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

March 13, 2020

Steamboat Springs School District RE-2
Mark Rydberg
325 7th Street
Steamboat Springs, Colorado 80487

Job Number: 19-11673

Subject: Subsoil and Foundation Investigation, Strawberry Park Elementary School Addition, Steamboat Springs, Colorado.

Mark,

This report presents the results of the Subsoil and Foundation Investigation for the proposed Strawberry Park Elementary School Addition to be constructed at 39620 Amethyst Drive in Steamboat Springs, Colorado. The approximate location of the project site is shown in Figure #1.

It should be noted that NWCC previously completed a *Subsoil and Foundation Investigation* for earlier Strawberry Park Elementary School additions, constructed on the west side of the school, under Job Number 07-7417 and dated February 10, 2007. A copy of this report is included in Appendix A.

NWCC, Inc.'s (NWCC) scope of work included obtaining data from cursory observations made at the site, logging of four (4) test holes, sampling of the probable foundation soils, laboratory testing of the samples obtained and the review of the previously completed field and laboratory investigation and report. 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: Based on conversations with the client and review of the plans provided by the architect, NWCC understands that an addition to the existing elementary school will be constructed east of the existing building. NWCC assumes the addition will be constructed with slab-on-grade floor systems with similar slab grades to the existing building and be located slightly below to slightly above the existing ground surface. We also understand that a new equipment storage building will be constructed to the northwest of the existing school and the playground on the west side of the building will be reconstructed with a snowmelt system. We also understand additions/improvements to the existing access roads are being considered.

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For design purposes, NWCC has assumed that building loads will be moderate, typical of this type of school 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 building site is located east of the existing elementary school building and west and north of the existing playground. A paved access road runs through the proposed building site. Vegetation at the proposed building site is sparse due to paving and consists of landscaped grasses and weeds.

Topography of the site is fairly flat due to previous site grading. Natural topography appears to slope gently down to the west. A maximum elevation difference of approximately 2 to 3 feet appears to exist across the proposed building site.

Subsurface Conditions: To investigate the subsurface conditions at the site, four (4) test holes were advanced on November 21, 2019 with a truck-mounted CME 55 drill rig using 4-inch diameter continuous flight augers. A site plan showing existing features, along with the approximate test hole locations is presented in Figure #2.

Subsurface conditions encountered at the site were somewhat variable generally consisted of a layer of asphalt overlying sand and gravel fill materials overlying natural clays overlying natural sands and gravels to the maximum depth investigated, 17 feet beneath the existing ground surface (bgs). Graphic logs of the exploratory test holes are presented in Figure #3, and associated Legend and Notes are presented in Figure #4.

A layer of asphalt 1 to 2 inches in thickness was encountered at the surface in Test Holes 1, 2 and 3. A layer of concrete 6 inches in thickness was encountered beneath the asphalt in Test Hole 3. Fill materials were encountered beneath the asphalt in Test Holes 1 and 2, beneath the concrete in Test Hole 3 and at the ground surface in Test Hole 4. Fill materials extended to depths ranging from 2 feet to 6 feet bgs. Fill materials consisted of gravelly clays and sands to clayey sands and gravels that were low plastic, fine to coarse grained, low to moderately plastic, loose to medium dense, moist to wet and brown in color. A sample of the fill materials classified as a CL soil in accordance with the Unified Soil Classification System (USCS).

Natural clays were encountered beneath the fill materials in Test Holes 1, 2 and 3 and extended to depths ranging from 7 to 8 feet bgs, respectively. The natural clays were very sandy to silty, low to moderately plastic, fine to coarse grained with occasional gravels, medium stiff to stiff, moist to wet and brown in color. Samples of the natural clays classified as CL soils in accordance with the USCS.

Natural sands and gravels were encountered beneath the clays in Test Holes 1, 2 and 3 and beneath the fill materials in Test Hole 4 and extended to the maximum depth investigated in each test hole. It should be noted that practical rig refusal was encountered on very dense cobbles in all of the test holes at depths ranging from 13 to 17 feet bgs. The sands and gravels were clayey to silty, very low to non plastic, fine to coarse grained with cobbles, dense to very dense, moist to wet and brown in color. Samples of the sands and gravels classified as SM soils in accordance with the USCS.

Swell-consolidation testing conducted on samples of the natural clays indicate the materials tested will exhibit no volume change to very low swell potential when wetted under a constant load of 1,000 psf. One test on the clays also exhibited a moderate to high degree of consolidation under relative light loading (1,000 psf). Swell-consolidation test results are presented in Figures #5, #6, #7 and #8, and all the other laboratory test results are summarized in the attached Table 1.

Groundwater was encountered in the test holes at depths ranging from 2 to 6 feet bgs when measured at the time of the investigation. Due to safety concerns, the test holes were backfilled immediately after drilling was completed. 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 spread or continuous footings placed directly on the natural sands and gravels or on properly compacted structural fill materials placed over the natural sands and gravels.

1) Footings placed on the natural sands and gravels or properly compacted structural fill materials placed over the sands and gravels should be designed using an allowable soil bearing pressure of 3,000 psf. A minimum dead load pressure will not be required for the footings.

2) Footings or pad sizes should be computed using the above soil pressures and placed on the natural sands and gravels or on properly compacted structural fill materials placed over the sands and gravels after all of the clays and existing fill materials are removed.

3) Any topsoil and organic materials, existing fill materials or clays found beneath the footings when excavations are opened should be removed and footings extended down to the natural sands and gravels prior to structural fill or concrete placement. Foundation design should be closely checked to assure that it distributes loads per the allowable pressures given.

4) Any fill materials placed beneath the footings should be a non-expansive granular soil approved by NWCC prior to placement. Based on the relatively shallow depth to ground water, NWCC recommends that clean gravel fill materials meeting the gradation specifications for Colorado Department of Transportation (CDOT) Class A or Class B Filter Materials.

   The gravel fill materials placed under the footings should be uniformly placed and compacted in 6 to 8-inch loose lifts and compacted to at least 80% of the maximum relative density in accordance with ASTM D4253/4254. The structural fill materials should extend out from the edge of the footings on a 1(horizontal) to 1(vertical) or flatter slope.

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

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

7) The proposed footing elevations may be below the groundwater level. Therefore, it will probably be necessary to dewater the footing excavations during construction. If the concrete is not to be placed in the excavations within 24 hours, we would recommend that a layer of lean concrete or 1 ½ inch gravels be placed in the base of the foundation excavations immediately after the excavations are completed. This "mud mat" will reduce disturbance of the natural soils caused by exposure to the elements and the construction operations.

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 Figure #9.

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.

Alternate Deep Foundation Recommendations: Alternative deep foundation system recommendations would consist of either helical screw piles or rammed aggregate piers advanced into the natural sands and gravels encountered below the existing fill materials and underlying natural clays.

Helical Piles: The helical screw pile foundations will place the bottom of the foundations in a zone of relatively stable moisture content, reduce the risk of foundation movement from the swell-consolidation potential of the clays and eliminate the need for removing these materials from beneath the foundations.

Foundation movement should be less than ½-inch if the following design and construction conditions are observed. The following recommendations have been included for foundation design purposes.

A 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 the site and observed by NWCC 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 8-inch diameter helix.
- Minimum pile depth of 6 feet from upper 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.

Rammed Aggregate Piers: NWCC believes rammed aggregate piers, such as *Geopier* foundation system, would be another safe type of foundation system. The rammed aggregate piers are typically constructed to bridge poor bearing soils, such as the existing fill materials and underlying natural clays, encountered at this site, extending down to a suitable bearing layer, such as the underlying natural sands and gravels.

A rammed aggregate pier foundation system should develop an end bearing pressure of at least 4,000 psf for aggregate piers founded in the sand and gravels. A rammed aggregate pier 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 native soils between the piers, thus decreasing the potential for floor slab movement and sometimes eliminating the need for structural slabs or structural floors over crawlspaces.

- *Geopier* and other rammed aggregate pier foundation elements are designed as proprietary foundation systems and as noted on the Geopier website *"Geopier has a team of local representatives to provide you with a high level of service and support during the project design phase. The engineers work with project geotechnical and structural engineers, using loads and geotechnical information to detail the best ground improvement solution. These registered professional engineers develop the design. After preliminary design work is completed, each project undergoes an internal peer-review process by engineers at Geopier headquarters. Before going to construction, design submittals and "shop" drawings are prepared and stamped by a P.E. and provided to the general contractor".*

- If a *Geopier* foundation system is selected, NWCC should be contacted to coordinate with the *Geopier* design team during foundation design. Additional information of the *Geopier* foundation systems can be found at: https://www.geopier.com/FAQs.

Floor Slab Recommendations: NWCC has assumed the lower level of the proposed addition will most likely be constructed with a concrete slab-on-grade floor system with an elevation that matches the existing floor slab elevations.

On-site soils, apart from any topsoil and organic materials and 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 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, 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 #10.

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

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

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

Drains should be located around 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 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 may be required for the proposed structures. Caution should be taken when backfilling so as not to damage or disturb the installed underdrains. NWCC recommends the drainage systems include a clean out 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 flow tests prior to backfilling the systems.

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. 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 #11.

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

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

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

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

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

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

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

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) The 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 from structures. Ponding must be avoided. If possible, 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 in order 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.

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

Site Grading: General site grading 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.

1) Temporary cuts for foundation construction should be constructed to OSHA standards for temporary excavations. Permanent, unretained cuts for driveways or building sites should be kept as shallow as possible and should not exceed a 3(Horizontal) to 1(Vertical) configuration for the topsoil and organic materials and a 2(Horizontal) to 1(Vertical) configuration for the other soils. We recommend these cuts be limited to 10 feet in height or less unless if groundwater 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.

2) 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.

3) Fills up to 10 feet in height can be constructed at the site and should be constructed to a 2(Horizontal) to 1(Vertical) or flatter configuration. The fill areas should be prepared by stripping any existing fill materials and topsoil and organics, scarification and compaction to at least 95% of the maximum standard Proctor density and within 2% of optimum moisture content as determined by ASTM D698. The fills should be properly benched/keyed into the natural hillsides after the natural topsoil and organic materials 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.

4) 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.

5) 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 subsurface conditions encountered at this site and NWCC's assumptions regarding 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.

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.
Project Engineer

COLORADO LICENSED BRIAN D. LEN 25750 PROFESSIONAL ENGINEER 3/13/2020

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

cc: Pascal Ginesta – SSSD RE-2
Todd Raper- Dynamic Program Management
Colleen Kaneda – Dynamic Program Management

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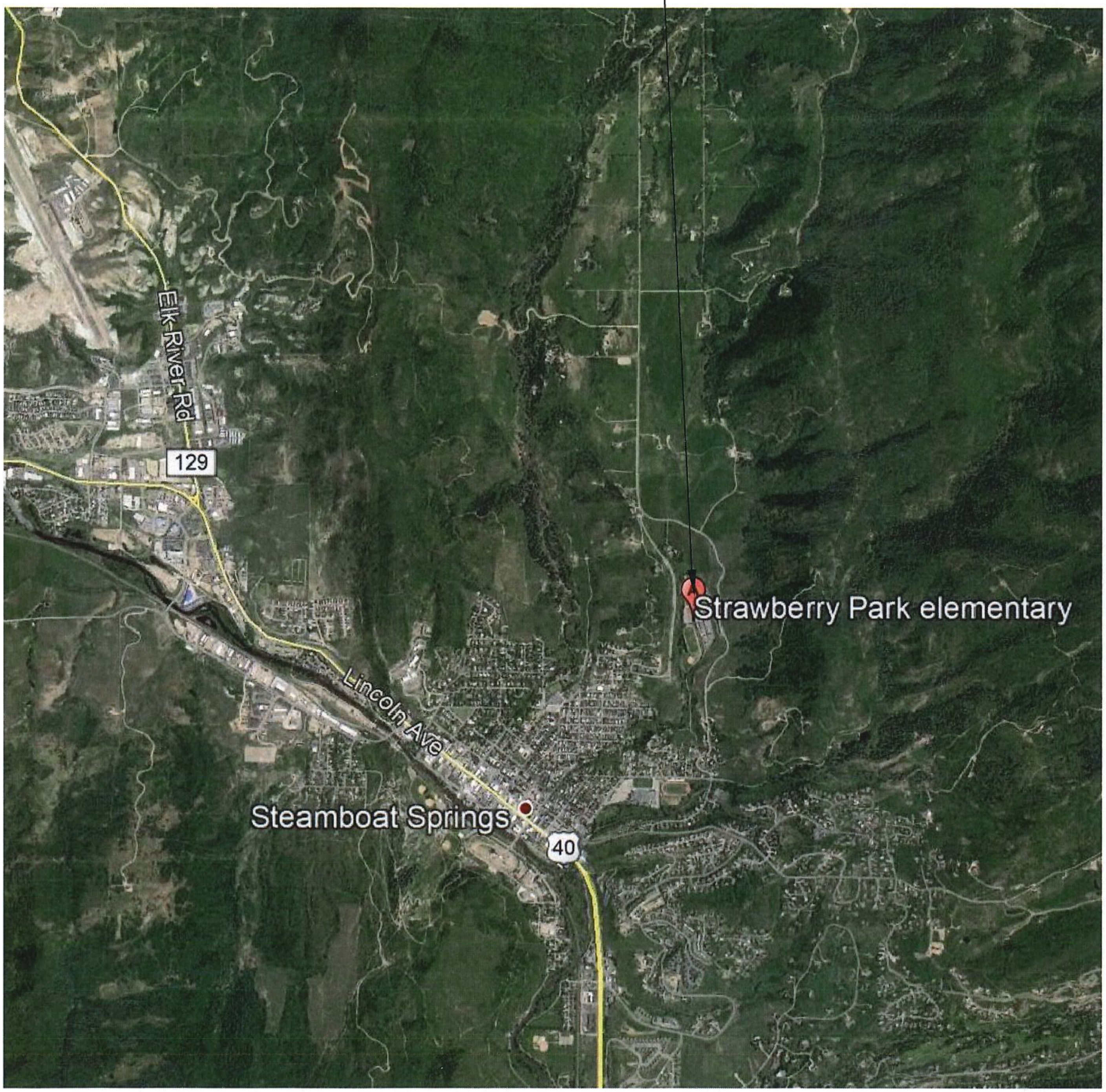
NOT TO SCALE

