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

September 18, 1995

Fox Construction
P.O. Box 772971
Steamboat Springs, CO 80477

Attn: Mr. Tom Fox

Job Number 95-2382

Subject: Subsoil Investigation, Proposed Hunt Residence, A Tract in Section 24, T10N, R86W, and Section 19, T10N, R85W, Routt County, Colorado.

Gentlemen:

This report presents the result of a subsoil investigation and geotechnical evaluation for the proposed Hunt residence to be constructed within a tract of land located in Section 24, T10N, R86W, and in Section 19, T10N, R85W in Routt County, Colorado. The approximate location of the project site is shown on Figure #1.

The scope of our work included obtaining data from a visual inspection of the site, the excavation of three test pits, the sampling of the probable foundation soils and laboratory testing of the samples obtained. The contents of this report present 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: At the time of this investigation, the building plans were in the conceptual phase; however, we understand that the owner proposes to construct several residential structures at the site. For the purposes of this report we have assumed that the structures will consist of one and two story log and conventional wood framed structures. We have also assumed that the main house will have a full depth basement which will be constructed with a slab-on-grade floor system placed between 3 and 6 feet below the existing ground surface.

For design purposes, we have assumed that the building loads will be light to moderate, typical of residential construction. If loadings or conditions are significantly different from those above, we should be notified to reevaluate the recommendations in this report.

Site Conditions: The project site is located along the north side of County Road 62 directly across the roadway from Steamboat Lake State Park in Routt County, Colorado. At the time of this investigation the site was vacant and the main residence site had been roughly staked. The building sites are

generally bordered by aspen and pine forest on the north and an open meadow vegetated with natural grasses and weeds to the south.

The topography of the building sites are fairly consistent and generally slope gently down to the east on the order of 3 to 5 percent. It appears that a maximum elevation difference of approximately 3 feet exists across the proposed main building site.

Subsurface Conditions: To investigate the subsurface conditions at the site three (3) test pits were excavated on August 8, 1995 with a backhoe. The approximate test pit locations are shown on Figure #2.

The subsoils encountered were consistent and generally consisted of a layer of topsoil overlaying natural sands and gravels that extended to the maximum depth investigated, 7 feet. Graphic logs of the exploratory test pits, as well as the associated legend and notes are presented in Figure #3.

The topsoil encountered in the test pits varied from approximately 6 to 18 inches in thickness. Natural sands and gravels were encountered beneath the topsoil layer in all the test pits. The sands and gravels were slightly clayey, low plastic, dense, fine to coarse grained with cobbles and small boulders, moist and brown in color. Samples of the sands and gravels classified as SC-GC and GC-GW soils in accordance with the Unified Soil Classification System. The laboratory test results are summarized in Table 1.

Free ground water was not encountered in the test pits at the time of this investigation. It should be noted that groundwater conditions can be expected to fluctuate with changes in precipitation and runoff.

Foundation Recommendations: Based on the soils encountered in the test pits, the results of the field and laboratory investigations and the proposed construction, we believe an economically feasible and safe type of foundation system is spread footings or individual pads with grade beams founded on the natural sands and gravels. Foundation movement should be within tolerable limits if the following design and construction precautions are observed.

1) The footings placed on the undisturbed natural sands and gravels should be designed for an allowable soil bearing pressure of 3,000 psf.

2) All footings or pad sizes should be computed based on the above soil pressures and placed on the natural soils found beneath the topsoil.

3) Spread footings placed on granular soils should have a minimum width of 16 inches.

4) Any topsoil or loose natural soils encountered within the foundation excavations, should be removed and the footings extended down to more competent natural soils prior to concrete placement.

5) All footing areas should be thoroughly recompacted with a vibratory plate compactor prior to steel and concrete placement.

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

7) Care should be taken when excavating the foundations to avoid disturbing the supporting materials. Hand excavation or careful backhoe soil removal may be required in excavating the last few inches.

8) All 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.

9) Based on experience, we estimate 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 #4.

10) We suggest a soils engineer be called to the site when the foundation excavation is near completion to identify the bearing soils and confirm the recommendations in this report.

