WHITE FARMS SUBDIVISION

SOILS REPORT

PROPERTY LOCATION:
2700 SOUTH 8000 WEST
MAGNA, UTAH

PREPARED FOR:
JEFF WHITE

FEBRUARY 2006

PREPARED BY:
WILDING ENGINEERING
14721 SOUTH HERITAGE CREST DRIVE
BLUFFDALE, UTAH 84065
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1. INTRODUCTION

The field investigation included the examination of the subsurface soil conditions by excavating 6 test pits. Results of the soil investigation are included in the appendix in the form of test pit logs. The field investigation took place on December 21, 2005. Recommendations in this report are based upon information gathered from the test pit investigation, site inspection, lab testing, and from reviewing geologic maps and reports of the area.

2. PURPOSE AND SCOPE

The purpose of this report is to determine the suitability of on site soils for the construction of a 111 lot residential subdivision with the accompanying roadways and utilities. The investigation includes a review of surface water and ground water conditions and their affects. Engineering and construction recommendations are based on subsurface conditions encountered in the field along with the effects of both subsurface and surface waters.

3. SITE AND PROJECT INFORMATION

3.1. Existing Site Conditions
The site is comprised of roughly 41.5 acres and is located at 2700 South 8000 West, in Magna, Utah. The site is located in Section 29, Township 1 South, Range 2 West, Salt Lake Base and Meridian.

The site is currently has a single residence with several barns located in the northeast corner, and the remaining area is in use agriculturally growing Alfalfa. The adjoining properties are developed as residential property, with Pleasant Green Elementary to the northwest.

Vegetation on site consists of residential foliage, Alfalfa, and roughly 15 Elm and other trees in the center of the site.

The site elevation ranges from about 4290 to 4320 feet above mean sea level. Generally the site slopes southwest to northeast.

3.2. Proposed Project Description
The 41.5-acre site will be developed for a residential subdivision. The site plan is located in the Appendix.

4. GENERAL GEOLOGY AND HYDROLOGY

4.1. Surficial Geology
Soils on this site consist of lacustrine deposits from Lake Bonneville and alluvial fan deposits. The site is mapped with two USGS soil units; “af2- Fan alluvium 2 (Middle Holocene to uppermost Pleistocene),” and “lbpm- Lacustrine clay and silt, undivided (upper Pleistocene).” The majority of the site is on the af2, with the lbpm located in the northeast corner of the site.

The af2 is described as: “Clast-supported pebble and cobble gravel, locally bouldery, in a matrix of sand and silty sand; poorly sorted; clasts subangular to round. Thin to thick, parallel bedding and crossbedding; locally massive. Deposited by perennial and intermittent streams, debris flows, and debris floods (hyper-concentrated floods) graded approximately to modern stream level. May contain small deposits of units afl 1

1USGS soil units were found using two Surficial Geologic Maps: Surficial Geologic Map Along Part of the Wasatch Front, Salt Lake Valley, Utah; U. S. Geological Survey, R. D. Miller, 1980 (for identification purposes); and Surficial Geologic Map of the Salt Lake City Segment and Parts of Adjacent Segments of the Wasatch Fault Zone, Davis, Salt Lake and Utah Counties, Utah; U.S. Geological Survey, Steven Personius and William E. Scott, 1992 (for descriptive purposes).
and cdl, especially near fan heads and along active stream channels. No shorelines present on surfaces. Typical soil profiles range from A-Bw-Cox-Cn to A-Bt(weak)-Cox-Cn. Thickness 1 to >10 m."

The lbpm is described as: "Clay, silt, and minor fine sand and pebble gravel; bedding locally disrupted by soft-sediment deformation or liquefaction. Deposited in deep and (or) quiet water in lower part of basin. Usually grades laterally to other deposits of the Bonneville lake cycle. Unit probably contains small deposits of unit clsp (Lateral spread deposits) Thickness 1 to >10m."

4.2. Geologic Hazards

4.2.1. Faulting
The site is located six miles west of the Granger Fault.

4.2.2. Liquefaction
Liquefaction is a common earthquake condition in which soils lose virtually all shear strength and act as viscous liquids during severe ground shaking. A physical change occurs to the soil transforming it "from solid ground capable of supporting a structure, to a quicksand-like liquid with a greatly reduced ability to bear the weight of a building." This site is mapped as having both moderate (the south half of the site) and high (the north half) potentials for liquefaction. The moderate potential corresponds to a probability of liquefaction of 10 to 50 percent in 100 years, and the high corresponds to a probability of >50%.

A Liquefaction Potential Study was conducted on Phase 1 of this subdivision by AGEC. This study, dated April 9, 1999, concluded that phase 1 soils are not susceptible to liquefaction.

4.3. Subsurface Water
The site is mapped as having depths to ground water generally less than 30 feet. Ground water was not encountered in the test pits during the investigation to depths of 12 feet. Groundwater was not encountered during the Liquefaction Study to depths of 30 feet.

4.4. Surface Water
The storm drainage plan must include measures to properly convey surface water runoff from the paved surfaces and structures into the storm drain. The site should be graded to direct any surface flows away from buildings and structures. Natural drainage is generally from southwest to northeast.

This site is mapped by FEMA as a zone X, which is outside the 500-year flood event. See the FEMA map in the Appendix.

5. SUBSURFACE EXPLORATION

5.1. Subsurface Profile
As part of the field exploration, 6 test pits were excavated to examine subsurface conditions. Stratigraphy and classification of the soil was logged. Relatively undisturbed samples were taken at various depths. Sample types and depths are shown in detail in the Test Pit logs found in the Appendix. The pits were excavated with a backhoe to depths of 12 feet. The test pit locations are shown on the "Test Pit Location Map" drawing in the Appendix. Foundations of any structures or driveways that are located on test pit excavation sites require that the disturbed soil be compacted to the requirements as stated in Section 6.2.

