REPORT OF PRELIMINARY SUBSURFACE EXPLORATION AND SITE DEVELOPMENT RECOMMENDATIONS IOWA FERTILIZER COMPANY SITE INVESTIGATION MIDDLETON, IOWA

BY

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PREPARED FOR

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DATE

June 4, 2012

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TESTS ★ INVESTIGATIONS
ANALYSIS ★ DESIGN ★ EVALUATIONS
CONSULTATION ★ REPORTS ★ INSPECTIONS
ARBITRATION ★ EXPERT WITNESS TESTIMONY
★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★
SOILS ★ PORTLAND CEMENT CONCRETE
BITUMINOUS CONCRETE ★ STEEL
ASPHALT ★ AGGREGATES ★ EMULSIONS
POZZOLANIC MATERIALS ★ LIME

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CONSTRUCTION QUALITY CONTROL
SUBSURFACE EXPLORATIONS
ENVIRONMENTAL INVESTIGATIONS
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BUILT-UP ROOF INVESTIGATIONS
WELDER CERTIFICATIONS
INSURANCE INVESTIGATIONS

June 4, 2012

Mr. Bill Holman
Stanley Consultants
5775 Wayzata Boulevard
Suite 300
Minneapolis, Minnesota 55416

Re: Subsurface Exploration And Site
Development Recommendations
Iowa Fertilizer Company Site Investigation
Middleton, Iowa

Dear Mr. Holman:

Pursuant to your request, our geotechnical engineering firm has performed a preliminary subsurface soils and ground water investigation in conjunction with an evaluation of these subsurface conditions for the above referenced project.

The results of our subsurface investigation and evaluation indicate that a shallow, reinforced concrete spread foundation system is most likely appropriate for support of the proposed structures. In addition, recommendations regarding an auger cast pile, deep foundation system have been prepared for preliminary evaluation. Only a few minor excavation and/or construction problems are anticipated at the proposed building site, providing all of the recommendations outlined in this report are satisfied.

If any questions or comments arise in regard to this geotechnical engineering report, or if any additional information is desired, please do not hesitate to contact us at your convenience.

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Respectfully submitted,
WHITNEY & ASSOCIATES

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Enclosures

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INTRODUCTION

This geotechnical engineering Report of Subsurface Exploration and Foundation Recommendations presents the results of a preliminary subsurface soils and ground water investigation at the proposed site for the Iowa Fertilizer Company near Middleton, Iowa. A Plot Plan illustrating the general layout of the project and scope of this investigation has been included in the Appendix of this report.

Included in this report are the results of our field and laboratory tests as well as a summary of the data that was obtained during the investigation. In addition, this geotechnical engineering report includes our recommendations relevant to the proposed foundation system, earthwork operations and potential construction problems which may occur as a direct result of the subsurface soils and/or ground water conditions encountered at the project site.

PURPOSES OF THE INVESTIGATION

The principal purposes of this soils and ground water investigation were as follows:

1. To determine the general nature, extent and engineering properties of the soils which exist in the area of the proposed site.

2. To determine the subsurface conditions at the site that will significantly affect the foundation design as well as the construction of the proposed foundations.

3. To determine ground and seepage water conditions at the site along with any anticipated construction difficulties that could result from them.

4. To provide recommendations regarding earthwork operations and the treatment of the in-situ soils in the vicinity of the proposed structures.

5. To determine the type or types of foundations, which in our opinion, will be most suitable and economical for the support of the proposed structures.

6. To provide information concerning the types and strengths of the soils encountered at the site so that the Structural Engineer may proceed with a preliminary evaluation of the proposed foundation system.

The results of the field exploration and laboratory tests, which form the basis for our recommendations, are summarized in the Appendix of this report.

SCOPE OF THE INVESTIGATION

This subsurface soils and ground water investigation included the drilling of eight (8) exploratory soil test borings within the limits of the proposed site which extended to depths ranging from forty-one (41) to eight-one (81) feet below the existing ground surface elevations. During the drilling and sampling phase of the investigation, tests, visual classifications and analyses of the various soil types encountered were performed by our personnel and their results were recorded on the enclosed Soil Boring Logs.