Floor Slabs: We understand that the proposed main residence will be constructed with the lower level having a slab-on-grade floor system. The natural on-site soils, exclusive of topsoil, are suitable to support lightly to moderately loaded slab-on-grade construction. Floor slabs should be provided with control joints to reduce damage due to shrinkage cracking, and the slabs should be adequately reinforced. We suggest that control joints be provided on the order of 12 feet on center.

A minimum 6-inch layer of free draining gravel should be placed beneath floor slabs. This material should consist of aggregate with less than 10% passing the #200 sieve and more than 50% retained on the No. 4 sieve. The granular layer will help distribute floor slab loadings, ease construction, prevent capillary water rise and aid in drainage.

Fill placed beneath floor slabs should be a nonexpansive, granular material approved by the soil engineer. Fill should be placed and compacted to at least 95% of the maximum standard Proctor density within 2% of optimum moisture content. The natural sands and gravels encountered at the site are suitable for use in compacted fills beneath floor slabs.

Underdrain System: The lower level of the main residence should be protected by an underdrain system to help reduce the problems associated with surface drainage during high runoff periods. Localized perched water or runoff can infiltrate the foundation at the footing levels. This water can be one of the primary causes of differential foundation and slab movement.

The drain should be located around the entire perimeter of the building and should be located between the top and bottom of footings. We recommend the use of perforated PVC pipe for the drain tile, which meets ASTM D-2729 requirements, to minimize the potential for crushing the pipe during backfill operations. The drain tile should be surrounded by at least 6 inches of free draining gravel. The holes in the drain tile should be oriented down between 4 o'clock and 8 o'clock to promote rapid runoff of the water. The drain tile system should be protected from contamination by a filter covering of Mirafi 140N subsurface drainage fabric or an equivalent product. The drain should have a minimum slope of 1/8 inch per foot and should be daylighted at a positive outfall protected from freezing, or be led to a sump from which the water can be pumped. Caution should be taken when backfilling so as not to damage or disturb the installed underdrain. We recommend the drainage system include at least one cleanout, be protected against intrusion by animals at the outfall and be tested prior to backfilling. A typical perimeter/underdrain detail is shown in Figure #5.

Foundation and Retaining Walls: 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 the on-site granular 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 the on-site granular materials.

All foundation and retaining structures should be designed for appropriate hydrostatic and surcharge pressures such as adjacent buildings, traffic and construction materials. An upward sloping backfill also increases the earth pressures on foundation walls and retaining structures.

The lateral resistance of retaining wall foundations placed on undisturbed natural soils and/or properly compacted fill material at the site will be a combination of the sliding resistance of the footing on the foundation materials and the passive pressure against the side of the footing. Sliding friction can be taken as 0.4 times the vertical dead load. Passive pressure against the sides of the footing can be calculated using an equivalent fluid pressure of 275 pcf.

We recommend the use of imported granular backfill for use Backfill should be carefully placed in uniform lifts and compacted to between 90 and 95 percent of the maximum standard Proctor density, 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.

Compacted fill placed against the sides of the footings to resist lateral loads should be a non expansive material approved by the soil engineer. Fill should be compacted to at least 95% of the maximum standard Proctor density, near the optimum moisture content.

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 building has been completed:

1) The ground surface surrounding the building should be sloped (minimum of 1.0 inch per foot) to drain away from the building 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 around the building should be compacted to at least 90% of the maximum standard Proctor density at or near the optimum moisture content, as determined by ASTM D-698, 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 feet of soil within 10 feet of the foundation 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 foundation 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 building.

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

Limitations: The recommendations given in this report are based on the soils exposed at this site and the behavior of structures at neighboring, similar sites. 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; therefore, no warranties of the accuracy of these recommendations beyond the limits of the obtained data is herein expressed or implied.

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 are changed, the results would also most likely change. 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 for 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,
NORTHWEST COLORADO CONSULTANTS, INC.

Harold N. Schlicht, P.E.

COLORADO REGISTERED BRIAN D. LEN 25750 PROFESSIONAL ENGINEER

Reviewed by Brian D. Len, P.E.

