Thiele Geotech Inc

Geotechnical Exploration Report

Offutt Vet Clinic SGBP 07-0019

Offutt AFB
Bellevue, Nebraska

Prepared for:
Alley Poyner Macchietto Architecture, P.C.
1213 Jones Street
Omaha, Nebraska 68102

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PROFESSIONAL CIVIL ENGINEER
JOHN A. CHRISTIANSEN
E-7821
STATE OF NEBRASKA

THIELE GEOTECH, INC.
13478 Chandler Road
Omaha, Nebraska 68138-3716
402.556.2171 Fax 402.556.7831
www.thielegeotech.com

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INTRODUCTION

Thiele Geotech, Inc. has completed a geotechnical exploration study for the proposed Offutt Vet Clinic to be located on Offutt Air Force Base near building 678 in Bellevue, Nebraska. The purpose of this study was to identify the general soil and ground water conditions underlying the site; to evaluate engineering properties of the existing soils; to provide earthwork and site preparation recommendations; and to recommend design criteria and parameters for foundations, pavements, and other earth supported improvements.

This study included soil borings, laboratory testing, and engineering analysis. A series of 3 test borings was spaced across the project site at strategic locations. The field and laboratory data are presented in the Appendix, along with a description of investigative methods.

The drilling and testing performed for this study were conducted solely for geotechnical analysis. No analytical testing or environmental assessment has been conducted. Any statements or observations in this report regarding odors, discoloration, or suspicious conditions are strictly for the information of our client. If an evaluation of environmental conditions is desired, a separate environmental assessment should be conducted. This study did not include biological assessment (e.g. mold, fungi, bacteria) or evaluation of measures for their control.

It should also be noted that this report was prepared for design purposes only, and may not be sufficient for a contractor in bid preparation. Prospective contractors should evaluate potential construction problems on the basis of their own knowledge and experience in the local area and on similar projects, taking into account their own intended construction methods and procedures.

This report is an instrument of service prepared for use by our client on this specific project. The report may be duplicated as necessary and distributed to those directly associated with this project, including members of the design team and prospective contractors. However, the technical approach and report format shall be considered proprietary and confidential, and this report may not be distributed in whole or in part to any third party not directly associated with this project. By using and relying on this report, all other parties agree to the same terms, conditions, and limitations to which the client has agreed.

PROJECT DESCRIPTION

We understand the project to consist of a single-story, slab-on-grade, 2,600 square feet veterinary clinic. The design is to meet Department of Defense minimum Antiterrorism Standards for buildings, which includes structural requirements for blast rated construction of buildings. We assume that exterior walls may consist of masonry or poured concrete, with steel interior framing and joists. A standing seam metal roof with a 4/12 pitch is preferred. Shallow concrete spread foundations will be used. An entrance driveway and parking pavements will also be constructed. We assume that cuts and fills of up to 3 feet will be needed to achieve the desired site grades

SURFACE AND SUBSURFACE CONDITIONS

SITE CONDITIONS

The site is located within Offutt Air Force Base southwest of Butler Boulevard and Recon Road. The vet clinic is west of building 594. The site is currently a parking/storage lot for equipment. The site is currently paved with concrete to the west and to the east is a weed/gravel covered area.

LOCAL GEOLOGY

The surface geology of the Papillion Creek Basin is Pleistocene in age and consists of eolian (wind-blown) deposits of Peoria and Loveland loess. The loess formed in dune-shaped hills between the Elkhorn and Missouri Rivers. The Peoria loess typically consists of silty lean clays that are stiff when dry but become softer with increasing moisture content. The Peoria often exhibits low unit weight and is collapse susceptible. The Loveland loess is an older deposit, and typically consists of lean clays. The Loveland generally exhibits higher unit weights and shear strengths than the Peoria.

The loess overlies Pleistocene glacial deposits of Kansan and Nebraskan till. The till consists of lean to fat clays mixed with sand, gravel, and occasional cobbles. The glacial deposits are generally fairly deep, but are sometimes near the surface at lower elevations on steep slopes. Cretaceous sandstone or Pennsylvanian limestone and shale form the bedrock unit below the glacial deposits. The depth to bedrock is normally great, and rock is rarely encountered in construction.

Along drainageways, alluvial and colluvial deposits are typically present. These soils were formed by erosion of the adjoining loess-mantled hills. Alluvial deposits are generally present along creeks and in major drainageways. The upper several feet of alluvium are usually stiffer due to the effects of desiccation. Colluvial soils are usually located at the base of steep slopes and in upland draws, and are formed by local creep and sloughing.

SOIL CONDITIONS

The soils encountered in the test borings generally consisted of man-placed overlying alluvium.

Man-placed fill was encountered at the surface of all 3 borings and extended to depths ranging from 6 to 7 feet below grade. The fill was described as light to dark brown, olive gray, moist to very moist, firm to hard, lean clay. Compaction levels were calculated to be 95 to over 100 percent of an assumed Standard Proctor.