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3 Surface Rupture and Liquefaction Potential, Special Study Areas, Salt Lake County, Utah., Revised February 1997; Reference Anderson, Keaton, Spitzler, and Allen 1985, Liquefaction Potential Map for Salt Lake County.
5 Salt Lake County FEMA; http://www.pw.slco.org/eng/flood/html/f_plain.html

WHITE FARMS 2
The site has 1.5' of top soil. Organics are in the top soil, and one foot of the topsoil should be removed from areas designated to be paved or to have structures.

Soils exposed in the test pits, below the 1.5' of topsoil, consisted of:
- Pit 1- 8' of brown sandy clay, then 2.5' of a light brown well graded gravel (3" minus- many 3" size particles), and from there to the bottom of the pit at 12' is a brown sandy clay.
- Pit 2- 2.5' of brown sandy clay with some white coloration and some pinholes and some gravel, then 3' of light brown well graded gravel, next 1' of a sandy clay with poorly graded sand lenses, then six inches each of first gravel then sandy clay, next two feet of gravel, and from there to the bottom of the pit at 12' is a brown sandy clay.
- Pit 3- 1' of brown clay, then 3.5' of a brown sandy clay, next 1.5' of well graded gravel, then 1.5' of sandy clay, and then from there to the bottom of the pit at 11' is a well graded gravel.
- Pit 4- 3' of a gray blocky clay, then 4' of a brown sandy clay, next is 1' of well graded gravel, and then to the bottom of the pit at 12' is a sandy clay.
- Pit 5- 2.5' of a gray blocky clay, then 1.5' of a brown sandy clay, next is 6" of well graded gravel, and from there to the bottom of the pit at 12' is a sandy clay.
- Pit 6- 5' of a tan sandy clay, then 1' of a well graded gravel, next is 2.5' of sandy clay, and from there to the bottom of the pit at 12' is a well graded gravel.

5.2. Penetrometer Tests
Pocket Penetrometer measurements were taken on the following soils: in pit 1- the brown sandy clay at 6' in depth measured 2.0 tons per square foot (tsf), the light brown well graded gravel at 10' did not allow a measurement due to the loose, dry soils; in pit 4- the gray blocky clay at 3' in depth measured >4.5 tsf, and the tan sandy clay at 11' measured >4.5 tsf. Pocket Penetrometer tests give a relatively good first estimate of the insitu soil bearing capacity.

5.3. Density of Soils
Insitu unit weight was determined by obtaining relatively undisturbed samples. The brown sandy clay in pit 1 at 8' was found to have an in place density of 86.3 pcf.

5.4. Soil Moisture
Soils exposed in the test pits were moist near the surface, and below this, the soils were variable in moisture depending usually upon the particle size in the soil. The brown sandy clay had an in place moisture content of 25.3%.

5.5. Laboratory Testing
A consolidation test was performed on the light gray clay. Preconsolidation Stress ($\sigma_p$) and the Modified Recompression Index ($c_r$) were found to be 8000 psf and 0.0030 respectively.

Gradations were performed as well as an Atterberg Limits test to aid in classification.

6. RECOMMENDATIONS

6.1. Site Work
6.1.1. Site Preparation
It is the contractor's responsibility to locate and protect all existing utility lines, whether shown on the drawings or not.

All topsoil or any soil containing organic materials should be removed from where structures or pavement are to be placed. We recommend removing one foot of the topsoil. Topsoil may be stockpiled on site for subsequent use in landscape areas. Any unsuitable material (loose, soft, saturated, or otherwise unstable soils where structures are to be placed), shall be replaced with structural fill according to the standards set forth in section 6.1.3 and 6.1.4 of this report.
6.1.2. Excavation
All utilities encountered in excavating shall be carefully supported, maintained, and protected during construction. It is the responsibility of the contractor to have safe working conditions. Temporary construction excavations should be properly sloped or shored, in compliance with current federal, state, and local requirements. Construction excavations up to 4 feet deep may be constructed with near-vertical side slopes. Excavations between 4 feet and 14 feet deep should have side slopes not steeper than 1 to 1, or a trench box or shoring may be used. Excavations are to be made to minimize subsequent filling. Coarse-grained material can easily become unstable and will collapse. Boulders and cobbles larger than six inches should be removed from trenches.

6.1.3. Structural Fill Material
Structural fill shall consist of well-graded granular material, with a maximum aggregate size of 2 inches, and a maximum of 20% passing the #200 sieve. This material is to be free from organics, garbage, ice, and other loose, compressible, or biodegradable materials. If bearing soils are excessively moist, fine grained soils, a larger aggregate (up to 6" - possibly a bank run material) with little passing the #200 sieve, may be necessary. This should be placed in thin lifts which are then compacted down into the moist soil, the native soil forming the matrix for the bank run material.

Fine-grained materials (clays and silts) are not suitable for use as fill in areas that will be carrying a structural load such as roads, buildings, and utility trenches in roadways, but may be used as site grading fills in landscaped areas.

6.1.4. Fill Placement and Compaction
Lift thickness of structural fill under roads, driveways, and parking areas and utilities should not exceed 8 inches and shall be compacted to at least 96% of the modified proctor (maximum dry density as determined by the ASTM D 1557 method of compaction). Each lift should be tested for adequate compaction (See Section 6.2.1 for fills placement and compaction under foundations).

