hgm
ASSOCIATES INC.

ADDENDUM NO. 3
POTTAWATTAMIE COUNTY, IOWA
ROADS OPERATION CENTER – EARTHWORK AND EROSION CONTROL PLANS
Council Bluffs, Iowa

HGM PROJECT # 105120
DATE OF ISSUE: August 6, 2021
DATE OF BID OPENING: Tuesday, August 10, 2021, at 9:00 a.m.

NOTE TO PLANHOLDERS: Please insert this addendum into your copy of the Project Contract Documents. The following additions or changes to the Contract Documents for the above named project are issued by the Engineer and have the same force and effect as though part of the original issued.

PROJECT MANUAL ADDITION

Geotechnical Report
The Attached Geotechnical Report, prepared by Thiele Geotech Inc. dated July 27, 2020, is made part of the contract document.

If a substitute material, product or manufacturer has been requested to be allowed, it will appear in an addendum only if approved. If not in the addenda, the alternate method, product or manufacturer is not approved.

All other stipulations and requirements of the plans and specifications remain in effect. This addendum shall be attached to and made part of the Contract Documents and shall be acknowledged with the bidders proposal.

Respectfully Submitted:
HGM ASSOCIATES INC.

John E. Jorgensen, PE
Project Manager

Thiele Geotech Inc

Geotechnical Exploration Report

Council Bluffs Airport Maintenance Facility

Eastern Hills Drive and McPherson Avenue
Council Bluffs, Iowa

I HEREBY CERTIFY THAT THIS ENGINEERING DOCUMENT WAS PREPARED BY ME OR UNDER MY DIRECT PERSONAL SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF IOWA.

Heath E. Cutler — 7/27/2020 (DATE)

HEATH E. CUTLER
LICENSE NUMBER 24341
MY LICENSE RENEWAL DATE IS DECEMBER 31, 2020.

PAGES OR SHEETS COVERED BY THIS SEAL:
Entire Bound Document

Prepared for:
HGM Associates, Inc.
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July 27, 2020
TG Project No. 20235.00

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Geotechnical Exploration Report

Council Bluffs Airport Maintenance Facility

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INTRODUCTION

Thiele Geotech, Inc. has completed a geotechnical exploration study for the proposed Council Bluffs Airport Maintenance Facility project to be located near the Eastern Hills Drive and McPherson Avenue intersection in Council Bluffs, Iowa. 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 building foundations, pavements, culvert construction, and other earth supported improvements.

This study included soil borings, laboratory testing, and engineering analysis. A series of seven 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

Our understanding of the project is based upon information provided by HGM Associates, Inc.

The project consists of constructing a new facility for the Council Bluffs Municipal Airport near the north end of the existing property. The facility will include an office/training building on the south side of the site and a maintenance building to its north.

The office/training building will be a single-story, slab-on-grade structure. The west side of the building will consist of offices, a conference room, and storage, while the east side will consist of a large training room. The two sides of the building will be connected by a lobby area. It is anticipated that the building's structural system will utilize steel framing and columns, concrete slabs, precast exterior concrete wall panels, and a metal roofing system. Loads for the structure were not provided, but are assumed to be moderately light. For the purposes of this report, we have assumed maximum column loads of 75 kips and maximum continuous wall loads of 3 kips per lineal foot.

The maintenance building will be a single-story, slab-on-grade structure with several service bays and an office area. The building's structural system will utilize steel framing and columns, concrete slabs, precast exterior concrete wall panels, and a metal roofing system. For purposes of this report, maximum column loads of 150 kips, maximum continuous wall loads of 6 kips per lineal foot, and maximum floor loads of 250 psf have been assumed.

A paved access drive will be constructed off Eastern Hills Drive and over an adjacent drainageway to allow access to both buildings. A parking lot will be constructed on the north side of the office/training building, while the maintenance building will be surrounded by a concrete yard with parking stalls on the east side.

The project site slopes down from the east and west toward the drainageway, with approximately 70 feet of relief. A final grading plan was not available at the time of this report, and the finished floor elevation of each proposed structure has not yet been determined; however, based on the preliminary rough grading plan provided, the main site pad will be graded to an approximate elevation of 1,160 feet. Mass grading will be required to establish finished grades across the project site. Maximum cuts and fills ranging from 10 to 40 feet over the vast majority of the site pad are anticipated, in addition to placement of up to 60 feet of fill in portions of the drainageway to establish proposed grades for the access drive. A new 24-inch diameter CMP culvert will be constructed for the access crossing over the drainageway, replacing an existing CMP culvert at a crossing south of the proposed access drive.

SURFACE AND SUBSURFACE CONDITIONS

SITE CONDITIONS

The proposed maintenance facility is planned near the north end of the existing eastern runway at the Council Bluffs Municipal Airport east of Council Bluffs, Iowa. Based on historical aerial photographs, the site has primarily been utilized for agricultural production. In addition, a low-lying drainage path runs along the western extent of the project site near Eastern Hills Drive. At the time of the exploration the field was primarily bare ground with corn stubble, and the western drainage path along Eastern Hills Drive and its surrounding areas were well vegetated with established trees and shrubs.

LOCAL GEOLOGY

The surface geology of western Iowa is Pleistocene in age and consists of eolian (wind-blown) deposits of Peoria and Loveland loess. The loess formed in dune-shaped hills along the Missouri River and various tributaries. The Peoria loess typically consists of silty lean clays that are stiff when dry but become softer with increasing moisture content. The Peoria sometimes 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. Perched moisture conditions sometimes occur above the Peoria/Loveland interface.

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 fill, altered Peoria loess, Peoria loess, Loveland loess, and Kansan-aged glacial till.

Man-placed fill was encountered at the surface of borings B-3, B-4, and B-5, ranging from 1 to 3 feet in depth below existing grades. It was generally described as a brown, moist, firm to hard, lean clay.

A 1.5 to 3-feet thick layer of altered Peoria loess was encountered at the surface of borings B-1, B-6, and B-7. This is a weathered layer of Peoria loess that has been altered physically and chemically due

to the effects of freeze-thaw and exposure, and has become slightly organic from years of vegetative growth. It was generally described as a brown, moist to very moist, firm to hard, lean clay.

Peoria loess was encountered at the surface of boring B-2, as well as below the fill and altered Peoria loess in the borings noted above. It ranged in thickness from 20 to 38 feet, with the thickness increasing from west to east up the hill's slope. The Peoria loess was generally described as a brown, light brown, or grayish brown, moist to wet, soft to hard, lean clay and silt.

Loveland loess was encountered below the Peoria loess in borings B-1 to B-6, ranging from 9.5 to 19.5 feet in thickness and extending to the termination depth of borings B-4 to B-6. It was generally described as a light brown, reddish brown, or reddish gray, moist to very moist, soft to hard, lean clay, fat clay, and silt.

Kansan glacial till was encountered below the Peoria loess in boring B-7 and below the Loveland loess in borings B-1 to B-3, extending to the termination depth of each. It was generally described as various shades of mottled grays and browns, slightly moist to wet, firm to very hard, fat clay with minor to much sand. Coarse-grained glacial outwash deposits were encountered in the lower samples of boring B-7, which were described as brown or gray, wet, medium dense to dense, silty and clayey sands.

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)	Standard Penetration Values (N)*	Classification *(LL/PI)*
Man-placed fill	17 to 23	95 to 103	1.9	--	CL (*visual*)
Altered Peoria loess	21 to 33	88 to 100	--	--	CL (*visual*)
Peoria loess	17 to 33	88 to 102	0.4 to 2.1	--	CL (34/10, 37/15) ML (*visual*)
Loveland loess	21 to 29	92 to 103	0.4 to 1.4	--	CL (35/13) CH (*visual*) ML (29/5)
Kansan till	5 to 28	99 to 131	1.3	17 to 42	CH (*visual*) SM (*visual*) SC (*visual*)

* Standard Penetration Values are actual field recorded values and have not been corrected for hammer energy

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. The materials encountered in the test borings have relatively low permeabilities and observations over an extended period of time through use of piezometers or cased borings would be required to better define current ground water conditions.

Table 2 – Water Level Observations

Boring Number	*Boring Elevation (ft.)	Water Level (ft. below grade)		Ground Water Elevation (ft.)
		During Drilling	End of Drilling	
B-7	1,134	37.0	26.4	1,108
* *Boring elevations were interpolated from Pottawattamie County GIS contours.*				

Ground water observations were made in the borings both during and after completion of drilling operations. The borings were drilled with hollow stem augers limiting observation during drilling operations. Upon removal of the augers, partial filling of the boring occurred due to the loss of cuttings into the boring. Water level observations taken after completion of the borings were limited to the remaining depth of the open boring. The water level observations include the condition observed (such as cave in) and the depth to which the observations could be made.

ANALYSIS AND RECOMMENDATIONS

GENERAL

The primary geotechnical engineering concerns for this project are fill-induced settlement that is expected to occur due to the significant fill placement required to construct the access drive on the west side of the site, potential failure of the access drive embankment prior to reaching its full height, and the presence of moist to very moist, soft to firm natural loess soils with low unconfined compressive strength properties at or near the presumed building footing elevations. Site preparation recommendations have been provided in the following sections to address these concerns. With the recommendations provided in this report, the soil conditions appear suitable to support the proposed buildings on conventional shallow foundations.

For the measured shear strengths of the loess soils encountered at the site, it is possible that the access drive embankment could fail prior to reaching full height. Therefore, we are recommending that a phased approach to construction be implemented, which is further discussed in the following section.

