Worldwest Subdivision in Steamboat Springs, Colorado. A Subsoil Investigation report was prepared for a proposed retail building under NWCC's Job Number 95-2241, dated June 27, 1995 within Lot 3, Block 1 of the Curve Subdivision. A Subsoil and Foundation Investigation report was prepared for a proposed building in the northeast corner of the property under NWCC's Job Number 07-7550, dated July 27, 2007. These reports were used in the preparation of this report as well as information from a Supplemental Subsurface Investigation completed at the site on November 11, 2020.

Proposed Construction: Based on our discussions with the client and Jake Mielke with Steamboat Engineering and Design, NWCC understands the project will consist of the renovation of the existing building and the construction of several multi-family residential and mixed use buildings, as well as several garage buildings in three phases.

The existing building will be remodeled for mixed commercial/residential use in Phase I of the project. A two-story addition will be constructed in the southeast portion of the building. Isolated interior pads will be constructed under the existing concrete slab to support the upper floors. A small addition will also be constructed in the northwest portion of the building. We have assumed that the addition will be constructed with a concrete slab-on-grade floor system placed near the existing ground surface.

Phase 2 of the project will consist of the construction of a multi-family building with 21 units and a commercial area in the northwest corner. Phase 3 of the project will consist of two multi-family units with separate garage structures within Lot 2 of the Worldwest Subdivision. We understand the buildings will consist of one to four story wood framed structures with the lower levels constructed with concrete slab on grade floor systems and/or crawlspaces. NWCC has assumed the lower levels of the buildings will be constructed at or above the existing ground surface. NWCC has assumed site grading will include minor unretained cuts and fills of less than 6 feet in height.

Subsurface Conditions: To investigate the subsurface conditions at the site, six test holes were advanced in the area of the existing building for the investigation completed in 1995. Three additional test holes were drilled within Lot 2 for the investigation completed in 2007. Four test pits were advanced within Phase 2 and 3 on November 11, 2020 with a Komatsu PC238 trackhoe. A site plan showing the approximate test hole and pit locations is presented in Figure #1.

The subsurface conditions encountered in the test holes and test pits were variable and generally consisted of variable layers of fill materials overlying natural topsoil and organic materials, natural clays and natural sands and gravels to the maximum depth investigated, 15 feet below the existing ground surface (bgs). It should be noted that practical rig refusal was encountered in the test holes on cobbles at depths ranging from 8 to 15 feet bgs. Graphic logs of the exploratory test holes and test pits are presented in Figures #2, #3 and #4. The associated Legend and Notes are presented in Figure #5.

A thin layer of topsoil and organic fill materials was encountered at the ground surface in Test Pits 1 through 4 and was approximately 3 to 6 inches in thickness. Sand and gravel fill materials were encountered below the topsoil fill materials in Test Pits 1 and 2 and were approximately 12 to 30 inches in thickness. The sand and gravel fill materials were silty to clayey, low to non-plastic, medium dense, moist and brown in color. Clay fill materials were encountered at the existing ground surface in Test Holes 3, 4, 5, 7, 8 and 9; below the topsoil fill materials in Test Pits 3 and 4; and below the sand and gravel fill materials in Test Pit 1. The clay fill materials ranged from approximately 1 to 6 feet in thickness. The clay fill materials were sandy with occasional gravels and debris, low to highly plastic, medium stiff to soft, moist and brown in color.

A layer of natural topsoil and organic materials was encountered at the ground surface in Test Holes 1, 2, and 6 and below the fill materials in Test Holes 3, 4, and 5 and Test Pits 2 and 3. The layer of natural topsoil and organic materials was approximately 3 to 18 inches in thickness.

Natural clays were encountered below the natural topsoil materials in Test Holes 1, 3, 4, 5, 6 and Test Pits 2 and 3, and below the clay fill materials in Test Holes 8 and 9, and Test Pits 1 and 4 at depths ranging from 1 ½ to 5 feet bgs. The natural clays extended to depths ranging from 2 ½ to 12 feet bgs. The natural clays were slightly sandy to sandy, moderately to highly plastic, stiff, moist and brown in color. Samples of the natural clays classified as CL to CH soils in accordance with the Unified Soil Classification System (USCS).

Natural sands and gravels were encountered below the natural topsoil and organic materials in Test Hole 2, below the fill materials in Test Hole 7 and below the natural clays in Test Holes 1, 3, 4, 5, 6, 8 and 9, and Test Pits 1, 2, 3 and 4. The natural sands and gravels were encountered at depths ranging from 6 inches to 12 feet bgs in all of the test holes and test pits. The sands and gravels extended to the maximum depth investigated in each test hole and test pit. The natural sands and gravels were silty to slightly clayey, fine to coarse grained with cobbles and small boulders, very low to non-plastic, dense, moist to wet and brown to gray in color. Samples of the natural gravels classified as SM to GM soils in accordance with the USCS.

Swell-consolidation tests conducted on samples of the natural clays from the previous investigations indicate these materials exhibited a moderate to high swell potential when wetted under a constant load.

Groundwater was encountered at depths ranging from 7 to 10 feet bgs in the Test Holes 1 through 6 at the time of drilling. These test holes were drilled on May 25, 1995, which was likely near the seasonal high groundwater table. Groundwater seepage was not encountered in any of the other test holes or pits at the time of drilling/excavation. It should be noted that the groundwater conditions at the site can be expected to fluctuate with changes in precipitation and runoff and flows in the Yampa River, located approximately 1,000 feet to the south.

During construction of the existing building all of the existing fill materials, topsoil and organic materials and natural clays were removed from under the foundations. Structural fill materials consisting of ¾-inch washed rock materials were compacted under the footings. The structural fill materials were compacted to a minimum of 80 percent of the maximum relative density of the materials.