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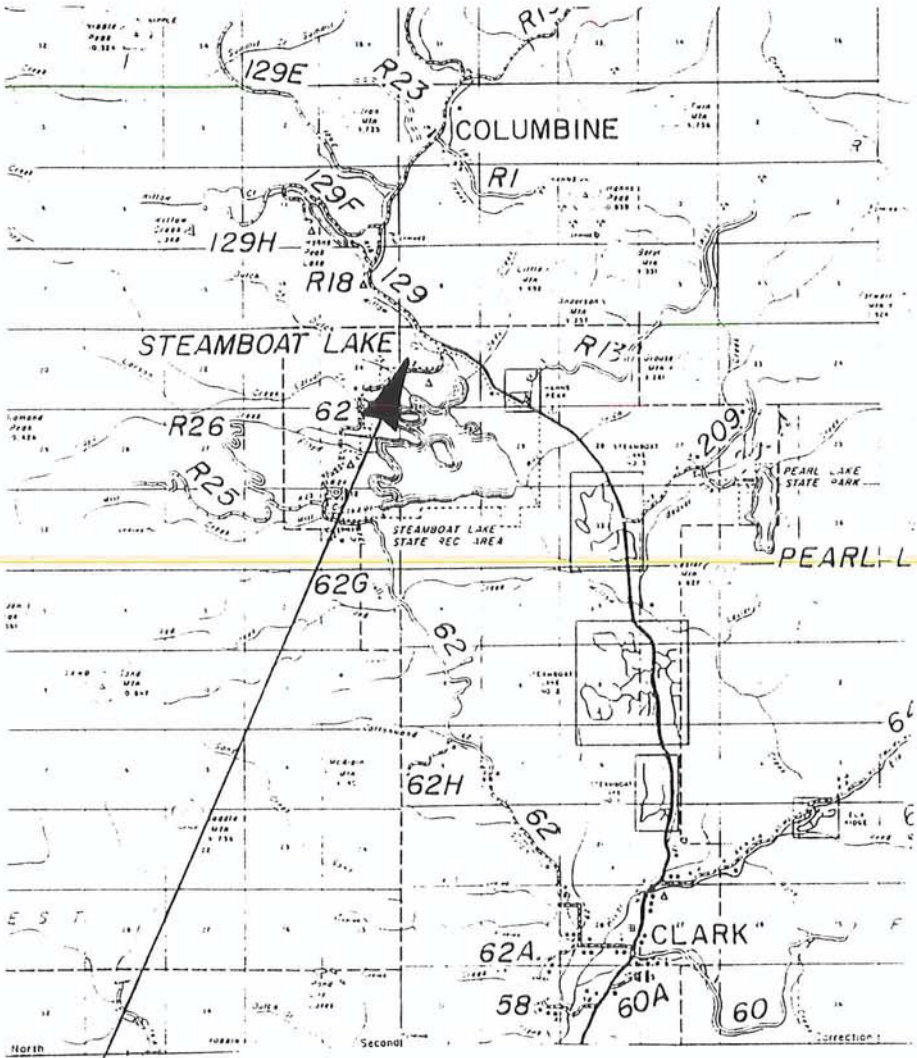
STEAMBOAT SPRINGS COLORADO

(No Scale)



Project Site

VICINITY MAP

Job Name: Proposed Hunt Residence	Job No. 95-2381
Location: Steamboat Lake, Routt County, Colordo	Figure #1

