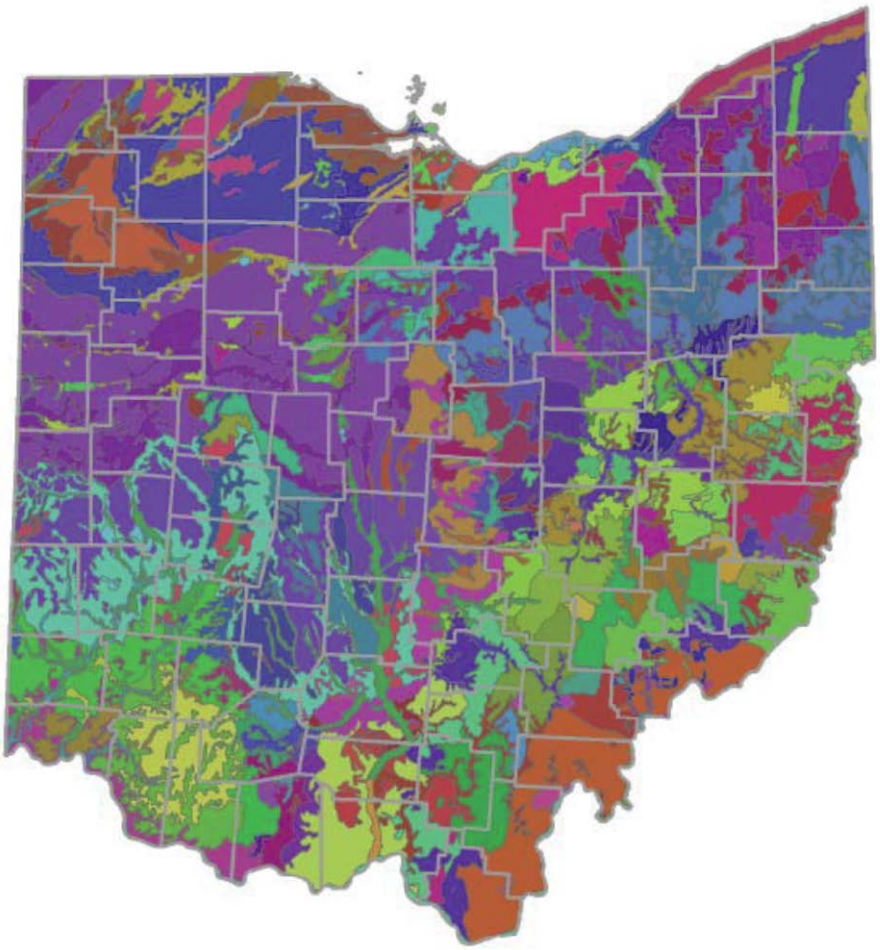
May 2015

Evaluation of Background Metal Soil Concentrations in Hamilton County – Cincinnati Area

DEVELOPED IN SUPPORT OF
THE OHIO VOLUNTARY ACTION PROGRAM

Summary Report



*Generalized soil map for the State of Ohio
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Acknowledgements

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Disclaimer

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The summary report serves as a tool in the aide of investigation and evaluation of environmentally impacted sites in Ohio. It is not meant as a regulatory document and any statements provided herein are not legally binding.

ACRONYMS

amsl	Above mean sea level
AVO	Avoca Park, Hamilton County Conservation Area
bgs	Below ground surface
C_v	Coefficient of variation
DERR	Division of Environmental Response and Revitalization
DP	Delhi Park, Delhi Township
ft	Feet
FP	French Park Metro Park
FP-XRF	Field Portable X-ray Fluorescence
GOF	Goodness-of-fit
JHP	Johnson Hills Park, Anderson Township
KM	Kaplan-Meier
MAF	Mount Airy Forest Metro Park
mg/kg	Milligram per kilogram
MMF	Mitchell Memorial Forest, Hamilton County Park
MWW	Miami Whitewater Forest, Hamilton County Park
n_b	Number of background observations
OAC	Ohio Administrative Code
ODNR	Ohio Department of Natural Resources
OEPA	Ohio Environmental Protection Agency
QA	Quality Assurance
QAPP	Quality Assurance Project Plan
RCRA	Resource Conservation Recovery Act
SAP	Sampling and Analysis Plan
S_b	Standard deviation
SHAW	Shawnee Lookout, Hamilton County Park
SIFU	Site Investigation Field Unit
SW	Sharon Woods, Hamilton County Park
TAL	Target Analyte List
TBA	Targeted Brownfields Assessment
TOC	Total Organic Carbon
UCL	Upper confidence level
USCS	Unified Soil Classification System
USDA	United States Department of Agriculture
USEPA	United States Environmental Protection Agency
UPL	Upper prediction limit
UTL	Upper tolerance limit
VAP	Voluntary Action Program
VAP UL	Voluntary Action Program Upper Limit
WW	Winton Woods, Hamilton County Park

EXECUTIVE SUMMARY

Ohio EPA Division of Environmental Response and Revitalization (DERR) sampled and analyzed surface soils at 10 Cincinnati-area properties for background concentrations of Resource Conservation and Recovery Act (RCRA) metals (As, Ba, Cd, Cr, Pb, Hg, and Se) in addition to nickel (Ni) and thallium (Tl). Silver was removed from the RCRA analytical suite due to repeated non-detections found in other Ohio counties. Soil sample locations met the location restriction requirements of OAC 3745-300-07(H)(1)(b).

A reconnaissance was performed whereby one preliminary soil boring was installed at each property. The reconnaissance evaluated the shallow soil horizon (less than four feet deep) to ensure that areas of the property where samples were collected met location restrictions. Select soil samples from the preliminary borings were screened for metals concentrations using Ohio EPA's mobile laboratory field-portable X-ray fluorescence (FP-XRF) analyzer. Screening results were used to further evaluate the suitability of the sampling locations and depth intervals.

Ten soil samples per targeted soil horizon at each property were collected to provide a statistically representative data set as described by OAC 3745-300-07(H)(1)(d)(i). Ohio EPA collected all surficial soil samples between the ground surface and depth of two feet using a hand auger. Sample locations were within a 15 ft. radius of the preliminary soil boring location. Upon sample collection completion all samples were sent to a fixed-base, VAP-certified laboratory for analyses of each soil sample.

Statistical evaluations were performed to determine the representative background concentrations for each metal. Background soil concentrations were calculated in accordance with the VAP rules effective August 1, 2014, found in OAC 3745-300-07(H)(1)(d)(ii). All statistical analyses, including outlier tests, were run using ProUCL version 4.1. A summary of the background determination results for Hamilton County are provided in tablular format as part of this report. A representative concentration for cadmium could not be obtain because all values in the data set were reported as non-detections. Final and representative background concentrations of all remaining metals in Hamilton County are as follows:

Arsenic	12.9 mg/kg
Barium	118 mg/kg
Chromium	18.8 mg/kg
Lead	32.9 mg/kg
Mercury	0.053 mg/kg
Nickel	14.8 mg/kg
Selenium	1.08 mg/kg
Thallium	0.27 mg/kg

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1.0 INTRODUCTION

Evaluation of metals in soils for the assessment and remediation of brownfield sites often requires that "background" concentrations be determined. Background metal concentrations are typically attributed to the natural composition of soil and not from the impact of hazardous substances or petroleum, hazardous or solid wastes, or wastewater. Background concentrations are assumed to be largely dependent on soil texture and composition (i.e., the percentages of sand, silt and clay; the specific mineral components present; and the naturally occurring organic matter present) and also the types of geologic material from which the soil has been derived (e.g., sand and gravel outwash, shale bedrock, till, etc.).

Background metal concentrations in urban soils are particularly challenging to characterize as opposed to background concentrations in suburban or rural areas. Urban soils often have been subjected to decades of various unregulated anthropogenic activities that can elevate background metal concentrations. For example, aerial deposition of particulate matter from fuel combustion or industrial activities in urban areas may increase the concentrations of lead, arsenic, zinc and certain other metals in soils. Construction activities, demolition activities, and surface water runoff from roofs and paved areas may also increase soil metal concentrations.

This investigation evaluates background metal concentrations in urban, suburban and rural surface soils to provide a dataset that may be used as a reference to help satisfy the requirements of, in part, Ohio Voluntary Action Program (VAP) rules (OAC Chapter 3745-300). Specifically, this summary report applies to Hamilton County and Cincinnati-area brownfield properties being assessed and remediated under the Ohio VAP. For the purposes of this investigation, "Hamilton County – Cincinnati area urban soils" means surficial soils within the City of Cincinnati or adjacent municipalities, including suburban areas and metro parks within suburban or rural areas.

2.0 SCOPE

Under the direction of Ohio EPA – VAP Central Office, the Ohio EPA Site Investigation Field Unit (SIFU) sampled and analyzed surface soils at 10 Cincinnati-area properties for background concentrations of Resource Conservation and Recovery Act (RCRA) metals (As, Ba, Cd, Cr, Pb, Hg, and Se) in addition to nickel and thallium. Silver was removed from the RCRA metals analytical suite due to repeated non-detections found in soil samples collected from other counties. The property locations are shown on Figure 1, and Tables 1A and 1B provide additional location information and property characteristics including setting (land use), topography and general soil data. The properties were selected based on the following criteria:

- The ability to obtain access from local governments or private property owners.

- Compliance with the VAP location restrictions for background soil sampling investigations [OAC 3745-300-07(H)(1)(b)].

- Design of an investigation that provided representative data for the major soil mapping units within Hamilton County as described on the "General Soil Map, Hamilton County, Ohio" of the *Soil Survey of Hamilton County, Ohio* (USDA Soil Conservation Service) to the extent possible given limitations imposed by the first two criteria.

In addition, at each property one representative sample of the targeted soil horizon was submitted to a contract soil laboratory for USCS and USDA soil texture classification based on sieve, hydrometer and Atterberg limits analyses.

Prior to performing sampling activities, SIFU performed a reconnaissance and collected one preliminary soil boring at each property. The objectives of the reconnaissance were to evaluate the shallow (less than four feet deep) soil horizons present and select a target sampling horizon, ensure that areas of the property where samples were collected met location restrictions, and select a general sampling area. Each preliminary soil boring (one per sampling area) was field logged in accordance with the Unified Soil Classification System (USCS) and the USDA soil classification system to evaluate the soil types present and screen the sampling location for fill or waste materials. In addition, selected soil samples from the preliminary borings were screened for metals concentrations using Ohio EPA's mobile laboratory field-portable X-ray fluorescence (FP-XRF) analyzer. The screening results were used to further evaluate the suitability of the sampling locations and depth intervals for background data.

Data quality objectives (DQOs) for this project included the following:

1. Soil samples from Cincinnati-area urban properties meeting the location restriction requirements of OAC 3745-300-07(H)(1)(b)

2. USCS field classification of each preliminary soil boring per ASTM D2488, Standard Practice for Description and Identification of Soils (Visual–Manual Procedure)

3. USDA field classification of each preliminary soil boring using "texture-by-feel" analysis (Presley and Thien, 2008)

4. FP-XRF analyzer screening of each preliminary soil boring for selected metals (Ti, Cr, Mn, Fe, Co, Ni, Cu, Zn, As, Se, Rb, Sr, Zr, Mo, Ag, Cd, Sn, Sb, Hg and Pb) meeting the requirements of SW-846 Method 6200

5. Analysis of 10 soil samples per targeted soil horizon at each property to provide a statistically representative data set as described by OAC 3745-300-07(H)(1)(d)(i)

6. Fixed-base, VAP-certified laboratory analyses of each soil sample for RCRA metals (As, Ba, Cd, Cr, Pb, Hg, Se and Ag), nickel, and thallium meeting the requirements of Ohio EPA's Voluntary Action Program

7. USCS and USDA classification and textural composition of one selected soil sample per property based on soil laboratory testing in accordance with ASTM D422, Standard Test Method for Particle Size Analysis of Soils (modified to provide USDA soil particle size classes); ASTM D4318, Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils; and ASTM D2487, Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System)

3.0 CINCINNATI-AREA SOIL TYPES

Figure 2 ("General Soil Map, Hamilton County, Ohio" from the Soil Survey of Hamilton County, Ohio) shows the general soil mapping units present in the Cincinnati-area (USDA Soil Conservation Service, 1974). These include the following:

1. "Eden-Pate association: Moderately deep and deep, strongly sloping to very steep, well drained and moderately well drained medium textured soils; on uplands."

2. "Bonnell-Rossmoyne-Cincinnati association: Deep, gently sloping to very steep, well drained and moderately well drained medium textured soils; on uplands."

3. "Rossmoyne-Urban land-Switzerland association: Deep, nearly level to moderately steep, moderately well drained and well drained medium textured soils, and Urban land; on uplands."

4. "Ava-Urban land-Switzerland association: Deep, nearly level to strongly sloping, moderately well drained and well drained medium textured soils, and Urban land; on uplands."

5. "Russell-Urban land-Xenia association: Deep, nearly level and gently sloping, well drained and moderately well drained medium textured soils, and Urban land; on uplands."

6. "Urban land-Martinsville-Fox association: Urban land and deep, nearly level to strongly sloping, well drained medium textured soils; on stream terraces and outwash plains."

7. "Eldean-Princeton association: Deep, nearly level to sloping, well drained medium textured and moderately coarse textured soils; on terraces and outwash plains."

8. "Markland-Urban land-Patton association: Deep, nearly level to steep, moderately well drained and poorly drained moderately fine textured soils, and Urban land; on lacustrine terraces and basins."

9. "Parke association: Deep, gently sloping to steep, well drained medium textured soils; on high terraces."

10. "Jules-Stonelick association: Deep, nearly level well drained medium textured and moderately coarse textured soils; on flood plains."

11. "Genesee-Stonelick-Urban land association: Deep, nearly level, well drained medium textured and moderately coarse textured soils, and Urban land; on flood plains."

12. "Urban land-Huntington-Elkinsville association: Urban land and deep, nearly level to strongly sloping, well drained medium textured soils; on flood plains and terraces."

The majority of the land surface of Hamilton County is dominated by glacial deposits of Wisconsin Age (USDA, 1974). Soils in Hamilton County are formed on silt- and clay-rich glacial till.

In summary, properties were selected to incorporate as many of these general soil mapping units as possible to provide a background metal data set that is representative with respect to the soils present in the Cincinnati-area.

4.0 PROPERTY USE AND REGULATORY HISTORY

Properties evaluated for soil sampling included public parks that were not underlain by engineered or structural fill [OAC 3745-300-01(A)(41)] or industrial fill [OAC 3745-300-01(A)(70)], and where industrial or waste disposal activities have not occurred (Tables 1A and 1B and Figure 1). Soil types where disposal has occurred must be excluded from background determinations by rule. The reconnaissance effort conducted prior to the actual sampling event prevented sampling of these prohibited soil types.

Properties underlain by native fill may be sampled [OAC 3745-300-01(A)(81)]. "Native fill" is soil material derived from the property and transferred from one area of the property to another area in such a manner that the original soil structure and physical properties may be altered from the initial pre-excavation conditions, but the chemical and physical properties remain consistent with other undisturbed native soils at the property.

5.0 SUMMARY OF SAMPLING STRATEGY AND FIELD ACTIVITIES

5.1 Property Reconnaissance and Preliminary Soil Boring Evaluation

SIFU performed a property reconnaissance to evaluate potential sampling areas and inspect the property soils. The results of the reconnaissance were used to select the general area where samples were ultimately collected, as well as determine the soil horizon sampled for chemical (metals) and soil texture analysis (classification).

Prior to each property reconnaissance, a review of property soil descriptions provided by the Soil Survey of Hamilton County, Ohio was conducted. During site reconnaissance, field staff evaluated sampling location restrictions based on OAC 3745-300-07(H)(1)(b), which include:

(i) Areas underlain by engineered fill, structural fill or industrial fill
(ii) Areas where the management, treatment, handling, storage or disposal of hazardous substances or petroleum, solid or hazardous wastes, waste waters or material handling areas are known or are suspected to have occurred
(iii) Areas within three feet of a roadway
(iv) Parking lots or areas surrounding parking lots or other paved areas
(v) Railroad tracks or railway areas or other areas affected by their runoff
(vi) Areas of concentrated air pollution depositions or areas affected by their runoff
(vii) Storm drains or ditches presently or historically receiving industrial or urban runoff
(viii) Spill areas

The sampling locations were evaluated based on visual inspection of the property, interviews with the property owners or representatives, review of Sanborn Maps and other historical records, and sampling and inspection of property soils.

A hand auger was used to collect a preliminary soil boring at each proposed sampling area to evaluate the upper four (4) feet of surficial soils, which were field-classified in accordance the USCS (ASTM D2488) and the USDA soil classification system (Presley and Thien, 2008). Soil boring logs are included in Appendix A.

Ohio EPA analyzed selected soil samples from each preliminary soil boring for selected metals (Ti, Cr, Mn, Fe, Co, Ni, Cu, Zn, As, Se, Rb, Sr, Zr, Mo, Ag, Cd, Sn, Sb, Hg, and Pb) using the FP – XRF analyzer in accordance with SW-846 Method 6200. The results were used to evaluate the influence of anthropogenic activities on the soil metal concentrations. Based on the screening results, the soil metal concentrations did not appear to be elevated by anthropogenic activities at any of the selected properties.

The FP-XRF results also were used to examine the vertical distributions of metal concentrations in the soil profile at each preliminary soil boring location. The results appear to indicate that some metal concentrations may be depth-related (e.g., at some locations, lead concentrations are higher near the ground surface and decrease with depth). The trends were not tested for statistical significance. However, based on these results, a sampling interval of ground surface to two feet deep (or until refusal on shallow bedrock) was selected for all analytical samples to avoid introducing additional variation in the analytical data set due to potential variability associated with an inconsistent sampling depth interval.