Foundation Recommendations: Based on a review of the Subsoil and Foundation (NWCC, 2007) and Subsoil Investigation (NWCC, 1995) reports, the subsurface conditions encountered in the recent test pits NWCC anticipates that the natural sands and gravels will be encountered from 5 to 12 feet below the existing ground surface. Due to the highly variable depth of the existing fill materials and the swell potential of the natural clays, NWCC believes the most economically feasible building foundation systems will consist of footings placed on properly compacted structural fill materials placed over the natural sands and gravels after all of the existing fill materials and underlying topsoil and organic materials, and natural clays are removed. Due to the moderate to high swell potential of the clays, NWCC recommends these materials be removed from beneath the footings.

NWCC recommends the footings placed on the natural sands and gravels or on properly compacted, structural fill materials placed over the natural sands and gravels be designed using a maximum allowable soil bearing pressure of 3,000 psf. NWCC recommends structural fill materials placed under the footings consist of a non-expansive granular soil approved by this office. Footings placed on the natural sands and gravels or on non-expansive granular fill placed over the natural sands and gravels will not require a minimum dead load.

Structural fill materials should be uniformly placed in 6 to 8 inch loose lifts and compacted to at least 100 percent of the maximum standard Proctor density, within 2 percent of the optimum moisture content as determined by 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.

NWCC recommends a **Site Class C** designation be used in structural design calculations in accordance with Table 20.3-1 in Chapter 20 of ASCE 7.

Alternate Foundation Recommendations: If the removal of all of the existing fill materials and natural clays is not economically feasible, an alternative deep foundation system for the buildings would be to place the buildings on deep foundation systems consisting of helical screw piles advanced into the natural sands and gravels. High capacity helical piles or pile groups with pile caps will most likely be required for the buildings due to anticipated loadings. The helical screw pile foundations will place the bottom of the foundations in a zone of relatively stable bearing soils and eliminate the risk of foundation movement from swell and/or consolidation of the existing fill materials and natural clays.

Utilizing this type of foundation, each column is supported on a single or group of screw piles and the structures are founded on grade beams or pier caps that are supported by a series of piles. Load applied to the piles is transmitted to the natural sands and gravels through the end bearing pressure at the helices of the screw pile. Foundation movement should be less than ½-inch if the following design and construction conditions are observed.

The helical screw pile foundation system should be designed by a qualified engineer, using industry standards and be installed by a licensed/certified installer. If pile groups are required, we recommend a minimum pile spacing of 3 times the largest helix to achieve the maximum capacity of each individual pile. Lateral loads should be resisted using battered piles or tiebacks or through passive soil pressures against foundation walls or grade beams.

We strongly recommend that at least two test piles be advanced at each building site so that the torque versus depth relationships can be established and the proper shaft and helix size and type can be determined. In addition, load testing of the helical screw piles is strongly recommended to verify the design capacity of the piles. Difficult installation should be anticipated due to the presence of cobbles and boulders in the fill materials.

A representative of this office should observe the test piles/load test and helical screw pile installations.

NWCC also recommends the following:

- Minimum 10-inch diameter helix;
- Minimum installation torque of 4,000 ft-lbs;
- Full-time installation observation by a qualified special inspector;
- Review of the Contractor's quality control plan regarding instrumentation calibration and testing, materials QC, and pile installation procedures.

An alternative deep foundation system would consist of rammed aggregate piers (RAP). The rammed aggregate piers are typically constructed to bridge poor bearing soils, such as the existing fill materials and natural clays encountered at this site, extending down to a suitable bearing layer, the underlying natural sands and gravels. A RAP foundation system should develop an end bearing pressure of at least 4,000 psf for aggregate piers founded in the sand and gravels. A RAP foundation system has the advantage of not only supporting shallow foundation elements, but also supporting floor slab areas and improving the engineering characteristics of the existing fill materials and native soils between the piers, thus decreasing the potential for floor slab movement and eliminating the need for structural slabs or structural floors over crawlspaces.

RAP foundation elements are designed as proprietary foundation systems. If a RAP foundation system is selected, NWCC should be contacted to coordinate with the RAP contractor/design team during foundation design.

Floor Slabs: NWCC has assumed the lower levels of the buildings will most likely be constructed with concrete slab-on-grade floor systems placed near the existing grades. The natural soils, excluding the existing fill materials and topsoil and organic materials, are capable of supporting slab-on-grade construction. However, floor slabs present a very 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 natural clays encountered at this site, NWCC believes 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 clays are subjected to moisture changes.

1) Floor slabs must be separated from all bearing walls; columns and their foundation support 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 #6. This detail can be omitted if all of the clays are removed from beneath the floor slabs.

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, all existing fill materials and topsoil and organic materials should be removed prior to placement of the underslab gravels or new granular fill materials. If the removal of all of the existing fill materials and topsoil and organics and replacing with granular fill materials is not economically feasible, we recommend the lower levels be constructed on structural floor systems over a crawlspace.

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. 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) It has been NWCC's experience that the risk of floor slab movement can be reduced by removing at least 2 feet of the expansive soils and replacing them with a well compacted, non-expansive fill. 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.

Following the above precautions and recommendations will not prevent floor slab movement in the event the clays 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 or remove all of the expansive clays and replace them with non-expansive granular fill materials.

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 on-site soils.

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

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 earth pressures on foundation walls and retaining structures and the structural engineer should carefully evaluate these additional lateral loads when designing foundation and retaining walls.

Lateral resistance of retaining wall foundations placed on undisturbed natural soils at the site will be a combination of sliding resistance of the footings on the foundation materials and passive pressure against the sides of 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. Fill placed against the sides of 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. Imported granular soils should be free draining and have less than 7 percent passing the No. 200 sieve. Granular soils placed 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. The 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 backfill since this could cause excessive lateral pressure on the walls. Some settlement of deep foundation wall backfill materials will occur even if materials are placed correctly.

Underdrain System: Any floor levels 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. If any level is placed within 2 feet of the seasonal high groundwater table, a permanent/full-time dewatering system may be required in the lower level. NWCC must be consulted to provide or review the design of a dewatering system.