PROJECT SITE



Title: VICINITY MAP	**Date:** 12/10/19	NWCC North West Colorado Consultants, Inc.
Job Name: Strawberry Park Elementary School	**Job No.** 19-11673	Geotechnical / Environmental Engineering · Materials Testing
Location: 39620 Amethyst Dr., Steamboat Springs, CO	**Figure** #1	(970)879-7888- Fax (970)879-7891 2580 Copper Ridge Drive Steamboat Springs, Colorado 80487

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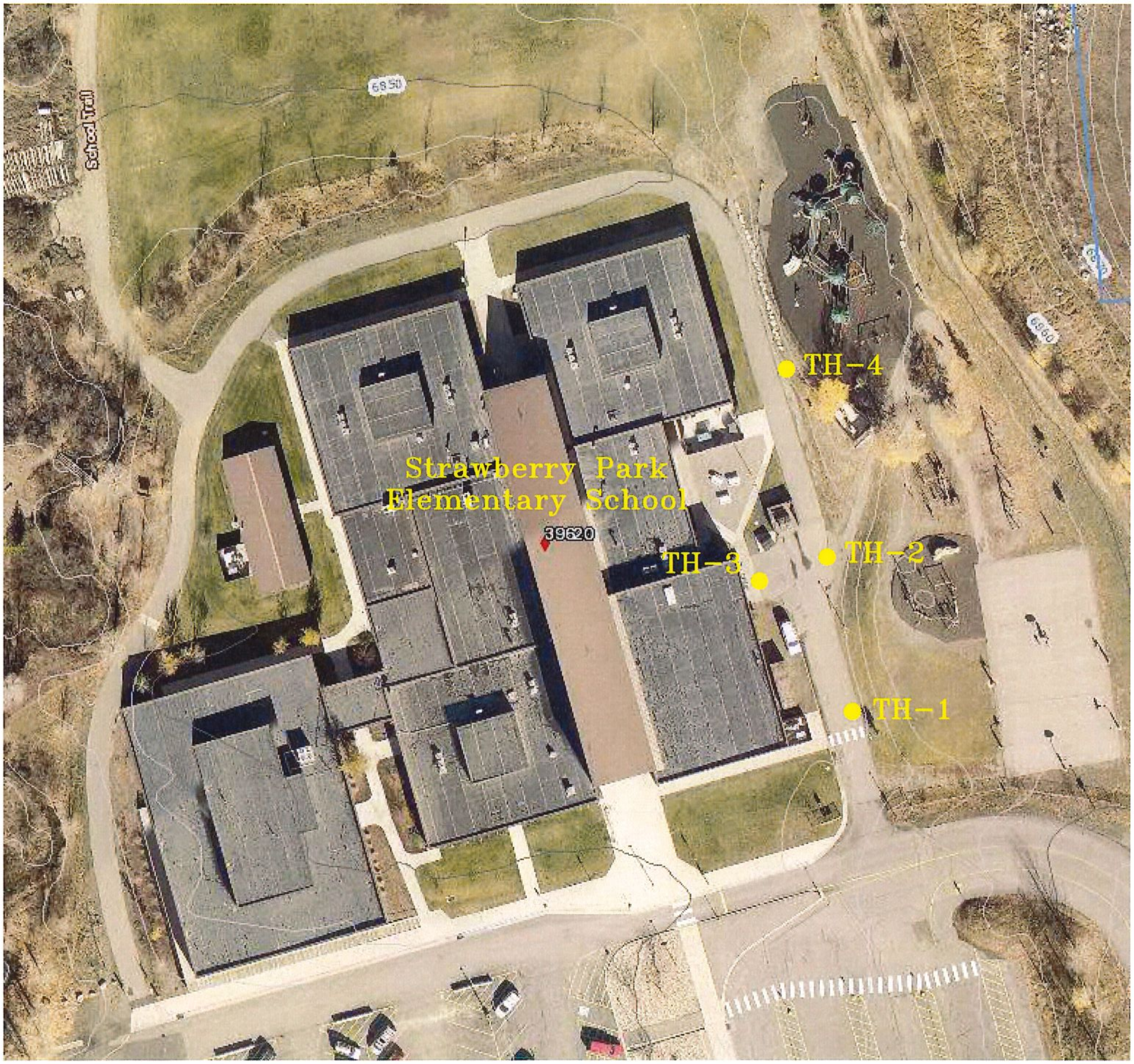
NOT TO SCALE



Title: SITE PLAN–LOCATION OF TEST HOLES	Date: 12/4/19		
Job Name: Strawberry Park Elementary School	Job No. 19-11673		
Location: 39620 Amethyst Dr., Steamboat Springs, CO	Figure #2		

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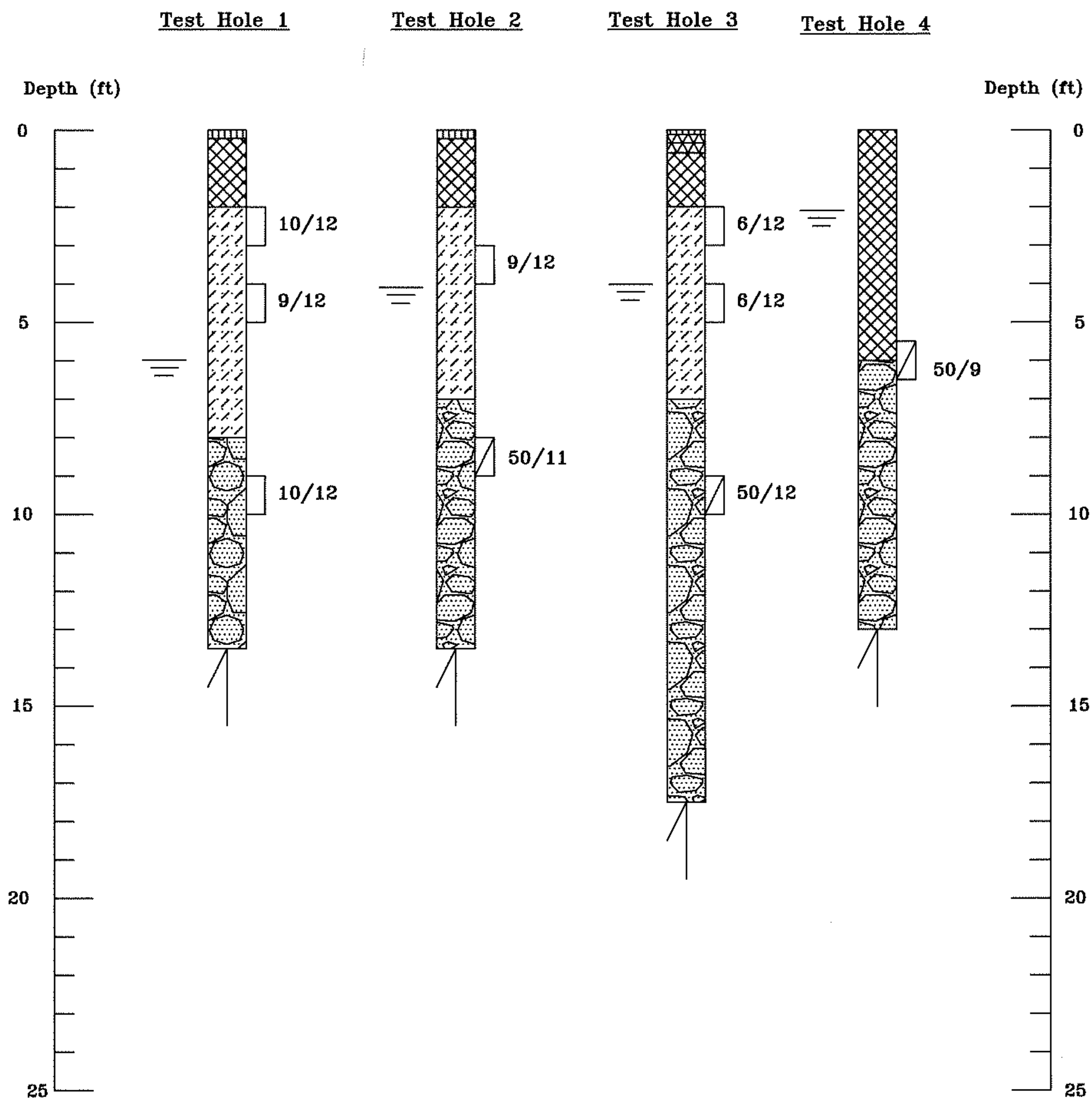

Title: LOGS OF EXPLORATORY TEST HOLES	Date: 12/5/19
Job Name: Strawberry Park Elementary School	Job No. 19-11673
Location: 39620 Amethyst Dr., Steamboat Springs, CO	Figure #3

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LEGEND:

ASPHALT

CONCRETE

FILL: Gravelly clays and sands to clayey sands and gravels, low plastic, fine to coarse grained, low to moderately plastic, loose to medium dense, moist to wet and brown.

CLAYS: Very Sandy to silty, low to moderately plastic, fine to coarse grained with occasional gravels, medium stiff to stiff, moist to wet and brown.

SANDS and GRAVELS: Clayey to silty, very low to non plastic, fine to coarse grained with cobbles, medium dense to very dense, moist to wet and brown.

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

Drive Sample, Standard Split Spoon Sampler.

10/12 Drive Sample Blow Count, indicates 10 blows of a 140-pound hammer falling 30 inches were required to drive the sampler 12 inches.

Indicates depth of practical rig refusal on very dense cobbles.

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

NOTES:

1) Test holes were drilled on November 21, 2019 with a truck-mounted CME 55 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) Water level readings shown on the logs were made at the time and under the conditions indicated. Fluctuations in water levels will likely occur with time.