Ground water was encountered in the boring nearest the drainageway on the west side of the site, but is not anticipated to be encountered during construction. However, it should be noted that ground water has a tendency to fluctuate with changes in season.

SITE PREPARATION

Construction of the access drive embankment will involve placement of approximately 60 feet of compacted structural fill at the drainageway crossing to achieve proposed subgrade elevations. As previously noted, settlement is expected to occur under this added fill weight. Based on our settlement analysis, we expect total settlement in the range of 12 to 18 inches may occur. Settlement of this magnitude is expected to damage structures within the embankment, such as the culvert pipe.

An associated delay period of approximately 12 to 20 weeks is expected to achieve approximately 90% of primary consolidation. This delay period range was obtained using coefficient of consolidation values obtained from a consolidation test and was reduced based on previous experiences with similar soil conditions and fill placement. Depending on the construction schedule, this delay period may not be feasible. Therefore, we recommend the installation of settlement plates in the deepest portions of fill placement to monitor the area and determine when approximately 90% of primary consolidation has been achieved.

Due to the significant fill placement above the proposed 24-inch CMP culvert, we recommend the permanent culvert be installed during initial embankment construction in lieu of a temporary pipe, as removal of a temporary pipe does not appear to be feasible. In order to account for settlement of the permanent pipe and to minimize slumping near the center, we recommend that the permanent culvert pipe be placed 18 inches above the determined flowline elevation at the centerline of the embankment.

It can then be tapered down to match the flowline elevations at each end of the pipe. Another option that could be considered is installing an oversized culvert during the fill operations and sliding the 24-inch culvert through the oversized culvert after settlement has reached 90 percent of primary consolidation. The annulus between these two culverts could then be grouted. It will be very important to verify that the selected culvert(s) can tolerate the amount of fill being placed as cover. Key factors to consider are corrugation configuration, steel thickness (Gage), pipe size and shape, and galvanized thickness.

Fill placement on the order of 60 feet will also induce a significant increase in pore pressure within the underlying soils. If not monitored closely during the fill placement process, increases of this nature could result in a failed embankment due to a substantial loss of effective stress within the supporting soil. We estimate that the limiting point at which fill placement would need to cease and pore pressures would need to dissipate before fill placement begins again is 10 feet of head rise in the ground water table. Therefore, we recommend installing a minimum of three piezometers along the embankment centerline to monitor pore pressure increases during fill placement. These can consist of 1-inch diameter piezometers with 20 feet of screen surrounded by well pack. The piezometers should be installed at least 5 feet into the glacial till layer. Glacial till was encountered at approximate elevations of 1,138 feet, and 1,106 feet in borings B-3, and B-7, respectively. Based on these elevations, it is estimated that glacial till will be encountered at an elevation of approximately 1,075 feet in the deepest portion of the drainageway. We also estimate that approximately 10 feet of fill can initially be placed in this area before a delay would be required. We further estimate that approximately 20 to 25 days would be required to dissipate 60 percent of the pore water pressure and up to 35 days would be required to dissipate 90 percent of the pore pressure. We recommend at a minimum, 60 percent of the pore pressure be dissipated before fill placement could resume. This equates to a 6 feet drop in water level within the piezometers. It is possible that there will be multiple delays prior to completing the fill placement.

Based on an assumed finished floor elevation of 1,160 feet, the soils encountered at the maintenance and office buildings' anticipated bearing elevations consisted of moist to very moist, soft to firm natural loess soils. At a minimum, we recommend that footings for the structures be designed using a reduced net allowable bearing pressure, as provided in the Shallow Foundations section of the report. A representative of the geotechnical engineer should be provided an opportunity to observe the base of all excavations prior to construction of footings.

If a higher net allowable bearing pressure is required, we recommend overexcavating the building footprints a minimum depth of 3 feet below the deepest footing elevations. This includes both continuous wall and column footings. The overexcavation should also extend laterally 5 feet outside the building footprints. The overexcavated material may then be moisture conditioned and recompacted as structural fill to support the planned footings and slabs. Should unsuitable materials be encountered at the base of the 3 feet undercuts, the unsuitable material should be removed in preparation for fill

placement. Acceptable structural fill properties are highlighted in the Earthwork and Excavations section below.

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. Where trees are cleared, the stumps should be excavated and removed.

Relocation of any existing utility lines within the zone of influence of proposed construction areas should also be completed as part of the site preparation. The lines should be relocated to areas outside of the proposed construction. Excavations created by removal of the existing lines should be cut wide enough to allow for use of heavy construction equipment to recompact the fill. In addition, the base of the excavations should be evaluated by a geotechnical engineering representative prior to placement of fill.

Topsoil and vegetation should be stripped to a depth of 4 to 6 inches in areas to be disturbed during grading, including borrow and fill areas. Stripping depths will likely vary and should be adjusted to remove all vegetation and root systems. A representative of the geotechnical engineer should monitor the stripping operations to observe that all unsuitable materials have been removed. Care should be exercised to separate these materials to avoid incorporation of the organic matter in structural fill sections.

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. A shrinkage factor of 35 to 40 percent is recommended for the on-site soil. 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 0 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 0 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 of both buildings. Based on our bearing capacity and settlement analysis, the net allowable bearing pressures in Table 3 were determined. These bearing pressures were 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 150 kips for columns or 6 kips per foot for walls, these bearing pressures may not be applicable and should be reevaluated.

Table 3 – Net Allowable Bearing Pressures

Condition	Allowable Bearing Pressure
Overexcavation (3 feet below all footings)	2,500 psf
Existing condition (no overexcavation)	1,500 psf

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.

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 1613.3.3 of the 2012 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, due to the presumed heavy truck traffic, 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 0 and +4 percent of optimum as determined by Modified Proctor (ASTM D1557). Subgrade preparation should extend a minimum of 2 feet laterally beyond the edge of the pavement.

Upon completion of pavement subgrade preparation, we recommend placement of a crushed aggregate subbase conforming to the Iowa DOT Specifications Section 4121, Aggregate Gradation 12.a. ("Granular Subbase"). Subbase should be shaped smooth and compacted to a minimum of 95 percent of the maximum dry density at a moisture content between 0 and +4 percent of optimum (ASTM D698, Standard Proctor), or at no less than 70% of a relative density (ASTM D4253/54). Construction traffic should not be allowed to travel across the prepared subbase.

We also recommend placement of an underdrain pipe system below the aggregate subbase areas of the parking lot. The underdrain system should consist of a minimum 4-inch diameter rigid, perforated drain tile. A trunk line tying the laterals together will likely be required. The laterals should be spaced a maximum 50-feet apart. The drain tile can daylight into the basin, connect to the storm sewer system which will likely empty into the basin, or daylight into an adjacent ditch.

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. Note that we do not recommend using an aggregate base as part of the pavement section if no underdrain system will be installed due to concerns over drainage and freeze/thaw deterioration of the base material.

Table 4 – Minimum Pavement Thicknesses

Pavement Category	Concrete Thickness (inches)
Sidewalks	4
Parking Areas	5
Medium Duty *(up to 3 trucks/day)*	6
Dumpster Pads *(including pickup area)*	7
Subgrade Support Values: CBR = 3, k=120 pci *Materials: (reference SUDAS Standard Specifications, 2015 Edition and City of Council Bluffs Supplemental Specifications, 2018 Edition)* *concrete mixture – CV-QMC-C15 (f'_c = 4,000 psi) (Division 7, Section 7010)*	

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. Joint sealing should be considered as a two part process, sealing of the exposed sawcut face of the concrete and sealing of the joint itself. Following sawcutting and cleaning the joints with compressed air, a penetrating concrete sealer (Silane, Silicate, or Siliconate based) should be spray applied to the joint extending outwards a minimum of 8 inches either side of the sawcut. This penetrating sealer will help to limit moisture infiltration along the sawcut face, helping to mitigate premature joint damage from freeze-thaw cycles. Following the spray applied sealer, a hot pour joint sealer can be used to fill the sawcut. Use of backer rods is not recommended.

Backfill behind curbs and within islands/medians 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.

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.

Reviewed by,

Raeanna C. Doyle, P.E.
Iowa License 24569

Prepared by,

Heath E. Cutler, P.E.
Iowa License 24341

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APPENDIX

Subsurface Exploration Methods

Legend of Terms

Boring Location Plan

Boring Logs

Soil Test Summary

Consolidation Test

SUBSURFACE EXPLORATION METHODS

The fieldwork for this study was conducted between May 19 and May 21, 2020. The exploratory program consisted of seven 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. A handheld GPS and coordinates interpreted from Google Earth were used to lay out the borings in the field. Elevations were interpolated from Pottawattamie County GIS contours. The boring locations and elevations should only be considered accurate to the degree implied by the methods used to define them.

Test borings were advanced using hollow-stem 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). The SPT values presented on the boring logs are actual field recorded numbers and have not been corrected for hammer energy or overburden.

