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

December 6, 2021

Steamboat Ski and Resort Corp.
Lance Miles
2305 Mt Werner Circle
Steamboat Springs, CO 80847

Job Number: 21-12412

Subject: Subsoil and Foundation Investigation, Christie Peak Express Lift, Steamboat Ski Resort, Steamboat Springs, Colorado.

Lance,

This report presents the results of the Subsoil and Foundation Investigation (SFI) for the proposed Christie Peak Express Lift Base and Mid-station Relocation at the Steamboat Ski Resort in Steamboat Springs, Colorado. The approximate location of the project site is shown in Figure #1.

NWCC, Inc.'s (NWCC) scope of work included obtaining data from cursory observations made at the site, logging of four 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.

Proposed Construction: NWCC understands the existing Christie Express Chairlift (CPX) base terminal and midstation will be moved to allow for construction of a new gondola. It is our understanding that the CPX mid-station will be rotated to accommodate the new base terminal location. Based on the preliminary site plan provided by ESA Architecture and observations of existing topography, it appears that cuts of 15 to 20 feet may be required at the base of CPX.

For design purposes, NWCC has assumed that building loads will be moderate, 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.

Site Conditions: The proposed CPX base terminal site is located south of the existing CPX base terminal, north of the existing gondola base terminal, and south of the existing mini golf course at the Steamboat Ski Resort. Extensive regrading of the slope has been previously completed in the area. Burgess Creek runs north to south to the west and downhill of the proposed base building site. This creek was resurfaced in recent history and previously was located farther east.

Vegetation at the proposed base terminal site generally consists primarily of grasses and weeds. Topography of the site is variable and generally slopes moderately down to the west on the order of 12 to 15 percent. An elevation difference of approximately 15 to 20 feet appears to exist across the proposed base terminal building site.

Vegetation at the mid-station generally consists of weeds and grasses. The grading at the existing mid-station site appears to consist of entirely fill placement with fill depths ranging from 1 to 20 feet in height. The embankment fill slopes generally slope steeply away from the existing mid-station to the south, west and north. The embankment fill slopes situated to the south and west of the mid-station appear stable; however, it appears that slope stabilization, consisting of the placement of boulders, has occurred at the base of the embankment fill slope along the north side of the mid-station. It also appears that settlement of the fill materials has occurred beneath the lift shack. It appears that additional wood blocking has been placed under the shack to try and level it out.

Subsurface Conditions: To investigate the subsurface conditions at the site, four test holes were drilled at the site on September 14 and 15, 2021 with a track-mounted drill rig using 4-inch diameter continuous flight augers. Site plans showing existing features along with the approximate test hole locations are presented in Figures #2 and #3.

Subsurface conditions encountered at both the base terminal and mid-station building sites were highly variable and generally consisted of a layer of fill materials overlying natural clays overlying sands and gravels overlying bedrock materials. The maximum depth investigated was 30 feet beneath existing ground surface (bgs). Graphic logs of the exploratory test holes are presented in Figure #4, and associated Legend and Notes are presented in Figure #5.

Fill materials were encountered at the ground surface in all four of the test holes and extended to depths of 8 feet bgs in Test Hole 1, 7 feet bgs in Test Hole 2, 12 feet bgs in Test Hole 3 and 14 ½ feet bgs in Test Hole 4. Fill materials consisted of sandy gravelly clays that were low to moderately plastic, fine to coarse grained with gravels and occasional cobbles, soft to stiff, moist and gray to dark brown in color.

Natural clays were encountered below the fill materials in Test Holes 1, 2 and 4. Natural clays extended to 16 feet bgs in Test Hole 1, 23 feet bgs in Test Hole 2 and 30 feet bgs in Test Hole 4, which was the maximum depth drilled. The clays were nil to very sandy, moderately to highly plastic, fine to coarse grained with occasional gravels, stiff to very stiff, moist and brown to light brown to reddish brown in color. Samples of the natural clays classified as CL soils in accordance with the Unified Soil Classification System (USCS).

Natural sands and gravels were encountered beneath the clays in Test Holes 1 and 2. The sands and gravels encountered were silty to clayey, low to non-plastic, fine to coarse grained with cobbles, dense, moist to wet and brown to gray in color.

The bedrock materials encountered in Test Holes 1 and 3 consisted of interbedded layers of sandstone, claystone and conglomerate bedrock of the Browns Park Formation. The bedrock materials were low to moderately plastic, fine to coarse grained with cobbles, hard slightly moist to wet and light brown to reddish brown in color. Samples of the sandstone and conglomerate bedrock classified as SM and SC soils in accordance with the USCS.

Swell-consolidation tests conducted on samples of the natural clays indicate the materials tested exhibited low to high swell potentials when wetted under a constant load. A swell-consolidation test conducted on a sample of the sandstone bedrock indicates the material tested exhibited a very low swell potential when wetted under a constant load. The swell-consolidation test results are presented in Figures #6, #7 and #8, and all other laboratory test results are summarized in the attached Table 1.

Water soluble sulfate (WSS), chloride content, resistivity and pH testing will be completed on bulk samples to evaluate corrosivity of the soils to metal and cement. Final corrosivity test results including WSS, chloride content and pH testing will be included in the final draft of this report.

Groundwater was encountered in Test Hole 1 at 19 ½ feet bgs at the time of drilling. Groundwater was encountered at 17 feet bgs in Test Hole 1 and at 22 ½ feet bgs in Test Hole 3 when measured 10 days after drilling. A trace of groundwater was encountered at 30 feet bgs in Test Hole 4 when measured 10 days after drilling. It should be noted that the groundwater conditions at the site can be expected to fluctuate with seasonal changes in precipitation and runoff.

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 would consist of straight-shaft skin friction/end bearing piers drilled through the overburden soils and into the underlying bedrock materials. Foundation movement less than ½ inch should be within tolerable limits if the following design and construction precautions are observed.

1) A minimum pier diameter of 16 inches, a minimum pier length of 20 feet and a minimum bedrock penetration of 6 feet are recommended. A maximum pier length to diameter ratio of 25 is also recommended.

2) Piers should be designed using an allowable skin friction value of 900 psf for the portion of the pier penetrating the natural, undisturbed overburden soils and an allowable skin friction value of 4,000 psf for the portion of the pier penetrating the competent bedrock materials. The upper 5 feet of penetration into the natural soils and all penetration in the fill materials should be neglected in the skin friction calculations. A drill rig of sufficient size, type and operating condition should be used so bottom of the piers can be cleaned out properly and minimum length requirements can be met. If bottom of piers are properly cleaned and approved by an engineer from this office, then an allowable end bearing pressure of 40,000 psf for the bedrock materials may be used in the design.

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

4) Piers should be properly cleaned and dewatered prior to steel and concrete placement. Groundwater and granular soils were encountered in the test holes; therefore, temporary casing and dewatering equipment will most likely be required to reduce water infiltration and caving. The concrete should not be placed in more than 3 inches of water unless the tremie or pump methods are used.

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

6) A representative of NWCC must observe pier drilling operations.