Localized perched water or runoff can infiltrate the lower levels of the structures at the foundation levels. This water can be one of the primary causes of differential foundation and slab movement. Especially, when expansive soils are encountered. Excessive moisture in crawl space areas or lower level 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 crawl space levels and at least 6 inches below the bottom of the foundation walls or footings. NWCC recommends the use of perforated PVC pipe for the drainpipe, which meets or exceeds ASTM D-3034/SDR 35 requirements, to minimize the 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 be surrounded with at least 12 inches of free-draining gravel and should be protected from contamination by a filter covering of Mirafi 140N subsurface drainage fabric or an equivalent product. Drains 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 will likely 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 and/or foundation walls. The 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 #7.

Surface Drainage: Proper surface drainage at this site is of paramount importance for minimizing infiltration of surface drainage into 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 structures should be sloped (minimum of 1.0 inch per foot) to drain away from 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 structures should be compacted to at least 95% of the maximum standard Proctor density at or near the optimum moisture content to minimize future settlement of the fill. 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 foundations should be impervious in nature to minimize infiltration of surface water into 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 foundation walls, 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 or any permanent, unretained cuts. Additionally, large piles of man-made or natural snow should be removed prior to melting within 10 feet of the foundation walls of the structures or any permanent, unretained cuts.

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

Site Grading: Temporary cuts for foundation construction should be constructed to OSHA standards for temporary excavations. Permanent, unretained cuts should be kept as shallow as possible and should not exceed a 3(Horizontal) to 1(Vertical) configuration for the existing fill materials and natural clays.

We recommend permanent, unretained cuts be limited to 10 feet in height or less. The risk of slope instability will be significantly increased if groundwater seepage is encountered in the cuts. NWCC office should be notified immediately to evaluate the site if seepage is encountered or deeper cuts are planned and determine if additional investigations and/or stabilization measures are warranted.

Excavating during periods of low runoff at the site can reduce potential slope instability during excavation. Excavations should not be attempted during the spring or early summer when seasonal runoff and groundwater levels are typically high.

Fills up to 10 feet in height can be constructed at the site and should be constructed to a 2(Horizontal) to 1(Vertical) or flatter configuration. The fill areas should be prepared by stripping any existing fill materials and topsoil and organics, scarification, and compaction to at least 95% of the maximum standard Proctor density and within 2% of optimum moisture content as determined by ASTM D698. The fills should be properly benched/keyed into the natural hillsides after the existing fill materials, natural topsoil, and organic materials, silts, and clays have been removed. The fill materials should consist of the on-site soils (exclusive of topsoil, organics, or silts) and be uniformly placed and compacted in 6 to 8-inch loose lifts to the minimum density value and moisture content range indicated above.

Proper surface drainage features should be provided around all permanent cuts and fills and steep natural slopes to direct surface runoff away from these areas. Cuts, fills, and other stripped areas should be protected against erosion by revegetation or other methods. Areas of concentrated drainage should be avoided and may require the use of riprap for erosion control. NWCC recommends that a maximum of 4 inches of topsoil be placed over the new cut and fill slopes. It should be noted that the newly placed topsoil materials may slough/slide off the slopes during the spring runoff seasons until the root zone in the vegetated cover establishes.

A qualified engineer experienced in this area should prepare site grading and drainage plans. The contractor must provide a construction sequencing plan for excavation, wall construction, and bracing and backfilling for the steeper and more sensitive portions of the site prior to starting the excavations or construction.

Pavement Section Recommendations: Pavement section alternatives presented below are based on anticipated soil conditions, assumed traffic loadings indicated below, pavement design procedures presented in the AASHTO Guide for Design of Pavement Structures, and our experience with similar sites and conditions in this part of Steamboat Springs. AASHTO pavement design procedures have been adopted and are used by the Colorado Department of Transportation (CDOT). NWCC has assumed the proposed pavement areas will be subjected to automobiles with occasional delivery trucks and with regular trash truck service.

Based on the results of the field and laboratory investigations and our understanding of the proposed construction, it appears the materials to be encountered at proposed pavement subgrade elevations will most likely consist of existing fill materials or natural clays. We have assumed the fill materials will generally classify as CL soils in accordance with the USCS, which is the worst-case scenario. NWCC recommends the pavement areas subjected to both truck and automobile traffic, such as at the entrances and roadways through the facility be constructed with a minimum of 4 inches of hot mix asphalt (HMA) overlying a minimum of 4 inches of CDOT class 6 aggregate base course (ABC) and a minimum of 8 inches of subbase aggregates (Pit Run). The pavement areas subjected to automobiles only, such as the parking stalls, can be paved with a minimum of 3 inches of HMS, 4 inches of CDOT class 6 aggregate base course (ABC), and a minimum of 6 inches of subbase aggregates (subbase).

NWCC recommends the areas subjected to heavy truck turning movements, such as the pads in front of the trash dumpsters or loading docks be paved with a rigid pavement section consisting of at least 8 inches of Portland cement concrete (PCC).

NWCC recommends the asphalt pavement material (HMA) consist of an approved "Superpave" mix designed by a qualified, registered engineer. The mix design should be designed using the SX gradation and mixed with PG 58-28 oil or other performance graded asphaltic materials. The mix should be produced and placed by a qualified contractor and should be compacted to between 92 and 96 percent of the maximum theoretical (Rice) density or at least 92 percent of the maximum Rice density. Quality control activities should be conducted on paving materials at the time of placement.

Base course materials (ABC) should consist of a well-graded aggregate base course material that meets CDOT Class 6 ABC grading and durability requirements and the subbase should consist of well-graded aggregate materials that meet CDOT Class 2 ABC grading and durability requirements.

ABC and subbase materials should be uniformly placed and compacted in 4 to 6-inch loose lifts to at least 95 % of the maximum modified Proctor density and within +/- 2 % of the optimum moisture content as determined by ASTM D1557.

Concrete pavement materials shall be based on a mix design established by a qualified engineer. Concrete should have a minimum 28-day compressive strength of 4,500 psi, be air-entrained with approximately 6 percent air, and have a maximum water/cement ratio of 0.42. Concrete should have a maximum slump of 4 inches and should contain control joints no greater than 10 to 12 feet on center, depending on slab configurations. The depth of the control joints should be at least ¼ of the slab thickness.