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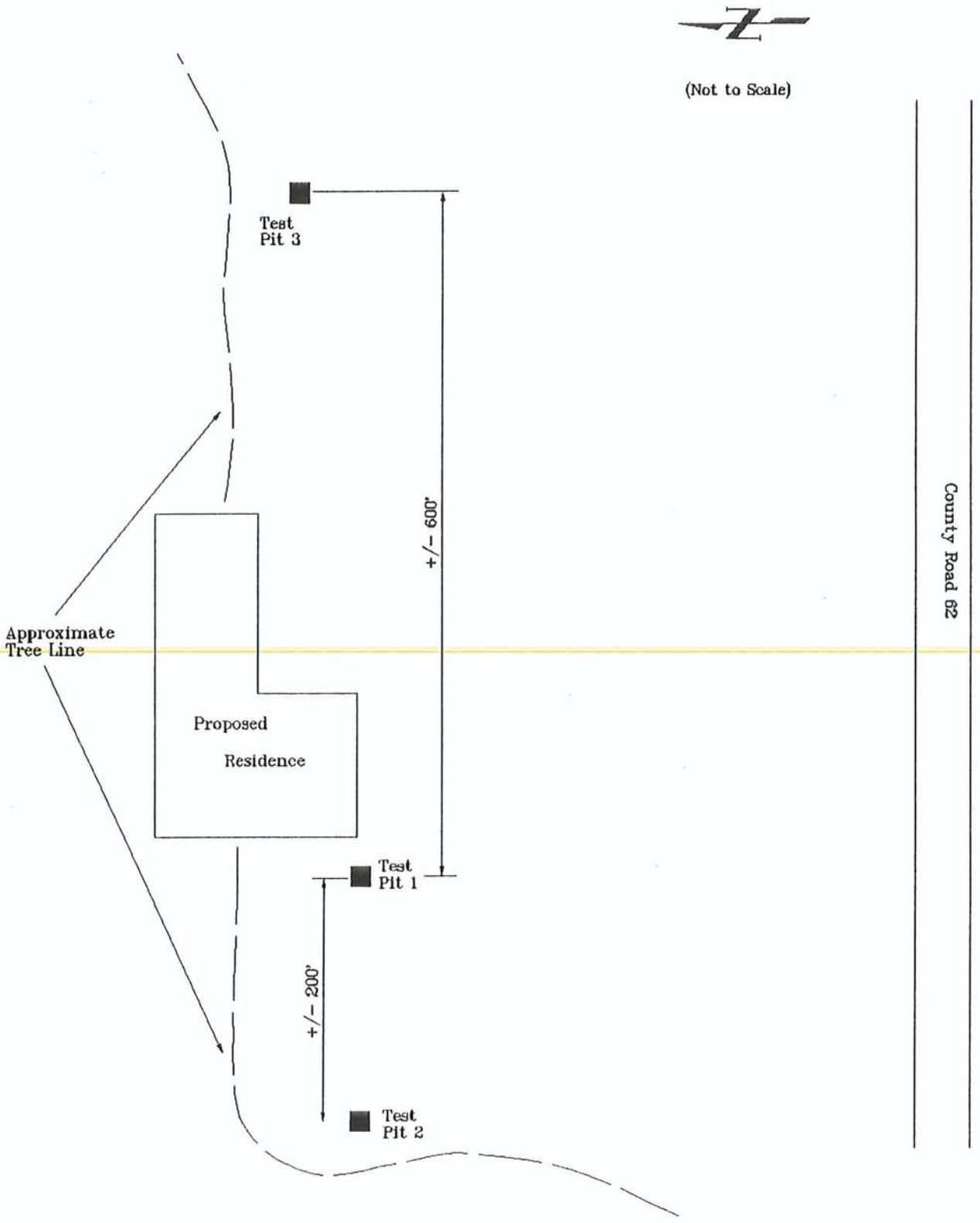
STEAMBOAT SPRINGS COLORADO



SITE PLAN / LOCATION OF TEST PITS

Job Name: Proposed Hunt Residence	Job No. 95-2381
Location: Steamboat Lake, Routt County, Colorado	Figure #2