The XP-XRF analytical results are considered 'screening' level data quality under the current VAP rules. As such, these results cannot be used as part of a background demonstration where comparison to soil applicable standards is required. However, the results are provided in Appendix B for general reference purposes.

5.2 Soil Sampling and Analysis

Based on the results of the preliminary field investigation, the team selected 10 soil sampling localities (properties) to collect soil samples for RCRA metal laboratory analysis (excluding silver), including nickel and thallium.

At each locality, Ohio EPA collected 10 surficial soil samples between the ground surface and depth of two feet using a hand auger; a total of 100 samples (10 at each location) were thus collected for the background dataset. At each of the 10 locations Ohio EPA was able to auger to the minimum required depth interval (i.e., two-feet below ground surface). No stiff clays or auger impediments were encountered at any location, therefore at each location the auger was extended to four-feet below ground surface as noted in the boring logs in Appendix A.

The sample locations were within a 15 ft. radius of the preliminary soil boring location (the sampling area circular with an approximate diameter of 30 ft. with the preliminary soil boring location in the center). Ohio EPA collected the geotechnical and 10 analytical samples within an area approximately 30 feet in diameter to ensure that the soil samples were similar in texture and composition (i.e., from the same population). The Ohio EPA SIFU sampling team used this approach at all sampling localities for a consistent investigative approach across all properties sampled.

At each locality, the first analytical sample (e.g., WW-1, SW,-1, AVO-1, etc.) and the geotechnical sample were collected adjacent to the preliminary soil boring location. The other nine analytical samples were collected at random locations within a radius of 15 ft. of the preliminary soil boring. Upon completion, each sampling location was backfilled with native soil.

Each soil sample (approximately three to four pounds) was homogenized in a stainless steel mixing pan. A two-ounce subsample was collected and preserved on ice at 4° C and submitted to Ohio EPA's contract laboratory for RCRA metals, nickel and thallium analysis. Approximately two (2) pounds of soil were collected for laboratory USCS and USDA classification and soil texture composition based on sieve, hydrometer, and Atterberg limits testing (one per sampling area).

5.3 Field Sampling Equipment Decontamination

Hand augers, sampling spoons, mixing bowls, and other field equipment used to sample soils were decontaminated between properties by washing with a solution of non-phosphate detergent and potable water and rinsing with deionized water.

5.4 Laboratory Analyses

Ohio EPA's contract laboratory (Microbac Laboratories, Inc.) analyzed 110 soil samples (10 per site) for RCRA metals (As, Ba, Cd, Cr, Pb, Hg and Se), nickel (Ni), and thallium (Tl) using Inductively Coupled Plasma (ICP) and/or Graphite Furnace Atomic Absorption Spectrophotometry (GFAAS) via U.S. EPA Method 6020 and Method 7471. Geotechnics, subcontracted by Microbac, Inc. performed the USCS and USDA classification (see Table 2 and Appendix C) and soil texture composition in accordance with ASTM D422, Standard Test Method for Particle Size Analysis of Soils (modified to provide USDA soil particle size classes); ASTM D4318, Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils; and ASTM D2487, Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System). Data received from Microbac are considered certified under the Ohio EPA VAP certified laboratory program.

6.0 SAMPLING LOCATIONS

6.1 Property Descriptions and Locations

Details for the 10 locations sampled for this investigation are included in Tables 1A and 1B. Information contained in Table 1A provides property information such as site location (latitude/longitude), generalized setting (e.g., urban, suburban or rural), and the topography (e.g., level, gently sloping, etc.). Surveying the location of each sampling point was determined not to be practical; therefore, the longitude and latitude coordinates are presented for the approximate location of the preliminary soil boring. As noted in Section 5.0, samples were collected within a 15-foot radius of the original preliminary sample boring. Table 1B provides information relative to the soil survey for Hamilton County. Specific details on the table includes the mapping (soil type) unit at each property and the underlying parent material (e.g., bedrock, lake deposits, etc.) underlying each property.

7.0 METHOD OF BACKGROUND VALUE DETERMINATION

Upon receipt of all laboratory data, statistical evaluations were performed to determine the representative background concentrations. It was determined that data collected from all 10 property locations would be incorporated into a single data set. Preliminary evaluations were performed whereby a comparison of properties was performed. Using this method statistically similar sites were combined into a single data set. Though statistically correct, this method was found to be cumbersome such that multiple background values were generated per metal. Therefore, the more direct approach was selected whereby all data points were combined into a single data set and outliers were removed as the entire data set was analyzed. The result was that a single, representative

background number was generated for each metal. Background values were determined for the 0-2 ft bgs interval from all 10 property locations.

7.1 Outlier Test

The data set was evaluated for the presence of outliers in accordance with the VAP Rule OAC 3745-300-07(H)(1)(d)(ii)(d). The presence of outliers in the background data sets could yield higher or lower estimates of the upper limits. Statistical outlier tests give evidence that a value does not fit with the distribution of the remainder of the data and is, therefore, a statistical outlier. The outlier identification was performed by the Rosner outlier test utilizing ProUCL. All outliers were removed prior to completing background calculations.

7.2 Nondetect Test

According to the ProUCL user's guide, when the percentage of non-detects in a data set is high (greater than 50 percent (%)) or when multiple detection limits are present, it is hard to reliably perform goodness-of-fit (GOF) tests to determine data distribution. In those cases, the uncertainty associated with the GOF tests is high, especially with smaller data sets (less than 10 to 20 samples). In those situations, the use of nonparametric methods such as the Kaplan-Meier (KM) method to compute statistics such as upper confidence limits, upper prediction limits (UPLs), and upper tolerance limits (UTLs) is preferred because nonparametric methods do not require any distributional assumptions about the data sets.

By example, Table 3 shows that cadmium results had approximately 91% non-detectable values. In this scenario the KM method was not used, however the maximum value in the dataset was chosen as the representative concentration by ProUCL. Due to the elevated number of non-detects a definitive distribution of the dataset could not be determined. Further evaluation of the data set detailed below shows that this provides an acceptable representation of the data obtained.

7.3 Soil Background Mean

The background mean (X_b) for data sets without non-detects was calculated by ProUCL by dividing the sum of the total background values (X_n) by the total number of background readings (n_b):

$$X_b = \frac{X_1 + X_2 + X_3 \text{ (etc.)}}{n_b}$$

The background mean for data sets with non-detects was calculated by ProUCL using the appropriate method based on the distribution (e.g., the KM method for nonparametric data sets with multiple detection limits).

7.4 Standard Deviation

The standard deviation (S_b) for data sets without non-detects was calculated by ProUCL by taking the square root of the sum of the squares of each value (X_n) minus the mean (X_b), divided by the degrees of freedom (number of background soil samples minus one):

$$S_b = \left[\frac{(X_1 - X_b)^2 + (X_2 - X_b)^2 + (X_3 - X_b)^2 \text{ (etc.)}}{n_b - 1} \right]^{1/2}$$

For data sets with non-detects, the standard deviation was calculated by ProUCL using the appropriate method based on the distribution (e.g., the KM method for nonparametric data sets with multiple detection limits).

7.5 Coefficient of Variation

The C_v is the ratio of the standard deviation (S_b) to the mean (X_b) and describes the magnitude of sample values and the variation within them:

$$C_v = \frac{S_b}{X_b}$$

The C_v is used to evaluate the distribution of the data, where generally a C_v of less than 0.5 indicates a normal distribution. A C_v was calculated only for data sets without non-detects.

7.6 Distribution

The distribution of each data set was also evaluated using ProUCL to determine if the distributions were normal, lognormal, or gamma distributed. The upper limits for the data sets that were normal were then calculated as described below. Data sets that were not normally distributed were evaluated for the upper limits using nonparametric methods. Nonparametric methods do not assume a particular population probability distribution, and are therefore valid for data from any population with any probability distribution, which can remain unknown.

7.7 VAP Upper Limit (UL)

In accordance with the VAP background soil determination requirements in OAC 3745-300-07(H)(1), the background mean plus two standard deviations is the maximum allowable limit or upper limit for normally distributed data. The background upper limit for normally distributed data sets was calculated by multiplying the standard deviation by two and adding the background mean such that:

$$\text{VAP UL} = X_b + (2 \times S_b)$$

If the data follows a lognormal, nonparametric, or gamma distribution, the upper limit was calculated using ProUCL to determine the 95% upper prediction limit (UPL) based on the best fit distribution. This is noted in Table 3.

7.8 95% UTL with 95% Coverage

An UTL represents an upper limit to be used for point-by-point individual site observation comparisons. UPLs and UTLs are computed based upon background data sets, and point-by-point onsite observations are compared with those limits. A site observation exceeding a background UTL may lead to the conclusion that the constituent is present at the site at levels greater than the background concentrations level.[1]

7.9 95% UCL

A UCL represents an average value that should be compared with a threshold value also representing an average value (pre-established or estimated), such as a mean Cs. For example, a site 95% UCL exceeding a Cs, may lead to the conclusion that the Cs has not been attained by the average site area concentration. It should also be noted that UCLs of means are typically computed based upon the site data set.

A UCL represents a "collective" measure of central tendency, and it is not appropriate to compare individual site observations with a UCL. Depending upon data availability, single or two-sample hypotheses testing approaches are used to compare a site average or a site median with a specified or pre-established cleanup standard (single-sample hypothesis), or with the background population average or median (two-sample hypothesis).[1]

[1.] Singh, Anita Ph.D. and Robert Maichle, ProUCL Version 5.0.00 User Guide, Statistical Software for Environmental Applications for Data Sets with and without Nondetect Observations, ORD Site Characterization and Monitoring Technical Support Center (SCMTSC), September 2013

8.0 CINCINNATI-AREA SOIL BACKGROUND VALUES

Background soil concentrations were calculated in accordance with the VAP rules effective August 1, 2014, found in OAC 3745-300-07(H)(1)(d)(ii). As noted in Section 7.7, for normally distributed data, the background mean plus two standard deviations is the maximum allowable limit, or UL, which was calculated by multiplying the standard deviation by two and then adding the mean concentration. Normally distributed data were observed in the mercury, nickel and selenium data sets only. The 95% upper tolerance limit was used as the representative background concentrations for the arsenic, barium, chromium, lead, and thallium data sets. All values for cadmium were nondetect.

A summary of the background determination results for Hamilton County are provided in Table 3. Seven of the eight original RCRA metals are presented. As previously discussed, silver was not included in this study due to the characteristically high number of nondetects found for other county-wide soil background studies completed in the State. Therefore, silver has been determined not to be a significant contributor to elevated background concentrations across the Hamilton County region. As a replacement both nickel and thallium were added to the suite of metals analyses.

The ProUCL output data sheets are provided in Appendix D. Analytical results for each metal are provided in Tables 5 through 13. Metal concentrations for each sample at each location are provided. Summary statistics including maximum, minimum, average, and standard deviation are also provided. The following sections are a narrative of the summary results.

8.1 Arsenic

Concentrations of arsenic ranged from 4.09 to 14.3 mg/kg with no non-detects. There were 97 valid data points, with three outliers removed. The data set mean was calculated to be 7.645 mg/kg, with a standard deviation of 2.33 mg/kg. The VAP UL for was determined to be 12.31 mg/kg, however the VAP UL cannot be used as the background concentration because the data are not normally distributed. The 95% UTL was calculated to be 12.9 mg/kg. This value is determined to be the representative soil background concentration for arsenic.

8.2 Barium

Concentrations of barium ranged from 48.8 to 129 mg/kg with no non-detects. There were no outliers removed. The data set mean was calculated to be 69.62 mg/kg, with a standard deviation of 18.1 mg/kg. The VAP UL for was determined to be 105.82 mg/kg, however the VAP UL cannot be used as the background concentration because the data are not normally distributed. The 95% UTL was calculated to be 118 mg/kg. This value is determined to be the representative soil background concentration for barium.

8.3 Cadmium

There were no detected concentrations of cadmium. The detection limits for cadmium ranged from 0.360 mg/kg to 1.02 mg/kg. Due to the elevated number of non-detections in the overall data set no meaningful statistics could be performed on the cadmium data. Therefore, no cadmium representative background concentration was determined.

8.4 Chromium

Concentrations of chromium ranged from 6.57 to 24.0 mg/kg with no non-detects. There were 100 valid data points with no outliers removed. The data set mean was calculated to be 12.14 mg/kg, with a standard deviation of 3.62 mg/kg. The VAP UL was determined to be 19.38 mg/kg. The VAP UL cannot be used as the representative concentration because the data have a non-normal distribution. The 95% UTL with 95% coverage was determined to be 18.8 mg/kg. This value is determined to be the representative soil background concentration for chromium.

8.5 Lead

Detected concentrations of lead ranged from 11.4 to 34.2 mg/kg. There were 92 valid data points, after the removal of eight outliers. There were no non-detects in the data set. The data set mean was calculated to be 19.21 mg/kg, with a standard deviation of 5.22 mg/kg. The VAP UL was determined to be 29.65 mg/kg which cannot be used as the data set is not normally distributed. The 95% UTL with 95% coverage was determined to be 32.9 mg/kg. This value is determined to be the representative soil background concentration for lead.

8.6 Mercury

Detected concentrations of mercury ranged from 0.0121 to 0.0632 mg/kg. There were 98 valid data points with two outliers removed. There were ten non-detects in the data set. Regression-on-statistics methods were used to approximate the values for the 10 nondetect samples. The data set mean was calculated to be 0.034 mg/kg, with a standard deviation of 0.010 mg/kg. The 95% UTL with 95% coverage was determined to be 0.053 mg/kg. The VAP UL was determined to be 0.0528 mg/kg. The data set is normally distributed therefore; this value is determined to be the representative soil background concentration for lead.

8.7 Nickel

Detected concentrations of nickel ranged from 6.70 to 17.2 mg/kg. There were 91 valid data points, with nine outliers removed. There were no non-detects in the data set. The data set mean was calculated to be 11.17 mg/kg, with a standard deviation of 1.858 mg/kg. The 95% UTL with 95% coverage was determined to be 14.8 mg/kg. The VAP UL was determined to be 14.8 mg/kg. The data set is normally distributed therefore; this value is determined to be the representative soil background concentration for nickel.

8.8 Selenium

Detected concentrations of selenium ranged from 0.36 to 1.20 mg/kg. There were 98 valid data points, with two outliers removed. There were no non-detects in the data set. The data set mean was calculated to be 0.763 mg/kg, with a standard deviation of 0.15 mg/kg. The 95% UTL with 95% coverage was determined to be 1.06 mg/kg. The VAP UL was determined to be 1.08 mg/kg. The data set is normally distributed therefore; this value is determined to be the representative soil background concentration for nickel.

8.9 Thallium

Concentrations of thallium ranged from 0.11 to 0.31 mg/kg with no non-detects. There were 95 valid data points with five outliers removed. The data set mean was calculated to be 0.183 mg/kg, with a standard deviation of 0.041 mg/kg. The VAP UL was determined to be 0.265 mg/kg. The VAP UL cannot be used as the representative concentration because the data have a lognormal distribution. The 95% UTL with 95% coverage was determined to be 0.27 mg/kg. This value is determined to be the representative soil background concentration.

9.0 APPLICATION OF THIS REPORT AND SUMMARY OF BACKGROUND DETERMINATION

Background results generated in this report are specific to Hamilton County. Users of this report may elect to utilize the results presented in Section 8.0 and Table 3 for direct comparison purposes to other properties in Hamilton County in accordance with VAP soil background rule requirements (OAC 3745-300-07(H)(2)). It is generally inappropriate to apply these background values to properties located in non-adjacent or surrounding counties. Exceptions to this provision may be allowable if the user can demonstrate that the subject property has a similar soil provenance and type to one or more soil types listed for properties within this study. Geotechnical analysis of the subject property soil type is advisable to make the soil type comparison. Additionally, samples collected at the subject property must be representative of the zone (e.g., 0-2 ft. bgs.) assessed in this study.