Prior to placement of subbase materials, NWCC recommends that all of the existing fill materials be removed, any debris removed and the materials moisture conditioned and compacted. Prior to placement of the subgrade fill materials the natural clays should be scarified and recompacted to a depth of 8 inches. The scarified natural clays and subgrade materials should be compacted in 6 to 8 inch lifts to at least 95 % of the maximum standard Proctor density and within +/- 2 % of the optimum moisture content as determined by ASTM D698. The finished subgrade surface, after recompaction, should also be sloped at least 1 percent to avoid ponding and to reduce the potential for wetting and expansion of the subgrade soils. The finished subgrade surface should be proof rolled with a loaded tandem dump truck or loaded water truck and any areas deflecting or rutting should be removed and or stabilized prior to placing the subbase aggregates.

The collection and diversion of surface and subsurface drainage away from the paved areas is extremely important to the satisfactory performance of the pavement. The design of the surface and subsurface drainage features should be carefully considered to remove all water from paved areas and to prevent ponding of water on and adjacent to paved areas.

Limitations: The recommendations provided in this report are based on the subsurface conditions encountered at this site and our 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.

Expansive soils were encountered at this site. These soils are not prone to volume changes at their natural moisture content but can consolidate or swell with changes in moisture and loading. The behavior of expansive soils is not fully understood. The swell and/or consolidation potential of any particular site can change erratically both in lateral and vertical extent. Moisture changes also occur erratically, resulting in conditions, which cannot always be predicted. The recommendations presented in this report are based on the current state of the art for foundations and floor slabs on swelling/consolidating soils. The owner should be aware that there is a risk in construction on these types of 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; therefore, positive surface drainage should be maintained away from the structures. Any distress noted in the structures should be brought to the attention of this office.

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 do from time to time 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 his representative to ensure information in this report is incorporated into the plans and/or specifications and construction of the project. It is advisable that a contractor familiar with construction details typically used to dealing with the local subsoils and climatic conditions be retained to build the structures.

If you have any questions regarding this report or if we may be of further service, please do not hesitate to contact us.

