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

Preliminary Subsoil Investigation and Supplemental Geologic Hazard Evaluation
Proposed Alpine Mountain Ranch LPS
A Parcel in Section 34, Township 6 North, Range 84 West
And in Section 3, Township 5 North, Range 84 West
Routt County, Colorado

Prepared For:

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Conclusions

We believe that the construction of the proposed residential development is feasible from a geotechnical standpoint provided the recommendations in this report are followed. A discussion of geologic and geotechnical considerations related to the proposed development are outlined herein. It should be noted that this investigation is preliminary in nature with regards to the construction of the individual building sites and detailed Subsoil and Foundation Investigations on a site-specific basis should be performed prior to construction on each of the lots.

Purpose and Scope of Study

This report presents the results of a Preliminary Subsoil Investigation and Supplemental Geologic Hazard Evaluation for the Proposed Alpine Mountain Ranch LPS to be developed within a $^{+/-}$1,500-acre parcel of land located within Section 34 in Township 6 North, Range 84 West and Section 3 in Township 5 North, Range 84 West of the 6th P.M. in Routt County, Colorado. The approximate location of the project site is shown in Figure #1.

A field exploration program was conducted to obtain general information on subsurface conditions. Material samples obtained during the subsurface investigation were tested in the laboratory to provide data on the general classification and engineering characteristics of the on-site soils and bedrock materials. 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 preliminary recommendations based on our current understanding of the proposed construction and development, and the subsurface conditions encountered. A discussion of preliminary geotechnical engineering considerations, local geology and site conditions related to construction of the proposed residential development are included.

Proposed Development

It is our understanding that the subject property was originally to be subdivided into 43 residential lots under Routt County's Land Preservation Subdivision (LPS) regulations. At this time, an additional 20 "contingent" lots are now planned for the subdivision. The contingent lots are proposed as additional development density pursuant to the amendments to the LPS regulations recently adopted by the county. We understand that the development will have a central water supply system and that individual on-site wastewater systems (OWS's) will be required for each lot. A ranch manager's residence, guest cabin and welcome center building are planned near the subdivision main entrance. Primary access to the development will be gained from a new intersection with U.S. Highway 40 located in the southwest corner of the property. Subdivision roadway construction for the original development plan included approximately 35,000 lineal feet of new roadways, as well as a two-span bridge over Walton Creek. Much of the proposed roadway cuts and embankment fills will be limited to a maximum of 10 feet in depth. However, isolated

areas along all of the roads will have cuts and/or fills up to 30 feet in depth and several isolated areas will have cuts of up to 70 feet and fills up to 40 feet (as measured from the finished roadway grade to catch points). These proposed cut and fill depths are based on a preliminary site grading plan prepared by Civil Design Consultants using 2 (Horizontal) to 1(Vertical) slope configurations and are measured from the final road surface to the cut or fill catch point. Steeper slope configurations and slope retention systems are being considered in some of the larger cut and fill areas to reduce site disturbance. One pond will be constructed in the lower meadow area situated east of Walton Creek and near the bridge crossing. The pond will be constructed for the purposes of extracting gravel materials for use in roadway building and will likely be finished as a fishing pond for a subdivision amenity. We also understand that no other significant overlot site grading is planned.

We anticipate structure loadings from the residential development will range from light to moderate. Structure loadings from the proposed bridge will likely be moderate to high. 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 property generally consists of undisturbed rural land used primarily for agricultural purposes of livestock grazing and hay production. Walton Creek flows down from the south and roughly forms the western boundary of the property. The river forms a gently sloping floodplain in this area with irrigation ditches providing additional water for hay production. The proposed ranch manager's residence, guest cabin, welcome center building sites and pond sites are located within this portion of the property and just east of Walton Creek. This portion of the property is characterized by open hay meadows with willow brush and mature cottonwood groves lining the creek drainage course. The topography of this portion of the site generally slopes gently to strongly down to the west from less than 5 percent up to 15 percent.

Most of the development activities will be located on the upland areas east of the Walton Creek drainage and the lower hay meadows. This area consists of upland ridges and slopes that form the lower elevations of the Park Range mountain front. The topography of this portion of the site consists of several west-trending ridge lines sloping strongly to steeply on the order of 15 to 35 percent. Vegetation ranges from grasses, weeds, deciduous brush scrub oak and aspen on the more arid south facing slopes and ridge lines to coniferous forest on some of the steeper north facing slopes.

The primary drainage within the development area is Pine Spring Gulch which is a tributary of Walton Creek. The drainage runs down from the southeast corner of the property, through the central portion of the site joining with Priest Creek near the existing ranch manager's residence in the north-central portion of the property and just upstream of its confluence with Walton Creek. A ditch delivering irrigation water to the lower meadow area enters the south property line and runs approximately 2,500 feet along the crest of the southerly-most ridge line. The ditch

follows the ridge crest before flowing down the north side into the eastern meadow area. The ditch has eroded a sizable channel up to 20 feet in depth into the ridge exposing the overburden soils and bedrock materials. The channels banks are nearly vertical in some areas and erosion appears to be ongoing.

The "contingent" lot development areas are concentrated in two main areas: (1) 12 lots in the forested areas east of Pine Spring Gulch in the southeastern portion of the property and (2) 4 lots in along the north side of Priest Creek in the west-central portion of the property. The topography in these areas typically slopes strongly to steeply down to the west and south from 15 to 35 percent. Visual observations of or subsurface investigations in these area have not been conducted at the time of this report due to limitations from snow cover.

Field Investigation

The field investigations for this project were conducted between August 31 and September 28, 2005. Thirteen (13) test holes and seventeen (17) test pits were drilled or excavated at the approximate locations shown on Figure #2 to explore the subsurface conditions across the site. Locations of the test holes were determined approximately by pacing from building sites and roadway centerlines as staked in the field and shown on the site plan provided. The test holes and test pits were advanced mainly along the proposed roadway alignments that provide access to the development areas. Logs of the exploratory test holes are shown in Figures #3 and #4, and the logs of the exploratory test pits are shown in Figures #5 through #7. The Legend and Notes associated with the logs are shown in Figure #8.

Laboratory Investigation

Samples obtained from the test holes were examined and classified in the laboratory by the project engineer. Laboratory testing included standard property tests such as natural moisture contents, unit weights, grain size analyses and Atterberg limits. Swell-consolidation testing was also conducted on samples of the sands and clays, and bedrock materials to determine the compressibility or swell characteristics of these soils under loading and saturation. In addition, unconfined-compressive strength tests were conducted on samples of the overburden soils and bedrock.

The swell-consolidation test results are shown in Figures #9 through #18 and all of the other test results are summarized in the attached Table 1. The laboratory testing was conducted in general accordance with applicable ASTM/AASHTO specifications.

Subsurface Conditions

The subsurface conditions encountered in the test holes and test pits were variable and generally consisted of a layer of topsoil and organics overlying natural sands and clays, sands and gravels, gravels, cobbles and boulders, sandstone-siltstone-claystone bedrock materials of the Browns Park Formation or granite and gneiss bedrock to the

maximum depth investigated, 20 feet. Graphic logs of the exploratory test holes and test pits are shown in Figures #3 through #7 and the associated Legend and Notes are presented in Figure #8.

A layer of topsoil and organics was encountered at the ground surface of all the test holes and test pits and generally ranged in thickness from approximately less than 6 inches up to 42 inches.

Natural sands and clays were encountered below the topsoil and organic materials in many of the test holes and pits and extended to depths ranging from 5 to 11 feet. The sands and clays were fine grained with occasional gravels and cobbles, low to moderately plastic, stiff to very stiff to medium dense, moist and reddish brown to brown in color. Samples of the sands and clays classified as SC and CL and soils in accordance with the Unified Soil Classification System.

Clayey to silty sands and gravels were encountered beneath the topsoil and organics in test holes 6, 8, 9 and 10 and in test pits 2 and 3. The sands and gravels were clayey to silty, fine to coarse grained, low plastic, dense, slightly moist and brown in color. Samples of the sands and gravels classified as SM soils in accordance with the Unified Soil Classification System.

Gravels, cobbles and boulders were encountered beneath the topsoil and organics in test pits 11, 12, 13, 14 and 17. The gravels, cobbles and boulders were sandy, clean, non-plastic, medium dense, moist to wet and brown in color. Samples of the gravels, cobbles and boulders classified as GW and SW-GW soils in accordance with the Unified Soil Classification System.

Sandstone-siltstone-claystone bedrock of the Browns Park Formation was encountered beneath the topsoil and organics, sands and clays and/or sands and gravels in many of the test holes and test pits. The bedrock materials were low to moderately plastic, fine grained, weathered to very hard, weakly to lightly cemented, moist and light brown in color. Samples of the sandstone-siltstone-claystone bedrock materials classified as CL, SC-CL, SM, SM-ML, and ML soils in accordance with the Unified Soil Classification System.

Granite and gneiss bedrock was encountered beneath the sands and gravels in test hole 8 and beneath the sandstone-siltstone-claystone bedrock materials in test pit 2. These bedrock materials were non-plastic, very hard, dry and white to dark gray in color.

It should be noted that practical rig refusal was encountered at depths of 15, 16, 8 and 17 feet in test holes 1, 2, 8 and 12, respectively, in very hard bedrock materials. Practical rig refusal was also encountered at a depth of 7½ feet in test pit 2 in the bedrock materials.

Swell-consolidation testing conducted on relatively undisturbed samples of the natural sands and clays indicate that the materials tested will exhibit a low to moderate swell potential when wetted under a constant load. Swell-consolidation testing conducted on relatively undisturbed samples of the sandstone-siltstone-claystone bedrock

materials indicate that the samples tested also exhibit a low to moderate swell potential when wetted under a constant load. The swell-consolidation test results are summarized in the attached Table A and shown in Figures #9 through #18, and all of the other test results are summarized in the attached Table 1.

TABLE A

SUMMARY OF SWELL TEST RESULTS

Soil Type	Compression	Range of Swell (%)			
	<0	Low 0 to <2	Moderate 2 to <4	High 4 to <6	Very High >6
	Number of Samples and Percent				
Sands and Clays	0	2	3	0	0
Bedrock	0	2	3	0	0
Total	0	4	6	0	0
Percent	0%	40%	60%	0%	0%

Groundwater seepage was encountered at depths of 9 and 4½ feet beneath the ground surface in the test pits 11 and 12 at the time of excavation. The groundwater levels are shown on the logs of the exploratory test pits. It should be noted that the groundwater conditions can be expected to fluctuate with changes in precipitation and runoff conditions across the site. Irrigation practices in the lower hay meadows and water levels in Walton Creek are likely to significantly influence the groundwater levels in the vicinity of these features.

Preliminary Construction Considerations and Recommendations

Residential Foundations: The foundation recommendations for all of the proposed residences should be developed on an individual basis due to the highly variable nature of the subsurface conditions and swell potentials of the soils and bedrock materials. The final foundation grades for the structures should be carefully considered with the underlying soil conditions in mind. Foundations at the site may be founded on spread footings placed on the natural sands and clays, sands and gravels or bedrock materials in areas where the swell potential has been determined to be nil to low. In areas where the natural sands and clays or bedrock are encountered at the foundation level and the

swell potential is moderate to high, we recommend that these structures be founded on straight-shaft piers or piles advanced into the underlying sands and clays and/or bedrock materials. The location, depth and consistency of the soils and bedrock materials encountered during this investigation were highly variable and site specific investigations and sampling should be conducted for each structure to determine which foundation type is most appropriate and feasible.

Walton Creek Bridge Foundations: Based on the subsurface conditions encountered in test pits 11 and 12 and our understanding of the proposed construction, we believe the most feasible type foundation system for the proposed bridge abutments and any piers will be a spread footing foundation system placed on the natural gravels, cobbles and boulders. Due to the coarse grained nature of these soils and the groundwater conditions, we believe that a deep foundation system such as drilled piers or driven piles advanced into the underlying bedrock materials will be very difficult to achieve.

Spread footing foundations should be designed using an allowable soil bearing pressure of 5,000 psf and placed on a thin layer of structural fill or lean concrete placed directly on the undisturbed natural gravels, cobbles and boulders encountered beneath the topsoil and organics and any loose natural sands, and below the anticipated scour depth. It appears that the footing elevations may be near groundwater level and dewatering of excavations for construction is likely. We recommend the base of the excavations be stabilized by the placement of a 12 inch layer of lean concrete or compacted 1½-inch screened rock materials. This layer will aid in drainage and reduce disturbance to the bearing soils.