A representative concentration for cadmium could not be obtain because all values in the data set were reported as non-detections. The following results are the background upper limits for all remaining metal soil concentrations in Hamilton County – Cincinnati Area:

Arsenic	12.9 mg/kg
Barium	118 mg/kg
Chromium	18.8 mg/kg
Lead	32.9 mg/kg
Mercury	0.053 mg/kg
Nickel	14.8 mg/kg
Selenium	1.08 mg/kg
Thallium	0.27 mg/kg

10.0 REFERENCES

ASTM D2487, Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System)

ASTM D2488, Standard Practice for Description and Identification of Soils (Visual – Manual Procedure)

ASTM D422, Standard Test Method for Particle Size Analysis of Soils

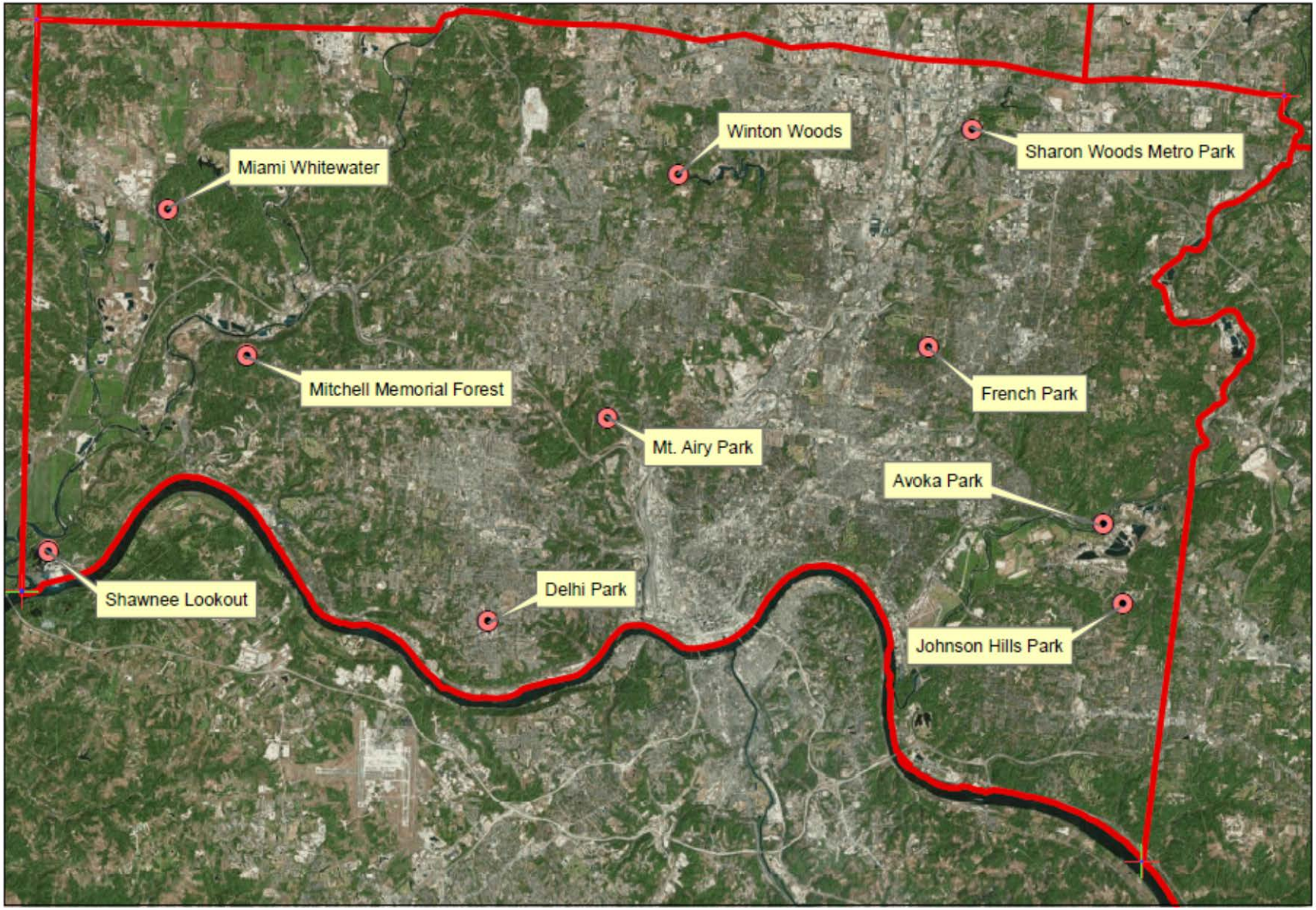
ASTM D4318, Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils

Presley, D., and S. Thien, September 2008, Estimating Soil Texture By Feel, Kansas State University Department of Agronomy, MF-2852

USDA Soil Conservation Service, December 1974, Soil Survey of Hamilton County, Ohio

U.S. EPA SW-846 Method 6200 (Revision 0, February 2007), Field Portable X-ray Fluorescence Spectrometry for the Determination of Elemental Concentrations in Soil or Sediment

U.S. EPA, U.S. EPA Statistical Software ProUCL 4.1 for Environmental Applications for Data Sets With and Without Non-detect Observations



Sample Location

County Boundary

Figure 1: Sample Locations, Hamilton County, Ohio

5 Miles

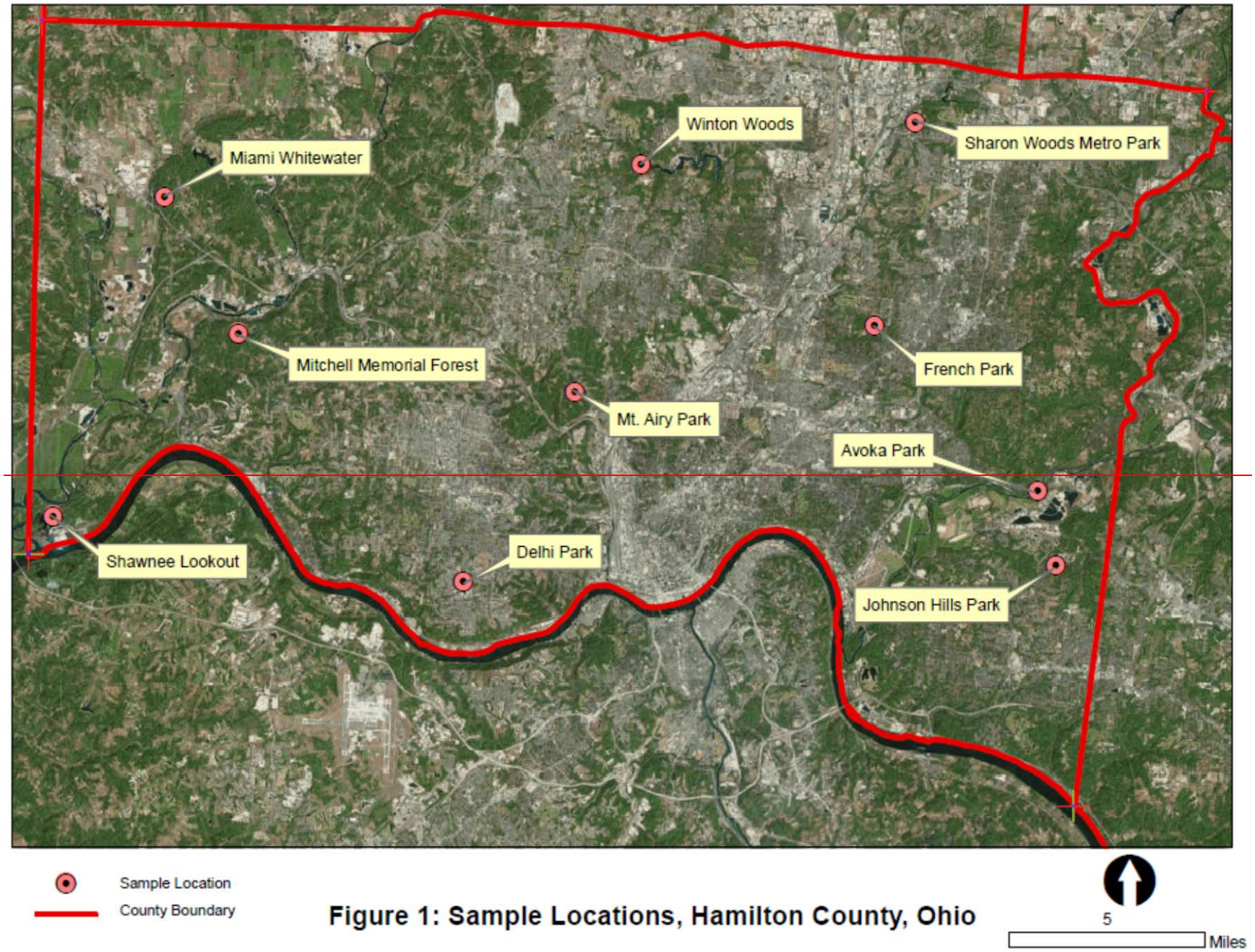


Figure 1: Sample Locations, Hamilton County, Ohio

Sample Location

County Boundary

Figure 2: General Soils Map, Hamilton County, Ohio

5 Miles

TABLE 1A

Soil Sampling Property Information Summary: Locations, Settings & Topography

Sampled Property (Sample Abbreviation)	Location			Setting	Topography
	Address	Latitude[1]	Longitude		
Avoca Park (AVO), County Conservation Area	~8065 Wooster Pike, Avoca Pk. Trailhead to Little Miami Scenic (Bike) Trail, Cincinnati, OH 45227	39.138340	-84.340710	suburban park	Level to nearly level
Delhi Park (DP), Delhi Twp.	5048 Foley Road, Cincinnati, OH 45238	39.099990	-84.612840	suburban park	Level to gently sloping
French Park (FP), Metro Park	3012 Section Road Cincinnati, OH 45237	39.198787	-84.420131	suburban park	Gently slopoing to sloping
Johnson Hills Park (JHP), Anderson Twp. Park District	7950 Bridle Road, Cincinnati, Ohio 45244	39.110710	-84.331440	suburban park	Gently slopoing to sloping
Miami Whitewater Forest (MWF), County Park	~9467 Harrison Ave, Cleves, OH 45002	39.240430	-84.759530	suburban park	Gently slopoing to sloping
Mitchell Memorial Forest (MMF), County Park	5401 Zion Road, Cleves, OH 45002	39.190490	-84.722740	suburban park	Level to gently sloping
Mount Airy Forest (MAF), Metro Park	5083 Colerain Avenue (Oak Ridge Rd.), Cincinnati, Ohio 45223	39.171460	-84.562030	suburban park	Gently slopoing to sloping
Sharon Woods (SW), County Park	11450 Lebanon Road, Cincinnati, OH 45241	39.274570	-84.402670	suburban park	Gently slopoing to sloping
Shawnee Lookout (SHAW), County Park	2008 Lawrenceberg Road, North Bend, OH 45052	39.120660	-84.808890	suburban park	Gently slopoing to sloping
Winton Woods (WW), County Park	10245 Winton Road, Cincinnati, OH 45231	39.256610	-84.532910	suburban park	Level to gently sloping

Note:

1 Latitude and longitude values (Google Maps or ArcGIS) are for the approximate center of area from which soil samples were collected.

TABLE 1B

Soil Sampling Property Information Summary: Soil Mapping Units, Parent Materials and Soil Types

Sampled Property (Sample Abbreviation)	Preliminary Soil Boring[1] (PSB) & Location			Soil Mapping Units, Classification and Parent Materials			
	PSB	Latitude[2]	Longitude	Mapping Unit[3]	USCS Soil Type	USDA Soil Type	Parent Material[4]
Avoca Park	AVO	39.138340	-84.340710	Loam till, Illinoian-age	Lean Clay with Sand (CL)	Silt Loam	sandy silt
Delhi Park	DP	39.099990	-84.612840	Clay-loam till, Pre-Illinoian-age	Lean Clay (CL)	Silt Loam	silty clay to silt
French Park	FP	39.171490	-84.562000	Loam till, Illinoian-age	Lean Clay (CL)	Silt Loam	clayed silt to silty clay
Johnson Hills Park	JHP	39.110710	-84.331440	Loam till, Illinoian-age	Lean Clay (CL)	Silt Loam	clayed silt
Miami Whitewater Forest	MWF	39.240430	-84.759530	Sand and Gravel, Wisconsinan-age	Lean Clay (CL)	Silt Loam	clay silt
Mitchell Memorial Forest	MMF	39.190490	-84.722740	Clay-loam till, Pre-Illinoian-age	Lean Clay with Sand (CL)	Silt Loam	silty clay
Mount Airy Forest	MAF	39.171460	-84.562030	Clay-loam till, Pre-Illinoian-age	Lean Clay (CL)	Silt Loam	sandy silt
Sharon Woods	SW	39.274570	-84.402670	Loam till, Wisconsinan-age	Lean Clay (CL)	Silt Loam	silty clay
Shawnee Lookout	SHAW	39.120660	-84.808890	Fine sand, clay, and silt, unspecified age	Lean Clay (CL)	Silt Loam	silty loam to clayed silt
Winton Woods	WW	39.256610	-84.532910	Loam till, Illinoian-age	Lean Clay with Sand (CL)	Clay Loam	clayed silt to silty clay

Note:

1. One preliminary soil boring (PSB) was installed at each samplilng location to evaluate soil conditions prior to collecting analytical samples; PSB logs (with field soil descriptions) are included in Appendix A
2. Latitude and longitude values (Google Maps or ArcGIS) are for the approximate center of area from which soil samples were collected.
3. Mapping Number is based on Hamilton County Soil Survey data.
4. Parent Material is based on Hamilton County Soil Survey data and Preliminary Soil Boring (PSB) logs.

TABLE 2
Summary of Soil Geotechnical Testing Results

Sampled Property	Soil Sample	Soil Parent Material[1]	Unified Soil Classification System (USCS)								USDA Soil Classification System				
			USCS Soil Type	Particle Size Distribution				Atterberg Limits			USDA Soil Type	Particle Size Distribution			
				% Gravel (>4.76 mm)	% Sand (<=4.76 mm, >0.074 mm)	% Silt (<=0.074 mm, >0.002 mm)	% Clay (<=0.002 mm)	LL (%)	PL (%)	PI (%)		% Gravel (>2 mm)	% Sand (<=2 mm, >0.05 mm)	% Silt (<=0.05 mm, >0.002 mm)	% Clay (<=0.002 mm)
Avoca Park	AVO	sandy silt	Lean Clay with Sand (CL)	0	25.2	74.8*	74.8*	30	12	18	Silt Loam	0	34.31	52.47	13.23
Delhi Park	DP	silty clay to sand	Lean Clay (CL)	0.01	6.93	93.06*	93.06*	44	21	23	Silt Loam	0	13.43	64.17	22.4
French Park	FP	clayed silt to silty sand	Lean Clay (CL)	0	2.65	97.35*	97.35*	39	21	18	Silt Loam	0	7.87	69.53	22.59
Johnson Hills Park	JHP	clayed silt	Lean Clay (CL)	0.11	13.34	86.55*	86.55*	35	20	15	Silt Loam	0	18.77	61.45	19.78
Miami Whitewater Forest	MWF	clayed silt	Lean Clay (CL)	0	1.99	98.01*	98.01*	32	17	15	Silt Loam	0	10.63	74.52	14.85
Mitchell Memorial Forest	MMF	silty clay	Lean Clay with Sand (CL)	1.02	21.15	77.83*	77.83*	41	22	19	Silt Loam	0	24.76	57.79	17.45
Mount Airy Forest	MAF	sandy silt	Lean Clay (CL)	0.3	4.02	95.68*	95.68*	40	18	22	Silt Loam	0	8.61	70.34	21.05
Sharon Woods	SW	silty clay	Lean Clay (CL)	0.35	8.51	91.13*	91.13*	37	16	21	Silt Loam	0	14.81	68.79	16.41
Shawnee Lookout	SHAW	silty loam to claye silt	Lean Clay (CL)	0.06	1.44	98.5*	98.5*	40	28	12	Silt Loam	0	11.47	75.67	12.86
Winton Woods	WW	clayed silt to silty clay	Lean Clay with Sand (CL)	0.47	15.22	84.31*	84.31*	46	23	23	Clay Loam	0	21.18	46.22	32.59

[1] Parent Material is based on Hamilton County Soil Survey data and Preliminary Soil Boring (PSB) logs.

Table 3
Background Statistics for Hamilton County
Summary Results for Nine Metals

Metal	Number of Sites Included	Number of Outliers	% ND	Data points	Maximum	Mean	SD	Distribution	VAP UL	95% UTL with 95% Coverage	95% UCL	Units	Comments
Arsenic	10	3	0%	97	14.3	7.645	2.33	Lognormal	12.31	**12.9**	8.1	mg/kg	Lognormal dist., 3 outliers removed
Barium	10	0	0%	100	129	69.62	18.1	Nonparametric	105.82	**118**	72.6	mg/kg	Nonparametric distribution
Cadmium(1)	10	0	100%	100	-	-	-	-	-	-	-	mg/kg	All values non-detect
Chromium	10	0	0%	100	24.0	12.14	3.62	Nonparametric	19.38	**18.8**	12.7	mg/kg	Nonparametric distribution
Lead	10	8	0%	92	34.2	19.21	5.22	Nonparametric	29.65	**32.9**	20.1	mg/kg	Nonparametric dist., 8 outliers removed
Mercury	10	2	0%	98	0.0632	0.0335	0.010	Normal	**0.0528**	0.053	0.035	mg/kg	10 samples nondetect, 2 outliers
Nickel	10	9	10%	91	17.2	11.17	1.858	Normal	**14.8**	14.8	11.5	mg/kg	Normal dist., 9 outliers
Selenium	10	2	0%	98	1.2	0.763	0.15	Normal	**1.08**	1.06	0.79	mg/kg	Normal dist., 2 outliers
Thallium	10	5	0%`	95	0.31	0.183	0.041	Lognormal	0.265	**0.27**	0.19	mg/kg	Lognormal dist., 5 outliers

(1) No observed value was calculated for cadmium due to high number of non-detects. No statistical evaluations were made (e.g., mean, SD, distribution).

{ } = mean + 2SD calculated, but dataset is not normal or lognormal and value may not be appropriate for use as the UL.

