PRELIMINARY GEOTECHNICAL INVESTIGATION FOR THE LAKES SUBDIVISION, DACONO, COLORADO

Prepared for:

Community Development Group
7950 East Prentice Avenue, #210
Englewood, Colorado 80111

July 31, 2000
Revised August 10, 2000
Project No.: 00520

Prepared By
SCOTT, COX & ASSOCIATES, INC.
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SCOTT, COX & ASSOCIATES, INC. consulting engineers

July 31, 2000
Project No.: 00520

Community Development Group
7950 East Prentice Avenue, #210
Englewood, Colorado 80111

Gentlemen:

The enclosed report presents the results of a preliminary geotechnical investigation for The Lakes Subdivision, Dacono, Colorado. This report contains the results of our investigation and preliminary recommendations concerning design and construction of the foundation, ground-level floor systems and slabs-on-grade.

In summary, silty, sandy clays were encountered over silty claystone bedrock strata to the depths explored. Although the soils and/or rock appear to be suitable for support of the proposed structures, care will be needed in both the design and construction of the buildings to minimize the potential for foundation and floor slab movement.

We appreciate the opportunity to be of service to you on this project. If you have any questions, please feel free to call.

SCOTT, COX & ASSOCIATES, INC.

Respectfully,

Kenneth J. Miller,
Engineer

Approved by:

M. Edward Glassgow, P.E.

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SCOPE

The following report presents the results of our preliminary geotechnical investigation for The Lakes Subdivision, situated in Section 14, Township 1 North, Range 68 West of the 6th Prime Meridian, Weld County, Colorado. We understand the site is to be developed into single family residential lots with commercial development along the western edge of the parcel.

The purpose of this investigation is to identify subsurface conditions and obtain test data to determine the feasibility of this project. The conclusions and recommendations presented in this report are based upon the acquired field and laboratory data and on previous experience with subsurface conditions in this area.

SITE DESCRIPTION

The site is located between County Roads 8 and 10, and between County Road 11 and Interstate 25. The Union Pacific Railroad defines the southern border of the site. At the time of our investigation this 497 +/- acre site was vegetated with corn, wheat, grasses and weeds and had a slight slope to the northeast and west. Gas and/or oil wells and associated pipelines are located on site. No rock outcrops were observed.

FIELD INVESTIGATION

The field investigation was conducted on July 6, 2000. The field investigation consisted of drilling, logging and sampling five (5) borings at selected locations across the site, as indicated on the Boring Location Map. The borings were drilled to depths ranging from ten (10) to thirty one

(31) feet using a truck-mounted continuous flight auger drilling rig.

The boring locations were established by Scott, Cox & Associates, Inc. personnel based on a zoning map provided by Community Development Group. Distances from the referenced features are approximate and were made by pacing. Angles for locating the borings were estimated. The boring locations should be considered accurate only to the degree implied by the methods used to make those measurements.

Logs of the boring operations were compiled by a representative of our firm as the borings were advanced. The graphical logs of the borings are presented in Figure No. 3. Soil sampling was concentrated at approximate foundation-influence elevations. The approximate location of soil and rock contacts, free groundwater levels, samples and standard penetration tests are shown on each boring log. The transition between different strata can be, and often is, gradual. The descriptions of the soil and/or bedrock strata are based, primarily, on visual and tactual methods which are subject to interpretation pending other methods, classification systems and/or tests.

An index of relative density and consistency was obtained in general accordance with the procedures of the standard penetration test, ASTM Standard Test D-1586. The penetration test result listed on the log is the number of blows required to drive the two (2) inch diameter split-spoon sampler twelve (12) inches (or as shown) into undisturbed soil by a one hundred forty (140) pound hammer dropped thirty (30) inches.

Undisturbed samples for use in the laboratory were collected using three (3) inch O.D. thin wall samplers (Shelby) in general accordance with sections of ASTM D-1587. In this procedure, a seamless steel tube with a beveled cutting edge is pushed hydraulically into the ground to obtain a relatively undisturbed sample of cohesive or moderately cohesive soil. A two and one-half (2½) inch O.D. California Barrel Sampler was also used to collect partially disturbed samples. All samples were sealed in the field and preserved at natural moisture content prior to testing.

LABORATORY TESTING PROCEDURES

The recovered samples were tested in the laboratory to measure their dry unit weights, natural water contents, and for classification purposes. Selected samples were tested to determine strength and stability characteristics such as swelling, compressibility, collapse and shear strength.