Water Storage Tank Site: Based on the subsurface conditions encountered in test hole 10, we anticipate that competent bedrock materials will be encountered within 10 feet of the existing ground surface at the proposed tank site. We believe that undisturbed bedrock materials will provide suitable bearing for the tank; however, the steep site will generate large lateral earth pressures, which may require additional retaining systems to reduce the pressure on the structure. Additional subsurface investigation for this structure is recommended, but will require an access road and platform be constructed for drill rig access.

Floor Slabs: Lightly to moderately loaded floor slabs-on-grade can be constructed at the site with varying degrees of protection from swelling subgrade materials depending on the swell potential. A layer of free draining gravel beneath the slab, separation from bearing walls and columns, control joints and subgrade overexcavation and replacement are some of the measures that should be taken to allow slab-on-grade construction. However, structural floor systems constructed over crawlspaces should be used in the areas where the swell potential is known to be moderate to high or in areas where the client and/or structure cannot tolerate the differential floor slab movement that will occur when the expansive soils or bedrock materials become wetted and swell.

Underdrain Systems: Underdrain systems will be necessary to protect the lower levels and crawl space areas of the structures due to the presence of stiff cohesive soils and seasonal perched water table. Groundwater, localized perched or runoff water can infiltrate the foundation areas at the foundation levels. This water can be one of the primary causes of differential foundation and slab movement, especially where expansive clays and bedrock materials have been encountered.

Roadway and Pavement Design and Construction: Based on our review of the roadway construction plans prepared by Civil Design Consultants (10/3/05), the cut and fill depths will vary greatly across the site ranging from less than 5 feet up to 70 feet as measured from the slope catch point to the final road surface. Based on our experience with similar soil conditions, we recommend that unretained cuts and fills in the overburden soils be constructed to no steeper than a 2(Horizontal) to 1(Vertical) slope configuration. Flatter slopes than those indicated above for the topsoil, overburden soils and bedrock materials are often desirable in that they help reduce erosion and minor sloughing of newly completed cut slopes and also help revegetation efforts. Unretained cut slopes in competent sandstone-siltstone-claystone bedrock materials may also be cut to a 1(H) to 1(V) slope configuration; however placement of topsoil and revegetation of these slopes will be very difficult. Unretained cut slopes in competent granite and gneiss bedrock materials may be cut to a ½(H) to 1(V) slope configuration. However as noted above, revegetation of these slopes is likely unfeasible. Fill slopes up to 15 feet in height may be constructed to a 1½ (H) to 1(V) configuration if they are properly compacted, especially at the edge of the fill slope.

Cuts in the granite/gneiss and deeper sandstone-claystone bedrock materials will most likely require blasting or other rock breaking methods for excavation, whereas, the shallower cuts in the sandstone-siltstone-claystone materials should be feasible using conventional heavy duty excavation equipment with ripper teeth.

Slope retaining systems should be considered to help reduce disturbance to the site from the construction of the larger roadway cut and fill slopes. Mechanically stabilized earth (MSE) embankment slopes may be constructed up to a 1/2(H) to 1(V) configuration with geogrid reinforcement, typically placed at 1-foot centers vertically. These reinforced slopes will require erosion control matting on the face to help stabilize the fill face, reduce erosion and establish vegetative cover. On-site sands and clays and sandstone-siltstone-claystone bedrock materials should be suitable for use in MSE fills, but additional materials testing and engineering design will be required on a case by case basis.

Cut and fill slopes can be retained by a variety of retaining wall construction methods including soil nailing, MSE wall systems, drilled piers and piles with timber lagging or stacked boulders (for walls less than 10 feet in height). Soil nailed retaining walls typically offer the good flexibility for visual treatment of the finished wall face.

We anticipate groundwater seepage between the topsoil and overburden soil/bedrock contact zone across the site in the roadway cuts during heavy runoff periods. However, if seepage is encountered deeper in the overburden soils or bedrock (>5' depth), this seepage will significantly increase the risk of slope instability, and these areas will need to

be reevaluated. Additional slope stabilization measures may be required in areas where groundwater seepage is encountered.

The seepage encountered just below the topsoil and any other surface runoff encountered should be directed away from the cuts by providing surface drainage around and away from the top of the cuts. A "V" ditch cut at least 6 inches into the underlying sands and clays or bedrock materials is recommended. The natural sands and clays and sandstone-siltstone-bedrock materials are very erodable materials. Therefore, all cut slopes and other stripped areas should be protected against erosion by revegetation or other methods. Riprap or other erosion control measures will probably be required in areas of concentrated drainage and steeper slopes.

We recommend that unretained fill slopes should be constructed to a 2(H) to 1(V) or flatter configuration, although steeper slopes are feasible, as noted above. All embankments must be properly compacted and constructed on suitable bearing soils with properly channeled surface drainage. All fills should be properly benched into hillsides exceeding 4(H) to 1(V). The on-site soils and bedrock materials, exclusive of the topsoil and organic materials, should be suitable for use in roadway embankment and utility trench backfill. The clay materials may require moisture conditioning (wetting or drying) to bring them to near optimum moisture content prior to placement and compaction. We recommend that common roadway embankment fill materials and utility trench backfill materials be uniformly placed and compacted in 6 to 8 inch loose lifts to at least 95 percent of the maximum standard Proctor density and within 3 percent of the optimum moisture content determined in accordance with ASTM D-698/AASHTO T-99.

Rock fills may be constructed to a 1(H) to 1(V) or flatter configuration. Placement of rock fill materials should be accomplished by placement of rock materials in uniform lifts of the maximum particle size with smaller materials filling voids between larger particles. The fill should be compacted in lifts with a bull dozer making at least 2 passes to fully consolidate the rock materials. A layer of filter fabric on top of the rock fill is recommended prior to placement of finer grained embankment to prevent migration of these materials into the rock fill voids.

We recommend that all of topsoil and organic materials, as indicated on the test hole and test pit logs, be stripped from the proposed embankment areas and cut areas when encountered at plan subgrade elevations. However, some of the topsoil materials may be used in fills provided the following can be achieved:

1) Organic materials are not used in the embankments;

2) The use of topsoil materials should be limited to deeper fill areas and is not recommended in the upper 2 feet of embankment subgrade;

3) Topsoil materials incorporated into the embankments must be placed at or very near optimum moisture content and compacted to meet minimum compaction requirements;

4) All topsoil materials should be stripped beneath embankments less than 3 feet in depth;

5) A stable subgrade surface is achieved as evidenced by proof rolling with heavily loaded pneumatic tired construction equipment.

The use and incorporation of topsoil into embankments should be discussed prior to the beginning of site grading operations. We recommend blending of these materials with other suitable embankment fill materials to aid in moisture control and stability. The use of these materials is highly dependent on the moisture conditions and should be evaluated at the time of construction by an engineer from this office. We also recommend additional testing and observation during construction by NWCC during use of these materials.

Although other pavement sections may be viable, we recommend that the main subdivision roadways be paved with a composite section consisting of at least 4 inches of asphalt overlying a minimum of 4 inches of aggregate base course (Class 6) and at least 8 inches of pit run sand and gravel subbase material. For lower service roadways, and driveways we recommend a composite section consisting of at least 3 inches of asphalt overlying a minimum of 4 inches of aggregate base course (Class 6) and at least 6 inches of pit run sand and gravel subbase material. The base course and subbase aggregates should be compacted to at least 95 percent of the maximum modified Proctor density and within 2 percent of the optimum moisture content determined in accordance with ASTM D-1557/AASHTO T-180. We also recommend a minimum shoulder width of 2 feet outside the edge of asphalt to support fire equipment.

Asphalt pavements should consist of a hot bituminous plant mix material meeting the job mix formula established by a qualified engineer and which meets Colorado Department of Transportation (CDOT) specifications. Placement and compaction of the hot bituminous plant mix should generally conform to CDOT guidelines outlined in Section 401 of the Standard Specifications for Road and Bridge Construction. Base course materials should consist of a well-graded aggregate base course material that meets Class 6 grading and durability requirements. Subbase materials should consist of a pit run sand and gravel material that meets Class 3 grading requirements.

Supplemental Geologic Hazard Evaluation

Slope Stability: The stability of both the natural and proposed cut and fill slopes proposed in the original development plan has been considered in this evaluation; however, no formal slope stability analyses were performed, since this is beyond the scope of work for this report.

Based on the topography in the proposed roadway and home site areas, the results of the subsurface investigation and our experience with similar conditions, we do not believe that there is a significant slope stability risk associated with the proposed roadway construction or development of individual homes sites with On-site Wastewater Systems (OWS's) provided good engineering design and construction practices are observed. OWS's will require careful site-specific investigations to help reduce the risk of slope instability in steeper portions of the site.

We have observed evidence of several small slumps along the proposed Road C alignment roughly between Stations 15+00 and 22+00, and Stations 36+00 and 43+00. These slumps occurred on moderately steep to steep (20 to 30 percent), north-facing slopes and appeared to be fairly shallow in nature (5 feet or less). Based on the subsurface conditions encountered in the test holes advanced in these areas (Test Holes 3, 4, 11 and 12), the subsurface conditions in this area generally consist of a layer of topsoil and organics overlying sandstone-siltstone-claystone bedrock. The morphology of the slope failures suggests high moisture contents (during high runoff periods) in the topsoil, overburden and weathered bedrock materials are key elements to creating instability. We believe that the slope failures identify a risk of shallow slope failure in the topsoil and weathered bedrock areas, but are not indicative of a larger, deep seated slope failure potential. Roadway construction in this area should not negatively affect the overall slope stability if fills are properly benched into competent bedrock materials and cuts are properly constructed, revegetated and/or retained. MSE embankments are recommended in these steep areas. Areas of concentrated roadway runoff discharge may require additional stabilization measures to ensure roadway runoff does not create an unstable slope condition.

Based on our review of the Routt County Geologic Hazard map, it appears that much of the development areas of the project site are mapped as Potentially Unstable Slopes (PUS). This implies a previously stable slope could become unstable due to either a natural or man-made process, such as development related activities. We recognize this hazard classification as a general, all-encompassing grouping of slopes that do not exhibit signs of instability at this time, but may have isolated steep areas, or other isolated soil and/or groundwater conditions which may be conducive to small-scale slope failures.

Swelling Soils: The potential hazards from swelling materials at the site and remedial measures have been discussed above. Swell-consolidation tests conducted on samples collected from the test holes indicate a variable swell potential, ranging from low to moderate, exists across the site. A site-specific Subsoil and Foundation Investigation for each individual building site will be necessary to better evaluate the potential hazard from swelling soils and to provide recommendations to reduce the risk of construction on swelling materials, since the swell potential of any particular site can change erratically both in lateral and vertical extent.

Geologic Setting and Seismic Activity: The project site is situated in the Southern Rocky Mountain Province and along the west flank of the Park Range. Portions of the Park Range are also referred to as the Gore Range in this area. The Park Range Uplift has been interpreted as a product of the Laramide orogeny which probably began in early Cretaceous time and reached its peak in Paleocene time. The Park Range uplift is anticlinal in nature with a core of igneous and metamorphic rocks flanked by sedimentary rocks of Miocene age in the project area.

Specifically, the near surface bedrock in the proposed development areas consists of the Miocene Browns Park Formation and the Precambrian rocks of granitic and gneissic composition. The Browns Park Formation is typically poorly exposed and helps form a thick topsoil layer which supports dense vegetation. Based on our field investigation, the near surface claystone, sandstone and siltstone beds of the Browns Park are nearly horizontal in the project area.

The Browns Park Formation lies unconformably on the Precambrian rocks located in the higher elevation portions of the site east of Pine Springs Gulch. The topography of the site represents ongoing erosion of these bedrock materials. Overlying the near surface bedrock, residual and colluvial sands and clays, sands and gravels soils and younger (Quaternary) alluvial floodplain gravel deposit are the product of chemical and mechanical erosion processes which continue.

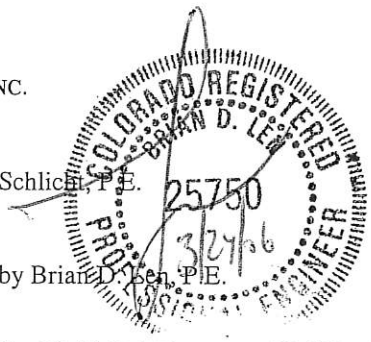
Seismic activity in the project area is considered to be low. According to the Uniform Building Code (1997) all of Colorado is located in Zone 1. This classification implies the following seismic risk: "minor damage; distant earthquakes may cause damage to structures with fundamental periods greater than 1.0 second; corresponding to intensities V and VI on the Modified Mercalli Intensity Scale" (Algermissen, 1969). Based on the UBC definitions, levels of peak horizontal ground acceleration should not exceed 0.04g with a 90 percent probability level. Two earthquakes of significance have been recorded in Steamboat Springs since 1870. Both earthquakes, March 1895 and February, 1955, corresponded to Modified Mercalli Intensities of V (Kirkham and Rogers, 1981).