6.1.5. Utility Trenches
Construction of the pipe bedding shall consist of preparing an acceptable pipe foundation, excavating the pipe groove in the prepared foundation and backfilling from the foundation to 12 inches above the top of the pipe. All piping shall be protected from lateral displacement and possible damage resulting from impact or unbalanced loading during backfilling operations by being adequately bedded.

The soils in the utility pipe zones consist of both gravelly and clayey soils. Clayey soils are not suitable as trench backfill.

**Pipe foundation**: shall consist of native soils if the soils are stable and undisturbed. Wherever the trench subgrade material does not afford a sufficiently solid foundation to support the pipe and superimposed load, the trench shall be excavated below the bottom of the pipe to such depth as may be necessary, and this additional excavation filled with compacted well-graded, granular soil (per 6.1.3), compacted to 96% of the modified proctor.

**Pipe groove**: shall be excavated in the pipe foundation to receive the bottom quadrant of the pipe so that the installed pipe will be true to line and grade. Bell holes shall be dug after the trench bottom has been graded. Bell holes shall be excavated so that only the barrel of the pipe bears on the pipe foundation.

**Pipe bedding**: (from pipe foundation to 12 inches above top of pipe) shall be deposited and compacted in layers not to exceed 8 inches in uncompacted depth. Deposition and compaction of bedding materials shall be done simultaneously and uniformly on both sides of the pipe. All bedding materials shall be placed in the trench in such a manner that they will be scattered alongside the pipe and not dropped into the trench in compact masses.
Backfill for utility trenches located beneath roads are to be compacted to 96% of the modified proctor. In non-load bearing areas, trenches are to be compacted to 85% of the modified proctor (ASTM D 1557).

6.1.6. Native Soil As Fill
The native soils consist of clays, sandy clays, and some well graded gravels. If the use of the gravelly soils as fill is desired, they must be inspected and accepted during construction. Generally, clayey soils are not acceptable as fill, because of the difficulty in achieving compaction due to their moisture sensitivity. We recommend that on site clayey soils not be used, and a well-graded granular material (section 6.1.3) be imported and used with the small amount of gravel on site.

6.1.7. Drainage
A grading and drainage plan should be prepared for the site by a qualified engineer, and adhered to for the site drainage. Generally, each building site shall be graded in such a manner that surface water will flow away from the buildings foundations. Natural drainage is generally from southwest to northeast.

6.2. Foundations
6.2.1. Installation and Bearing Material
Footings must be placed on native, undisturbed soils or structural fill which is bearing on native soils and is compacted to 98% of the modified proctor. Any existing topsoil is to be removed in the areas where footings are to be located. Footings are to be placed at least 2’ above the high groundwater elevation. Foundation excavations are to be inspected by a qualified soil engineer before placing concrete because of possible soil variation. The soils engineer should verify suitability of the soil and its preparation. All load bearing soils for building structures should be within ±2% of the optimum moisture content prior to placing foundations on them.

All debris, organic material, soft areas, frozen material or other inappropriate structural material shall be removed from the footing zone and be replaced with structural fill.

6.2.2. Bearing Pressure
The ASCE and USACE recommend residential wall loads of 1.0 to 1.5 klf as a minimum value for settlement calculations. We have chosen to use 2.25 klf. Assuming an 18” footing, this correlates to a 1500 psf contact pressure. Confirmation of this recommendation was made using Hansen’s modifications to Terzahgi’s original bearing capacity equation and an assumed value for internal friction angle (ϕ). The calculation yielded a factor of safety well above the typically accepted value of 3. The International Building Code table 1804.2 indicates an allowable foundation pressure of 1500 psf for clays. The maximum allowable bearing capacity for this site is 1500 psf.

6.2.3. Settlement
Several factors are generally considered in settlement. They are immediate settlement, consolidation settlement and secondary settlement. Immediate settlement happens very quickly, as the building is constructed. Since this factor is generally small and adjustments are made during construction to compensate, this factor is usually neglected. Secondary settlement happens over a very long period of time. It is generally not considered when dealing with residential construction. Therefore consolidation settlement was the focus of this analysis. The predicted settlement due to consolidation is much less than 1 inch, which is the recommended maximum settlement for this type of structure. Therefore: settlement does not control the bearing capacity and our recommendation remains 1500 psf.

6.2.4. Frost Depth
All exterior footings are to be at least 30 inches under the ground surface to protect against possible frost heave. This includes walk-out areas. This may require fill to be placed around buildings. Interior footings below residential structures at basement depths (below 18 inches) may
have the basement floor placed directly on the footing. With slab on grade construction, interior footings require 18 inches of cover.

6.2.5. Construction Observation
A qualified soil engineer shall periodically monitor installation of footings. Inspection of soil before placement of structural fill is required to detect any field conditions not encountered in the investigation, which would alter the recommendations of this report. All structural fill material shall be tested by the engineer for adequate compaction.

6.2.6. Foundation Drainage
Consideration must be given to subsurface drainage around foundations. According to the International Residential Code (IRC 2003), soils with poor drainage characteristics (soils below the IRC group I) require that a foundation drain be installed to allow water to drain away from the foundation. Soils on site at basement elevations are in groups one (classification GW) and two (CL). Group two soils require that a foundation drain be installed.

6.3. Lateral Forces
6.3.1. Resistance for Footings
Wind and seismic forces, which cause lateral loads on foundations, are resisted by friction and passive earth pressures at the foundation ground interface. In the design of spread footings, the coefficient of friction for lateral sliding ($\mu$) is 0.25 for sands, and the resistance of lateral sliding is 130 psf for clays and silts.

