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Geotechnical Evaluation Report

City of Grafton Pool Replacement

Leistikow Park
435 West 5th Street
Grafton, North Dakota

Prepared for

Grafton Parks and Recreation

Professional Certification:
I hereby certify that this plan, specification, or report was prepared by me or under my direct supervision and that I am a duly Registered Professional Engineer under the laws of the State of North Dakota.

JENNIFER MCKINNON
PE-9482
DATE
11/08/25

Jennifer McKinnon

Jennifer McKinnon, PE
Senior Engineer
Registration Number: PE-9482
November 8, 2025

Braun Intertec Corporation

Project B2508443

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INTERTEC

November 8, 2025

Project B2508443

Grafton Parks and Recreation
c/o Jon Markusen, PE
KLJ
864 West 12th Street
Grafton, ND 58237

Re: Geotechnical Evaluation
City of Grafton Pool Replacement
Leistikow Park
435 West 5th Street
Grafton, North Dakota

Dear Mr. Markusen:

We are pleased to present this geotechnical evaluation report for the proposed pool replacement located in the same location as the existing pool at Leistikow Park in Grafton, North Dakota. Based on our borings, it appears the site is suitable for the proposed pool. The following report provides geotechnical recommendations for the proposed construction. Please read the report in its entirety.

Thank you for making Braun Intertec your geotechnical consultant for this project. If you have questions about this report, or if there are other services that we can provide in support of our work to date, please contact Jennifer McKinnon at 701.205.6246 or email at jmckinnon@braunintertec.com.

Sincerely,
Braun Intertec Corporation

Jennifer McKinnon

Jennifer McKinnon, PE
Senior Engineer

Steven P Nagle

Steven P. Nagle, PE
Vice President, Principal Engineer

c: William Dahl, Director of Grafton Parks & Recreation

Table of Contents

Table of Contents (Continued)

1.0 Introduction

1.1 Project Description

This Geotechnical Evaluation Report addresses the design and construction of the proposed pool replacement located in the same location as the existing pool at Leistikow Park in Grafton, North Dakota.

It is our understanding the City of Grafton is in the preliminary design phase for the construction of a new pool. At the time of this report, design details for the pool were not available. Based on our experience with similar structures, we anticipate the new pool will contain a diving well portion extending to a depth of 12 feet sloping upward to a shallower portion (approximately 3 to 5 feet deep). We have also assumed the pool will be surrounded by a new bathhouse and locker structures. This report provides geotechnical recommendations for the pool only and not the surrounding structures. It is our understanding the new pool will be constructed in the same location as the existing pool. There are no grade raises anticipated for the project and finished grades will be within 2 feet of existing grades.

The figure below shows an aerial figure of the existing pool.

Figure 1-1. Project Site

Figure obtained from Google Earth™, dated April 7, 2025.

1.2 Site Conditions and History

The site is currently the existing City Park in the City of Grafton. The proposed project location is the existing public pool and locker rooms. The entire site is relatively level with ground relief between the borings of less than 1-foot.

1.3 Purpose

The purpose of our geotechnical evaluation is to characterize subsurface geologic conditions at selected exploration locations, evaluate their impact on the project, and provide geotechnical recommendations for the design and construction of the proposed pool.

1.4 Background Information and Reference Documents

We reviewed the following information:

- Aerial photographs from Google Earth™, image dates ranging from September 16, 1997 to April 7, 2025, were referenced to evaluate site access and site development history.
- Communications with Jon Markusen, PE with KLJ regarding project details.
- *Geology of Walsh County, North Dakota*, prepared by the North Dakota Geological Survey, Part 1, Plate2, County Groundwater Studies 17, Bulletin No. 57, not dated, used to evaluate the surficial geology on the project site.

We have described our understanding of the proposed construction and site to the extent others reported it to us. Depending on the extent of available information, we may have made assumptions based on our experience with similar projects. If we have not correctly recorded or interpreted the project details, the project team should notify us. New or changed information could require additional evaluation, analyses, and/or recommendations.

1.5 Scope of Services

We performed our scope of services for the project in accordance with our Proposal QTB202130, dated September 11, 2025, and authorized through KLJ Task Order No. 2404-01223-1. The following list describes the geotechnical tasks completed in accordance with our authorized scope of services.

- Reviewing the background information and reference documents previously cited.
- Staking and clearing the exploration location of underground utilities. We selected and staked the exploration locations as close to the existing pool as access would allow. We acquired the surface

elevations and coordinates from Google Earth™. The Soil Boring Location Sketch included in the Appendix shows the approximate locations of the borings.

- Performing two standard penetration test (SPT) borings, denoted as ST-01 and ST-02, to a depth of 31 feet below grade across the site.
- Installing one piezometer to a depth of 30 feet for long-term groundwater monitoring.
- Performing laboratory testing on select samples to aid in soil classification and engineering analysis.
- Preparing this report containing a boring location sketch, logs of soil borings, a summary of the soils encountered, results of laboratory tests, and recommendations for structure subgrade preparation and the design of the proposed pool.

Our scope of services did not include environmental services or testing and our geotechnical personnel performing this evaluation are not trained to provide environmental services or testing. We can provide environmental services or testing at your request.

2.0 Results

2.1 Geologic Overview

The geologic literature referenced previously indicates the site lies in an area underlain with alluvial deposits. The alluvial deposits generally consist of clays and sands with varying amounts of gravel. The alluvial deposits are underlain with glacial lake deposited soil consisting mainly of fat clays that are strength sensitive and compressible. The glacial lake soils are underlain with glacial till (moraine deposits) that also consist mainly of clay but possess greater strength and are less compressible. Our borings did not extend deep enough to encounter the glacial till deposits.

We based the geologic origins used in this report on the soil types and laboratory testing, and available common knowledge of the geological history of the site. Because of the complex depositional history, geologic origins can be difficult to ascertain. We did not perform a detailed investigation of the geologic history for the site.

2.2 Boring Results

Table 2-1 provides a summary of the soil boring results in the general order we encountered the strata. Please refer to the Log of Boring sheets in the Appendix for additional details. The Descriptive Terminology sheet in the Appendix includes definitions of abbreviations used in the table below.

Table 2-1. Subsurface Profile Summary

Strata	Soil Type -ASTM Classification	Range of Penetration Resistances	Commentary and Details
Topsoil	CL	Not Applicable	▪ Initially encountered in both borings. ▪ Predominantly sandy lean clay. ▪ Dark brown in color. ▪ Thickness at boring locations approximately 1-foot. ▪ Moisture condition generally moist.
Alluvial	CH	5 to 11 BPF	▪ Encountered in both borings directly below the topsoil. ▪ Consisted of fat clay. ▪ Dark gray and brown in color. ▪ Extended to depths ranging from 7 to 11 feet below existing grades. ▪ Moisture condition generally moist.
Glacial Lake	CH	3 to 8 BPF	▪ Encountered in both borings below the alluvial deposits to termination depth of the borings. ▪ Consisted of fat clay. ▪ Brown and Gray in color. ▪ Moisture condition generally moist.

2.3 Groundwater

We did not observe groundwater while performing our borings. Groundwater may take days or longer to reach equilibrium in the boreholes so we installed a piezometer in Boring ST-01 for long-term groundwater monitoring. Groundwater was observed in the piezometer at an approximate depth of 4 feet (corresponding elevation of 822 feet) when measured 4 weeks after installation. Project planning should anticipate seasonal and annual fluctuations of groundwater.

