NorthWest Colorado Consultants, Inc.

Geotechnical / Environmental Engineering • Materials Testing

Included for reference only. Proposed structure is supported by the existing, and previously approved, Promenade Building.

December 30, 2020

Steamboat Ski & Resort Corp.
Attn: Jim Schneider
2305 Mt. Werner Circle
Steamboat Springs, CO 80487

Job Number: 20-12000

Subject: Subsoil and Foundation Investigation, Steamboat Base Area Redevelopment, Steamboat Springs, Colorado.

Jim,

This report presents the results of the Subsoil and Foundation Investigation for the proposed Steamboat Base Area Redevelopment project within the Steamboat Ski & Resort located at 2305 Mt. Werner Circle in Steamboat Springs, Colorado. The approximate location of the project site is shown in Figure #1.

NWCC, Inc. (NWCC) scope of our work included obtaining data from observations made at the site, logging of seven test holes, sampling of the probable foundation soils, and 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.

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

Proposed Construction: NWCC understands the first phase of the project will consist of the demolition of two of the existing buildings within the existing ski area base and the construction of two new buildings to be named the Promenade and Building B.

The existing Gondola building will be demolished and reconstructed as the Promenade. We understand the Promenade will be a composite steel-framed or mild reinforced concrete elevated slab structure with the main level at the existing grade and one level below expected to extend approximately 14 feet below the existing grade. It is anticipated the Promenade may have additional floors built above the main level in the future. We understand the maximum column dead load for this building is anticipated to be approximately 375 kips and the maximum anticipated column dead load plus live load for this building is approximately 750 kips. Wall loads are anticipated to be on the order of 15 kips per foot.

The building currently housing Ski School will be demolished and replaced with Building B. We understand Building B will be a two-story composite steel-framed structure with steel columns. We understand Building B will not have a level below the current grade. NWCC understands the lower levels of the buildings will be constructed with concrete slab-on-grade floor systems placed from approximately 14 feet below to 3 feet above the existing grade. We understand the maximum column dead load for this building is anticipated to be approximately 190 kips and the maximum anticipated column dead load plus live load for the building is approximately 350 kips.

Site Conditions: The site consists of existing occupied buildings utilized for the everyday operation of the ski area. The existing Gondola building is a three-story structure with a lower level. The area around the existing Gondola building and the proposed Building B is covered with brick pavers utilized for pedestrian walkways and occasional vehicles. The pedestrian walkways are generally level except for the walkway on the east side of the existing Gondola Building. The pathway on the east side slopes gently to the south towards One Steamboat Place.

Burgess Creek is located immediately east of the Gondola Building and it generally flows down from the north/northeast to south/southwest. An elevation difference of 10 to 20 feet exists across the planned site of the Promenade building and Building B. Extensive grading, primarily consisting of fills, has occurred across the site during the original development of the base area.

The existing drop shuttle and bus drop off area is bounded by the Gondola Square Condominiums to the east and Mount Werner Circle to the west. This portion of the site consists predominately of asphaltic pavement in the drop off locations and brick pavers in the pedestrian walkways. This portion of the site generally slopes gently to moderately down to the south. Between the Gondola Square Condominiums and the drop-off area, there exists an access ramp leading to underground parking that generally slopes down to the north. It appeared that an elevation difference of 5 to 15 feet exists across this portion of the site.

Subsurface Conditions: To investigate the subsurface conditions across the site seven (7) test holes were advanced on November 6 and 16, 2020, with a truck mounted drill rig utilizing 4-inch continuous flight augers. The approximate Test Hole locations are shown in Figure #2.

Three of the test holes were advanced in the vicinity of the existing shuttle and bus drop off points to the west of the proposed Promenade and Building B sites. Four (4) additional test holes were advanced at the approximate corners of the proposed Promenade building. Potholing with a vacuum trailer was completed in the first 3 to 4 feet of the four test holes drilled in the Promenade building to avoid existing underground utilities and snowmelt lines.

Subsurface conditions encountered across the site were variable. In Test Holes 1 to 3, located at the shuttle and bus drop off-site, the subsurface conditions generally consisted of either existing fill materials or asphalt pavement overlaying existing fill, overlying natural claystone bedrock that extended to the maximum depths investigated, 20 to 29 feet below the existing ground surface (bgs).

Subsurface conditions encountered in the vicinity of the Promenade building and Building B (Test Holes 4 to 7) were also highly variable. The subsurface conditions encountered below the brick paver system generally consisted of existing fill materials overlying natural clays and/or sands and gravels overlying claystone bedrock to the maximum depths investigated, 28 to 39 ½ feet bgs.

Graphic logs of the exploratory test holes are shown in Figures #3 and #4, and the associated Legend and Notes are presented in Figure #5 and #6.

Test Holes 1 and 2 had similar subsoil profiles. A layer of fill materials was encountered at the ground surface extending approximately 2 to 5 feet bgs. The fill material layer was underlain by natural claystone bedrock. In Test Hole 3, a layer of asphalt was encountered at the ground surface approximately 6 inches in thickness. The asphalt was underlain by aggregate base course and subbase fill materials extending to 2 feet bgs. The subbase materials were underlain by claystone bedrock consistent with Test Holes 1 and 2.

In Test Holes, 4 through 7, a brick pavement section, consisting of brick pavers underlain by wire mesh, snowmelt lines, leveling sand and fabric, was encountered at the ground surface. The pedestrian pavement section was underlain by fill materials extending to depths of approximately 9 to 14 feet bgs.

In Test Holes 4 and 6, the fill materials were underlain by natural clays that extended to depths of 20 to 24 feet bgs. The clay were underlain by natural sands and gravels that extended to a depth of 34 ½ feet in Test Hole 4 and to the maximum depth explored in Test Hole 6, 29 ½ feet bgs. The sands and gravels in Test Hole 4 were underlain by claystone bedrock, consistent with Test Holes 1-3, that extended to the maximum depth explored of 39 ½ feet bgs.

In Test Holes 5 and 7, the fill materials were underlain by natural sands and gravels that extended to the maximum depths investigated, 25 feet bgs and 29 ½ feet bgs, respectively. In Test Hole 5, practical rig refusal was encountered at 25 feet bgs in very dense sands and gravels with cobbles and boulders.

The fill materials encountered in the test holes were highly variable and ranged from sandy clays to clayey sands that were low to moderately plastic, fine to coarse grained with gravels and occasional cobbles and boulders, soft to very stiff to loose to medium dense, slightly moist to very moist, and gray to dark brown. Samples of the fill materials classified as SC and CL soils in accordance with Unified Soil Classification System (USCS).

The natural clays encountered in Test Holes 4 and 6 were slightly sandy to very sandy, low to moderately plastic, fine to coarse grained with gravels and occasional cobbles, soft to stiff, moist to wet, and light brown to brown in color. Samples of the clays classified as CL soils in accordance with the USCS

The natural sands and gravels encountered below the existing fill materials and natural clays were silty to clayey, low to non-plastic, fine to coarse grained with cobbles and occasional boulders, medium dense to very dense, moist to wet and brown to gray in color. Samples of the sands and gravels classified as SP, SC, and SM soils in accordance with the USCS.

The claystone bedrock encountered in Test Holes 1, 2, 3 and 4 was sandy to very sandy to silty, low to moderately plastic, fine to medium grained with occasional gravels, weathered to very hard, moist, and light brown in color. Samples of the claystone bedrock classified as CL soils in accordance with the Unified Soil Classification System.

Swell-consolidation testing conducted on samples of the fill materials, clays, and claystone bedrock indicates the materials tested exhibited a low to moderate swell potential when wetted under a constant load. The swell-consolidation test results are presented in Figures #7 through #10, and all additional laboratory test results are summarized in the attached Table 1.

Soil resistivity testing was conducted on a bulk sample of the clayey sand fill materials obtained from Test Holes 5 and 6 in accordance with ASTM G187. Results of resistivity testing conducted are summarized in Table A below. The soils tested exhibited values of 2,200 to 2,900 ohm-cm. Soils exhibiting a resistivity of 2,000 to 10,000 ohm-cm are rated as moderately corrosive.

TABLE A
SUMMARY OF RESISTIVITY TEST RESULTS

	Test #1	Test #2	Test #3
Ambient Air Temp (°F)	65	65	65
Moisture Content of Soil (%)	13.1	20.4	28.6
Calculated Resistivity (ohms-cm)	**2,900**	**2,500**	**2,200**

Soil ph, chloride content, and water-soluble sulfate-testing were also conducted on the bulk sample. Results of PH, chloride content and water-soluble sulfate testing conducted are summarized in Table B below. Water-soluble sulfate levels of 0.11 % are considered sulfate exposure class S1 or moderate in accordance with ACI 318-14 Table 13. Therefore, NWCC recommends the concrete to be used in the proposed buildings have Type I/Type II cement and at least 15 percent fly ash.