The soil samples obtained in the field were returned to our materials testing laboratory where they were further subjected to engineering tests and evaluation. An analysis of the field and laboratory tests was conducted by our geotechnical engineer and this engineering report was prepared which presents our recommendations and our substantiating data regarding the proposed earthwork operations and foundation construction.

GENERAL DISCUSSION

FIELD DRILLING PROCEDURES

The exploratory soil borings were conducted with an ATV-mounted, rotary auger drill rig using 3.25-inch inside diameter, hollow-stem, continuous-flight auger attachments. By using these hollow-stem augers, our drill crew was able to retrieve relatively undisturbed soil samples in advance of the auger cutting head and to determine the approximate depth at which seepage water was encountered during drilling. Also by using the hollow augers, the depth of water could be obtained upon removal of the augers from the open holes after a time lapse of at least 24 hours.

FIELD EXPLORATION PROCEDURES

Representative soil samples were obtained at approximately two and one-half (2.5) feet intervals throughout the soil borings to a depth of fifteen (15) feet whereupon five (5) feet intervals were utilized until the borings were discontinued by our drill crew personnel. Standard split-barrel soil samplers (ASTM D1586) as well as a few thin wall Shelby tubes (ASTM D-1587) were used in the investigation to obtain the soil samples.

With the split-barrel sampling procedures, a standard 2-inch outside diameter, split-barrel sampling spoon is driven into the subsoils at the various sampling intervals with a 140-pound weight falling a distance of thirty (30) inches. The number of blows, "N" values, required to advance the sampling spoon the last twelve (12) inches of a typical eighteen (18) inch, sampling interval is recorded as the standard penetration (SPT) value and have been recorded on the Soil Boring Logs.

An automatic SPT hammer was used to advance the split-spoon samplers and collect the representative soil samples at the various sampling intervals. A greater efficiency is achieved with the automatic hammer compared to a conventional safety hammer operated with a cathead and rope. The results of these standard penetration tests provide a comparative consistency of the soils and thereby provide a basis for estimating the relative shear strength and compressibility of the soil profile components. Where appropriate, the effect of the automatic hammer's efficiency has been considered in the interpretation and analysis of the subsurface information for this report.

TESTING PROCEDURES

Representative cohesive soil samples obtained during the field investigation were tested in unconfined compression with the aid of a calibrated,

compression testing machine to determine their relative shear strength characteristics. A hand penetrometer was also used to assist our soil mechanics engineer in determining the relative consistency of the cohesive soils encountered at the various soil strata. Natural moisture content and dry density tests were also conducted on the cohesive soil samples obtained. In addition, a few Grain Size Analyses and Atterberg Limits tests are being performed on representative soils to more precisely define the characteristics of the various soils.

The results of the field and laboratory tests have been recorded on the Soil Boring Logs and data sheets enclosed in the Appendix of this report. All tests were conducted in accordance with current ASTM specifications and procedures.

SOIL CLASSIFICATION

The Unified Soil Classification System (ASTM D-2488) in conjunction with the United States Bureau of Soils and Chemistry classification system were used to visually classify and describe the soils encountered in the various soil borings. The soils were identified in the field and further visual verification or refinement of these classifications were made in the laboratory. The soils encountered in the borings have been described in accordance with the textural classification charts which are included in the Appendix. Also included in the Appendix of this report is a Soil Mechanics Classification System sheet which will aid in clarifying the descriptions of the various soils encountered throughout the site.

The stratification of the soils as indicated on the Soil Boring Logs represents the subsurface soil conditions in the actual boring locations and other variations may occur between the borings. The lines of demarcation represent the approximate boundary between the soil types although the transition may be gradual.