Title: LEGEND AND NOTES	Date: 12/4/19
Job Name: Strawberry Park Elementary School	Job No. 19-11673
Location: 39620 Amethyst Dr., Steamboat Springs, CO	Figure #4

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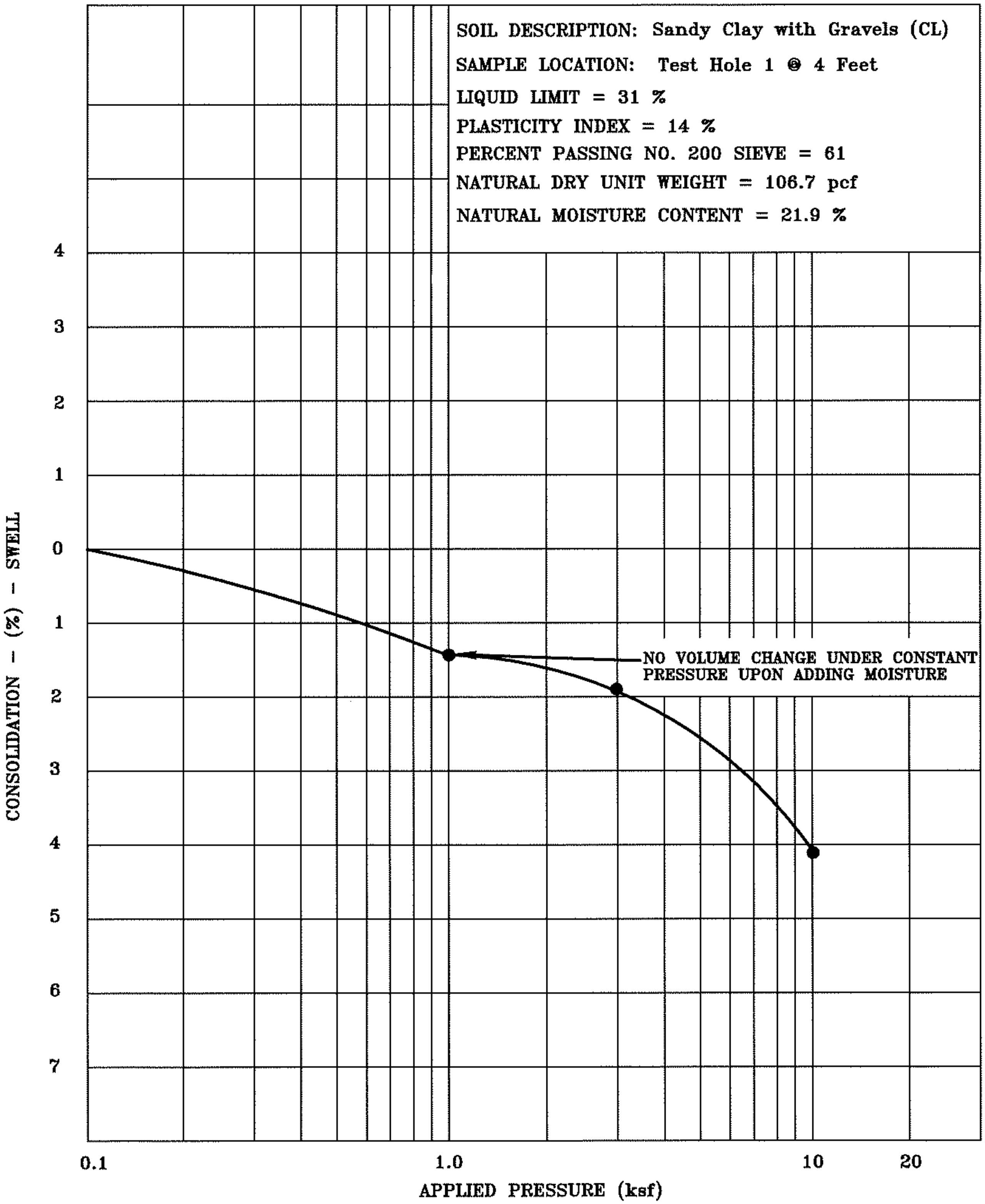
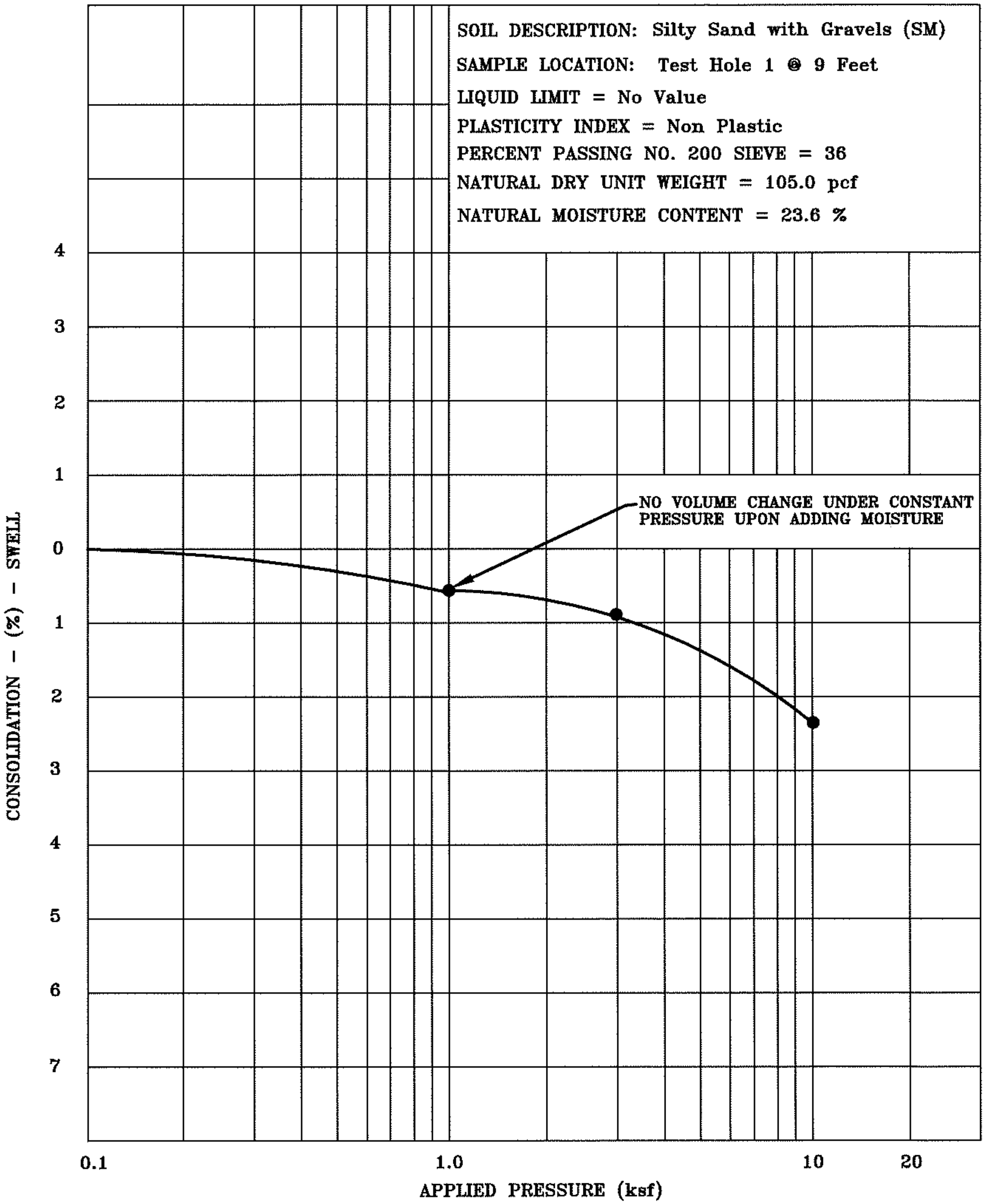


Title: SWELL–CONSOLIDATION TEST RESULTS	Date: 12/10/19	NWCC North West Colorado Consultants, Inc. Geotechnical / Environmental Engineering · Materials Testing (970)879-7888 · Fax (970)879-7891 2580 Copper Ridge Drive Steamboat Springs, Colorado 80487
Job Name: Strawberry Park Elementary School	Job No. 19-11673	
Location: 39620 Amethyst Dr., Steamboat Springs, CO	Figure #5	



Title: SWELL-CONSOLIDATION TEST RESULTS	Date: 12/10/19
Job Name: Strawberry Park Elementary School	Job No. 19-11673
Location: 39620 Amethyst Dr., Steamboat Springs, CO	Figure #6

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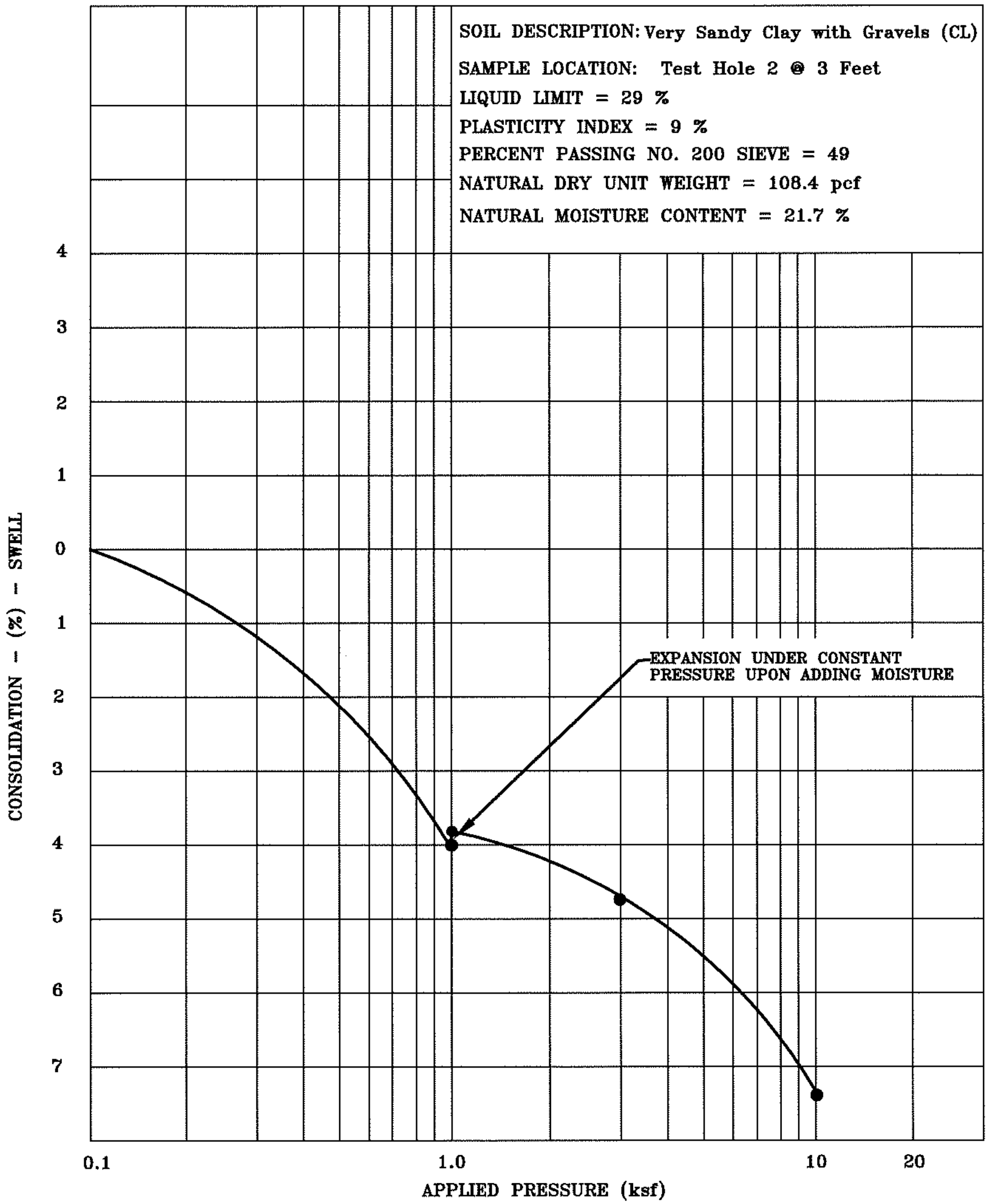