Alternate Deep Foundation Recommendations: An alternative foundation system to the drilled piers would be a helical pile foundation system advanced into the underlying clays, sands and gravels or bedrock materials. 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 both the base terminal and mid-station sites 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. A representative of this office should observe the test piles, load test and helical screw pile installations.

NWCC also recommends the following:

- Minimum 6-inch diameter helix;
- Minimum penetration of 8 feet between upper helix and ground surface;
- Minimum installation torque of 5,000 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;
- Refusal in fill materials is not acceptable.

Alternate Shallow Foundation Recommendations: If the owner is aware of the risks associated with placing shallow foundations on expansive soils and can tolerate and/or design for differential movements that could result if the natural clays or bedrock materials become wetted and swell, the structure may be supported by spread footings founded on undisturbed natural clays, sands and gravels or bedrock materials or on properly compacted structural fill materials placed over the natural soils or bedrock materials.

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

1) Footing excavations should be extended through the existing fill materials and any topsoil and organic materials, and down to natural clays, sands and gravels, or bedrock materials, which were encountered from approximately 7 to 14 ½ feet beneath the existing ground surface in the test holes. Deeper fill materials may be encountered at the western edge of the mid-station.

2) Footings placed on the natural clays, sands and gravels or bedrock materials should be designed using an allowable soil bearing pressure of 3,500 psf. Footings placed on properly compacted structural fill materials should be designed using a maximum allowable soil bearing pressure of 2,500 psf. Footings placed on the natural clays or bedrock materials should also be designed using a minimum dead load pressure of at least 1,000 psf. No dead load is required for footings placed on natural sands and gravels or on structural fill materials placed over the sands and gravels.

3) Footings or pad sizes should be computed using the above soil pressures and placed on the natural clays, sands and gravels, and bedrock materials encountered below the topsoil and organic materials and existing fill materials.

4) Any topsoil and organic materials, existing fill materials or soft natural clays found beneath the footings when excavations are opened should be removed and footings extended down to competent natural clays, sands and gravels or bedrock materials prior to structural fill or concrete placement. Footings placed on the clays and bedrock materials may have to be narrow or interrupted to maintain the minimum dead load. Foundation design should be closely checked to assure that it distributes loads per the allowable pressures given.

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) Structural fill materials should consist of a non-expansive granular soil approved by NWCC. If groundwater is encountered in the footing excavations, NWCC recommends that clean gravel fill materials meeting the gradation specifications for Colorado Department of Transportation (CDOT) Class A or Class B Filter Materials be used. 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. Structural fill materials should extend out from the edge of the footings or mats on a 1(horizontal) to 1(vertical) or flatter slope.

8) 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 Figures #9 and #10.

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 placed beneath the footings 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 clays or sands, gravels, cobbles and boulders. The footings placed on the natural soils or bedrock materials should be designed using an allowable soil bearing pressure of 3,500 psf. Footings placed on structural fill materials placed over the natural soils should be designed using a maximum allowable soil bearing pressure of 2,500 psf. All of the existing fill materials and any topsoil and organic materials encountered within the excavations must be removed from beneath the wall foundation areas. Structural fill materials should extend out from the edge of footings on a 1 (horizontal) to 1(vertical) or flatter slope.

An engineer from this office must observe the foundation excavation prior to placement of formwork and reinforcing steel to verify the soil conditions exposed in the base of the excavations and the fill materials placed beneath the footings must be tested for compaction.

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 a lateral earth pressured calculated based on an equivalent fluid unit weight of 45 pcf for imported, free draining granular backfill and 60 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 50 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 retaining walls.

The lateral resistance of retaining wall foundations placed on undisturbed natural soils 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 to 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 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 overcompact the backfill since this could cause excessive lateral pressure on the walls. Some settlement of deep foundation wall backfill materials will occur even if the material is placed correctly.

Floor Slabs: On-site soils, apart from the existing fill 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 be subjected to moisture changes.

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

2) Interior non-bearing partition walls resting on the floor slabs must be provided with a slip joint at either the top or bottom of the wall, 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. A typical detail for the slip joint at the bottom of the wall is shown in Figure #11. If a slip joint at the top of the wall is used, a detail should be provided to NWCC for review.

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 topsoil and organic materials and all of the 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.

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.

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

Localized perched water or runoff can infiltrate the lower levels of the 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.

Drains should be located around entire perimeter of the lower levels and be placed and at least 12 inches below any floor slab and at least 6 inches below the foundation voids and 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 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 through the voided areas and/or under footings and/or foundation walls. Barrier should be constructed of an impervious material, which is approved by this office and placed below the perimeter drain and up against the sides of the foundation walls. A typical perimeter/underdrain detail is shown in Figure #12.

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

Site Grading: The slopes on which the proposed structures are proposed could become unstable due to the proposed construction. Design and construction considerations must be addressed to avoid and/or limit the potential for slope instability at the site. Although a detailed slope stability analysis is beyond the scope of this report, some general guidelines are provided below for initial planning and design.

Our office should review the construction plans as they are being prepared so that we can verify that our recommendations are being properly incorporated into the plans. Additional recommendations and/or investigations may be warranted to provide additional information for the design and construction of temporary or permanent shoring and slope stabilization structures. Slope reinforcement should be designed and constructed by engineers and contractors experienced in earth retention systems.

1) Slopes greater than 25 percent should be avoided whenever possible for construction of permanent structures.

2) 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 ½ (Horizontal) to 1(Vertical) configuration for the existing fill materials and a 2(Horizontal) to 1(Vertical) configuration for the underlying natural soils. Steeper cut slopes are not recommended for permanent, unretained cuts without additional stabilization measures, such as soil nails or unless competent bedrock is encountered in the cuts. Additional stabilization measures are typically designed by a design contractor with experience in this field.

   We recommend permanent, unretained cuts be limited to 20 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.

3) 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 very heavy.

4) Fills up to 20 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 have been removed. The fill materials should consist of the on-site soils (exclusive of topsoil and 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.

5) 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.

6) 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.

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 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/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 soils and bedrock materials. Performance of the structure 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.