2.4 Laboratory Test Results

2.4.1 Moisture Contents

We performed moisture content (MC) tests (per ASTM D2216) on selected penetration test samples to aid in our classifications and estimations of the materials' engineering properties. The moisture content of the alluvial soils ranged from 20 to 43 percent indicating they were below to above their anticipated optimum moisture content. The moisture content of the glacial lake deposits tested ranged from 32 to 45 percent indicating they were above their anticipated optimum moisture content. The results of the moisture content tests are listed in the "MC" column of the Log of Boring sheets attached in the Appendix.

2.4.2 Moisture Contents and Unit Weights

Unit weight tests were performed on selected thin-walled tube samples to assist in our estimation of the materials' engineering properties. The results of the tests indicate the materials' have wet densities (WD) of

107 and 112 pounds per cubic foot (pcf); and dry densities (DD) of 75 and 80 pcf. The results of the unit weight tests are listed in the “Tests or Remarks” column of the Log of Boring sheets attached in the Appendix.

2.4.3 Atterberg Limits Tests

We performed Atterberg limits tests (per ASTM D4318) on selected samples for classification, evaluation of the range of soil plasticity, and estimation of engineering parameters. The tests indicate the soils have liquid limits (LL) of 83 and 90 percent, plastic limits (PL) of 26 and 33 percent, and a plastic index (PI) of 57. The results indicate the soils tested classify as fat clay (ASTM Symbol “CH”) and likely have a high potential for shrink or swell with changes in their moisture content. The “Tests or Remarks” column of the Log of Boring sheets shows the results of the Atterberg limits tests.

2.4.4 Unconfined Compressive Strength Tests

We performed unconfined compressive strength (Q_u) tests (per ASTM D2166) on selected thin-walled tube samples to aid in estimating the soils’ undrained shear strength for bearing capacity calculations. The results of the tests indicate the soils had unconfined compressive strengths of 2,820 pounds per square foot (psf) and 3,960 psf, indicating undrained shear strengths of 1,410 and 1,980 psf. The results of the unconfined compressive tests are listed in the “Tests or Remarks” column on the attached Log of Boring sheets and graphically in the Appendix.

3.0 Recommendations

3.1 Design and Construction Discussion

3.1.1 Construction Process

We anticipate the pool will be a concrete structure with the deepest portion of the pool at a depth of 12 feet and the shallow portion of the pool at depths ranging from 3 to 5 feet. Taking into consideration this is an outdoor pool, we anticipate the pool will be winterized during the freezing months. We recommend verifying with the pool designer how to properly winterize the pool.

3.1.2 Pool Support

Based on the results of the soil borings and our understanding of the proposed structure, it is our opinion the site is suitable for support of the proposed pool. Some subgrade improvements, including removal of the topsoil and overexcavations due to the expansive clay soils will be required.

In addition, it is our understanding the new pool will be located in the same location as the existing pool. We anticipate existing fills will likely be encountered during removal of the old structure. All existing fills, existing pavements, existing utilities and their associated backfills, existing structures and all associated foundations should be completely removed from within the footprint of the new pool.

3.1.3 Pool Area Preparation

Topsoils are not considered suitable for support of the proposed structure and will need to be completely removed.

The clay soils encountered on this site are susceptible to swelling and shrinkage with changes in their moisture content. The on-site clay is currently wet, but if they are allowed to dry and then allowed to become wet, the clays will swell and could potentially exceed slab and foundation pressures causing the overlying structure to heave.

To reduce the potential for future swelling of the clays, all clays placed below the structure must be placed at a moisture content that is at or above its optimum moisture content. In addition, exposed and reused clays must be maintained at or above optimum until they are covered by foundations, slabs or subsequent lifts of fill.

We recommend working closely with a pool designer to determine the details for the pool design. Do to the relatively high groundwater at the site and the presence of fat clay, consideration should be given to providing a minimum of 3 feet of vertical “separation” between the structure’s bottom of slab elevation and clay subgrade. This “separation” should be provided by placing imported, free-draining materials down to a depth 3 vertical feet below the pool’s bottom of slab elevation. A separation fabric should be placed between the clay and the free- draining material. We recommend that a collection system consisting of perforated pipe be installed at the bottom of the free draining granular material to direct infiltrated water to a sump for disposal. Specifications for the free draining material is discussed in Section 3.2.5 of this report.

Onsite excavations are anticipated to be achieved through open cut methods. If site conditions dictate the need for soil retention methods to facilitate excavations, we should be consulted to provide recommendations regarding methods and soil design parameters.

3.1.4 Groundwater Considerations

Based on the measured groundwater levels and anticipated depths of excavations, we anticipate dewatering of groundwater will be necessary during construction. Dewatering should be performed to remove all water from the excavation immediately. If standing water is found in the base of the excavation bottom, no construction traffic should be allowed to operate over those areas until the water is completely removed.

The native clays are highly susceptible to strength loss under repetitive construction traffic when they are wet. Construction traffic over wet clay subgrades should be limited to low-pressure (tracked) equipment.

3.2 Site Grading and Subgrade Preparation

3.2.1 Excavations

We recommend removing all “unsuitable materials” from below the pool’s floor slab, foundations, and their 1H:1V oversize areas. “Unsuitable materials” consist of surficial vegetation, topsoils, organic or foreign materials, existing fills, existing pavements, existing utilities and their associated backfills, existing structures and all associated foundations. Oversize areas are those areas extending down and away from the bottom outside edges of the proposed foundations at a 1H:1V gradient.

The site should then be excavated down to anticipated depths. In addition, as mentioned above in Section 3.1.3, we recommend overexcavations of 3 feet below the entire pool structure in order to provide a vertical separation between the pool and the potentially expansive clays.

To provide lateral support to replacement backfill, additional required fill and the structural loads they will support, we recommend oversizing (widening) the excavations 1 foot horizontally beyond the outer edges of the pool footings, for each foot the excavations extend below bottom-of-footing subgrade elevations.

The soils anticipated in the bottom of the excavations will consist of clays that when wet will be easily disturbed by construction traffic. Any soils that are weakened during earthwork operations or construction should be removed from the proposed building pad areas and should be replaced with on-site materials that can be placed and compacted per the recommendations listed in this report.

3.2.2 Scarification

In order to provide a subgrade with relatively uniform support, the resulting excavation bottom should be scarified (thoroughly mixed) to a depth of at least 6 inches, moisture conditioned to within 0 to +4 percentage points above the soil's optimum moisture content and compacted to a minimum of 95 percent of the material's standard Proctor maximum dry density (determined in accordance with ASTM Test Method D698).

We wish to note that it is imperative that the scarified clay subgrade be maintained within the required moisture content range (0 to +4 percentage points above optimum) until it is covered by subsequent lifts of backfill. Hence, if the scarified surface is left open over a weekend during dry, warm and windy weather, the resulting hardened "crust" that forms over the top of the subgrade will need to be re-scarified, moisture conditioned, and recompacted.

3.2.3 Excavated Slopes

The soils encountered in the anticipated excavations will be considered Type B Soils under OSHA guidelines; unless groundwater is encountered, at which point they would be classified as Type C Soils under OSHA guidelines. Unsupported excavations in Class B soils should be maintained at a gradient no steeper than 1H:1V; and for Class C soils maintained at a gradient no steeper than 1.5H:1V.