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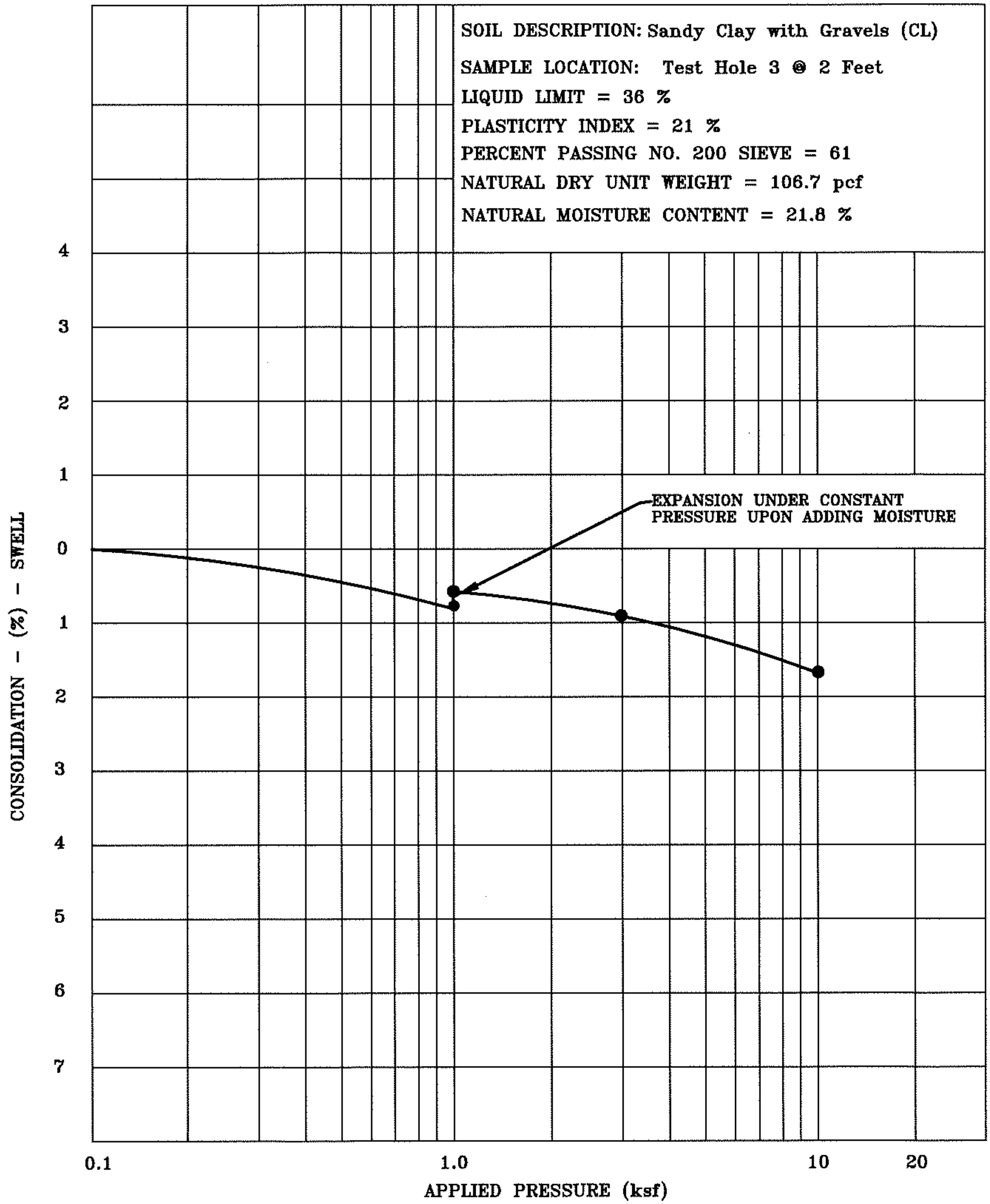
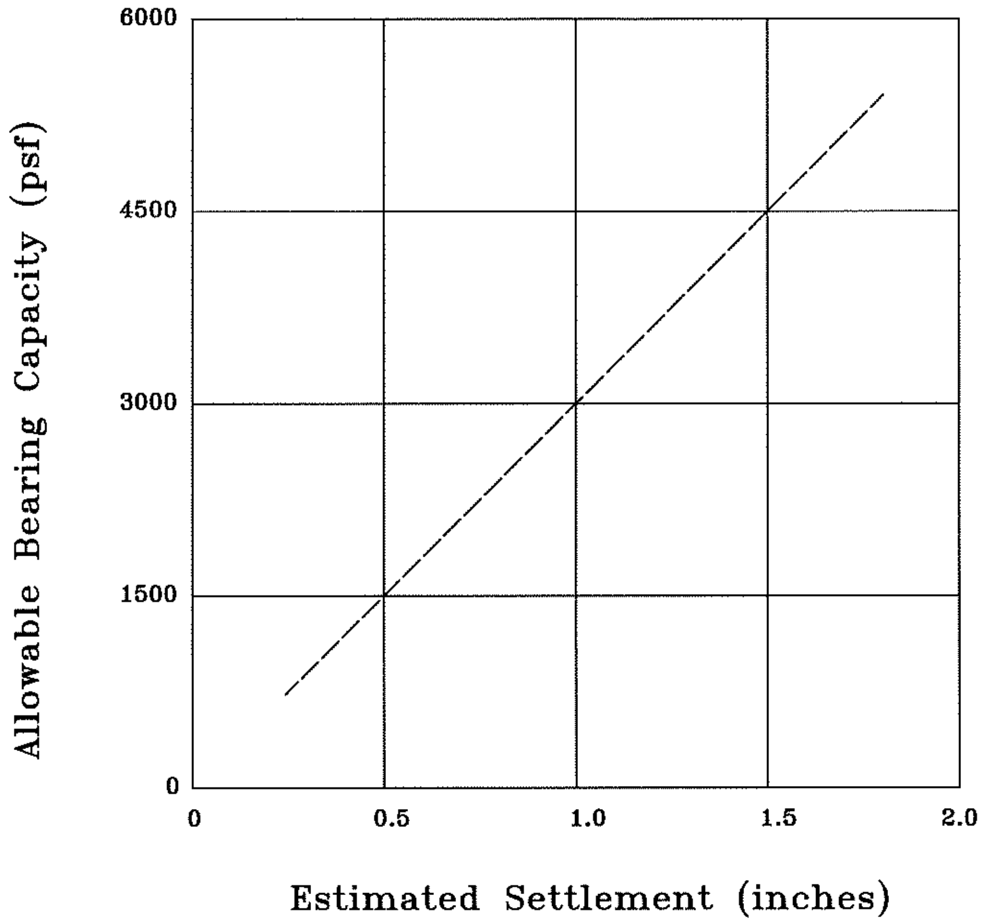
Job Name: Strawberry Park Elementary School	Job No. 19–11673	
Location: 39620 Amethyst Dr., Steamboat Springs, CO	Figure #7	



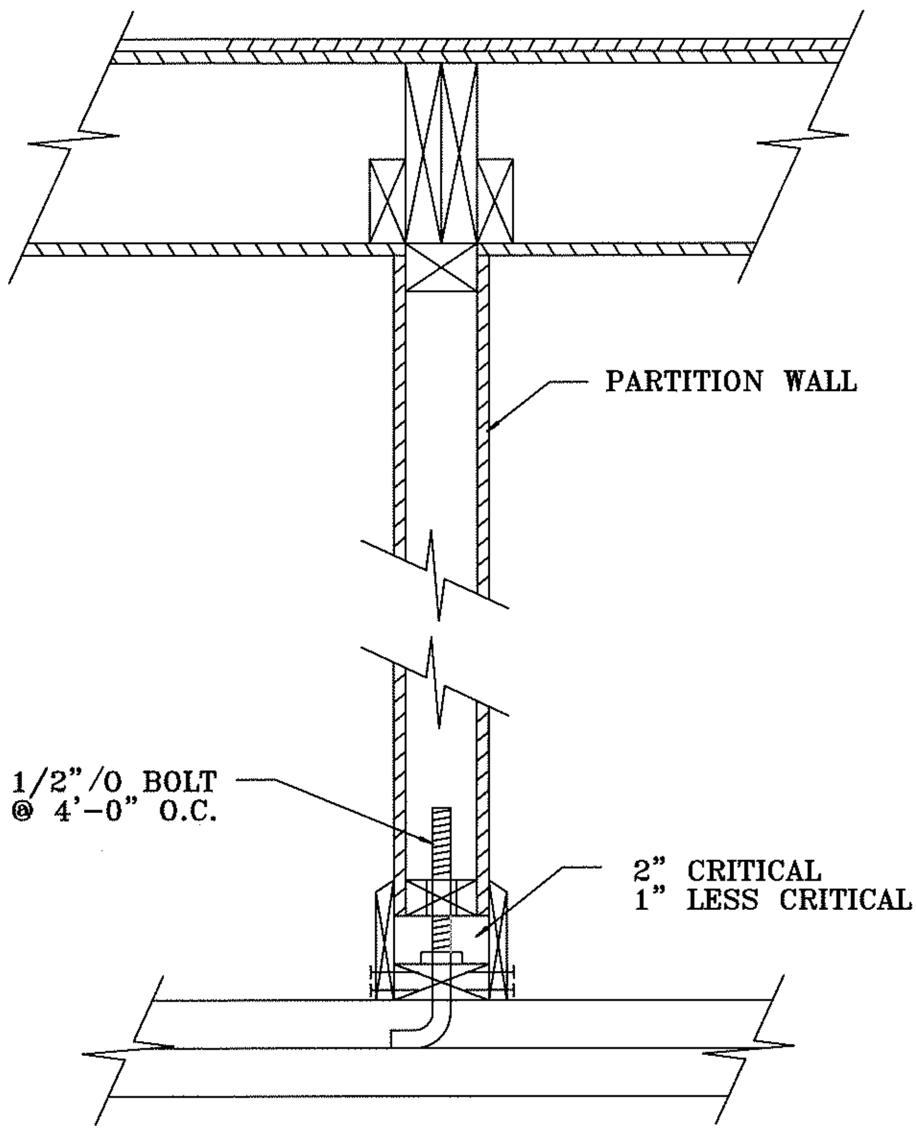
Title: SWELL–CONSOLIDATION TEST RESULTS	Date: 12/10/19
Job Name: Strawberry Park Elementary School	Job No. 19–11673
Location: 39620 Amethyst Dr., Steamboat Springs, CO	Figure #8

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

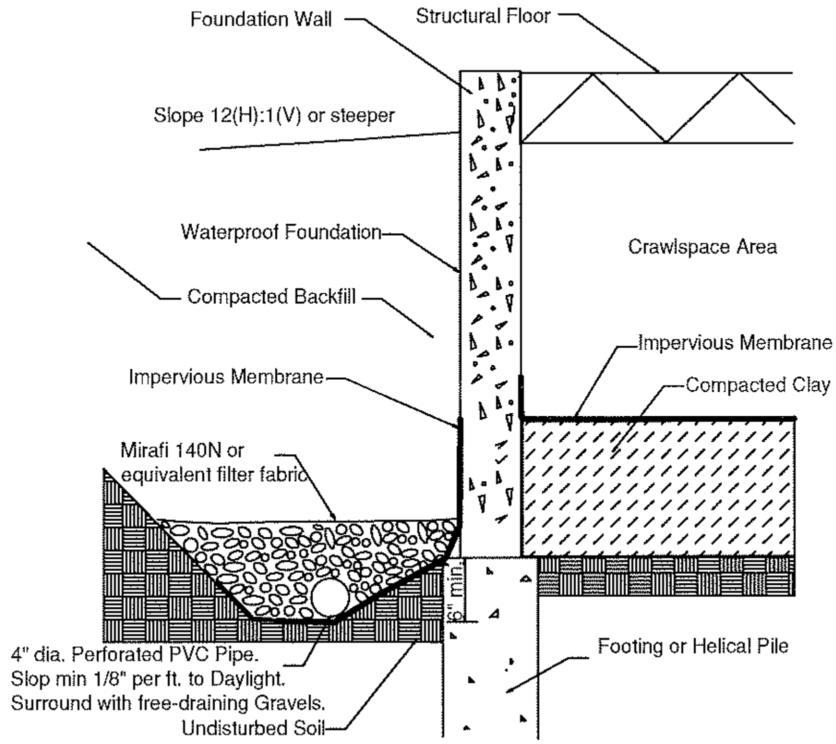


Note: These values are based on footing widths of 1 to 4 feet. If the footing width is to be greater than 4 feet in width, then we should be notified to re-evaluate these recommendations.