Erika K. Hill, P.E., P.G.
Project Engineer

COLORADO LICENSED BRIAN D. LEN 25750 PROFESSIONAL ENGINEER 12/6/2021

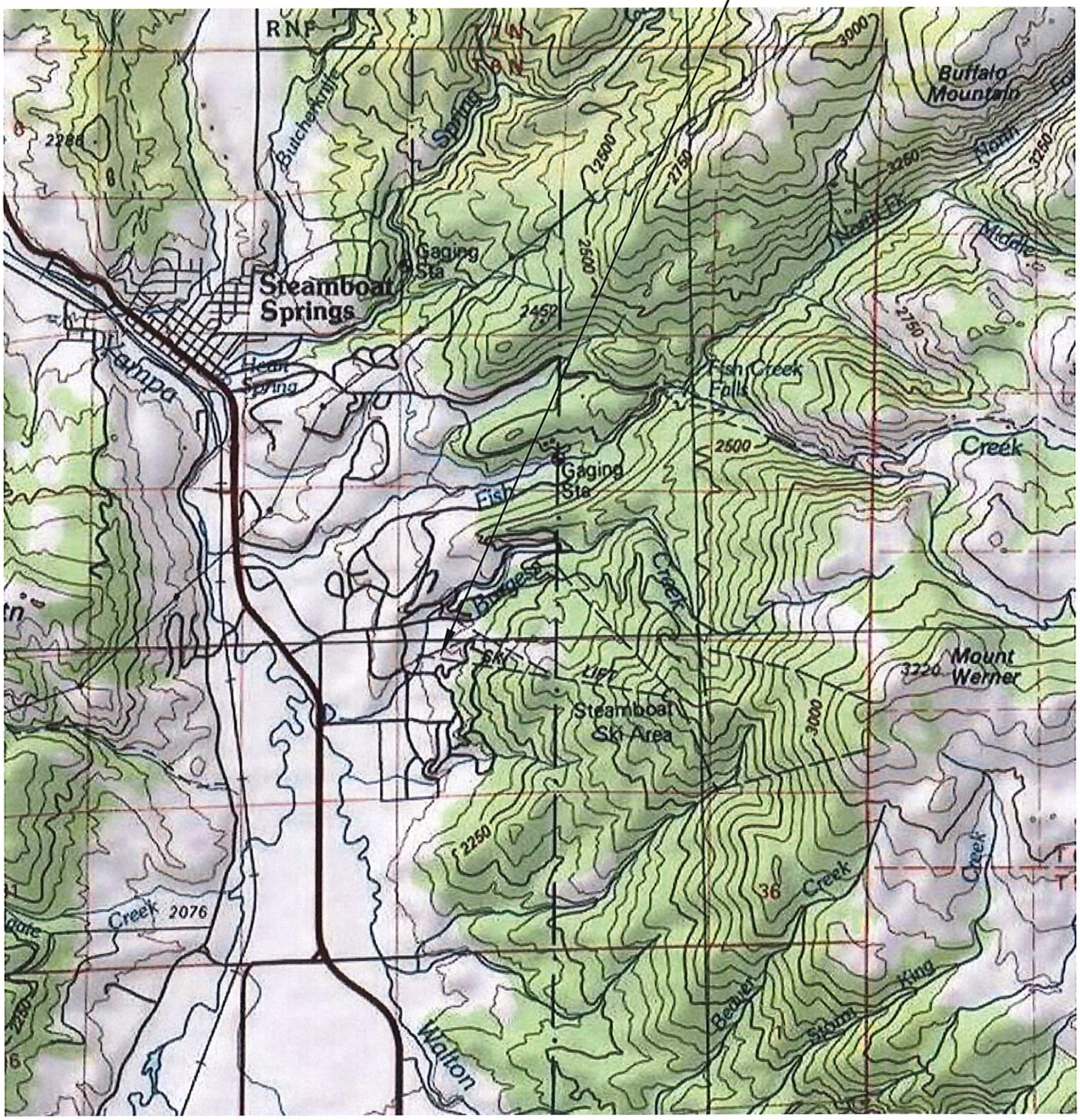
Reviewed by Brian D. Len, P.E.
Principal Engineer

cc: Kate Leggett – ESA
John Albright - SSRC
Erik Griepentrog - Landmark Consultants