All excavations must comply with the requirements of OSHA 29 CFR, Part 1926, Subpart P, "Excavations and Trenches." This document states that excavation safety is the responsibility of the contractor. Reference to these OSHA requirements should be included in the project specifications.

3.2.4 Excavation Dewatering

Based on the measured groundwater levels and anticipated depths of excavations, we anticipate dewatering of groundwater will be necessary. Dewatering should be performed to remove all water from the excavation immediately. If standing water is found in the base of the excavation bottom, no construction traffic should be allowed to operate over those areas until the water is completely removed. When necessary, dewatering can likely be performed with the placement of multiple sumps and pumps in the excavation.

3.2.5 Backfill Materials Below Pool Slab and Foundations

Backfills placed below the pool's foundations and slabs should consist of free-draining materials meeting the following requirements:

- Free of black or organic materials;
- Plasticity index (PI) less than 15%;
- 100% particles by weight passing a 2-inch sieve;
- 35 – 70% passing the #4 sieve;
- ≤5% particles by weight passing a #200 sieve; and
- Able to be placed and compacted per the recommendations of this report.

Where the granular materials are placed outside of the footprint of the pool slabs or sidewalks, we recommend the excavation sidewalls that the granular soils are backfilled against be transitioned outward and upward at a 2H:1V, or flatter, slope to reduce the potential for differential frost heaving and subgrade support. A separation fabric should be provided between the clay and the free-draining materials.

3.2.6 Placement and Compaction of Backfill and Fill

We recommend spreading clay backfill and fill in loose lifts of approximately 4 to 8 inches. Granular materials may be placed in loose lifts of approximately 6 to 12 inches. We recommend compacting backfill and fill in accordance with the criteria presented below in Table 3-1. Compaction of the granular material should be performed with the use of a vibratory steel-drum roller or a vibratory plate compactor; and compaction of the clay material should be performed with the use of a sheep's foot. The relative compaction of the backfill should be evaluated based on the structure below which it is installed, and vertical proximity to that structure.

Table 3-1. Compaction Recommendations Summary

Reference	Relative Compaction, percent (ASTM D698 – Standard Proctor)	Moisture Content Variance from Optimum, percentage points	
		< 12% Passing #200 Sieve (typically SP, SP-SM)	> 12% Passing #200 Sieve (typically CH, CL, SC, SM)
Below foundations and oversizing zones	95	±3	-1 to +3
Below slabs	95	±3	-1 to +3

Increase compaction requirement to meet compaction required for structure supported by this engineered fill.

The project documents should not allow the contractor to use frozen material as engineered fill or to place engineered fill on frozen material. Frost should not penetrate under foundations during construction.

We recommend performing density tests in engineered fill to evaluate if the contractors are effectively compacting the soil and meeting project requirements.

3.2.7 Special Inspections of Soils

We recommend including the site grading and placement of engineered fill within the structure's footprint under the requirements of Special Inspections, as provided in Chapter 17 of the International Building Code. Special Inspection requires observation of soil conditions below engineered fill or footings, evaluations to determine if excavations extend to the anticipated soils, and if engineered fill materials meet requirements for engineered fill and compaction condition of engineered fill. A licensed geotechnical engineer should direct the Special Inspections of site grading and engineered fill placement. The purpose of these Special Inspections is to evaluate whether the work is in accordance with the approved geotechnical report for the project. Special Inspections should include evaluation of the subgrade, observing preparation of the subgrade (surface compaction or dewatering, excavation oversizing, placement procedures and materials used for engineered fill, etc.) and compaction testing of the engineered fill.

3.3 Construction Adjacent to Existing Structures

3.3.1 Excavations

Excavations for the new pool may extend near or below existing footing grades of the adjacent locker room structure. To reduce the risk of undermining the existing foundations, we recommend excavations not extend within a 2H:1V oversize zone of the existing building's foundations. After reaching the design depth, a geotechnical representative should observe the excavation bottom to evaluate the suitability of the soils near the existing foundation for support of the new slab and foundation. We recommend contacting us if excavations need to extend beyond the limits described above, as this may warrant additional construction such as ground improvement, retention, or underpinning.

During construction, the contractor should monitor the slope and structure for movement. We also recommend protecting the slope from disturbance, such as precipitation, runoff, or sloughing. The project team should establish threshold limits of movement and required action if the movement exceeds the limits.

3.3.2 Footing Depth

New structure foundations constructed adjacent to the foundations of the existing building may exert additional stresses on existing foundations. In general, we recommend constructing new foundations to bear at the same elevation as the existing foundations. We also recommend lowering or offsetting foundations so a foundation or its oversize zone does not exert a load on adjacent structures.

3.3.3 Settlement

If the new pool is constructed within the same footprint of the existing pool, we do not anticipate new or additional loads within the footprint of the new structure that would cause excessive settlement. We anticipate total settlements of less than 1 inch and differential settlements of less than 1/2 inch. Due to the existing building not likely settling with the new pool addition, approximately 1 inch of differential settlement could occur between the existing building and the new pool. To accommodate this settlement, we recommend connecting the addition to the building later in the construction process after most of the deadload is in place on the addition. We also recommend installing expansion joints between the existing building and the addition or designing the structure to accommodate differential movement.

3.4 Below-Grade Walls

3.4.1 Embedment Depth

For frost protection, we recommend embedding perimeter footings a minimum of 6 feet below the lowest exterior grade. We recommend embedding structure footings not protected from freezing during winter construction, and other unheated footings associated with canopies, stoops or sidewalks 6 feet below the lowest exterior grade.

3.4.2 Net Allowable Bearing Pressure

The underlying soils including the recommended improvements will be suitable for foundation support with a net allowable bearing pressure of 2,000 pounds per square foot (psf), including all transient loads. This value includes a safety factor of at least 3.0 with regard to bearing capacity failure.

3.4.3 Settlement

If foundation subgrades, including overexcavations, are prepared as recommended above, we estimate total settlements of less than 1 inch and differential settlements of less than 1/2 inch.

3.4.4 Drainage Control

We recommend installing subdrains below the below grade pool walls, adjacent to the wall base. Preferably the subdrains should consist of perforated pipes embedded in washed gravel, which in turn is wrapped in filter fabric. Perforated pipes encased in a filter “sock” and embedded in washed gravel, however, may also be considered. We recommend routing the subdrains to allow the trapped water to drain to the storm sewer or some other suitable discharge system.

3.4.5 Selection, Placement and Compaction of Backfill

Unless a drainage composite is placed against the backs of the pool walls, we recommend that backfill placed within 2 horizontal feet of those walls consist of sand having less than 50 percent of the particles by weight passing a #40 sieve and less than 5 percent of the particles by weight passing a #200 sieve. Sand meeting this gradation will need to be imported. We recommend that the balance of the backfill placed against the wall also consist of sand, though it is our opinion that the sand may contain up to 20 percent of the particles by weight passing a #200 sieve.

If clay must be considered for use to make up the balance of the wall backfill (assuming drainage composite or sand is placed against the backs of the walls), post-compaction consolidation of the clay occurring under its own weight can be expected to continue beyond the end of construction. The magnitude of consolidation could amount to between 1 and 3 percent of the backfill thickness, or wall height, and if not accommodated could cause slabs to settle unfavorably or be damaged.

We recommend a walk behind compactor be used to compact the backfill placed within about 5 feet of the retaining wall. Further away than that, a self-propelled compactor can be used. Compaction criteria for below grade walls should be determined based on the compaction recommendations provided above in Section 3.2.6.