TABLE B
SUMMARY OF CORROSIVITY TEST RESULTS

SAMPLE LOCATION	PH	Chloride Content		Water Soluble Sulfates	
		ppm	%	ppm	%
Test Hole #5 (Bulk Sample)	7.42	105	0.011	<100	<0.01

Groundwater was not encountered at the time of drilling in Test Holes 1 through 3. However, when measured 5 days after drilling, groundwater was encountered in Test Holes 2 and 3 at depths of 24 and 12 ½ feet, respectively (approximately 6,903.4' and 6,907' elevation). Groundwater was not encountered in Test Hole 1.

Groundwater was encountered at depths of 12-29 feet bgs (6876.5'-6886.8') at the time of drilling Test Holes 4 thru 7. When measured 4 days after drilling, groundwater was encountered at depths of 9 to 14 feet bgs (6883.2'to 6891.7'). Test Holes 5 and 6 both had caved in since initial drilling at depths of 12 and 18 feet bgs, respectively.

It should be noted that the test holes were backfilled with the auger cuttings immediately after the last groundwater measurements were taken. It should be noted that the groundwater conditions at the site can be expected to fluctuate with seasonal changes in precipitation, runoff, and flows in Burgess Creek.

Based on anticipated geologic site conditions, 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.

Foundation Recommendations: Based on the subsurface conditions encountered in the test holes, the results of the field and laboratory investigations and our understanding of the proposed construction, NWCC believes an economically feasible and safe type of foundation system for the Promenade Building and Building B 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, such as 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.

Alternative Deep Foundation Recommendations: 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 or underlying bedrock materials. High capacity helical piles or pile groups with pile caps will most likely be required for the Promenade building due to proposed loadings. The helical screw pile foundations will place the bottom of the foundations in a zone of relatively stable moisture content 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 soils 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.

Alternate Shallow Foundation Recommendations: NWCC believes that a feasible shallow foundation system for the proposed buildings would consist of footings founded on undisturbed sands and gravels or on properly compacted structural fill materials placed over the natural sands and gravels after all of the existing fill materials and natural clays are removed.

The design and construction details presented below should be observed if a shallow foundation system is opted for.

1) Footings placed on the natural sands and gravels or properly compacted structural backfill materials should be designed using an allowable soil bearing pressure of 3,000 psf. No dead load is required for footings placed on sands and gravels or on properly compacted structural fill materials after the existing fill materials and clays are removed.

2) Footings or pad sizes should be computed using the above soil pressure and placed on the natural sands and gravels encountered below the fill materials and natural clays or on compacted structural fill or flow fill placed on the natural sands and gravels.

3) Any existing fill materials and the natural clays found beneath the footings when excavations are opened should be removed and footings extended down to competent sands and gravels prior to concrete or structural fill placement. Any fill materials placed beneath the footings should be a non-expansive granular soil approved by NWCC prior to placement. The fill materials placed under the footings should be uniformly placed and compacted 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, or to at least 80% of the maximum relative density in accordance with ASTM D4253/4254 if free draining gravels are used as structural fill. The structural fill materials should extend out from the edge of the footings on a 1(horizontal) to 1(vertical) or flatter slope.

4) The ultimate coefficient of friction for footing sliding can be taken as 0.4 times the vertical dead load.

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, NWCC estimates 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 #11.

8) Based on the observed water levels during exploration and assumed depths of foundation elements dewatering of the site during construction will likely be necessary.

9) NWCC must be retained by the client to observe the foundation excavations when they are near completion to identify bearing soils and confirm the recommendations in this report, as well as test the structural fill materials for compaction.

Retaining Structures and Foundation Wall Recommendations: Structural concrete retaining walls should be supported by continuous or spread footings placed directly on the undisturbed sands and gravels or on properly compacted structural fill materials. The footings should be designed using an allowable soil bearing pressure of 3,000 psf. All existing fill materials must be removed from beneath the retaining wall foundation areas.

Foundation walls and retaining structures that are laterally supported and can be expected to undergo only a moderate amount of deflection may be designed for lateral earth pressured calculated based on equivalent fluid unit weight of 45 pcf for imported, free-draining granular backfill and 55 pcf for the on-site soils.

Cantilevered retaining structures can be expected to deflect sufficiently to mobilize the full active earth pressure condition. Therefore, the 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.

The retaining structures should also 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 walls.

The lateral resistance of retaining wall foundations placed on undisturbed clays, sands and gravels or properly compacted structural fill materials 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 275 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. The imported granular materials should be placed within 2 to 3 feet of the ground surface. Imported granular soils should be free draining and have less than 5 percent passing the No. 200 sieve. The granular soils behind the 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.

The 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 over compact 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.

Floor Slabs: NWCC understands the lower levels of the buildings will most likely be constructed with concrete slab-on-grade floor systems placed from approximately 14 feet below to 3 above the existing grades. The on-site soils and bedrock, apart from existing fill 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 and/or bedrock materials 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 #12.

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 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. 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 materials 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.

6) The modulus of subgrade reaction can be taken as 200 psi/in for the natural clays, sands and gravels or properly compacted structural fill materials.

Following the above precautions and recommendations will not prevent floor slab movement in the event the 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 or remove all of the expansive materials.

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. NWCC also recommends that at least two piezometers be installed as soon as possible next spring in the proposed Promenade building so that the ground water levels during peak runoff period (April to June) can be monitored.

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 #13.

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 2(Horizontal) to 1(Vertical) configuration for the existing fill materials and natural soils.

We recommend permanent, unretained cuts be limited to 15 feet in height or less, unless stable bedrock is encountered. 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 15 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 laboratory test results, 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 (consisting of cars, shuttle buses, and full busses) 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 fill materials. 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 roadway through the facility be constructed with a minimum of 5 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 the subgrade materials be scarified and recompacted to a depth of 12 inches 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 scarification and 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.

Brick/Concrete Paver Section Recommendations: It is our understanding that the client intends to use brick or concrete pavers in the Promenade Area after construction of the new buildings. Based on the subsurface conditions encountered at the site, our understanding of the proposed construction, and experience with similar projects, we recommend that the brick/concrete pavers be constructed over 2 inches of bedding sands that are underlain by a minimum of 12 inches of aggregate base course (ABC).

The sand used for bedding should be clean concrete sand conforming to ASTM C-33 or masonry sand conforming to ASTM C-144 specifications. The ABC materials should consist of a well-graded aggregate base course material that meets CDOT Class 6 grading and durability requirements.

Prior to placement of the ABC materials, NWCC recommends that the exposed subgrade materials be scarified to a depth of at least 12 inches and be recompacted 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 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 ABC materials. Placing geotextiles and/or geogrid over the subgrade soils prior to placement of the ABC may help stabilize these areas.

The bedding sands should be compacted to at least 75% of the maximum relative density determined in accordance with ASTM D-4253/4254. The ABC materials placed below the sands should be uniformly placed and compacted in 4 to 6 inch loose lifts to at least 95 percent of the maximum modified Proctor density and within +/- 2 percent of the optimum moisture content as determined by ASTM D-1557/AASHTO T-180. A detail of the paver pavement section is provided in Figure #14.

Limitations: The recommendations provided in this report are based on the soils and bedrock materials encountered at this site and NWCC's understanding of the proposed construction. NWCC believes this information gives a high degree of reliability for anticipating the behavior of the proposed structures; however, NWCC's 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.

Swelling soils and bedrock materials were encountered at this site. These soils and bedrock materials are stable at their natural moisture content but can shrink or swell with changes in moisture. The behavior of swelling soils and bedrock materials is not fully understood. The swell or consolidation potential of a 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 swelling soils and bedrock materials. As noted previously, the owner 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 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 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 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 that the information in this report is incorporated into the plans and/or specifications and construction of the project.