N

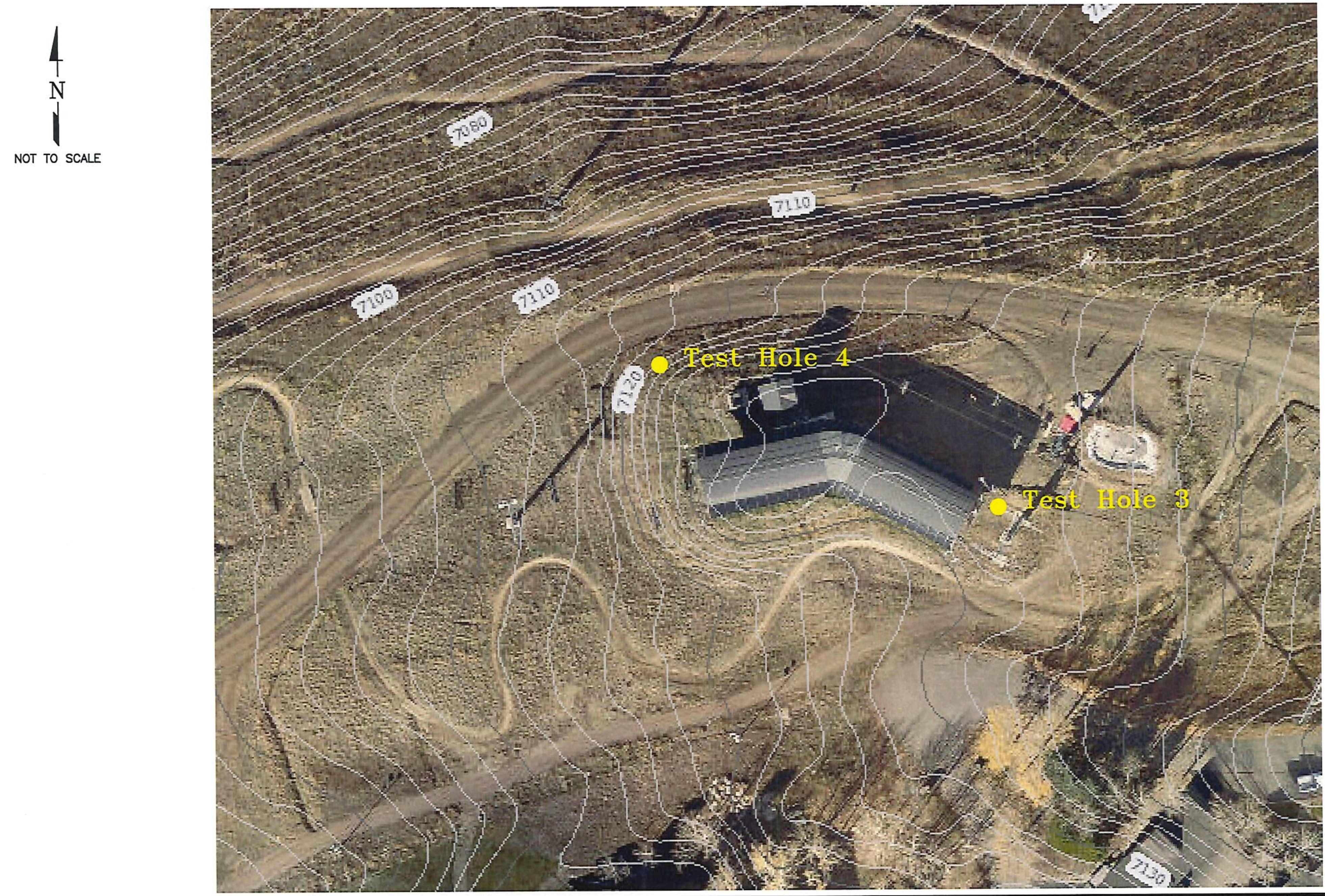
NOT TO SCALE

PROJECT SITE

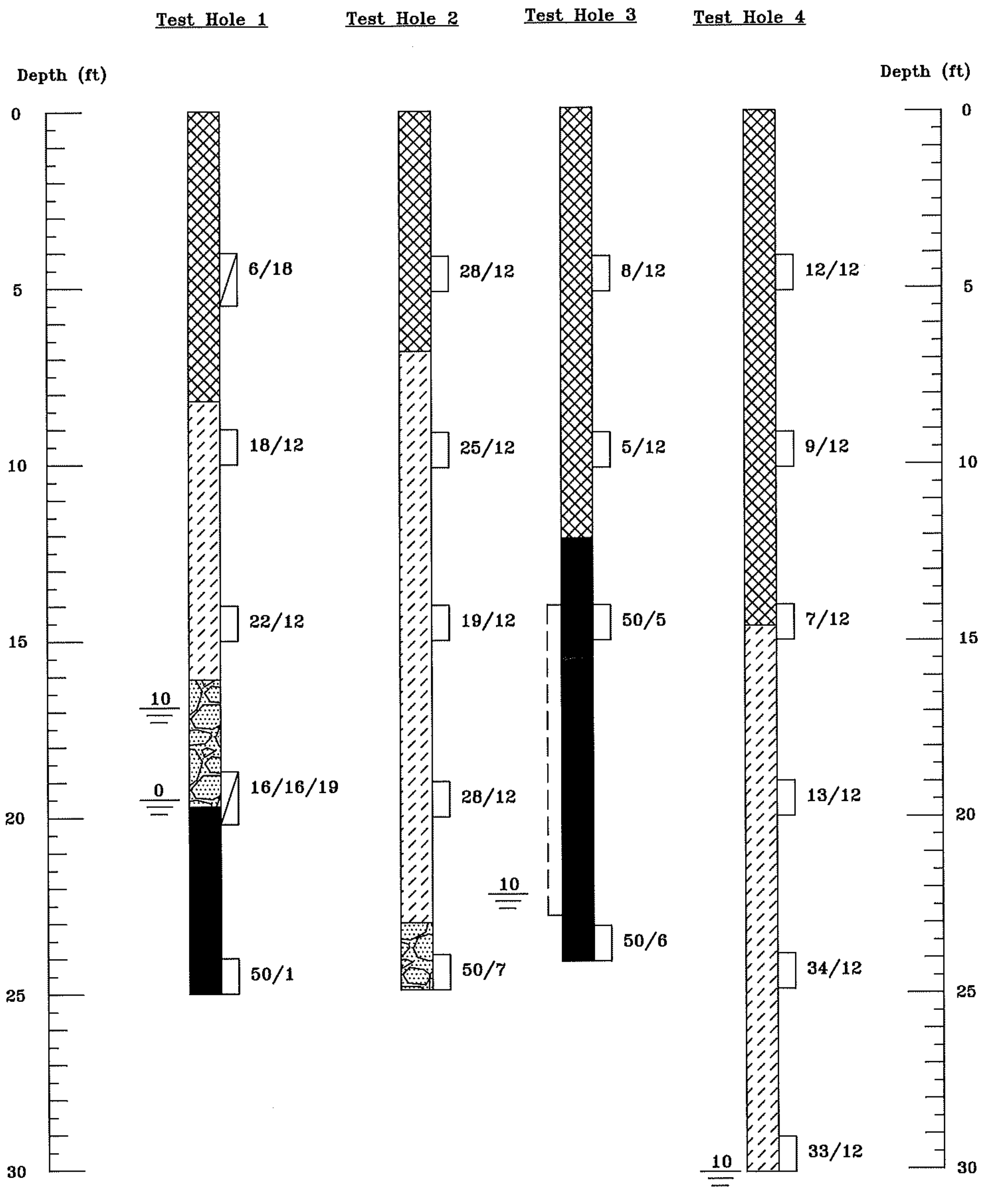


Title: VICINITY MAP		Date: 10/1/21	NWCC North West Colorado Consultants, Inc. Geotechnical / Environmental Engineering · Materials Testing (970)879-7888 · Fax (970)879-7891 2580 Copper Ridge Drive Steamboat Springs, Colorado 80487
Job Name: Christie Peak Express Lift		Job No. 21-12412	
Location: Steamboat Ski Resort, Steamboat Springs, CO		Figure #1	

Title: SITE PLAN/LOCATION OF TEST HOLES – BASE	Date: 10/1/21		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: Christie Peak Express Lift	Job No. 21-12412		
LOCATION: Steamboat Ski Resort, Steamboat Springs, CO	Figure #2		



Title: SITE PLAN/LOCATION OF TEST HOLES – MIDSTATION	Date: 10/1/21	NWCC North West Colorado Consultants, Inc.
Job Name: Christie Peak Express Lift	Job No. 21-12412	Geotechnical / Environmental Engineering · Materials Testing
LOCATION: Steamboat Ski Resort, Steamboat Springs, CO	Figure #3	(970)879-7888 · Fax (970)879-7891 2580 Copper Ridge Drive Steamboat Springs, Colorado 80487



Title: LOGS OF EXPLORATORY TEST HOLES	Date: 10/1/21	North West Colorado Consultants, Inc.
Job Name: Christie Peak Express Lift	Job No. 21-12412	Geotechnical / Environmental Engineering · Materials Testing
Location: Steamboat Ski Area, Steamboat Springs, Colorado	Figure #4	(970)879-7888 · Fax (970)879-7891 2580 Copper Ridge Drive · P.O. Box 775226 Steamboat Springs, Colorado 80477

LEGEND:

FILL: Sandy gravelly clays, low to moderately plastic, fine to coarse grained with gravels and occasional cobbles, soft to stiff, moist and gray to dark brown.

CLAYS: Nil to very sandy, moderately to highly plastic, fine to coarse grained with occasional gravels, stiff to very stiff, moist and light brown to brown to reddish brown.

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

BEDROCK: Browns Park Formation, claystone to sandstone to conglomerate, low to moderately plastic, fine to coarse grained, hard, slightly moist to wet and light brown to reddish brown in color.

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

Drive Sample, Split Spoon Sampler.

Large disturbed bulk sample

18/12 Drive Sample Blow Count, indicates 18 blows of a 140-pound hammer falling 30 inches were required to drive the sampler 12 inches.

16/16/19 Split Spoon Sample Blow Count, indicates 16 blows of a 140-pound hammer falling 30 inches were required to drive the sampler 6 inches, then another 16 blows to drive the sampler the next 6 inches and then 19 blows to drive the sampler the final 6 inches.

0,10 Indicates depth at which groundwater was encountered when measured at time of drilling and when measured 10 days after drilling.