Representative samples of the soils encountered in the field were placed in eight-ounce, sealed glass jars and are presently being stored in our materials testing laboratory for possible future reference and analysis, if desired. Unless our firm is notified to the contrary, all soil samples will be disposed of after approximately six (6) months.

SOIL BORING LOCATIONS AND ELEVATIONS

The general locations of the exploratory soil borings with respect to the proposed site were established by personnel from Stanley Consultants and were field located by Whitney & Associates personnel, with some minor relocation to avoid damage to the crops. A Plot Plan sheet depicting the approximate locations of the exploratory borings is located in the Appendix of this report. The ground surface elevations of the soil borings, as indicated on the Soil Boring Logs, have been referenced to the existing surface grades at the boring locations which were designated as 0.0. Corresponding depths below the ground surface elevations of the borings have also been depicted on these Soil Boring Logs.

EXISTING SITE CONDITIONS AND DESCRIPTIONS

SITE DESCRIPTION

The site for the proposed industrial development presently exists as undeveloped, agricultural property located adjacent to U.S. Business Route 34 within the northern portion of the Iowa Army Ammunition plant. In the area of the exploratory borings, approximately eighteen (18) to twenty-four (24) inches of dark brown, Silty Clay organic topsoil was noted at the existing surface grades.

No active utility lines are known to exist within the immediate vicinity of the proposed site. These observations by our personnel must be verified by others prior to the preparation of the final plans and specification documents.

SUBSURFACE SOILS DESCRIPTION

Beneath the existing surface cover, normally consolidated cohesive soils were typically encountered and extended to depths ranging from approximately ten (10) to eighteen (18) feet below the existing surface grades, although the soils near the surface grades of Borings B-1, B-2, B-4, B-5 and B-7 appear to be potential fill materials. These soils were primarily classified as Lean Clay (Silty Clay), Fat Clay (Silty Clay to Clay), Lean Clay With Sand (Clay Loam) and Sandy Lean Clay (Clay Loam) soil types. Fine- to coarse-grained gravel with considerable Silty Clay and fine- to medium-grained Sand with some Silty Clay were however penetrated between the approximate depths of fourteen (14) to seventeen (17) feet in Borings B-5 and B-6 respectively.

As the exploratory borings were extended into the subsoils, preconsolidated glacial till soils were encountered and typically extended in depth until the borings were discontinued by our drill crew personnel. The composition of these soils were classified as Lean Clay With Sand, Fat Clay With Sand, Fat Clay and Sandy Lean Clay soil types. Fine- to medium-grained Silty Clayey Sand was also penetrated below a depth of approximately seventy-seven (77) feet in Boring B-4 with weathered Limestone Fragments penetrated at the lower extent of Boring B-8.

The consistency of the normally consolidated cohesive soils encountered near the surface grades ranged from very soft to stiff and the relative density of the limited granular soils ranged from very loose to medium-density within

the upper portion of the soil borings. Upon encountering the glacial till soils, the consistency was classified as stiff to hard and the relative density of the granular soils at the lower extent of Borings B-4 and B-8 were classified as very dense. Standard penetration tests, designated as "N" values, ranged from 3 to 12 blows per foot within approximately twenty (20) feet from the existing surface grades and from 6 to 56 blows per foot beyond this approximate depth.

Based on the results of this subsurface investigation, in conjunction with our working knowledge of the general area, it is our opinion that an International Building Code (IBC) seismic Site Class "D" - Stiff Soil Profile is appropriate for this site. It should be noted however that this area is not considered a high risk seismic zone and the general area has experienced minimal seismic events.

A relatively high range of natural moisture contents was recorded for the soils encountered at this site. The natural moisture contents of the normally cohesive soils encountered near the existing surface grades ranged from 20 to 30 percent and, in general, would be considered well above an estimated optimum moisture content range of approximately 16 to 22 percent for the typical soil types encountered. Within the glacial till soils, natural moisture contents ranging from 13 to 22 percent were recorded and these soils would likewise be considered somewhat above the respective optimum moisture content of approximately 11 to 16 percent.