Bold Number = Representative background value for associated metal

Note: ND – Non-detect
SD – Standard deviation
VAP UL – Voluntary Action Program upper limit
UTL – Upper tolerance limit
UPL – Upper prediction limit

Table 4

Property Abbreviation Key

Abbreviation	Property & General Location
AV	Avoca Park, Cincinnati
DP	Delhi Park, Delhi Township
FP	French Park, Cincinnati
JHP	Johnson Hills Park, Anderson Township
MAF	Mt. Airy Forest, Cincinnati
MMF	Mitchell Memorial Forest, Cleves
MWW	Miami Whitewater Forest, Harrison
SHAW	Shawnee Lookout, North Bend
SW	Sharon Woods, Sharonville
WW	Winton Woods, Cincinnati

Table 5
Summary of Arsenic Data
Hamilton County Background Soils Summary Report

Sample	Location		SW	FP	MAF	SHAW	AV	DP	MWW	JHP	WW	MMF
	Units											
1	mg/kg		5.28	9.61	7.08	5.61	5.69	10.3	5.16	7.41	7.35	11.7
2	mg/kg		6.49	10.2	6.20	6.41	5.82	7.49	4.55	6.70	11.8	11.3
3	mg/kg		6.23	10.0	5.47	7.08	4.78	8.06	4.68	7.14	8.37	10.9
4	mg/kg		5.23	9.33	6.13	5.71	4.86	9.34	5.27	11.2	10.4	12.4
5	mg/kg		5.99	7.60	5.07	6.56	5.19	11.3	4.19	7.41	10.0	14.3
6	mg/kg		6.14	10.2	6.43	6.65	5.67	8.65	5.70	8.07	13.6	12.3
7	mg/kg		7.33	9.78	7.14	8.20	5.58	8.56	5.63	8.25	8.64	10.4
8	mg/kg		8.06	8.32	5.69	6.94	5.81	8.06	4.87	8.14	17.5	10.9
9	mg/kg		5.26	9.56	5.37	6.86	5.77	17.1	4.09	7.86	9.05	10.7
10	mg/kg		6.41	7.08	6.05	5.93	5.82	8.20	5.49	5.97	16.5	12.5

Notes:
mg/kg = milligrams per kilogram

Table 6
Summary of Barium Data
Hamilton County Background Soils Summary Report

Sample	Location		SW	FP	MAF	SHAW	AV	DP	MWW	JHP	WW	MMF
	Units											
1	mg/kg		60.0	75.4	86.8	54.6	65.6	76.1	57.8	59.1	69.5	59.7
2	mg/kg		92.3	68.5	88.6	52.1	58.1	78.2	50.1	85.9	129	49.8
3	mg/kg		69.3	82.8	88.9	55.3	53.5	68.6	48.8	73.8	109	59.5
4	mg/kg		64.5	83.3	89.3	51.7	56.5	63.5	51.2	63.4	91.4	54.4
5	mg/kg		70.4	104	122	55.4	51.1	72.7	49.2	65.9	79.2	52.5
6	mg/kg		74.7	63.1	78.5	55.6	61.3	63.6	59.4	49.8	99.4	62.7
7	mg/kg		78.4	64.1	86.2	57.4	59.2	62.0	58.0	58.6	56.1	58.9
8	mg/kg		114	62.6	104	51.8	62.0	69.1	60.8	67.5	73.4	68.5
9	mg/kg		81.8	60.5	115	48.8	72.8	56.3	52.3	71.2	97.3	56.8
10	mg/kg		80.3	86.3	118	51.2	63.3	65.2	54.1	56.0	56.4	59.5

Notes:
mg/kg = milligrams per kilogram

Table 7
Summary of Cadmium Data
Hamilton County Background Soils Summary Report

Sample	Location		SW	FP	MAF	SHAW	AV	DP	MWW	JHP	WW	MMF
	Units											
1	mg/kg		<0.448	<0.442	<0.425	<0.418	<0.360	<0.451	<0.433	<0.376	<0.365	<0.461
2	mg/kg		<0.462	<0.424	<0.404	<0.404	<0.443	<0.498	<0.401	0.446	<0.488	<0.411
3	mg/kg		<0.453	<0.450	<0.399	<0.456	<0.455	<0.437	<0.398	<0.442	<0.485	<0.408
4	mg/kg		<0.457	<0.406	<0.382	<0.461	<0.468	<0.471	<0.442	<0.443	<0.470	<0.398
5	mg/kg		<0.450	<0.421	<0.409	<0.446	<0.443	<0.442	<0.406	<0.461	<0.402	<1.02
6	mg/kg		<0.416	<0.429	<0.425	<0.433	<0.418	<0.431	<0.437	<0.458	<0.493	<0.465
7	mg/kg		<0.450	<0.433	<0.421	<0.420	<0.453	<0.448	<0.433	<0.473	<0.386	<0.422
8	mg/kg		<0.449	<0.432	<0.368	<0.467	<0.432	<0.468	<0.421	<0.473	<0.497	<0.453
9	mg/kg		<0.453	<0.392	<0.391	<0.433	<0.460	<0.461	<0.427	<0.477	<0.477	<0.455
10	mg/kg		<0.431	<0.455	<0.406	<0.420	<0.423	<0.455	<0.417	<0.372	<0.406	<0.409

Notes:
mg/kg – milligrams per kilogram

Table 8
Summary of Chromium Data
Hamilton County Background Soils Summary Report

Sample	Location		SW	FP	MAF	SHAW	AV	DP	MWW	JHP	WW	MMF
	Units											
1	mg/kg		9.07	13.2	12.1	8.40	8.68	14.3	8.90	19.6	15.1	14.3
2	mg/kg		14.8	18.8	12.6	7.40	8.32	15.0	7.11	12.2	24.0	13.6
3	mg/kg		9.01	18.0	9.49	9.73	6.88	15.3	7.21	13.2	15.8	15.5
4	mg/kg		8.41	13.5	11.0	8.84	7.47	15.6	8.75	17.5	15.9	17.7
5	mg/kg		8.90	13.1	9.33	8.55	6.65	18.8	6.57	14.4	11.4	17.3
6	mg/kg		10.5	18.1	9.51	8.62	8.43	16.3	9.05	14.1	13.8	12.6
7	mg/kg		10.6	16.1	15.0	10.2	8.18	10.8	9.30	15.4	11.1	15.0
8	mg/kg		10.7	15.5	10.9	7.89	8.34	15.8	7.53	15.4	15.0	14.5
9	mg/kg		9.29	15.9	12.8	9.94	9.42	15.9	7.22	12.2	15.3	11.9
10	mg/kg		10.2	16.5	13.7	7.51	9.22	13.5	8.73	9.37	9.75	14.1

Notes:
mg/kg – milligrams per kilogram

Table 9
Summary of Lead Data
Hamilton County Background Soils Summary Report

Sample	Location		SW	FP	MAF	SHAW	AV	DP	MWW	JHP	WW	MMF
	Units											
1	mg/kg		12.8	17.5	44.0	14.6	16.5	28.7	62.9	20.1	13.8	25.8
2	mg/kg		18.6	15.6	28.6	16.2	27.9	45.5	13.3	22.6	25.6	18.9
3	mg/kg		14.9	19.8	27.5	16.0	17.4	32.9	12.6	16.7	15.2	24.1
4	mg/kg		13.2	21.5	25.0	15.3	18.7	41.7	12.9	18.2	17.3	23.6
5	mg/kg		15.0	19.3	99.7	18.1	18.0	25.1	13.8	21.2	11.9	23.4
6	mg/kg		15.8	14.9	25.9	13.2	15.3	26.2	15.2	18.8	17.3	22.1
7	mg/kg		15.7	17.0	33.5	14.0	13.6	21.1	14.0	63.0	14.9	20.3
8	mg/kg		19.7	18.8	23.9	14.1	15.7	25.9	13.8	22.3	17.7	18.0
9	mg/kg		14.5	17.7	62.2	14.6	22.5	23.9	20.1	13.8	15.5	21.8
10	mg/kg		24.4	19.0	61.1	15.4	19.4	26.4	22.6	25.6	11.4	28.0

Notes:
mg/kg – milligrams per kilogram

Table 10
Summary of Mercury Data
Hamilton County Background Soils Summary Report

Sample	Location		SW	FP	MAF	SHAW	AV	DP	MWW	JHP	WW	MMF
	Units											
1	mg/kg		0.0308	0.0358	0.0288	0.0365	0.0587	0.0366	<0.0109	0.0156	0.0194	0.0326
2	mg/kg		0.0366	0.0336	0.0401	0.0387	0.0372	0.0512	<0.0111	0.0145	0.0255	0.0264
3	mg/kg		0.0246	0.0443	0.0377	0.0267	0.0274	0.0529	<0.0112	0.0200	0.0326	0.0261
4	mg/kg		0.0342	0.0493	0.0385	0.0277	0.0329	0.0522	<0.0114	0.0135	0.0333	0.0309
5	mg/kg		0.0332	0.0394	0.0430	0.0283	0.0632	0.0448	<0.0120	0.0121	0.0184	0.0325
6	mg/kg		0.0281	0.0357	0.0433	0.0277	0.0774	0.0483	<0.0116	0.0195	0.0273	0.0257
7	mg/kg		0.0307	0.0342	0.0420	0.0173	0.116	0.0334	<0.0116	0.0262	0.0337	0.0293
8	mg/kg		0.0342	0.0364	0.0302	0.0306	0.0432	0.0423	<0.0115	0.0254	0.0289	0.0221
9	mg/kg		0.0256	0.0370	0.0396	0.0244	0.0434	0.0408	<0.0114	0.0280	0.0278	0.0257
10	mg/kg		0.0441	0.0386	0.0239	0.0497	0.0343	0.0463	<0.0111	0.0478	0.0268	0.0276

Notes:
mg/kg – milligrams per kilogram

Table 11
Summary of Nickel Data
Hamilton County Background Soils Summary Report

Sample	Location		SW	FP	MAF	SHAW	AV	DP	MWW	JHP	WW	MMF
	Units											
1	mg/kg		11.1	10.8	9.79	12.2	12.0	10.7	9.21	12.9	21.7	12.1
2	mg/kg		16.7	12.5	10.3	11.1	10.8	12.5	7.24	11.7	42.8	11.2
3	mg/kg		11.8	12.8	8.93	13.0	9.91	10.6	7.58	11.2	35.1	12.7
4	mg/kg		11.0	11.2	9.75	11.9	10.8	9.34	9.46	15.3	23.1	13.6
5	mg/kg		11.8	11.7	9.20	12.2	9.63	9.44	6.70	10.9	26.4	13.2
6	mg/kg		12.8	11.9	8.33	12.3	11.9	9.42	9.39	10.2	22.2	13.4
7	mg/kg		12.8	11.6	10.8	13.5	11.6	9.36	9.83	9.78	20.0	11.5
8	mg/kg		14.9	11.4	9.42	11.3	11.8	10.9	7.76	11.3	25.7	12.6
9	mg/kg		12.6	11.4	9.77	12.4	12.6	9.50	7.10	11.0	30.7	10.8
10	mg/kg		13.2	12.2	10.9	10.8	12.3	10.7	9.23	8.72	17.2	11.8

Notes:
mg/kg – milligrams per kilogram

Table 12
Summary of Selenium Data
Hamilton County Background Soils Summary Report

Sample	Location		SW	FP	MAF	SHAW	AV	DP	MWW	JHP	WW	MMF
	Units											
1	mg/kg		0.806	0.731	0.858	0.788	0.649	1.63	0.646	0.546	0.787	0.766
2	mg/kg		0.838	0.773	0.874	0.938	0.683	0.992	0.542	0.874	0.591	0.610
3	mg/kg		0.742	0.815	0.856	0.745	0.600	1.07	0.523	0.798	0.825	0.862
4	mg/kg		0.676	0.896	0.788	0.709	0.611	0.810	0.622	0.435	0.833	0.672
5	mg/kg		0.754	0.984	0.902	0.714	0.720	0.934	0.706	0.760	0.558	0.616
6	mg/kg		0.806	0.642	0.894	1.20	0.702	0.945	0.667	0.413	0.842	0.648
7	mg/kg		0.868	0.889	0.902	0.362	0.571	0.854	0.577	0.618	0.763	0.500
8	mg/kg		0.766	0.861	0.769	0.955	0.631	0.947	0.694	0.833	0.782	0.653
9	mg/kg		0.645	0.648	0.793	0.813	0.887	1.18	0.539	0.818	0.786	0.640
10	mg/kg		1.02	0.645	1.03	0.973	0.681	0.967	0.583	0.705	1.98	1.06

Notes:
mg/kg – milligrams per kilogram

Table 13
Summary of Thallium Data
Hamilton County Background Soils Summary Report

Sample	Location		SW	FP	MAF	SHAW	AV	DP	MWW	JHP	WW	MMF
	Units											
1	mg/kg		0.142	0.158	0.187	0.188	0.144	0.260	0.174	0.205	0.229	0.180
2	mg/kg		0.138	0.203	0.19	0.176	0.146	0.173	0.130	0.224	0.394	0.155
3	mg/kg		0.132	0.173	0.160	0.204	0.119	0.286	0.149	0.201	0.239	0.277
4	mg/kg		0.144	0.168	0.164	0.167	0.134	0.173	0.182	0.337	0.309	0.202
5	mg/kg		0.130	0.207	0.220	0.189	0.140	0.286	0.154	0.182	0.313	0.197
6	mg/kg		0.128	0.164	0.201	0.178	0.162	0.173	0.183	0.187	0.408	0.156
7	mg/kg		0.113	0.200	0.181	0.160	0.147	0.176	0.173	0.212	0.261	0.154
8	mg/kg		0.144	0.175	0.160	0.234	0.180	0.194	0.185	0.170	0.530	0.200
9	mg/kg		0.136	0.130	0.161	0.205	0.148	0.179	0.130	0.198	0.282	0.234
10	mg/kg		0.193	0.152	0.198	0.203	0.158	0.210	0.179	0.175	0.448	0.250

Notes:
mg/kg – milligrams per kilogram

APPENDIX A

BORING LOGS (PRELIMINARY SOIL BORINGS)

Ohio Environmental Protection Agency
4675 Homer-Ohio Lane
Groveport, OH 43125
Telephone: (614) 836-8760, Fax: (614) 836-8795
Edward.Link@epa.ohio.gov

Avoca Pk., Co. Conserv. Area (AVO)
8063 Wooster Pk, (L Miami bike trailhead)
Cincinnati, OH 45227
Hamilton County, SWDO

Project No./Type: NA/County Soil Background

DERR-SIFU
Soil Boring Log
AVO--PSBs: AVO-1 & 4

LAT/LONG and/or **LOCATION DESCRIPTION:** Lat 39.138340° / Long 84.340710°, in woods; ~325' SE of picnic pavillon building at park's parking area

GROUND ELEVATION: ~490 ft. a.m.s.l. | **TOC ELEVATION:** NA | **DRILLING SERVICES:** Ohio EPA - SIFU - DERR

START DATE: 12/17/14 | **COMPLETION DATE:** 12/17/14 | **DRILLER:** Gavin Armstrong, Karl Reinbold, Jeff Wander

DRILLING & SAMPLING METHODS: Hand Auger | **LOGGED BY:** Gavin Armstrong, Karl Reinbold or Jeff Wander

DIAMETER (in): ~2 | **TOTAL DEPTH** (ft): 4 | **REFUSAL** (ft): NA

GROUND WATER LEVELS

Date	Time	Depth (ft)	Notes

NOTES: Preliminary Soil Boring (PSB) & Laboratory Sampling both performed on a cloudy & cold day.

DEPTH (ft)	CORING: Core Type	CORING: Core Interval/ Recovery (ft)	SAMPLING: Sample Interval (ft)	SAMPLING: Sample Purpose/ID	SAMPLING: PID (ppmv)	REMARKS	GRAPHIC LOG	USCS	MATERIAL DESCRIPTION
	HA	0.0-0.5 0.5	0.0 - 0.5		NA	2	0.5'	ML/SM	**USCS Sandy Silt (USDA Sandy Silt):** dark brown, slight grey
	HA	0.5-1.0 0.5	0.5 - 1.0	Lab Sample, AV--1, 0--2 ft., COMPOSITE -------- XRF screening, AVO-PSBs: AVO-1 & AVO-4, 0.0--2.0 ft.	NA		1'	CL/ML	same as above
1	HA	1.0-1.5 0.5	1.0 - 1.5		NA		1.5'	CL/ML	same as above
	HA	1.5-2.0 0.5	1.5 - 2.0		NA		2'	CL/ML	same as above
2	HA	2.0-2.5 0.5	2.0 - 2.5		NA		2.5'	CL/ML	same as above
	HA	2.5-3.0 0.5	2.5 - 3.0		NA		3'	CL/ML	same as above
3	HA	3.0-3.5 0.5	3.0 - 3.5		NA		3.5'	CL/ML	same as above
	HA	3.5-4.0 0.5	3.5 - 4.0		NA		4'	CL/ML	same as above
4									

Soil analytical and geotechnical testing samples AV-1 through AV-10 were collected on 2014-12-17. AV-1 was collected adjacent to the AVO-PSB locations (AVO-1 & AVO-4), and AV-2 through AV-10 were collected at random locations within a 15 ft. radius of AVO-PSBs. Each sample was collected from ground surface to a depth of 2 ft. using a 1.5 to 2-inch inside diameter hand auger. Each sample was homogenized in the field and submitted to Microbac Laboratories of Marietta, OH for RCRA metals analysis (As, Ba, Cd, Cr, Pb, Hg, Se) with Ni substituted for Ag and Tl added. In addition, sample AV-1 was submitted to Geotechnics of Pittsburgh, PA for sieve and hydrometer analyses, Atterberg limits, and USDA and USCS laboratory soil classification.

REMARKS:
1. Samples from this location have been identified with the prefix of either **AV** or **AVO**.
2. Based on lab analysis, homogenized soil from 0.0-2.0 ft deep (sampling location AV-1) consists of **USCS Lean Clay with Sand (CL, TESTED) / USDA Silt Loam**.