NOTES:

1) Test holes were drilled on September 14 and 15, 2021 with an all terrain drill rig using 4-inch diameter continuous flight 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 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: 10/1/21
Job Name: Christie Peak Express Lift	Job No. 21-12412
Location: Steamboat Ski Area, Steamboat Springs, Colorado	Figure #5

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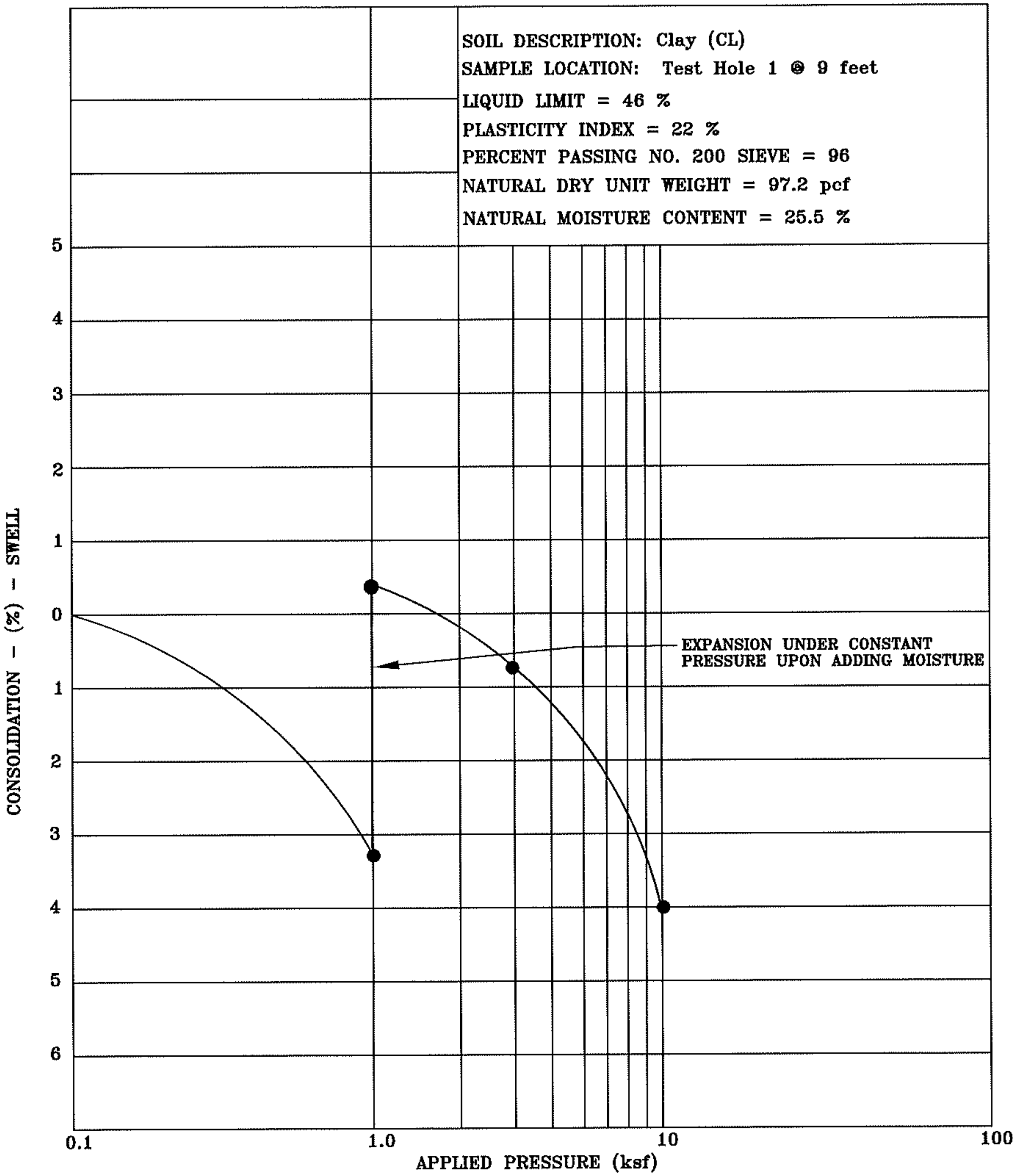

Title: SWELL–CONSOLIDATION TEST RESULTS	Date: 10/1/21
Job Name: Christie Peak Express Lift	Job No. 21-12412
Location: Steamboat Ski Resort, Steamboat Springs, CO	Figure #6

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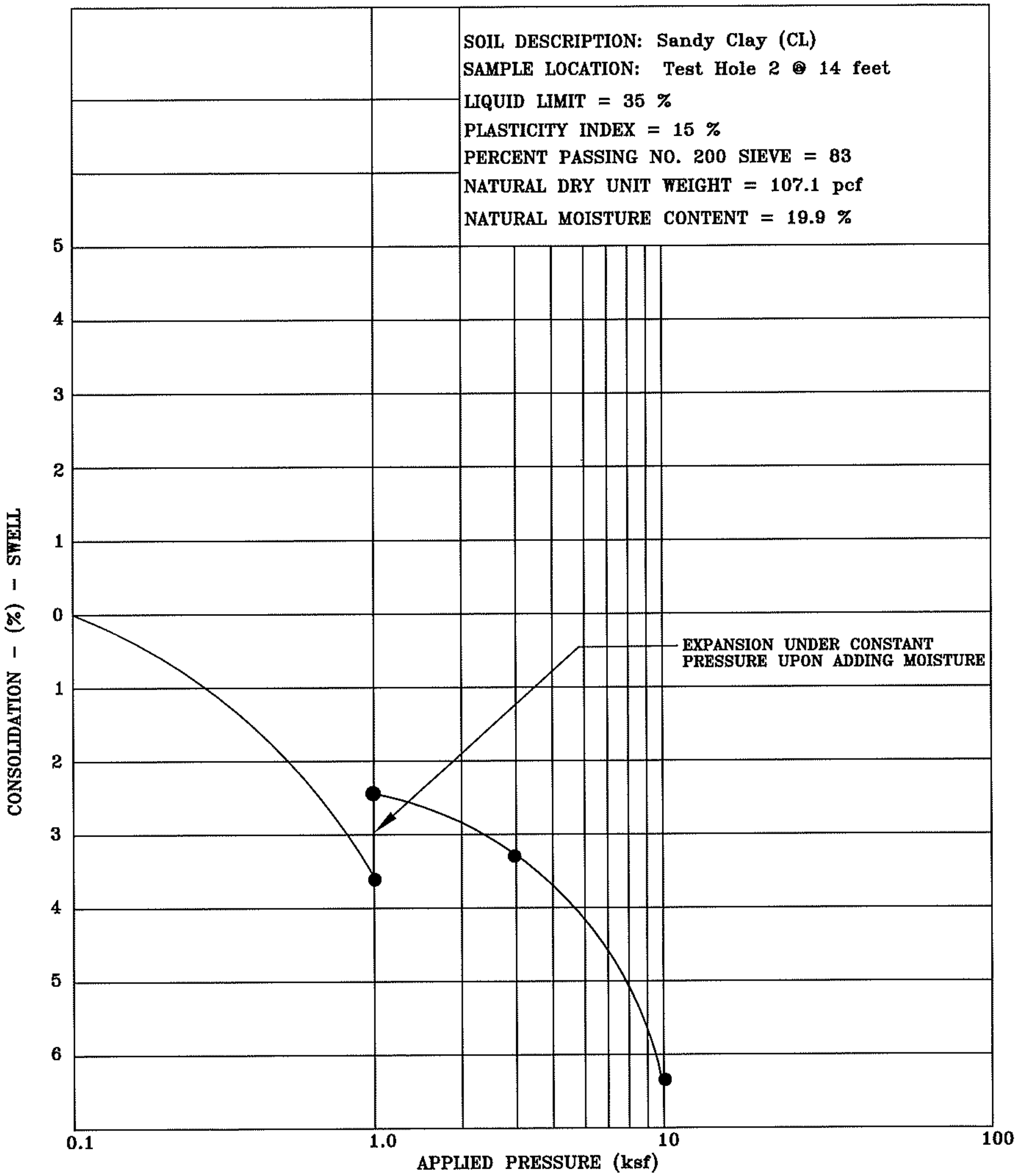