Below the fill, alluvium was encountered. The alluvium was described as olive gray, gray, very moist to wet, firm, lean to fat clay, and loose poorly graded sand and silty sand.

Ranges of engineering properties from laboratory tests on selected samples are presented in Table 1.

Table 1 - Laboratory Results

Soil Layer	Moisture Content (%)	Dry Unit Weight (pcf)	Unconfined Compressive Strength (tsf)	Classification *(LL/PI)*
Man-placed fill	18 to 25	99 to 111	0.6 to 1.31	CL(42/19)
Alluvium	22 to 36	87 to 104	- -	CL, SP, CH, SM (visual)

GROUND WATER OBSERVATIONS

Ground water levels were observed in the borings as presented in Table 2. Note that ground water levels may fluctuate due to seasonal variations and other factors.

Table 2 - Water Level Observations

Boring Number	Water Level (ft. below grade)	
	During Drilling	End of Drilling
B-2	- -	11.0

ANALYSIS AND RECOMMENDATIONS

GENERAL

With the soil conditions identified in the test borings, the site appears suitable for the proposed construction. Approximately 7 feet of compacted fill was encountered at the surface of each boring. We expect the footings for the proposed vet clinic to bear within this fill layer.

A hydrocarbon (possibly petroleum) odor was very apparent at a shallow depth of 2½ feet below grade. A vapor barrier should be used for the vet clinic. However, the odor noted in our borings does not match what was reported to us for type and amount of contamination. Therefore, we recommended additional testing to further characterize the impacted soils so that the proper vapor barrier is used.

EARTHWORK AND EXCAVATIONS

Rubble and waste materials from site clearing and demolition should be removed from the site and lawfully disposed or recycled. Waste materials should not be buried on-site. Demolition of structures should include excavation and removal of foundations and floor slabs. Where trees are cleared, the stumps should be excavated and removed.

Topsoil and vegetation should be stripped to a depth of 4 inches in areas to be disturbed during grading, including borrow and fill areas. Surfaces to receive fill should be broken up and recompacted to allow new fill to bond to the existing soil. Slopes steeper than 5H:1V should be benched before placing fill.

The excavated site soils will generally be suitable for reuse as structural fill, although some moisture conditioning may be required. Any off-site borrow should be a clean, inorganic silt or lean clay with a liquid limit less than 45 and a plasticity index less than 20. Borrow material should not contain an appreciable amount of roots, rock, or debris, and should not contain any foreign material with a dimension greater than 3 inches.

All fills should be placed and compacted as structural fill. Fill should be placed in thin lifts not to exceed 8 inches loose thickness. Structural fill should be compacted with a sheepsfoot type roller to a minimum of 95 percent of the maximum dry density (ASTM D698, Standard Proctor). Moisture content should be controlled to between -3 and +4 percent of optimum.

Backfill soils in utility trenches should be compacted to a minimum of 95 percent of the maximum dry density at a moisture content between -3 and +4 percent of optimum. Lift thicknesses should be appropriately matched to the type of compaction equipment used. Backfill soils around foundations, basement walls, and retaining walls should be compacted to a minimum of 95 percent of the maximum

dry density at a moisture content between -3 and +4 percent of optimum. Granular backfill should not be used in exterior trenches or around foundation elements.

Quality control testing is an important part of any earthwork operation. It is recommended that a representative of the geotechnical engineer periodically monitor earthwork operations to verify proper compliance with these recommendations, including compaction levels.

OSHA's Construction Standards for Excavations require that the contractor's excavation activities follow certain worker safety procedures. These include a requirement that excavations over 4 feet deep be sloped back, shored, or shielded. The soils encountered in the test borings generally classify as type B and C soils according to the OSHA standard. The maximum allowable slope for an unbraced excavation in these soils is 1H:1V and 1.5H:1V, respectively, although other provisions and restrictions apply. Excavations over 20 feet deep require specific design by a licensed Professional Engineer. The contractor is solely responsible for site/excavation safety and compliance with OSHA regulations. The geotechnical engineer assumes no responsibility for site safety, and the above information is provided only for consideration by the designers.

SHALLOW FOUNDATIONS

The site conditions identified are favorable for the use of conventional spread foundations to support structural loads. Based on our bearing capacity and settlement analysis, a net allowable bearing pressure of 1,500 pounds per square foot was determined. This allowable bearing pressure may be used to size wall footings and column pads. The bearing pressure was calculated based on a safety factor of 3 against bearing failure. Foundation settlements are estimated at less than 1 inch total and ½ inch differential over a span of 20 feet. If maximum design loads significantly exceed 80 kips for columns or 4 kips per foot for walls, these bearing pressures may not be applicable and should be reevaluated.