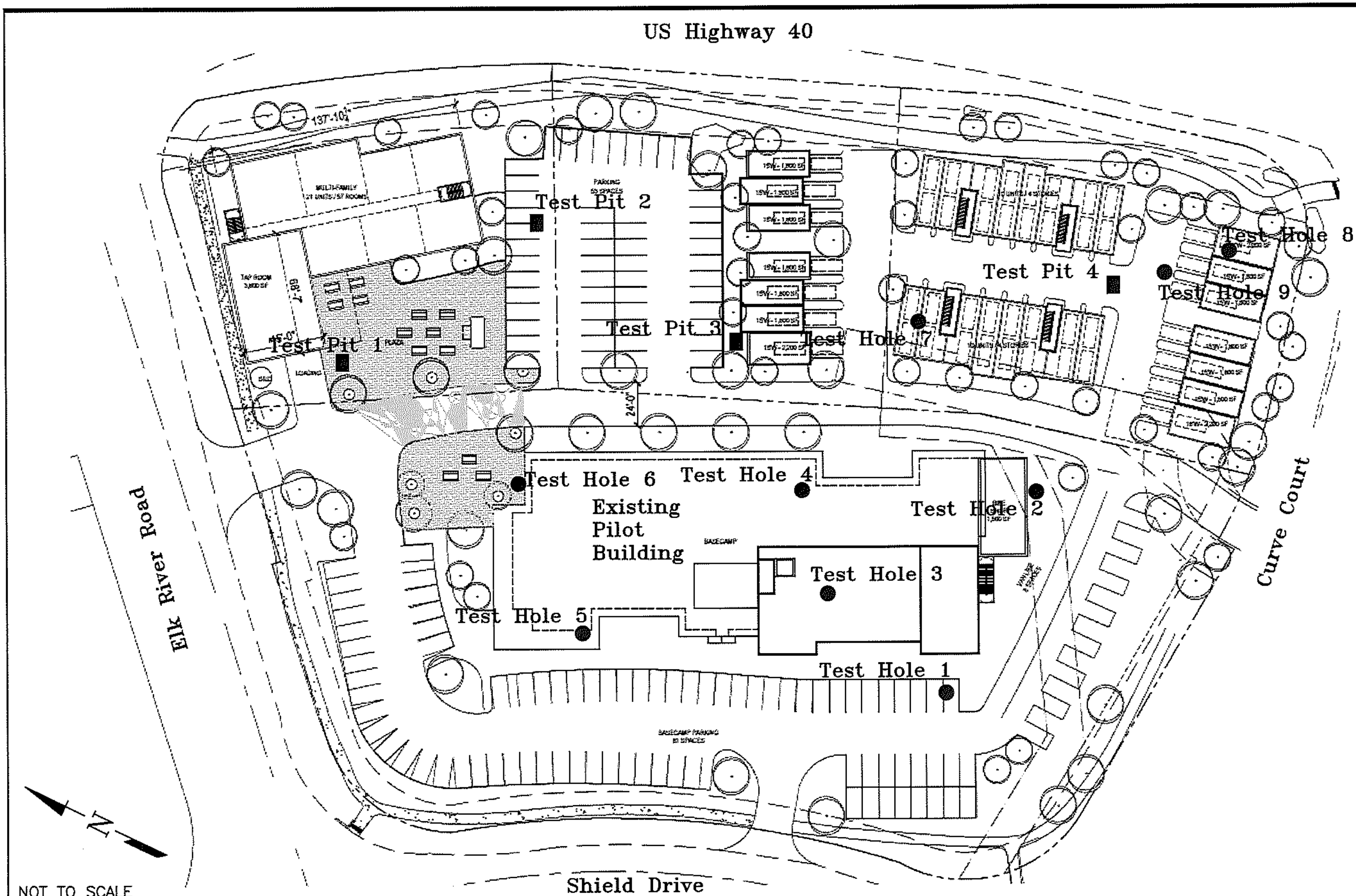
Sincerely,
NWCC, INC.,

Timothy S. Travis, P.E.
Senior Project Engineer

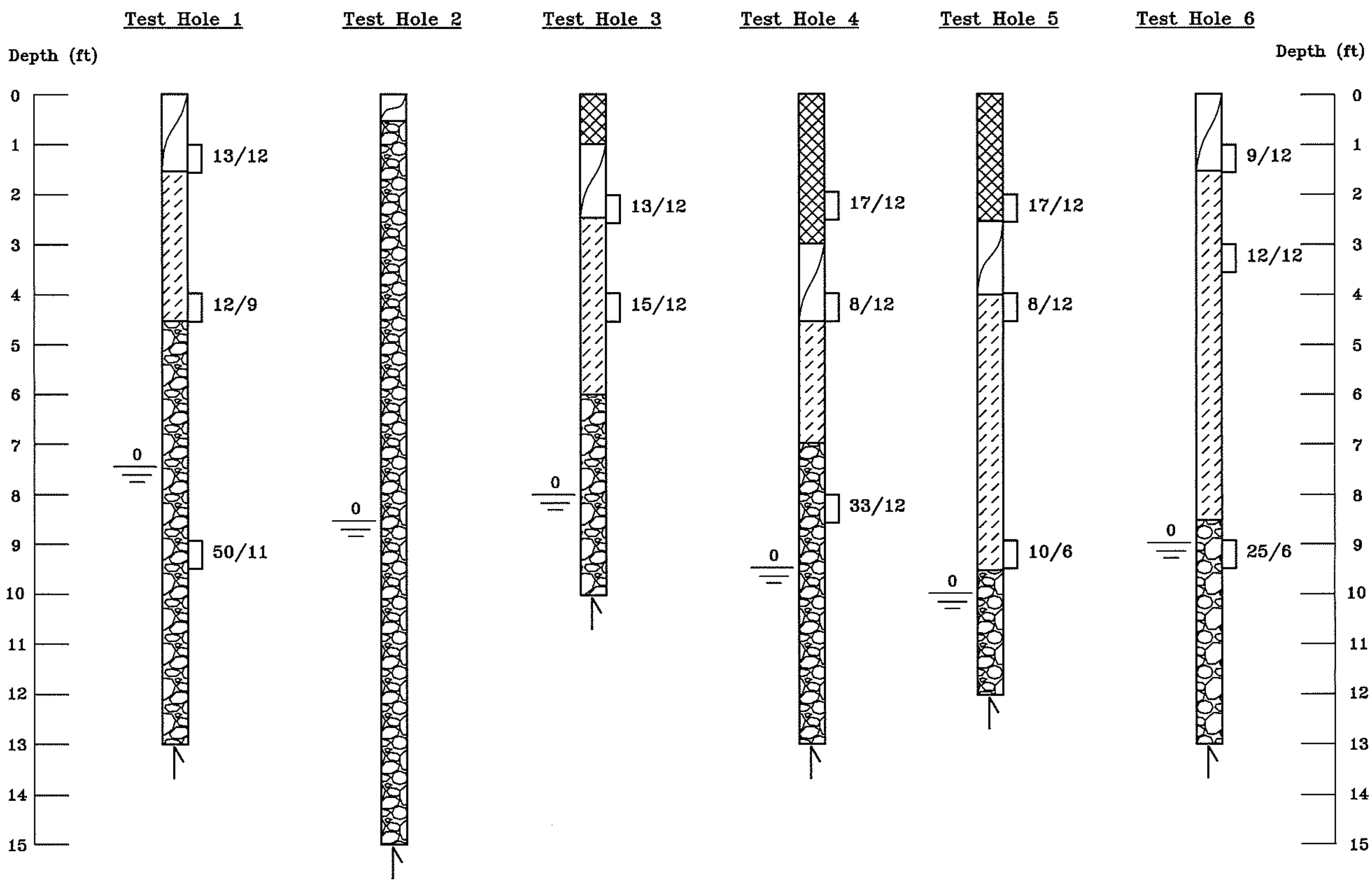
COLORADO LICENSED
BRIAN D. LEN
25750
3/16/21
PROFESSIONAL ENGINEER

Reviewed by Brian D. Len, P.E.
Principal Engineer

cc: Jake Mielke, SEAD



Title: SITE PLAN—LOCATION OF TEST HOLES AND PITS		**Date:** 2/2/2021	**NWCC** North West Colorado Consultants, Inc. Geotechnical / Environmental Engineering · Materials Testing (970)879-7888 · Fax (970)879-7891 2580 Copper Ridge Drive Steamboat Springs, Colorado 80487
Job Name: Steamboat Basecamp		**Job No.** 20-11961	
LOCATION: Worldwest Subdivision, Steamboat Springs, Colorado		**Figure** #1	



Title:	LOGS OF EXPLORATORY TEST HOLES
Job Name:	Steamboat Basecamp
LOCATION:	Worldwest Subdivision, Steamboat Springs, Colorado