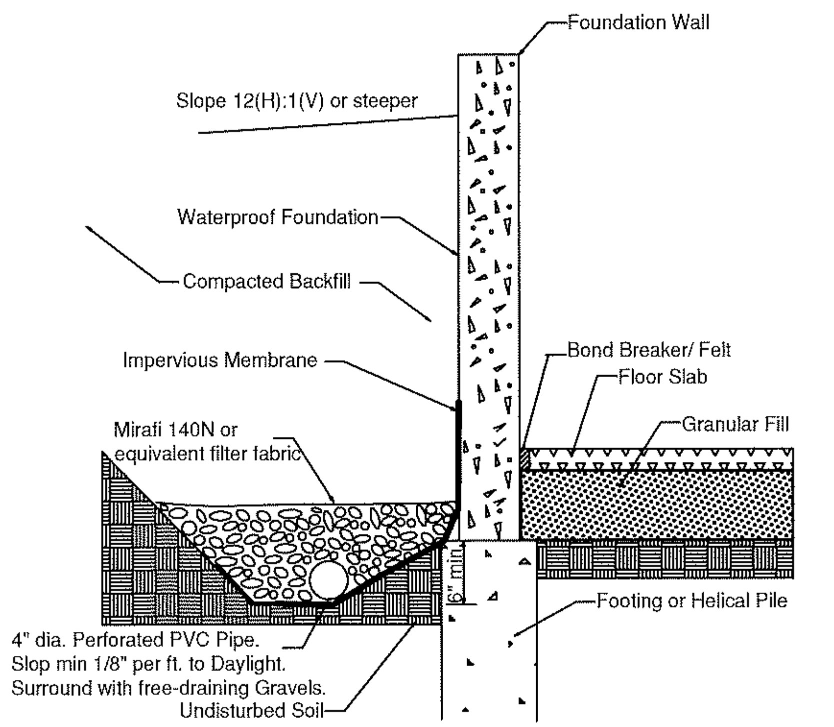
Title: BEARING CAPACITY CHART – SANDS AND GRAVELS	Date: 12/10/19	NWCC North West Colorado Consultants, Inc. Geotechnical / Environmental Engineering · Materials Testing (970)879-7888 · Fax (970)879-7891 2580 Copper Ridge Drive Steamboat Springs, Colorado 80487
Job Name: Strawberry Park Elementary School	Job No. 19–11673	
Location: 39620 Amethyst Dr., Steamboat Springs, CO	Figure #9	



Title: HUNG PARTITION WALL DETAIL	Date: 12/10/19	NWCC North West Colorado Consultants, Inc.
Job Name: Strawberry Park Elementary School	Job No. 19-11673	Geotechnical / Environmental Engineering · Materials Testing
Location: 39620 Amethyst Dr., Steamboat Springs, CO	Figure #10	(970)879-7888 · Fax (970)879-7891 2580 Copper Ridge Drive Steamboat Springs, Colorado 80487



Crawlspace Area



Lower Level with
Floor Slab

Title: PERIMETER/UNDERDRAIN DETAIL	Date: 12/10/19	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: Strawberry Park Elementary School	Job No. 19-11673	
Location: 39620 Amethyst Dr., Steamboat Springs, CO	Figure #11	

NWCC, Inc.

TABLE 1

SUMMARY OF LABORATORY TEST RESULTS

STRAWBERRY PARK ELEMENTARY SCHOOL

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	4	21.9	106.7	31	14	7	32	61		Sandy Clay with Gravels	CL
1	9	23.6	105.0	NV	NP	10	54	36		Silty Sand with Gravels	SM
2	3	21.7	108.4	29	9	10	41	49		Very Sandy Clay with Gravels	CL
2	8	11.1		24	2	33	55	12		Silty Gravelly Sand	SM
3	2	21.8	106.7	36	21	6	33	61		Sandy Clay with Gravels	CL
4	5 1/2	28.0		32	13	8	21	71		FILL: Sandy Clay with Gravels	CL

JOB NUMBER: 19-11673

APPENDIX A

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

Subsoil and Foundation Investigation
Strawberry Park Elementary School Additions
39620 Amethyst Drive
Steamboat Springs, Colorado

Prepared for:

Steamboat Springs School District RE-2
P.O. Box 774368
Steamboat Springs, CO 80477

Attn: Mr. Rick Denney

Job Number: 07-7417

February 10, 2007

(970) 879-7888 • Fax (970) 879-7891
2580 Copper Ridge Drive • Steamboat Springs, CO 80487

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Conclusions

The proposed building additions should be supported on a foundation system consisting of spread footings placed on the natural sands and gravels or on properly compacted structural fill materials placed over the natural sands and gravels. Design parameters for the proposed structures are outlined herein.

Purpose and Scope of Study

This report presents the results of Subsoil and Foundation Investigation for the proposed Strawberry Park Elementary School Additions to be constructed at 39620 Amethyst in Steamboat Springs, Colorado. The approximate location of the project site is shown on Figure #1.

A field exploration program was conducted to obtain information on the subsurface conditions at the proposed building sites. Material samples obtained during the subsurface investigation were tested in the laboratory to provide data on the classification and engineering characteristics of the on-site soils. The results of the field and laboratory investigations are presented herein.

This report has been prepared to summarize the data obtained and to present our conclusions and recommendations based on our understanding of the proposed construction and the subsurface conditions encountered. Design parameters and a discussion of geotechnical engineering considerations related to construction of the proposed building additions are included.

Proposed Construction

It is our understanding that one or two additions will be made to existing elementary school building either on the north and/or west side of the building. It is also our understanding that the proposed additions will consist of one-story wood or brick-framed structures constructed with concrete slab-on-grade floor systems placed from 0 to 3 feet above the existing ground surface.

For design purposes, we have assumed the structure loadings to be light to moderate, typical of this type of construction. If loadings or conditions are significantly different from those described above, we should be notified to reevaluate the recommendations contained in this report.

Site Conditions

The project site is located west of Amethyst Drive in Steamboat Springs, Colorado. The existing Strawberry Park Elementary and Middle Schools are currently located at the site. The proposed building sites were covered with 6 to 18 inches of snow at the time the field investigation was completed. The vegetation to the north and west of the existing elementary school appears to consist of grasses and weeds with scattered cottonwood trees. An active ditch, creek, and wetland areas are located to the west and north of the proposed building sites.

The north building site generally slopes gently down to the north on the order of 1 to 3 percent. It appears that a maximum elevation difference of approximately 1 to 2 feet exists across this portion of the site. The west building site is generally flat with a minimal slope to the west. The west building site is occupied by and existing playground and temporary modular classroom building.

Field Investigation

The field investigation for this project was conducted on January 12, 2007. Three (3) test holes were advanced at the approximate locations shown in Figure #2 to determine the subsurface conditions. Locations of the test holes were determined by pacing from the existing structures at the site.

The test holes were advanced through the existing asphalt, fill materials, natural clays and natural sands and gravels with 4-inch diameter continuous flight augers. The test holes were advanced with an all-terrain drill rig and were logged by the project engineer for NWCC, Inc.

Samples of the subsurface materials were taken with either a California Liner or split spoon sampler. The samplers were driven into the various strata with blows from a 140-pound hammer falling 30 inches. This test is similar to the standard penetration test described by ASTM Method D-1586. Penetration resistance values, when properly evaluated, indicate the relative density or consistency of the soils. Depths at which the samples were taken and the penetration resistance values are shown on the logs of the exploratory test holes in Figure #3. The Legend and Notes associated with the test hole logs are shown in Figure #4.

Laboratory Investigation

Samples obtained from the exploratory test holes were examined and classified in the laboratory by the project engineer. The laboratory testing included standard property tests, such as natural moisture contents, density, grain size analyses, organic content and liquid and plastic limits. A swell-consolidation test was also conducted on a relatively undisturbed sample of the natural clays to determine the swell-consolidation potential of these materials.

Results of the swell-consolidation test are presented in Figure #5 and all of the other laboratory test results are summarized in the attached Table 1. The laboratory testing was conducted in general accordance with applicable ASTM specifications.

Subsurface Conditions

The subsurface conditions encountered at the site were variable and generally consisted of a layer of asphalt pavement, road base, fill materials and/or natural clays overlying natural sands and gravels to the maximum depth investigated, 13 feet. The logs of the exploratory test holes are shown in Figure #3 and the associated Legend and Notes are shown in Figure #4.

A 3-inch thick layer of asphalt pavement was encountered at the ground surface in test hole 1. A layer of road base fill materials was encountered beneath the asphalt pavement and was approximately 8 to 9 inches in thickness. Natural clays were encountered beneath the layer of road base materials in test hole 1 and at the ground surface in test hole 2. The natural clays extended to depths of 3½ and 4 feet beneath the existing ground surface. The clays were slightly sandy to sandy, low to moderately plastic, medium stiff to stiff, moist to wet and dark gray to black in color. Samples of the clays classified as CL soils in accordance with the Unified Soil Classification System. A layer of fill materials was encountered at the ground surface in test hole 3 and extended to a depth and of approximately 1 foot below the existing ground surface. The fill materials consisted of a mixture of topsoil and organics, clays, and sands and gravels. The fill materials were fine to coarse grained, low to moderately plastic, medium stiff, moist and brown in color. Natural sands and gravels were encountered below the clays in test holes 1 and 2, and below the fill materials in test hole 3 at depths ranging from 1 to 4 feet beneath the existing ground surface. The natural sands and gravels extended to the maximum depth investigated in each test hole. Practical rig refusal was encountered at depths of 13, 8, and 9 feet in the test holes on boulders. The sands and gravels were slightly silty to silty, fine to coarse grained with occasional cobbles and boulders, low to non-plastic, dense to very dense, moist to wet and dark brown to brown in color. Samples of the sands and gravels classified as SM-GM soils in accordance with the Unified Soil Classification System.

A swell-consolidation test conducted on a sample of the natural clays indicate that these materials will exhibit a very low to low swell potential, and a moderate to high consolidation potential when wetted under a constant load. The swell-consolidation test results are presented in Figure #5 and all of the other laboratory test results are summarized in the attached Table 1.

Groundwater seepage was encountered in all of the test holes at the time of drilling at depths ranging from 3 ½ to 4 feet beneath the ground surface. It should be noted that groundwater conditions can be expected to fluctuate with changes in precipitation and runoff at the site.

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, we believe an economically feasible type of foundation system is spread footings or individual pads with grade beams founded on the undisturbed natural sands and gravels or properly compacted structural fill materials placed over the natural sands and gravels.

1) The footings placed on the undisturbed, sands and gravels or properly compacted structural fill materials should be designed using an allowable soil bearing pressure of 3,000 psf. A minimum dead load pressure is not required for footings placed on the natural sands and gravels or properly compacted structural fill materials placed over the natural sands and gravels after the clays are removed.

2) The footings or pad sizes should be computed using the above soil pressures and placed on the natural undisturbed sands and gravels found below the layer of clays and fill materials or on properly compacted structural fill materials placed over the natural sands and gravels.

3) Any existing asphalt pavement, fill materials, natural clays, topsoil and organic materials, loose or soft natural soils encountered within the foundation excavations, should be removed and the excavations extended to competent natural sands and gravels prior to structural fill or concrete placement. Any fill materials placed beneath the footings should be a non-expansive granular soil approved by the soil engineer. 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/AASHTO T-99. The structural fill materials should extend out from the edge of the footings on a 1(horizontal) to 1(vertical) or flatter slope. The on-site sands and gravels can be used for structural fill materials after the cobbles and boulders are removed.

4) It appears that the foundation excavations will most likely be constructed at or below the groundwater surface at the site. The excavations will probably have to be dewatered during construction. We strongly recommend that a gravel mat consisting of a minimum of 12 inches of free draining gravels be placed beneath the footings to aid in drainage and to reduce the disturbance of the bearing soils, which could cause differential settlement of the foundations. The gravels should be compacted to at least 80% of the maximum relative density.

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

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

7) Based on experience, we estimate the total settlement for footings and pads designed and constructed as discussed in this section will be approximately 1 inch. Additional bearing capacity values along with the associated settlements are presented in Figure #6.

8) We strongly recommend that the client retain our firm to observe the foundation excavations when they are near completion to identify the bearing soils and confirm the recommendations in this report, as well as test the fill materials placed under the foundations for compaction.

Floor Slabs

We have assumed that the lower levels of the structures will be constructed utilizing concrete slab-on-grade floor systems placed from 0 to 3 feet above the existing ground surface. The on-site soils, with the exception of the existing fill materials and topsoil and organic materials, are suitable to support slab-on-grade construction. However, floor slabs present a difficult problem where moisture sensitive 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 clays encountered at this site, we believe slab-on-grade construction may be used, provided the risk of distress resulting from slab movement is recognized and special design precautions are followed.

The following measures should be taken to reduce the damage, which could result from movement should the underslab clays be subjected to moisture changes.

1) The floor slabs should be separated from all bearing walls, columns and their foundation supports with a positive slip joint. We recommend the use of ½-inch thick cellotex or impregnated felt.

2) Interior non-bearing partition walls resting on the floor slabs should be provided with a slip joint, preferably at the bottom, so that 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 #7.

3) A minimum 6-inch gravel layer should be provided beneath all floor slabs to act as a capillary break and to help distribute pressures. Prior to placing the gravel, the 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 of the existing asphalt, fill materials and topsoil and organic materials should be removed prior to placement of the underslab gravels or new fill materials.

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

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

6) If fills are required to bring the underslab soils to the desired grade, the fill should consist of non-expansive, granular materials. The fill should be uniformly placed and compacted in 6 to 8 inch loose lifts to at least 95% of the maximum standard Proctor density at or near the optimum moisture content, as determined by ASTM D-698/AASHTO T-99.

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 remove all of the clays or construct a structural floor over a well-vented crawl space.

Underdrain System

Any lower floor levels or crawl space areas constructed below the existing or finished ground surfaces should be protected by underdrain systems to help reduce the problems associated with surface and subsurface drainage during high runoff periods. Localized perched water or runoff can infiltrate the lower levels of the structure at the foundation level. 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. The 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.