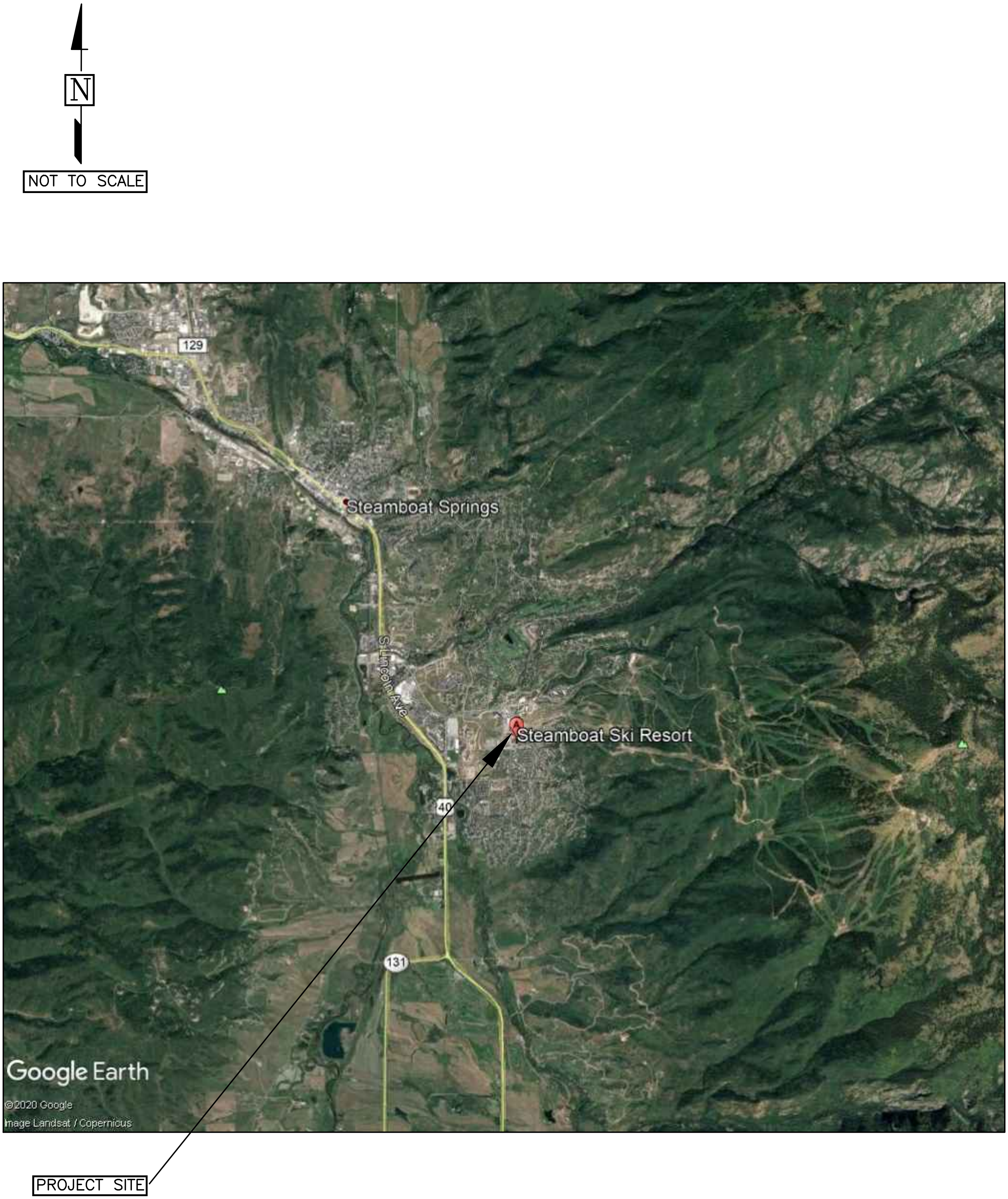
If you have any questions regarding this report or if NWCC may be of further service, please do not hesitate to contact us.

Sincerely,
NWCC, INC.

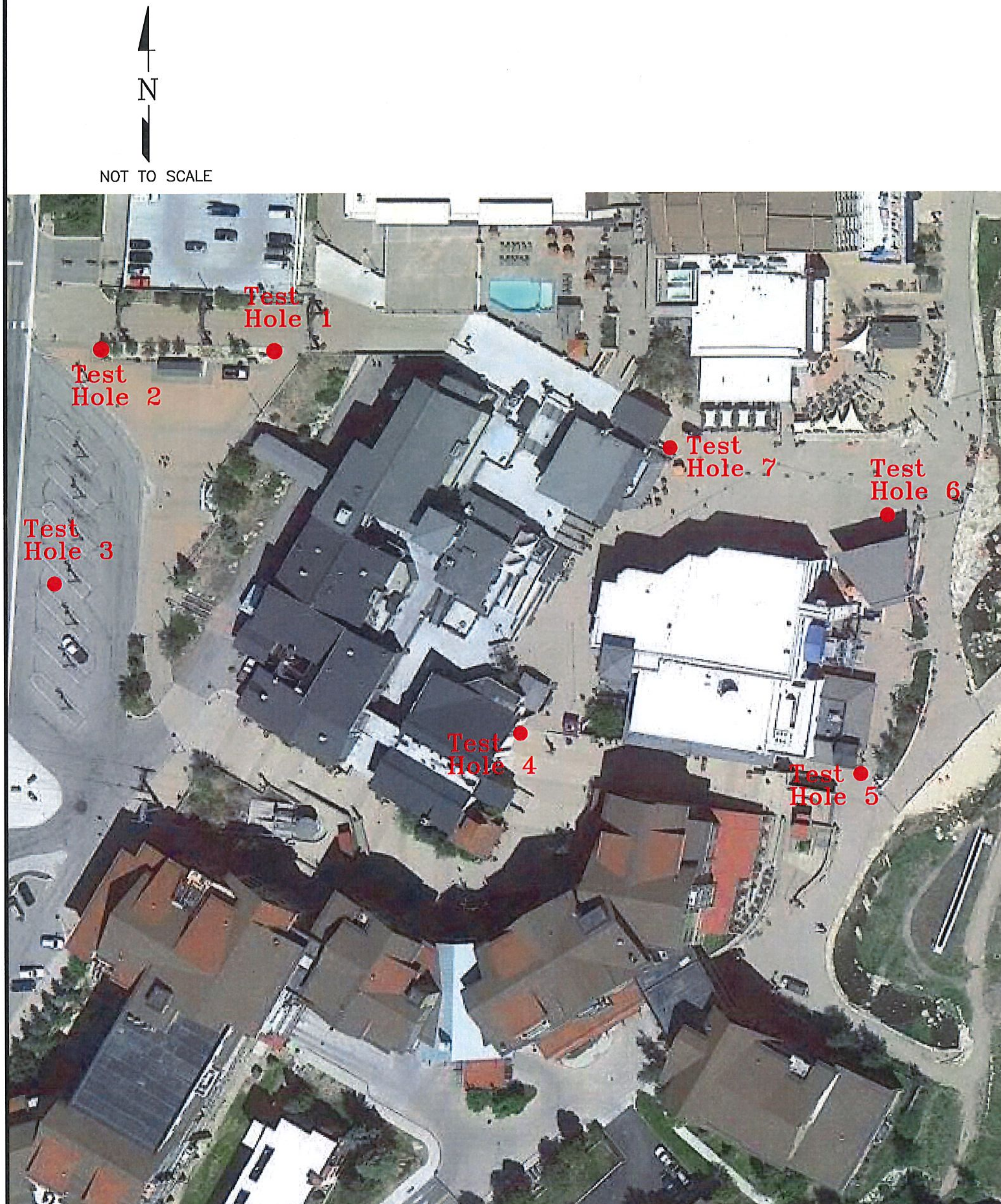
COLORADO LICENSED
BRIAN D. LEN
25750
2/10/21
PROFESSIONAL ENGINEER