Title: SWELL–CONSOLIDATION TEST RESULTS	Date: 10/1/21		
Job Name: Christie Peak Express Lift	Job No. 21-12412		
Location: Steamboat Ski Resort, Steamboat Springs, CO	Figure #7		

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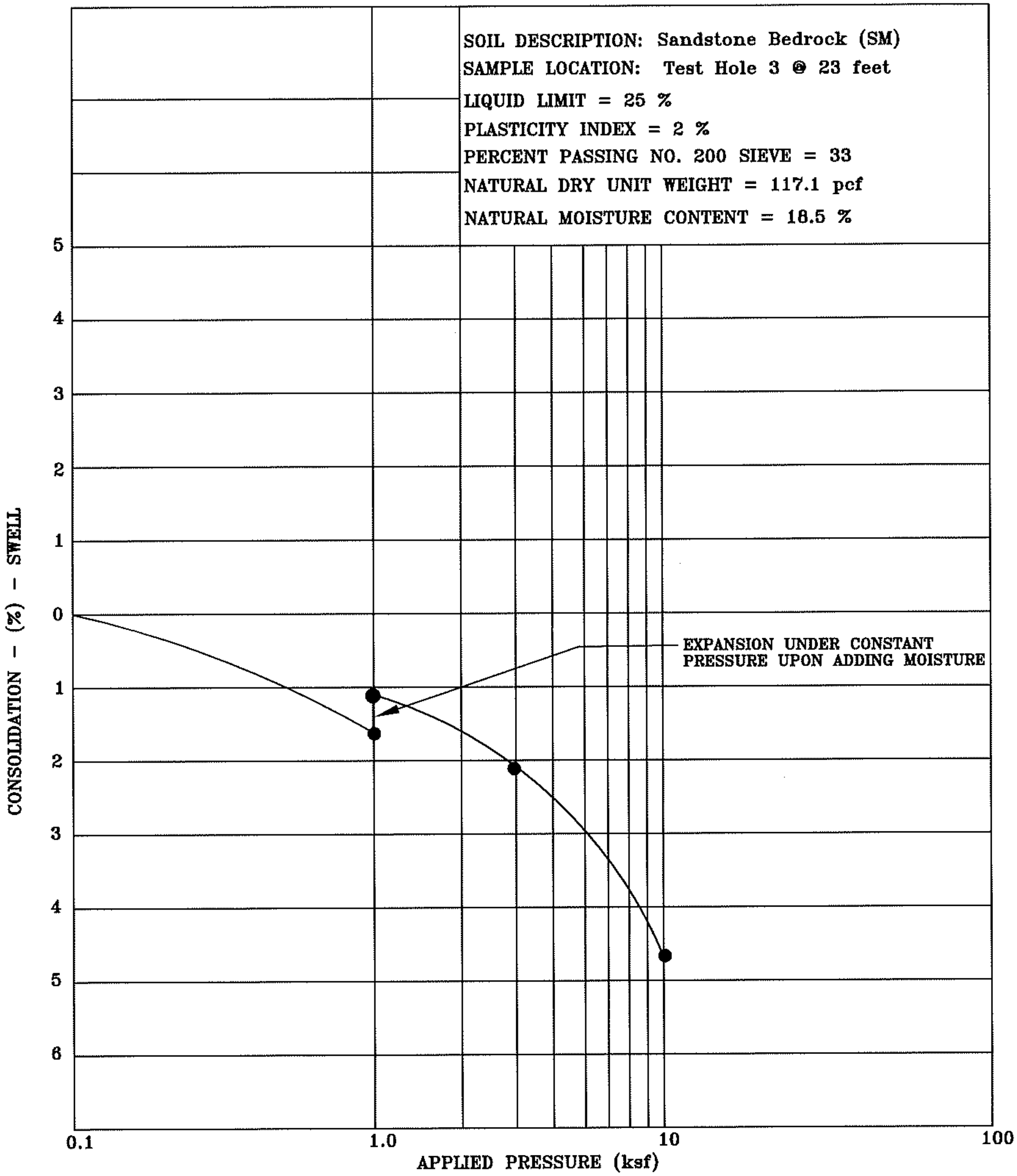
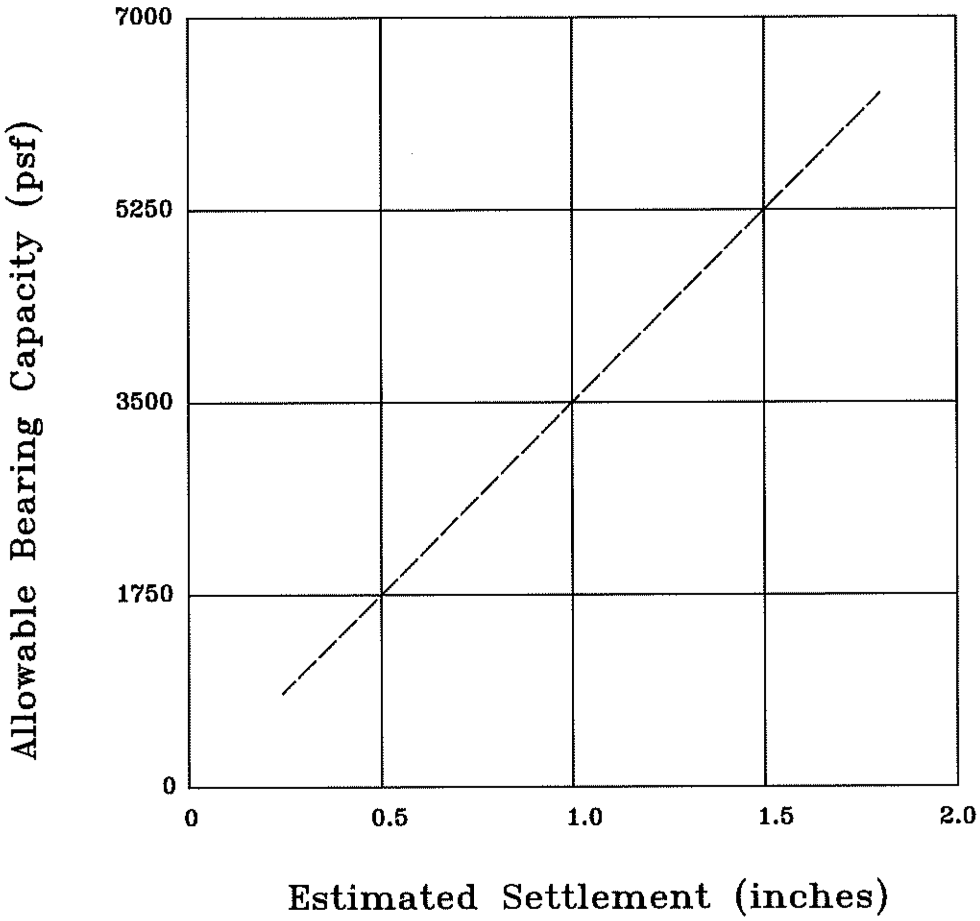
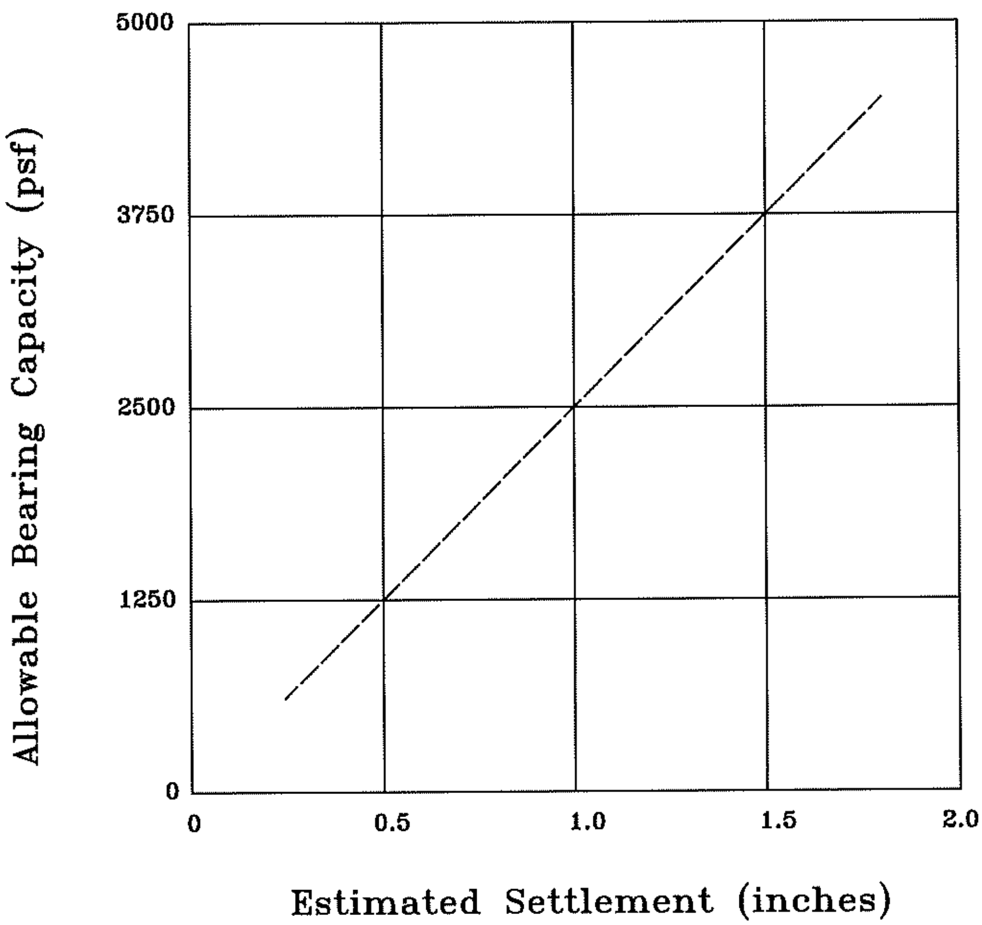