It is recommended that column footings be at least 3 feet square and that load bearing wall footings be at least 16 inches wide. Exterior footings and footings in unheated areas should be founded a minimum of 3.5 feet below adjacent grade to provide reasonable frost protection. It is recommended that all footings be steel reinforced.

The condition of the bearing soils can vary and should be observed by the geotechnical engineer at the time of excavation. If unsuitable bearing soils are identified, they should be improved by compaction or replaced by structural fill. As an alternative, the footing bottom could be extended through unsuitable materials if suitable material is present below.

Below grade walls will be subjected to lateral earth pressures due to an unbalanced soil height. The properties listed in Table 3 can be used in wall design.

Table 3 - Lateral Earth Pressure Values

Property	Coefficient	Drained Conditions	Undrained Conditions
Active Lateral Pressure	0.40	40 pcf (Equivalent Fluid)	85 pcf (Equivalent Fluid)
At-Rest Lateral Pressure	0.50	50 pcf (Equivalent Fluid)	90 pcf (Equivalent Fluid)
Passive Resistance	2.50	300 pcf (Equivalent Fluid)	150 pcf (Equivalent Fluid)
Soil Unit Weight (compacted backfill)		120 pcf	60 pcf
Base Adhesion *		500 psf	500 psf

** Multiply by contact area to determine lateral resistance, limited to ½ of the vertical load*
Note: Coefficients and equivalent fluid values are for level backfill. Sloping backfill adds significantly greater load to the wall. These values should be re-evaluated if sloping backfill conditions are present.

If the top of the wall is able to deflect inward approximately 0.4% of the wall height, then active earth pressures can develop. However, if the wall is braced or otherwise restricted from deflecting, such as a basement wall braced by floor framing at the top, then at-rest earth pressures should be used. Safety factors of 2.0 for sliding and for overturning are recommended. Drainage measures should be incorporated in the wall to ensure drained conditions. Proper backfill compaction is also an important factor in long-term stability.

SEISMIC SITE CLASS

Seismic structural design requirements are dictated by a site classification based on average soil properties within the top 100 feet. Based on our local experience, the soil profile was estimated below the maximum boring depth. The average undrained shear strength was then estimated based on the actual laboratory testing and on assumed soil properties for the deeper soil profile.

The site classifies as Site Class D (stiff soil profile) according to Table 1615.1.1 of the 2000 International Building Code.

FLOOR SLABS

To avoid localized slab failures, it is important that interior backfill around foundation elements and in plumbing trenches be properly compacted. Interior backfill should be compacted to a minimum of 95 percent of the maximum dry density at a moisture content between -3 and +4 percent of optimum (ASTM D698, Standard Proctor).

To provide uniform support for floor slabs, the upper 6 inches of the subgrade should be compacted to a minimum of 95 percent of the maximum dry density at a moisture content between -3 and +4 percent of optimum (ASTM D698, Standard Proctor). Care should be taken to maintain the condition of the

subgrade. Areas that become saturated, frozen, or disturbed should be reworked prior to slab placement. Any unstable areas should be excavated and replaced with structural fill. A granular cushion beneath the floor slab is considered a construction convenience and may be used, but is not considered critical to proper slab performance.

A 10 mil thick vapor retarder is recommended beneath the concrete to inhibit upward migration of moisture through the slab. Care should be taken when finishing concrete placed directly on a vapor retarder to minimize potential problems with curling and blistering.

Interior partition walls weighing up to 1,000 pounds per lineal foot may be supported directly on the floor slab. It is recommended that control joints be provided between partition walls that bear on the floor slab and walls supported on footings. Entrance slabs should be designed as structural stoops with a cavity beneath the slab to accommodate frost heave.

Contraction joints are important to control the location of cracks in the floor slab that result from stresses caused by normal drying shrinkage. Joints should be cut as soon as practical after the concrete has set sufficiently to support foot traffic, and must be cut before any shrinkage cracks form. Contraction joints should be cut to a minimum of ¼ of the slab thickness (1/5 of the thickness for early entry saw method). Joints should be spaced no more than 30 times the thickness of the slab or 15 feet maximum. Panels should be kept as square as possible, with the length to width ratio limited to 125 percent. Dowel bars should be used for load transfer across construction joints where slabs are subjected to heavy loads. Joints should be carefully planned and laid out to match column lines and to meet reentrant corners. Joints should be perpendicular to edges and should not form angles less than 45 degrees or over 225 degrees. To accommodate the relative movement that commonly occurs between floors and foundations, isolation joints should be provided against walls, and diamond or circular isolation joints should be constructed around columns.

PAVEMENTS

Pavement performance is directly affected by the degree of compaction, uniformity, and stability of the subgrade. This is particularly important where traffic from heavy trucks is anticipated. The final subgrade should be reworked and compacted immediately prior to pavement construction. The subgrade should then be proof rolled, and any unstable areas should be excavated and replaced to create a uniform and stable subgrade.