One dimensional swell/consolidation tests were performed on selected samples to evaluate the expansive, compressive and collapsing nature of the soils and/or bedrock strata. In the swell/consolidation test, a trimmed specimen is placed in a one-dimensional confinement ring and a vertical load of 100psf and/or 500 psf is applied. The sample is allowed to air-dry for the 100 psf tests. The sample is then inundated with water and allowed to swell or consolidate until no further change in volume is recorded. The confining load is then incrementally increased until the specimen is compressed to its original volume. Results of those tests are presented at the end of this report.

A calibrated hand penetrometer was used to estimate the approximate unconfined compressive strength of selected samples. The calibrated hand penetrometer has been correlated with unconfined compression tests and provides a better estimate of soil consistency than visual examination alone.

SUBSURFACE CONDITIONS

In summary, silty, sandy clays were encountered over silty claystone bedrock strata to the depths explored. Free groundwater was encountered in the borings. Refer to the attached boring logs, swell/consolidation table and summary of tests.

CLAY- Clays with moderate amounts of silt and slight to moderate amounts of sand were encountered in the upper one (1) to eleven (11) feet of all Test Holes. The clays appear to be moist to very moist, soft to hard and brown to light grey. The clays exhibit very low to moderate bearing capacities with swell potentials ranging from high to non-swelling.

CLAYSTONE- Claystone bedrock strata with moderate amounts of silt were encountered from below the upper soils to the depths explored. The upper two (2) to eight (8) feet appear to be slightly to moderately weathered. The competent claystone bedrock exhibits high bearing capacities with swell potentials ranging from low to very high. Our experience with the bedrock in this area has shown it to have swell potential ranging from low to very high.

Due to the often variable nature of soil deposits and sedimentary bedrock formations, it is impossible to fully characterize the strength and swelling properties of these materials at all *depths at any given site. Strata may exist at the site which possess higher or lower swell potentials than these tests indicate.*

GROUNDWATER- Groundwater levels were recorded as the borings were advanced, immediately after completion and several days after the drilling operation. At the time of our field investigation, free groundwater was encountered in Test Hole Nos. 1 and 2 at depths ranging from four and one-half (4 ½) feet to twenty nine (29) feet. The groundwater table can be expected to fluctuate throughout the year depending on variations in precipitation, irrigation ditch usage, surface irrigation, and runoff on the site. Surface water from the above sources could percolate through the upper soils or backfill becoming trapped upon the relatively impervious soil or bedrock strata forming a perched water table.

The groundwater levels recorded represent the free, static water levels after equalization of hydrostatic pressures in the borings. This means that the groundwater levels recorded in the borings may not be present at those levels in the excavations. Flow rates, seepage paths, hydrostatic pressures, seasonal groundwater fluctuations, water quality and other factors were not determined in this investigation. A program, which may include special well construction, test procedures, long-term monitoring program and analysis, would be necessary to determine these factors.

FOUNDATION RECOMMENDATIONS

Site specific investigations are required to develop design and construction criteria for the foundations. This report shall not be used solely to design those items. The type of foundation system will depend on the proximity of the bedrock strata and the swell potential of the clays.

SPREAD FOOTINGS- Where low to non-swelling soils are encountered and there exists a separation with bedrock strata, we feel that the structures could be supported by continuous spread footing and isolated pad foundations. The footings could be designed for maximum allowable bearing capacities ranging from 800 to 3,000 pounds per square foot (dead load plus live load) with minimum dead loads ranging from 0 to 1,000 pounds per square foot.

DRILLED STRAIGHT-SHAFT PIERS- Where moderate to high swelling clays and/or bedrock strata is encountered we feel that the structures should be supported by a drilled straight-shaft pier foundation system. Further investigations will be needed to provide additional and more specific parameters for the piers.

FLOOR SYSTEMS AND SLABS-ON-GRADE

Floor slabs placed on or near potentially swelling soils and/or bedrock strata are expected to heave and crack to some degree. Most of the movement will be differential or uneven. It is impossible, with the current state of technology, to predict with certainty how much slab movement will actually occur. From an engineering perspective, slab movements on the order of ½ inch or so would be considered low, whereas 1½ inches or more would be considered moderate to high.