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 in-situ 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. Soil compressibility was evaluated using the one-dimensional consolidation 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

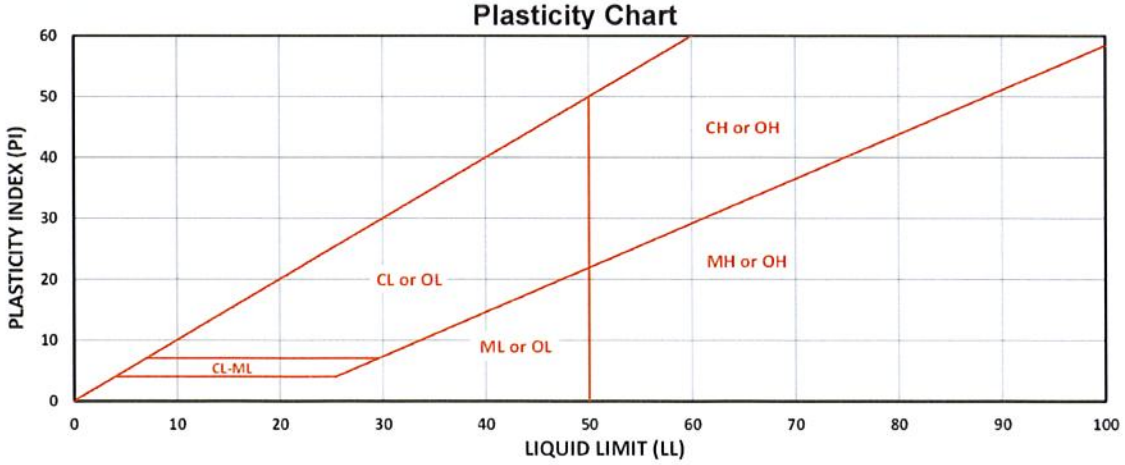
Unified Soil Classification System

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

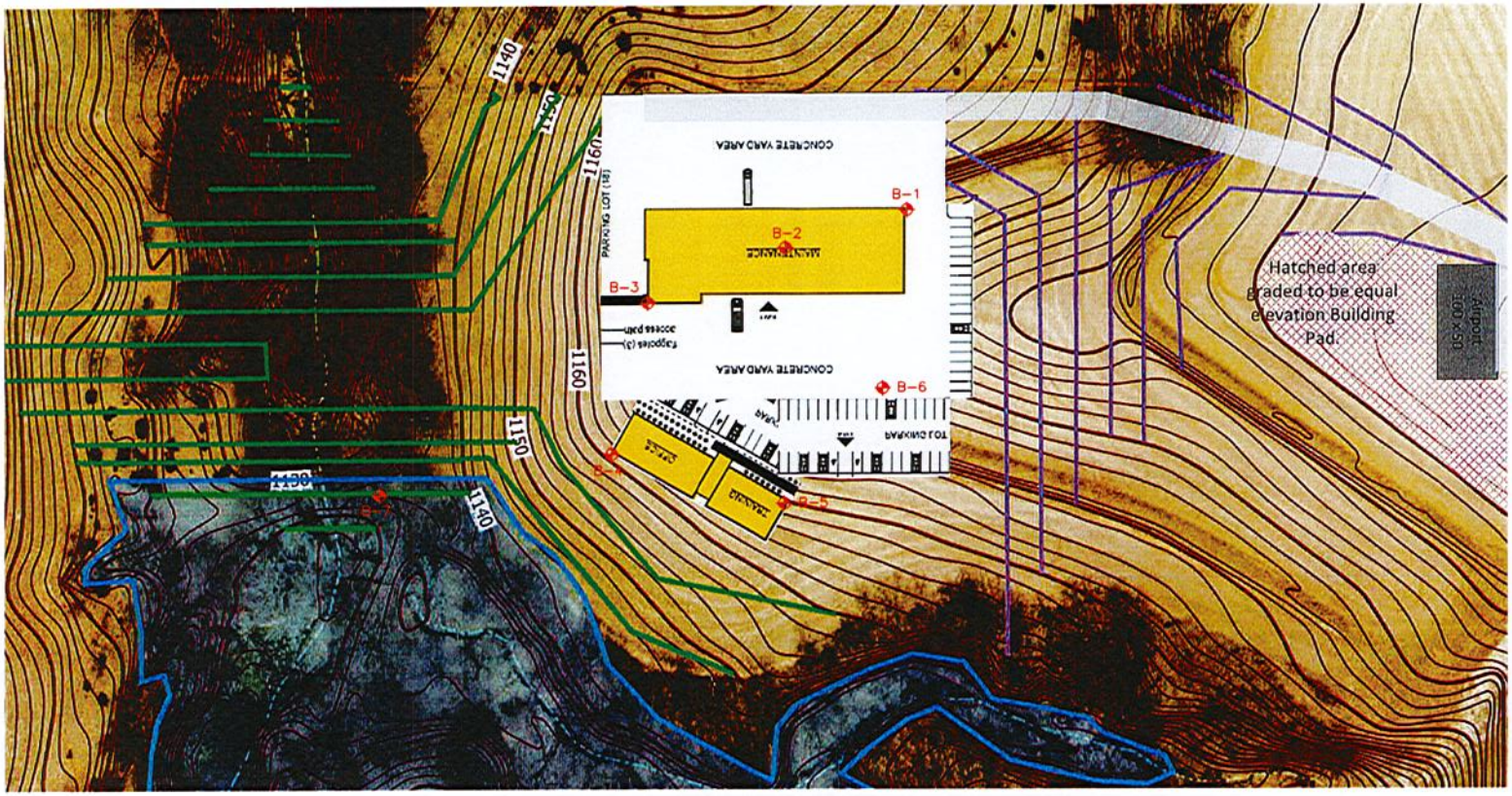


Criteria for Sands and Gravels

Boulders	Cobbles	Coarse Gravel	Fine Gravel	Coarse Sand	Medium Sand	Fine Sand	FINES (silt or clay)
Sieve size	12"	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



LEGEND:

◆ BORING LOCATION

Thiele Geotech Inc

PROJECT

COUNCIL BLUFFS AIRPORT MAINTENACE FACILITY

EASTERN HILLS DR. & MCPHERSON AVE.

COUNCIL BLUFFS, IA

JOB # 20235.00 DATE: 7/2/20

BORING LOCATION PLAN

Thiele Geotech, Inc.
13478 Chandler Road
Omaha, NE 68138
Telephone: 402.556.2171
Thiele Geotech Inc Fax: 402.556.7831

BORING NUMBER B-1

CLIENT HGM Associates, Inc.
PROJECT NAME Council Bluffs Airport Maintenance Facility
PROJECT NUMBER 20235.00
PROJECT LOCATION Eastern Hills Dr. & McPherson Ave., Council Bluffs, IA
DRILLING DATE 5/21/2020 **SURFACE** Corn Stubble **GROUND ELEVATION** 1186 ft **BORING DEPTH** 60.0 feet
DRILLING METHOD HSA **HOLE SIZE** 8 inches **GROUND WATER LEVELS:**
DRILLER Rick Jentz **DRILL RIG** CME 750 ATV **DURING DRILLING** None encountered
LOGGED BY Nick Phillips **CHECKED BY** Heath Cutler **END OF DRILLING** None encountered
NOTES Boring backfilled with cuttings **AFTER DRILLING** Not measured

DEPTH (ft)	GRAPHIC LOG	VISUAL/MANUAL DESCRIPTION: MOISTURE	COLOR	CONSIST.	SOIL TYPE	GEOLOGIC ORIGIN	REMARKS	SAMPLE TYPE NUMBER	RECOVERY (IN)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	MOISTURE CONTENT (%)	DRY UNIT WT. (pcf)	q_u (tsf)	ATTERBERG LIMITS: LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	FINES CONTENT (%)
0		moist	brown	firm	lean clay	altered Peoria loess		U-1	10			21.1	99.7					
		moist	brown	firm	lean clay	Peoria loess												
5								U-2	10			17.3	102.2					
			light brown				iron stains	U-3	12			19.5	95.2					
10																		
15								U-4	12			22.0	95.9					
			brown					U-5	12			22.9	98.5					
20		very moist																
25								U-6	12			26.6	93.1					

(Continued Next Page)

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BORING NUMBER B-1

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PROJECT NAME Council Bluffs Airport Maintenance Facility
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DRILLING DATE 5/21/2020 **SURFACE** Corn Stubble **GROUND ELEVATION** 1186 ft **BORING DEPTH** 60.0 feet
DRILLING METHOD HSA **HOLE SIZE** 8 inches **GROUND WATER LEVELS:**
DRILLER Rick Jentz **DRILL RIG** CME 750 ATV **DURING DRILLING** None encountered
LOGGED BY Nick Phillips **CHECKED BY** Heath Cutler **END OF DRILLING** None encountered
NOTES Boring backfilled with cuttings **AFTER DRILLING** Not measured

DEPTH (ft)	GRAPHIC LOG	VISUAL/MANUAL DESCRIPTION: MOISTURE	COLOR	CONSIST.	SOIL TYPE	GEOLOGIC ORIGIN	REMARKS	SAMPLE TYPE NUMBER	RECOVERY (IN)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	MOISTURE CONTENT (%)	DRY UNIT WT. (pcf)	q_u (tsf)	ATTERBERG LIMITS: LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	FINES CONTENT (%)
25		very moist	brown	firm	lean clay	Peoria loess												
		very moist	reddish brown	soft	silt	Loveland loess		U-7	12			28.8	92.2	0.49	29	24	5	
30					lean clay													
				firm				U-8	12			28.9	92.8	0.85				
35																		
		moist			fat clay			U-9	12			23.3	101.0	1.38				
40																		
			light brown		lean clay			U-10	12			23.8	101.0	0.95				
45																		
		moist	brown	very hard	fat clay	Kansan glacial till	minor sand	U-11	12			18.5	110.9					
50																		