For concrete pavements, it is recommended that the upper 12 inches of the subgrade be compacted to a minimum of 90 percent of the maximum dry density at a moisture content between -3 and +4 percent of optimum (ASTM D1557, Modified Proctor). Subgrade preparation should extend a minimum of 2 feet laterally beyond the edge of the pavement.

For asphalt pavements, greater stability is required due to the extreme loading conditions placed on the subgrade during laydown. Subgrades for asphalt pavements should be prepared by compacting the upper 12 inches to a minimum of 92 percent of the maximum dry density at a moisture content between -3 and +4 percent of optimum (ASTM D1557, Modified Proctor). Subgrade preparation should extend a minimum of 2 feet laterally beyond the edge of the pavement, including the concrete curb and gutter section.

Under sidewalks, the upper 6 inches of the subgrade should be compacted to a minimum of 95 percent of the maximum dry density at a moisture content between -3 and +4 percent of optimum (ASTM D698, Standard Proctor). Subgrade preparation should extend laterally 6 inches beyond the edge of the sidewalk

Based on the forgoing subgrade preparation procedures, recommended minimum pavement thicknesses are provided in Table 4. These minimum thicknesses are prescriptive values based on traffic classification, and not on a detailed analysis using traffic counts. It should be noted that life cycle costs for concrete pavements are generally lower, despite their higher initial cost. Local experience has shown that well constructed concrete pavements typically perform better, have lower maintenance costs, and have longer service lives than comparable asphalt pavements. Note that we do not recommend using an aggregate base as part of the pavement section due to concerns over drainage and freeze/thaw deterioration of the base material.

Table 4 - Minimum Pavement Thicknesses

Pavement Category	Pavement Type/Thickness (inches)	
	Concrete	**Full Depth Asphalt**
Sidewalks	4	- -
Parking Areas	5	6
Drive Lanes *(concentrated traffic - occasional trucks)*	5	7
Medium Duty *(up to 3 trucks/day)*	6	8
Dumpster Pads *(including pickup area)*	7	- -

Subgrade Support Values: CBR = 3, k=120 pci
Materials: (reference City of Omaha Standard Specifications for Public Works Construction, 2003 Edition)
concrete - mix type L6(f'_c = 3,500 psi) (Section 500)
asphalt surface - mix type CMR w/ PG64-22 binder (Section 400)
asphalt base - mix type Base w/ PG64-22 binder (Section 400)

Contraction joints are important to control the location of cracks in concrete pavement that result from stresses caused by normal drying shrinkage and thermal effects. A proper jointing system will

enhance structural capacity and prolong the life span of a concrete pavement as well as improve ride quality. Contraction joints should be cut to a minimum of ¼ of the slab thickness (1/5 of the thickness for early entry saw method). Joints should be cut as soon as practical after the concrete has set sufficiently to support foot traffic, and must be cut before any shrinkage cracks form. Joints should be spaced no more than 24 times the thickness of the slab or 12½ feet maximum. Panels should be kept as square as possible, with the length to width ratio limited to 125 percent. Dowel bars should be used for load transfer across construction joints, and should be considered for contraction joints subjected to heavy truck traffic. Joints should be carefully planned and laid out to meet inlets, drainage structures, reentrant corners, and radiuses. Joints should be perpendicular to edges and radiuses, and should not form angles less than 45 degrees or over 225 degrees. Isolation joints should be provided around any structures. We recommend that joints be sealed to reduce moisture infiltration and to reduce the accumulation of non-compressible materials.

Backfill behind curbs and within islands should consist of relatively impervious cohesive soils. Backfill should be compacted to a minimum of 95 percent of the maximum dry density (ASTM D698) to minimize subsidence and to reduce moisture infiltration around the edges of the pavement. Granular soils should not be used for fill in islands as this can increase infiltration into the subgrade. Porous fills, including granular material and loosely placed clay soils, also act as a reservoir that can allow moisture to seep through cracks and joints onto the pavement surface, sometimes long after the water is trapped. This condition is especially pronounced when loose backfill consolidates and allows surface water to pond.

CORROSIVITY

The on-site soils have moderate corrosive potential. Therefore, corrosion of buried metals is a concern on this site, and protective measures should be taken. Typically, protective measures include polyethylene encasement of buried ductile iron pipe. The soils are not expected to be corrosive to concrete, and the use of Type I cement is recommended.

SURFACE DRAINAGE AND LANDSCAPING

The long-term performance of any project is contingent upon keeping the subgrade soils at more or less constant moisture content, and by not allowing surface drainage a path to the subsurface. Positive surface drainage away from structures must be maintained at all times. Landscaped areas should be designed and built such that irrigation and other surface water will be collected and carried away from the structure.