Ultimately, though, it should be the owner who determines whether ½ inch of slab heave is low or high. In some cases, the amount of movement may be considered to be intolerable. Slabs placed on the native, unaltered low to non-swelling clays may experience slight heaving and cracking, but, in our opinion, should not be excessive. Slabs placed on the moderately or higher swelling clays or bedrock strata may experience excessive heaving and cracking. Where moderate or higher swelling soils and/or bedrock strata are encountered structural floors or overexcavation methods should be considered as an alternative to conventional floating slabs.

BELOW-GRADE FLOORS AND SUBDRAINS

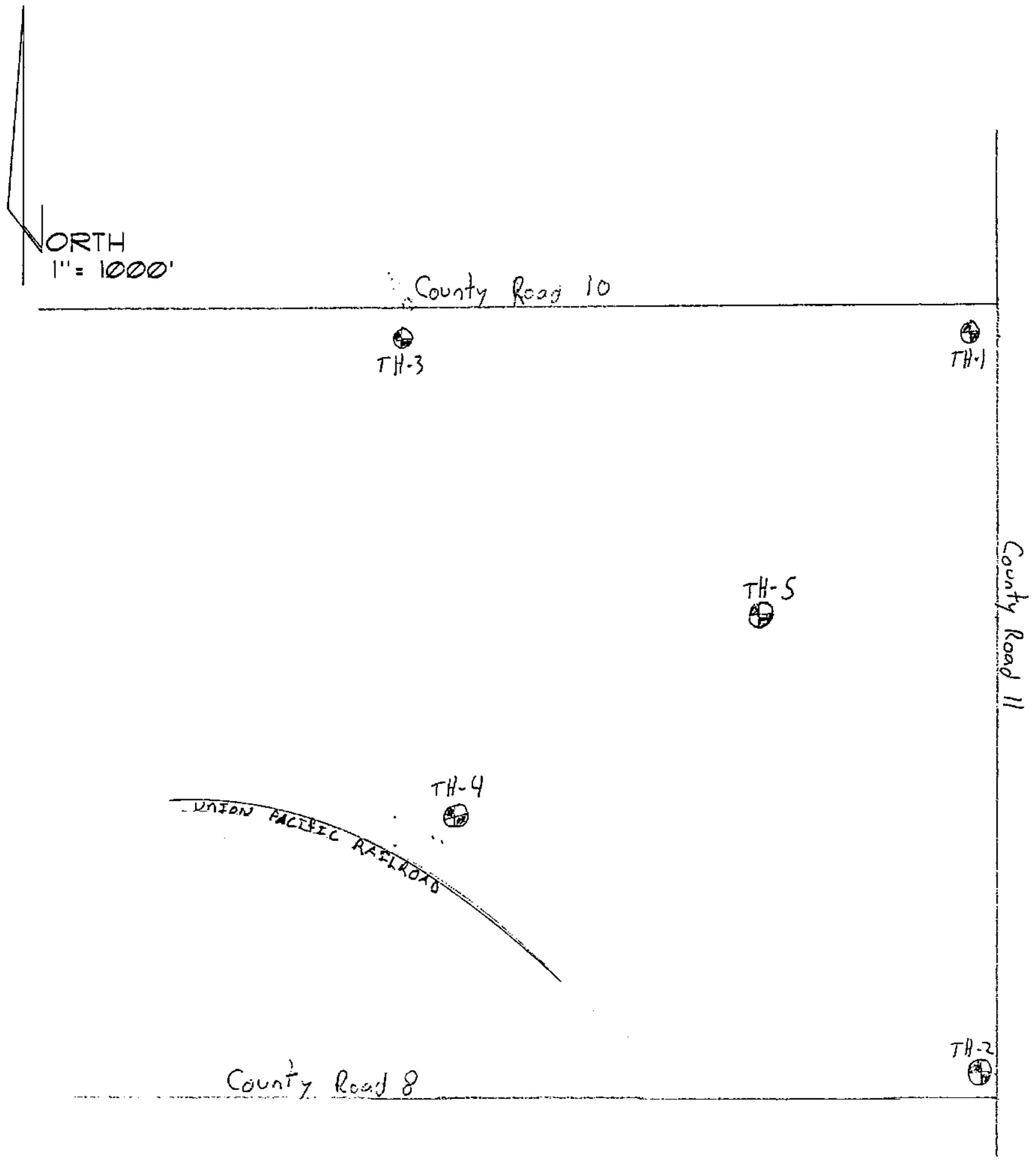
Basement level construction appears to be feasible at some locations across this site, with some limitations from the depth of the groundwater. Due to the potential for groundwater fluctuations and to alleviate hydrostatic pressures behind the foundation walls, below-grade floor levels should be constructed with a perimeter drainage system. The type of drain, i.e. interior (underslab), exterior or both, should be determined at the time of the excavation inspection. Additionally, it is possible that the groundwater levels could be lowered to a level that would allow for basement construction, with the installation of properly design and installed underdrain systems.