6.3.2. Pressures on Foundation Walls
The following equivalent fluid weights are given for the design of sub-grade walls and retaining structures. “Basement, foundation and retaining walls shall be designed to resist lateral soil loads. Basement walls and other walls in which horizontal movement is restricted at the top shall be designed for at-rest pressure. Retaining walls free to move and rotate at the top are permitted to be designed for active pressure. Exception: Basement walls extending not more than 8 feet below grade and supporting flexible floor systems shall be permitted to be designed for active pressure.”

The values listed assume the on site material is used as backfill and that the surface adjacent the wall is horizontal.

Design Lateral Soil Loads:
Clayey sands, poorly graded sand-clay mixes...........60 psf/ft. of depth active; 100 psf/ft. of depth at rest
Well-graded, clean gravels; gravel-sand mixes...........30 psf/ft. of depth active; 60 psf/ft. of depth at rest

6.3.3. Seismic Conditions
Under seismic conditions, the equivalent fluid weight should be increased by 27 pcf in the active and at-rest conditions and decreased by 27 pcf in the passive condition.

6.3.4. Safety Factors
A factor of safety of 1.5 is required in all soil/structure interactive design.

6.4. Concrete Slabs on Grade
Concrete slabs may be placed on undisturbed native soils, or structural fills compacted to 98% density of the modified proctor values. It is recommended that areas below driveways be compacted. Temperature steel reinforcement is recommended in slabs.

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6 International Residential Code 2003, Section R405
7 International Building Code 2003, Ch. 18, Table 1804.2
6 International Building Code 2003, Section 1610, Table 1610.1
6.5. Seismic Information

6.5.1. Faulting
The Granger Fault is located about six miles to the east. Surface rupture is not a hazard at the site. However, strong ground motion due to earthquake events must be considered. The International Building Code (IBC 2003), and the USGS Earthquake Hazards Program interpolated probabilistic ground motion values for S$_2$ and S$_1$ are 1.0856 and 0.4038 respectively. (See table below)

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<th>LOCATION</th>
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<td>10%PE in 50 yr</td>
<td>2%PE in 50 yr</td>
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<td>PGA</td>
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<tr>
<td>0.2 sec SA</td>
<td>54.78</td>
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<tr>
<td>1.0 sec SA</td>
<td>18.56</td>
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The design spectral accelerations were determined according to IBC 2003 and ASCE 07-05 and were found to be 0.7713 and 0.4215 for SD and SDI respectively. The figure below shows the spectral response parameters used to develop the design values and a code specified response spectrum for the site based upon a site class of “D” for a stiff soil profile.

Seismic Provisions ASCE 7-05

<table>
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<th>Site Class: D</th>
<th>Mapped MCE Spectral Response Acceleration Parameters Fa and Fv</th>
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<tr>
<td>Short Period</td>
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<tr>
<td>1 Second</td>
<td>2.4 2.0 1.8 1.6 1.5</td>
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</table>

Obtained Sa and S1 from http://eqint.cr.usgs.gov/eq-men/cgi-bin/find-it-2002-interp.cgi

| S3: 1.0856 | Fa = 1.07 | Sd3 = 1.1570 | Sd = 0.7713 |
| S1: 0.4038 | Fv = 1.57 | Sd1 = 0.6323 | Sd1 = 0.4215 |

6.5.2. Liquefaction
Anderson and others map the site as having a moderate potential for liquefaction.9 The moderate potential has a 10–50 percent probability for liquefaction in 100 years. The Liquefaction Potential Study conducted by AGEC gave a low probability of liquefaction for phase one of this subdivision. No special precautions above standard IBC requirements will be required.

6.5.3. Structures
Structures are to be designed for lateral loading as defined in the International Building Code. The site location has a design spectral response acceleration of 0.7713 for short periods and 0.4215 for a one second period. Lateral loading is to be the greater of seismic loads or wind loads.

9 Surface Rupture and Liquefaction Potential, Special Study Areas, Salt Lake County, Utah., Revised February 1997; Reference Anderson, Keaton, Spitzler, and Allen 1985, Liquefaction Potential Map for Salt Lake County.
6.6. Pavement Design and Construction

6.6.1. Sub-grade Preparation
All topsoil, or any soil containing organic materials, should be removed from locations where structural loads will be applied. To evaluate its stability, the sub-grade must be "proof rolled" with a loaded dump truck or tested with a nuclear density gauge. Any unstable soils shall be removed and replaced with structural fill according to Section 6.1.4. Any areas of fill or disturbed areas shall be compacted to 96% of the modified proctor. A qualified engineer should observe unsuitable sub-grade remediation.

Sub-grade below driveway areas should be compacted to minimize settlement in these areas.

6.6.2. Base Course
Eight inches of untreated base course is required for all roadways. The base course shall comply with a ¾-inch mix per UDOT Standard Specifications, Section 02721, “Untreated Base Course.”

6.6.3. Surface Course
Three inches of asphalt concrete pavement is required for all roadway surfaces. This asphalt concrete pavement is to comply with UDOT Standard Specifications, Section 02741, and “Hot Mix Asphalt (HMA).”

6.6.4. Drainage Consideration
A storm drainage plan will be required to detain and convey storm water to protect the site and adjacent properties from flooding, and to protect the natural waterways in the area from pollution.
LIMITATIONS AND PROFESSIONAL STATEMENT

This report has been prepared in accordance with generally accepted geologic and geotechnical engineering practices in the area for the use of the client for design purposes. The conclusions and recommendations included within the report are based on the information obtained from the test holes excavated at the locations indicated on the site plan, laboratory results, data obtained from the U.S.G.S. Library, and previous reports and studies. Variations in the subsurface conditions may not become evident until additional exploration or excavation is conducted. If the subsurface soil or groundwater conditions are found to be significantly different than that which is described in this report, we should be notified so that we can re-evaluate recommendations.