Date: 3/5/2021
Job No. 20-11961
Figure #2

North West Colorado Consultants Inc.
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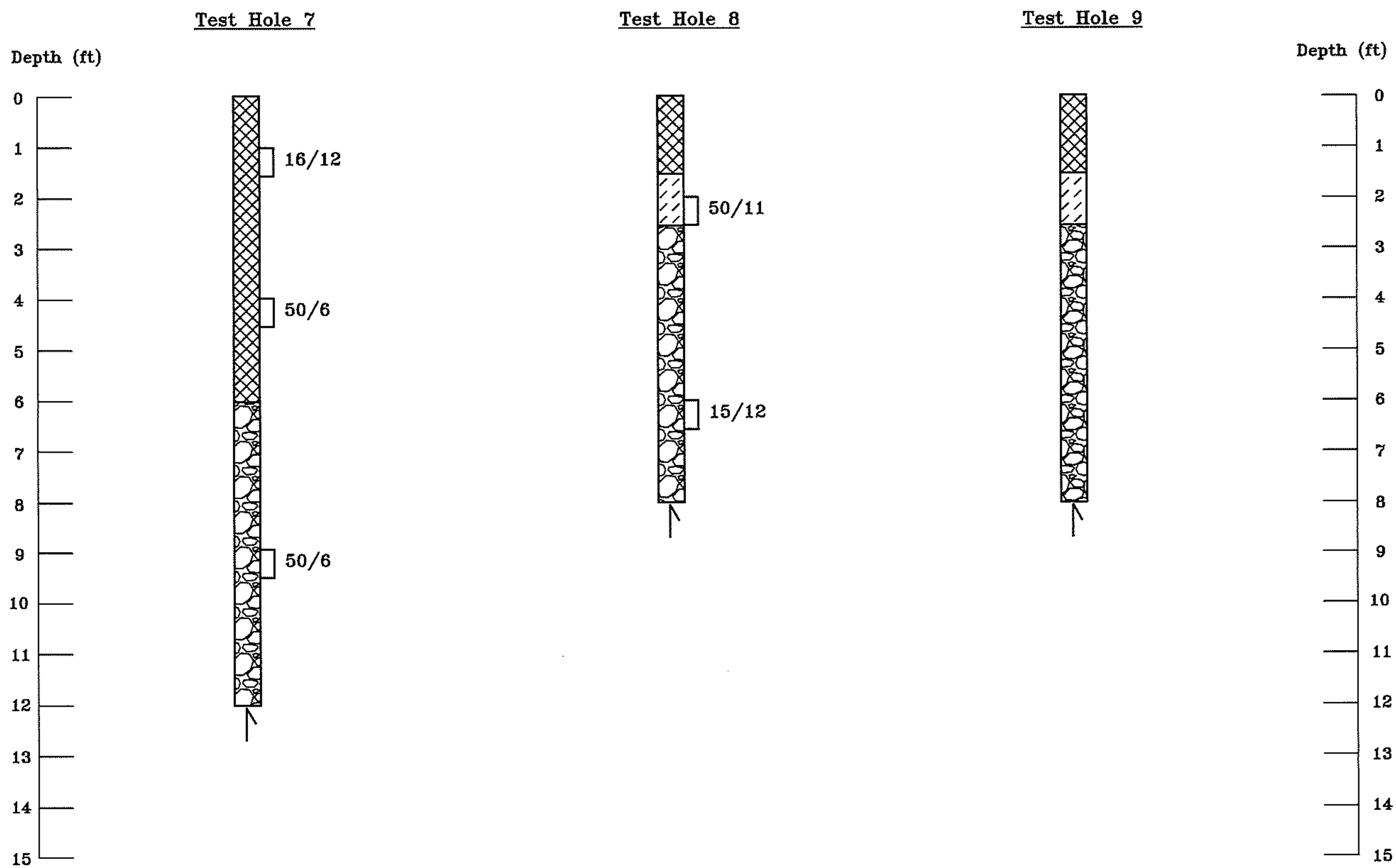
2580 Copper Ridge Drive
Steamboat Springs, Colorado 80487



Title: LOGS OF EXPLORATORY TEST HOLES		Date: 3/5/2021	
Job Name: Steamboat Basecamp		Job No. 20-11961	
LOCATION: Worldwest Subdivision, Steamboat Springs, Colorado		Figure #3	

North West Colorado Consultants, Inc.
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(970)879-7888 - Fax (970)879-7891
2580 Copper Ridge Drive
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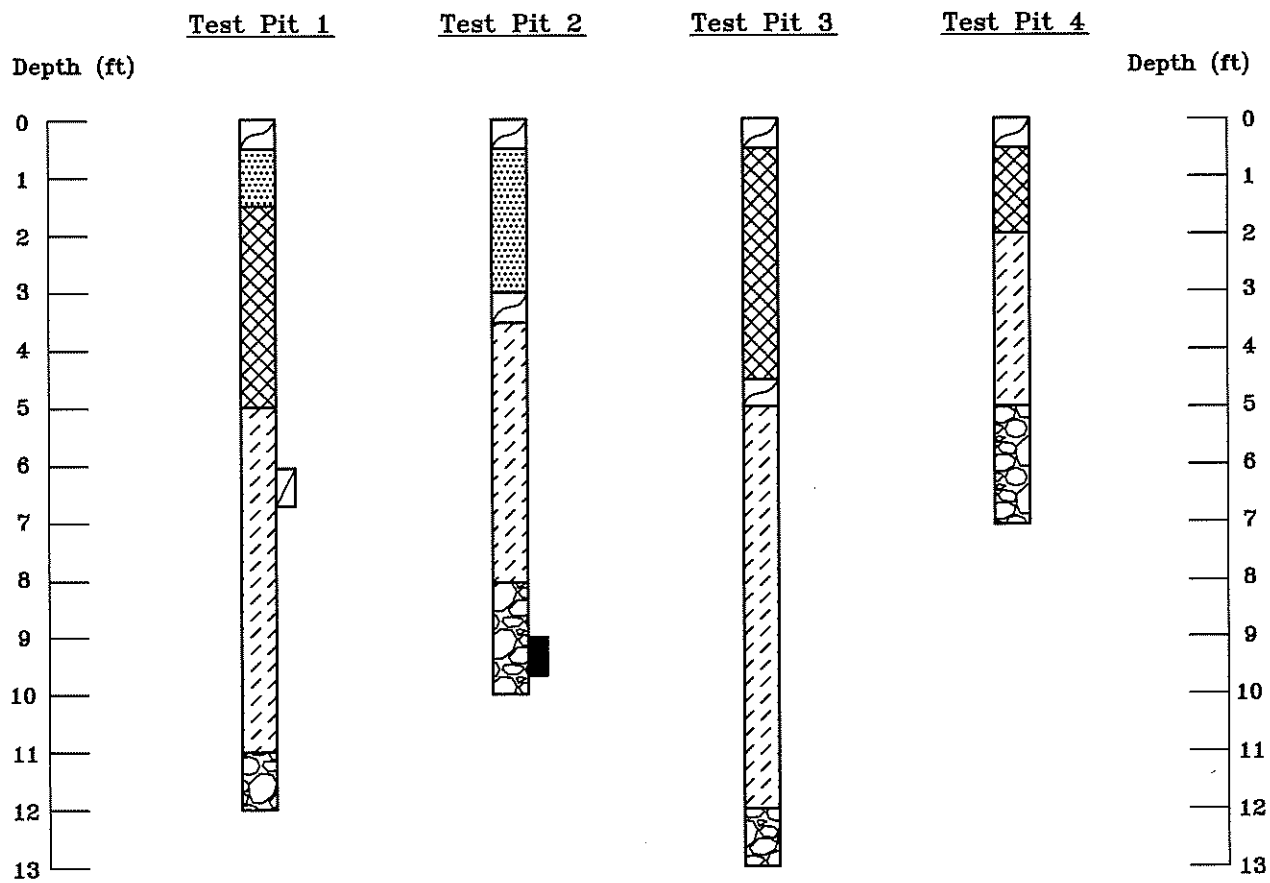