Wall backfill not capped with slabs should be capped with a low-permeability soil, such as the on-site fat clays, to limit the infiltration of surface drainage into the backfill. The finished surface should also be sloped to divert water away from the walls.

3.4.6 Configuring and Resisting Lateral Loads

The pool wall design should be based on at-rest earth pressure conditions. Recommended equivalent fluid pressures for wall design based on at-rest earth pressure conditions are presented below in Table 3-2. Assumed wet unit backfill weights, and internal friction angles are also provided. The recommended equivalent fluid pressures in particular assume a level backfill with no surcharge – they would need to be revised for sloping backfill or other dead or live loads that are placed within a horizontal distance behind the walls that is equal to the height of the walls. Our design values also assume that the walls are drained so that water cannot accumulate behind the walls.

Table 3-2. Recommended Below-Grade Wall Design Parameters – Drained Conditions

Backfill Soil	Wet Unit Weight (pcf)	Friction Angle (degrees)	At-Rest Lateral Coefficient/ Equivalent Fluid Pressure (pcf)
Sand	120	33	50

Resistance to lateral earth pressures will be provided by passive resistance against the wall footings and by sliding resistance along the bottoms of the wall footings. We recommend assuming a passive pressure equal to 400 pcf for sands with sliding coefficients equal to 0.50. These values are un-factored.

3.5 Exterior Slabs

Though not necessarily designed to accommodate dead and live load surcharges or vehicles, exterior slabs can be subjected to both. Settlement of exterior slabs on poorly compacted foundation backfill, utility backfill and other compressible naturally deposited soils or fills can also contribute to unfavorable surface drainage conditions and frost-related damage (see below) to the slabs and adjacent structures, including buildings and pavements.

We recommend stripping all surficial vegetation and topsoils from below the proposed slab areas. Backfills and fills placed within the pavement areas should be placed and compacted per requirements reported in Section 3.2 above. Additional commentary on the risks associated with frost, and recommendations for helping mitigate those risks is provided in Section 3.6.

3.6 Frost Protection

3.6.1 General

Fat Clays will underlie exterior slabs, as well as pavements. We consider fat clays to be highly frost susceptible. Soils of this type can retain moisture and heave upon freezing. In general, this characteristic is not an issue unless these soils become saturated, due to surface runoff or infiltration, or are excessively wet in-situ. Once frozen, unfavorable amounts of general and isolated heaving of the soils and the surface structures supported on them could develop. This type of heaving could affect design drainage patterns and the performance of exterior slabs and pavements, as well as any isolated exterior footings and piers.

Note that general runoff and infiltration from precipitation are not the only sources of water that can saturate subgrade soils and contribute to frost heave. Roof drainage and irrigation of landscaped areas in close proximity to exterior slabs, pavements, and isolated footings and piers, contribute as well.

3.6.2 Frost Heave Mitigation

To address most of the heave related issues, we recommend setting general site grades and grades for exterior surface features to direct surface drainage away from buildings, across large, paved areas and away from walkways. Such grading will limit the potential for saturation of the subgrade and subsequent heaving. General grades should also have enough “slope” to tolerate potential larger areas of heave, which may not fully settle after thawing.

Even small amounts of frost-related differential movement at walkway joints or cracks can create tripping hazards. Project planning can explore several subgrade improvement options to address this condition.

One of the more conservative subgrade improvement options to mitigate potential heave is removing any frost-susceptible soils present below the exterior slab areas down to a minimum depth of 6 feet below subgrade elevations. We recommend the resulting excavation then be refilled with sand or sandy gravel having less than 50 percent of the particles by weight passing the #40 sieve and less than 5 percent of the particles by weight passing a #200 sieve. We recommend providing drainage at the base of the subcut, as well as gradual transitions from this subcut (3H:1V or flatter gradient). We also recommend sloping the bottom of the excavation toward one or more collection points to remove any water entering the engineered fill. This approach will not be effective in controlling frost heave without removing the water.

An important geometric aspect of the excavation and replacement approach described above is sloping the banks of the excavations to create a more gradual transition between the unexcavated soils considered frost susceptible and the engineered fill in the excavated area, which is not frost susceptible. The slope allows attenuation of differential movement that may occur along the excavation boundary. We recommend slopes that are 3H:1V, or flatter, along transitions between frost-susceptible and non-frost-susceptible soils.

Figure 3-1 shows an illustration summarizing some of the recommendations.

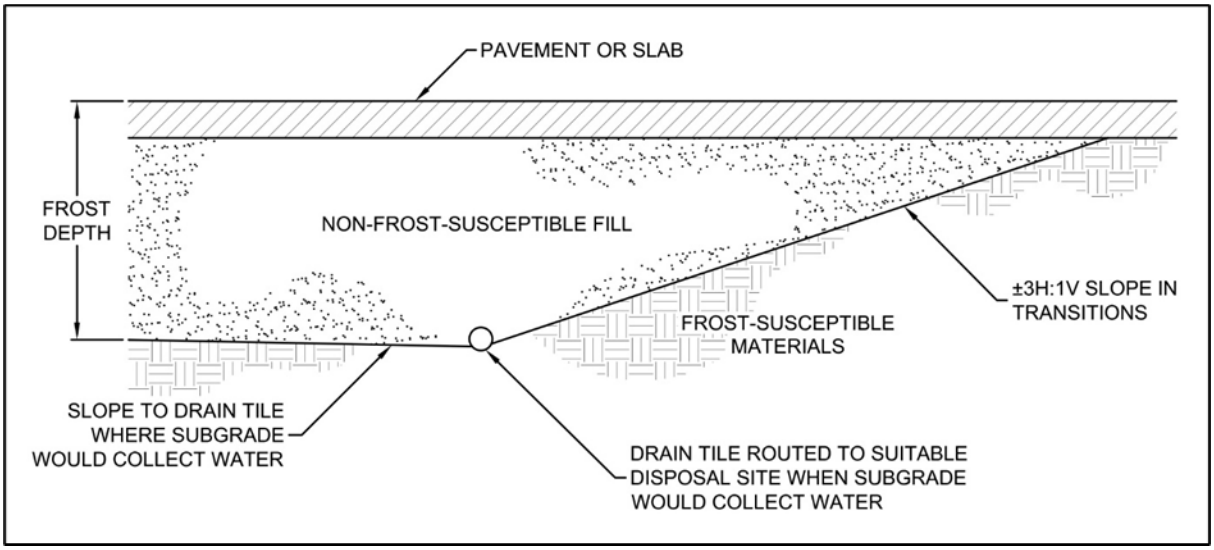

Figure 3-1. Frost Protection Geometry Illustration

Another option is to limit frost heave in critical areas, such as doorways and entrances, via frost-depth footings or localized excavations with sloped transitions between frost-susceptible and non-frost-susceptible soils, as described above.

Over the life of slabs and pavements, cracks will develop, and joints will open up, which will expose the subgrade and allow water to enter from the surface and either saturate or perch atop the subgrade soils. This water intrusion increases the potential for frost heave or moisture-related distress near the crack or joint. Therefore, we recommend implementing a detailed maintenance program to seal and/or fill any cracks and joints. The maintenance program should give special attention to areas where dissimilar materials abut one another, where construction joints occur and where shrinkage cracks develop.