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PROJECT NAME Council Bluffs Airport Maintenance Facility
PROJECT NUMBER 20235.00
PROJECT LOCATION Eastern Hills Dr. & McPherson Ave., Council Bluffs, IA
DRILLING DATE 5/21/2020 **SURFACE** Corn Stubble **GROUND ELEVATION** 1186 ft **BORING DEPTH** 60.0 feet
DRILLING METHOD HSA **HOLE SIZE** 8 inches **GROUND WATER LEVELS:**
DRILLER Rick Jentz **DRILL RIG** CME 750 ATV **DURING DRILLING** None encountered
LOGGED BY Nick Phillips **CHECKED BY** Heath Cutler **END OF DRILLING** None encountered
NOTES Boring backfilled with cuttings **AFTER DRILLING** Not measured

DEPTH (ft)	GRAPHIC LOG	VISUAL/MANUAL DESCRIPTION: MOISTURE	COLOR	CONSIST.	SOIL TYPE	GEOLOGIC ORIGIN	REMARKS	SAMPLE TYPE NUMBER	RECOVERY (IN)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	MOISTURE CONTENT (%)	DRY UNIT WT. (pcf)	q_u (tsf)	ATTERBERG LIMITS: LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	FINES CONTENT (%)
50		moist	brown	very hard	fat clay	Kansan glacial till												
55								U-12	12			13.8	122.6					
60								U-13	12			15.4	118.5					

Bottom of borehole at 60.0 feet.

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BORING NUMBER B-2

CLIENT HGM Associates, Inc.
PROJECT NAME Council Bluffs Airport Maintenance Facility
PROJECT NUMBER 20235.00
PROJECT LOCATION Eastern Hills Dr. & McPherson Ave., Council Bluffs, IA
DRILLING DATE 5/21/2020 **SURFACE** Corn Stubble **GROUND ELEVATION** 1184 ft **BORING DEPTH** 50.0 feet
DRILLING METHOD HSA **HOLE SIZE** 8 inches **GROUND WATER LEVELS:**
DRILLER Rick Jentz **DRILL RIG** CME 750 ATV **DURING DRILLING** None encountered
LOGGED BY Nick Phillips **CHECKED BY** Heath Cutler **END OF DRILLING** None encountered
NOTES Boring backfilled with cuttings **AFTER DRILLING** Not measured

DEPTH (ft)	GRAPHIC LOG	VISUAL/MANUAL DESCRIPTION: MOISTURE	COLOR	CONSIST.	SOIL TYPE	GEOLOGIC ORIGIN	REMARKS	SAMPLE TYPE NUMBER	RECOVERY (IN)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	MOISTURE CONTENT (%)	DRY UNIT WT. (pcf)	q_u (tsf)	ATTERBERG LIMITS: LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	FINES CONTENT (%)
0		very moist	brown	firm	lean clay	Peoria loess												
		moist						U-1	11			24.1	96.4					
5							iron stains	U-2	9			19.8	98.4					
10								U-3	8			21.0	97.2					
15								U-4	10			19.8	97.7					
20			light brown					U-5	12			22.4	94.6					
25								U-6	12			21.2	97.5	0.98				

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BORING NUMBER B-2

CLIENT HGM Associates, Inc.
PROJECT NAME Council Bluffs Airport Maintenance Facility
PROJECT NUMBER 20235.00
PROJECT LOCATION Eastern Hills Dr. & McPherson Ave., Council Bluffs, IA
DRILLING DATE 5/21/2020 **SURFACE** Corn Stubble **GROUND ELEVATION** 1184 ft **BORING DEPTH** 50.0 feet
DRILLING METHOD HSA **HOLE SIZE** 8 inches **GROUND WATER LEVELS:**
DRILLER Rick Jentz **DRILL RIG** CME 750 ATV **DURING DRILLING** None encountered
LOGGED BY Nick Phillips **CHECKED BY** Heath Cutler **END OF DRILLING** None encountered
NOTES Boring backfilled with cuttings **AFTER DRILLING** Not measured

DEPTH (ft)	GRAPHIC LOG	VISUAL/MANUAL DESCRIPTION: MOISTURE	COLOR	CONSIST.	SOIL TYPE	GEOLOGIC ORIGIN	REMARKS	SAMPLE TYPE NUMBER	RECOVERY (IN)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	MOISTURE CONTENT (%)	DRY UNIT WT. (pcf)	q_u (tsf)	ATTERBERG LIMITS: LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	FINES CONTENT (%)
25		moist	light brown	firm	lean clay	Peoria loess												
		very moist	brown	soft				U-7	12			24.6	91.8	0.56				
30																		
								U-8	12			26.4	93.5	0.60				
35																		
		moist	reddish brown	firm	fat clay	Loveland loess	blocky	U-9	12			21.2	101.7	1.36				
40																		
								U-10	12			21.2	103.2					
45																		
		moist	brown	hard	fat clay	Kansan glacial till	minor sand											
50								U-11	12			18.0	112.6					

Bottom of borehole at 50.0 feet.

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BORING NUMBER B-3

CLIENT HGM Associates, Inc.
PROJECT NAME Council Bluffs Airport Maintenance Facility
PROJECT NUMBER 20235.00
PROJECT LOCATION Eastern Hills Dr. & McPherson Ave., Council Bluffs, IA
DRILLING DATE 5/20/2020 **SURFACE** Corn Stubble **GROUND ELEVATION** 1171 ft **BORING DEPTH** 50.0 feet
DRILLING METHOD HSA **HOLE SIZE** 8 inches **GROUND WATER LEVELS:**
DRILLER Rick Jentz **DRILL RIG** CME 750 ATV **DURING DRILLING** None encountered
LOGGED BY Nick Phillips **CHECKED BY** Heath Cutler **END OF DRILLING** None encountered
NOTES Boring backfilled with cuttings **AFTER DRILLING** Not measured

DEPTH (ft)	GRAPHIC LOG	VISUAL/MANUAL DESCRIPTION: MOISTURE	COLOR	CONSIST.	SOIL TYPE	GEOLOGIC ORIGIN	REMARKS	SAMPLE TYPE NUMBER	RECOVERY (IN)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	MOISTURE CONTENT (%)	DRY UNIT WT. (pcf)	q_u (tsf)	ATTERBERG LIMITS: LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	FINES CONTENT (%)
0		moist	brown	firm	lean clay	fill		U-1	8			22.5	94.5					
		moist	light brown	firm	lean clay	Peoria loess		U-2	7			21.2	99.1					
5																		
							iron and carbon deposits	U-3	12			23.1	95.7					
10																		
								U-4	12			23.1	97.6					
15																		
								U-5	12			23.6	96.4	0.96				
20																		
		moist	reddish gray	firm	lean clay	Loveland loess		U-6	12			22.0	97.6		35	22	13	
25																		

(Continued Next Page)

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BORING NUMBER B-3

CLIENT HGM Associates, Inc. **PROJECT NAME** Council Bluffs Airport Maintenance Facility

PROJECT NUMBER 20235.00 **PROJECT LOCATION** Eastern Hills Dr. & McPherson Ave., Council Bluffs, IA

DRILLING DATE 5/20/2020 **SURFACE** Corn Stubble **GROUND ELEVATION** 1171 ft **BORING DEPTH** 50.0 feet

DRILLING METHOD HSA **HOLE SIZE** 8 inches **GROUND WATER LEVELS:**

DRILLER Rick Jentz **DRILL RIG** CME 750 ATV **DURING DRILLING** None encountered

LOGGED BY Nick Phillips **CHECKED BY** Heath Cutler **END OF DRILLING** None encountered

NOTES Boring backfilled with cuttings **AFTER DRILLING** Not measured

DEPTH (ft)	GRAPHIC LOG	VISUAL/MANUAL DESCRIPTION: MOISTURE	COLOR	CONSIST.	SOIL TYPE	GEOLOGIC ORIGIN	REMARKS	SAMPLE TYPE NUMBER	RECOVERY (IN)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	MOISTURE CONTENT (%)	DRY UNIT WT. (pcf)	q_u (tsf)	ATTERBERG LIMITS: LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	FINES CONTENT (%)
25		moist	reddish gray	firm	lean clay	Loveland loess												
		very moist		soft				U-7	12			28.1	91.6	0.35				
30																		
		very moist	reddish brown	firm	fat clay	Kansan glacial till		U-8	12			25.8	99.2	1.33				
35																		
		slightly moist		very hard				U-9	12			13.8	119.3					
40																		
							much sand	U-10	12			5.1	130.7					
45																		
								U-11	12			14.8	118.5					
50																		

Bottom of borehole at 50.0 feet.