GEOTECHNICAL LIMITATIONS

The data presented herein were collected to help develop designs and cost estimates for this project. Professional judgments and estimates on design alternatives and criteria are presented in this report. These are based on evaluation of technical information gathered, our understanding of the characteristics of the development proposed, and our experience with subsurface conditions in this area. We do not guarantee the performance of the project in any respect, but only that our engineering work and judgments rendered meet the standard of care of our profession. Site specific investigations are required to develop design and construction criteria for the foundations and roadways. This report shall not be used solely to design those items.

The methodology used to establish recommendations for construction on expansive soils is not an exact science. Engineering judgement and experience, in addition to laboratory and field analyses, are used to make these recommendations. Therefore, the recommendations and solutions made in this report cannot be considered risk-free and are not a guarantee of the performance of the structures. The recommendations included in this report are our best estimates of the measures that are necessary to help ensure that the proposed structures perform in a satisfactory manner. **The contractor and owner should discuss and understand the risks of construction at this site, and should agree on what level of risks and measures are acceptable.**

We recommend that construction be observed by a qualified soils technician trained and experienced in the field to take advantage of opportunities to recognize undetected conditions which might affect the performance of the foundation systems. A copy of ***A Guide to Swelling Soils for Colorado Homebuyers and Homeowners, Colorado Geological Survey Special Publication 43*** should be provided to any new or future owners of the property. The CGS publication states "It is essential that the homeowner understands how to check and maintain all of the different systems that were designed to protect a house against swelling soil damage". This applies to not only homes but other structures as well.