GROUND WATER CONDITIONS

It may be observed from an inspection of the Soil Boring Logs that ground water was encountered at the site. The ground water levels were checked upon completion of the soil borings and after a time lapse ranging from a few hours

to 24+ hours following the soil boring operations. The bore holes were subsequently backfilled which prevented long-term ground water readings. These readings and site observations indicate that the ground water level currently appears to exist at a depth of approximately four (4) to six (6) below the existing surface grades. Some variation in the ground water levels may be anticipated however due to typical seasonal variations.

Only a few minor excavation and/or construction problems are anticipated as a result of the ground water levels. Pumping of ground and seepage water accumulations may be anticipated from those excavations which extend beyond a depth of approximately five (5) feet from the existing surface grades and are allowed to remain open for an extended period of time.

DESIGN CONSIDERATIONS

A few preliminary design parameters relating to the proposed site development were known at the time of this report preparation. It is our understanding that the proposed fertilizer plant is to consist of several process and storage buildings although the magnitude of the proposed foundation loads is not known at this time. Concrete floor slabs-on-grade established slightly above the existing surface grades are anticipated for the proposed site development. Conventional, reinforced concrete spread foundations are most likely feasible for many of the proposed structures. In addition, recommendations regarding an auger cast pile, deep foundation system have also been presented for preliminary review and evaluation.

A network of parking and service drives has also been indicated throughout the proposed plant. Engineered structural fills must also be included in

the overall site development to provide adequate support for the proposed floor slabs-on-grade and adjacent pavement areas as well as to insure that the structures are adequately elevated above the adjacent ground areas to the extent that positive surface water drainage away from the structure exists at all times in the future.

PROJECT RECOMMENDATIONS

The following recommendations are made in regard to the earthwork operations and foundation construction for the proposed Iowa Fertilizer Company near Middleton, Iowa. These recommendations are based on the data which was obtained in this subsurface investigation and the laboratory tests which were conducted on select representative soil samples in conjunction with our evaluation of the preliminary project information provided by the owner's representative.

EARTHWORK OPERATIONS

During initial site development, it is recommended that the organic topsoil be stripped to an average depth of approximately eighteen (18) inches. Exact depths of topsoil stripping should however be determined by a representative of the soils engineer during initial site development. It is further recommended that the subgrade soils be scarified, moisture conditioned and recompacted to at least 95 percent of standard Proctor maximum dry density prior to placement of the engineered structural fills. Should any soft or unstable soils be observed during the subgrade preparation, it is recommended that these soils be reprocessed and recompacted or removed and replaced with the engineered structural fills as discussed below.

Where engineered structural fills will be required to satisfy the proposed subgrade elevations, it is recommended that the fills consist of select

cohesive soils or unprocessed, pit-run sands and gravels placed in eight (8)-inch thick layers near their respective optimum moisture content range. It is also recommended that the structural fill materials, as well as the finished subgrade in those areas requiring excavation cuts, be compacted near optimum moisture content to 98 percent of standard Proctor maximum dry density (ASTM D-698).

Around all foundation walls within the confines of the structures, it is recommended that pit-run sands and gravels compacted to 98 percent of standard Proctor maximum dry density (ASTM D-698) be used to insure that all voids are filled and adequate bearing for the slab-on-grade construction is accomplished. Any loose debris or water must be removed prior to placement of the backfill materials. Where excavations are made for pipes, conduits, etc. beneath the concrete slabs-on-grade, care must be exercised to insure these trenches are backfilled with cohesionless sands and gravels, and adequately compacted. It is also recommended that a four (4)-inch minimum blanket of free-draining sands exist beneath all slab-on-grade floors and again are compacted to 98 percent of standard Proctor maximum dry density (ASTM D-698).