Construction staging and grading should provide for removal of surface water from the site. If prolonged ponding of surface water occurs, removal and replacement of wet or disturbed soils may be necessary. Temporary grades should be established to prevent runoff from entering excavations or

footing trenches. Backfill should be placed as soon as structural strength requirements are met, and should be graded to drain away from the building.

The final grade of the foundation backfill and any overlying pavements should have a positive slope away from foundation walls on all sides. For grass or landscape covered areas, a minimum slope of 1 inch per foot for 5 to 10 feet away from the building is recommended. A minimum slope of 2 percent is recommended for grassed or landscaped areas of the site away from the building. For paved areas, minimum slopes of 1 percent for concrete pavements and 1½ percent for asphalt pavements are recommended. Pavements and exterior slabs that abut the structure should be carefully sealed against moisture intrusion at the joint.

OTHER RECOMMENDATIONS

During detailed design, additional issues may arise and possible conflicts may occur with our recommendations. Such issues and conflicts should be resolved through dialogue between the geotechnical engineer and designers. It is recommended that the geotechnical engineer review the final design, including the plans and specifications, to verify that our recommendations are properly interpreted and incorporated into the design.

If any changes are made in the design of the project, including the nature or location of proposed facilities on the site or significant elevation changes, the analysis and recommendations of this report shall not be considered valid unless the changes are reviewed. The analysis and recommendations of this report should not be applied to different projects on the same site or to similar projects on different sites.

The analysis and recommendations in this report are based upon borings at specific locations. The nature and extent of variation between boring locations is impossible to predict. Because of this, geotechnical recommendations are preliminary until they have been confirmed through observation of site excavation and earthwork preparation. If variations appear during subsequent exploration or during construction, we may reevaluate our recommendations and modify them, if appropriate. The geotechnical engineer should be retained during construction to observe compliance with the recommendations of this report and to provide quality control testing of earthwork construction.

If these services are provided by others, including the contractor, the entity that provides construction phase observation and testing shares responsibility as the geotechnical engineer of record for implementing or modifying these recommendations.

Respectfully submitted,
Thiele Geotech, Inc.

Prepared by,

Melissa R. Polito

Prepared under the supervision of,

John A. Christiansen, P.E.
Nebraska License E-7821

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APPENDIX

Subsurface Exploration Methods

Legend of Terms

Boring Location Plan

Boring Logs

Soil Test Summary

SUBSURFACE EXPLORATION METHODS

The fieldwork for this study was conducted on November 16, 2007. The exploratory program consisted of 3 test borings drilled at the approximate locations shown on the Boring Location Plan. Boring locations were selected to provide the desired site coverage and were adjusted to accommodate access conditions. The boring locations were laid out by estimating angles and measuring from existing site features. The boring locations should only be considered accurate to the degree implied by the methods used to define them.

Test borings were advanced using flight augers powered by a truck-mounted drill rig. Soil samples were obtained at selected depths as indicated on the boring logs. A 3-inch nominal diameter thin-walled sampler was hydraulically pushed to obtain undisturbed samples. Disturbed samples were obtained by driving a 2-inch nominal diameter split barrel sampler while conducting standard penetration tests (SPT). Auger samples were obtained directly from the drill cuttings.

The boring logs were prepared based on visual classification of the samples and drill cuttings, and by observation of the drilling characteristics of the subsurface formations. The logs have been supplemented and modified based on the laboratory test results and further examination of the recovered samples. The stratification lines on the boring logs represent the approximate boundary between soil types, but the insitu transition may be gradual.

Water level observations were made at the times stated on the boring logs. The borings were backfilled with drill cuttings at the completion of the fieldwork.

The field boring logs were reviewed to outline the depths, thicknesses, and extent of the soil strata. A laboratory testing program was then developed to further classify the basic soils and to evaluate the engineering properties for use in our analysis.

Laboratory tests to further classify the soils included visual classification, moisture content, dry unit weight, and Atterberg limits. The shear strengths of cohesive samples were evaluated using the unconfined compression test.

The boring logs and related information in this report are indicators of subsurface conditions only at the specific locations and times noted. Subsurface conditions, including ground water levels, at other locations of the site may differ significantly from conditions that exist at the sampling locations. Also note that the passage of time may affect conditions at the sampling locations.

Thiele Geotech Inc

LEGEND OF TERMS

Soil Description Terms

Consistency - Fine Grained	Consistency - Coarse Grained	Moisture Conditions
Very Soft, Soft, Firm, Hard, Very Hard	Very Loose, Loose, Medium Dense, Dense, Very Dense	Dry, Slightly Moist, Moist Very Moist, Wet (Saturated)

Sample Identification

Sample Type	Sample Data	Laboratory Data
U -- Undisturbed (Shelby Tube)	No. -- Number	MC -- Moisture content
S -- Split barrel (disturbed)	SPT -- Standard penetration test	γ_d -- Dry unit weight
C -- Continuous sample	bpf -- blows per foot	q_u -- Unconfined compression
A -- Auger cuttings (disturbed)	Rec -- Recovery	LL/PI -- Liquid limit & plasticity index