Limitations

This report is preliminary and suitable for general design and planning. The test holes and pits were widely spaced to investigate the general subsurface profiles across the original development plan site. Based on our present knowledge, there are no subsurface or geological conditions, which constitute a major hazard or would render the proposed development infeasible. However, we recommend that additional observation and subsurface investigations be conducted in the "conditional" lot developments areas prior to final design. The investigations should be conducted to observe the sites for indications of slope stability problems and determine the subsurface the conditions in the new proposed development areas. Additional Subsoil and Foundation Investigations are also warranted to provide specific design criteria for each of the individual building foundations, slabs, lateral earth pressures and other soil related construction activities. Areas of the development where large earthwork-related construction occurs may require additional investigation and/or considerations.

We strongly recommend that the owner retain NWCC, Inc. to monitor the construction of the roadways and other development related site work to ensure compliance with the specifications and verify that the subsoil and groundwater conditions encountered in the field during construction are similar to those assumed herein. If there are any further questions concerning this report, or if we may be of further service, please contact this office.

Sincerely,
NWCC, INC.



Harold N. Schlicht, P.E.

Reviewed by Brian D. Lee, P.E.

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Peter Patten – Patten Associates

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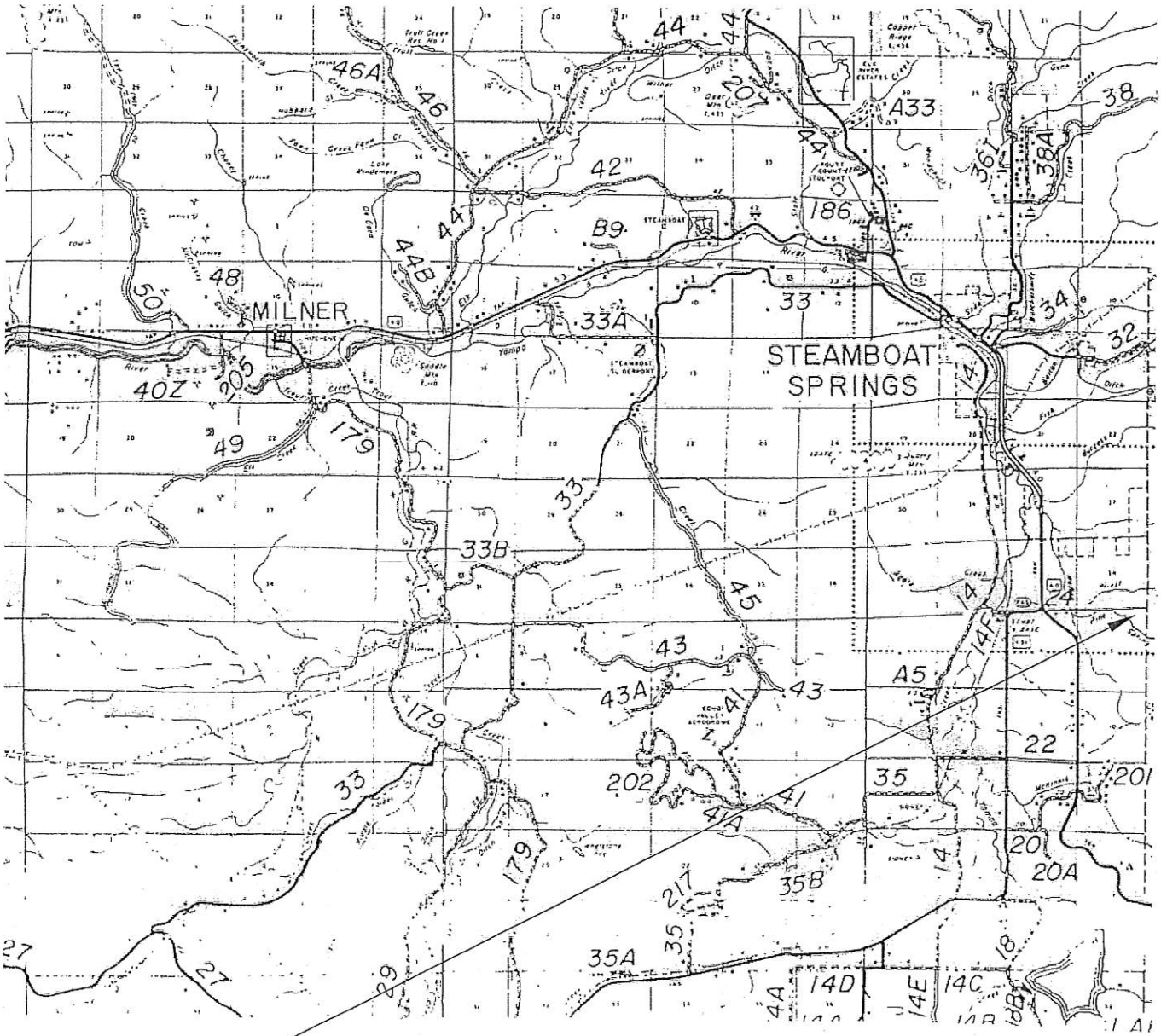
NOT TO SCALE



Title: VICINITY MAP	Date: 10/15/05	NWCC North West Colorado Consultants, Inc. Geotechnical / Environmental Engineering · Materials Testing
Job Name: Alpine Mountain Ranch	Job No. 05-6547	(970)879-7888 · Fax (970)879-7891 2580 Copper Ridge Drive · P.O. Box 775226 Steamboat Springs, Colorado 80477
Location: Routt County, CO	Figure #1	

LEGEND:


TOPSOIL & ORGANICS.


GRAVEL FILL.


SANDS & GRAVELS: Clayey to silty, fine to coarse grained, low plastic, dense, slightly moist and brown.


GRAVELS, COBBLES & BOBLDERS: Sandy, clean, non-plastic, medium dense, moist to wet and brown.


SANDS & CLAYS: Fine grained with occasional gravels and cobbles, low to moderately plastic, stiff to very stiff and medium dense, moist and reddish brown to brown.


SANDSTONE-SILTSTONE-CLAYSTONE: Low to moderately plastic, fine grained, weathered to very hard, weakly to lightly cemented, moist and light brown.


GRANITE & GNEISS: Non-plastic, very hard, dry and white to dark gray.


Drive Sample, 2-inch California Liner Sampler.


Hand Drive Sample, 2-inch California Liner.


Small disturbed bag sample.

50/3 Drive Sample Blow Count, indicates that 50 blows of a 140-lb. hammer falling 30 inches were required to drive the sampler 3 inches.


Depth at which practical rig refusal was encountered.


Depth at which groundwater seepage was encountered at the time of excavation.

NOTES:

1) Test Holes were drilled on 9/27 and 9/28/05 with a all-terrain CME 45 drill rig using 4-inch diameter augers

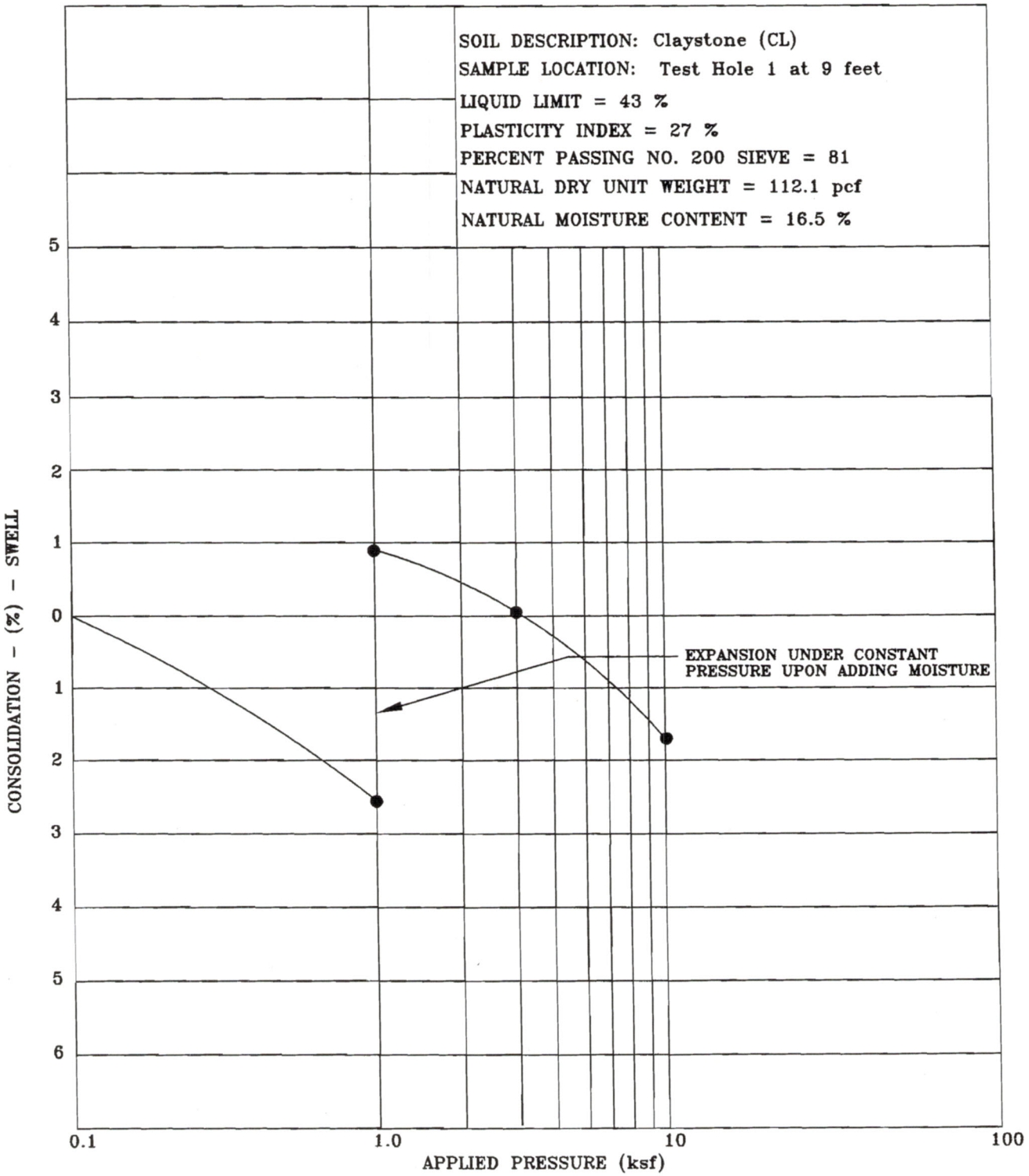
2) Test pits were excavated on 8/31 and 9/1/05 with a Cat 315 trackhoe.

3) Locations of the test holes and pits were determined in the field by pacing from staked roadway centerline.