3.7 Construction Quality Control

3.7.1 Excavation Observations

We recommend having a geotechnical engineer observe all excavations related to subgrade preparation and pool construction. The purpose of the observations is to evaluate the competence of the geologic materials exposed in the excavations, and the adequacy of required excavation oversizing.

3.7.2 Materials Testing

We recommend relative moisture and compaction tests be taken in excavation backfill and additional required fill placed below the pool slabs and foundations. Relative moisture and compaction tests should be performed at the following frequencies:

- 1/500 square feet of slab area for every 1 foot of backfill; and
- 1/25 linear feet of foundation wall backfill.

Standard Proctors (ASTM D698) should be performed by the independent testing agency prior to the start of backfill placement and compaction. Sieve analyses should be performed on all granular materials imported to the site to verify they meet the project requirements.

We also recommend slump, air content and strength tests of Portland cement concrete in accordance with ACI guidelines.

3.7.3 Cold Weather Precautions

If site grading and construction is anticipated during cold weather, all snow and ice should be removed from cut and fill areas prior to additional grading. No fill should be placed on frozen subgrades. No frozen soils should be used as fill.

Concrete delivered to the site should meet the temperature requirements of ASTM C 94. Concrete should not be placed on frozen subgrades. Concrete should be protected from freezing until the necessary strength is attained. Frost should not be permitted to penetrate below footings.

4.0 Procedures

4.1 Penetration Test Borings

We drilled the penetration test borings with an ATV-mounted core and auger drill equipped with hollow-stem auger. We performed the borings in general accordance with ASTM D6151 taking penetration test samples at 2 1/2- or 5-foot intervals in general accordance with ASTM D1586. We collected thin-walled tube samples in general accordance with ASTM D1587 at selected depths. The boring logs show the actual sample intervals and corresponding depths.

4.2 Exploration Logs

4.2.1 Log of Boring Sheets

The Appendix includes Log of Boring sheets for our penetration test borings. The logs identify and describe the penetrated geologic materials and present the results of penetration resistance tests performed. The logs also present the results of laboratory tests performed on penetration test samples and groundwater measurements. The Appendix also includes a Fence Diagram intended to provide a summarized cross-sectional view of the soil profile across the site.

We inferred strata boundaries from changes in the penetration test samples and the auger cuttings. Because we did not perform continuous sampling, the strata boundary depths are only approximate. The boundary depths likely vary away from the boring locations, and the boundaries themselves may occur as gradual rather than abrupt transitions.

4.2.2 Geologic Origins

We assigned geologic origins to the materials shown on the logs and referenced within this report, based on: (1) a review of the background information and reference documents cited above, (2) visual classification of the various geologic material samples retrieved during the course of our subsurface exploration, (3) penetration resistance testing performed for the project, (4) laboratory test results, and (5) available common knowledge of the geologic processes and environments that have impacted the site and surrounding area in the past .

4.3 Material Classification and Testing

4.3.1 Visual and Manual Classification

We visually and manually classified the geologic materials encountered based on ASTM D2488. When we performed laboratory classification tests, we used the results to classify the geologic materials in accordance with ASTM D2487. The Appendix includes a chart explaining the classification system we used.

4.3.2 Laboratory Testing

The exploration logs in the Appendix note most of the results of the laboratory tests performed on geologic material samples. The remaining laboratory test results follow the exploration logs. We performed the tests in general accordance with ASTM procedures.

4.4 Groundwater Measurements

The drillers checked for groundwater while advancing the penetration test borings, and again after auger withdrawal. We then filled the boreholes or allowed them to remain open for an extended period of observation, as noted on the boring logs.

5.0 Qualifications

5.1 Variations in Subsurface Conditions

5.1.1 Material Strata

We developed our evaluation, analyses, and recommendations from a limited amount of site and subsurface information. It is not standard engineering practice to retrieve material samples from exploration locations continuously with depth. Therefore, we must infer strata boundaries and thicknesses to some extent. Strata boundaries may also be gradual transitions, and project planning should expect the strata to vary in depth, elevation, and thickness, away from the exploration locations.

Variations in subsurface conditions present between exploration locations may not be revealed until performing additional exploration work or starting construction. If future activity for this project reveals any such variations, you should notify us so that we may reevaluate our recommendations. Such variations could increase construction costs, and we recommend including a contingency to accommodate them.

5.1.2 Groundwater Levels

We made groundwater measurements under the conditions reported herein and shown on the exploration logs and interpreted in the text of this report. Note that the observation periods were relatively short, and project planning can expect groundwater levels to fluctuate in response to rainfall, flooding, irrigation, seasonal freezing and thawing, surface drainage modifications and other seasonal and annual factors.

5.2 Continuity of Professional Responsibility

5.2.1 Plan Review

We based this report on a limited amount of information, and we made a number of assumptions to help us develop our recommendations. We should be retained to review the geotechnical aspects of the designs and specifications. This review will allow us to evaluate whether we anticipated the design correctly, if any design changes affect the validity of our recommendations, and if the design and specifications correctly interpret and implement our recommendations.

5.2.2 Construction Observations and Testing

We recommend retaining us to perform the required observations and testing during construction as part of the ongoing geotechnical evaluation. This will allow us to correlate the subsurface conditions exposed during construction with those encountered by the borings and provide professional continuity from the design phase to the construction phase. If we do not perform observations and testing during construction, it becomes the responsibility of others to validate the assumption made during the preparation of this report and to accept the construction-related geotechnical engineer-of-record responsibilities.

5.3 Use of Report

This report is for the exclusive use of the addressed parties. Without written approval, we assume no responsibility to other parties regarding this report. Our evaluation, analyses and recommendations may not be appropriate for other parties or projects.

5.4 Standard of Care

In performing its services, Braun Intertec used that degree of care and skill ordinarily exercised under similar circumstances by reputable members of its profession currently practicing in the same locality. No warranty, express or implied, is made.

Appendix

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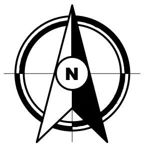
◑ **DENOTES APPROXIMATE LOCATION OF STANDARD PENETRATION TEST BORING**



40' 0 80'

SCALE: 1"= 80'

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11001 Hampshire Avenue S
Minneapolis, MN 55438
952.995.2000
braunintertec.com