The 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 level and at least 6 inches below the bottom of the footings. We recommend the use of perforated PVC pipe for the drainpipe, which meets ASTM D-2729 requirements, to minimize the potential for crushing the pipe during backfill operations. The holes in the drainpipe should be oriented down between 4 o'clock and 8 o'clock to promote rapid runoff of the water. The 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. The drains should have a minimum slope of 1/8 inch per foot and should be day lighted at positive outfalls protected from freezing, or be led to sumps from which the water can be pumped. Caution should be taken when backfilling so as not to damage or disturb the installed underdrains. We recommend the drainage systems include at least one cleanout, be protected against intrusion by animals at the outfalls and be tested prior to backfilling. We also recommend that the client retain this firm to observe the underdrain systems during construction to verify that they are being installed in accordance with our recommendations and observe a flow test prior to backfilling the systems.

In addition, we recommend that an impervious barrier be constructed to keep water from flowing under the footings. 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 #8. The placement of the impervious membrane and properly compacted clays in the crawl space areas to the top of the footings will help reduce the moisture problems in these areas.

If any lower levels of the structures are placed within 2 feet of the seasonal high groundwater table, then an interior underslab drainage system will be required for these levels. The design of an interior underslab drainage system is beyond the scope of work of this report. Our firm can assist in the design of the underslab drainage system upon request.

Foundation Walls and Retaining Structures

Foundation walls and retaining structures, which are laterally supported and can be expected to undergo only a moderate amount of deflection, may be designed for a lateral earth pressure computed on the basis of an equivalent fluid unit weight of 45 pcf for imported, free draining granular backfill, 50 pcf for the on-site sands and gravels and 55 pcf for the on-site clays and fill materials.

Cantilevered retaining structures on the site can be expected to deflect sufficiently to mobilize the full active earth pressure condition. Therefore, cantilevered structures may be designed for a lateral earth pressure computed on the basis of an equivalent fluid unit weight of 35 pcf for imported, free draining granular backfill, 40 pcf for the on-site sands and gravels and 45 pcf for the on-site clays and fill materials.

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

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

We recommend 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 7 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.

Surface Drainage

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

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

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

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

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

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

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

Site Grading

Where permanent embankment fills are required, we recommend that the finished fill slopes not exceed 2 (H) to 1 (V) configuration. The fill slopes should be limited to 20 feet in height. All fills should be benched into hillsides exceeding 4(H):1(V). Positive surface drainage should be provided around all permanent cut and fill slopes to direct surface drainage away from the slope faces. All cut and fill slopes and other stripped areas should be protected against erosion by revegetation or other methods.

All of the fill materials placed beneath the floor slabs, pavement areas, underground utilities or embankments should be uniformly placed and compacted to at least 95 percent of the maximum standard Proctor density and within 2 percent of the optimum moisture content as determined in accordance with ASTM D-698/AASHTO T-99. The fill materials placed in these areas should not contain boulders, topsoil, organics or other deleterious substances. The fill materials placed in the landscaped areas should be compacted to at least 90 percent of the maximum standard Proctor density. The materials not suitable for use under the building and pavement areas should be placed in the bottom of the fills in landscaped areas, where some settlement can be tolerated.

We recommend that the unretained cuts constructed in the natural overburden soils not exceed a 2(H) to 1(V) configuration and the cuts in the topsoil and organic materials not exceed a 3(H) to 1(V) configuration. Flatter slopes than those indicated above for the topsoil and overburden soils are often desirable in that they help reduce erosion and minor sloughing of newly constructed cuts and also help with revegetation efforts.

Groundwater seepage is likely to be encountered in the cuts or utility trench excavations constructed greater than 10 feet below the existing ground surface. If groundwater seepage is encountered in the overburden soils, this seepage may increase the risk of slope instability and these areas will need to be reevaluated. Additional stabilization measures will probably be required in these areas. Dewatering may also be required during construction of the utility trenches. In addition, soils from the deeper excavations may be over the optimum moisture content and may have to be dried out prior to use as fill materials.

Site grading should be carefully planned to provide positive surface drainage away from all building and pavement areas. The building and pavement areas should be placed as high as possible on the site so that positive drainage away from these structures can be provided. Surface diversion features should be provided around parking areas to prevent surface runoff from flowing across the paved surfaces.

Limitations

The recommendations given in this report are based on the soils encountered at this site and our understanding of the proposed construction. We believe that this information gives a high degree of reliability for anticipating the behavior of the proposed structure; however, our recommendations are professional opinions and cannot control nature, nor can they assure the soils profiles beneath those or adjacent to those observed. No warranties expressed or implied are given on the content of this report.

Moisture sensitive/expansive soils were encountered at this site. These soils are stable at their natural moisture content but can shrink or swell with changes in moisture. The behavior of swelling soils is not fully understood. The swell potential of any particular site can change erratically both in lateral and vertical extent. Moisture changes also occur erratically, resulting in conditions, which cannot always be predicted. The recommendations presented in this report are based on the current state of the art for foundations and floor slabs on swelling soils. The owner should be aware that there is a risk in construction on these types of soil. 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 structure. Any distress noted in the structure should be brought to the attention of a professional engineer.

This report is based on the investigation at the described site and on the specific anticipated construction as stated herein. If either of these conditions is changed, the results would also most likely change. Therefore, we strongly recommend that our firm be contacted prior to finalizing the construction plans so that we can verify that our recommendations are being properly incorporated into the construction plans. Man-made or natural changes in the conditions of a property can also occur over a period of time. In addition, changes in requirements due to state of the art knowledge and/or legislation do from time to time occur. As a result, the findings of this report may become invalid due to these changes. Therefore, this report is subject to review and not considered valid after a period of 3 years or if conditions as stated above are altered.

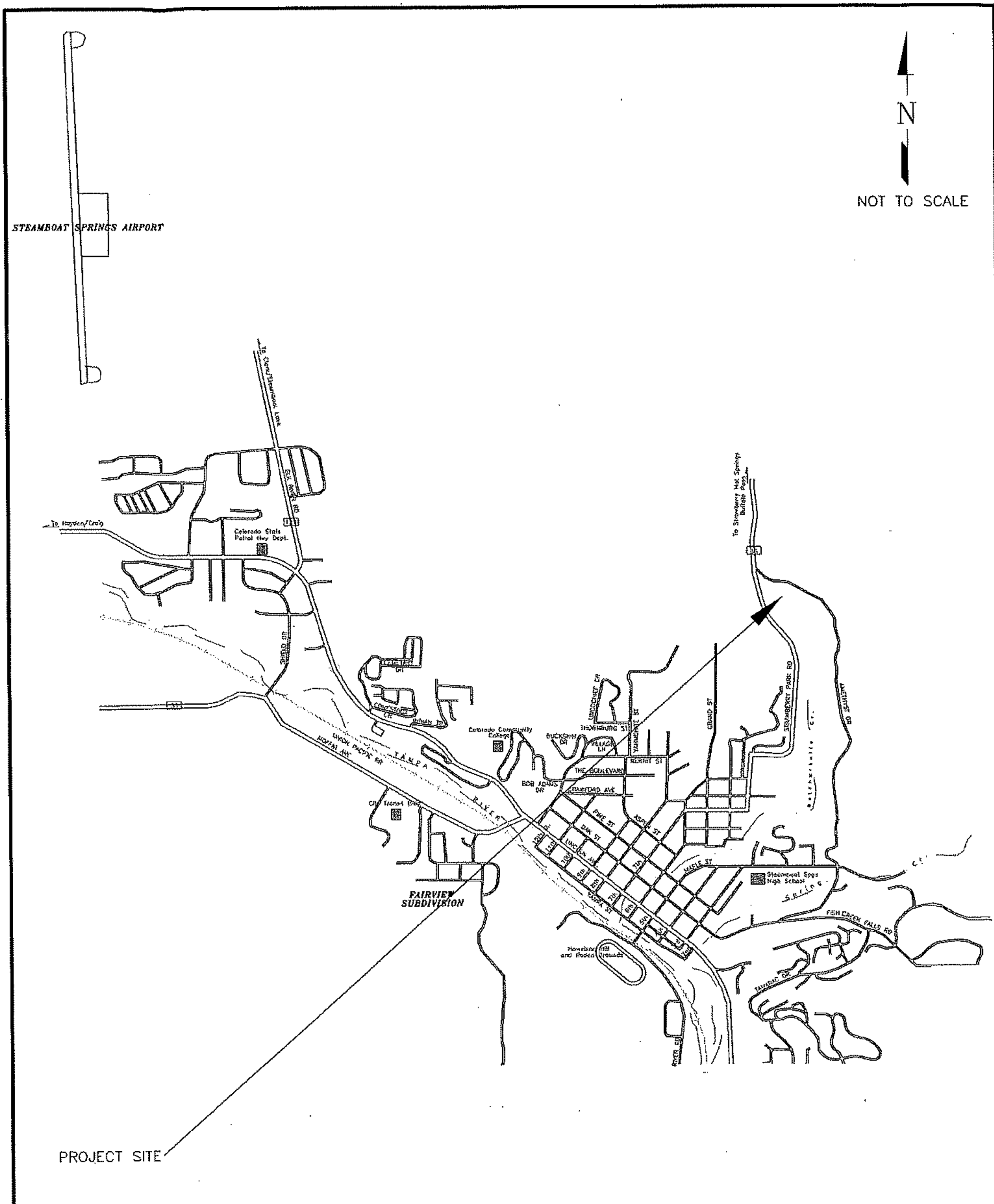
It is the responsibility of the owner or his representative to insure that the information in this report is incorporated into the plans and/or specifications and construction of the project. It is advisable that a contractor familiar with construction details typically used to dealing with the local subsoils and climatic conditions be retained to build the structure. If you have any questions regarding this report or if we may be of further service, please do not hesitate to contact us.

Sincerely,
NWCC, INC.

Josh P. Frappart, E.I.T.

Reviewed by Brian D. Len, P.E.

COLORADO LICENSED
BRIAN D. LEN
25750
PROFESSIONAL ENGINEER



Title: VICINITY MAP

Date: 1/31/07

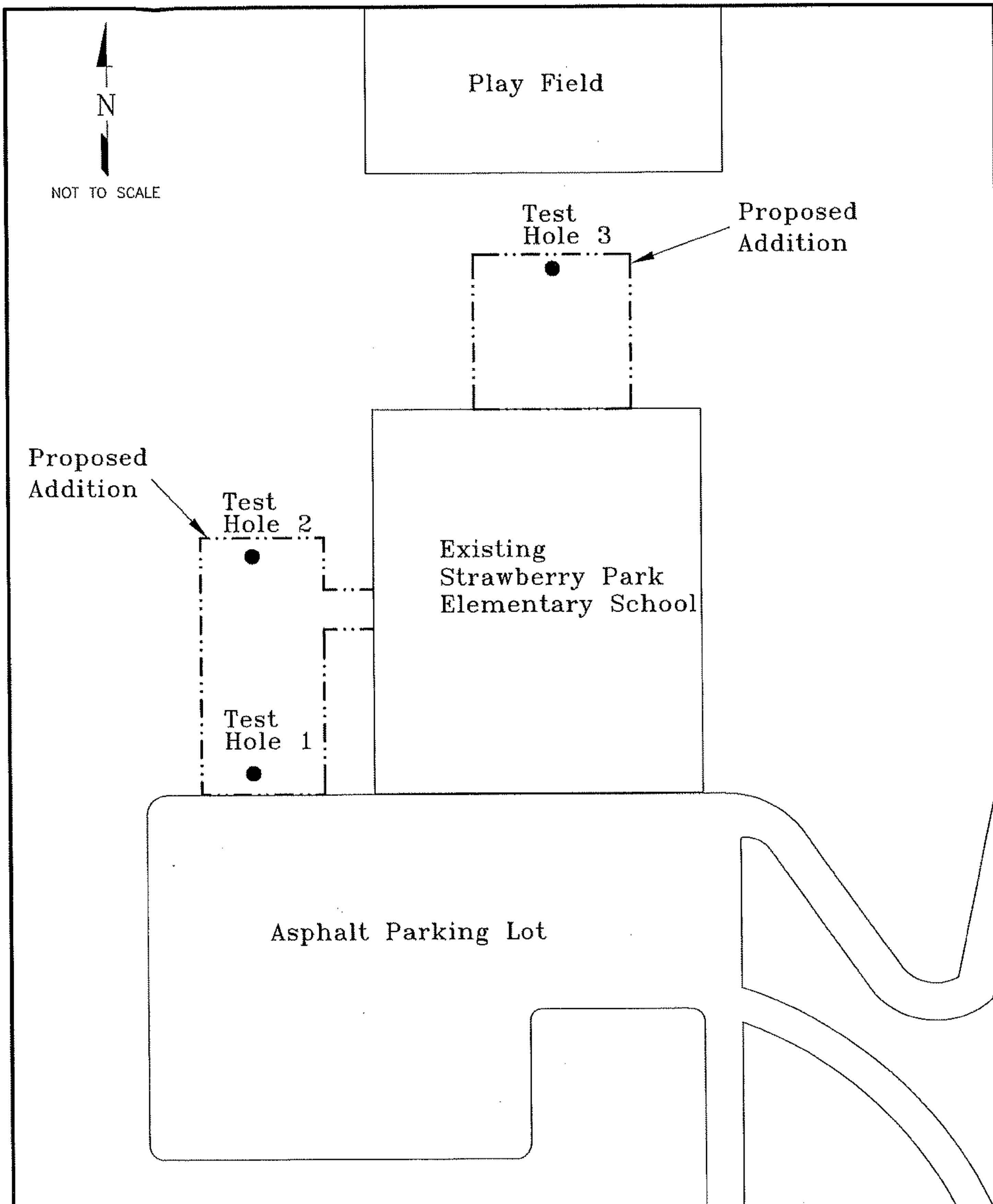
Job Name: Strawberry Park Elementary School Addition