SURVEY BENCHMARK & DATUM: Trimble sub-meter GPS, Pathfinder conversion software, Google Maps, ArcGIS

OHIO EPA GEOPROBE LOG - OHIO EPA GEOPROBE LOG.GDT - 4/13/15 12:55 - G:\HAMILTON_CO_BKG_SOILS_STUDY\HC-AVOCA_PK.GPJ

Ohio Environmental Protection Agency
4675 Homer-Ohio Lane
Groveport, OH 43125
Telephone: (614) 836-8760, Fax: (614) 836-8795
Edward.Link@epa.ohio.gov

Delhi Park, Delhi Township (DP)
~5125 Foley Road,
Cincinnati, OH 45238
Hamilton County, SWDO

Project No./Type: NA/County Soil Background

DERR-SIFU
Soil Boring Log
DP--PSBs: DP-1 & DP-2

LAT/LONG and/or **LOCATION DESCRIPTION:** Lat 39.099990° / Long 84.612840°, in woods; S end of N pk. parcel; ~170' NNW of pk.'s hexagonal pavillon

GROUND ELEVATION: ~860 ft. a.m.s.l. | **TOC ELEVATION:** NA | **DRILLING SERVICES:** Ohio EPA - SIFU - DERR

START DATE: 11/25/14 | **COMPLETION DATE:** 11/25/14 | **DRILLER:** Gavin Armstrong, Karl Reinbold, Jeff Wander

DRILLING & SAMPLING METHODS: Hand Auger | **LOGGED BY:** Gavin Armstrong, Karl Reinbold or Jeff Wander

DIAMETER (in): ~2 | **TOTAL DEPTH** (ft): 4 | **REFUSAL** (ft): NA

GROUND WATER LEVELS

Date	Time	Depth (ft)	Notes

NOTES: Preliminary Soil Boring (PSB) & Laboratory sampling both performed on a sunny/cloudy day in low 40's F.

DEPTH (ft)	CORING: Core Type	CORING: Core Interval/ Recovery (ft)	SAMPLING: Sample Interval (ft)	SAMPLING: Sample Purpose/ID	SAMPLING: PID (ppmv)	REMARKS	GRAPHIC LOG	USCS	MATERIAL DESCRIPTION
	HA	0.0-0.5 0.5	0.0 - 0.5	Lab Sample, DP--1, 0--2 ft., COMPOSITE --------- XRF screening, DP-PSBs: DP-1 & DP-2, 0.0--2.0 ft	NA	1	0.5'	ML/SM	**USCS Silty Clay (USDA Silty Clay):** dark brown/grey silty clay, some sand, heavy root zone, glass fragments in DP-10 area near picnic benches
	HA	0.5-1.0 0.5	0.5 - 1.0		NA		1'	CL/ML	same as above, but brown
1	HA	1.0-1.5 0.5	1.0 - 1.5		NA		1.5'	CL/ML	**USCS Silt, Sandy & Clayey (USDA Sandy Clayey Silt):** light brown, clay silt w/ some sand
	HA	1.5-2.0 0.5	1.5 - 2.0		NA		2'	ML	**USCS Silt (USDA Silt):** tan silt, dry
2	HA	2.0-2.5 0.5	2.0 - 2.5		NA		2.5'	ML	same as above
	HA	2.5-3.0 0.5	2.5 - 3.0		NA		3'	CL/ML	**USCS Clayey Silt (USDA Clayey Silt):** tan clayey silt, some mositure
3	HA	3.0-3.5 0.5	3.0 - 3.5		NA		3.5'	CL/ML	same as above, but dark tan, moist
4	HA	3.5-4.0 0.5	3.5 - 4.0		NA		4'	ML/SM	**USCS Silty Clay (USDA Silty Clay):** tab silty clay

Soil analytical and geotechnical testing samples DP-1 through DP-10 were collected on 2014-11-25. DP-1 was collected adjacent to the DP-PSB locations (DP-1 & DP-2), and DP-2 through DP-10 were collected at random locations within a 15 ft. radius of DP--PSBs. Each sample was collected from ground surface to a depth of 2 ft. using a 1.5 to 2-inch inside diameter hand auger. Each sample was homogenized in the field and submitted to Microbac Laboratories of Marietta, OH for RCRA metals analysis (As, Ba, Cd, Cr, Pb, Hg, Se) with Ni substituted for Ag and Tl added. In addition, sample DP-1 was submitted to Geotechnics of Pittsburgh, PA for sieve and hydrometer analyses, Atterberg limits, and USDA and USCS laboratory soil classification.

REMARKS:
1. Based on lab analysis, homogenized soil from 0.0-2.0 ft deep (sampling location DP-1) consists of **USCS Clay, Lean (CL, TESTED) / USDA Silt Loam**.

SURVEY BENCHMARK & DATUM: Trimble sub-meter GPS, Pathfinder conversion software, Google Maps, ArcGIS

OHIO EPA GEOPROBE LOG - OHIO EPA GEOPROBE LOG.GDT - 4/13/15 12:55 - G:\HAMILTON_CO_BKG_SOILS_STUDY\HC--DEPHI_PK.GPJ

Ohio Environmental Protection Agency
4675 Homer-Ohio Lane
Groveport, OH 43125
Telephone: (614) 836-8760, Fax: (614) 836-8795
Edward.Link@epa.ohio.gov

French Park, Metro Park (FP)
3012 Section Road,
Cincinnati, OH 45237
Hamilton County, SWDO

Project No./Type: NA/County Soil Background

DERR-SIFU
Soil Boring Log
FP--PSBs: FP-1 & FP-2

LAT/LONG and/or **LOCATION DESCRIPTION:** Lat 39.171490° / Long 84.562000°, in woods' edge; ~270' NNE of turnaround circle @ end of driveway

GROUND ELEVATION: ~825 ft. a.m.s.l. | **TOC ELEVATION:** NA | **DRILLING SERVICES:** Ohio EPA - SIFU - DERR

START DATE: 10/27/14 | **COMPLETION DATE:** 10/27/14 | **DRILLER:** G. Armstrong, K. Jones, K. Reinbold, J. Wander

DRILLING & SAMPLING METHODS: Hand Auger | **LOGGED BY:** Gavin Armstrong, Karl Reinbold or Jeff Wander

DIAMETER (in): ~2 | **TOTAL DEPTH** (ft): 4 | **REFUSAL** (ft): NA

NOTES: Preliminary Soil Boring (PSB) & Laboratory sampling both performed on a partly cloudy, dry day.

GROUND WATER LEVELS

Date	Time	Depth (ft)	Notes

DEPTH (ft)	CORING: Core Type	CORING: Core Interval/ Recovery (ft)	SAMPLING: Sample Interval (ft)	SAMPLING: Sample Purpose/ID	SAMPLING: PID (ppmv)	REMARKS	GRAPHIC LOG	USCS	MATERIAL DESCRIPTION
	HA	0.0-0.5 0.5	0.0 - 0.5		NA	1	0.5'	ML	**USCS Silt (USDA Silt):** light brown silt
	HA	0.5-1.0 0.5	0.5 - 1.0	Lab Sample, FP--1, 0--2 ft., COMPOSITE --------- XRF screening, FP-PSBs: FP-1 & FP-2, 0.0--2.0 ft.	NA		1'	CL/ML	**USCS Silt, Clayey (USDA Clayey Silt):** light brown clayey silt
1	HA	1.0-1.5 0.5	1.0 - 1.5		NA		1.5'	CL/ML	**USCS Clay, Silty (USDA Silty Clay):** light brown silty clay
	HA	1.5-2.0 0.5	1.5 - 2.0		NA		2'	CL/ML	same as above
2	HA	2.0-2.5 0.5	2.0 - 2.5		NA		2.5'	CL/ML	**USCS Clayey Silt (USDA Clayey Silt):** light brown/tan clayey silt
	HA	2.5-3.0 0.5	2.5 - 3.0		NA		3'	CL/ML	same as above, tan grey
3	HA	3.0-3.5 0.5	3.0 - 3.5		NA		3.5'	CL/ML	same as above
	HA	3.5-4.0 0.5	3.5 - 4.0		NA		4'	CL/ML	same as above
4									

Soil analytical and geotechnical testing samples FP-1 through FP-10 were collected on 2014-10-27. FP-1 was collected adjacent to the FP-PSB locations (FP-1 & FP-2), and FP-2 through FP-10 were collected at random locations within a 15 ft. radius of FP--PSBs. Each sample was collected from ground surface to a depth of 2 ft. using a 1.5 to 2-inch inside diameter hand auger. Each sample was homogenized in the field and submitted to Microbac Laboratories of Marietta, OH for RCRA metals analysis (As, Ba, Cd, Cr, Pb, Hg, Se) with Ni substituted for Ag and Tl added. In addition, sample FP-1 was submitted to Geotechnics of Pittsburgh, PA for sieve and hydrometer analyses, Atterberg limits, and USDA and USCS laboratory soil classification.

REMARKS:
1. Based on lab analysis, homogenized soil from 0.0-2.0 ft deep (sampling location FP-1) consists of **USCS Clay, Lean (CL, TESTED) / USDA Silt Loam**.

SURVEY BENCHMARK & DATUM: Trimble sub-meter GPS, Pathfinder conversion software, Google Maps, ArcGIS

OHIO EPA GEOPROBE LOG - OHIO EPA GEOPROBE LOG.GDT - 4/13/15 12:54 - G:\HAMILTON_CO_BKG_SOILS_STUDY\HC--FRENCH_PK.GPJ

Ohio Environmental Protection Agency
4675 Homer-Ohio Lane
Groveport, OH 43125
Telephone: (614) 836-8760, Fax: (614) 836-8795
Edward.Link@epa.ohio.gov

Johnson Hills Pk, Anderson Twp (JHP)
7950 Bridle Road,
Cincinnati, Ohio 45244
Hamilton County, SWDO

Project No./Type: NA/County Soil Background

DERR-SIFU
Soil Boring Log
JHP-PSBs: JHP-1 & 6

LAT/LONG and/or **LOCATION DESCRIPTION:** Lat 39.110710° / Long 84.331440°, near treeline; ~355' WSW of "pole barn" bldg. @ N end of service rd.

GROUND ELEVATION: ~850 ft. a.m.s.l. | **TOC ELEVATION:** NA | **DRILLING SERVICES:** Ohio EPA - SIFU - DERR

START DATE: 12/17/14 | **COMPLETION DATE:** 12/17/14 | **DRILLER:** Gavin Armstrong, Karl Reinbold, Jeff Wander

DRILLING & SAMPLING METHODS: Hand Auger | **LOGGED BY:** Gavin Armstrong, Karl Reinbold or Jeff Wander

DIAMETER (in): ~2 | **TOTAL DEPTH** (ft): 4 | **REFUSAL** (ft): NA

GROUND WATER LEVELS

Date	Time	Depth (ft)	Notes

NOTES: Preliminary Soil Boring (PSB) & Laboratory sampling both performed on a cloudy, cold day.

DEPTH (ft)	CORING: Core Type	CORING: Core Interval/ Recovery (ft)	SAMPLING: Sample Interval (ft)	SAMPLING: Sample Purpose/ID	SAMPLING: PID (ppmv)	REMARKS	GRAPHIC LOG	USCS	MATERIAL DESCRIPTION
	HA	0.0-0.5 0.5	0.0 - 0.5		NA	1 2	0.5'	ML	**USCS Silt with Clay & Gravel (USDA Silt):** dark brown silts with some clay & gravel
	HA	0.5-1.0 0.5	0.5 - 1.0	Lab Sample, JHP--1, 0--2 ft., COMPOSITE --------- XRF screening, JHP-PSBs: JPH-1 & JPH-6, 0.0--2.0 ft.	NA		1'	CL	**USCS Lean Clay (USDA Lean Clay):** brown clay
1	HA	1.0-1.5 0.5	1.0 - 1.5		NA		1.5'	CL/ML	**USCS Clayey Silt (USDA Clayey Silt):** light brown clayey silt
	HA	1.5-2.0 0.5	1.5 - 2.0		NA		2'	CL/ML	same as above
2	HA	2.0-2.5 0.5	2.0 - 2.5		NA		2.5'	CL/ML	same as above
	HA	2.5-3.0 0.5	2.5 - 3.0		NA		3'	CL/ML	same as above
3	HA	3.0-3.5 0.5	3.0 - 3.5		NA		3.5'	CL/ML	same as above
	HA	3.5-4.0 0.5	3.5 - 4.0		NA		4'	CL/ML	same as above
4									

Soil analytical and geotechnical testing samples JHP-1 through JHP-10 were collected on 2014-12-17. JHP-1 was collected adjacent to the JHP-PSB locations (JHP-1 & JHP-6), and JHP-2 through JHP-10 were collected at random locations within a 15 ft. radius of JHP-PSBs. Each sample was collected from ground surface to a depth of 2 ft. using a 1.5 to 2-inch inside diameter hand auger. Each sample was homogenized in the field and submitted to Microbac Laboratories of Marietta, OH for RCRA metals analysis (As, Ba, Cd, Cr, Pb, Hg, Se) with Ni substituted for Ag and Tl added. In addition, sample JHP-1 was submitted to Geotechnics of Pittsburgh, PA for sieve and hydrometer analyses, Atterberg limits, and USDA and USCS laboratory soil classification.

REMARKS:
1. Samples from this location have been identified with the prefix of either **JHP** or **JPH**.
2. Based on lab analysis, homogenized soil from 0.0-2.0 ft deep (sampling location JHP-1) consists of **USCS Clay, Lean (CL, TESTED) / USDA Silt Loam**.

SURVEY BENCHMARK & DATUM: Trimble sub-meter GPS, Pathfinder conversion software, Google Maps, ArcGIS

OHIO EPA GEOPROBE LOG - OHIO EPA GEOPROBE LOG.GDT - 4/13/15 12:53 - G:\HAMILTON_CO_BKG_SOILS_STUDY\HC--JOHNSON.GPJ

Ohio Environmental Protection Agency
4675 Homer-Ohio Lane
Groveport, OH 43125
Telephone: (614) 836-8760, Fax: (614) 836-8795
Edward.Link@epa.ohio.gov

Mount Airy Forest, Metro Pk. (MAF)
5083 Colerain Ave., (Oak Ridge Rd.),
Cincinnati, Ohio 45223
Hamilton County, SWDO

Project No./Type: NA/County Soil Background

DERR-SIFU
Soil Boring Log
MAF-PSBs: MAF-1 & 9

LAT/LONG and/or **LOCATION DESCRIPTION:** Lat 39.171460° / Long 84.562030°, In woods; ~180' NE of Oak Ridge Rd@circle,~2150' SE of Trail Ridge Rd

GROUND ELEVATION: ~805 ft. a.m.s.l. | **TOC ELEVATION:** NA | **DRILLING SERVICES:** Ohio EPA -- DERR -- SIFU

START DATE: 10/28/14 | **COMPLETION DATE:** 10/28/14 | **DRILLER:** Gavin Armstrong, Karl Reinbold, Jeff Wander

DRILLING & SAMPLING METHODS: Hand Auger | **LOGGED BY:** Gavin Armstrong, Karl Reinbold or Jeff Wander

DIAMETER (in): ~2 | **TOTAL DEPTH** (ft): 4 | **REFUSAL** (ft): NA

GROUND WATER LEVELS

Date	Time	Depth (ft)	Notes

NOTES: Preliminary Soil Boring (PSB) & Laboratory sampling both performed on a cloudy, cold day.

DEPTH (ft)	CORING: Core Type	CORING: Core Interval/ Recovery (ft)	SAMPLING: Sample Interval (ft)	SAMPLING: Sample Purpose/ID	SAMPLING: PID (ppmv)	REMARKS	GRAPHIC LOG	USCS	MATERIAL DESCRIPTION
	HA	0.0-0.5 0.5	0.0 - 0.5		NA	1	0.5'	CL/ML	**USCS Clayey Silt (USDA Clayey Silt):** grey/brown silt (slight clay)
	HA	0.5-1.0 0.5	0.5 - 1.0	Lab Sample, MAF-1, 0--2 ft., COMPOSITE --------- XRF screening, MAF-PSBs: MAF-1 & MAF-9, 0.0--2.0 ft.	NA		1'	ML	**USCS Silt (USDA Silt):** grey/brown silt
1	HA	1.0-1.5 0.5	1.0 - 1.5		NA		1.5'	ML/SM	**USCS Sandy Silt (USDA Sandy Silt):** light brown/tan sandy silt
	HA	1.5-2.0 0.5	1.5 - 2.0		NA		2'	ML/SM	same as above
2	HA	2.0-2.5 0.5	2.0 - 2.5		NA		2.5'	ML/SM	same as above
	HA	2.5-3.0 0.5	2.5 - 3.0		NA		3'	CL/ML	**USCS Clayey Silt with Sand (USDA Clayey Silt):** light brown/tan clayey silt, slight **Sand**
3	HA	3.0-3.5 0.5	3.0 - 3.5		NA		3.5'	CL/ML	**USCS Silty Clay (USDA Silty Clay):** light brown/tan silty clay
	HA	3.5-4.0 0.5	3.5 - 4.0		NA		4'	CL/ML	same as above
4									

Soil analytical and geotechnical testing samples MAF-1 through MAF-10 were collected on 2014-10-28. MAF-1 was collected adjacent to the MAF--PSB locations (MAF-1 & MAF-9), and MAF-2 through MAF-10 were collected at random locations within a 15 ft. radius of MAF--PSB. Each sample was collected from ground surface to a depth of 2 ft. using a 1.5 to 2-inch inside diameter hand auger. Each sample was homogenized in the field and submitted to Microbac Laboratories of Marietta, OH for RCRA metals analysis (As, Ba, Cd, Cr, Pb, Hg, Se) with Ni substituted for Ag and Tl added. In addition, sample MAF-1 was submitted to Geotechnics of Pittsburgh, PA for sieve and hydrometer analyses, Atterberg limits, and USDA and USCS laboratory soil classification.