Title:	LOGS OF EXPLORATORY TEST PITS	Date: 3/5/2021	North West Colorado Consultants Inc. Geotechnical / Environmental Engineering · Materials Testing (970)879-7888 · Fax (970)879-7891 2580 Copper Ridge Drive Steamboat Springs, Colorado 80487
Job Name:	Steamboat Basecamp	Job No. 20-11961	
LOCATION:	Worldwest Subdivision, Steamboat Springs, Colorado	Figure #4	

LEGEND:

Topsoil and organics.

SAND AND GRAVEL FILL: Silty to clayey, low to non-plastic, medium dense, moist and brown in color.

CLAY FILL: Sandy with occasional gravels and debris, low to highly plastic, medium stiff to soft, moist and brown in color.

CLAY: Slightly sandy to sandy, moderately to highly plastic, stiff, moist and brown in color.

SANDS AND GRAVELS: Silty to slightly clayey, fine to coarse grained with cobbles and small boulders, very low to non-plastic, dense, moist to wet and brown to gray in color.

Drive Sample, 2-inch I.D. California Liner Sampler.

Hand Drive Sample-California Liner.

Small Disturbed Sample.

Indicates depth of practical rig refusal on cobbles.

13/12 Drive Sample Blow Count, indicates 13 blows of a 140-pound hammer falling 30 inches were required to drive the sampler 12 inches.

Indicates depth at which groundwater was encountered at the time of drilling.

NOTES:

1) Test Holes 1 through 6 were drilled on May 25, 1995 and Test Holes 7 through 9 were drilled on May 10, 2007 with a truck-mounted drill rig using 4-inch diameter continuous flight power augers. Test Pits 1 through 4 were excavated on November 11, 2020 with a Cat trackhoe.

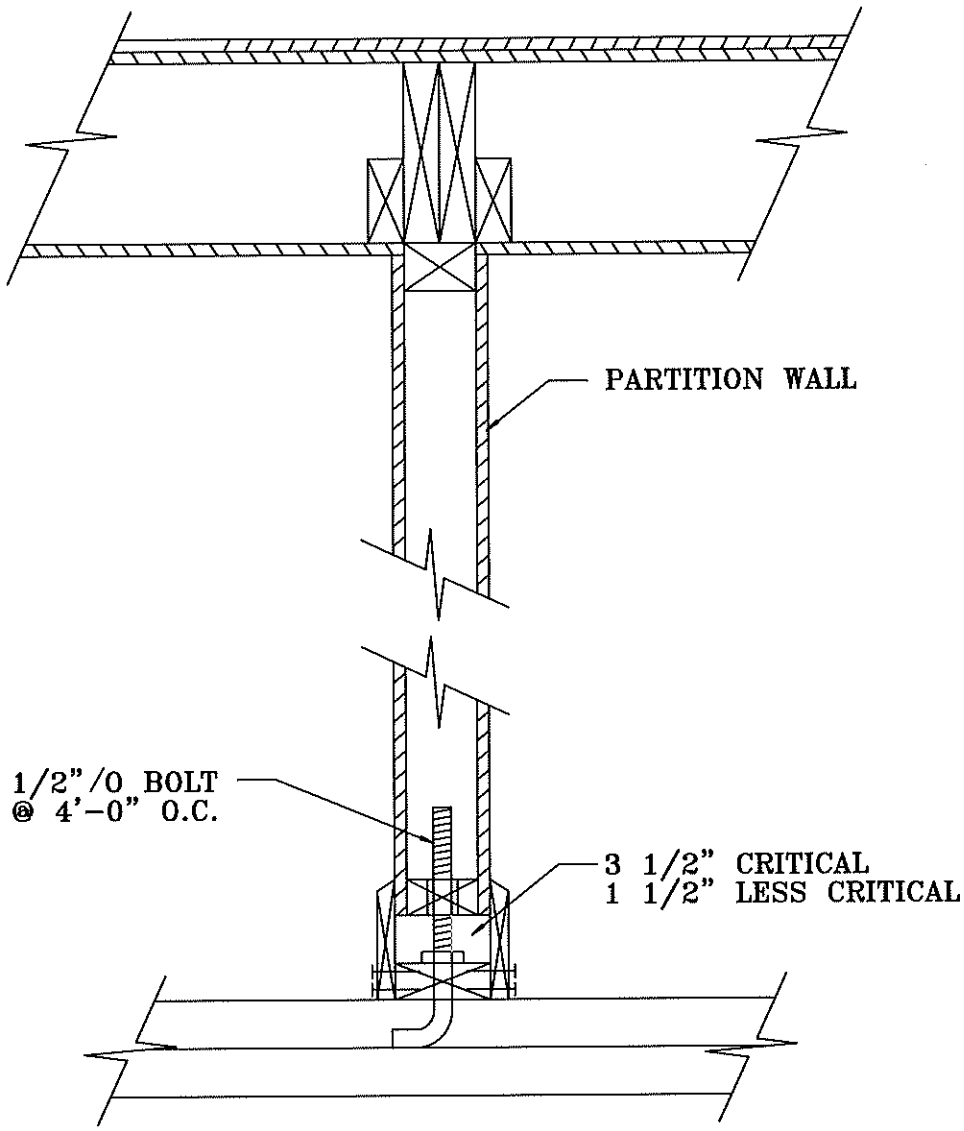
2) Locations of the test holes and test pits were determined in the field by pacing from the existing structure.