Job No. 07-7417

Location: 39620 Amethyst Drive, Steamboat Springs, Colorado

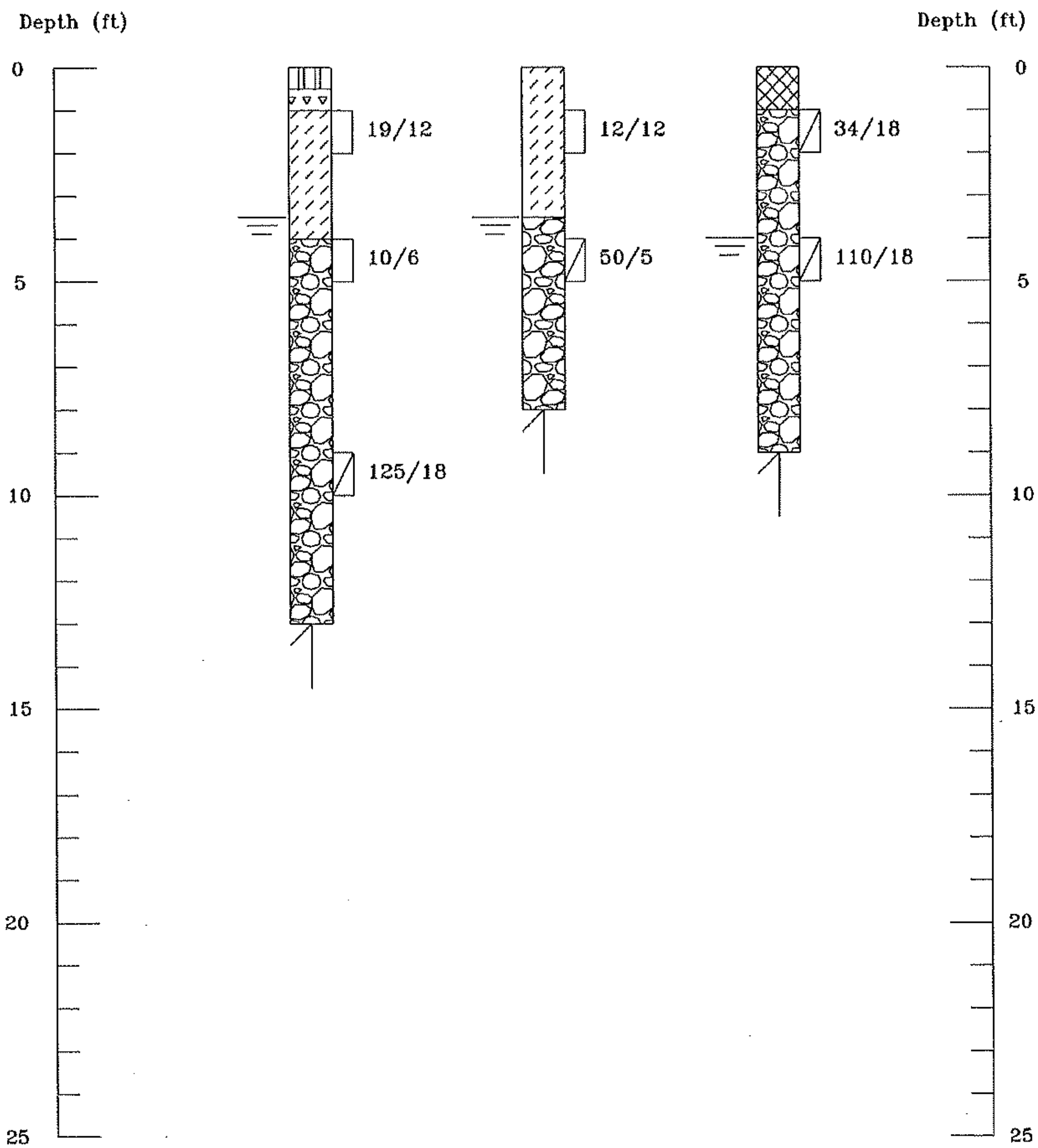
Figure #1

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



Title: SITE PLAN–LOCATION OF TEST HOLES	Date: 1/31/07	North West Colorado Consultants, Inc. Geotechnical / Environmental Engineering • Materials Testing
Job Name: Strawberry Park Elementary School Addition	Job No. 07–7417	(970)879-7888 · Fax (970)879-7891 2580 Copper Ridge Drive · P.O. Box 775226 Steamboat Springs, Colorado 80477
Location: 39620 Amethyst Drive, Steamboat Springs, Colorado	Figure #2	

Test Hole 1 Test Hole 2 Test Hole 3



Title: LOGS OF EXPLORATORY TEST HOLES	Date: 1/31/07	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: Strawberry Park Elementary School Addition	Job No. 07-7417	
Location: 39620 Amethyst Drive, Steamboat Springs, Colorado	Figure #3	

LEGEND:

ASPHALT:

ROAD BASE:

FILL: Topsoil, clays, sands and gravels, fine to coarse grained, low to moderately plastic, medium stiff, moist and brown in color.

CLAYS: Slightly sandy to sandy, low to moderately plastic, medium stiff to stiff, moist to wet and dark gray to black in color.

SANDS AND GRAVELS: Slightly silty to silty, fine to coarse grained with occasional cobbles and boulders, low to non-plastic, dense to very dense, moist to wet and dark brown to brown in color.

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

Drive Sample, Split Spoon Sampler.

19/12 Drive Sample Blow Count, indicates 19 blows of a 140-pound hammer falling 30 inches were required to drive the sampler 12 inches.

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

Indicates depth at which practical rig refusal was encountered in boulders.

NOTES:

1) The test holes were drilled on January 12, 2007 with an all terrain drill rig using 4-inch diameter continuous flight power augers.

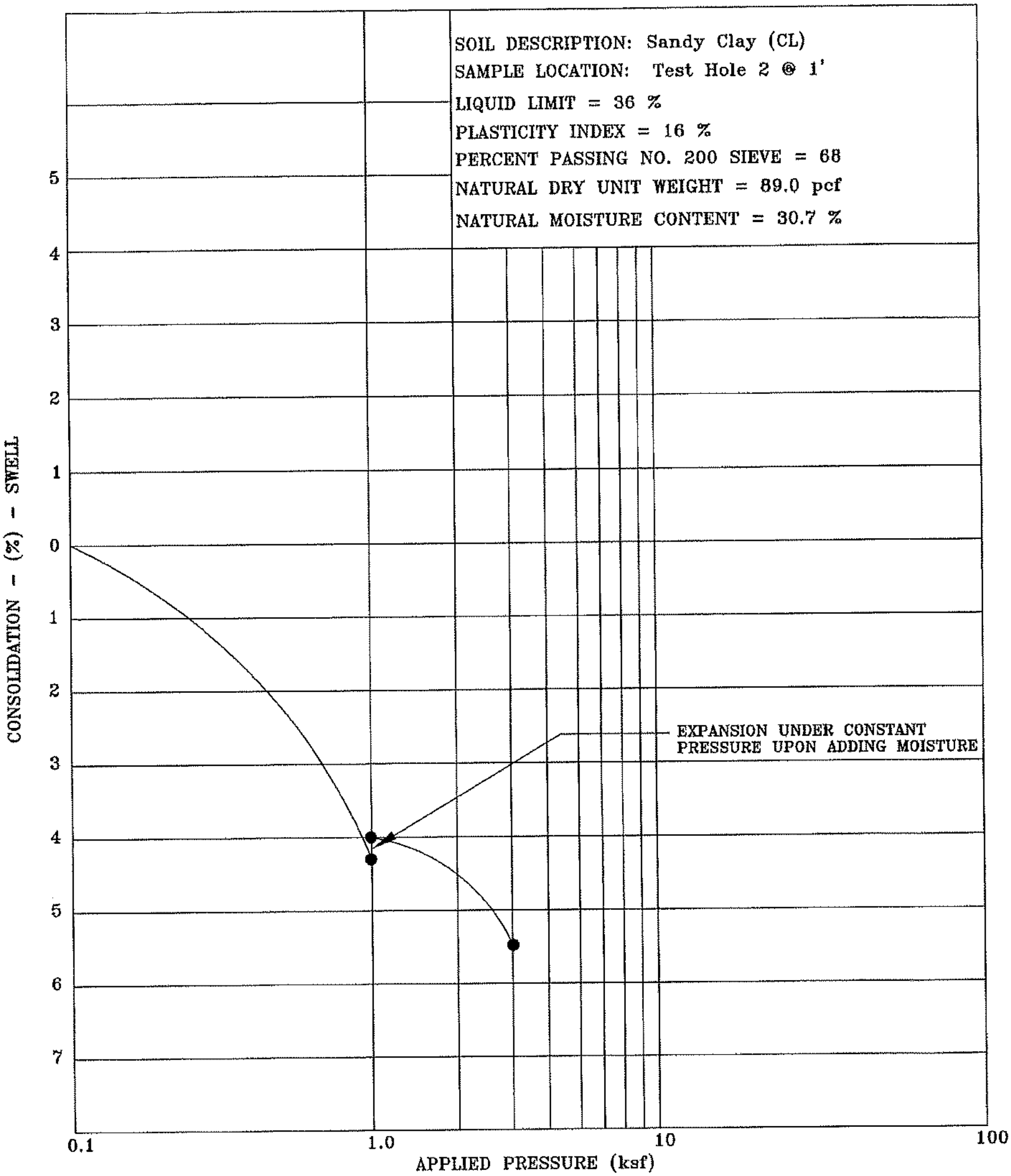
2) Locations of the test holes were determined in the field by pacing from existing structures at the site.