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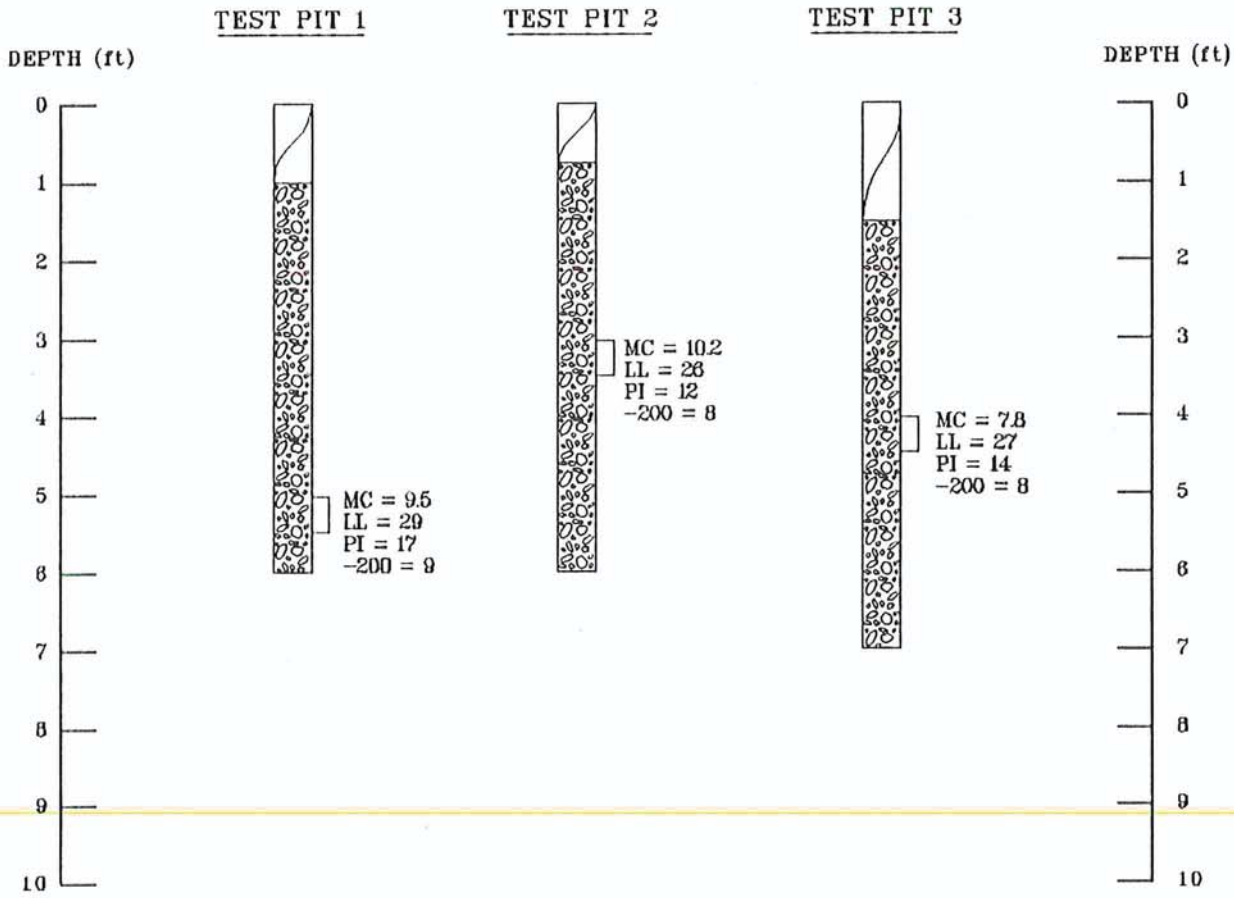
STEAMBOAT SPRINGS COLORADO



LEGEND:

TOPSOIL.

SANDS & GRAVELS: Slightly clayey, low plastic, dense, fine to coarse grained with cobbles and small boulders, moist and brown.

Small disturbed bag sample.

NOTES:

1) MC = Natural Moisture Content (%)
   DD = Natural Dry Density (pcf)
   LL = Liquid Limit (%)
   PI = Plasticity Index (%)
   -200 = Percent Passing the #200 US Standard Sieve

2) Test pits were excavated on 8/8/94 with a backhoe.

3) Locations of test pits were provided by the client.

4) Elevations of test pits were not measured and logs of test pits are drawn to depth.