Bjorn R. Utu, E.I.
Project Engineer

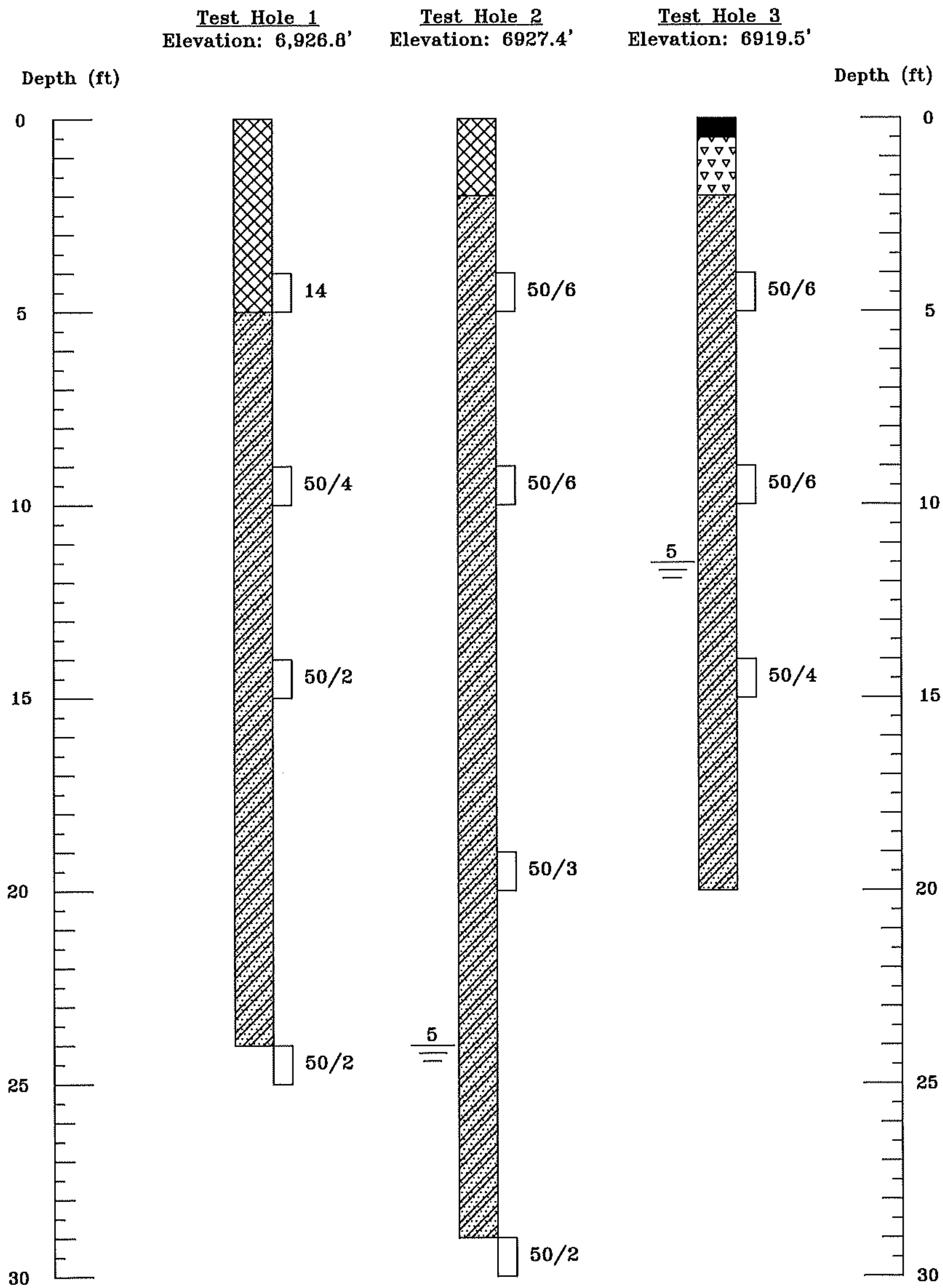
Reviewed by Brian D. Len, P.E.
Principal Engineer



Title: VICINITY MAP	Date: 12/18/2020	NWCC North West Colorado Consultants, Inc.
Job Name: Steamboat Base Area Redevelopment	Job No. 20-12000	Geotechnical / Environmental Engineering • Materials Testing
Location: Steamboat Ski Area, Steamboat Springs, Colorado	Figure #1	(970)879-7888 • Fax (970)879-7891 2580 Copper Ridge Drive • P.O. Box 775226 Steamboat Springs, Colorado 80477



Title: SITE PLAN—LOCATION OF TEST HOLES	Date: 12/18/2020	NWCC North West Colorado Consultants, Inc. Geotechnical / Environmental Engineering - Materials Testing (970)879-7888 · Fax (970)879-7891 2580 Copper Ridge Drive · P.O. Box 775226 Steamboat Springs, Colorado 80477
Job Name: Steamboat Base Area Redevelopment	Job No. 20-12000	
Location: Steamboat Ski Area, Steamboat Springs, Colorado	Figure #2	



Title: LOGS OF EXPLORATORY TEST HOLES		Date: 12/18/2020
Job Name: Steamboat Base Area Redevelopment		Job No. 20-12000
Location: Steamboat Ski Area, Steamboat Springs, Colorado		Figure #3

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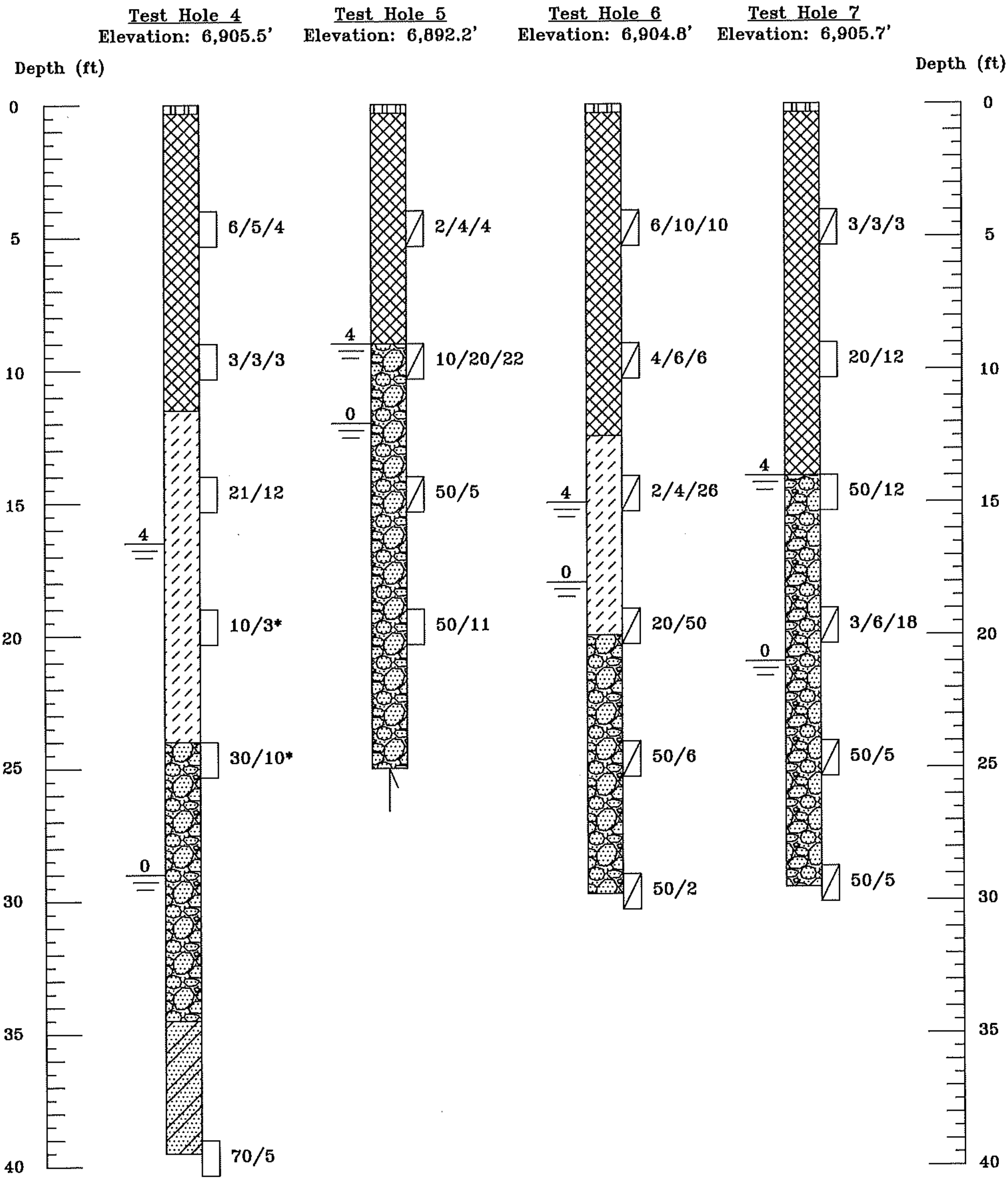

Title: LOGS OF EXPLORATORY TEST HOLES

Date: 12/18/2020

Job Name: Steamboat Base Area Redevelopment

Job No. 20-12000

Location: Steamboat Ski Area, Steamboat Springs, Colorado

Figure #4

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LEGEND:

BRICK PAVER UNDERLAIN BY: WELDED WIRE MESH, SNOWMELT LINE AND LEVELING SAND.

ASPHALT PAVEMENT.

FILL: Aggregate Base Course and Subbase Aggregate.

FILL: Sandy clays to clayey sands, low to moderately plastic, fine to coarse grained with gravels and occasional cobbles and boulders, soft to very stiff to loose to medium dense, slightly moist to very moist and gray to dark brown.