We have correlated soil types and properties such as bearing pressure and equivalent fluid lateral pressure with U.S.G.S. surveys, the International Building Code, and surrounding investigations. Any assumptions made, based on these correlations, are conservative.

We appreciate the opportunity of providing this service for you. If you have any questions concerning this report or require additional information or services feel free to contact us.

Report prepared by:
WILDING ENGINEERING, INC.

David P. Wilding, P.E.
President

WHITE FARMS
APPENDIX
Site Pictures
Soils are visually classified for engineering purposes by the United Soil Classification System. Gram-sized analyses and Atterberg Limits tests often are performed on selected samples to aid in classification. The classification system is briefly outlined on this chart. Graphic symbols are used on boring logs presented on this report. For a more detailed description of the system, see "Standard Practice for Description and Identification of Soils (Visual-Manual Procedure)" ASTM Designation: D2488-84 and "Standard Test Method for Classification of Soils for Engineering Purposes" ASTM Designation: D2487-85.

### MAJOR DIVISIONS

<table>
<thead>
<tr>
<th>GRADES OF SOILS</th>
<th>CLEAN GRAVELS</th>
<th>GRAVELS WITH FINES</th>
<th>CLEAN SANDS</th>
<th>Sands with Fin</th>
<th>Silts of Low Plasticity</th>
<th>Silts of High Plasticity</th>
<th>Clays of Low Plasticity</th>
<th>Clays of High Plasticity</th>
<th>Organic Silts and Clays of Low Plasticity</th>
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<td>Lines plot below &quot;A&quot; line &amp; hatched zone on plasticity chart</td>
<td>Lines plot above &quot;A&quot; line &amp; hatched zone on plasticity chart</td>
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<td>5% to 12% passes No. 200 sieve</td>
<td>(5%) or more of No. 200 sieve</td>
<td>Lines plot below &quot;A&quot; line &amp; hatched zone on plasticity chart</td>
<td>Lines plot above &quot;A&quot; line &amp; hatched zone on plasticity chart</td>
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### TYPICAL NAMES

- **GW**: WELL GRADED GRAVELS, GRAVEL-SAND MIXTURES, OR SAND GRAVEL-COBBLE MIXTURES
- **GP**: POORLY GRADED GRAVELS, GRAVEL-SAND MIXTURES, OR SAND-GRAVEL-COBBLE MIXTURES
- **GM**: SILTY GRAVELS, GRAVEL-SAND-SILT MIXTURES
- **GC**: CLAYEY GRAVELS, GRAVEL-SAND-CLAY MIXTURES
- **SW**: WELL GRADED SANDS, GRAVELLY SANDS
- **SP**: POORLY GRADED SANDS, GRAVELLY SANDS
- **SM**: SILTY SANDS, SAND-SILT MIXTURES
- **SC**: CLAYEY SANDS, SAND-CLAY MIXTURES
- **ML**: INORGANIC SILTS, CLAYEY SILTS OF LOW TO MEDIUM PLASTICITY
- **MH**: INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS SILT SOILS, ELASTIC SILTS
- **CL**: INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY, SANDY, AND SILTY CLAYS
- **CH**: INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS, SANDY CLAYS OF HIGH PLASTICITY
- **OL**: ORGANIC SILTS AND CLAYS OF LOW TO MEDIUM PLASTICITY, SANDY ORGANIC SILTS AND CLAYS
- **OH**: ORGANIC SILTS AND CLAYS OF HIGH PLASTICITY, SANDY ORGANIC SILTS AND CLAYS
- **PT**: PEAT

### NOTE:
Coarse-grained soils with between 5% and 12% passing thru No. 200 sieve and fine-grained soils with limit plotting in the hatched zone on the plasticity chart have dual classifications.

### DEFINITION OF SOIL FRACTIONS

<table>
<thead>
<tr>
<th>SOIL COMPONENT</th>
<th>PARTICLE SIZE RANGE</th>
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<tbody>
<tr>
<td>Boulder</td>
<td>Above 12 in.</td>
</tr>
<tr>
<td>Cobble</td>
<td>12 in to 3 in.</td>
</tr>
<tr>
<td>Gravel</td>
<td>3 in to No. 4 sieve</td>
</tr>
<tr>
<td>Coarse Gravel</td>
<td>3 in to 3/4 in.</td>
</tr>
<tr>
<td>Fine Gravel</td>
<td>3/4 in to No. 4 sieve</td>
</tr>
<tr>
<td>Sand</td>
<td>No. 4 to No. 200 sieve</td>
</tr>
<tr>
<td>Coarse sand</td>
<td>No. 4 to No. 10 sieve</td>
</tr>
<tr>
<td>Medium sand</td>
<td>No. 10 to No. 40 sieve</td>
</tr>
<tr>
<td>Fine sand</td>
<td>No. 40 to No. 200 sieve</td>
</tr>
<tr>
<td>Fines (silt and clay)</td>
<td>Less than No. 200 sieve</td>
</tr>
<tr>
<td>DEPTH IN FEET</td>
<td>GRAPHICAL LOG</td>
</tr>
<tr>
<td>---------------</td>
<td>---------------</td>
</tr>
<tr>
<td>0</td>
<td></td>
</tr>
<tr>
<td>X T</td>
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</tr>
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<td></td>
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**GROUND WATER Sample Type**