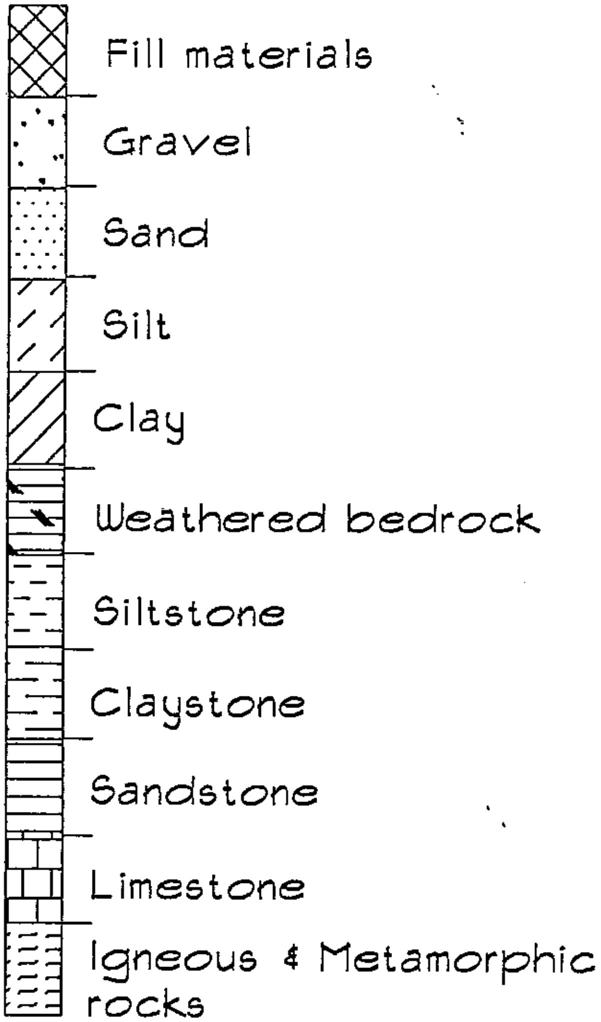
BORING LOCATION MAP

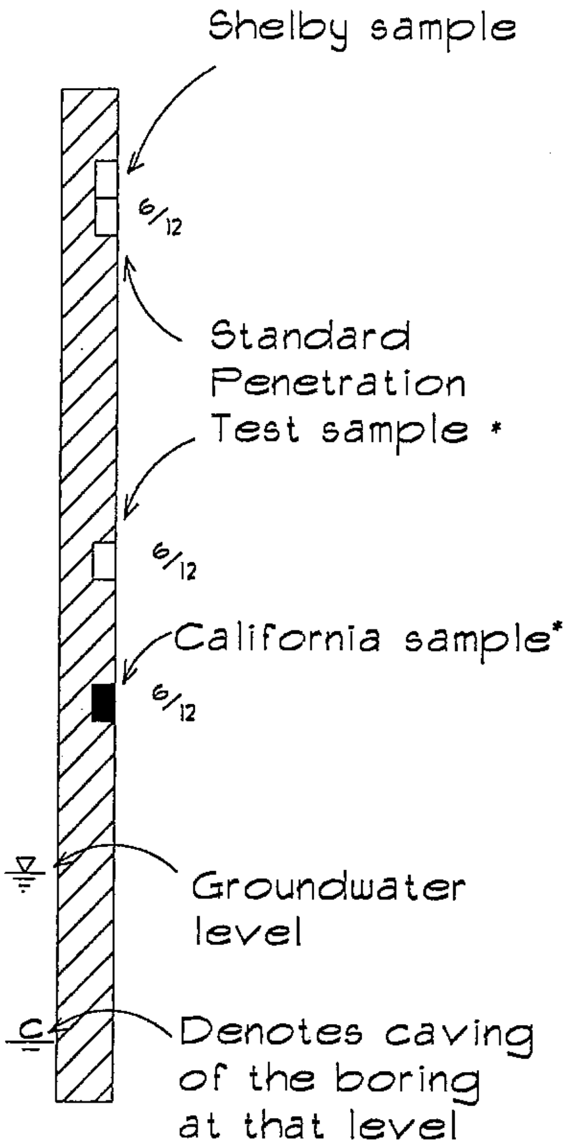
The Lakes
Dacono, Colorado

SCOTT, COX & ASSOCIATES, INC.
Loveland, Colorado

FIGURE NO. 1

LEGEND OF SYMBOLS





Symbols may be combined to represent mixtures.

* 6/12 indicates that 6 blows of a 140# hammer falling 30" was required to penetrate 12"

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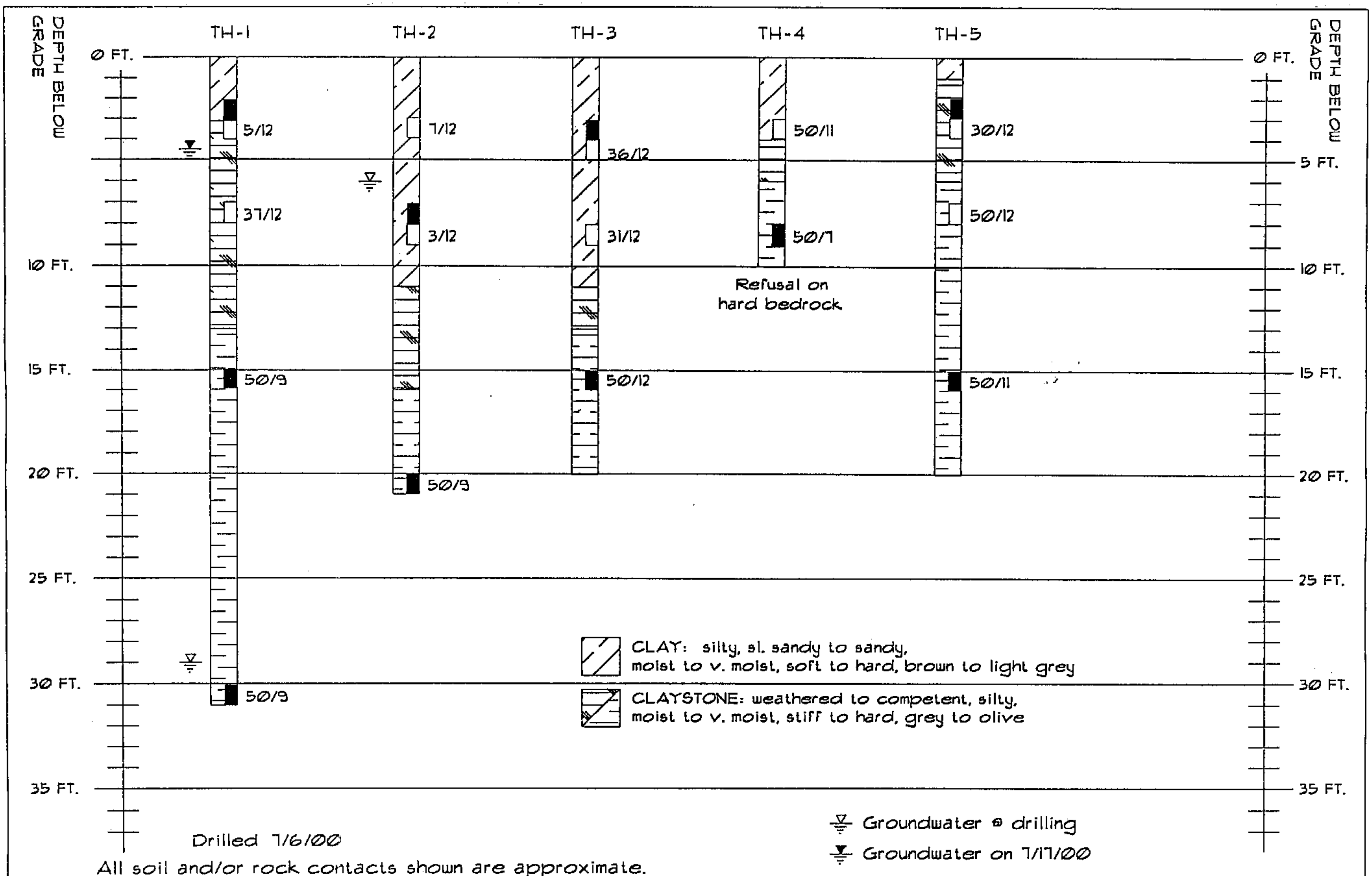
Figure No. 2