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

LOGS, LEGEND, & NOTES

Job Name: Proposed Hunt Residence	Job No. 95-2381
Location: Steamboat Lake, Routt County, Colorado	Figure #3

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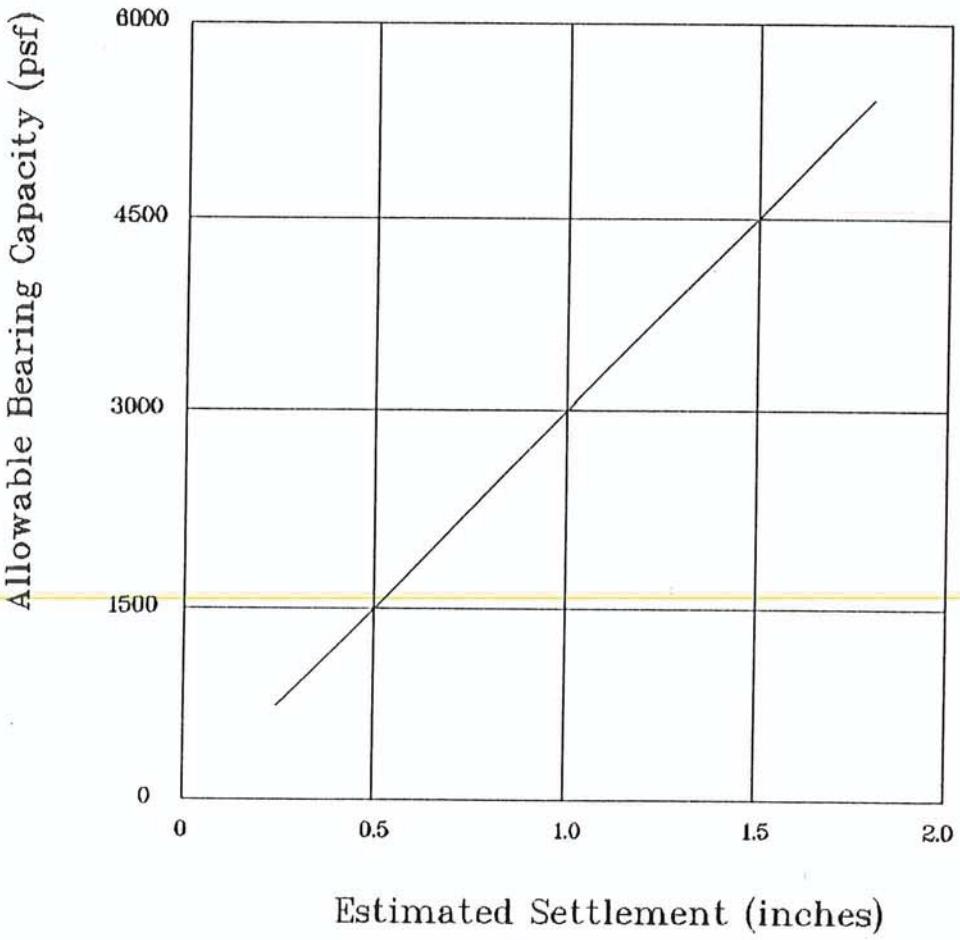
STEAMBOAT SPRINGS COLORADO



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.

BEARING CAPACITY CHART

Job Name: Proposed Hunt Residence	Job No. 95-2381
Location: Steamboat Lake, Routt County, Colorado	Figure #4