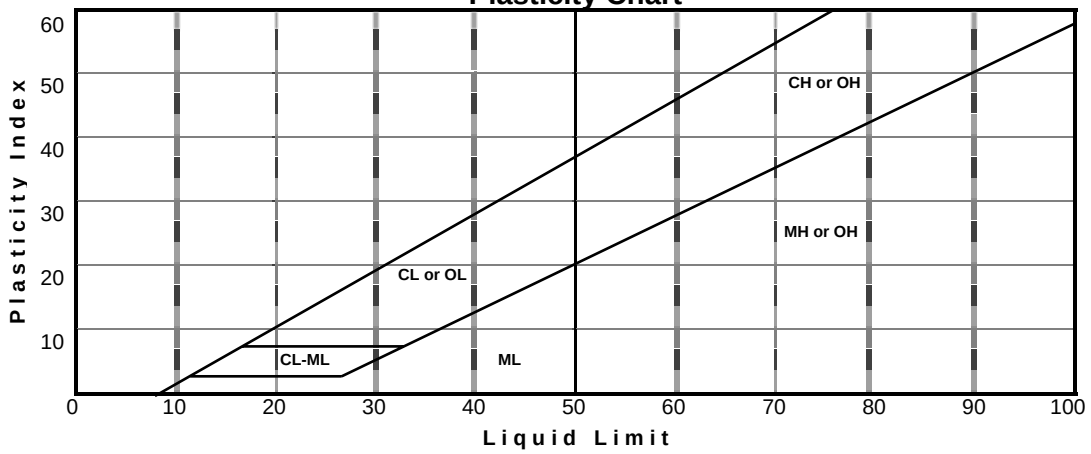
Unified Soil Classification System

Peat	Pt	Highly organic soils	50% or more smaller than No. 200 sieve
Fat Clay	CH	Clay - Liquid Limit > 50 *	
Elastic Silt	MH	Silt - Liquid Limit > 50 *	
Lean Clay	CL	Clay - Liquid Limit < 50 *	
Silt	ML	Silt - Liquid Limit < 50 *	
Silty Clay	CL-ML	Silty Clay *	
Clayey Sand	SC	Sands with 12 to 50 percent smaller than No. 200 sieve *	More than 50% larger than No. 200 sieve and % sand > % Gravel
Silty Sand	SM		
Poorly-Graded Sand with Clay	SP-SC	Sands with 5 to 12 percent smaller than No. 200 Sieve *	
Poorly-Graded Sand with Silt	SP-SM		
Well-Graded Sand with Clay **	SW-SC		
Well-Graded Sand with Silt **	SW-SM		
Poorly-Graded Sand	SP	Sands with less than 5 percent smaller than No. 200 sieve *	
Well-Graded Sand **	SW		
Clayey Gravel	GC	Gravels with 12 to 50 percent smaller than No. 200 Sieve *	More than 50% larger than No. 200 sieve and % gravel > % sand
Silty Gravel	GM		
Poorly-Graded Gravel with Clay	GP-GC	Gravels with 5 to 12 percent smaller than No. 200 sieve *	
Poorly-Graded Gravel with Silt	GP-GM		
Well-Graded Gravel with Clay **	GW-GC		
Well-Graded Gravel with Silt **	GW-GM		
Poorly-Graded Gravel	GP	Gravels with less than 5 percent smaller than No. 200 sieve *	
Well-Graded Gravel **	GW		