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BORING NUMBER B-4

CLIENT HGM Associates, Inc.
PROJECT NAME Council Bluffs Airport Maintenance Facility
PROJECT NUMBER 20235.00
PROJECT LOCATION Eastern Hills Dr. & McPherson Ave., Council Bluffs, IA
DRILLING DATE 5/19/2020 **SURFACE** Corn Stubble **GROUND ELEVATION** 1161 ft **BORING DEPTH** 25.0 feet
DRILLING METHOD HSA **HOLE SIZE** 8 inches **GROUND WATER LEVELS:**
DRILLER Rick Jentz **DRILL RIG** CME 750 ATV **DURING DRILLING** None encountered
LOGGED BY Nick Phillips **CHECKED BY** Heath Cutler **END OF DRILLING** None encountered
NOTES Boring backfilled with cuttings **AFTER DRILLING** Not measured

DEPTH (ft)	GRAPHIC LOG	VISUAL/MANUAL DESCRIPTION: MOISTURE	COLOR	CONSIST.	SOIL TYPE	GEOLOGIC ORIGIN	REMARKS	SAMPLE TYPE NUMBER	RECOVERY (IN)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	MOISTURE CONTENT (%)	DRY UNIT WT. (pcf)	q_u (tsf)	ATTERBERG LIMITS: LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	FINES CONTENT (%)
0		moist	brown	hard	lean clay	fill		U-1	12			17.3	102.0	1.85				
5		moist	light brown	soft	silt	Peoria loess		U-2	12			21.2	88.3	0.45				
10		very moist			lean clay		iron and carbon stains	U-3	7			24.9	96.1	0.62				
15								U-4	12			25.4	96.6	0.67				
20		moist		hard				U-5	12			23.5	101.6					
25		moist	reddish brown	hard	fat clay	Loveland loess		U-6	12			23.2	101.3					

Bottom of borehole at 25.0 feet.

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BORING NUMBER B-5

CLIENT HGM Associates, Inc.
PROJECT NAME Council Bluffs Airport Maintenance Facility
PROJECT NUMBER 20235.00
PROJECT LOCATION Eastern Hills Dr. & McPherson Ave., Council Bluffs, IA
DRILLING DATE 5/20/2020 **SURFACE** Corn Stubble **GROUND ELEVATION** 1171 ft **BORING DEPTH** 30.0 feet
DRILLING METHOD HSA **HOLE SIZE** 8 inches **GROUND WATER LEVELS:**
DRILLER Rick Jentz **DRILL RIG** CME 750 ATV **DURING DRILLING** None encountered
LOGGED BY Nick Phillips **CHECKED BY** Heath Cutler **END OF DRILLING** None encountered
NOTES Boring backfilled with cuttings **AFTER DRILLING** Not measured

DEPTH (ft)	GRAPHIC LOG	VISUAL/MANUAL DESCRIPTION: MOISTURE	COLOR	CONSIST.	SOIL TYPE	GEOLOGIC ORIGIN	REMARKS	SAMPLE TYPE NUMBER	RECOVERY (IN)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	MOISTURE CONTENT (%)	DRY UNIT WT. (pcf)	q_u (tsf)	ATTERBERG LIMITS: LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	FINES CONTENT (%)
0		moist	brown	firm	lean clay	fill												
		moist	light brown	firm	lean clay	Peoria loess		U-1	10			22.7	102.6					
5								U-2	8			20.4	98.4					
							iron & carbon stains											
10								U-3	8			22.7	97.0	1.24				
		very moist		soft														
15								U-4	12			25.7	95.2	0.65				
			grayish brown	firm														
20								U-5	12			25.6	98.8	1.14				
		moist	reddish brown	firm	fat clay	Loveland loess												
25								U-6	12			23.9	99.6	1.26				

TG COLUMNS - GINT STD US LAB.GDT - 6/26/20 13:05 - P:\20235.00\CB AIRPORT MAIN FACILITY.GPJ

(Continued Next Page)

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BORING NUMBER B-5

CLIENT HGM Associates, Inc.
PROJECT NAME Council Bluffs Airport Maintenance Facility
PROJECT NUMBER 20235.00
PROJECT LOCATION Eastern Hills Dr. & McPherson Ave., Council Bluffs, IA
DRILLING DATE 5/20/2020 **SURFACE** Corn Stubble **GROUND ELEVATION** 1171 ft **BORING DEPTH** 30.0 feet
DRILLING METHOD HSA **HOLE SIZE** 8 inches **GROUND WATER LEVELS:**
DRILLER Rick Jentz **DRILL RIG** CME 750 ATV **DURING DRILLING** None encountered
LOGGED BY Nick Phillips **CHECKED BY** Heath Cutler **END OF DRILLING** None encountered
NOTES Boring backfilled with cuttings **AFTER DRILLING** Not measured

DEPTH (ft)	GRAPHIC LOG	VISUAL/MANUAL DESCRIPTION: MOISTURE	COLOR	CONSIST.	SOIL TYPE	GEOLOGIC ORIGIN	REMARKS	SAMPLE TYPE NUMBER	RECOVERY (IN)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	MOISTURE CONTENT (%)	DRY UNIT WT. (pcf)	q_u (tsf)	ATTERBERG LIMITS: LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	FINES CONTENT (%)
25		moist	reddish brown	firm	fat clay	Loveland loess												
30								U-7	12			23.7	101.0					

Bottom of borehole at 30.0 feet.

Thiele Geotech, Inc.
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BORING NUMBER B-6

CLIENT HGM Associates, Inc.
PROJECT NAME Council Bluffs Airport Maintenance Facility
PROJECT NUMBER 20235.00
PROJECT LOCATION Eastern Hills Dr. & McPherson Ave., Council Bluffs, IA
DRILLING DATE 5/21/2020 **SURFACE** Corn Stubble **GROUND ELEVATION** 1189 ft **BORING DEPTH** 40.0 feet
DRILLING METHOD HSA **HOLE SIZE** 8 inches **GROUND WATER LEVELS:**
DRILLER Rick Jentz **DRILL RIG** CME 750 ATV **DURING DRILLING** None encountered
LOGGED BY Nick Phillips **CHECKED BY** Heath Cutler **END OF DRILLING** None encountered
NOTES Boring backfilled with cuttings **AFTER DRILLING** Not measured

DEPTH (ft)	GRAPHIC LOG	VISUAL/MANUAL DESCRIPTION: MOISTURE	COLOR	CONSIST.	SOIL TYPE	GEOLOGIC ORIGIN	REMARKS	SAMPLE TYPE NUMBER	RECOVERY (IN)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	MOISTURE CONTENT (%)	DRY UNIT WT. (pcf)	q_u (tsf)	ATTERBERG LIMITS: LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	FINES CONTENT (%)
0		very moist	brown	firm	lean clay	altered Peoria loess		U-1	11			25.1	95.8					
		moist	light brown	firm	lean clay	Peoria loess												
5								U-2	6			20.3	100.0					
10								U-3	10			20.3	100.2					
							iron & carbon deposits											
15								U-4	12			22.1	96.6					
20								U-5	11			21.0	94.9	0.86	34	24	10	
				soft														
25								U-6	12			20.3	93.6	0.40				

(Continued Next Page)

Thiele Geotech, Inc.
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BORING NUMBER B-6

CLIENT HGM Associates, Inc.
PROJECT NAME Council Bluffs Airport Maintenance Facility
PROJECT NUMBER 20235.00
PROJECT LOCATION Eastern Hills Dr. & McPherson Ave., Council Bluffs, IA
DRILLING DATE 5/21/2020 **SURFACE** Corn Stubble **GROUND ELEVATION** 1189 ft **BORING DEPTH** 40.0 feet
DRILLING METHOD HSA **HOLE SIZE** 8 inches **GROUND WATER LEVELS:**
DRILLER Rick Jentz **DRILL RIG** CME 750 ATV **DURING DRILLING** None encountered
LOGGED BY Nick Phillips **CHECKED BY** Heath Cutler **END OF DRILLING** None encountered
NOTES Boring backfilled with cuttings **AFTER DRILLING** Not measured

DEPTH (ft)	GRAPHIC LOG	VISUAL/MANUAL DESCRIPTION: MOISTURE	COLOR	CONSIST.	SOIL TYPE	GEOLOGIC ORIGIN	REMARKS	SAMPLE TYPE NUMBER	RECOVERY (IN)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	MOISTURE CONTENT (%)	DRY UNIT WT. (pcf)	q_u (tsf)	ATTERBERG LIMITS: LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	FINES CONTENT (%)
25		moist	light brown	soft	lean clay	Peoria loess												
		very moist																
					silt			U-7	12			24.2	92.0					
30																		
		very moist	reddish brown	firm	fat clay	Loveland loess		U-8	12			24.6	98.2	0.78				
35																		
								U-9	12									
40																		

Bottom of borehole at 40.0 feet.