- A - AUGER CUTTINGS
- S - 2" O.D. 1.38" I.D. TUBE SAMPLE
- U - 3" O.D. 2.42" I.D. TUBE SAMPLE
- T - 3" O.D. DENSITY DRIVE SAMPLER TUBE
- H - HAND SAMPLE
<table>
<thead>
<tr>
<th>DEPTH</th>
<th>GRAPHICAL LOG</th>
<th>SAMPLE</th>
<th>BLOWS/FOOT 1-40 LB 30' FREE FALL</th>
<th>DENSITY PER CUBIC FOOT</th>
<th>MOISTURE CONTENT OF DRY WEIGHT</th>
<th>REMARKS</th>
<th>VISUAL CLASSIFICATION</th>
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<tr>
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<td>5</td>
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<td></td>
<td>CL</td>
<td>DRY</td>
</tr>
<tr>
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<td>GW</td>
<td>DRY</td>
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GROUND WATER

SAMPLE TYPE

- A - AUGER CUTTINGS
- S - 2" O.D. 1.38" ID TUBE SAMPLE
- U - 3" O.D. 2.42" I.D. TUBE SAMPLE
- T - 3" O.D. DENSITY DRIVE SAMPLER TUBE
- H - HAND SAMPLE

FIELD ENGINEER: RUSSELL WILDING/ BARRETT MORLEY
## Log of Test Pit No.

**Project** | WHITE FARMS  
---|---
**Project Location** | 2700 SOUTH 8000 WEST, MAGNA, UT

### Remarks | Visual Classification
---|---
0 | CL<br>MOIST<br>DARK BROWN CLAYEY TOPSOIL
5 | CL<br>MOIST<br>BROWN CLAY
10 | CL<br>SOME MOISTURE<br>BROWN SANDY CLAY
15 | GW<br>DRY<br>LIGHT BROWN WELL GRADED GRAVEL (3" MINUS)
20 | CL<br>MOIST<br>BROWN SANDY CLAY
25 | GW<br>SOME MOISTURE<br>LIGHT BROWN WELL GRADED GRAVEL (3" MINUS)

### Ground Water Sample Type

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**Sample Type**

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<td>2&quot; O.D. 1.38&quot; I.D. TUBE SAMPLE</td>
</tr>
<tr>
<td>U</td>
<td>3&quot; O.D. 2.42&quot; I.D. TUBE SAMPLE</td>
</tr>
<tr>
<td>T</td>
<td>3&quot; O.D. DENSITY DRIVE SAMPLER TUBE</td>
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<tr>
<td>H</td>
<td>HAND SAMPLE</td>
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**Other Information**

- **Date:** 12/21/05
- **Log of Test Pit No.**
- **Rig Type:** BACKHOE
- **Boring Type:** OPEN PIT EXCAVATION
- **Surface Elevation:** 4305 (Estimated from USGS quad map)
- **Field Engineer:** RUSSELL WILDING/ BARRETT MORLEY
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<th>SAMPLE</th>
<th>BLOWS/FOOT</th>
<th>FREE FALL DROP</th>
<th>DENSITY</th>
<th>MOISTURE CONTENT</th>
<th>DRY WEIGHT</th>
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<th>REMARKS</th>
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<td>OL</td>
<td>MOIST DARK BROWN CLAYY TOPSOIL</td>
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<td></td>
<td>CL</td>
<td>DRY BLOCKY GRAY CLAY WITH SOME PINHOLES IN UPPER 2' (POTENTIALLY COLLAPSIBLE)</td>
</tr>
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<td>VERY DRY TAN SANDY CLAY</td>
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<td>GW</td>
<td>SOME MOISTURE LIGHT BROWN WELL GRADED GRAVEL (3&quot; MINUS)</td>
</tr>
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**GROUND WATER**

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**SAMPLE TYPE**

- A - AUGER CUTTINGS
- S - 2" O.D. 1.38" I.D. TUBE SAMPLE
- U - 3" O.D. 2.42" I.D. TUBE SAMPLE
- T - 3" O.D. DENSITY DRIVE SAMPLER TUBE
- H - HAND SAMPLE
<table>
<thead>
<tr>
<th>DEPTH</th>
<th>GRAPHICAL LOG</th>
<th>SAMPLE</th>
<th>SAMPLE TYPE</th>
<th>BLOWNS/FOOT</th>
<th>140 LB. 30&quot; FALL</th>
<th>DRY BULK DENSITY</th>
<th>DRY BULK DENSITY PER CUBIC FOOT</th>
<th>MOISTURE CONTENT OF DRY WEIGHT</th>
<th>UNIFIED SOIL CLASSIFICATION</th>
<th>REMARKS</th>
<th>VISUAL CLASSIFICATION</th>
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<tbody>
<tr>
<td>0</td>
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<td>OL</td>
<td>MOIST</td>
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<td></td>
<td></td>
<td></td>
<td>CL</td>
<td>DARK BROWN CLAYEY TOPSOIL</td>
</tr>
<tr>
<td>5</td>
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<td>CL</td>
<td>DRY</td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td>CL</td>
<td>BLOCKY GRAY CLAY WITH SOME PINHOLES IN UPPE'R 2'</td>
</tr>
<tr>
<td>10</td>
<td></td>
<td>CL</td>
<td>DRY</td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td>GW</td>
<td>TAN SANDY CLAY</td>
</tr>
<tr>
<td>15</td>
<td></td>
<td>GW</td>
<td>DRY</td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td>CL</td>
<td>LIGHT BROWN WELL GRADED GRAVEL (3&quot; MINUS)</td>
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<tr>
<td>20</td>
<td></td>
<td>CL</td>
<td>DRY</td>
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<td></td>
<td></td>
<td></td>
<td>CL</td>
<td>TAN SANDY CLAY</td>
</tr>
</tbody>
</table>