CLIENT:	LOCATION:	LOG OF BORINGS	SCOTT, COX & ASSOCIATES, INC.
Community Development Group	The Lakes Dacono, Colorado		Loveland, Colorado

JOB NO. 00520

FIGURE NO. 3

Summary of Test Results

Project No. 00520

Boring No.	Depth, ft	Moisture Content, %	Dry Density, pcf	% passing No.10/200	Liquid Limit, %	Plasticity Index	Unconfined Compressive Strength, psf*	Standard Penetration Test	Soil Description
TH-1	2-3	21.9	102.5				5000		Silty clay
	3-4	24.2					4000	5/12	Wx. silty claystone
	7-8	13.4					>9000	37/12	Wx. silty claystone
	15-16	12.5	118.9				>9000	50/9	Silty claystone
	30-31	16.0	115.1				>9000	50/9	Silty claystone
TH-2	2-3	19.4					6000	7/12	Silty, sl. sandy clay
	7-8	27.5	98.1				2000		Silty, sl. sandy clay
	8-9	25.8					1500	3/12	Silty, sl. sandy clay
	20-21	12.5	129.5				>9000	50/9	Silty claystone
TH-3	3-3' 6"	11.8	108.5				>9000		Silty clay
	3'6"-4'6"	16.3					>9000	36/12	Silty, sandy clay
	8-9	12.2					>9000	31/12	Silty, sl. sandy clay
	15-16	16.3	111.5				>9000	50/12	Claystone
TH-4	3-4	12.2					>9000	50/11	Silty, sl. sandy clay
	8-9	11.5	123.4				>9000	50/7	Silty claystone
TH-5	2-3	13.9	119.1				>9000		Wx. silty claystone
	3-4	14.0					>9000	30/12	Wx. silty claystone
	7-8	9.4					>9000	50/12	Silty claystone
	15-16	15.5	117.4				>9000	50/11	Silty claystone