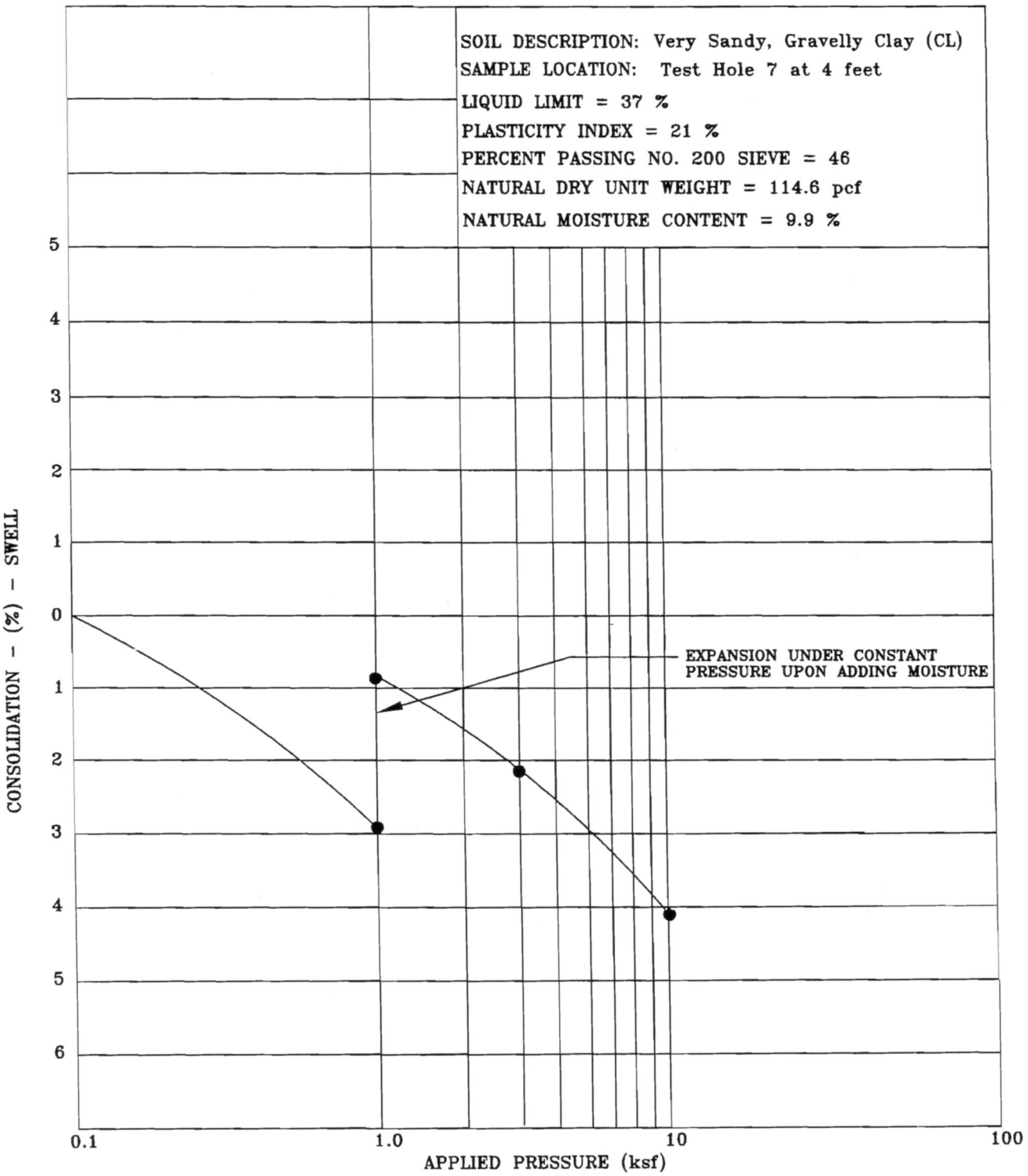
4) Elevations of the test holes and pits were not determined and the logs are drawn to the depths investigated.

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

Title: LEGEND AND NOTES	Date: 10/13/05	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: Alpine Mountain Ranch	Job No. 05-6547	
Location: Routt County, CO	Figure #8	



Title: SWELL–CONSOLIDATION TEST RESULTS		Date: 10/28/05	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: Alpine Mountain Ranch		Job No. 05–6547	
Location: Routt County, CO		Figure #9	



Title: SWELL-CONSOLIDATION TEST RESULTS		Date: 10/28/05
Job Name: Alpine Mountain Ranch		Job No. 05-6547
Location: Routt County, CO		Figure #10

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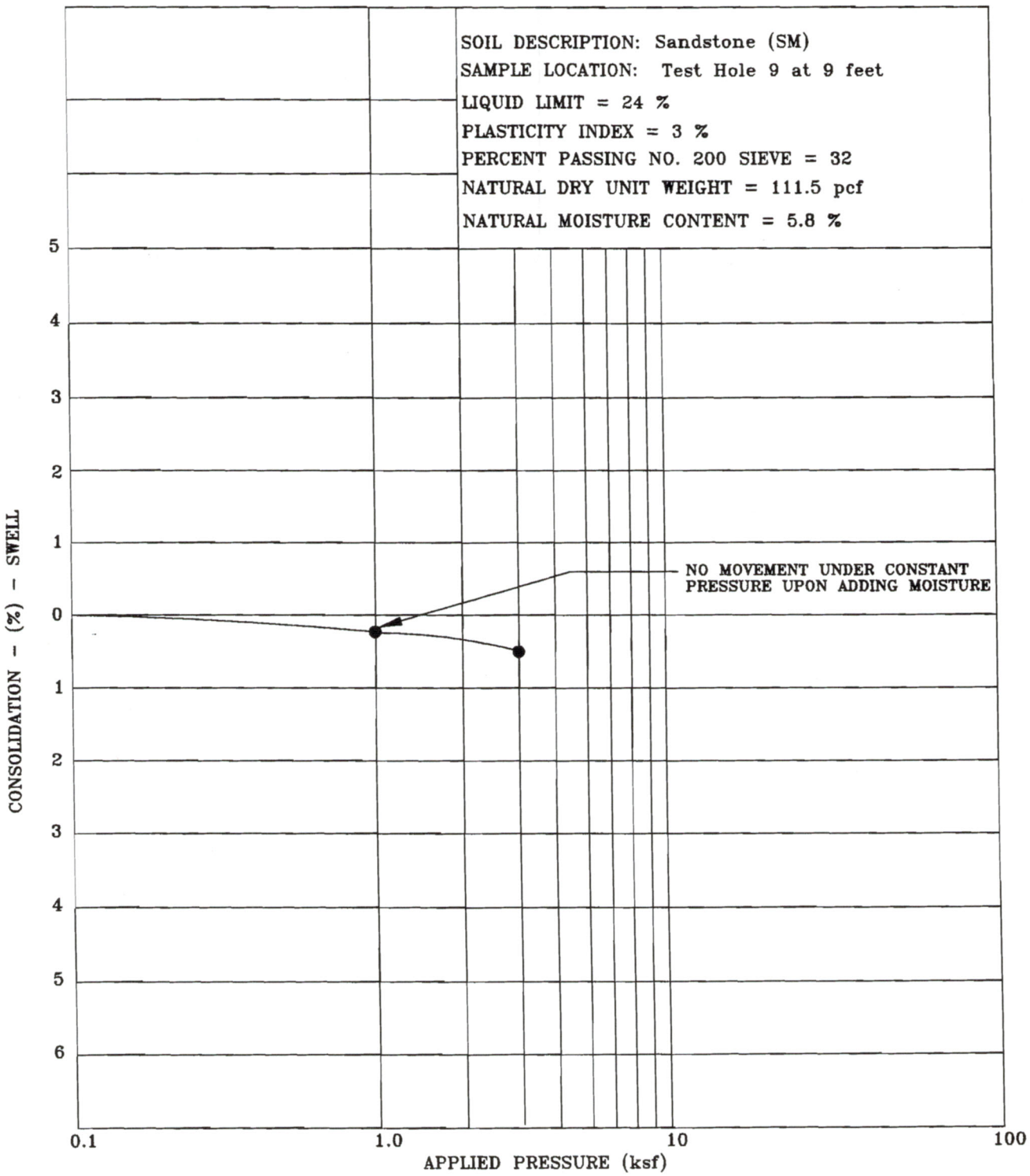
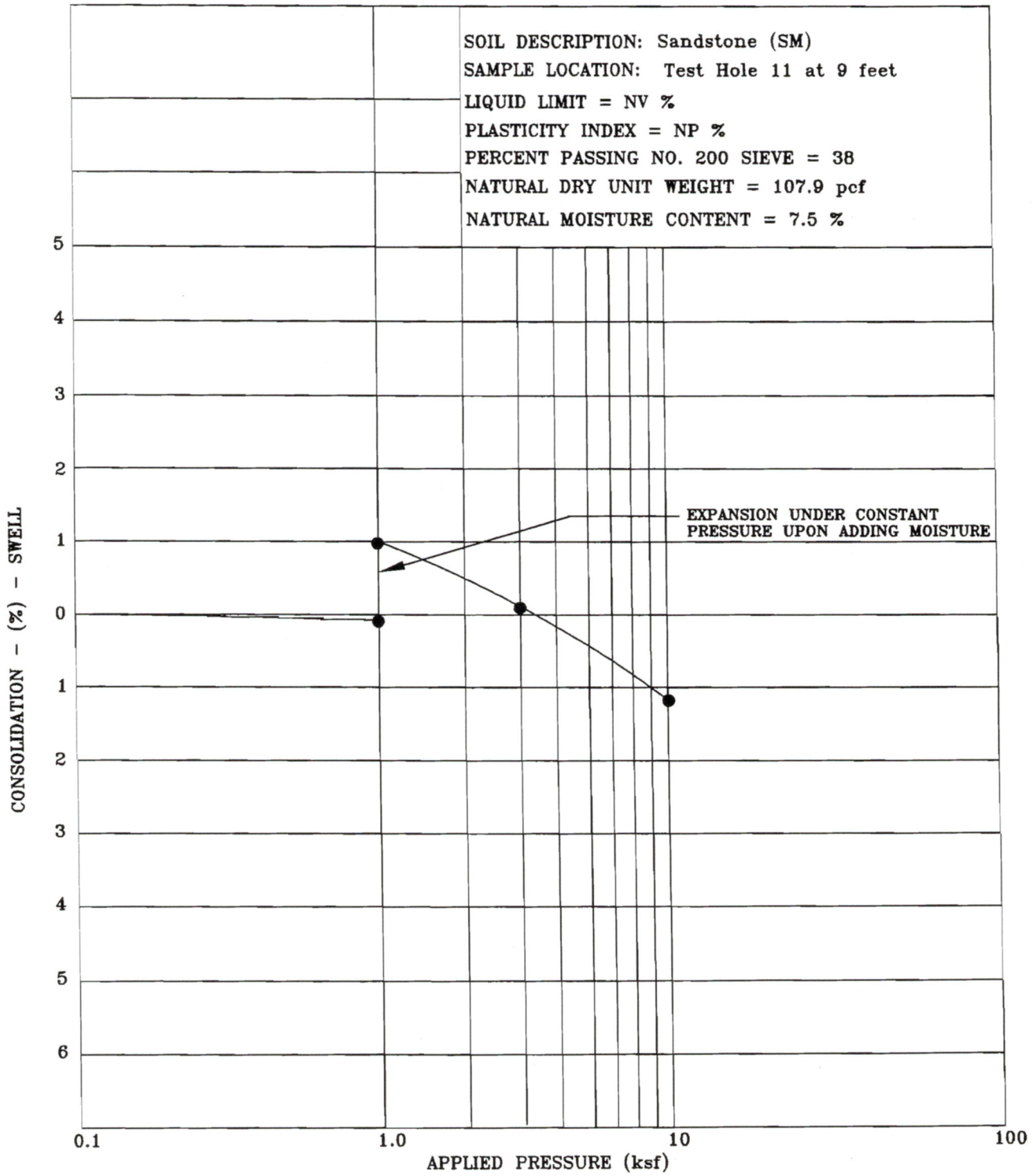
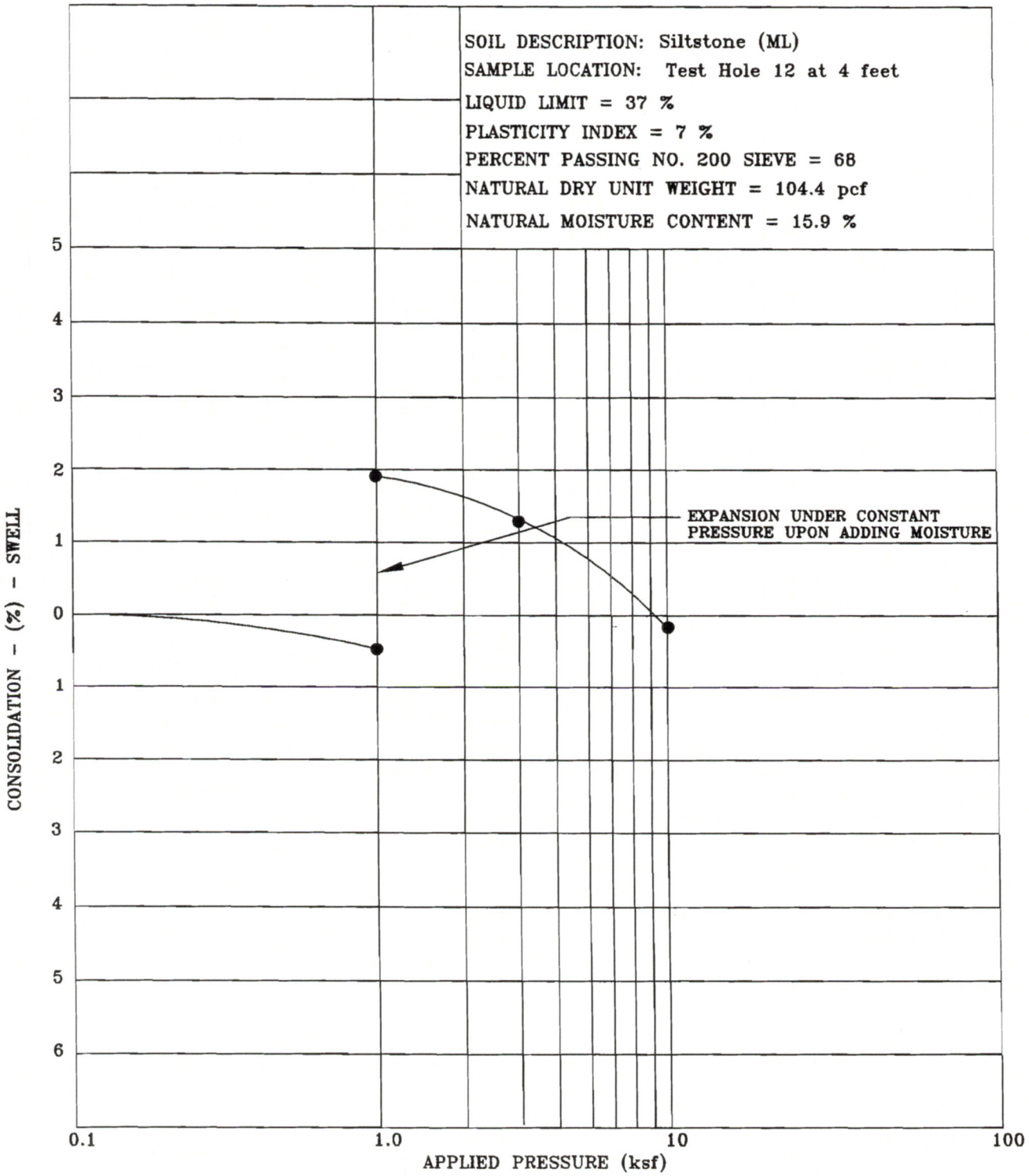