It is recommended that the exterior foundation walls in non-loadbearing areas be backfilled with compacted cohesive soils after the walls have achieved adequate strength. All downspouts which collect runoff water from the roof areas must be directed away from the foundation walls at all times. Positive surface water management practices must be established at this building site which includes, but is not limited to, the diversion of all surface waters away from the structure at all times in the future. It is imperative that no waters be allowed to impound adjacent to any foundation walls or systems. This requirement of design

must be satisfied at all times both during construction as well as upon completion of the project.

SHALLOW FOUNDATION DESIGN INFORMATION

The proposed Iowa Fertilizer Company near Middleton, Iowa, may be supported on a system of reinforced concrete spread foundation established on the in-situ soils or the engineered structural fills as discussed previously. Should any soft or deleterious soils be encountered during the foundation excavation, it is essential that these materials be removed and replaced with compacted, granular structural fills or lean concrete as required. It is further recommended that the preliminary NET Allowable Soil Bearing Pressures as summarized below be utilized for the shallow, spread foundation system evaluation.

SHALLOW SPREAD FOUNDATION SUMMARY

SOIL BORING NUMBERS	PRELIMINARY NET ALLOWABLE SOIL BEARING PRESSURES - PSF
B-1	1000
B-2	1200
B-3	3000
B-4	1500
B-5	1500
B-6	1500
B-7	2000
B-8	2000

Bank-poured foundations in lieu of formed and poured construction techniques are recommended in aid in generating the recommended soil bearing pressures. Removal of all materials disturbed during this foundation excavation is considered essential prior to the reinforcing steel and concrete placement. It is

further recommended that the bases of all exterior concrete spread foundations be established at a minimum depth of forty-two (42) inches below the final exterior surface grades to satisfy normal frost penetration requirements. The bases of all interior spread foundations in climate control areas may be established directly beneath the concrete slabs-on-grade, as no frost requirements need be satisfied except during potential winter construction months.

The weight of the concrete in the foundations and the weight of the backfill materials over the foundations may be neglected in proportioning the foundations. The depth of surcharge below the existing ground surface has also been taken into consideration and should not be compensated for when proportioning the foundations. The bearing pressures recommended are net pressures in that they reflect the bearing capacity of the soils at their respective elevations with a factor of safety of three (3) included against a bearing capacity failure or a maximum settlement of one inch.

A preliminary evaluation of potential settlements of the shallow concrete foundations has been made by our geotechnical engineer and it has been estimated that total settlements should not exceed one (1.0) inch for the shallow spread foundations. Differential settlements of less than one-half (0.5) of an inch may be anticipated for the spread foundations provided that all requirements as set forth in this report are satisfied.

DEEP FOUNDATION DESIGN INFORMATION

Should the shallow foundation design result in unusually large spread foundations, the proposed structures may be supported on a system of auger cast concrete piles and reinforced concrete grade beams. It is recommended that an average frictional resistance value of 300 pounds per square foot around the auger

cast pile shaft be utilized for the soils encountered to a depth of approximately twenty (20) feet below the existing surface grades whereas an average frictional resistance value of 500 pounds per square foot may be used below this depth. In addition, a point bearing value of 4000 pounds per square foot may be utilized for the glacial till soils at a depth of approximately fifty (50) feet. Utilizing these values, a preliminary allowable working capacity of 50 tons may be anticipated for a sixteen (16) inch diameter pile established at a depth of fifty (50) feet whereas a working capacity of 70 tons may be utilized for a twenty-four (24) inch diameter pile installed to the same depth. Other pile diameters or embedment depths could be utilized to satisfy the proposed loading conditions.

Since the quality of an auger cast pile is sensitive to operator control, the installation of the auger cast piles for this project should be restricted to contractors with demonstrated ability and experience. Detailed specifications should be provided for the construction of the auger cast piles, and full-time field observation will be required during installation of the piles. Special attention should be given to construction techniques (i.e. slow auger rotation, prompt grouting, etc.) that minimize grout loss when the auger cast piles are being constructed. Adjacent piles within approximately ten (10) feet should not be installed within fifteen (15) hours of each other.