**GROUND WATER**

| A - AUGER CUTTINGS | S - 2" O.D. 1.38" ID TUBE SAMPLE | U - 3" O.D. 2.42" I.D. TUBE SAMPLE | T - 3" O.D. DENSITY DRIVE SAMPLER TUBE | H - HAND SAMPLE |

**PROJECT** WHITE FARMS

**PROJECT LOCATION** 2700 SOUTH 8000 WEST, MAGNA, UT

**DATE** 12/21/05

**HOLE LOCATION** NORTH END OF PH. 2

**RIG TYPE** BACKHOE

**BORING TYPE** OPEN PIT EXCAVATION

**SURFACE ELEVATION** 4290 (Estimated from USGS quad map)

**FIELD ENGINEER** RUSSELL WILDING/ BARRETT MORLEY
## LOG OF TEST PIT NO. 6

**DATE:** 12/21/05  
**PROJECT:** WHITE FARMS  
**PROJECT LOCATION:** 2700 South 8000 West, Magna, UT  
**HOLE LOCATION:** South End of PH. 2  
**RIG TYPE:** Backhoe  
**BORING TYPE:** Open Pit Excavation  
**SURFACE ELEVATION:** 4320 (Estimated from USGS quad map)  
**FIELD ENGINEER:** Russell Wilding/Barr~Morley

<table>
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<tr>
<th>DEPTH IN FEET</th>
<th>GRAPHICAL LOG</th>
<th>SAMPLE</th>
<th>SAMPLE TYPE</th>
<th>BLOWS/FOOT 140 LB. 30° FREE FALL DROP</th>
<th>DRY DENSITY LBS. PER CUBIC FOOT</th>
<th>MOISTURE CONTENT OF DRY WEIGHT</th>
<th>UNIFIED SOIL CLASSIFICATION</th>
<th>REMARKS</th>
<th>VISUAL CLASSIFICATION</th>
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<tbody>
<tr>
<td>0</td>
<td></td>
<td></td>
<td>OL</td>
<td>moist</td>
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<td>Dark Brown Clayey Topsoil</td>
</tr>
<tr>
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<td></td>
<td>CL</td>
<td>dry</td>
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<td></td>
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<td></td>
<td>Tan Sandy Clay</td>
</tr>
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<td></td>
<td>GW</td>
<td>dry</td>
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<td></td>
<td>Light Brown Well Graded Gravel (3&quot; minus)</td>
</tr>
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<td>15</td>
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<td>Tan Sandy Clay</td>
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<td>Light Brown Well Graded Gravel (3&quot; minus)</td>
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**GROUND WATER**

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<tbody>
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**SAMPLE TYPE**

A - Auger Cuttings  
S - 2" O.D. 1.38" I.D. Tube Sample  
U - 3" O.D. 2.42" I.D. Tube Sample  
T - 3" O.D. Density Drive Sampler Tube  
H - Hand Sample

WILDING ENGINEERING, INC  
SALT LAKE CITY, UTAH 84108  
PHONE: (801) 583-8700

*NOTE: The table and diagram represent the soil and groundwater conditions documented during the test pit excavation.*
CONSOLIDATION TEST RESULTS

Project Name: Wight Farms
Location: 61055114.0015
Date: 1/4/06
GRAIN SIZE ANALYSIS--MECHANICAL

Project: White Farms

Location of Project: 

Location of Sample: 

Tested by: Barrett Morley

Description of Soil: Brown sandy gravel

Soil Sample Size (ASTM D 1140-54)

<table>
<thead>
<tr>
<th>Wt of dry sample+container</th>
<th>1635.1</th>
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<tr>
<td>Wt of container</td>
<td>203.8</td>
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<tr>
<td>Wt of dry sample</td>
<td>1431.3</td>
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Sieve analysis and grain shape

<table>
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<tr>
<th>Sieve No.</th>
<th>Diam. (mm)</th>
<th>Sieve Wt</th>
<th>Sample Wt</th>
<th>Wt retained</th>
<th>% retained</th>
<th>% passing</th>
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<tbody>
<tr>
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<td>819.1</td>
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<td>916.6</td>
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<td>850.6</td>
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<td>89.6</td>
<td>6.3</td>
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</table>

Wt retained = Wt of dry sample - Wt of container

% passing = 100 - % retained

NOTE: % passing = 100 - sum of % retained

USCS Classification: GW
GRAIN SIZE ANALYSIS-- MECHANICAL

Project: White Farms
Location of Project:
Location of Sample:
Date of Testing: Jan. 31, 06

Tested by: Barett Morley

Description of Soil: Dark Brown sandy clay

Soil Sample Size (ASTM D 1140-54)

| Wt of dry sample+container | 432.8 |
| Wt of container            | 113.4 |
| Wt of dry sample           | 319.4 |

Steve analysis and grain shape

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<tr>
<th>Sieve No.</th>
<th>Diam. (mm)</th>
<th>Sieve Wt</th>
<th>Sample Wt</th>
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<th>% retained</th>
<th>% passing</th>
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<tr>
<td>0.75</td>
<td>19.000</td>
<td>819.1</td>
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<tr>
<td>0.38</td>
<td>9.500</td>
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NOTE: % passing = 100 - sum of % retained

USCS Classification: CL

WILDING ENGINEERING, INC
14721 SOUTHWEST CHEST WAY
HILLSBORO, OR 97123
(971)353-8112
**GRAIN SIZE ANALYSIS-- MECHANICAL**