* *See Plasticity Chart for definition of silts and clays*

** *See Criteria for Sands and Gravels for definition of well-graded*

Plasticity Chart

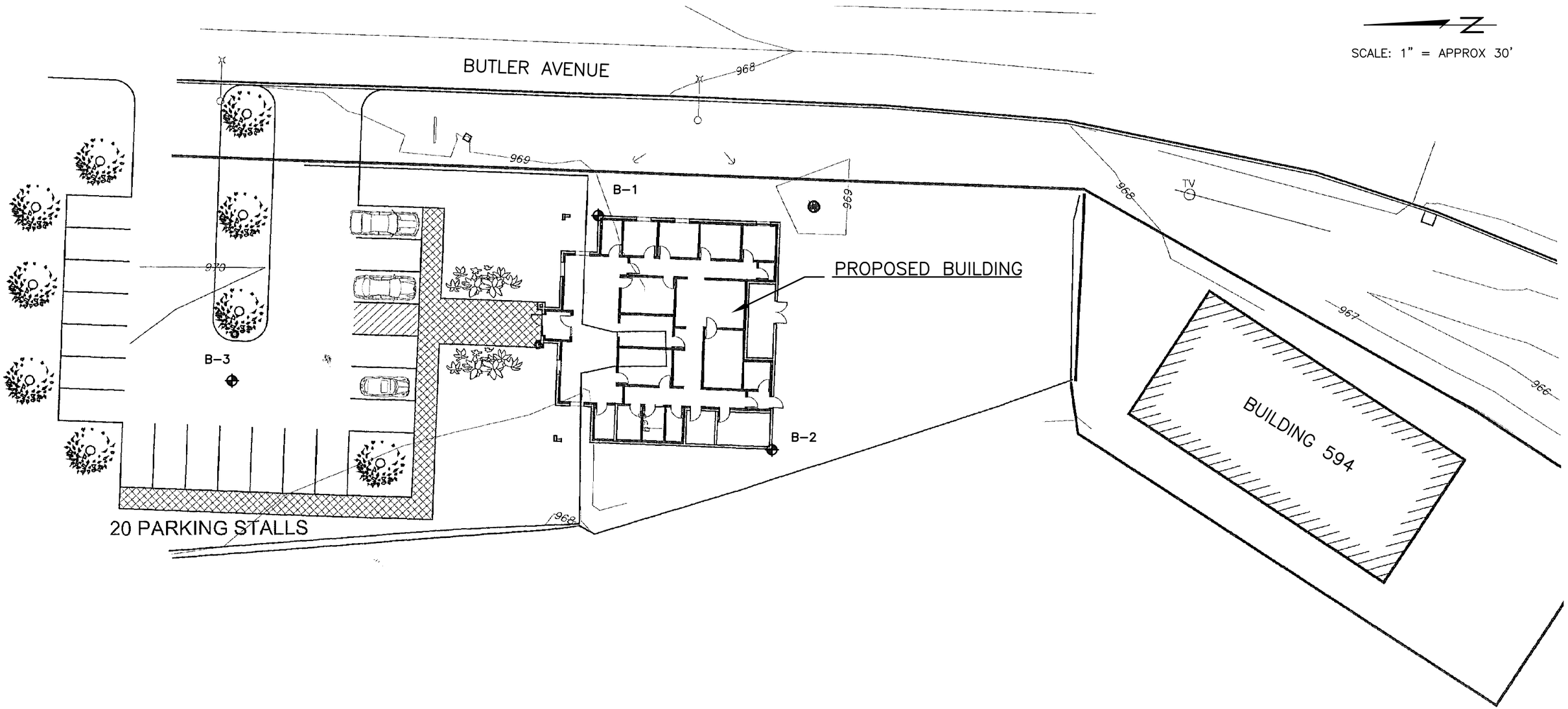


Criteria for Sands and Gravels

Boulders	Cobbles	Coarse Gravel	Fine Gravel	Coarse Sand	Medium Sand	Fine Sand	FINES (silt or clay)
Sieve size 10"	3"	¾"	#4	#10	#40	#200	

Well-graded sands (SW) $C_u=D_{60}/D_{10}\geq 6$ and $C_c=(D_{30})^2/(D_{10} \times D_{60}) \leq 3$ and ≥ 1

Well-graded gravels (GW) $C_u=D_{60}/D_{10}\geq 4$ and $C_c=(D_{30})^2/(D_{10} \times D_{60}) \leq 3$ and ≥ 1



Thiele Geotech Inc

PROJECT

OFFUTT VET CLINIC
BUTLER BLVD, OFFUTT AFB
BELLEVUE, NEBRASKA

JOB # 07578.00 DATE: 11/21/07

BORING LOCATION PLAN

Thiele Geotech Inc

BORING LOG

WATER LEVEL OBSERVATIONS		PROJECT	DRILLER	LOGGER	JOB NO.	DATE
During Drilling	N/E	Offutt Vet Clinic	Kalbach	Epley	07578.00	11/16/07
End of Drilling	N/E	LOCATION	DRILLING METHOD		DRILL RIG	BORING NO.
cave-in	11’	Offutt Air Force Base	6" flight augers		CME 45B	B-1
		LOCATION OF BORING	TYPE OF SURFACE		ELEVATION	DEPTH
boring backfilled with cuttings		see Boring Location Plan	weeds/gravel		969	20’

DEP (ft.)	VISUAL/MANUAL DESCRIPTION: COLOR	MOIST.	CONSIST.	SOIL TYPE	GEOLOGIC ORIGIN	REMARKS	SAMPLE DATA: NO. & TYPE	SPT (bpf)	REC (in.)	LABORATORY DATA: MC (%)	γ_d (pcf)	q_u (tsf)	LL/PI CLASS	DEP (ft.)
	light brown	moist	hard	lean clay	fill	appreciable fine gravel								
							U-1		10	18.8	107.8			
	olive gray	very moist	firm			petroleum odor	U-2		11	25.1	99.0	1.31	LL-42 PI-19 CL	
5														5
	olive gray	very moist	firm	lean clay	alluvium									
							U-3		12	29.1	91.0			
10														10
				poorly graded sand										
							S-4	5		32.4				
	gray			lean clay										
15	olive gray		loose	poorly graded sand										15
			very loose											
							S-5	2		30.5				
20	gray			fat clay										20
						bottom of boring @ 20’								
25														25