REMARKS:
1. Based on lab analysis, homogenized soil from 0.0-2.0 ft deep (sampling location MAF-1) consists of **USCS Clay, Lean (CL, TESTED) / USDA Silt Loam.**

SURVEY BENCHMARK & DATUM: Trimble sub-meter GPS, Pathfinder conversion software, Google Maps, ArcGIS

OHIO EPA GEOPROBE LOG - OHIO EPA GEOPROBE LOG.GDT - 4/13/15 13:04 - G:\HAMILTON_CO_BKG_SOILS_STUDY\HC--MT_AIRY.GPJ

Ohio Environmental Protection Agency
4675 Homer-Ohio Lane
Groveport, OH 43125
Telephone: (614) 836-8760, Fax: (614) 836-8795
Edward.Link@epa.ohio.gov

Mitchell Memorial Forest, Co.Pk.(MMF)
5401 Zion Road,
Cleves, OH 45002
Hamilton County, SWDO

Project No./Type: NA/County Soil Background

DERR-SIFU
Soil Boring Log
MMF-PSBs: MMF-1 & 5

LAT/LONG and/or **LOCATION DESCRIPTION:** Lat 39.190490° / Long 84.722740°, In meadow ~70' N of Doty Rd., ~375' W of Buffalo Ridge Rd. intersection

GROUND ELEVATION: ~875 ft. a.m.s.l. | **TOC ELEVATION:** NA | **DRILLING SERVICES:** Ohio EPA -- DERR -- SIFU

START DATE: 10/28/14 | **COMPLETION DATE:** 10/28/14 | **DRILLER:** G. Armstrong, K. Jones, K. Reinbold, J. Wander

DRILLING & SAMPLING METHODS: Hand Auger | **LOGGED BY:** Gavin Armstrong, Karl Reinbold or Jeff Wander

DIAMETER (in): ~2 | **TOTAL DEPTH** (ft): 4 | **REFUSAL** (ft): NA

NOTES: Preliminary Soil Boring (PSB) & Laboratory sampling both performed on a cloudy, cold day.

GROUND WATER LEVELS

Date	Time	Depth (ft)	Notes

DEPTH (ft)	CORING: Core Type	CORING: Core Interval/ Recovery (ft)	SAMPLING: Sample Interval (ft)	SAMPLING: Sample Purpose/ID	SAMPLING: PID (ppmv)	REMARKS	GRAPHIC LOG	USCS	MATERIAL DESCRIPTION
	HA	0.0-0.5 0.5	0.0 - 0.5		NA	1	0.5'	CL/ML	**USCS Clayey Silt (USDA Clayey Silt):** dark brown clay silt
	HA	0.5-1.0 0.5	0.5 - 1.0	Lab Sample, MMF--1, 0--2 ft., COMPOSITE -------- XRF screening, MMF-PSBs: MMF-1 & MMF-5, 0.0--2.0 ft.	NA		1'	CL/ML	**USCS Silty Clay (USDA Silty Clay):** brown silty clay
1	HA	1.0-1.5 0.5	1.0 - 1.5		NA		1.5'	CL/ML	same as above, but light brown silty clay
	HA	1.5-2.0 0.5	1.5 - 2.0		NA		2'	CL/ML	same as above
2	HA	2.0-2.5 0.5	2.0 - 2.5		NA		2.5'	CL/ML	same as above
	HA	2.5-3.0 0.5	2.5 - 3.0		NA		3'	CL/ML	same as above
3	HA	3.0-3.5 0.5	3.0 - 3.5		NA		3.5'	CL/ML	same as above
	HA	3.5-4.0 0.5	3.5 - 4.0		NA		4'	CL/ML	same as above
4									

Soil analytical and geotechnical testing samples MMF-1 through MMF-10 were collected on 2014-10-28. MMF-1 was collected adjacent to the MMF-PSB locations (MMF-1 & MMF-5), and MMF-2 through MMF-10 were collected at random locations within a 15 ft. radius of MMF-PSBs. Each sample was collected from ground surface to a depth of 2 ft. using a 1.5 to 2-inch inside diameter hand auger. Each sample was homogenized in the field and submitted to Microbac Laboratories of Marietta, OH for RCRA metals analysis (As, Ba, Cd, Cr, Pb, Hg, Se) with Ni substituted for Ag and Tl added. In addition, sample MMF-1 was submitted to Geotechnics of Pittsburgh, PA for sieve and hydrometer analyses, Atterberg limits, and USDA and USCS laboratory soil classification.

REMARKS:
1. Based on lab analysis, homogenized soil from 0.0-2.0 ft deep (sampling location MMF-1) consists of **USCS Clay, Lean with Sand (CL, TESTED) / USDA Silt Loam**.

SURVEY BENCHMARK & DATUM: Trimble sub-meter GPS, Pathfinder conversion software, Google Maps, ArcGIS

OHIO EPA GEOPROBE LOG - OHIO EPA GEOPROBE LOG.GDT - 4/13/15 13:12 - G:\HAMILTON_CO_BKG_SOILS_STUDY\HC--MITCHELL_FOREST.GPJ

Ohio Environmental Protection Agency
4675 Homer-Ohio Lane
Groveport, OH 43125
Telephone: (614) 836-8760, Fax: (614) 836-8795
Edward.Link@epa.ohio.gov

Miami Whitewater Forest Co.Pk.(MWW)
~9467 Harrison Ave.,(Timber Lakes Dr.)
Cleves, OH 45002
Hamilton County, SWDO

Project No./Type: NA/County Soil Background

DERR-SIFU
Soil Boring Log
MWW-PSBs: MWW-1&4

LAT/LONG and/or **LOCATION DESCRIPTION:** Lat 39.240430° / Long 84.759530°, At parking area, ~3650' (road distance) from Harrison Ave. entrance

GROUND ELEVATION: ~765 ft. a.m.s.l | **TOC ELEVATION:** NA | **DRILLING SERVICES:** Ohio EPA - SIFU - DERR

START DATE: 10/28/14 | **COMPLETION DATE:** 10/28/14 | **DRILLER:** G. Armstrong, K. Jones, K. Reinbold, J. Wander

DRILLING & SAMPLING METHODS: Hand Auger | **LOGGED BY:** Gavin Armstrong, Karl Reinbold or Jeff Wander

DIAMETER (in): ~2 | **TOTAL DEPTH** (ft): 4 | **REFUSAL** (ft): NA

GROUND WATER LEVELS

Date	Time	Depth (ft)	Notes

NOTES: Preliminary Soil Boring (PSB) & Laboratory sampling both performed on a cloudy, cold day.

DEPTH (ft)	CORING: Core Type	CORING: Core Interval/ Recovery (ft)	SAMPLING: Sample Interval (ft)	SAMPLING: Sample Purpose/ID	SAMPLING: PID (ppmv)	REMARKS	GRAPHIC LOG	USCS	MATERIAL DESCRIPTION
	HA	0.0-0.5 0.5	0.0 - 0.5		NA	1 2	0.5'	CL/ML	**USCS Clayey Silt (USDA Clayey Silt):** brown clay silt
	HA	0.5-1.0 0.5	0.5 - 1.0	Lab Sample, MWW--1, 0--2 ft., COMPOSITE --------- XRF screening, MWW-PSBs: MWW-1 & MWW-4, 0.0--2.0 ft.	NA		1'	CL/ML	same as above
1	HA	1.0-1.5 0.5	1.0 - 1.5		NA		1.5'	CL/ML	same as above
	HA	1.5-2.0 0.5	1.5 - 2.0		NA		2'	CL/ML	same as above
2	HA	2.0-2.5 0.5	2.0 - 2.5		NA		2.5'	CL/ML	same as above, but brown
	HA	2.5-3.0 0.5	2.5 - 3.0		NA		3'	CL/ML	same as above
3	HA	3.0-3.5 0.5	3.0 - 3.5		NA		3.5'	CL/ML	same as above
	HA	3.5-4.0 0.5	3.5 - 4.0		NA		4'	CL/ML	same as above
4									

Soil analytical and geotechnical testing samples MWW-1 through MWW-10 were collected on 2014-10-28. MWW-1 was collected adjacent to the MWW-PSB locations (MWW-1 & MWW-4), and MWW-2 through MWW-10 were collected at random locations within a 15 ft. radius of MWW--PSBs. Each sample was collected from ground surface to a depth of 2 ft. using a 1.5 to 2-inch inside diameter hand auger. Each sample was homogenized in the field and submitted to Microbac Laboratories of Marietta, OH for RCRA metals analysis (As, Ba, Cd, Cr, Pb, Hg, Se) with Ni substituted for Ag and Tl added. In addition, sample MWW-1 was submitted to Geotechnics of Pittsburgh, PA for sieve and hydrometer analyses, Atterberg limits, and USDA and USCS laboratory soil classification.

REMARKS:
1. Samples from this location have been identified with the prefix of either **MWP** or **MWW**.
2. Based on lab analysis, homogenized soil from 0.0-2.0 ft deep (sampling location MWW-1) consists of **USCS Clay, Lean (CL, TESTED) / USDA Silt Loam**.

SURVEY BENCHMARK & DATUM: Trimble sub-meter GPS, Pathfinder conversion software, Google Maps, ArcGIS

OHIO EPA GEOPROBE LOG - OHIO EPA GEOPROBE LOG.GDT - 4/13/15 13:16 - G:\HAMILTON_CO_BKG_SOILS_STUDY\HC--MIAMI_WHITEWATER.GPJ

Ohio Environmental Protection Agency
4675 Homer-Ohio Lane
Groveport, OH 43125
Telephone: (614) 836-8760, Fax: (614) 836-8795
Edward.Link@epa.ohio.gov

Sharon Woods, County Park (SW)
11450 Lebanon Road,
Cincinnati, OH 45241
Hamilton County, SWDO

Project No./Type: NA/County Soil Background

DERR-SIFU
Soil Boring Log
SW--PSBs: SW-1 & 3

LAT/LONG and/or **LOCATION DESCRIPTION:** Lat 39.274570° / Long 84.402670°, In woods; ~65' SE of Lone Oak Meadow picnic shelter off S. Meadow Dr.

GROUND ELEVATION: ~610 ft. a.m.s.l. | **TOC ELEVATION:** NA | **DRILLING SERVICES:** Ohio EPA -- DERR -- SIFU

START DATE: 10/27/14 | **COMPLETION DATE:** 10/27/14 | **DRILLER:** G. Armstrong, K. Jones, K. Reinbold, J. Wander

DRILLING & SAMPLING METHODS: Hand Auger | **LOGGED BY:** Gavin Armstrong, Karl Reinbold or Jeff Wander

DIAMETER (in): ~2 | **TOTAL DEPTH** (ft): 4 | **REFUSAL** (ft): NA

GROUND WATER LEVELS

Date	Time	Depth (ft)	Notes

NOTES: Preliminary Soil Boring (PSB) & Laboratory sampling both performed on a partly cloudy, dry day.

DEPTH (ft)	CORING: Core Type	CORING: Core Interval/ Recovery (ft)	SAMPLING: Sample Interval (ft)	SAMPLING: Sample Purpose/ID	SAMPLING: PID (ppmv)	REMARKS	GRAPHIC LOG	USCS	MATERIAL DESCRIPTION
	HA	0.0-0.5 0.5	0.0 - 0.5		NA	1	0.5'	ML/SM	**USCS Sandy Silt (USDA Sandy Silt):** dark brown sandy silt (almost all silt)
	HA	0.5-1.0 0.5	0.5 - 1.0	Lab Sample, SW--1, 0--2 ft., COMPOSITE -------- XRF screening, SW--PSBs: SW-1 & SW-3, 0.0--2.0 ft.	NA		1'	CL/ML	**USCS Silty Clay (USDA Silty Clay):** dark brown silty clay
1	HA	1.0-1.5 0.5	1.0 - 1.5		NA		1.5'	CL/ML	same as above, but brown (no sand)
	HA	1.5-2.0 0.5	1.5 - 2.0		NA		2'	CL/ML	same as above
2	HA	2.0-2.5 0.5	2.0 - 2.5		NA		2.5'	CL/ML	same as above
	HA	2.5-3.0 0.5	2.5 - 3.0		NA		3'	CL/ML	**USCS Clayey Silt (USDA Clayey Silt):** brown clayey silt
3	HA	3.0-3.5 0.5	3.0 - 3.5		NA		3.5'	ML/SM	**USCS Sandy Silt (USDA Sandy Silt):** brown sandy silty clay
	HA	3.5-4.0 0.5	3.5 - 4.0		NA		4'	ML/SM	same as above
4									

Soil analytical and geotechnical testing samples SW-1 through SW-10 were collected on 2014-10-27. SW-1 was collected adjacent to the SW--PSB locations (SW-1 & SW-3), and SW-2 through SW-10 were collected at random locations within a 15 ft. radius of SW--PSBs. Each sample was collected from ground surface to a depth of 2 ft. using a 1.5 to 2-inch inside diameter hand auger. Each sample was homogenized in the field and submitted to Microbac Laboratories of Marietta, OH for RCRA metals analysis (As, Ba, Cd, Cr, Pb, Hg, Se) with Ni substituted for Ag and Tl added. In addition, sample SW-1 was submitted to Geotechnics of Pittsburgh, PA for sieve and hydrometer analyses, Atterberg limits, and USDA and USCS laboratory soil classification.

REMARKS:
1. Based on lab analysis, homogenized soil from 0.0-2.0 ft deep (sampling location SW-1) consists of **USCS Clay, Lean (CL, TESTED) / USDA Silt Loam**.

SURVEY BENCHMARK & DATUM: Trimble sub-meter GPS, Pathfinder conversion software, Google Maps, ArcGIS

OHIO EPA GEOPROBE LOG - OHIO EPA GEOPROBE LOG.GDT - 4/13/15 13:23 - G:\HAMILTON_CO_BKG_SOILS_STUDY\HC--SHARON_WOODS.GPJ

Ohio Environmental Protection Agency
4675 Homer-Ohio Lane
Groveport, OH 43125
Telephone: (614) 836-8760, Fax: (614) 836-8795
Edward.Link@epa.ohio.gov

Shawnee Lookout, Co. Park (SHAW)
2008 Lawrenceburg Road,
North Bend, OH 45052
Hamilton County, SWDO

Project No./Type: NA/County Soil Background

DERR-SIFU
Soil Boring Log
SHAW-PSBs:SHAW-1&7

LAT/LONG and/or **LOCATION DESCRIPTION:** Lat 39.120660° / Long 84.808890°, In woods; ~50" W of westermost pk.rd.'s dead end @Miami Ft.Trailhead

GROUND ELEVATION: ~620 ft. a.m.s.l. | **TOC ELEVATION:** NA | **DRILLING SERVICES:** Ohio EPA -- DERR -- SIFU

START DATE: 10/28/14 | **COMPLETION DATE:** 10/28/14 | **DRILLER:** G. Armstrong, K. Jones, K. Reinbold, J. Wander

DRILLING & SAMPLING METHODS: Hand Auger | **LOGGED BY:** Gavin Armstrong, Karl Reinbold or Jeff Wander

DIAMETER (in): ~2 | **TOTAL DEPTH** (ft): 4 | **REFUSAL** (ft): NA

NOTES: Preliminary Soil Boring (PSB) & Laboratory sampling both performed on a partly cloudy, dry day.

GROUND WATER LEVELS

Date	Time	Depth (ft)	Notes

DEPTH (ft)	CORING: Core Type	CORING: Core Interval/ Recovery (ft)	SAMPLING: Sample Interval (ft)	SAMPLING: Sample Purpose/ID	SAMPLING: PID (ppmv)	REMARKS	GRAPHIC LOG	USCS	MATERIAL DESCRIPTION
	HA	0.0-0.5 0.5	0.0 - 0.5		NA	1	0.5'	CL/ML	**USCS Silty Loam (USDA Silt Loam):** dark brown silty loam
	HA	0.5-1.0 0.5	0.5 - 1.0	Lab Sample, SHAW--1, 0--2 ft., COMPOSITE -------- XRF screening, SHAW-PSBs: SHAW-1 & SHAW-7, 0.0--2.0 ft.	NA		1'	ML	same as above
1	HA	1.0-1.5 0.5	1.0 - 1.5		NA		1.5'	ML	**USCS Silt (USDA Silt):** dark brown silt
	HA	1.5-2.0 0.5	1.5 - 2.0		NA		2'	CL/ML	same as above, but light brown
2	HA	2.0-2.5 0.5	2.0 - 2.5		NA		2.5'	CL/ML	same as above
	HA	2.5-3.0 0.5	2.5 - 3.0		NA		3'	CL/ML	**USCS Silty Clay (USDA Silty Clay):** light brown silty clay
3	HA	3.0-3.5 0.5	3.0 - 3.5		NA		3.5'	ML/SM	same as above, light brown to slight tan
4	HA	3.5-4.0 0.5	3.5 - 4.0		NA		4'	ML/SM	same as above

Soil analytical and geotechnical testing samples SHAW-1 through SHAW-10 were collected on 2014-10-28. SHAW-1 was collected adjacent to the SHAW--PSB locations (SHAW-1 & SHAW-7), and SHAW-2 through SHAW--10 were collected at random locations within a 15 ft. radius of SHAW--PSBs. Each sample was collected from ground surface to a depth of 2 ft. using a 1.5 to 2-inch inside diameter hand auger. Each sample was homogenized in the field and submitted to Microbac Laboratories of Marietta, OH for RCRA metals analysis (As, Ba, Cd, Cr, Pb, Hg, Se) with Ni substituted for Ag and Tl added. In addition, sample SHAW-1 was submitted to Geotechnics of Pittsburgh, PA for sieve and hydrometer analyses, Atterberg limits, and USDA and USCS laboratory soil classification.

REMARKS:
1. Based on lab analysis, homogenized soil from 0.0-2.0 ft deep (sampling location SHAW-1) consists of **USCS Clay, Lean (CL, TESTED) / USDA Silt Loam**.