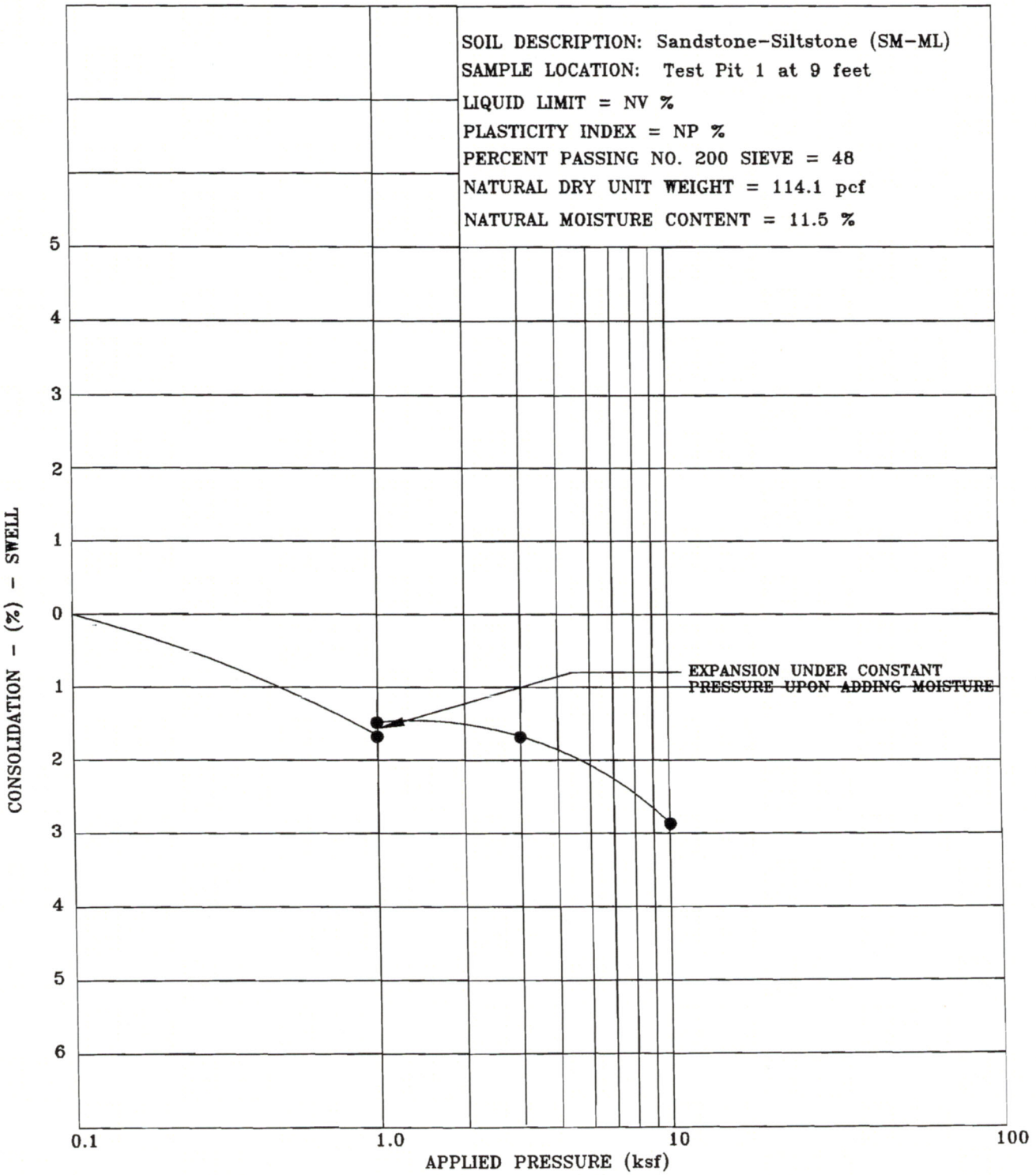
Title: SWELL-CONSOLIDATION TEST RESULTS		Date: 10/28/05	NWCC North West Colorado Consultants, Inc. Geotechnical / Environmental Engineering - Materials Testing (970)879-7888 - Fax (970)879-7891 2580 Copper Ridge Drive - P.O. Box 775226 Steamboat Springs, Colorado 80477
Job Name: Alpine Mountain Ranch		Job No. 05-6547	
Location: Routt County, CO		Figure #11	



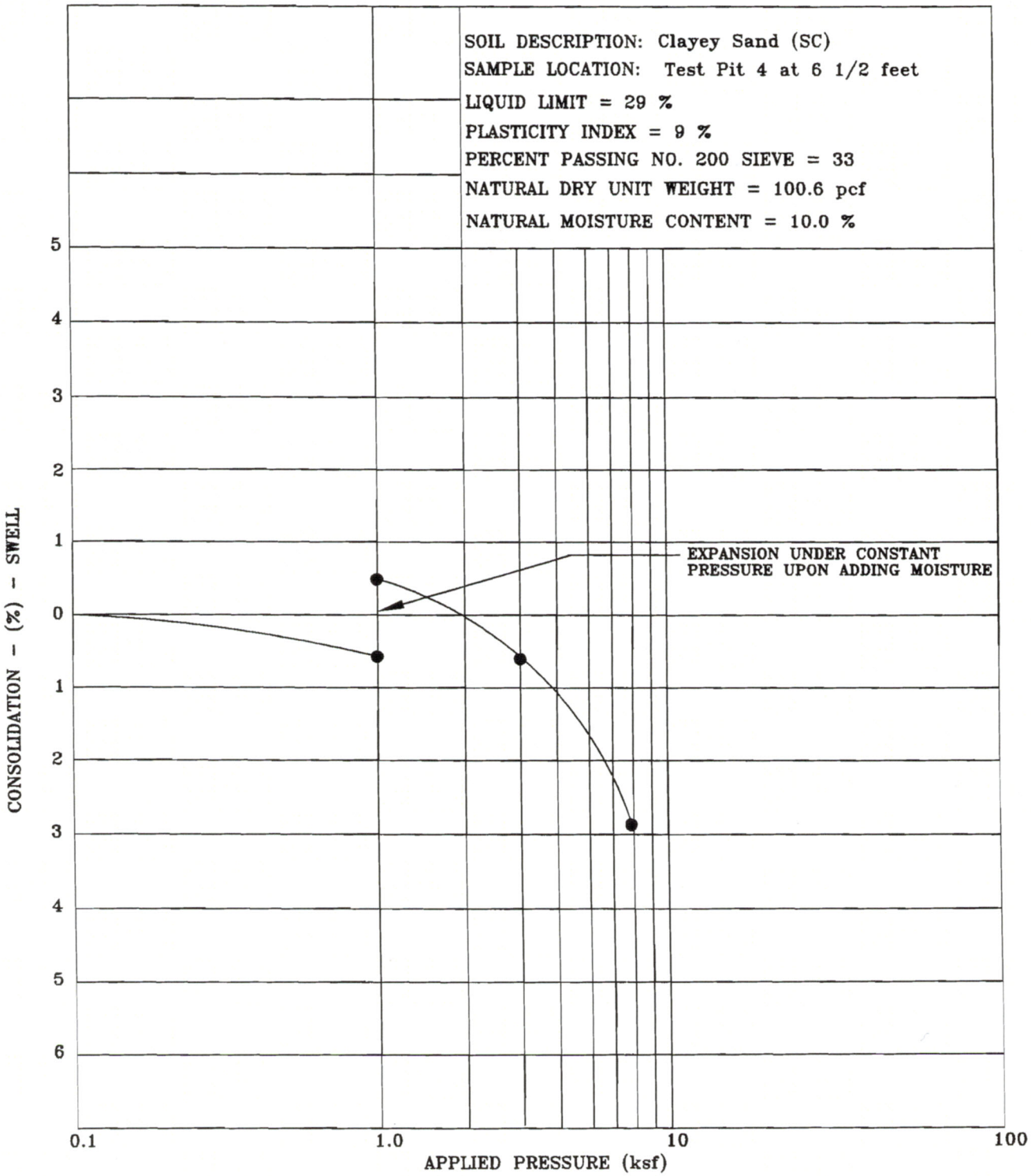
Title: SWELL-CONSOLIDATION TEST RESULTS		Date: 10/28/05	NWCC Northwest Colorado Consultants, Inc. Geotechnical / Environmental Engineering - Materials Testing (970)879-7888 - Fax (970)879-7891 2580 Copper Ridge Drive - P.O. Box 775226 Steamboat Springs, Colorado 80477
Job Name: Alpine Mountain Ranch		Job No. 05-6547	
Location: Routt County, CO		Figure #12	



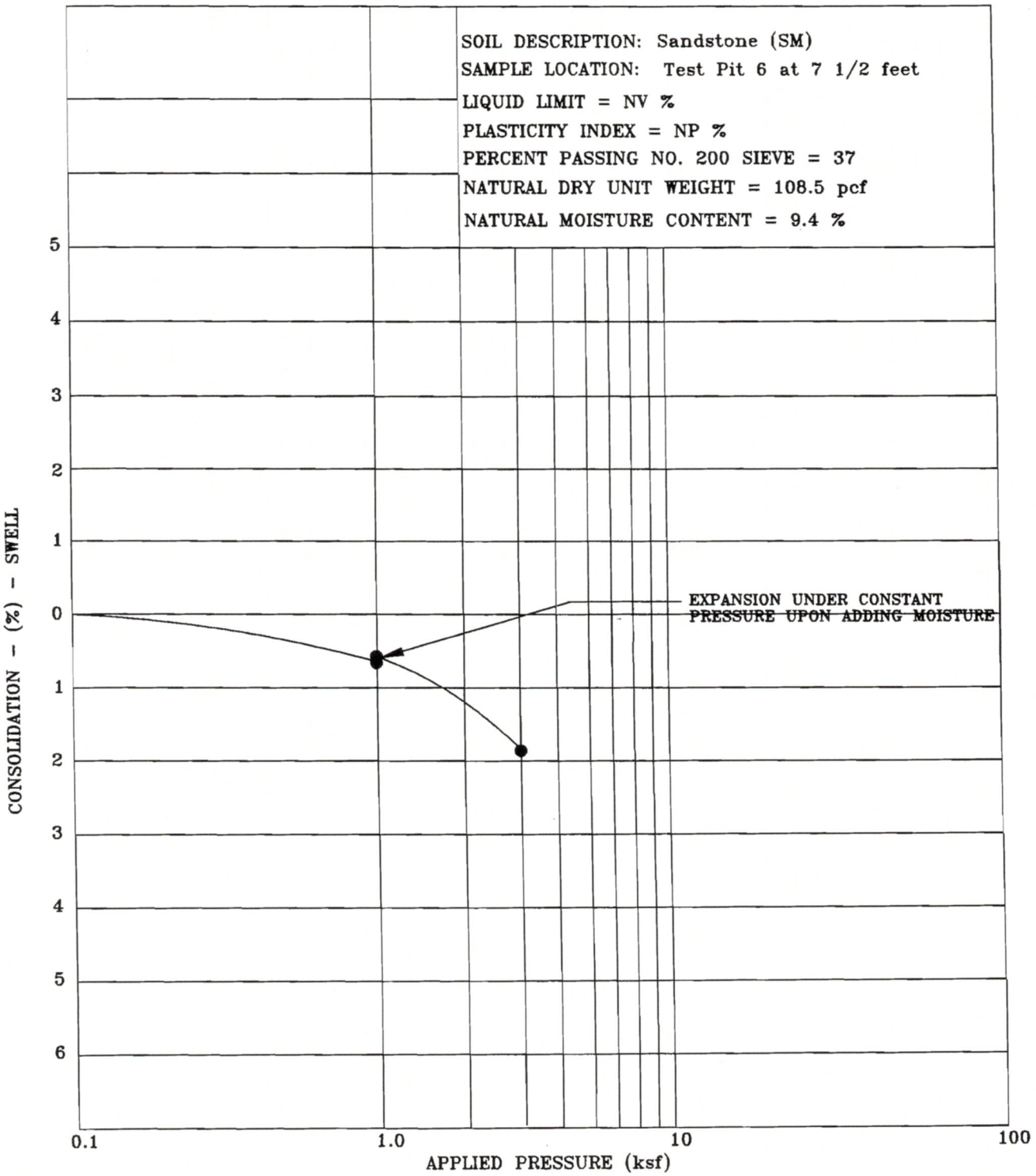
Title: SWELL–CONSOLIDATION TEST RESULTS		Date: 10/28/05	NWCC North West Colorado Consultants, Inc. Geotechnical / Environmental Engineering - Materials Testing (970)879-7888 - Fax (970)879-7881 2580 Copper Ridge Drive - P.O. Box 775226 Steamboat Springs, Colorado 80477
Job Name: Alpine Mountain Ranch		Job No. 05-6547	
Location: Routt County, CO		Figure #13	