Project No:
B2508443

Drawing No:
B2508443

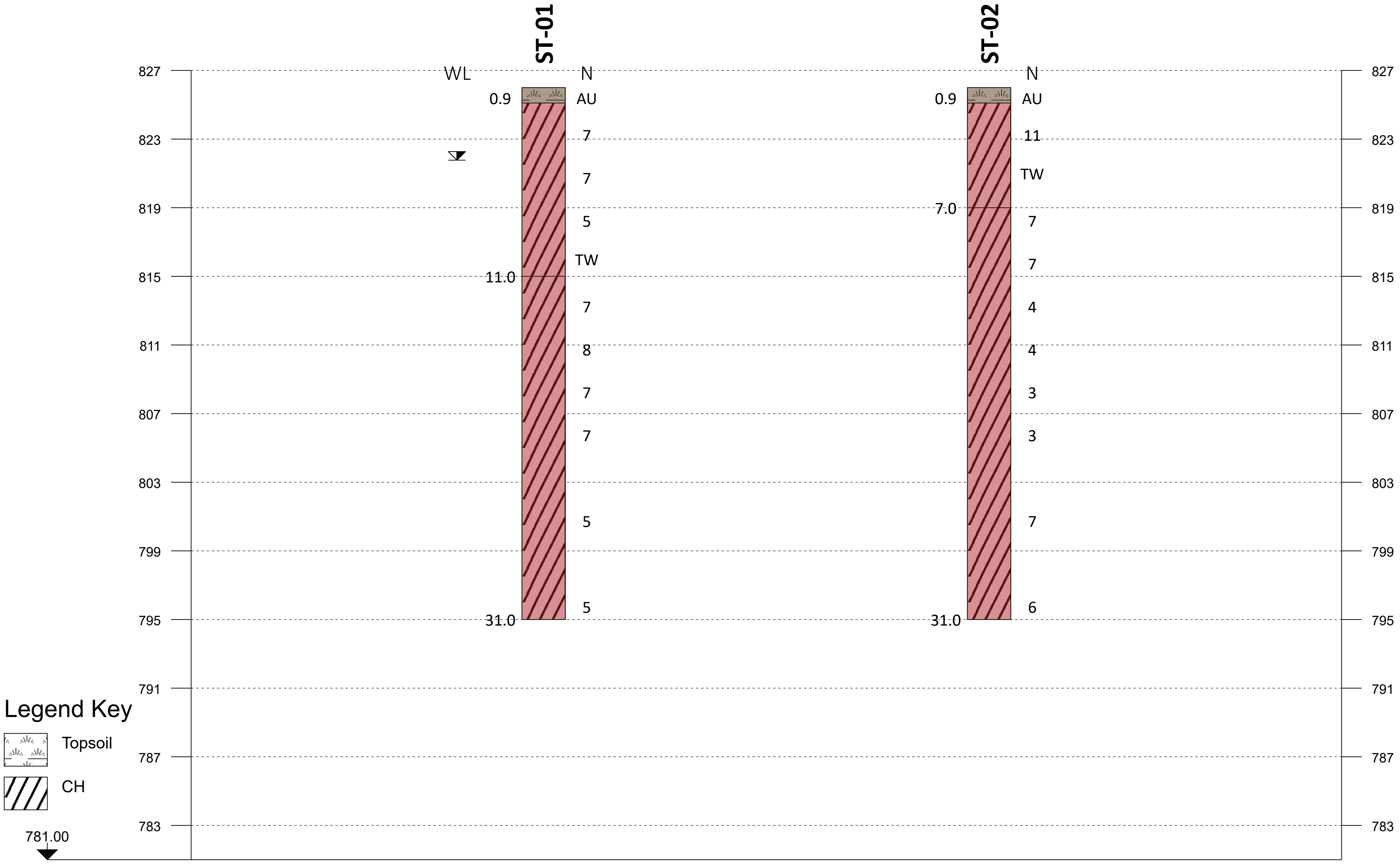
Drawn By:	JAG
Date Drawn:	10/30/25
Checked By:	JLM
Last Modified:	10/31/25

Leistikow Park Pool Replacement

435 W. 5th Street

Grafton, North Dakota

Soil Boring Location Sketch



SECTION LINE 1

Fence Diagram

Geotechnical Evaluation
City of Grafton Pool Replacement Leistikow Park
435 W 5th St
Grafton, North Dakota

Project ID:	B2508443
Vert. Scale:	1"= 8'
Hor. Scale:	NTS
Date:	11/05/2025

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LOG OF BORING

See Descriptive Terminology sheet for explanation of abbreviations

Project Number B2508443 **Geotechnical Evaluation** **City of Grafton Pool Replacement Leistikow Park** **435 W 5th St** **Grafton, North Dakota**	BORING: **ST-01**	
	LOCATION: Estimated.	
	DATUM: WGS 84	
	LATITUDE: 48.42051	LONGITUDE: -97.41758
DRILLER: C.Gorman / LOGGED BY: J.McKinnon	START DATE: 10/02/25	END DATE: 10/02/25
SURFACE ELEVATION: 826.0 ft / RIG: 7508 / METHOD: 3 1/4" HSA	SURFACING: Grass	WEATHER: Clear

Elev./ Depth ft	Water Level	Description of Materials (Soil-ASTM D2488 or 2487; Rock-USACE EM 1110-1-2908)	Sample	Blows (N-Value) Recovery	q_p tsf	MC %	Tests or Remarks
825.1 0.9		SANDY LEAN CLAY (CL), trace roots, dark brown, moist (TOPSOIL)		AU			
		FAT CLAY (CH), dark gray and brown, moist, medium (ALLUVIUM)		2-3-4 (7) 6"	3.5	32	
	▽						
			5	3-3-4 (7) 10"		34	
				2-2-3 (5) 8"		42	
			10	TW 24"		40	LL=83, PL=26, PI=57 DD=80 pcf WD=112 pcf q_u=1.41 tsf
815.0 11.0		FAT CLAY (CH), brown and gray, moist, medium (GLACIAL LAKE)					
				3-3-4 (7) 16"	3	38	
			15	3-4-4 (8) 18"	3		
				2-3-4 (7) 18"	1.5	45	
			20	2-3-4 (7) 12"	1.5		
			25	2-2-3 (5) 18"	1	38	
			30	2-2-3 (5) 18"	1		Water not observed while drilling.
795.0 31.0		END OF BORING Boring then backfilled with auger cuttings	35				Water observed at 4.0 feet when rechecked 4 weeks after drilling. Piezometer installed for long-term groundwater monitoring.

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LOG OF BORING

See Descriptive Terminology sheet for explanation of abbreviations

Project Number B2508443
Geotechnical Evaluation
City of Grafton Pool Replacement Leistikow Park
435 W 5th St
Grafton, North Dakota

BORING:	**ST-02**		
LOCATION: Estimated.			
DATUM: WGS 84			
LATITUDE:	48.42051	LONGITUDE:	-97.41809
DRILLER: C.Gorman	LOGGED BY: J.McKinnon	START DATE: 10/02/25	END DATE: 10/02/25
SURFACE ELEVATION: 826.0 ft	RIG: 7508	METHOD: 3 1/4" HSA	
SURFACING:	Grass	WEATHER:	Clear

Elev./ Depth ft	Water Level	Description of Materials (Soil-ASTM D2488 or 2487; Rock-USACE EM 1110-1-2908)	Sample	Blows (N-Value) Recovery	q_p tsf	MC %	Tests or Remarks
825.1 0.9		SANDY LEAN CLAY (CL), trace roots, dark brown, moist (TOPSOIL)		AU			
		FAT CLAY (CH), little Gravel, brown, moist, stiff (ALLUVIUM)		4-5-6 (11) 6"		20	
5				TW 24"		43	LL=90, PL=33, PI=57 DD=75 pcf WD=107 pcf q_u=1.98 tsf
819.0 7.0		FAT CLAY (CH), gray and brown, moist, soft to medium (GLACIAL LAKE)		3-3-4 (7) 12"	3	41	
10				2-3-4 (7) 14"	3	40	
				2-2-2 (4) 4"		39	
15				1-2-2 (4) 12"			
				1-1-2 (3) 10"	0.5	38	
20				1-1-2 (3) 14"	1		
25				2-3-4 (7) 18"	1	32	
30				3-3-3 (6) 18"	2		Water not observed while drilling.
795.0 31.0		END OF BORING Boring then backfilled with auger cuttings					
35							