Title: SWELL-CONSOLIDATION TEST RESULTS	Date: 10/1/21	NWCC North West Colorado Consultants, Inc. Geotechnical / Environmental Engineering - Materials Testing (970)879-7888 · Fax (970)879-7891 2580 Copper Ridge Drive Steamboat Springs, Colorado 80487
Job Name: Christie Peak Express Lift	Job No. 21-12412	
Location: Steamboat Ski Resort, Steamboat Springs, CO	Figure #8	



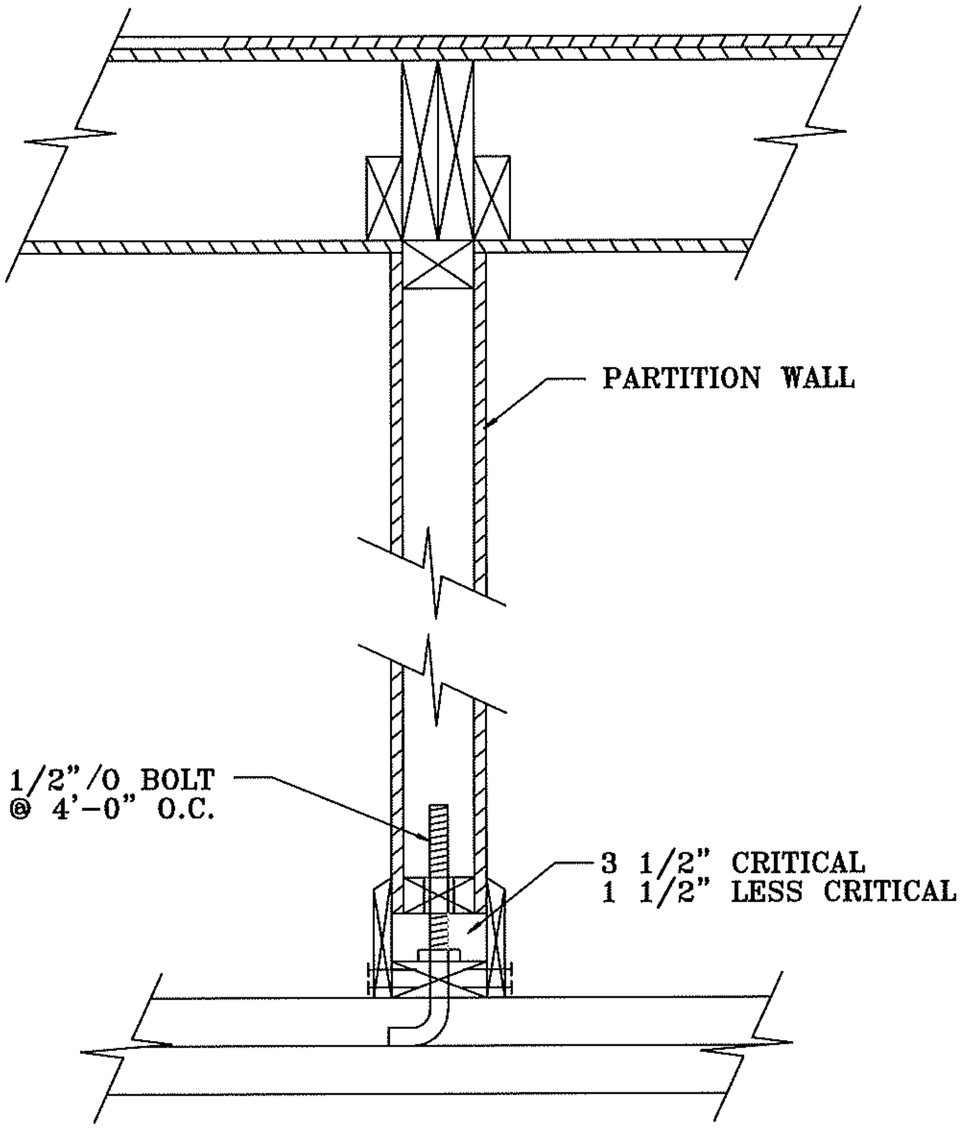
Note: These values are based on footing widths of 1 to 4 feet. If the footing width is to be greater than 4 feet in width, then we should be notified to re-evaluate these recommendations.