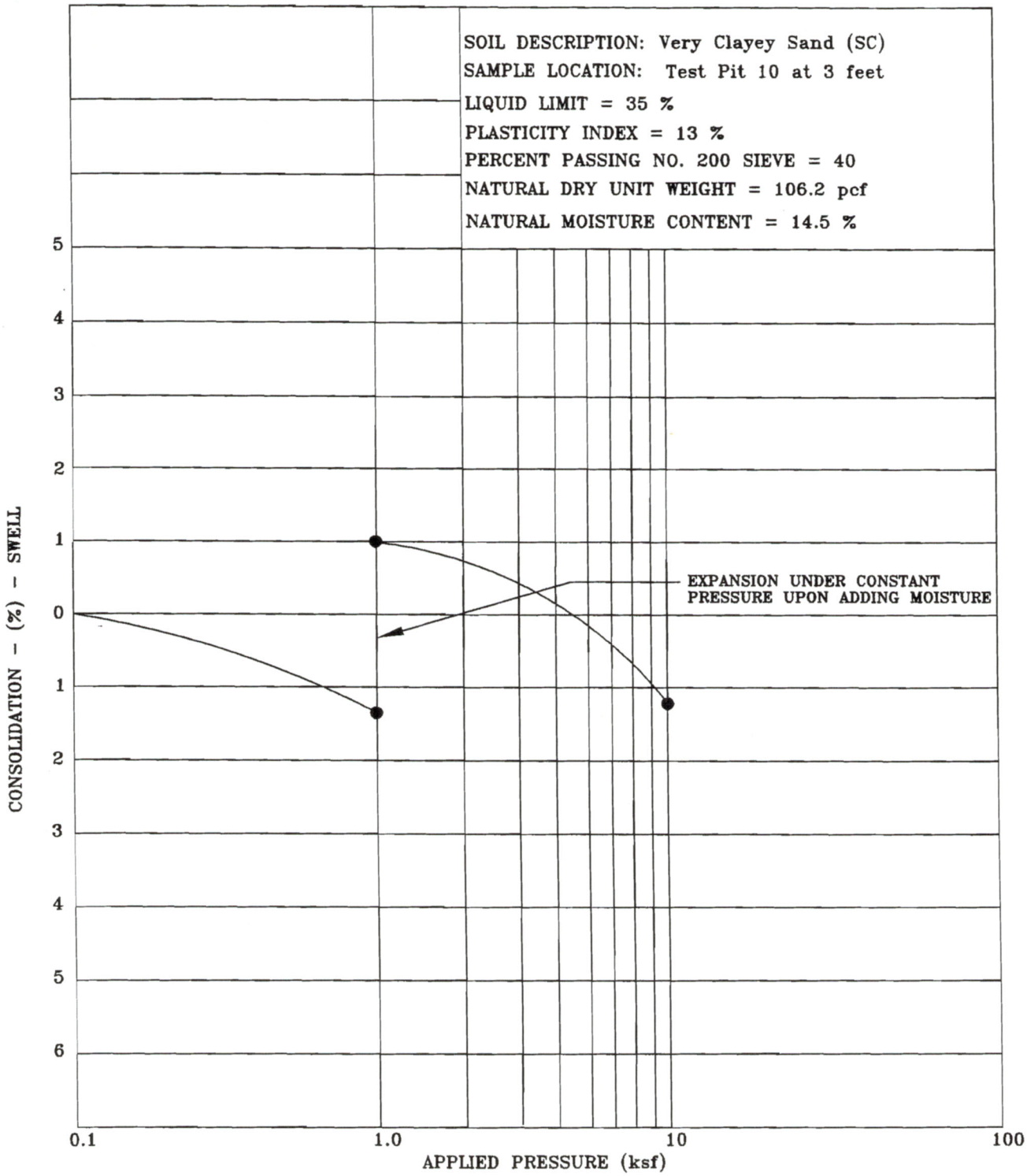
Title: SWELL-CONSOLIDATION TEST RESULTS		Date: 10/28/05	NWCC North West Colorado Consultants, Inc. Geotechnical / Environmental Engineering - Materials Testing (970)879-7888 - Fax (970)879-7891 2580 Copper Ridge Drive -P.O. Box 775226 Steamboat Springs, Colorado 80477
Job Name: Alpine Mountain Ranch		Job No. 05-6547	
Location: Routt County, CO		Figure #14	



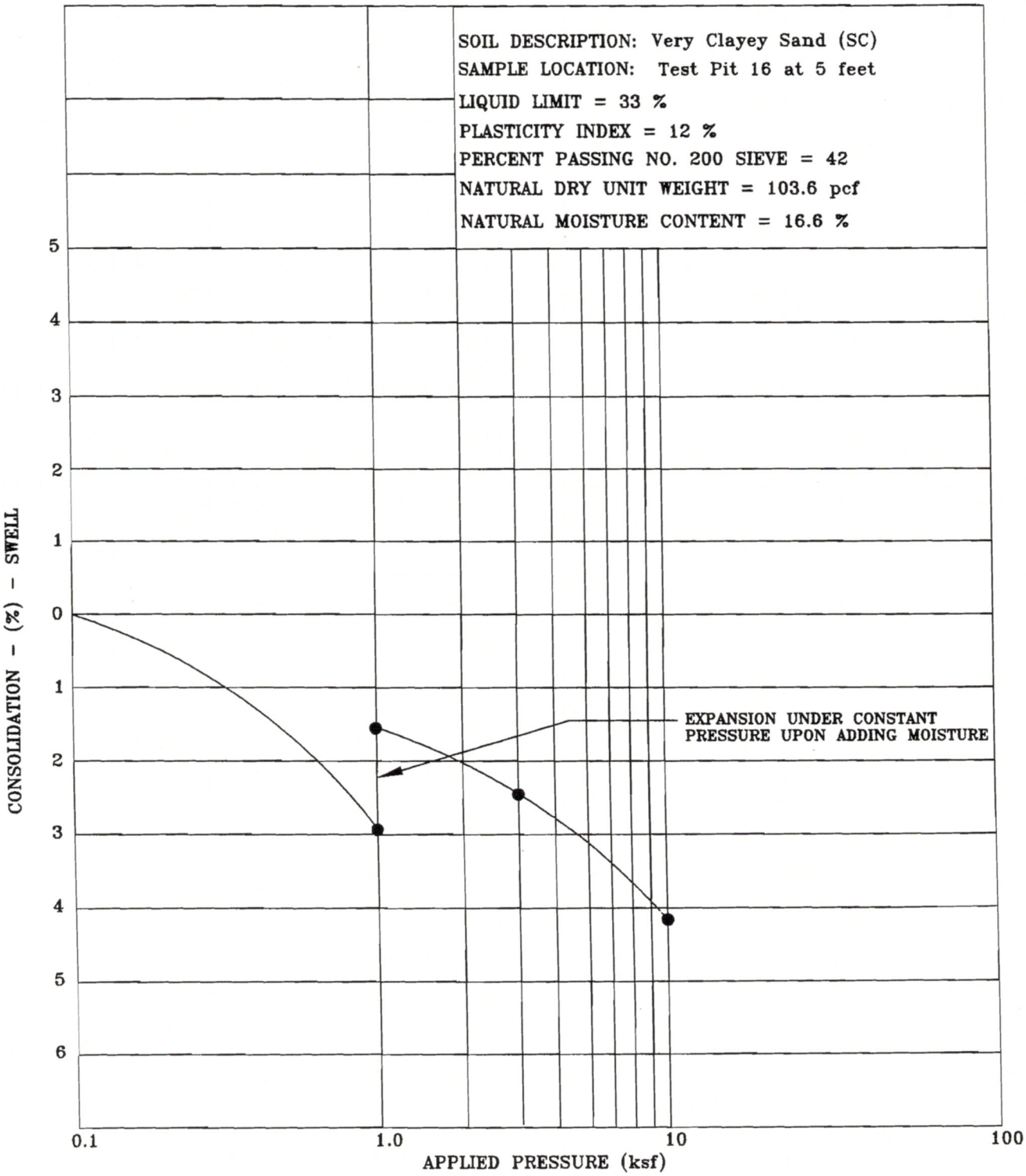
Title: SWELL–CONSOLIDATION TEST RESULTS		Date: 10/28/05	NWCC Northwest Colorado Consultants, Inc. Geotechnical / Environmental Engineering - Materials Testing (970)879-7888 - Fax (970)879-7891 2580 Copper Ridge Drive - P.O. Box 775226 Steamboat Springs, Colorado 80477
Job Name: Alpine Mountain Ranch		Job No. 05-6547	
Location: Routt County, CO		Figure #15	



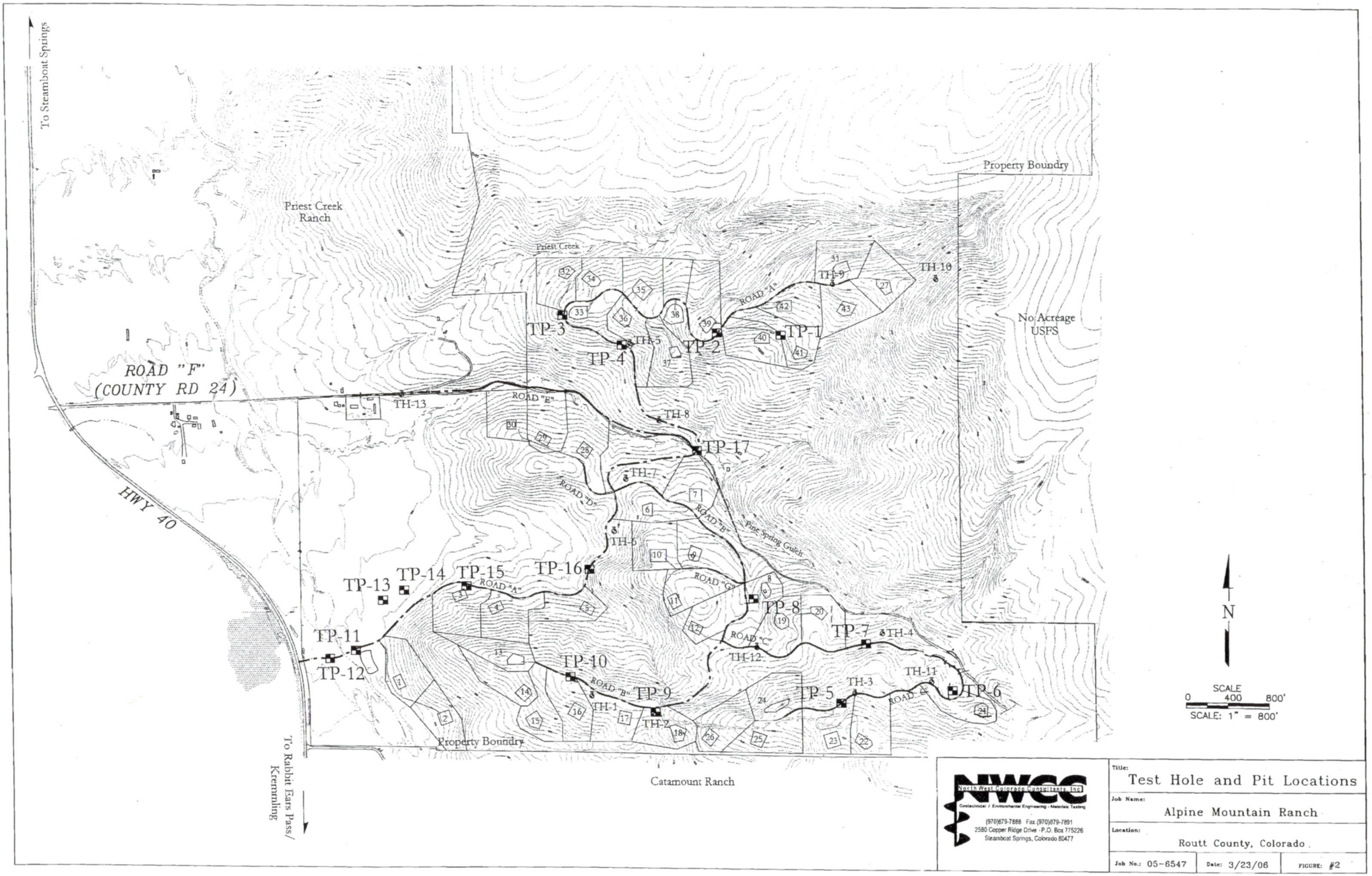
Title: SWELL-CONSOLIDATION TEST RESULTS		Date: 10/28/05	NWCC North West Colorado Consultants, Inc. Geotechnical / Environmental Engineering - Materials Testing (970)879-7888 - Fax (970)879-7891 2580 Copper Ridge Drive - P.O. Box 775226 Steamboat Springs, Colorado 80477
Job Name: Alpine Mountain Ranch		Job No. 05-6547	
Location: Routt County, CO		Figure #16	