* Calibrated hand-penetrometer

Table 2
Summary of Swell/Consolidation Tests
Project No.: 00520

Properties at Natural Moisture Content			Consolidation/Swell				Description
Natural Moisture (%)	Natural Dry Density (PCF)	Unconfined Compression (PSF)	Loading (PSF)	Settlement (Dry) (%)	Settlement (Saturated) (%)	Swell (%)	
TH-1 @ 2' **21.9** **1.2% Swell upon the addition of water**	102.5	5000	100 500 1000 2000 4000	0.3	 0.8 2.4 4.3	0.9 0.2	Silty clay, v. moist, stiff, brown
TH-1 @ 15' **12.5** **1.0% Swell upon the addition of water**	118.9	>9000	500 1000 2000 4000	0.3	 0.4 1.4	0.7 0.3	Silty claystone, moist, hard, olive
TH-1 @ 30' **16.0** **9.7% Swell upon the addition of water**	115.1	>9000	500 1000 2000 4000 8000	0.4	 0.6	9.3 8.2 6.7 3.7	Silty claystone, moist, hard, dark grey
TH-2 @ 7' **27.5** **0.8% Consolidation upon the addition of water**	98.1	2000	100 500 1000 2000 4000	0.4	1.2 3.6 5.3 8.0 10.8		Silty, sl. sandy clay, wet, soft, brown
TH-2 @ 20' **12.5** **5.2% Swell upon the addition of water**	129.5	>9000	500 1000 2000 4000 8000	0.3		4.9 4.5 3.8 2.5 0.3	Silty claystone, moist, hard, olive brown
TH-3 @ 3' **11.8** **6.5% Swell upon the addition of water**	108.5	>9000	100 500 1000 2000 4000	0.1		6.4 5.4 4.2 2.3 0.5	Silty clay, porous, moist, hard, brown

Table 2
Summary of Swell/Consolidation Tests
Project No.: L3023-17-01-01

Properties at Natural Moisture Content			Consolidation/Swell				Description
Natural Moisture (%)	Natural Dry Density (PCF)	Unconfined Compression (PSF)	Loading (PSF)	Settlement (Dry) (%)	Settlement (Saturated) (%)	Swell (%)	
TH-3 @ 15' **16.3** **11.5% Swell upon the addition of water**	111.5	>9000	500 1000 2000 4000 8000	0.2		11.3 10.8 8.8 6.2 2.4	Claystone, moist, hard, olive grey
TH-4 @ 8' **11.5** **12.8% Swell upon the addition of water**	123.4	>9000	100 500 1000 2000 4000 8000	0		12.8 11.6 10.4 8.0 5.8 3.4	Silty claystone, moist, hard, brown
TH-5 @ 2' **13.9** **9.5% Swell upon the addition of water**	119.1	>9000	100 500 1000 2000 4000 8000	0.2		9.3 8.4 6.9 5.2 3.0 0.3	Wx. silty claystone, moist, hard, olive
TH-5 @ 15' **15.5** **13.4% Swell upon the addition of water**	117.4	>9000	500 1000 2000 4000 8000 16000	0.3	 3.0	13.1 12.4 10.1 6.8 2.0	Silty claystone, moist, hard, olive grey

APPENDIX A

Suggested Specifications for Placement of Compacted Earth Fills and/or Backfills.

Note: This is intended to be used as a guideline for this project by the owner or owner's representative. Municipal codes, special construction requirements or other controlling factors may require modifications to these suggested specifications. Supervision and control of the fill operations is not within the scope of this investigation. This is not a claim that Scott. Cox & Associates is the Soils Engineer for the fill and compaction operations.

GENERAL

Supervision and control of the overlot and structural fill and backfill shall be under the direction of the Soils Engineer for the project. The soils engineer shall approve all earth materials prior to their use, the methods of placing, and the degree of compaction obtained. A letter of approval from the Soils Engineer will be required prior to the owner's final acceptance of the filling operations.

MATERIALS

The soils used for compacted fill beneath interior floor slabs and backfill around foundation walls should be relatively impervious and non-swelling for the depth specified in the soils report. No material with a maximum dimension of six (6) inches or greater shall be used for fill. All fill materials shall be subject to the approval of the Soils Engineer prior to placement.

SUBGRADE PREPARATION

All topsoil, vegetation, frozen materials, old structures or other unsuitable materials, shall be removed to a depth satisfactory to the Soils Engineer before beginning preparation of the subgrade.

The subgrade surface of the area to be filled shall be thoroughly scarified to a minimum depth of six (6) inches, moistened or dried as specified in the attached tables, and compacted in a manner specified below for the subsequent layers of fill. Fill shall not be placed on frozen or muddy ground.

MOISTURE CONTROL

The fill material, while being compacted, shall as nearly as practical contain the amount of moisture as required in the attached table of this Appendix. The moisture shall be uniform throughout the fill. In the event that water must be added to the soils or that the soils must be dried to meet the specifications, the soils must be thoroughly pulverized, mixed, blended and cured prior to placement. The effort required for optimum compaction will be minimized by keeping stockpile soils near Optimum Moisture Contents. When moisture is added to dry, clayey soils, a curing period of several days may be needed to allow uniform absorption of the water into the soil. Freezing temperatures and/or inclement weather conditions may impede moisture control and compaction operations.