SURVEY BENCHMARK & DATUM: Trimble sub-meter GPS, Pathfinder conversion software, Google Maps, ArcGIS

OHIO EPA GEOPROBE LOG - OHIO EPA GEOPROBE LOG.GDT - 4/13/15 13:25 - G:\HAMILTON_CO_BKG_SOILS_STUDY\HC--SHAWNEE_LOOKOUT.GPJ

Ohio Environmental Protection Agency
4675 Homer-Ohio Lane
Groveport, OH 43125
Telephone: (614) 836-8760, Fax: (614) 836-8795
Edward.Link@epa.ohio.gov

Winton Woods, County Park (WW)
10245 Winton Road, (Valley View Rd.)
Cincinnati, OH 45231
Hamilton County, SWDO

Project No./Type: NA/County Soil Background

DERR-SIFU
Soil Boring Log
WW--PSBs: WW-1 & 2

LAT/LONG and/or **LOCATION DESCRIPTION:** Lat 39.256610° / Long 84.532910°, At treeline; ~960" W of Elm Ridge Overlook Shelter of of Valley View Rd.

GROUND ELEVATION: ~730 ft. a.m.s.l. | **TOC ELEVATION:** NA | **DRILLING SERVICES:** Ohio EPA -- DERR -- SIFU

START DATE: 11/25/14 | **COMPLETION DATE:** 11/25/14 | **DRILLER:** Gavin Armstrong, Karl Reinbold, Jeff Wander

DRILLING & SAMPLING METHODS: Hand Auger | **LOGGED BY:** Gavin Armstrong, Karl Reinbold or Jeff Wander

DIAMETER (in): ~2 | **TOTAL DEPTH** (ft): 4 | **REFUSAL** (ft): NA

NOTES: Preliminary Soil Boring (PSB) & Laboratory sampling both performed on a cloudy, cold day.

GROUND WATER LEVELS

Date	Time	Depth (ft)	Notes

DEPTH (ft)	CORING: Core Type	CORING: Core Interval/ Recovery (ft)	SAMPLING: Sample Interval (ft)	SAMPLING: Sample Purpose/ID	SAMPLING: PID (ppmv)	REMARKS	GRAPHIC LOG	USCS	MATERIAL DESCRIPTION
	HA	0.0-0.5 0.5	0.0 - 0.5		NA	1	0.5'	CL/ML	**USCS Silty Clay (USDA Silty Clay):** dark brown silty clay
	HA	0.5-1.0 0.5	0.5 - 1.0	Lab Sample, WW--1, 0--2 ft., COMPOSITE --------- XRF screening, WW--PSBs: WW-1 & WW-2, 0.0--2.0 ft.	NA		1'	CL/ML	**USCS Clayey Silt (USDA Clayey Silt):** light brown clayey silt
1	HA	1.0-1.5 0.5	1.0 - 1.5		NA		1.5'	CL/ML	same as above
	HA	1.5-2.0 0.5	1.5 - 2.0		NA		2'	CL/ML	**USCS Silty Clay (USDA Silty Clay):** light brown silty clay
2	HA	2.0-2.5 0.5	2.0 - 2.5		NA		2.5'	CL/ML	same as above
	HA	2.5-3.0 0.5	2.5 - 3.0		NA		3'	CL/ML	same as above, but with some sands
3	HA	3.0-3.5 0.5	3.0 - 3.5		NA		3.5'	CL/ML	same as above, but dark tan, sandy silty clay
4	HA	3.5-4.0 0.5	3.5 - 4.0		NA		4'	CL/ML	same as above, but tan

Soil analytical and geotechnical testing samples WW-1 through WW-10 were collected on 2014-11-25. WW-1 was collected adjacent to the WW--PSB locations (WW-1 & WW-2), and WW-2 through WW-10 were collected at random locations within a 15 ft. radius of WW--PSBs. Each sample was collected from ground surface to a depth of 2 ft. using a 1.5 to 2-inch inside diameter hand auger. Each sample was homogenized in the field and submitted to Microbac Laboratories of Marietta, OH for RCRA metals analysis (As, Ba, Cd, Cr, Pb, Hg, Se) with Ni substituted for Ag and Tl added. In addition, sample WW-1 was submitted to Geotechnics of Pittsburgh, PA for sieve and hydrometer analyses, Atterberg limits, and USDA and USCS laboratory soil classification.

REMARKS:
1. Based on lab analysis, homogenized soil from 0.0-2.0 ft deep (sampling location WW-1) consists of **USCS Lean Clay with Sand (CL, TESTED) / USDA Clay Loam**.

SURVEY BENCHMARK & DATUM: Trimble sub-meter GPS, Pathfinder conversion software, Google Maps, ArcGIS

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APPENDIX B

FP-XRF SOIL ANALYTICAL SCREENING RESULTS

Hamilton County Background Soils

XRF Results 12/23/14

Results listed are in mg/kg (ppm)

Date	Sample ID	Ti	Cr	Mn	Fe	Co	Ni	Cu	Zn	As	Se	Sr	Mo	Ag	Cd	Sn	Sb	Ba	Hg	Pb
23-Dec-14	Standardization	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass
23-Dec-14	SiO2 BLANK	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	ND	<LOD	<LOD
23-Dec-14	MWW 01	3972.13	<LOD	531.74	16100.61	183.81	<LOD	<LOD	41.21	<LOD	<LOD	99.48	<LOD	<LOD	<LOD	<LOD	<LOD	ND	<LOD	28.21
23-Dec-14	MWW 04	3964.78	<LOD	492.98	17355.03	154.28	<LOD	<LOD	57.74	8.75	<LOD	92.38	<LOD	<LOD	<LOD	<LOD	<LOD	ND	<LOD	19.58
23-Dec-14	AVO 01	3559.43	<LOD	589.51	19013.47	<LOD	<LOD	<LOD	54.16	<LOD	<LOD	153.17	<LOD	<LOD	<LOD	<LOD	<LOD	ND	<LOD	25.55
23-Dec-14	AVO 04	3790.48	<LOD	556.42	19342.61	162.82	<LOD	<LOD	47.55	7.73	<LOD	166.72	<LOD	<LOD	<LOD	<LOD	<LOD	ND	<LOD	19.04
23-Dec-14	FP 01	5377.98	<LOD	597.4	27064.13	<LOD	<LOD	29 J	59.99	11.39	<LOD	89.14	<LOD	<LOD	<LOD	<LOD	<LOD	ND	<LOD	24.52
23-Dec-14	FP 02	4893.52	<LOD	632.3	31931.89	231.47	<LOD	<LOD	57.05	<LOD	<LOD	81.99	<LOD	<LOD	<LOD	<LOD	<LOD	ND	<LOD	32.74
23-Dec-14	SW 01	4747.13	<LOD	1051.42	21377.92	152.33	<LOD	<LOD	54.06	9.32	<LOD	123.43	<LOD	<LOD	<LOD	<LOD	<LOD	ND	<LOD	21.02
23-Dec-14	SW 03	4403.24	<LOD	982.42	21398.58	169.5	<LOD	<LOD	60.02	<LOD	<LOD	112.2	<LOD	<LOD	<LOD	<LOD	<LOD	ND	<LOD	30.33
23-Dec-14	MMF 01	4234.54	<LOD	262.18	28867.96	<LOD	<LOD	<LOD	52.73	10.89	<LOD	100.03	<LOD	<LOD	<LOD	<LOD	<LOD	ND	<LOD	31.25
23-Dec-14	MMF 05	3858.26	<LOD	250.11	26798.17	170.61	<LOD	<LOD	58.75	12.77	<LOD	97.54	<LOD	<LOD	<LOD	<LOD	<LOD	ND	<LOD	33.87
23-Dec-14	SHAW 01	4583.36	<LOD	689.48	19505.69	<LOD	<LOD	<LOD	55.78	12.58	<LOD	90.35	<LOD	<LOD	<LOD	<LOD	<LOD	ND	<LOD	20.38
23-Dec-14	SHAW 07	4283.84	170 J	528.76	20962.97	213.68	<LOD	<LOD	60.36	10.82	<LOD	90.18	<LOD	<LOD	<LOD	<LOD	<LOD	ND	<LOD	19.7
23-Dec-14	JPH 01	4617.41	<LOD	477.96	21215.31	<LOD	<LOD	<LOD	54.05	8.29	<LOD	72.23	<LOD	<LOD	<LOD	<LOD	<LOD	ND	<LOD	27.16
23-Dec-14	JPH 06	5043.28	<LOD	408.46	21938.27	184.13	<LOD	<LOD	58.41	12.71	<LOD	73.32	<LOD	<LOD	<LOD	<LOD	<LOD	ND	<LOD	26.34
23-Dec-14	MAF 01	5838.4	304 J	861.09	22240.99	<LOD	<LOD	<LOD	71.81	<LOD	<LOD	101.57	<LOD	<LOD	<LOD	<LOD	<LOD	ND	<LOD	55.08
23-Dec-14	MAF 09	5133.87	<LOD	1238.45	19809.15	200.65	<LOD	<LOD	101.13	<LOD	<LOD	113.54	<LOD	<LOD	<LOD	<LOD	<LOD	ND	<LOD	79.45
23-Dec-14	WW 01	4491.29	<LOD	558.22	37175.13	207.98	<LOD	36 J	88.69	11.57	<LOD	89.57	<LOD	<LOD	<LOD	<LOD	<LOD	ND	16 J	23.56
23-Dec-14	WW 02	5530.11	<LOD	363.58	42038.35	<LOD	<LOD	35 J	87.39	13.27	<LOD	80.96	<LOD	<LOD	<LOD	<LOD	<LOD	ND	<LOD	30.59
23-Dec-14	DP 01	4478.55	<LOD	465.76	25317.27	<LOD	<LOD	<LOD	56.77	<LOD	<LOD	78.67	<LOD	<LOD	<LOD	<LOD	<LOD	ND	<LOD	39.42
23-Dec-14	DP 02	4580.01	<LOD	710.62	25291.83	219.15	<LOD	27 J	74.54	10.45	<LOD	82.42	<LOD	<LOD	<LOD	<LOD	<LOD	ND	<LOD	40.73
23-Dec-14	DP 02 DUP	5278.48	<LOD	689.96	25131.03	<LOD	<LOD	<LOD	55.59	12.84	<LOD	80.07	<LOD	<LOD	<LOD	<LOD	<LOD	ND	12 J	31.96
23-Dec-14	MMF 05 DUP	4881.56	<LOD	324.57	26587.26	254.06	<LOD	<LOD	60.44	10.65	<LOD	95.43	<LOD	<LOD	<LOD	<LOD	<LOD	ND	<LOD	32.66
23-Dec-14	SiO2 BLANK	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	ND	<LOD	<LOD

MWW - Miami White Water Park
AVO - Avoca Park
FP - French Park
SW - Sharon Woods Park
MMF - Mitchell Memorial Forest
SHAW - Shawnee Lookout Park
JPH - Johnson Hills Park
MAF - Mt. Airy Forest
WW - Winton Woods
DP - Delphi Park

NOTE: <LOD - Concentration result is lower/less than the instrument Level of Detection (LOD)

J-qualified data: Data are positively identified, however, the associated numerical value is an estimated concentration (usually higher) of the true analyte concentration.

SiO2 BLANK: Silicon Dioxide Blank Analysis (QA check)

APPENDIX C

USCS AND USDA SOIL CLASSIFICATION
AND TEXTURAL COMPOSITION ANALYSES

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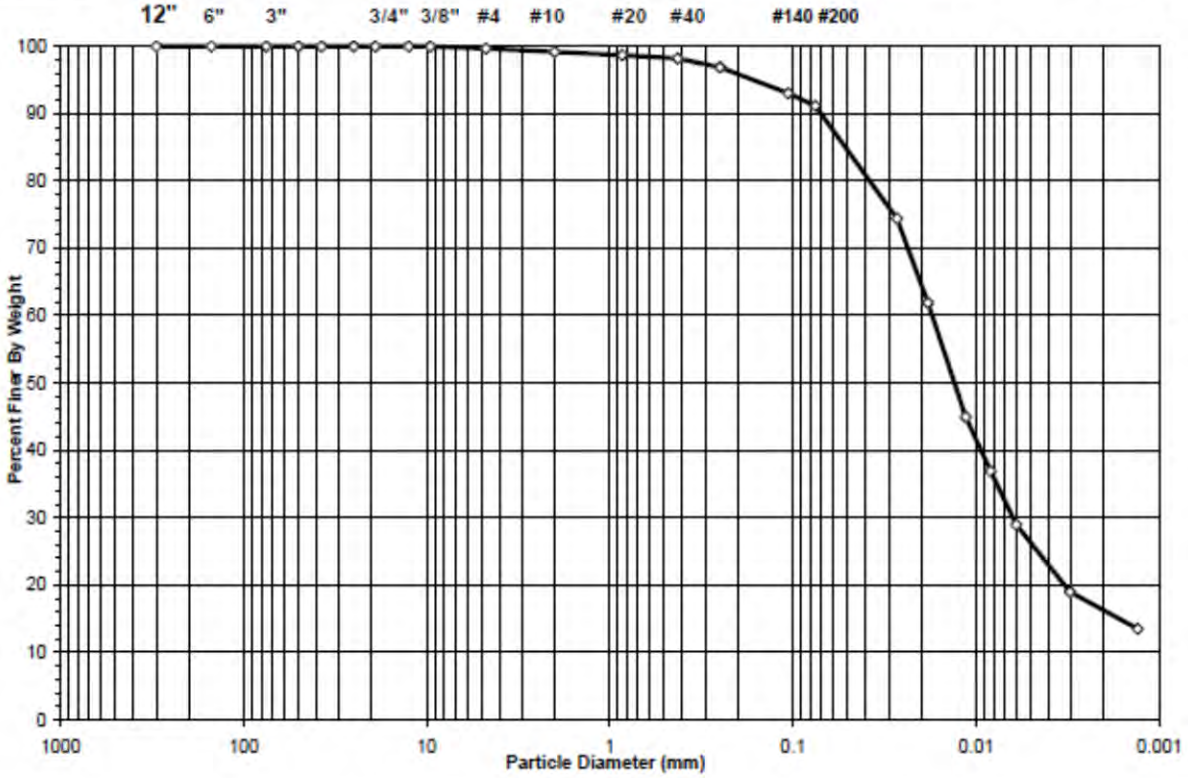
geotechnical & geosynthetic testing

SIEVE AND HYDROMETER ANALYSIS
ASTM D 422-63 (2007)

Client:	Microbac Laboratories	Boring No.:	10/27/14
Client Reference:	Hamilton Co. Background Soils	Depth (ft):	NA
Project No.:	2015-057-001	Sample No.:	SW-1
Lab ID:	2015-057-001-001	Soil Color:	BROWN

	SIEVE ANALYSIS			HYDROMETER	
USCS	cobbles	gravel	sand	silt and clay fraction	
USDA	cobbles	gravel	sand	silt	clay



Sieve Sizes (mm)	USCS Summary	Percentage
Greater Than #4	*Gravel*	0.35
#4 To #200	*Sand*	8.51
Finer Than #200	*Silt & Clay*	91.13

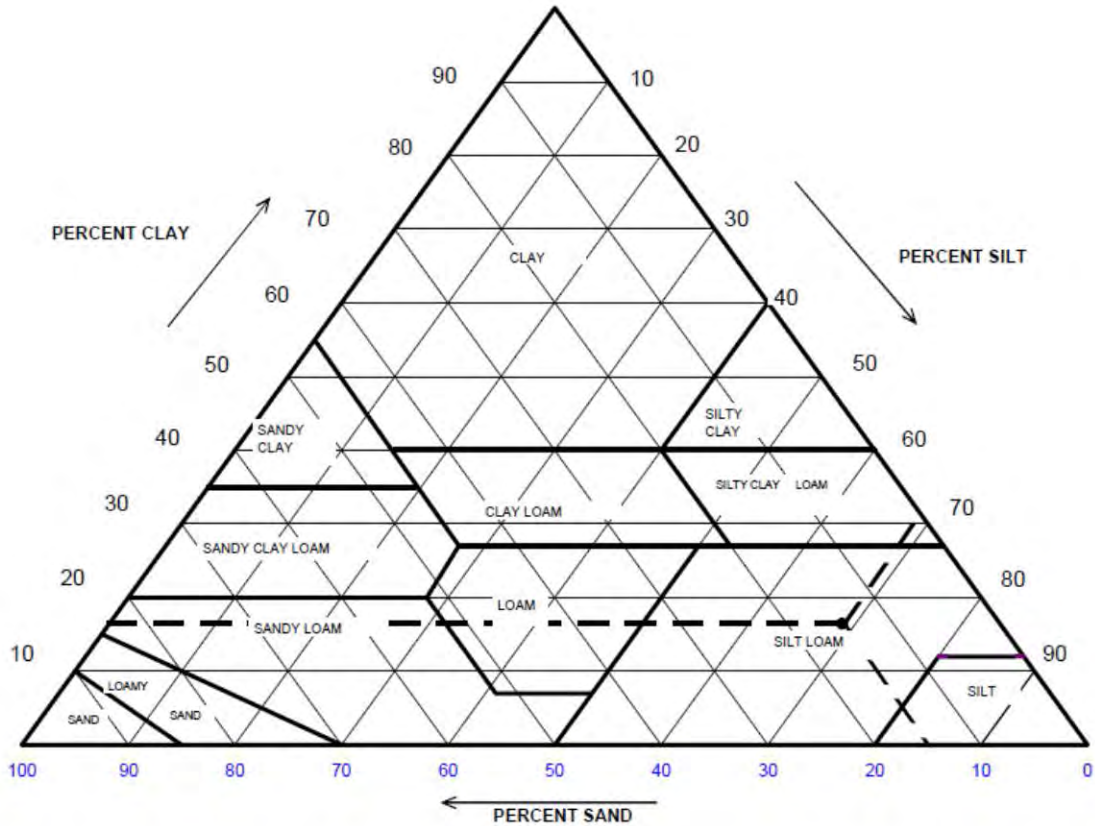
USCS Symbol *CL, TESTED*

USCS Classification *LEAN CLAY*

DCN: CT-63A DATE: 3/18/13 REVISION: 11

USDA CLASSIFICATION CHART

Client:	Microbac Laboratories	Boring No.:	10/27/14
Client Reference:	Hamilton Co. Background Soils	Depth (ft):	NA
Project No.:	2015-057-001	Sample No.:	SW-1
Lab ID:	2015-057-001-001	Soil Color:	BROWN