Thiele Geotech Inc

BORING LOG

WATER LEVEL OBSERVATIONS		PROJECT	DRILLER	LOGGER	JOB NO.	DATE
During Drilling		Offutt Vet Clinic	Kalbach	Epley	07578.00	11/16/07
End of Drilling	11’	LOCATION	DRILLING METHOD		DRILL RIG	BORING NO.
		Offutt Air Force Base	6" flight augers		CME 45B	B-2
		LOCATION OF BORING	TYPE OF SURFACE		ELEVATION	DEPTH
boring backfilled with cuttings		see Boring Location Plan	weeds		968	20’

DEP (ft.)	VISUAL/MANUAL DESCRIPTION: COLOR	MOIST.	CONSIST.	SOIL TYPE	GEOLOGIC ORIGIN	REMARKS	SAMPLE DATA: NO. & TYPE	SPT (bpf)	REC (in.)	LABORATORY DATA: MC (%)	γ_d (pcf)	q_u (tsf)	LL/PI CLASS	DEP (ft.)
	dark brown	very moist	firm	lean clay	fill									
							U-1		12	24.8	99.0			
	brown													
						minor fine gravel	U-2		12	23.6	98.9	0.59		
5														5
	light brown	very moist	firm	lean clay	alluvium									
				silty sand			U-3		12	32.0	86.8			
10														10
		wet												
			loose	poorly graded sand										
							S-4	5		31.9				
15														15
				silt										
						minor sand	S-5			35.5				
20														20
						bottom of boring @ 20’								
25														25

Thiele Geotech Inc

BORING LOG

WATER LEVEL OBSERVATIONS		PROJECT	DRILLER	LOGGER	JOB NO.	DATE
During Drilling	N/E	Offutt Vet Clinic	Kalbach	Epley	07578.00	11/16/07
End of Drilling	N/E	LOCATION	DRILLING METHOD		DRILL RIG	BORING NO.
		Offutt Air Force Base	6" flight augers		CME 45B	B-3
		LOCATION OF BORING	TYPE OF SURFACE		ELEVATION	DEPTH
boring backfilled with cuttings		see Boring Location Plan	concrete		969.5	10’

DEP (ft.)	VISUAL/MANUAL DESCRIPTION: COLOR	MOIST.	CONSIST.	SOIL TYPE	GEOLOGIC ORIGIN	REMARKS	SAMPLE DATA: NO. & TYPE	SPT (bpf)	REC (in.)	LABORATORY DATA: MC (%)	γ_d (pcf)	q_u (tsf)	LL/PI CLASS	DEP (ft.)
						concrete 8”								
	olive gray	moist	firm	lean clay	fill	minor fine gravel	U-1		11	18.4	110.6			
5							U-2		6	20.7	101.1			5
	olive gray	moist	firm	lean clay	alluvium									
				silt			U-3		12	22.3	103.7			
10				lean clay										10
						bottom of boring @ 10’								
15														15
20														20
25														25

Thiele Geotech Inc

SOIL TEST SUMMARY

Project: Offutt Vet Clinic

Job No.: 07578.00

Location: Offutt Air Force Base

Date: 11/20/07

BORING NO.	SAMPLE NO.	SAMPLE DEPTH (ft.)	SAMPLE DIA. (in.)	MOISTURE CONTENT (%)	UNIT WEIGHT WET (pcf)	UNIT WEIGHT DRY (pcf)	VOID RATIO (e)	SAT. (%)	UNCONFINED COMPRESSION q_u (tsf)	UNCONFINED COMPRESSION STRAIN (%)	SOIL CLASSIFICATION ATTERBERG LIMITS LL	ATTERBERG LIMITS PL	ATTERBERG LIMITS PI	PASS #200 (%)		REMARKS
B-1	U-1	0.5-2		18.8	128.1	107.8	0.562	90								
	U-2	3.5-5	2.85	25.1	123.8	99.0	0.702	96	1.31	4.7	42	23	19		CL	
	U-3	8.5-10		29.1	117.5	91.0	0.851	92								
	S-4	13.5-15		32.4												
	S-5	18.5-20		30.5												
B-2	U-1	0.5-2		24.8	123.6	99.0	0.701	95								
	U-2	3.5-5	2.85	23.6	122.2	98.9	0.703	91	0.59	5.6						
	U-3	8.5-10		32.0	114.6	86.8	0.941	92								
	S-4	13.5-15		31.9												
	S-5	18.5-20		35.5												
B-3	U-1	0.5-2		18.4	131.0	110.6	0.524	95								
	U-2	3.5-5		20.7	122.0	101.1	0.666	84								
	U-3	8.5-10		22.3	126.9	103.7	0.624	97								