Project: White Farms

Location of Project: 

Location of Sample: 

Hole No: 4

Depth of Sample: 9'

Date of Testing: Jan. 31, 06

Tested by: Barrett Morley

Description of Soil: Tan sandy clay

**Soil Sample Size (ASTM D 1140-54)**

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<tr>
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<td>202.5</td>
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<tr>
<td>Wt of dry sample</td>
<td>447.3</td>
</tr>
</tbody>
</table>

**Sieve analysis and grain shape**

<table>
<thead>
<tr>
<th>Sieve No.</th>
<th>Diam. (mm)</th>
<th>Sieve Wt</th>
<th>Sample Wt</th>
<th>Wt retained</th>
<th>% retained</th>
<th>% passing</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.75</td>
<td>19.000</td>
<td>819.1</td>
<td>819.1</td>
<td>0.0</td>
<td>0.0</td>
<td>100.00</td>
</tr>
<tr>
<td>0.50</td>
<td>12.500</td>
<td>761.6</td>
<td>761.6</td>
<td>0.0</td>
<td>0.0</td>
<td>100.00</td>
</tr>
<tr>
<td>0.38</td>
<td>9.500</td>
<td>763.4</td>
<td>763.4</td>
<td>0.0</td>
<td>0.0</td>
<td>100.00</td>
</tr>
<tr>
<td>4</td>
<td>4.750</td>
<td>745.1</td>
<td>745.1</td>
<td>0.0</td>
<td>0.0</td>
<td>100.00</td>
</tr>
<tr>
<td>16</td>
<td>1.180</td>
<td>603.2</td>
<td>604.7</td>
<td>1.5</td>
<td>0.3</td>
<td>99.60</td>
</tr>
<tr>
<td>40</td>
<td>0.425</td>
<td>572.3</td>
<td>576.2</td>
<td>3.9</td>
<td>0.9</td>
<td>98.70</td>
</tr>
<tr>
<td>200</td>
<td>0.075</td>
<td>345.3</td>
<td>467.7</td>
<td>122.4</td>
<td>27.4</td>
<td>71.43</td>
</tr>
<tr>
<td>PAN</td>
<td>-</td>
<td>494.1</td>
<td>813.6</td>
<td>319.5</td>
<td>71.4</td>
<td>0.00</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th></th>
<th>447.3</th>
<th>100.0</th>
</tr>
</thead>
</table>

NOTE: % passing = 100 - sum of % retained

USCS Classification: CL

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**WILDING ENGINEERING, INC**

14721 SOUTH HERITAGE CREST WAY
BLUFFDALE, UTAH 84065
(801)659-9112
ATTERBERG LIMITS

ATTERBURG LIMITS CALCULATIONS SHEET FOR THE LIQUID LIMIT AND PLASTIC LIMIT

PROJECT
White Farms

SOIL LOCATION
Pit 3, 4'

SOIL DESCRIPTION
Dark brown sandy clay

LIQUID LIMIT

<table>
<thead>
<tr>
<th>TRIAL NUMBER</th>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>CONTAINER NUMBER</td>
<td>1B</td>
<td>2B</td>
<td>3B</td>
</tr>
<tr>
<td>WEIGHT OF CONTAINER (W_1)</td>
<td>33.6</td>
<td>34.2</td>
<td>33.9</td>
</tr>
<tr>
<td>WEIGHT OF CONTAINER + WET SOIL (W_2)</td>
<td>42.8</td>
<td>43.3</td>
<td>42.6</td>
</tr>
<tr>
<td>WEIGHT OF CONTAINER + DRY SOIL (W_3)</td>
<td>40.6</td>
<td>40.8</td>
<td>40.0</td>
</tr>
<tr>
<td>WEIGHT OF WATER (W_4 = W_2 - W_3)</td>
<td>2.2</td>
<td>2.5</td>
<td>2.6</td>
</tr>
<tr>
<td>WEIGHT OF SOLIDS (W_5 = W_2 - W_1)</td>
<td>9.2</td>
<td>9.1</td>
<td>8.7</td>
</tr>
<tr>
<td>WATER CONTENT (= W_4/W_5)</td>
<td>23.9</td>
<td>27.5</td>
<td>29.9</td>
</tr>
<tr>
<td>NUMBER OF BLOWS</td>
<td>27</td>
<td>23</td>
<td>21</td>
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</tbody>
</table>

\[ y = -23.584\ln(x) + 101.58 \]

\[ R^2 = 0.9977 \]

PLASTIC LIMIT

<table>
<thead>
<tr>
<th>TRIAL NUMBER</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>CONTAINER NUMBER</td>
<td>4B</td>
<td>5B</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>WEIGHT OF CONTAINER (W_1)</td>
<td>34.6</td>
<td>34.4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>WEIGHT OF CONTAINER + WET SOIL (W_2)</td>
<td>37.1</td>
<td>37.4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>WEIGHT OF CONTAINER + DRY SOIL (W_3)</td>
<td>36.7</td>
<td>37.0</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>WEIGHT OF WATER (W_4 = W_2 - W_3)</td>
<td>0.4</td>
<td>0.4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>WEIGHT OF SOLIDS (W_5 = W_2 - W_1)</td>
<td>2.5</td>
<td>3.0</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>WATER CONTENT (= W_4/W_5)</td>
<td>16.0</td>
<td>13.3</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

LIQUID LIMIT (LL) = 25
PLASTICITY INDEX (PI) = 10.3
PLASTIC LIMIT (PL) = 14.7
USCS CLASSIFICATION = CL

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14721 SOUTH HERITAGE CREST WAY
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(801)353-8112