The grout should include a fluidifier admixture to inhibit early setup, decrease bleeding, minimize shrinkage and to increase fluidity. It is recommended that a grout mixture proportioned to achieve a minimum 28 day design strength of 3500 pounds per square foot be utilized for the auger cast pile construction. The grout pump should be a calibrated, positive displacement pump equipped with a stroke counter or a similar flow measuring device to allow measurement of the grout

volume per pile. The contractor should establish an accurate method of determining the auger depth at all times, and pressure gauges should be provided at the grout pump and the drill rig to allow determination of the grout pressure.

A preliminary estimate of potential settlements of the auger cast pile foundation system has been made by our geotechnical engineer and it has been estimated that total settlements should not exceed one (1.0) inch for the deep foundation system. Differential settlements of less than one-half (0.5) of an inch may be anticipated for the foundations provided that all requirements as set forth in this report are satisfied.

The use of driven steel piles may also be considered for support of the proposed structures, although would primarily be considered a friction type pile due to the fact that bedrock was not encountered during the scope of this investigation. The skin friction and point bearing values presented for the auger cast concrete piles above may be utilized for an evaluation of the driven steel pile, deep foundation system.

As an alternate to the deep foundation system, an intermediate foundation system consisting of densified aggregate piers may be considered for support of the proposed loading conditions, particularly in those areas where tanks or heavy floor loads may be anticipated. The densified aggregate pier construction consists of creating a cavity for satisfying the size and depth required to support the proposed loading conditions. Select, aggregates, consisting of local or recycled materials, are incrementally placed into the cavity and densified as well as forced into the cavity sidewalls by a vertical impact ram. This process is repeated to satisfy the proposed foundation base elevations in a pattern developed to satisfy the proposed loading conditions.

For this alternative, it is recommended that our Soil Boring Logs and the proposed foundation requirements be submitted to the following design engineers for preliminary design evaluation.

Mr. Stephen S. Weyda Ground Improvement Engineering 3950 Woodridge Court Colgate, Wisconsin 53017 262-628-1663 (Telephone) 262-628-1664 (Fax) geopier@charter.net	Mr. Jeff Hill Hayward Baker 1530 South Second Street St. Louis, Missouri 63104 314-802-2920 (Telephone) 314-802-2930 (Fax) jrhill@haywardbaker.com	Mr. Bret Campbell Helitech Civil Construction P. O. Box 24067 Belleville, Illinois 62223 618-235-5595 (Telephone) 618-397-3066 (Fax) bretc@helitechccd.com

SUMMARY

A preliminary exploration and evaluation of the subsurface soil and ground water conditions has been conducted at the site for the proposed Iowa Fertilizer Company near Middleton, Iowa. This report has been prepared with normally accepted geotechnical engineering practices to aid in the evaluation of the proposed site and to assist the design team in the preliminary analysis for this project.

Site development and foundation design criteria has been recommended and potential design as well as potential construction problems have been discussed in some detail. The subsurface exploration and analyses of the subsurface conditions presented in this engineering report are based on the data obtained from the exploratory borings at the indicated locations and does not reflect variations which may occur between the borings.

The recommendations submitted are based on the subsurface soil and ground water information which was obtained during this site investigation. The exploration and analyses of the foundation conditions presented in this report are

considered of sufficient detail and scope to form a reasonable basis for preliminary site evaluation, although must be supplemented by additional investigation and evaluation upon further definition of the proposed project. Any revisions for the proposed site development from those enumerated in this geotechnical engineering report must be brought to the attention of our geotechnical engineer so that it can be determined if changes or alterations in the proposed recommendations will be required and additional evaluations reviewed or proposed.

The geotechnical engineer of record is the professional engineer who has analyzed the data obtained during this investigation and participated in the preparation of this geotechnical engineering report. We recommend that we be retained during the design process to verify that the recommendations presented in this report have been interpreted with our intent. We will not be responsible for the misinterpretation of our data, analysis and/or recommendations.

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