3) Elevations of the test holes were not measured and logs are drawn to the depths investigated.

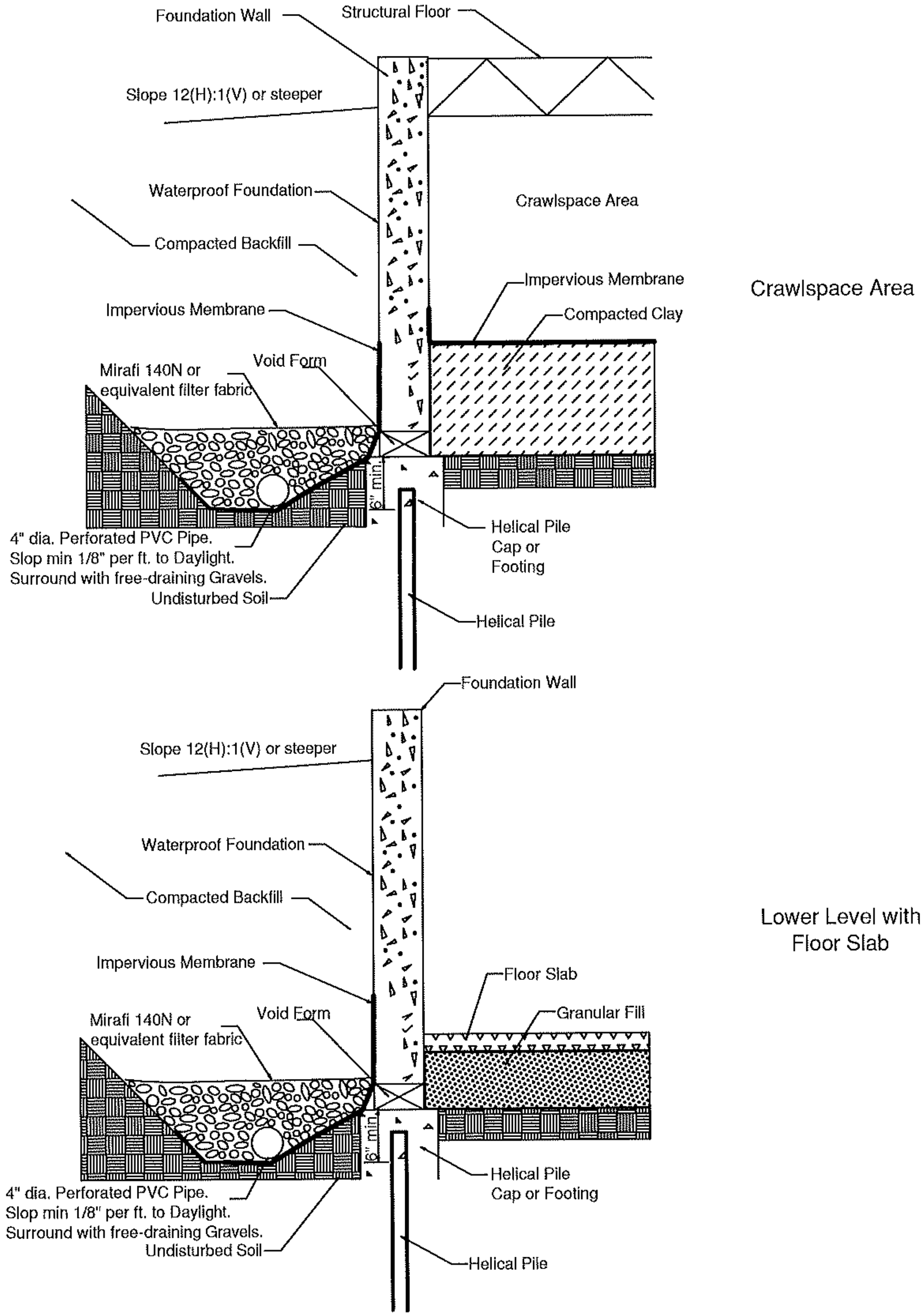
4) The lines between materials shown on the logs represent the approximate boundaries between material types and transitions may be gradual.

5) The water level readings shown on the logs were made at the time and under the conditions indicated. Fluctuations in the water levels will probably occur with time.

Title: LEGEND AND NOTES	Date: 3/5/2021	NWCC North West Colorado Consultants, Inc.
Job Name: Steamboat Basecamp	Job No. 20-11961	Geotechnical / Environmental Engineering · Materials Testing
Location: Worldwest Subdivision, Steamboat Springs, Colorado	Figure #5	(970)879-7888 · Fax (970)879-7891 2580 Copper Ridge Drive Steamboat Springs, Colorado 80487



Title: HUNG PARTITION WALL DETAIL	Date: 3/5/2021	NWCC North West Colorado Consultants, Inc. Geotechnical / Environmental Engineering · Materials Testing (970)879-7888 · Fax (970)879-7891 2580 Copper Ridge Drive Steamboat Springs, Colorado 80487
Job Name: Steamboat Basecamp	Job No. 20-11961	
Location: Worldwest Subdivision, Steamboat Springs, Colorado	Figure #6	



Title: PERIMETER/UNDERDRAIN DETAIL	Date: 3/5/2021	North West Colorado Consultants, Inc. Geotechnical / Environmental Engineering - Materials Testing
Job Name: Steamboat Basecamp	Job No. 20-11961	(970)879-7888 - Fax (970)879-7891 2580 Copper Ridge Drive Steamboat Springs, Colorado 80487
Location: Worldwest Subdivision, Steamboat Springs, Colorado	Figure #7	