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: 1/31/07	NWCC North West Colorado Consultants, Inc.
Job Name: Strawberry Park Elementary School Addition	Job No. 07-7417	Geotechnical / Environmental Engineering • Materials Testing
Location: 39620 Amethyst Drive, Steamboat Springs, Colorado	Figure #4	(970)879-7888 • Fax (970)879-7891 2580 Copper Ridge Drive -P.O. Box 775226 Steamboat Springs, Colorado 80477



Title: SWELL–CONSOLIDATION TEST RESULTS	Date: 1/31/07
Job Name: Strawberry Park Elementary School Addition	Job No. 07-7417
Location: 39620 Amethyst Drive, Steamboat Springs, Colorado	Figure #5

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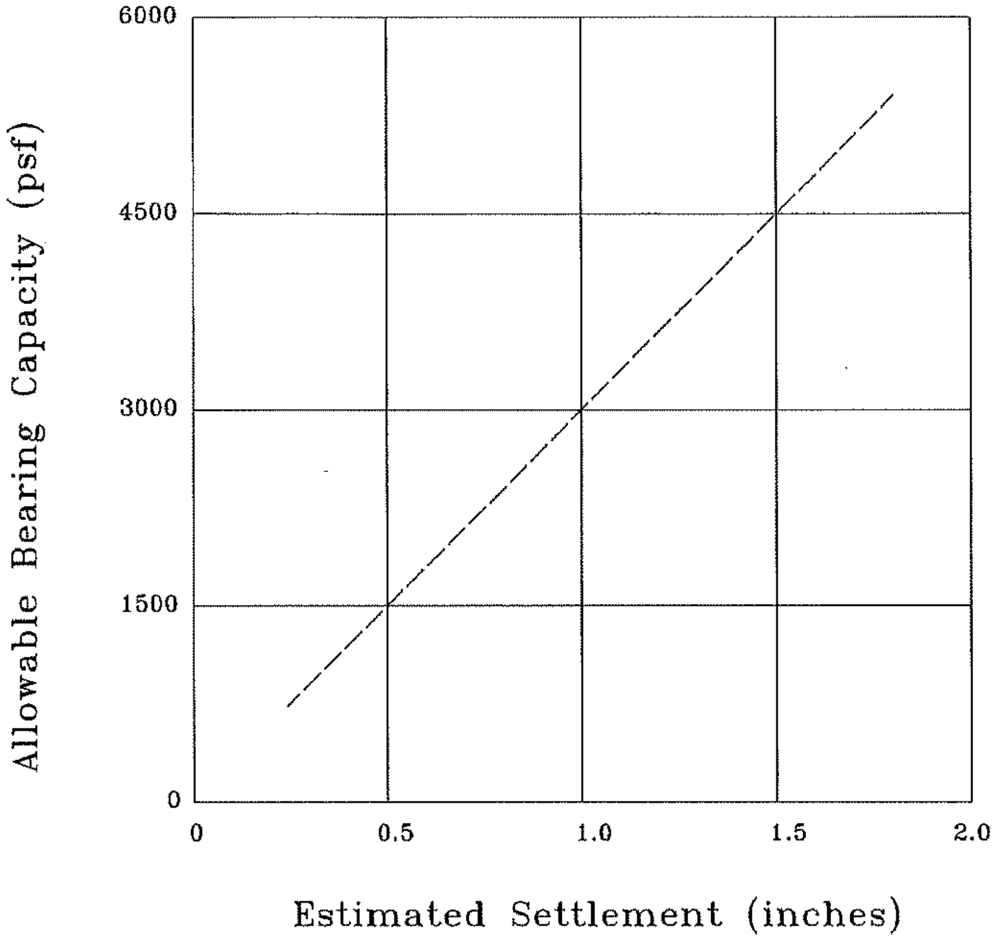
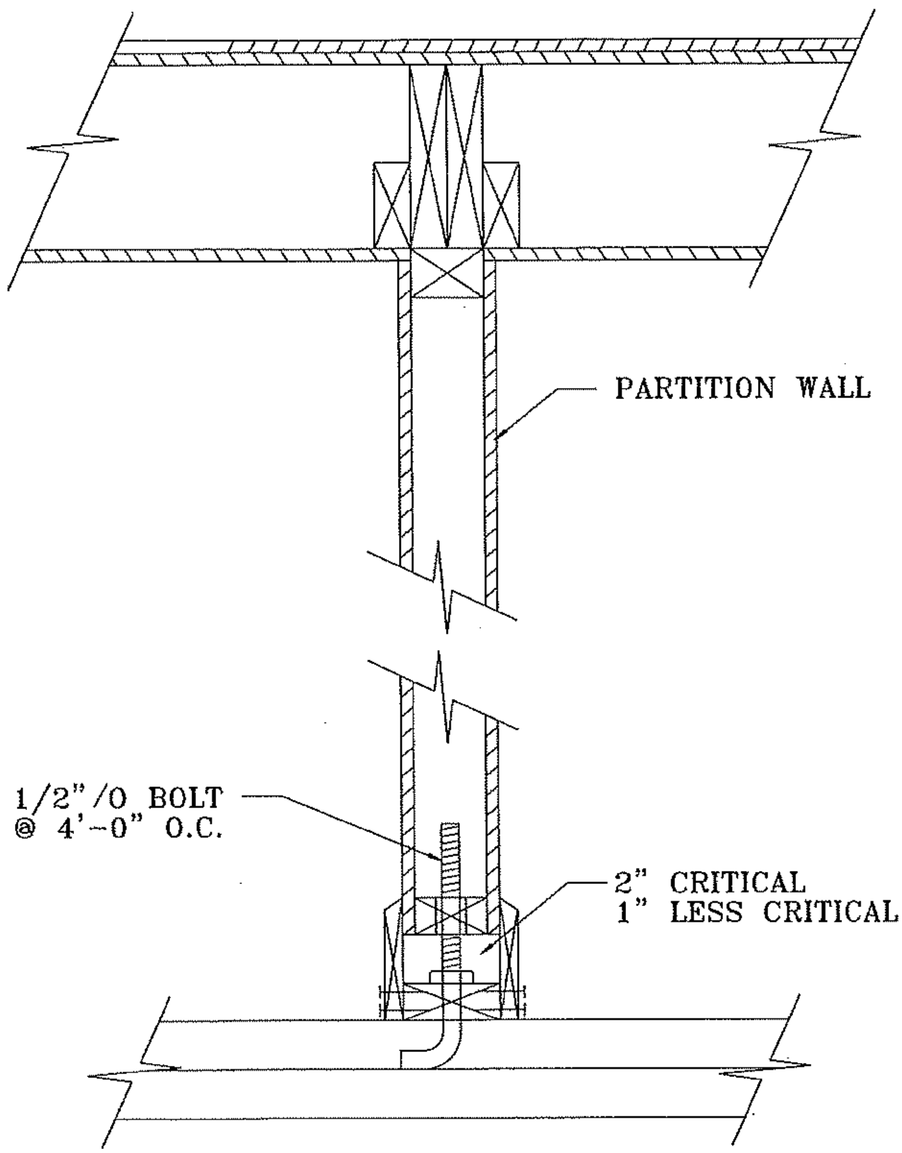
Steamboat Springs, Colorado 80477



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: 1/31/07	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 775229 Steamboat Springs, Colorado 80477
Job Name: Strawberry Park Elementary School Addition	Job No. 07-7417	
Location: 39620 Amethyst Drive, Steamboat Springs, Colorado	Figure #6	



Title: HUNG PARTITION WALL DETAIL	Date: 1/31/07
Job Name: Strawberry Park Elementary School Addition	Job No. 07-7417
Location: 39620 Amethyst Drive, Steamboat Springs, Colorado	Figure #7

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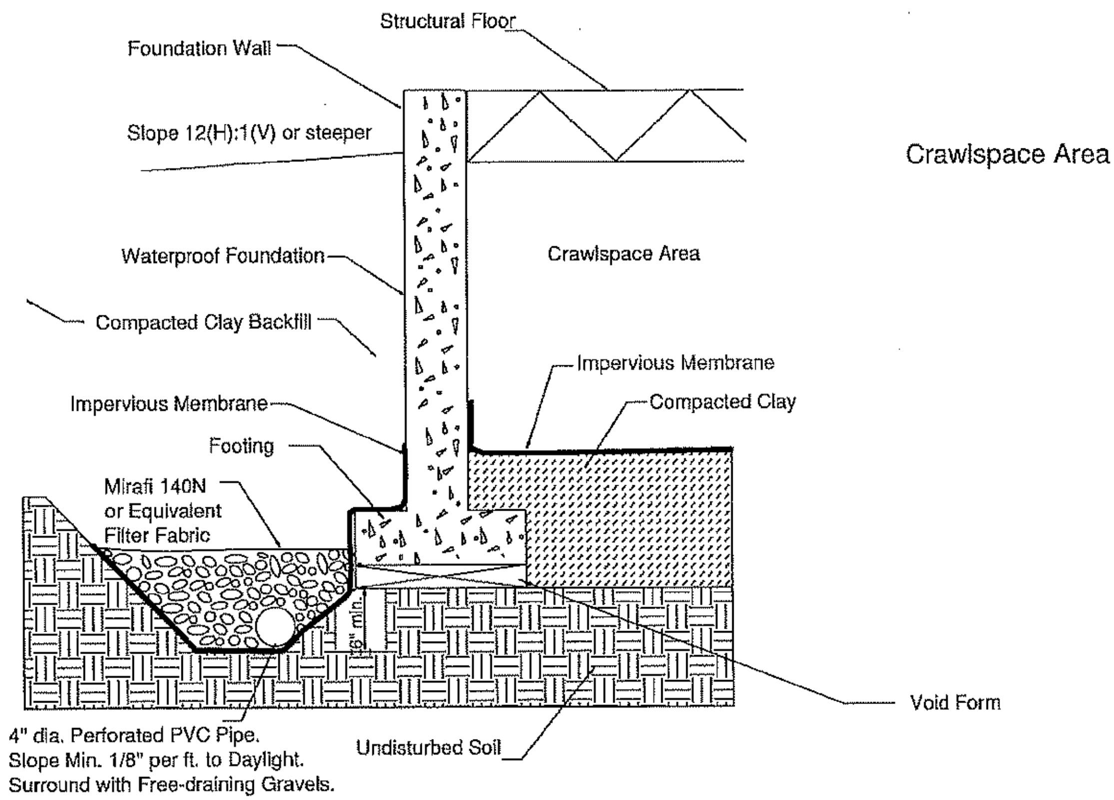

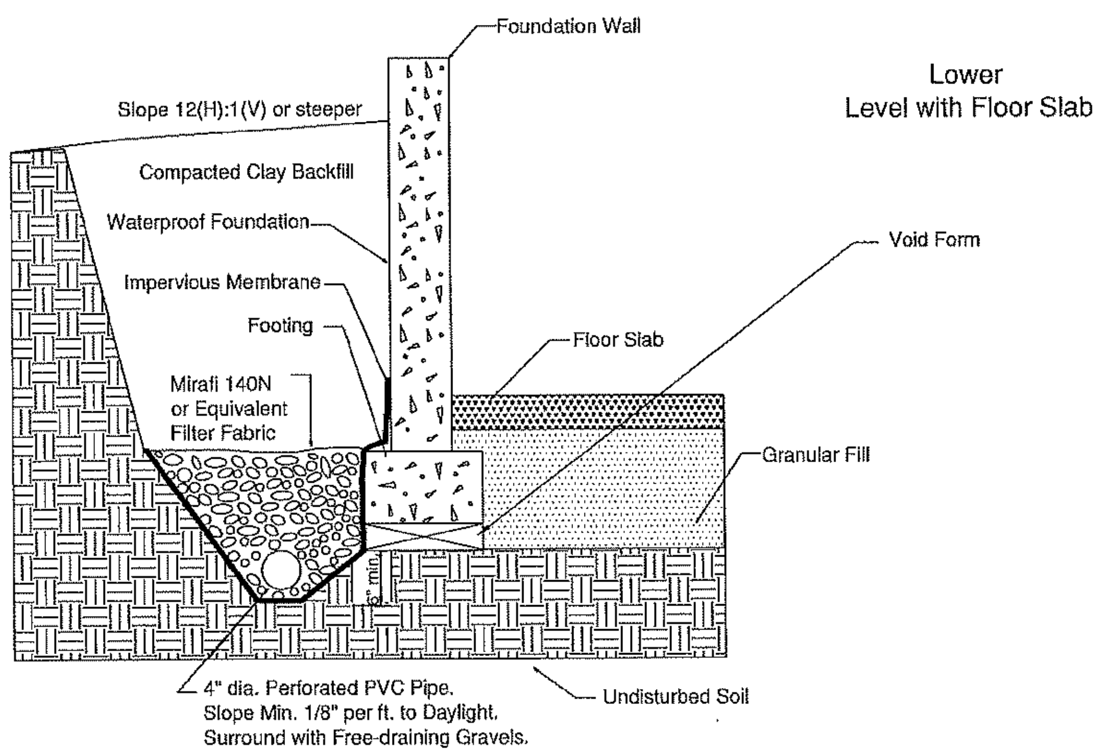

Title: PERIMETER/UNDERDRAIN DETAIL	Date: 1/31/07	NWCC North West Colorado Consultants, Inc. Geotechnical / Environmental Engineering - Materials Testing (970)879-7888 - Fax (970)879-7891 2580 Copper Ridge Drive - P.O. Box 775226 Steamboat Springs, Colorado 80477
Job Name: Strawberry Park Elementary School Addition	Job No. 07-7417	
Location: 39620 Amethyst Drive, Steamboat Springs, Colorado	Figure #8	

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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	ORGANIC CONTENT (%)	SOIL or BEDROCK DESCRIPTION	UNIFIED SOIL CLASS.
TEST HOLE	DEPTH (feet)			LIQUID LIMIT (%)	PLASTICITY INDEX (%)	GRAVEL (%)	SAND (%)				
1	1								5.5	Sandy Clay	CL
1	9	8.7		NP	NP	49	42	9		Slightly Silty Sands and Gravels	SM-GM
2	1	30.7	89.0	36	16	0	32	68		Sandy Clay	CL
3	4	9.2		NP	NP	51	41	8		Slightly Silty Sands and Gravels	SM-GM

JOB NUMBER: 07-7417