CLAYS: Slightly sandy to very sandy, low to moderately plastic, fine to coarse grained with gravels and occasional cobbles, soft to stiff, moist to wet and light brown to brown.

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

CLAYSTONE BEDROCK: Sandy to very sandy to silty, low to moderately plastic, fine to medium grained with occasional gravels, weathered to very hard, slightly moist to moist and light brown in color.

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

Drive Sample, Split Spoon Sampler.

35/12 Drive Sample Blow Count, indicates 35 blows of a 140-pound hammer falling 30 inches were required to drive the sampler 12 inches.
*Indicates hammer was bouncing on a suspected cobble or boulder.

3/5/20 Drive Sample Blow Count, indicates split spoon sampler with 3,5, and 20 blows of a 140-pound hammer falling 30 inches were required to drive the sampler 6 inches.

0,4,5 Indicates depth at which groundwater was encountered when measured at time of drill and when measured 4 or 5 days after drilling.

Indicates depth at which practical rig refusal was encountered in very dense cobbles and boulders.

Title: LEGEND AND NOTES	Date: 12/18/2020	North West Colorado Consultants, Inc.
Job Name: Steamboat Base Area Redevelopment	Job No. 20-12000	Geotechnical / Environmental Engineering · Materials Testing
Location: Steamboat Ski Area, Steamboat Springs, Colorado	Figure #5	(970)879-7888 · Fax (970)879-7891 2580 Copper Ridge Drive · P.O. Box 775226 Steamboat Springs, Colorado 80477

NOTES:

1) Test holes 1–3 were drilled on November 6, 2020 and test holes 4–7 on November 16, 2020 respectively with an all terrain drill rig using 4–inch diameter continuous flight power augers.

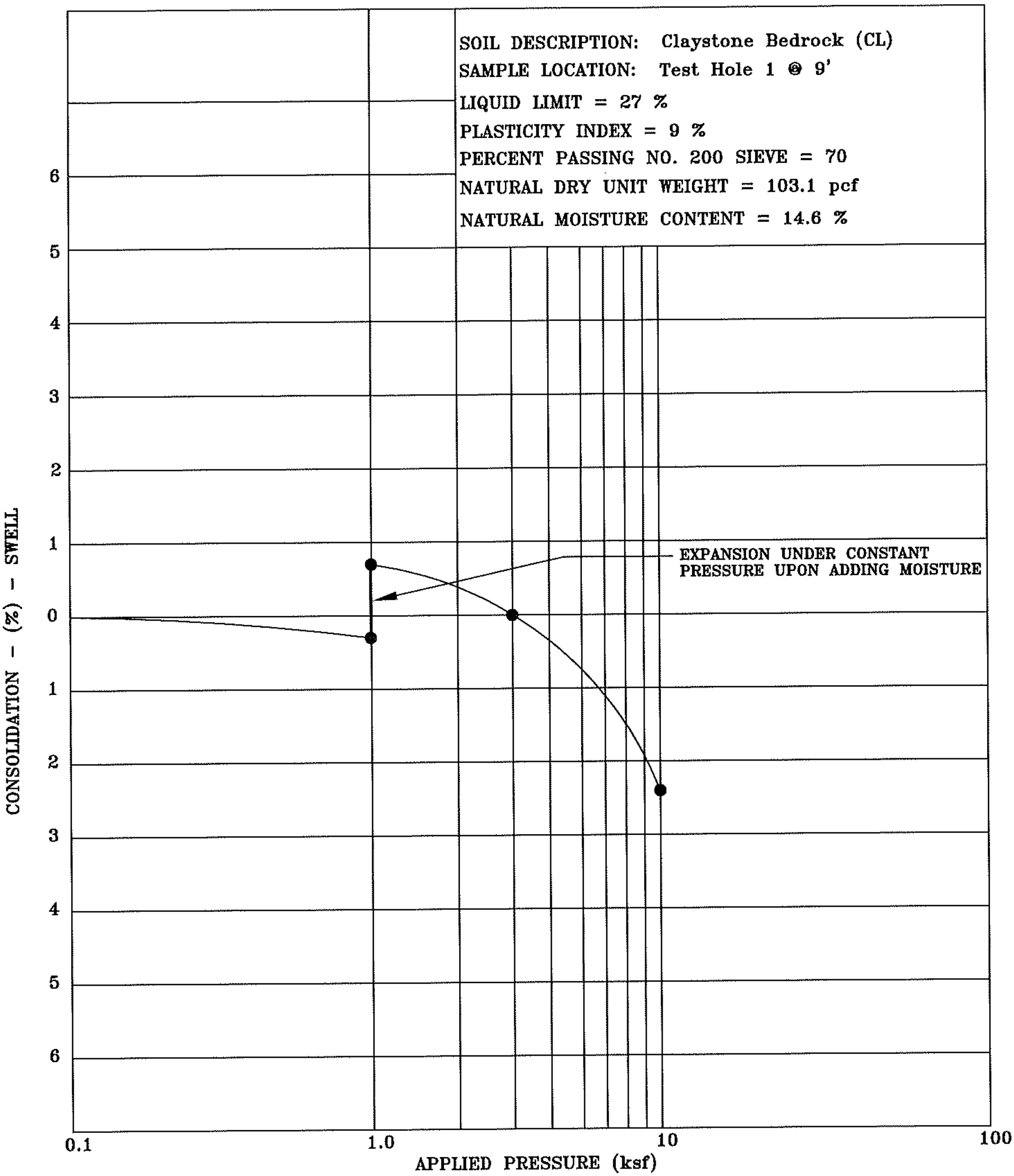
2) Locations of the test holes were determined in the field by pacing from existing features at the site.

3) Elevations of the test holes were determined by Landmark Consultants.

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: 12/18/2020	North West Colorado Consultants, Inc. Geotechnical / Environmental Engineering · Materials Testing (970)879-7888 · Fax (970)879-7891 2580 Copper Ridge Drive · P.O. Box 775226 Steamboat Springs, Colorado 80477
Job Name: Steamboat Base Area Redevelopment	Job No. 20–12000	
Location: Steamboat Ski Area, Steamboat Springs, Colorado	Figure #6	



Title: SWELL–CONSOLIDATION TEST RESULTS	Date: 12/18/2020
Job Name: Steamboat Base Area Redevelopment	Job No. 20–12000
Location: Steamboat Ski Area, Steamboat Springs, Colorado	Figure #7

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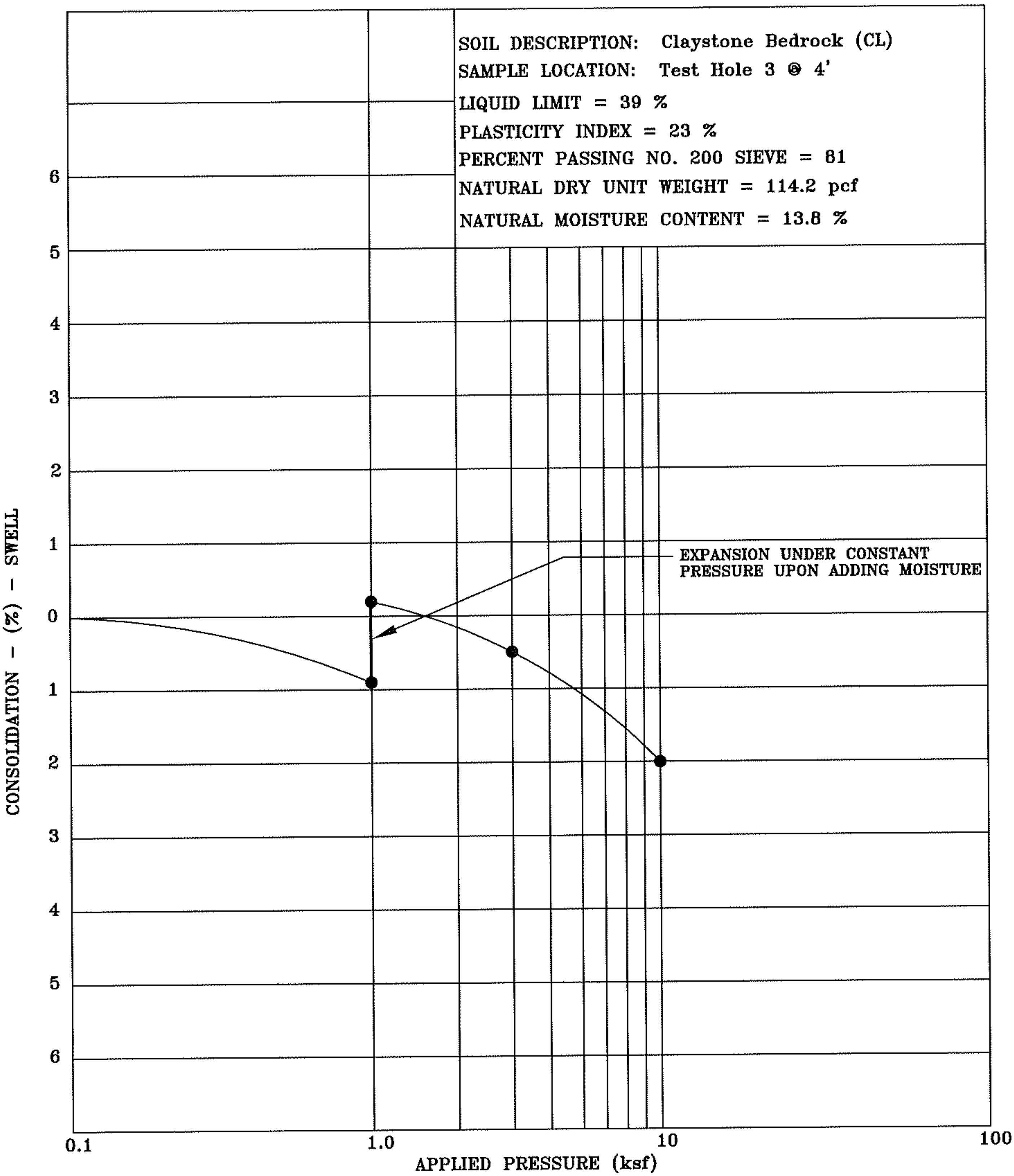