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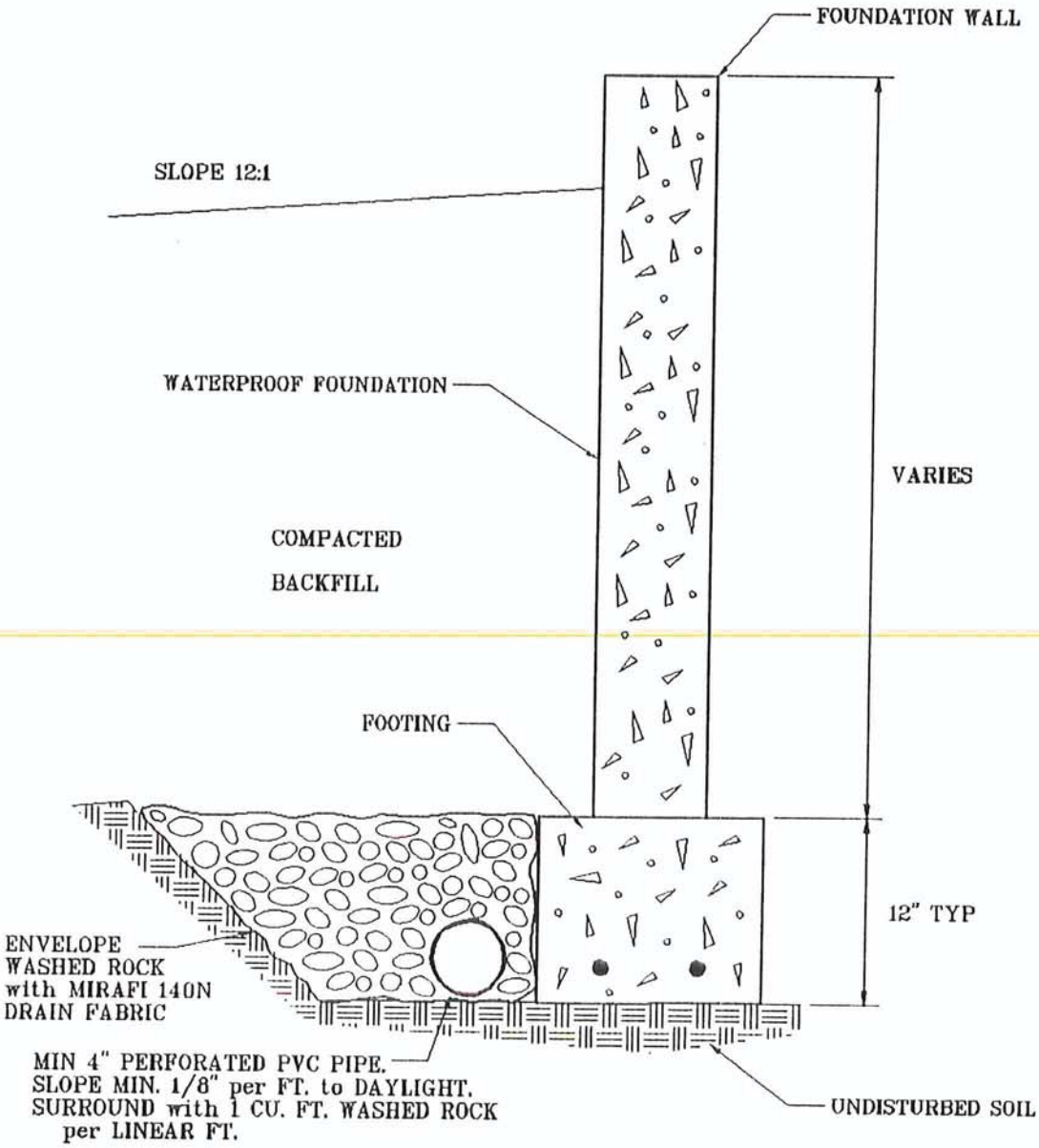
STEAMBOAT SPRINGS COLORADO



PERIMETER/UNDERDRAIN DETAIL

Job Name: Proposed Hunt Residence	Job No. 95-2381
Location: Steamboat Lake, Routt County, Colorado	Figure #5

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TABLE 1

SUMMARY OF LABORATORY TEST RESULTS

SAMPLE LOCATION		NATURAL MOISTURE CONTENT (%)	NATURAL DRY DENSITY (pcf)	ATTERBERG LIMITS		GRADATION		PERCENT PASSING No. 200 SIEVE	UNCONFINED COMPRESSIVE STRENGTH (psf)	SOIL or BEDROCK DESCRIPTION	UNIFIED SOIL CLASS.
TEST PIT	DEPTH (feet)			LIQUID LIMIT (%)	PLASTICITY INDEX (%)	GRAVEL (%)	SAND (%)				
1	5	9.5		29	17	40	51	9		Slighly Clayey Sand & Gravel	SC-GC
2	3	10.2		26	12	41	51	8		Slighly Clayey Sand & Gravel	SC-GC
3	4	7.8		27	14	70	22	8		Sandy Gravel	GC-GW

JOB NO. 95-2381