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BORING NUMBER B-7

CLIENT HGM Associates, Inc.
PROJECT NAME Council Bluffs Airport Maintenance Facility
PROJECT NUMBER 20235.00
PROJECT LOCATION Eastern Hills Dr. & McPherson Ave., Council Bluffs, IA
DRILLING DATE 5/19/2020 **SURFACE** Grass **GROUND ELEVATION** 1134 ft **BORING DEPTH** 45.0 feet
DRILLING METHOD HSA **HOLE SIZE** 8 inches **GROUND WATER LEVELS:**
DRILLER Rick Jentz **DRILL RIG** CME 750 ATV ▽ **DURING DRILLING** 37.0 ft / Elev 1097.0 ft
LOGGED BY Nick Phillips **CHECKED BY** Heath Cutler ▼ **END OF DRILLING** 26.4 ft / Elev 1107.6 ft
NOTES Boring backfilled with cuttings **AFTER DRILLING** Not measured

DEPTH (ft)	GRAPHIC LOG	VISUAL/MANUAL DESCRIPTION: MOISTURE	COLOR	CONSIST.	SOIL TYPE	GEOLOGIC ORIGIN	REMARKS	SAMPLE TYPE NUMBER	RECOVERY (IN)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	MOISTURE CONTENT (%)	DRY UNIT WT. (pcf)	q_u (tsf)	ATTERBERG LIMITS: LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	FINES CONTENT (%)
0		very moist	brown	hard	lean clay	altered Peoria loess		U-1	12			32.7	88.4					
5		very moist	brown	hard	lean clay	Peoria loess		U-2	12			26.3	99.3	2.07				
10			grayish brown	firm			iron & carbon deposits Consol test	U-3	12			27.1	93.7		37	22	15	
15			light brown	firm				U-4	12			30.3	91.3	0.42				
20								U-5	11			29.1	92.8					
25				soft				U-6	12			32.6	90.2	0.44				

(Continued Next Page)

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BORING NUMBER B-7

CLIENT HGM Associates, Inc.
PROJECT NAME Council Bluffs Airport Maintenance Facility
PROJECT NUMBER 20235.00
PROJECT LOCATION Eastern Hills Dr. & McPherson Ave., Council Bluffs, IA
DRILLING DATE 5/19/2020 **SURFACE** Grass **GROUND ELEVATION** 1134 ft **BORING DEPTH** 45.0 feet
DRILLING METHOD HSA **HOLE SIZE** 8 inches **GROUND WATER LEVELS:**
DRILLER Rick Jentz **DRILL RIG** CME 750 ATV **DURING DRILLING** 37.0 ft / Elev 1097.0 ft
LOGGED BY Nick Phillips **CHECKED BY** Heath Cutler **END OF DRILLING** 26.4 ft / Elev 1107.6 ft
NOTES Boring backfilled with cuttings **AFTER DRILLING** Not measured

DEPTH (ft)	GRAPHIC LOG	VISUAL/MANUAL DESCRIPTION: MOISTURE	COLOR	CONSIST.	SOIL TYPE	GEOLOGIC ORIGIN	REMARKS	SAMPLE TYPE NUMBER	RECOVERY (IN)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	MOISTURE CONTENT (%)	DRY UNIT WT. (pcf)	q_u (tsf)	ATTERBERG LIMITS: LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	FINES CONTENT (%)
25		very moist / wet	light brown	soft	lean clay	Peoria loess												
		wet	reddish brown	hard	fat clay	Kansan glacial till		U-7	12			18.4	112.3					
30																		
35							much sand	U-8	12			27.8	99.9					
			brown	medium dense	silty sand		coarse sand	S-9		17		15.6						
40																		
			gray	dense	clayey sand			S-10		42		15.7						
45							Bottom of borehole at 45.0 feet.											

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SUMMARY OF LABORATORY RESULTS

CLIENT HGM Associates, Inc. **PROJECT NAME** Council Bluffs Airport Maintenance Facility

PROJECT NUMBER 20235.00 **PROJECT LOCATION** Eastern Hills Dr. & McPherson Ave., Council Bluffs, IA

Boring Number	Sample Number	Depth	Water Content (%)	Unit Weight		Void Ratio	Sat. (%)	Unconfined Compression		Atterberg Limits		%<#200 Sieve	Class.	Other Tests
				Wet Density (pcf)	Dry Density (pcf)			q_u (tsf)	Strain (%)	LL	PI			
B-1	U-1	0.5-2.0'	21.1	120.6	99.7	0.690	82							
	U-2	3.5-5.0'	17.3	119.9	102.2	0.648	72							
	U-3	8.5-10.0'	19.5	113.7	95.2	0.770	68							
	U-4	13.5-15.0'	22.0	117.0	95.9	0.757	79							
	U-5	18.5-20.0'	22.9	121.1	98.5	0.710	87							
	U-6	23.5-25.0'	26.6	117.9	93.1	0.810	89							
	U-7	28.5-30.0'	28.8	118.8	92.2	0.827	94	0.49	15.0	29	5		ML	
	U-8	33.5-35.0'	28.9	119.7	92.8	0.815	96	0.85	4.4					
	U-9	38.5-40.0'	23.3	124.6	101.0	0.667	94	1.38	5.4					
	U-10	43.5-45.0'	23.8	125.1	101.0	0.668	96	0.95	8.9					
	U-11	48.5-50.0'	18.5	131.5	110.9	0.519	96							
	U-12	53.5-55.0'	13.8	139.4	122.6	0.375	99							
	U-13	58.5-60.0'	15.4	136.7	118.5	0.422	98							
B-2	U-1	0.5-2.0'	24.1	119.7	96.4	0.747	87							
	U-2	3.5-5.0'	19.8	117.9	98.4	0.712	75							
	U-3	8.5-10.0'	21.0	117.6	97.2	0.734	77							
	U-4	13.5-15.0'	19.8	117.0	97.7	0.725	74							
	U-5	18.5-20.0'	22.4	115.8	94.6	0.780	77							
	U-6	23.5-25.0'	21.2	118.2	97.5	0.728	79	0.98	4.2					
	U-7	28.5-30.0'	24.6	114.4	91.8	0.836	80	0.56	3.3					
	U-8	33.5-35.0'	26.4	118.1	93.5	0.802	89	0.60	5.3					
	U-9	38.5-40.0'	21.2	123.3	101.7	0.656	87	1.36	3.9					
	U-10	43.5-45.0'	21.2	125.1	103.2	0.633	91							
	U-11	48.5-50.0'	18.0	132.9	112.6	0.496	98							
B-3	U-1	0.5-2.0'	22.5	115.7	94.5	0.783	77							
	U-2	3.5-5.0'	21.2	120.1	99.1	0.701	82							
	U-3	8.5-10.0'	23.1	117.7	95.7	0.761	82							
	U-4	13.5-15.0'	23.1	120.1	97.6	0.727	86							
	U-5	18.5-20.0'	23.6	119.1	96.4	0.749	85	0.96	5.1					
	U-6	23.5-25.0'	22.0	119.0	97.6	0.727	82			35	13		CL	
	U-7	28.5-30.0'	28.1	117.3	91.6	0.840	90	0.35	14.9					
	U-8	33.5-35.0'	25.8	124.8	99.2	0.699	100	1.33	8.7					
	U-9	38.5-40.0'	13.8	135.7	119.3	0.412	90							
	U-10	43.5-45.0'	5.1	137.4	130.7	0.289	48							
	U-11	48.5-50.0'	14.8	136.1	118.5	0.422	95							
B-4	U-1	0.5-2.0'	17.3	119.7	102.0	0.651	72	1.85	12.0					
	U-2	3.5-5.0'	21.2	107.0	88.3	0.908	63	0.45	1.5					
	U-3	8.5-10.0'	24.9	120.0	96.1	0.753	89	0.62	8.9					
	U-4	13.5-15.0'	25.4	121.2	96.6	0.744	92	0.67	13.8					
	U-5	18.5-20.0'	23.5	125.5	101.6	0.658	96							
	U-6	23.5-25.0'	23.2	124.8	101.3	0.663	94							
B-5	U-1	0.5-2.0'	22.7	125.9	102.6	0.642	95							
	U-2	3.5-5.0'	20.4	118.5	98.4	0.712	77							

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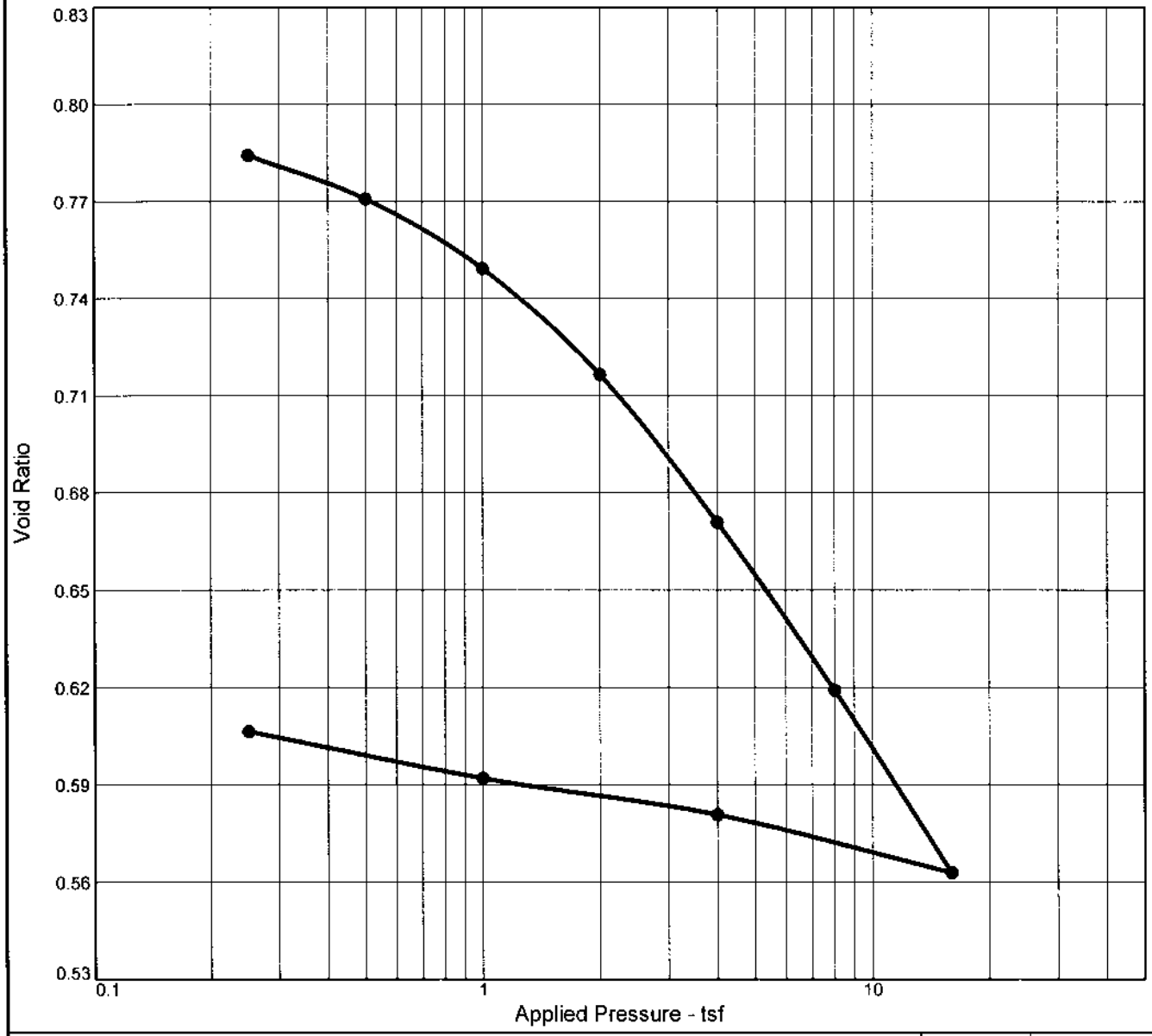
SUMMARY OF LABORATORY RESULTS