Title: SWELL–CONSOLIDATION TEST RESULTS	Date: 12/18/2020
Job Name: Steamboat Base Area Redevelopment	Job No. 20–12000
Location: Steamboat Ski Area, Steamboat Springs, Colorado	Figure #8

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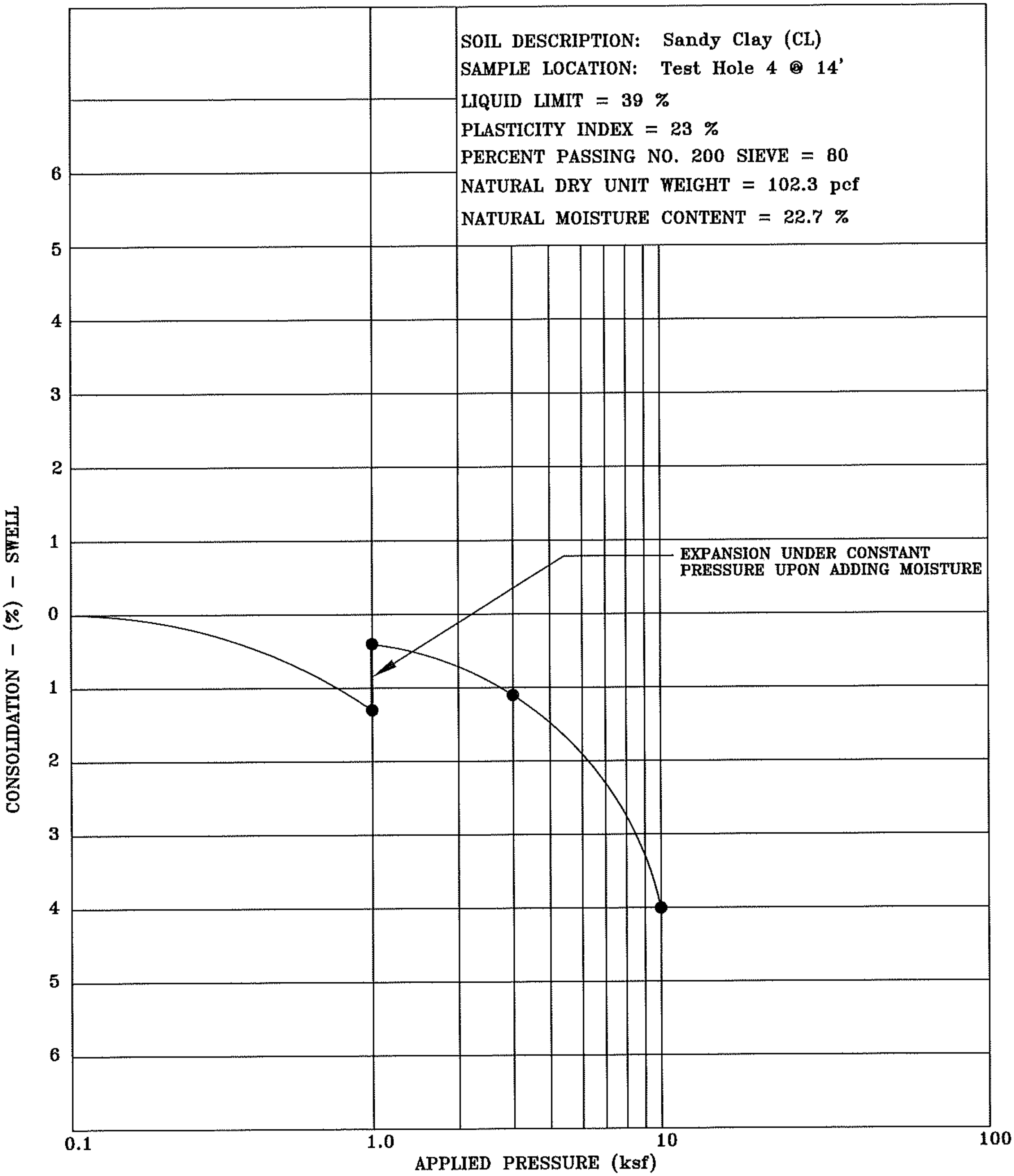

Title: SWELL-CONSOLIDATION TEST RESULTS

Date: 12/18/2020

Job Name: Steamboat Base Area Redevelopment

Job No. 20-12000

Location: Steamboat Ski Area, Steamboat Springs, Colorado

Figure #9

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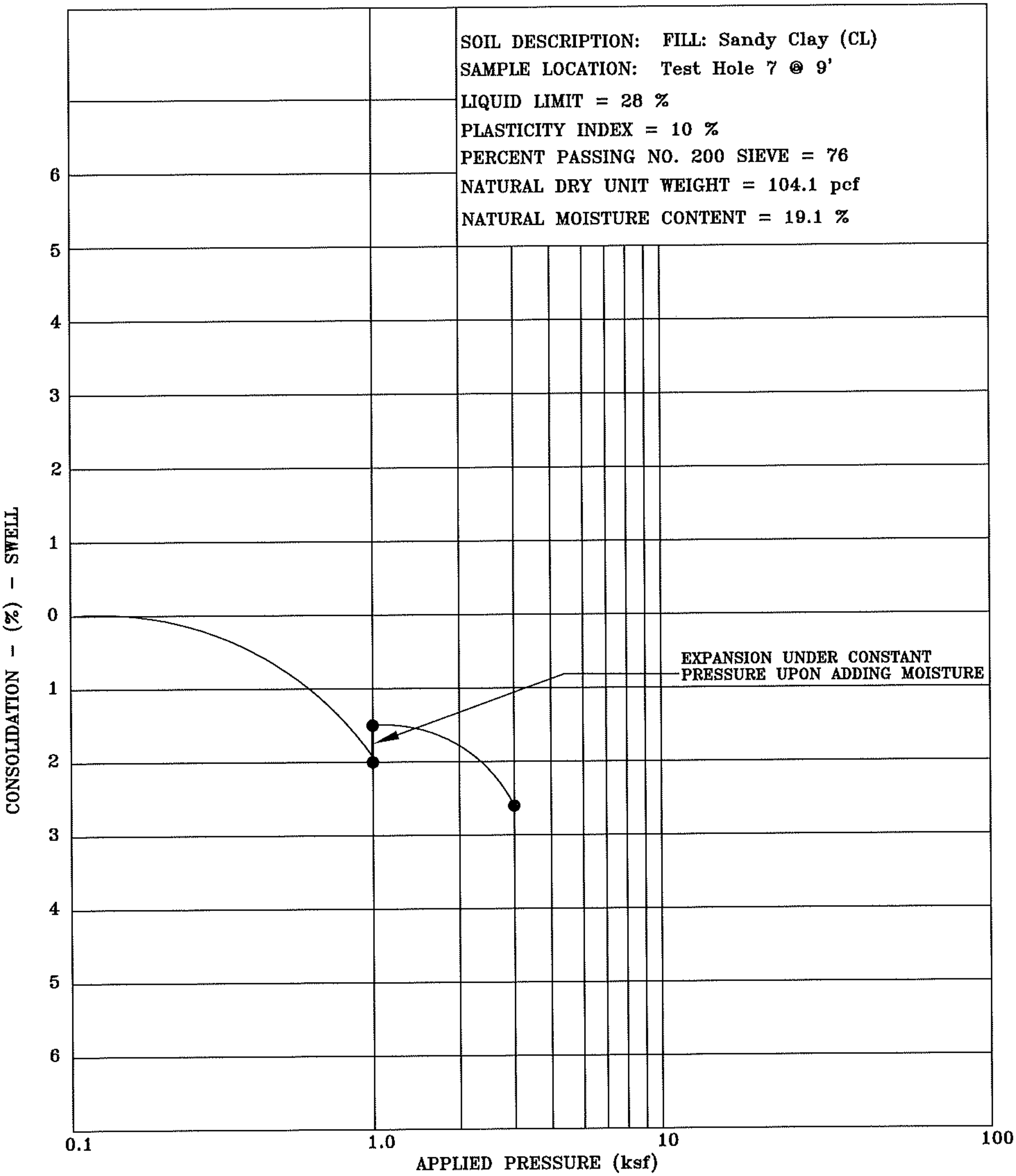
SOIL DESCRIPTION: FILL: Sandy Clay (CL)
SAMPLE LOCATION: Test Hole 7 @ 9'
LIQUID LIMIT = 28 %
PLASTICITY INDEX = 10 %
PERCENT PASSING NO. 200 SIEVE = 76
NATURAL DRY UNIT WEIGHT = 104.1 pcf
NATURAL MOISTURE CONTENT = 19.1 %