PLACEMENT OF FILL MATERIALS

Distribution of material in the fill shall be such as to preclude the formation of lenses of material differing from the surrounding material. The materials shall be delivered and spread on the fill or prepared surface in such a manner as will result in a level. uniformly compacted fill. Prior to compacting. each layer shall have a maximum "loose-lift" height of twelve (12) inches (or as dictated by the compaction equipment and/or soil conditions) and its upper surface shall be relatively horizontal. Test areas are recommended to determine the optimum lift thickness. Thinner lifts may be necessary in order to achieve the required compaction. Each lift shall be approved by the Engineer prior to placing each succeeding lift.

COMPACTION

When an acceptable uniform moisture content is obtained, each lift shall be compacted by a method acceptable to the Soils Engineer to the densities and moisture contents specified in the foregoing report or the attached table of this Appendix and as determined by the standard Proctor test (procedures in ASTM D698). Compaction shall be performed by rolling or tamping with approved tamping rollers, pneumatic-tired rollers, three-wheel power rollers, or other equipment suited to the soil being compacted. If a sheepsfoot roller is used, it shall be provided with cleaner bars attached in a manner which would prevent the accumulation of material between the tamper feet. The roller should be so designed that the effective weight can be increased. If the required compaction cannot be achieved with the equipment supplied, thinner "loose-lifts" and/or heavier equipment are recommended.

MOISTURE-DENSITY DETERMINATION: STANDARD AND MODIFIED PROCTORS

Samples of representative materials to be used for fill shall be furnished by the contractor to the Soils Engineer at least forty-eight (48) hours prior to compaction testing. Wetter samples will require extra time for test results due to the required drying for sample preparation. The sample is to be tested for determination of the maximum dry densities and optimum moisture contents (Proctor test) for these materials. Tests for these determinations will be made using methods conforming to the most recent procedures of ASTM D698 and AASHTO T99 (standard Proctor) or ASTM D1557 and AASHTO T180 (modified Proctor), whichever applies. Copies of the "Proctor Curves" will be furnished to the contractor. These test results shall be the basis of control for the field moisture/density tests.

DENSITY TESTING

A 24-hour notice shall be given to the Soils Engineer or testing agency for scheduling compaction tests. The density and moisture content of each layer of compacted fill will be determined by the Soils Engineer, or qualified technician, in accordance with ASTM D2167 and D3017 (nuclear method). Any material found not to comply with the minimum specified density shall be reworked and recompacted until the required density is obtained. Additional lifts shall not be placed until each underlying lift has been approved. The results of all density tests will be furnished to both the owner and the contractor by the soils engineer.

A minimum of one compaction test should be conducted for each twelve (12) inch of compacted lift. Trenches should have a minimum of one test every three hundred (300) feet with a minimum or two (2) tests per trench. Sub-excavations have a minimum of one test every twenty-five (25) lineal feet of footing with a minimum of three (3) tests per pad.

TRENCH SAFETY

All excavations shall comply with current OSHA standards for the soil conditions encountered. The Soils Engineer shall be consulted if there is a question regarding classification of the soils.

Compaction Specifications For GW-GC & SW-SC Soils		
On-site Soils or Approved Imported Soils	Minimum Compaction (ASTM D698)	Acceptable Deviation From Optimum Moisture Content
Beneath Interior Slabs	95% +	±3%
Beneath Garage and Exterior Slabs	95% +	±3%
Backfill and Trenches in Open Areas	90% +	±3%
Backfill and Trenches under Structures, Slabs, etc.	95% +	±3%

Compaction Specifications For ML, CL, MH, & CH Soils		
On-site Soils or Approved Imported Soils	*Minimum Compaction (ASTM D698)*	*Acceptable Deviation From Optimum Moisture Content*
*Beneath Interior Slabs**	*93% - 98%*	*0% to +3%*
*Beneath Garage and Exterior Slabs**	*93% - 98%*	*0% to +3%*
Backfill and Trenches in Open Areas	*90% +*	*0% to +3%*
*Backfill and Trenches under Structures, Slabs, etc.**	*95% - 98%*	*0% to +3%*

* MH and CH soils are not recommended in these areas