CLIENT HGM Associates, Inc. **PROJECT NAME** Council Bluffs Airport Maintenance Facility

PROJECT NUMBER 20235.00 **PROJECT LOCATION** Eastern Hills Dr. & McPherson Ave., Council Bluffs, IA

Boring Number	Sample Number	Depth	Water Content (%)	Unit Weight		Void Ratio	Sat. (%)	Unconfined Compression		Atterberg Limits		%<#200 Sieve	Class.	Other Tests
				Wet Density (pcf)	Dry Density (pcf)			q_u (tsf)	Strain (%)	LL	PI			
B-5	U-3	8.5-10.0'	22.7	119.0	97.0	0.737	83	1.24	5.5					
	U-4	13.5-15.0'	25.7	119.7	95.2	0.770	90	0.65	5.8					
	U-5	18.5-20.0'	25.6	124.1	98.8	0.705	98	1.14	8.2					
	U-6	23.5-25.0'	23.9	123.5	99.6	0.691	93	1.26	3.2					
	U-7	28.5-30.0'	23.7	124.9	101.0	0.668	96							
B-6	U-1	0.5-2.0'	25.1	119.8	95.8	0.758	89							
	U-2	3.5-5.0'	20.3	120.4	100.0	0.684	80							
	U-3	8.5-10.0'	20.3	120.6	100.2	0.682	81							
	U-4	13.5-15.0'	22.1	117.9	96.6	0.745	80							
	U-5	18.5-20.0'	21.0	114.9	94.9	0.775	73	0.86	4.8	34	10		ML	
	U-6	23.5-25.0'	20.3	112.6	93.6	0.800	69	0.40	5.1					
	U-7	28.5-30.0'	24.2	114.2	92.0	0.832	79							
	U-8	33.5-35.0'	24.6	122.3	98.2	0.716	93	0.78	7.1					
	U-9	38.5-40.0'												
B-7	U-1	0.5-2.0'	32.7	117.3	88.4	0.906	98							
	U-2	3.5-5.0'	26.3	125.5	99.3	0.696	100	2.07	10.0					
	U-3	8.5-10.0'	27.1	119.1	93.7	0.798	92			37	15		CL	Consol
	U-4	13.5-15.0'	30.3	119.0	91.3	0.844	97	0.42	15.0					
	U-5	18.5-20.0'	29.1	119.8	92.8	0.816	96							
	U-6	23.5-25.0'	32.6	119.7	90.2	0.867	100	0.44	15.0					
	U-7	28.5-30.0'	18.4	133.1	112.3	0.500	100							
	U-8	33.5-35.0'	27.8	127.6	99.9	0.687	100							
	S-9	38.5-40.0'	15.6											
	S-10	43.5-45.0'	15.7											

CONSOLIDATION TEST REPORT



MATERIAL DESCRIPTION	USCS	AASHTO
grayish brown lean clay	CL	

LL	PI	Sp. Gr.	Overburden (tsf)	Dry Dens. (pcf)		Moisture		Saturation		Void Ratio		P_c (tsf)	C_c
				Init.	Final	Init.	Final	Init.	Final	Init.	Final		
37	15	2.7	0.6	93.3		27.6 %	21.9	92.3 %	97.3 %	0.806	0.606	1.5	0.19

Preparation Process:	D2435 Method	C_r	Swell Press. (tsf)	%
Condition of Test:		0.02		

Project No. 20235.00 **Client:** HGM Associates, Inc.

Project: Council Bluffs Airport Maintenance Facility

Source of Sample: B-7 **Depth:** 8.5'-10' **Sample Number:** U-3

Remarks:

Checked By:

Title:

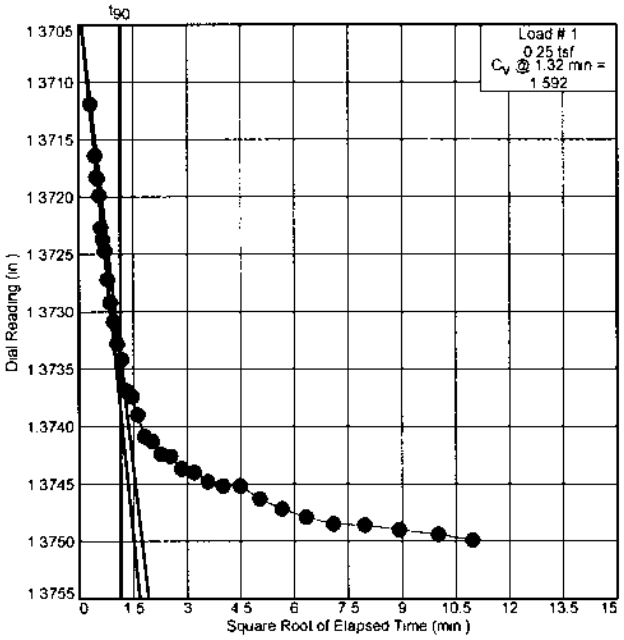
THIELE GEOTECH, INC.

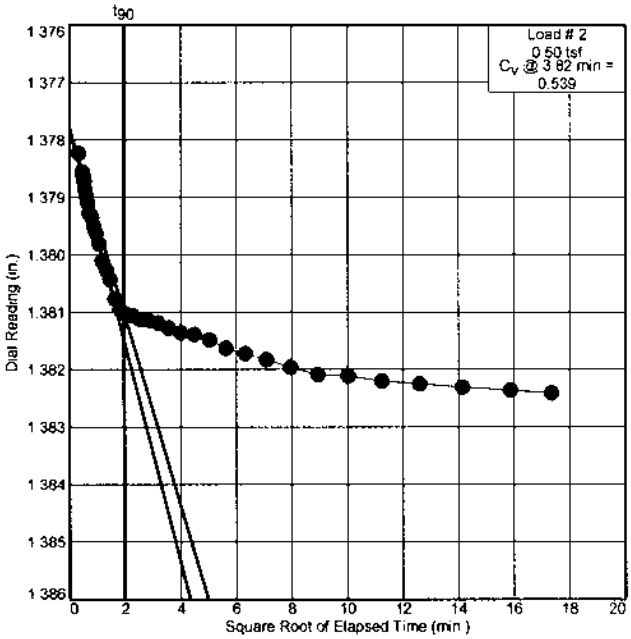
Figure

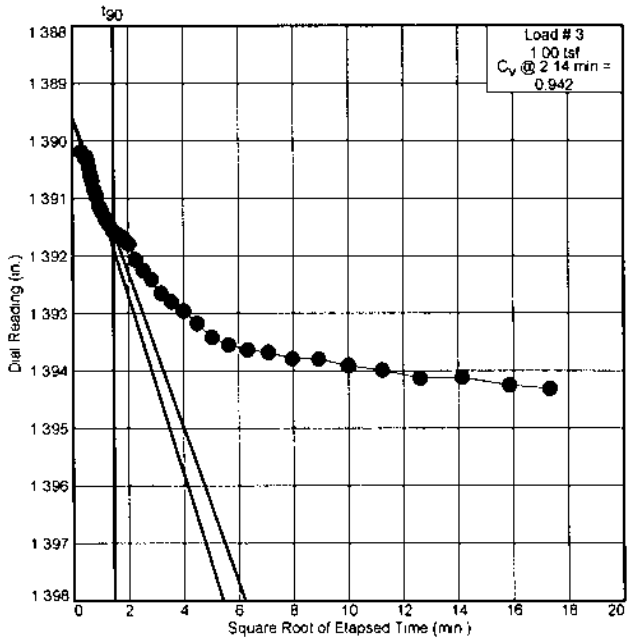
Dial Reading vs. Time

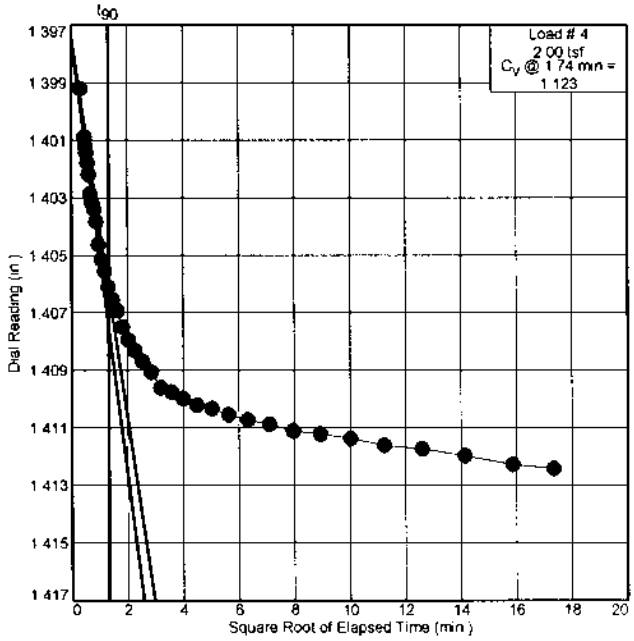
Project No.: 20235.00
Project: Council Bluffs Airport Maintenance Facility