Title: SWELL-CONSOLIDATION TEST RESULTS	Date: 12/18/2020
Job Name: Steamboat Base Area Redevelopment	Job No. 20-12000
Location: Steamboat Ski Area, Steamboat Springs, Colorado	Figure #10

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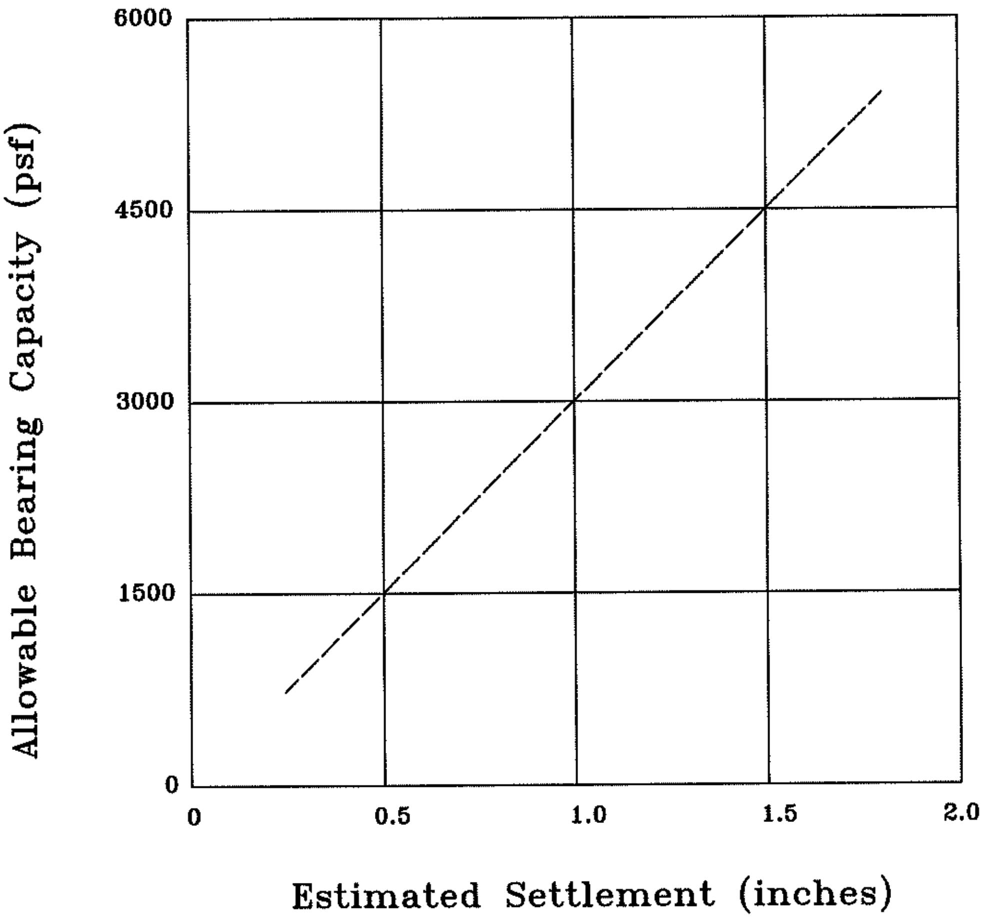
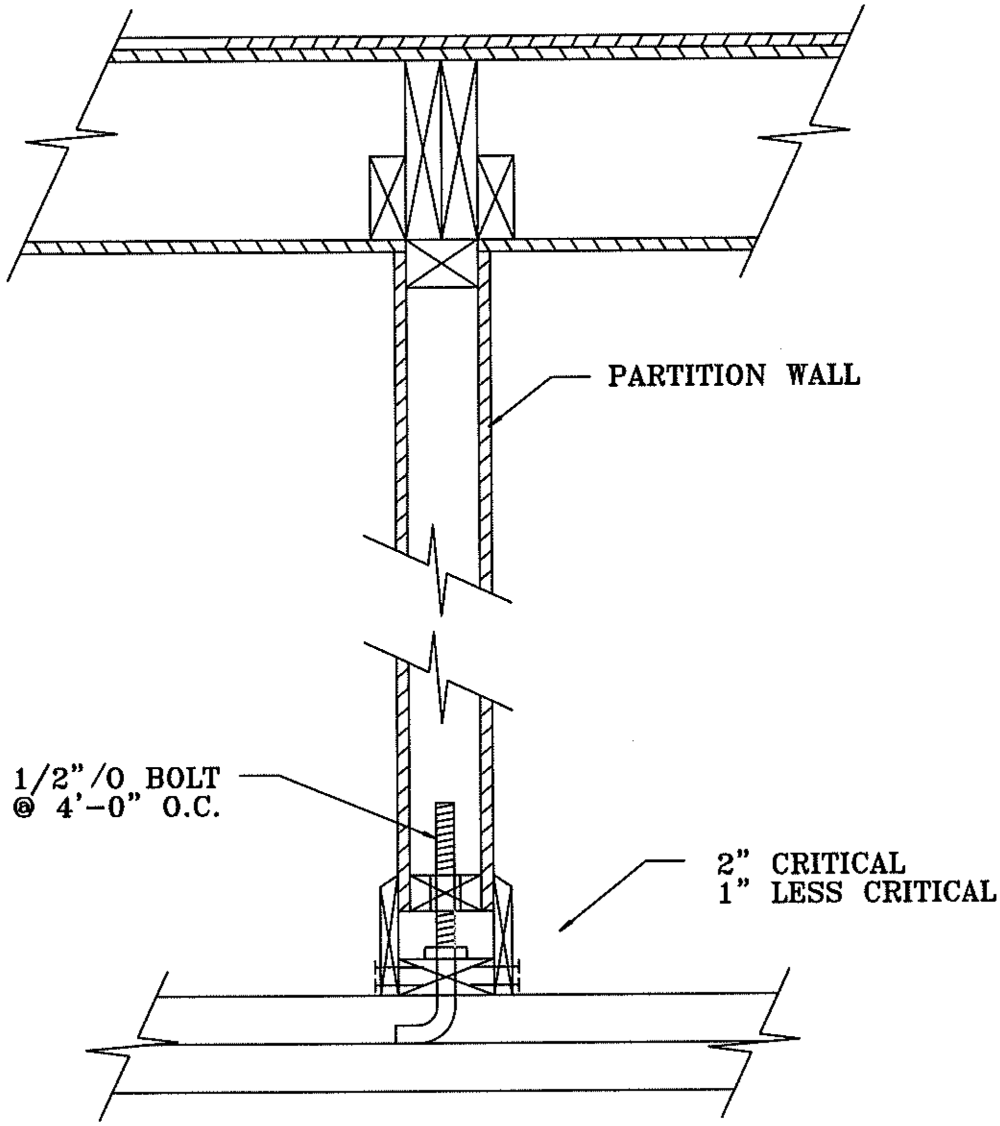


Note: These values are based on footing widths of 1 to 4 feet. If the footing width is to be greater than 4 feet in width, then we should be notified to re-evaluate these recommendations.