Title: BEARING CAPACITY CHART– NATURAL SOILS AND BEDROCK	Date: 10/1/21	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 80477
Job Name: Christie Peak Express Lift	Job No. 21-12412	
Location: Steamboat Ski Resort, Steamboat Springs, CO	Figure #9	



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– STRUCTURAL FILL	Date: 10/1/21	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 80477
Job Name: Christie Peak Express Lift	Job No. 21-12412	
Location: Steamboat Ski Resort, Steamboat Springs, CO	Figure #10	



Title: HUNG PARTITION WALL DETAIL	Date: 10/1/21
Job Name: Christie Peak Express Lift	Job No. 21-12412
Location: Steamboat Ski Resort, Steamboat Springs, CO	Figure #11

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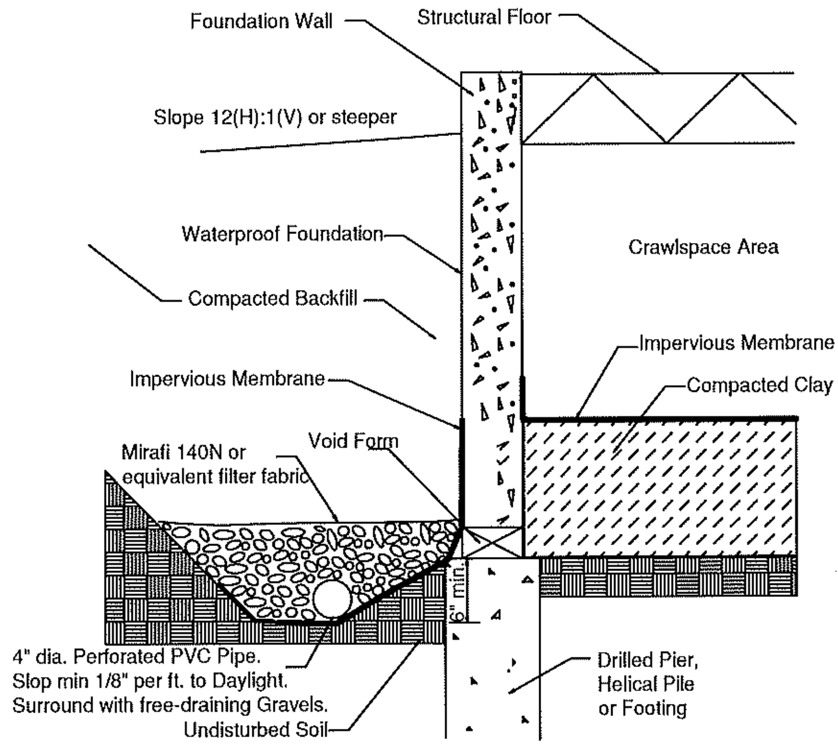
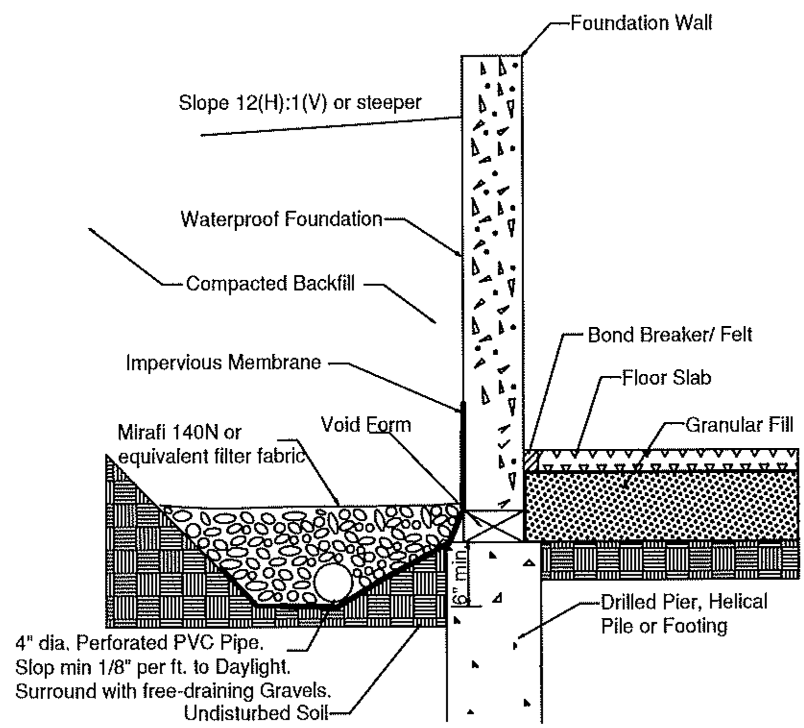


Crawlspace Area



Lower Level with
Floor Slab

Title: PERIMETER/UNDERDRAIN DETAIL	Date: 10/1/21	North West Colorado Consultants, Inc.
Job Name: Christie Peak Express Lift	Job No. 21-12412	Geotechnical / Environmental Engineering - Materials Testing
Location: Steamboat Ski Resort, Steamboat Springs, CO	Figure #12	(970)879-7888 · Fax (970)879-7891 2580 Copper Ridge Drive Steamboat Springs, Colorado 80487

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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	25.5	97.2	46	22	0	4	96		Clay	CL
2	9	18.1	109.5	38	20	1	8	91	10,750	Slightly Sandy Clay	CL
2	14	19.9	107.1	35	15	0	17	83		Sandy Clay	CL
3	23	14.8	117.1	25	2	1	66	33		Sandstone Bedrock	SM
4	19	18.5	107.4	29	9	14	17	69	5,050	Gravelly Sandy Clay	CL
3	14–23	6.0		24	12	24	53	23		Congolomerate Bedrock	SC

JOB NUMBER: 21–12412