Source of Sample: B-7 Depth: 8.5'-10' Sample Number: U-3









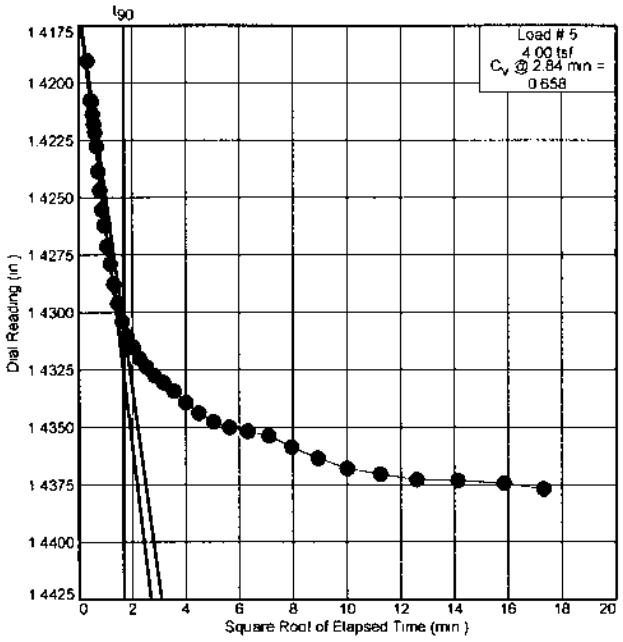
THIELE GEOTECH, INC.

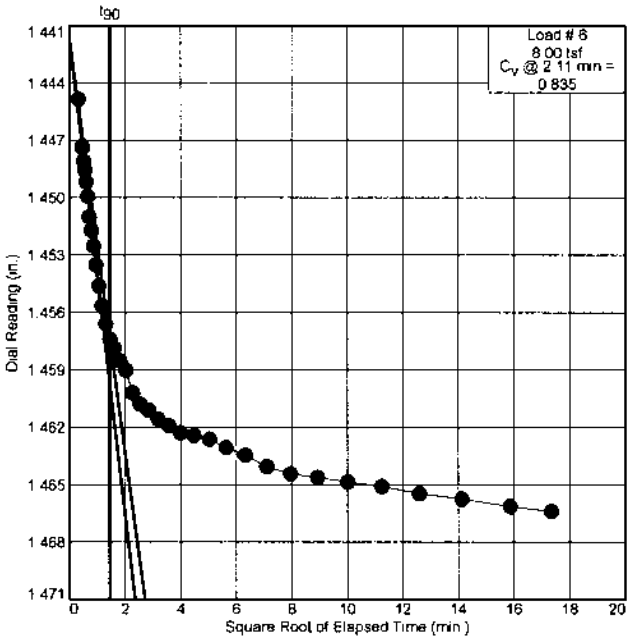
Figure

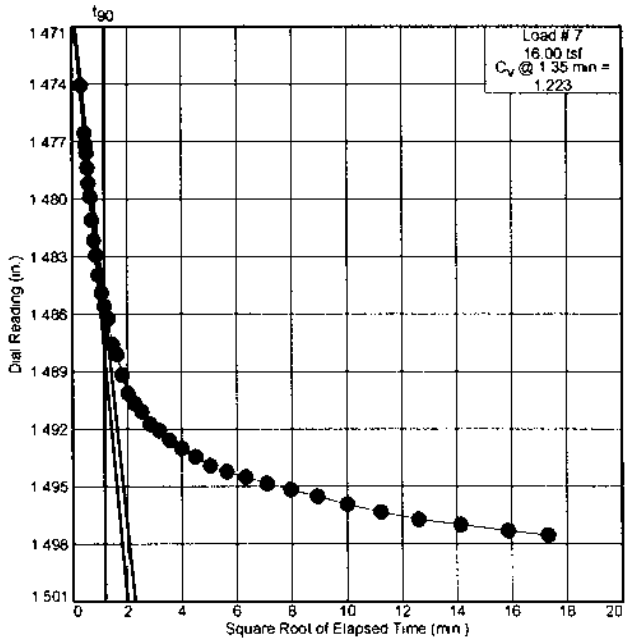
Dial Reading vs. Time

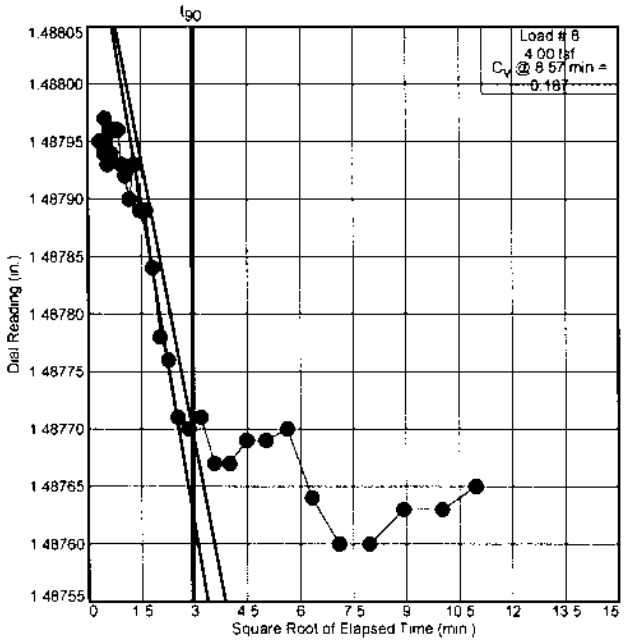
Project No.: 20235.00
Project: Council Bluffs Airport Maintenance Facility

Source of Sample: B-7 Depth: 8.5'-10' Sample Number: U-3









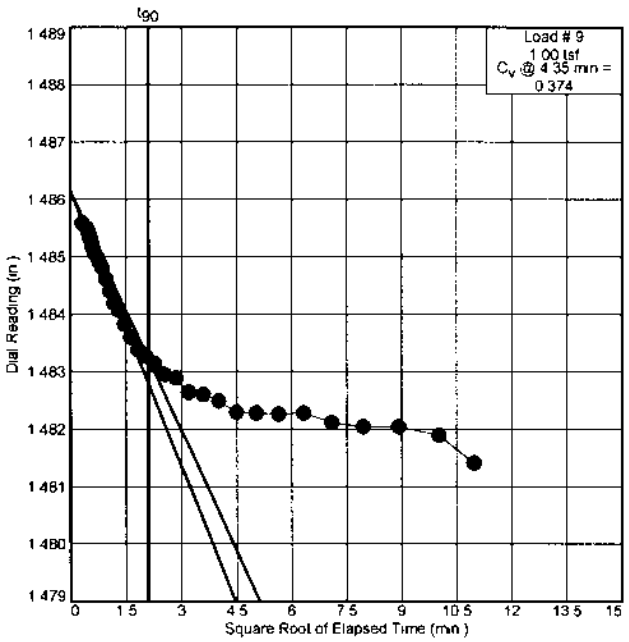
THIELE GEOTECH, INC.

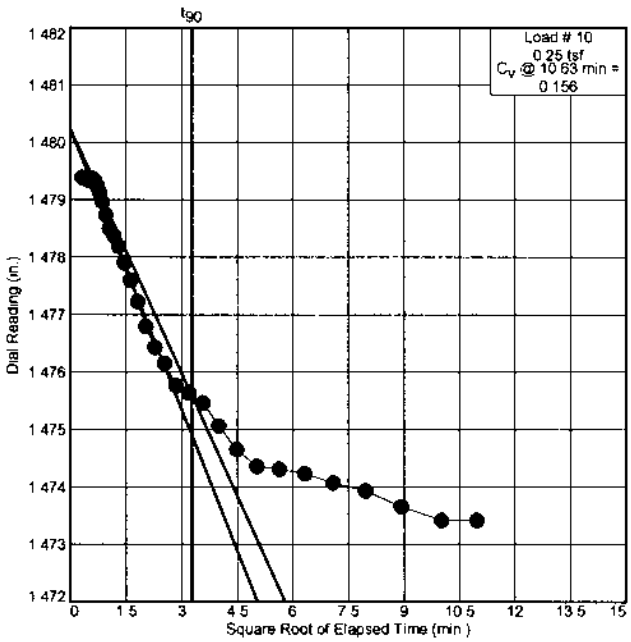
Figure

Dial Reading vs. Time

Project No.: 20235.00
Project: Council Bluffs Airport Maintenance Facility

Source of Sample: B-7 Depth: 8.5'-10' Sample Number: U-3





THIELE GEOTECH, INC.

Figure