Title: BEARING CAPACITY CHART	Date: 12/18/2020	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 Base Area Redevelopment	Job No. 20-12000	
Location: Steamboat Ski Area, Steamboat Springs, Colorado	Figure #11	



Title: HUNG PARTITION WALL DETAIL	Date: 12/18/2020
Job Name: Steamboat Base Area Redevelopment	Job No. 20-12000
Location: Steamboat Ski Area, Steamboat Springs, Colorado	Figure #12

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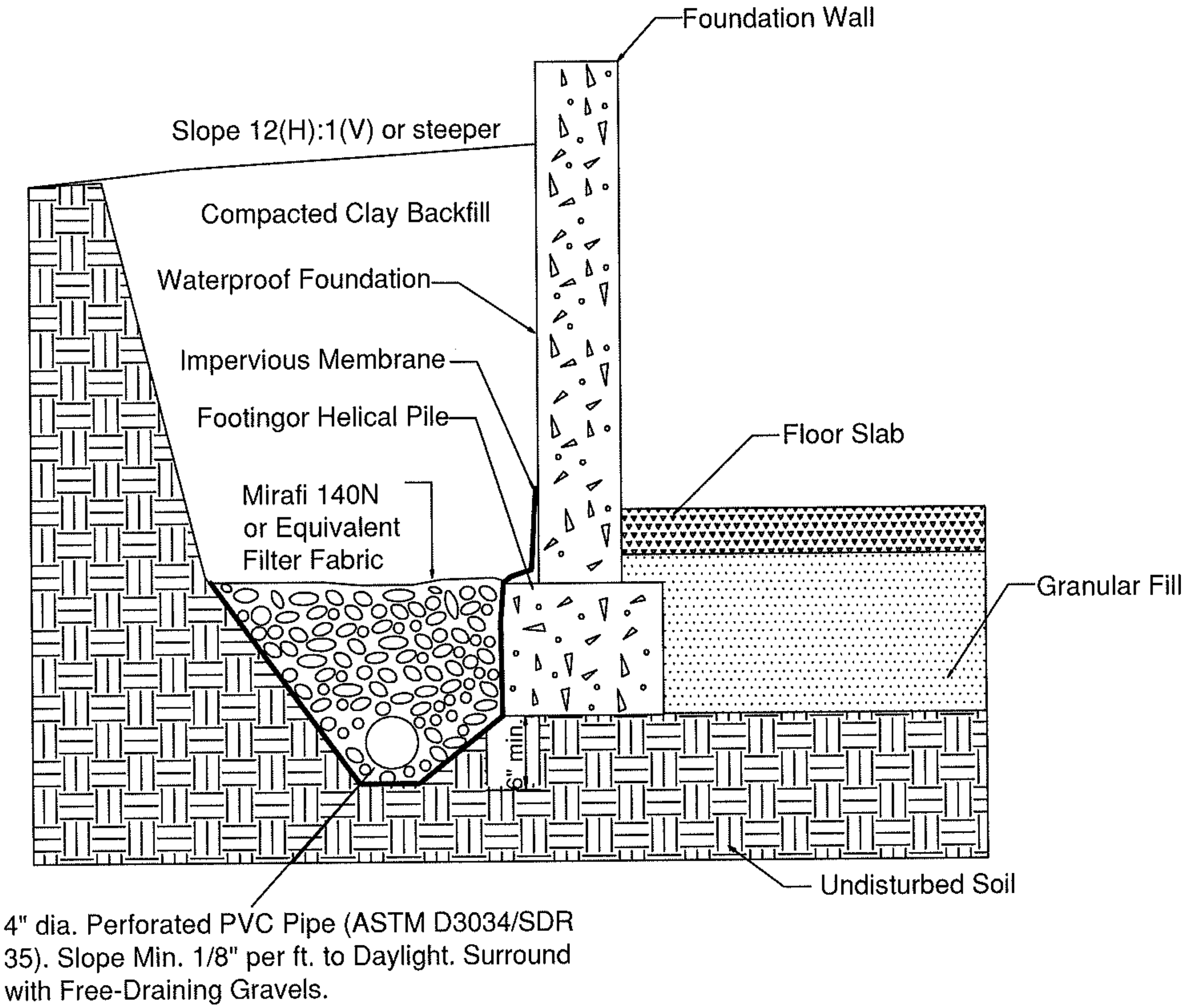
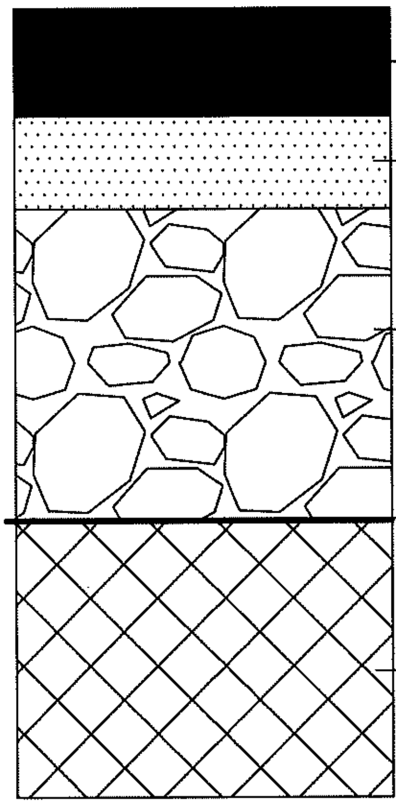


Title: PERIMETER/UNDERDRAIN DETAIL	Date: 12/18/2020	North West Colorado Consultants, Inc. Geotechnical / Environmental Engineering · Materials Testing (970)879-7888 · Fax (970)879-7891 2580 Copper Ridge Drive Steamboat Springs, Colorado 80487
Job Name: Steamboat Base Area Redevelopment	Job No. 20-12000	
Location: Steamboat Ski Area, Steamboat Springs, Colorado	Figure #13	



Brick Pavers

2-Inches of ASTM D-33 Concrete Sand Compacted to at least 75% of Maximum Relative Density

12-Inches of CDOT Class 6 ABC - Place in 6 inch loose lifts and compact to at least 95% of Modified Proctor Density.

Geotextile and/or Geogrid may be required over scarified and recompacted subgrade soils if unstable or can't meet compaction

Exposed Subgrade Soils - Scarify 12 inches, moisture condition and reompact to at least 95% of Standard Proctor Density

Title: BRICK PAVER CROSS SECTION	Date: 12/18/2020	NWCC North West Colorado Consultants, Inc. Geotechnical / Environmental Engineering · Materials Testing
Job Name: Steamboat Base Area Redevelopment	Job No. 20-12000	(970)879-7888 · Fax (970)879-7891 2580 Copper Ridge Drive Steamboat Springs, Colorado 80487
Location: Steamboat Ski Area, Steamboat Springs, Colorado	Figure #14	

NWCC, Inc.

TABLE 1

SUMMARY OF LABORATORY TEST RESULTS

SAMPLE LOCATION		NATURAL MOISTURE CONTENT (%)	NATURAL DRY DENSITY (pcf)	ATTERBERG LIMITS		GRADATION		PERCENT PASSING No. 200 SIEVE	UNCONFINED COMPRESSIVE STRENGTH (psf)	SOIL or BEDROCK DESCRIPTION	UNIFIED SOIL CLASS.
TEST HOLE	DEPTH (feet)			LIQUID LIMIT (%)	PLASTICITY INDEX (%)	GRAVEL (%)	SAND (%)				
1	9	14.6	103.1	27	9	1	29	70		Claystone Bedrock	CL
2	19	10.7	118.0	36	22	1	27	72	26,350	Claystone Bedrock	CL
3	4	13.8	114.2	39	23	0	19	81		Claystone Bedrock	CL
4	14	22.7	102.3	39	23	0	20	80		Sandy Clay	CL
4	24	11.4		22	3	4	76	20		Silty Sand	SM
4	39	16.0	110.3	28	10	0	36	64	16,190	Claystone Bedrock	CL
5	14	14.5			NP	7	80	13		Silty Sand	SM
5	19	11.4			NP	38	56	6		Very Gravelly Sand	SP
6	4	20.8		26	9	21	45	34		FILL: Clayey Gravelly Sand	SC
6	14	18.0		26	10	11	50	39		Very Clayey Sand	SC
7	9	19.1	104.1	28	10	4	20	76		FILL: Sandy Clay	CL
7	19	16.5		24	9	18	52	30		Gravelly Clayey Sand	SC
7	29	14.1		22	3	34	51	15		Gravelly Silty Sand	SM

NP = Non Plastic

JOB NUMBER: 20-12000