Title: SWELL–CONSOLIDATION TEST RESULTS		Date: 10/28/05	NWCC Northwest Colorado Consultants, Inc. Geotechnical / Environmental Engineering - Materials Testing (970)879-7888 - Fax (970)879-7881 2580 Copper Ridge Drive -P.O. Box 775226 Steamboat Springs, Colorado 80477
Job Name: Alpine Mountain Ranch		Job No. 05-6547	
Location: Routt County, CO		Figure #17	



Title: SWELL–CONSOLIDATION TEST RESULTS		Date: 10/28/05	NWCC Northwest 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: Alpine Mountain Ranch		Job No. 05-6547	
Location: Routt County, CO		Figure #18	



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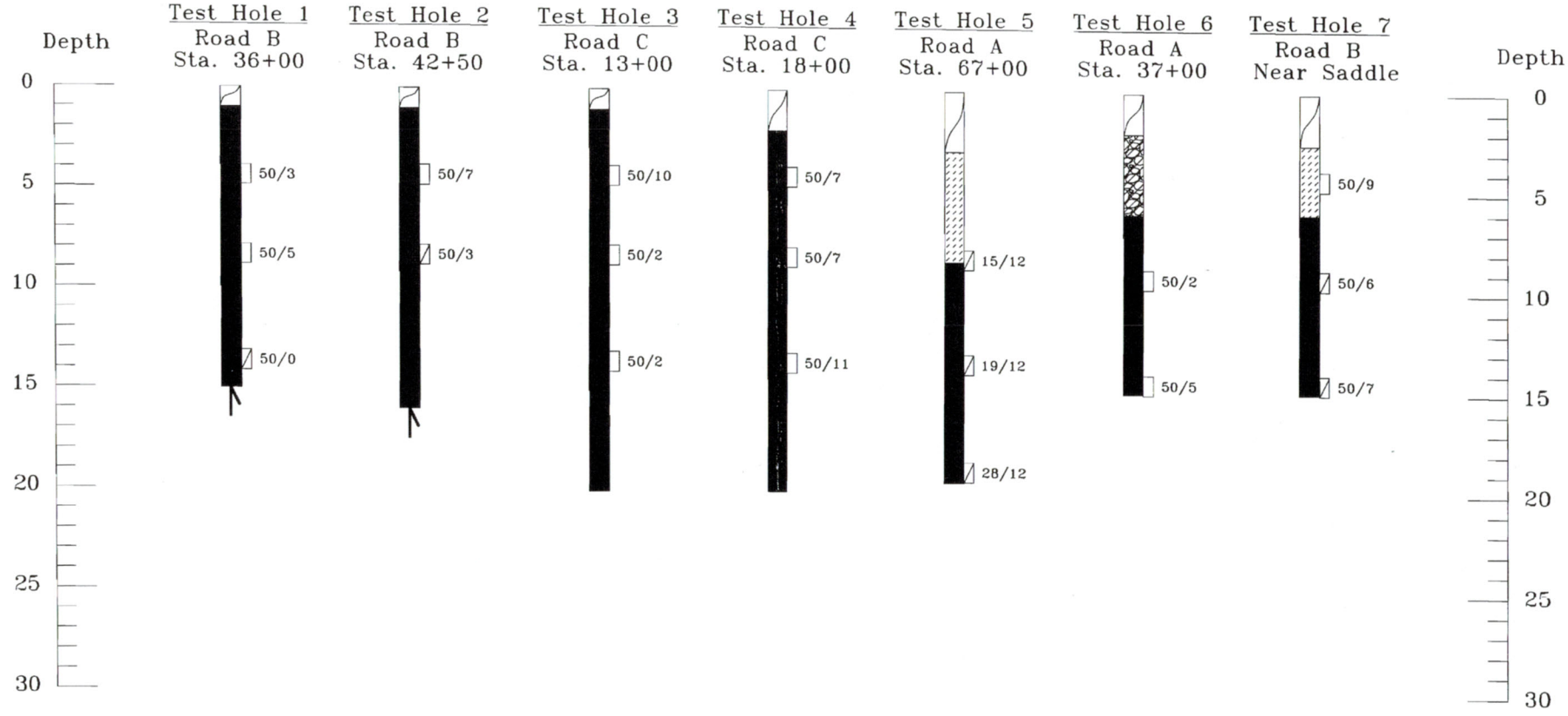
Title: Test Hole and Pit Locations

Job Name: Alpine Mountain Ranch

Location: Routt County, Colorado

Job No.: 05-6547 | Date: 3/23/06 | FIGURE: #2



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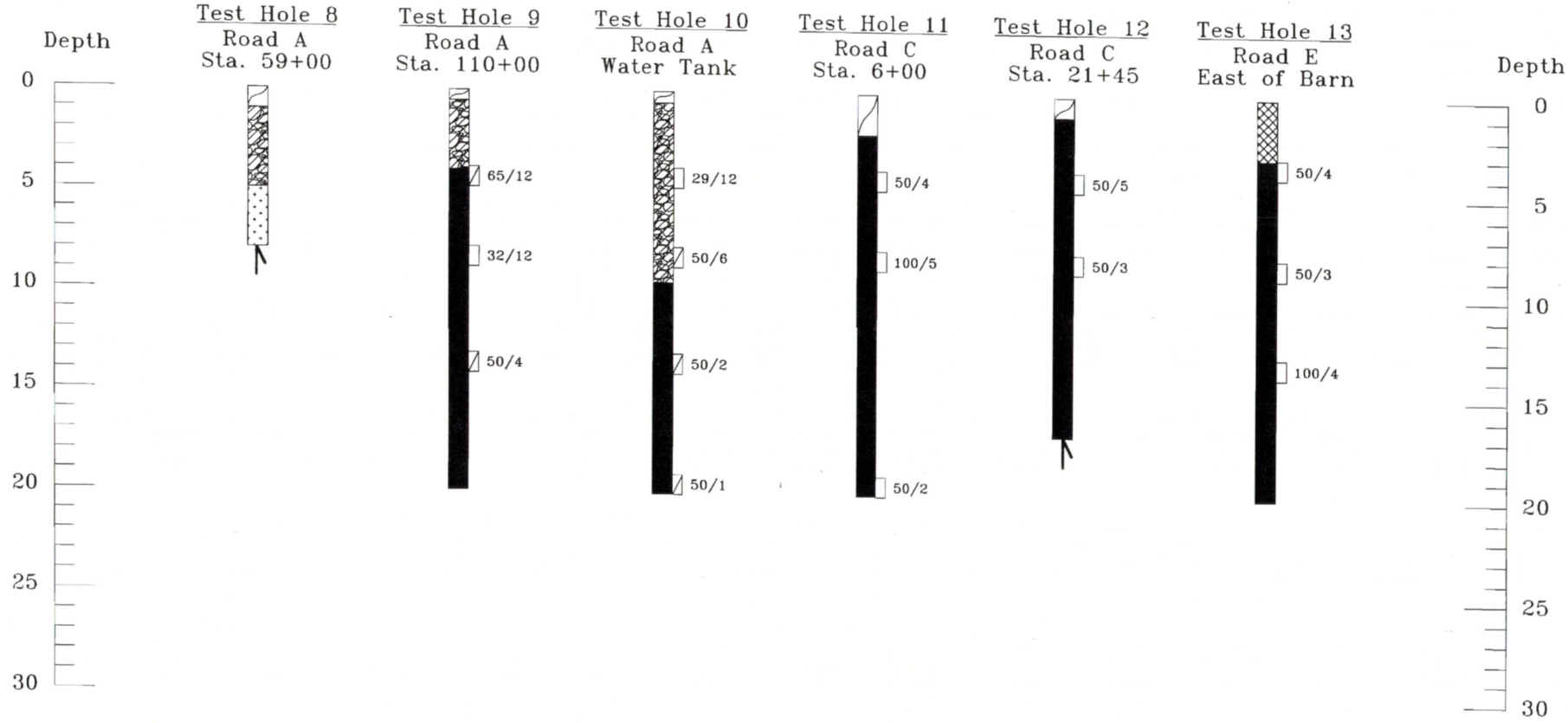
Title: Logs of Exploratory Test Holes

Job Name: Alpine Mountain Ranch

Location: Routt County, Colorado

Job No.: 05-6547 | Date: 10/13/05 | FIGURE: #3



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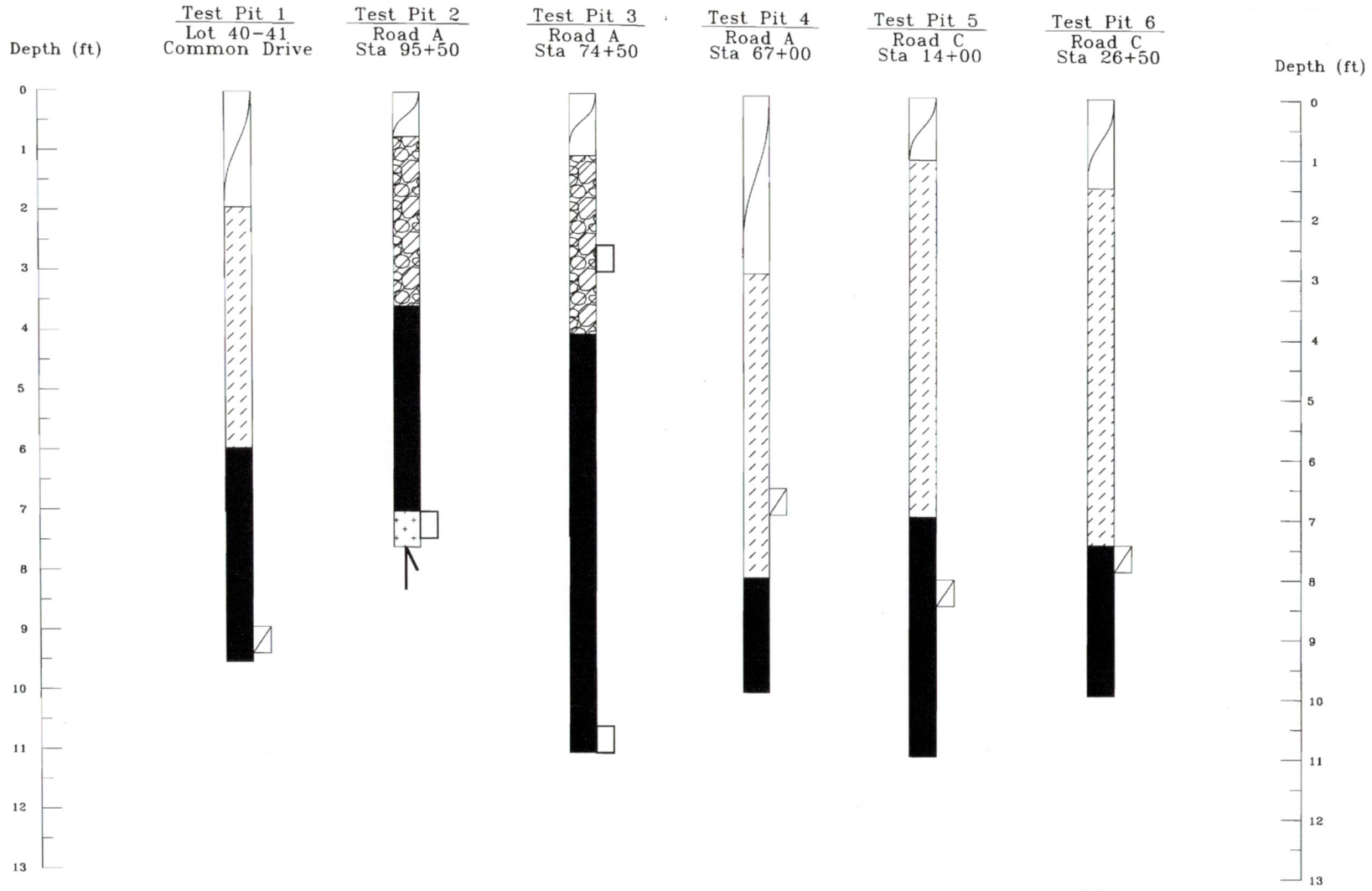
Title: Logs of Exploratory Test Holes