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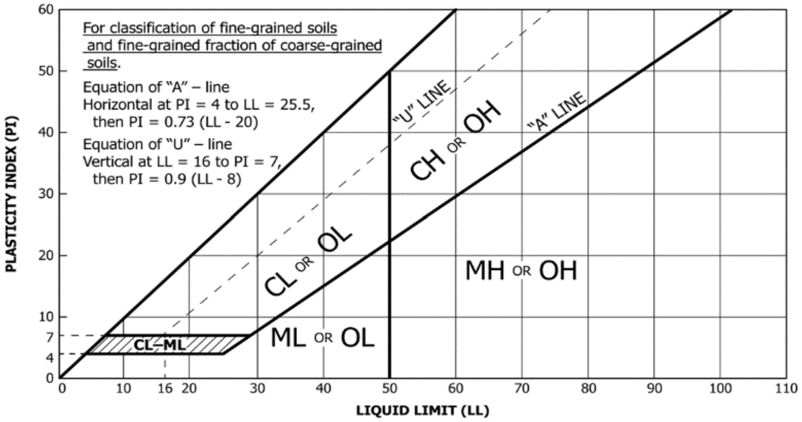
Descriptive Terminology of Soil

Based on Standards ASTM D2487/2488
(Unified Soil Classification System)

Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests^A				Soil Classification	
				Group Symbol	Group Name^B
Coarse-grained Soils (more than 50% retained on No. 200 sieve)	**Gravels** (More than 50% of coarse fraction retained on No. 4 sieve)	**Clean Gravels** (Less than 5% fines^C)	$C_u \geq 4$ and $1 \leq C_c \leq 3^D$	GW	Well-graded gravel^E
			$C_u < 4$ and/or $(C_c < 1$ or $C_c > 3)^D$	GP	Poorly graded gravel^E
		Gravels with Fines (More than 12% fines^C)	Fines classify as ML or MH	GM	Silty gravel$^{E\ F\ G}$
			Fines Classify as CL or CH	GC	Clayey gravel$^{E\ F\ G}$
	Sands (50% or more coarse fraction passes No. 4 sieve)	**Clean Sands** (Less than 5% fines^H)	$C_u \geq 6$ and $1 \leq C_c \leq 3^D$	SW	Well-graded sand^I
			$C_u < 6$ and/or $(C_c < 1$ or $C_c > 3)^D$	SP	Poorly graded sand^I
		Sands with Fines (More than 12% fines^H)	Fines classify as ML or MH	SM	Silty sand$^{F\ G\ I}$
			Fines classify as CL or CH	SC	Clayey sand$^{F\ G\ I}$
Fine-grained Soils (50% or more passes the No. 200 sieve)	**Silts and Clays** (Liquid limit less than 50)	Inorganic	PI > 7 and plots on or above "A" line^J	CL	Lean clay$^{K\ L\ M}$
			PI < 4 or plots below "A" line^J	ML	Silt$^{K\ L\ M}$
		Organic	$\frac{\text{Liquid Limit – oven dried}}{\text{Liquid Limit – not dried}} < 0.75$	OL	Organic clay $^{K\ L\ M\ N}$ Organic silt $^{K\ L\ M\ O}$
	Silts and Clays (Liquid limit 50 or more)	Inorganic	PI plots on or above "A" line	CH	Fat clay$^{K\ L\ M}$
			PI plots below "A" line	MH	Elastic silt$^{K\ L\ M}$
		Organic	$\frac{\text{Liquid Limit – oven dried}}{\text{Liquid Limit – not dried}} < 0.75$	OH	Organic clay $^{K\ L\ M\ P}$ Organic silt $^{K\ L\ M\ Q}$
Highly Organic Soils		Primarily organic matter, dark in color, and organic odor		PT	Peat

A. Based on the material passing the 3-inch (75-mm) sieve.
B. If field sample contained cobbles or boulders, or both, add "with cobbles or boulders, or both" to group name.
C. Gravels with 5 to 12% fines require dual symbols:
   GW-GM well-graded gravel with silt
   GW-GC well-graded gravel with clay
   GP-GM poorly graded gravel with silt
   GP-GC poorly graded gravel with clay
D. $C_u = D_{60} / D_{10}$ $C_c = (D_{30})^2 / (D_{10} \; x \; D_{60})$
E. If soil contains ≥ 15% sand, add "with sand" to group name.
F. If fines classify as CL-ML, use dual symbol GC-GM or SC-SM.
G. If fines are organic, add "with organic fines" to group name.
H. Sands with 5 to 12% fines require dual symbols:
   SW-SM well-graded sand with silt
   SW-SC well-graded sand with clay
   SP-SM poorly graded sand with silt
   SP-SC poorly graded sand with clay
I. If soil contains ≥ 15% gravel, add "with gravel" to group name.
J. If Atterberg limits plot in hatched area, soil is CL-ML, silty clay.
K. If soil contains 15 to < 30% plus No. 200, add "with sand" or "with gravel", whichever is predominant.
L. If soil contains ≥ 30% plus No. 200, predominantly sand, add “sandy” to group name.
M. If soil contains ≥ 30% plus No. 200 predominantly gravel, add “gravelly” to group name.
N. PI ≥ 4 and plots on or above “A” line.
O. PI < 4 or plots below “A” line.
P. PI plots on or above “A” line.
Q. PI plots below “A” line.



Laboratory Tests

DD	Dry density, pcf	q_p	Pocket penetrometer strength, tsf
WD	Wet density, pcf	q_U	Unconfined compression test, tsf
P200	% Passing #200 sieve	**LL**	Liquid limit
MC	Moisture content, %	**PL**	Plastic limit
OC	Organic content, %	**PI**	Plasticity index

Particle Size Identification

Boulders	over 12"
Cobbles	3" to 12"
Gravel	
Coarse	3/4" to 3" (19.00 mm to 75.00 mm)
Fine	No. 4 to 3/4" (4.75 mm to 19.00 mm)
Sand	
Coarse	No. 10 to No. 4 (2.00 mm to 4.75 mm)
Medium	No. 40 to No. 10 (0.425 mm to 2.00 mm)
Fine	No. 200 to No. 40 (0.075 mm to 0.425 mm)
Silt	No. 200 (0.075 mm) to .005 mm
Clay	< .005 mm

Relative Proportions$^{L,\ M}$

trace	0 to 5%
little	6 to 14%
with	≥ 15%

Inclusion Thicknesses

lens	0 to 1/8"
seam	1/8" to 1"
layer	over 1"

Apparent Relative Density of Cohesionless Soils

Very loose	0 to 4 BPF
Loose	5 to 10 BPF
Medium dense	11 to 30 BPF
Dense	31 to 50 BPF
Very dense	over 50 BPF

Consistency of Cohesive Soils	**Blows Per Foot**	**Approximate Unconfined Compressive Strength**
Very soft	0 to 1 BPF	< 0.25 tsf
Soft	2 to 4 BPF	0.25 to 0.5 tsf
Medium	5 to 8 BPF	0.5 to 1 tsf
Stiff	9 to 15 BPF	1 to 2 tsf
Very Stiff	16 to 30 BPF	2 to 4 tsf
Hard	over 30 BPF	> 4 tsf

Moisture Content:

Dry: Absence of moisture, dusty, dry to the touch.
Moist: Damp but no visible water.
Wet: Visible free water, usually soil is below water table.

Drilling Notes:

Blows/N-value: Blows indicate the driving resistance recorded for each 6-inch interval. The reported N-value is the blows per foot recorded by summing the second and third interval in accordance with the Standard Penetration Test, ASTM D1586.

Partial Penetration: If the sampler could not be driven through a full 6-inch interval, the number of blows for that partial penetration is shown as #/x" (i.e. 50/2"). The N-value is reported as "REF" indicating refusal.

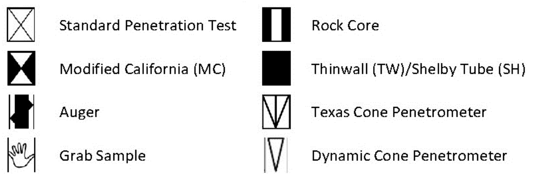
Recovery: Indicates the inches of sample recovered from the sampled interval. For a standard penetration test, full recovery is 18", and is 24" for a thinwall/shelby tube sample.

WOH: Indicates the sampler penetrated soil under weight of hammer and rods alone; driving not required.

WOR: Indicates the sampler penetrated soil under weight of rods alone; hammer weight and driving not required.

Water Level: Indicates the water level measured by the drillers either while drilling (▽), at the end of drilling (▼), or at some time after drilling (▼).

Sample Symbols



5/2021

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526 10th St NE, Suite 300
PO Box 485
West Fargo, ND 58078
Phone: 701-232-8701

Unconfined Compression

ASTM D2166

Report #: BI0508-000001
Report Date: 11/03/2025

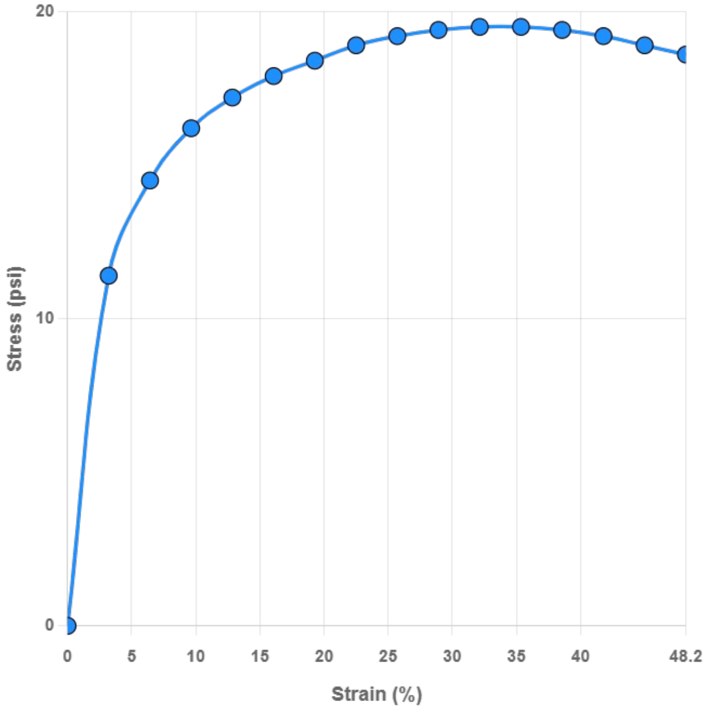
Client:	**Project:**
Grafton Parks and Recreation 864 West 12th Street Grafton, ND 58237	B2508443 City of Grafton Pool 435 W 5th St Grafton, ND 58237

Sample Information

Sample Number:	696963	**Alternate ID:**	Sample # 16
Sampling Method:	Thinwall Tube ASTM D1587	**Depth (ft):**	9' - 11'
Boring Number:	ST-01	**Sampled By:**	Drill Crew
Sample Date:	10/02/2025		
Received Date:	10/28/2025	**Lab:**	526 10th Street NE, Suite 300, West Fargo, ND
Tested Date:	11/03/2025	**Tested By:**	Jacquemart, Trevor

Laboratory Data

Specimen Type:	Intact
Average Diameter (in):	1.887
Average Length (in):	3.734
Height to Diameter Ratio:	1.98
Wet Density (pcf):	111.7
Moisture Specimen:	Entire sample after shear
Moisture Content (%):	39.6
Dry Density (pcf):	80.0
Average Strain Rate (%/min):	3.19
Strain At Failure (%):	32.14
Unconfined Compressive Strength (psi):	19.6
Unconfined Compressive Strength (tsf):	1.41
Shear Strength (tsf):	0.71



Soil Classification:	CH FAT CLAY

General

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Unconfined Compression

ASTM D2166

Report #: BI0508-000002
Report Date: 11/03/2025

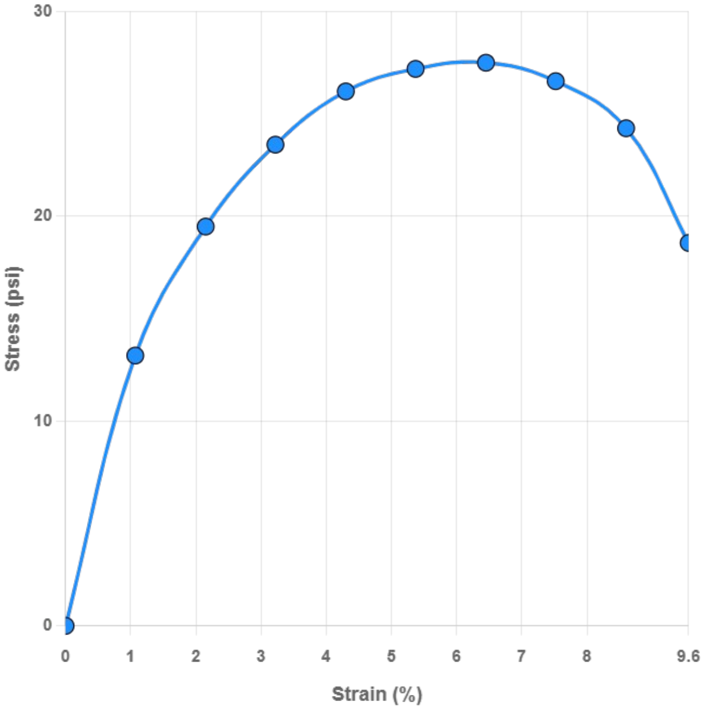
Client:	**Project:**
Grafton Parks and Recreation 864 West 12th Street Grafton, ND 58237	B2508443 City of Grafton Pool 435 W 5th St Grafton, ND 58237

Sample Information

Sample Number:	696964	**Alternate ID:**	Sample # 3
Sampling Method:	Thinwall Tube ASTM D1587	**Depth (ft):**	4' - 6'
Boring Number:	ST-02	**Sampled By:**	Drill Crew
Sample Date:	10/02/2025		
Received Date:	10/28/2025	**Lab:**	526 10th Street NE, Suite 300, West Fargo, ND
Tested Date:	11/03/2025	**Tested By:**	Jacquemart, Trevor

Laboratory Data

Specimen Type:	Intact
Average Diameter (in):	2.858
Average Length (in):	5.584
Height to Diameter Ratio:	1.95
Wet Density (pcf):	106.6
Moisture Specimen:	Entire sample after shear
Moisture Content (%):	43.1
Dry Density (pcf):	74.5
Average Strain Rate (%/min):	1.90
Strain At Failure (%):	6.45
Unconfined Compressive Strength (psi):	27.5
Unconfined Compressive Strength (tsf):	1.98
Shear Strength (tsf):	0.99
Soil Classification:	CH FAT CLAY



General