Job Name: Alpine Mountain Ranch

Location: Routt County, Colorado

Job No.: 05-6547 | Date: 10/13/05 | FIGURE: #4



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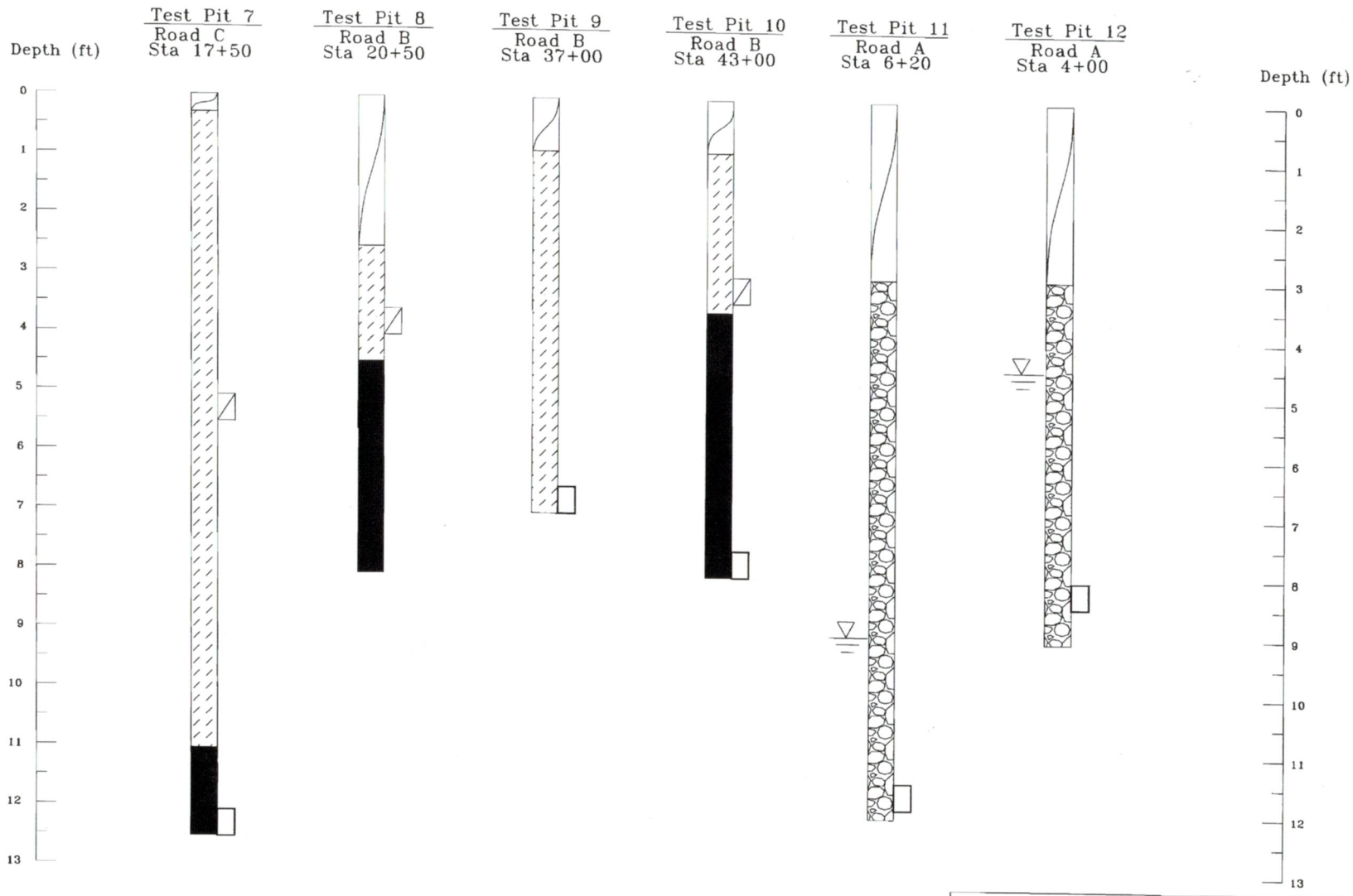
Title: Logs of Exploratory Test Holes

Job Name: Alpine Mountain Ranch

Location: Routt County, Colorado

Job No.: 05-6547 | Date: 10/13/05 | FIGURE: #5



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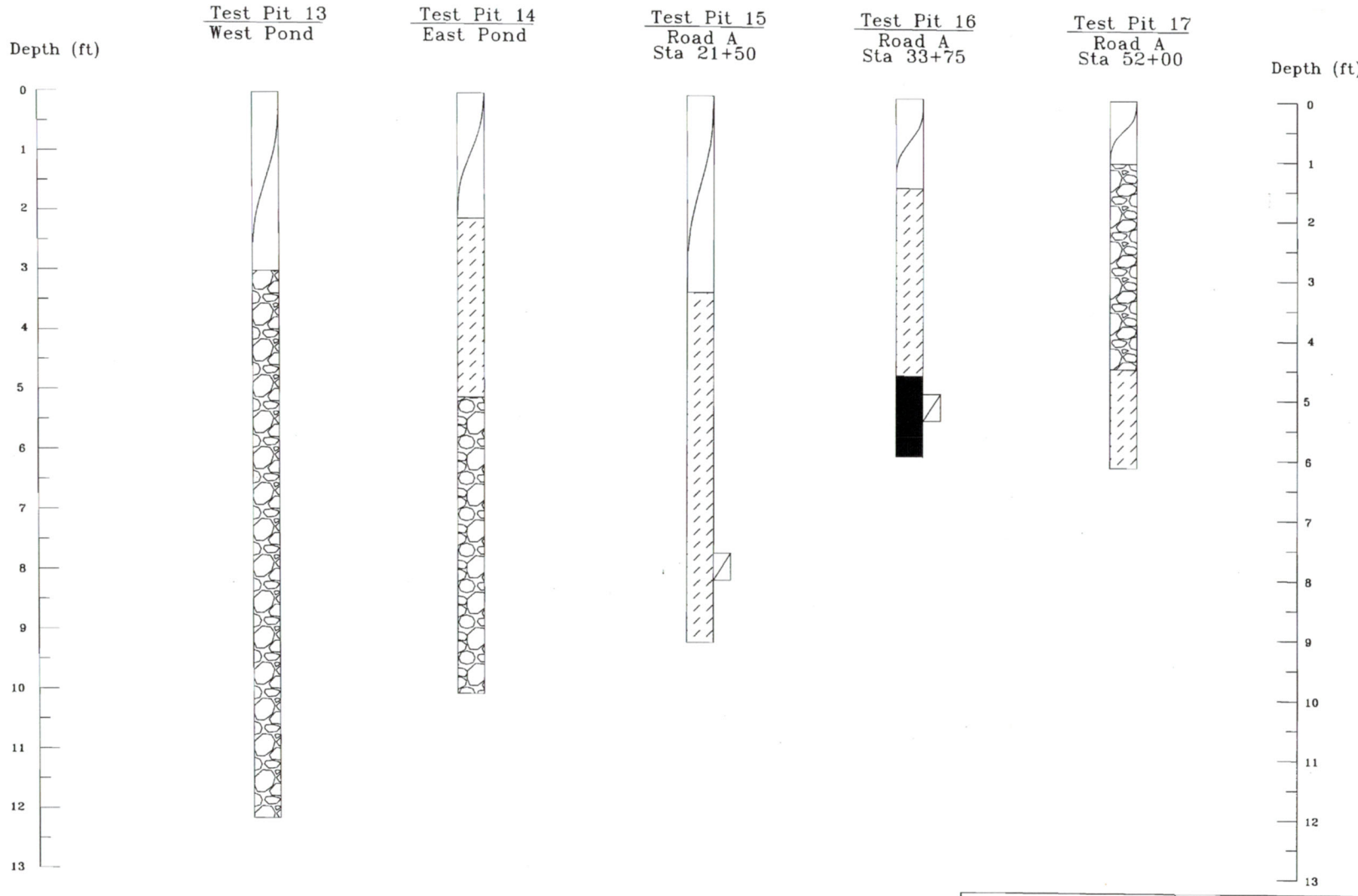
Title: Logs of Exploratory Test Holes

Job Name: Alpine Mountain Ranch

Location: Routt County, Colorado

Job No.: 05-6547 | Date: 10/13/05 | FIGURE: #6



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Title: Logs of Exploratory Test Holes

Job Name: Alpine Mountain Ranch

Location: Routt County, Colorado

Job No.: 05-6547 | Date: 10/13/05 | FIGURE: #7

NORTHWEST COLORADO CONSULTANTS

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 PIT	DEPTH (feet)			LIQUID LIMIT (%)	PLASTICITY INDEX (%)	GRAVEL (%)	SAND (%)				
10	7 1/2	10.8		31	11		49	51		Sandstone-Claystone	SC-CL
11	11 1/2	8.4		NV	NP	68	31	1		Sandy Gravel	GW
12	8-9 1/2	10.4		NV	NP	52	47	1		Sand & Gravel	SW-GW
15	7 1/2	23.3	99.4	32	14		43	57	3,500	Very Sandy Clay	CL
16	5	16.6	103.6	33	12		58	42		Sandstone	SC

JOB NUMBER: 05-6547

NORTHWEST COLORADO CONSULTANTS

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	16.5	112.1	43	27		19	81		Claystone	CL
2	4	13.7	114.3	33	15		25	75	12,850	Claystone	CL
3	9	13.6	110.5	30	4		50	50	6,650	Sandstone–Siltstone	SM–ML
4	4	18.6	106.5	35	11		31	69	6,850	Claystone	CL
6	14	13.9	115.2	31	16		50	50		Sandstone–Claystone	CL
7	4	9.9	114.6	37	21	15	39	47		Gravelly Sand & Clay	SC–CL
9	9	5.8	111.5	24	3	9	59	32		Sandstone	SM
11	9	7.6	107.9	NV	NP		62	38		Sandstone	SM
12	4	15.9	104.4	37	7		32	68		Siltstone	ML
12	9	14.3	111.3	26	3		55	45	7,500	Sandstone–Siltstone	SM–ML

JOB NUMBER: 05–6547

NORTHWEST COLORADO CONSULTANTS

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 PIT	DEPTH (feet)			LIQUID LIMIT (%)	PLASTICITY INDEX (%)	GRAVEL (%)	SAND (%)				
1	9	11.5	114.0	NV	NP		52	48		Sandstone–Siltstone	SM–ML
2	7	9.7		NV	NP	7	65	28		Sandstone	SM
3	2 1/2–3	5.3		25	2	36	51	13		Very Gravelly Silty Sand	SM
3	10	16.0		40	13		49	51		Sandstone–Siltstone	SM–ML
4	6 1/2	10.0	100.6	29	9		67	33		Clayey Sand	SC
4	6 1/2	13.2	101.3	37	21		39	47	10,750	Clayey Sand	SC
5	8	11.7		NV	NP		71	29		Sandstone	SM
6	7 1/2	9.4	108.5	NV	NP		63	37		Sandstone	SM
7	5	13.6	104.3	30	8		67	33	3,600	Clayey Sand	SC
7	12	11.3		NV	NP		66	34		Sandstone	SM
8	3 1/2	15.8	104.4	39	20		25	75		Sandy Clay	CL
9	6 1/2	12.1		34	14		38	62		Very Sandy Clay	CL
10	3	14.5	106.2	35	13		60	40		Very Clayey Sand	SC

JOB NUMBER: 05–6547