Particle Size	Percent Finer	USDA SUMMARY	Actual Percentage	Corrected % of Minus 2.0 mm material for USDA Classificat.
(mm)	(%)		(%)	(%)
		Gravel	0.79	**0.00**
2	99.21	*Sand*	14.69	**14.81**
0.05	84.52	*Silt*	68.24	**68.79**
0.002	16.28	*Clay*	16.28	**16.41**

USDA Classification: ***SILT LOAM***

DCN: CT-S3A DATE: 3/18/13 REVISION: 11

geotechnics
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WASH SIEVE ANALYSIS

ASTM D 422-63 (2007)

Client:	Microbac Laboratories	Boring No.:	10/27/14
Client Reference:	Hamilton Co. Background Soils	Depth (ft):	NA
Project No.:	2015-057-001	Sample No.:	SW-1
Lab ID:	2015-057-001-001	Soil Color:	BROWN

Moisture Content of Passing 3/4" Material		Water Content of Retained 3/4" Material	
Tare No.	1678	Tare No.	NA
Wt. of Tare & Wet Specimen (g)	494.60	Wt. of Tare & Wet Specimen (g)	NA
Wt. of Tare & Dry Specimen (g)	466.90	Wt. of Tare & Dry Specimen (g)	NA
Weight of Tare (g)	88.34	Weight of Tare (g)	NA
Weight of Water (g)	27.70	Weight of Water (g)	NA
Weight of Dry Specimen (g)	378.56	Weight of Dry Specimen (g)	NA
Moisture Content (%)	**7.3**	**Moisture Content (%)**	**NA**

Wet Weight of -3/4" Sample (g)	NA	Weight of the Dry Specimen (g)	378.56
Dry Weight of -3/4" Sample (g)	33.57	Weight of - #200 material (g)	344.99
Wet Weight of +3/4" Sample (g)	NA	Weight of + #200 material (g)	33.57
Dry Weight of +3/4" Sample (g)	0.00		
Total Dry Weight of Sample (g)	NA		

Sieve Size	Sieve Opening	Weight of Soil Retained	Percent Retained	Accumulated Percent Retained		Percent Finer	Accumulated Percent Finer
	(mm)	(g)	(%)	(%)		(%)	(%)
12"	300	0.00	0.00	0.00		100.00	**100.00**
6"	150	0.00	0.00	0.00		100.00	**100.00**
3"	75	0.00	0.00	0.00		100.00	**100.00**
2"	50	0.00	0.00	0.00		100.00	**100.00**
1 1/2"	37.5	0.00	0.00	0.00		100.00	**100.00**
1"	25.0	0.00	0.00	0.00		100.00	**100.00**
3/4"	19.0	0.00	0.00	0.00		100.00	**100.00**
1/2"	12.5	0.00	0.00	0.00		100.00	**100.00**
3/8"	9.50	0.00	0.00	0.00		100.00	**100.00**
#4	4.75	1.34	0.35	0.35		99.65	**99.65**
#10	2.00	1.65	0.44	0.79		99.21	**99.21**
#20	0.85	1.84	0.49	1.28		98.72	**98.72**
#40	0.425	1.87	0.49	1.77		98.23	**98.23**
#60	0.250	4.93	1.30	3.07		96.93	**96.93**
#140	0.106	14.78	3.90	6.98		93.02	**93.02**
#200	0.075	7.16	1.89	8.87		91.13	**91.13**
Pan	-	344.99	91.13	100.00		-	-

Tested By	RAL	Date	1/23/15	Checked By	KC	Date	2/3/15

DCN: CT-83A DATE: 9/18/13 REVISION: 11

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HYDROMETER ANALYSIS

ASTM D 422-63 (2007)

Client:	Microbac Laboratories	Boring No.:	10/27/14
Client Reference:	Hamilton Co. Background Soils	Depth (ft):	NA
Project No.:	2015-057-001	Sample No.:	SW-1
Lab ID:	2015-057-001-001	Soil Color:	BROWN

Elapsed Time		R Measured	Temp.	Composite Correction	R Corrected	N	K Factor	Diameter	N'
(min)			(°C)			(%)		(mm)	(%)
0		NA	NA	NA	NA	NA	NA	NA	NA
2		48.0	21.9	6.31	41.7	81.7	0.01314	0.0270	**74.5**
5		41.0	21.9	6.31	34.7	68.0	0.01314	0.0182	**62.0**
15		31.5	21.9	6.31	25.2	49.4	0.01314	0.0113	**45.0**
30		27.0	21.9	6.31	20.7	40.6	0.01314	0.0083	**37.0**
60		22.5	22.0	6.27	16.2	31.8	0.01313	0.0060	**29.0**
250		17.0	21.7	6.38	10.6	20.8	0.01317	0.0031	**19.0**
1440		14.0	21.6	6.41	7.6	14.9	0.01319	0.0013	**13.6**

Soil Specimen Data		Other Corrections		
Tare No.	964			
Weight of Tare & Dry Material (g)	156.12	a - Factor	0.99	
Weight of Tare (g)	100.6			
Weight of Deflocculant (g)	5.0	Percent Finer than # 200	91.13	
Weight of Dry Material (g)	50.52			
		Specific Gravity	2.7	Assumed

Note: *Hydrometer test is performed on - # 200 sieve material.*

Tested By TO Date 1/26/15 Checked By KC Date 2/3/15

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ATTERBERG LIMITS

ASTM D 4318-10

Client:	Microbac Laboratories	Boring No.:	10/27/14
Client Reference:	Hamilton Co. Background Soils	Depth (ft):	NA
Project No.:	2015-057-001	Sample No.:	SW-1
Lab ID:	2015-057-001-001	Soil Description:	**BROWN LEAN CLAY**

Note: The USCS symbol used with this test refers only to the minus No. 40 sieve material. See the "Sieve and Hydrometer Analysis" graph page for the complete material description .

(Minus No. 40 sieve material, Airdried)

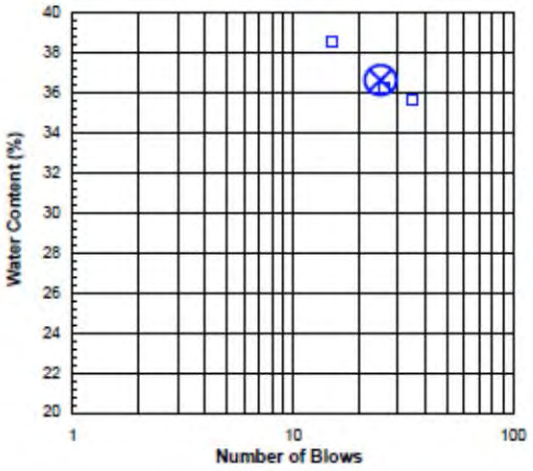
Liquid Limit Test	**1**	**2**	**3**	
				M
Tare Number	401	1271	313	**U**
Wt. of Tare & Wet Sample (g)	41.15	41.97	38.63	**L**
Wt. of Tare & Dry Sample (g)	35.40	36.60	33.32	**T**
Wt. of Tare (g)	20.48	21.76	18.41	**I**
Wt. of Water (g)	5.8	5.4	5.3	**P**
Wt. of Dry Sample (g)	14.9	14.8	14.9	**O**
				I
Moisture Content (%)	**38.5**	**36.2**	**35.6**	**N**
Number of Blows	**15**	**26**	**35**	**T**

Plastic Limit Test	**1**	**2**	**Range**
Tare Number	366	1264	
Wt. of Tare & Wet Sample (g)	23.53	17.02	
Wt. of Tare & Dry Sample (g)	22.63	16.13	
Wt. of Tare (g)	17.10	10.60	
Wt. of Water (g)	0.9	0.9	
Wt. of Dry Sample (g)	5.5	5.5	
Moisture Content (%)	**16.3**	**16.1**	**0.2**

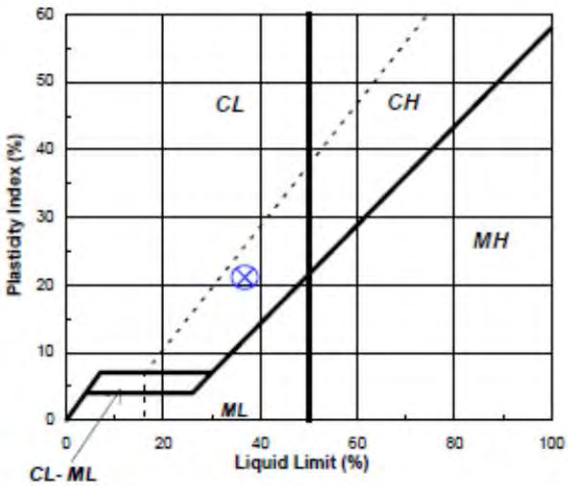
Note: The acceptable range of the two Moisture contents is ± 2.6

Test Results	
Liquid Limit (%)	**37**
Plastic Limit (%)	**16**
Plasticity Index (%)	**21**
USCS Symbol	**CL**

Flow Curve



Plasticity Chart

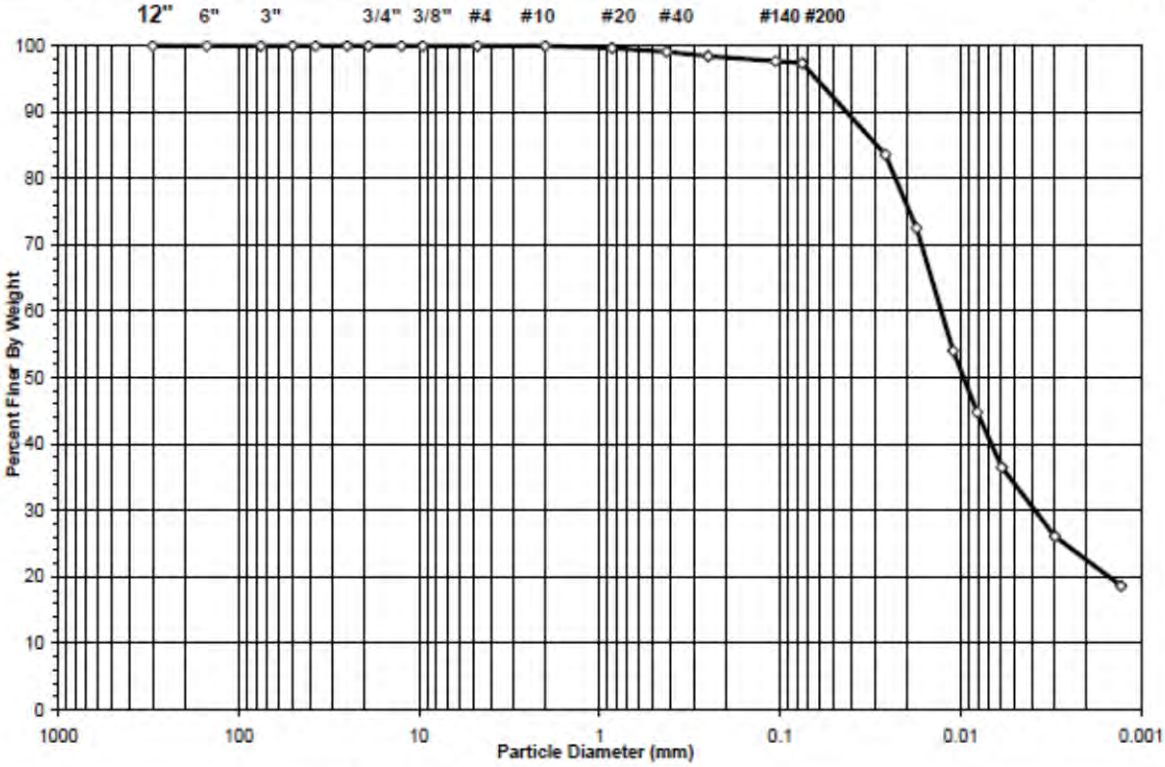


Tested By *RAL* *Date* *1/30/15* *Checked By* *KC* *Date* *2/3/15*

SIEVE AND HYDROMETER ANALYSIS
ASTM D 422-63 (2007)

Client:	Microbac Laboratories	Boring No.:	10/27/14
Client Reference:	Hamilton Co. Background Soils	Depth (ft):	NA
Project No.:	2015-057-001	Sample No.:	FP-01
Lab ID:	2015-057-001-002	Soil Color:	BROWN

	SIEVE ANALYSIS			*HYDROMETER*	
USCS	cobbles	gravel	sand	silt and clay fraction	
USDA	cobbles	gravel	sand	silt	clay



Sieve Sizes (mm)	USCS Summary	Percentage
Greater Than #4	*Gravel*	0.00
#4 To #200	*Sand*	2.65
Finer Than #200	*Silt & Clay*	97.35

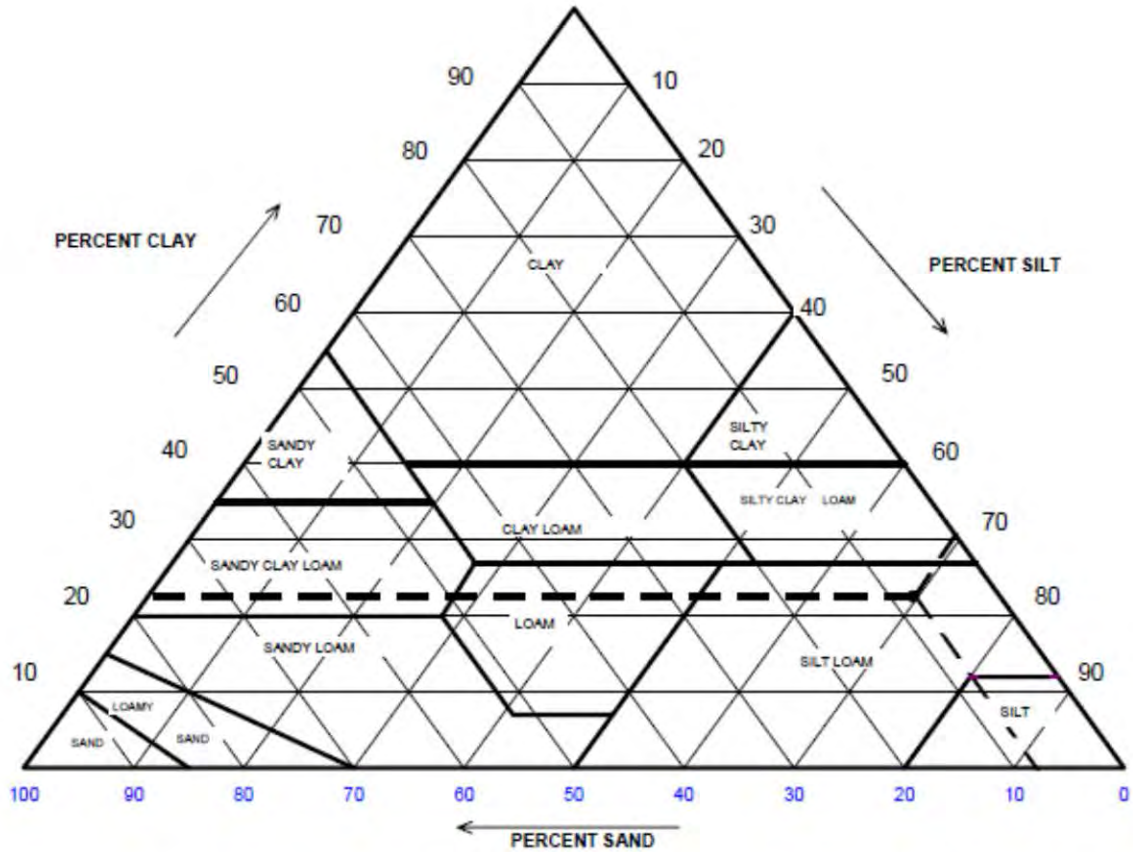
USCS Symbol *CL, TESTED*

USCS Classification *LEAN CLAY*

DCN: CT-S3A DATE: 3/18/13 REVISION: 11

USDA CLASSIFICATION CHART

Client:	Microbac Laboratories	Boring No.:	10/27/14
Client Reference:	Hamilton Co. Background Soils	Depth (ft):	NA
Project No.:	2015-057-001	Sample No.:	FP-01
Lab ID:	2015-057-001-002	Soil Color:	BROWN



Particle Size (mm)	Percent Finer (%)	USDA SUMMARY	Actual Percentage (%)	Corrected % of Minus 2.0 mm material for USDA Classificat. (%)
		Gravel	0.04	**0.00**
2	99.96	*Sand*	7.87	**7.87**
0.05	92.09	*Silt*	69.51	**69.53**
0.002	22.58	*Clay*	22.58	**22.59**

USDA Classification: ***SILT LOAM***

DCN: CT-83A DATE: 3/18/13 REVISION: 11

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WASH SIEVE ANALYSIS

ASTM D 422-63 (2007)

Client:	Microbac Laboratories	Boring No.:	10/27/14
Client Reference:	Hamilton Co. Background Soils	Depth (ft):	NA
Project No.:	2015-057-001	Sample No.:	FP-01
Lab ID:	2015-057-001-002	Soil Color:	BROWN

Moisture Content of Passing 3/4" Material		Water Content of Retained 3/4" Material	
Tare No.	649	Tare No.	NA
Wt. of Tare & Wet Specimen (g)	568.50	Wt. of Tare & Wet Specimen (g)	NA
Wt. of Tare & Dry Specimen (g)	541.00	Wt. of Tare & Dry Specimen (g)	NA
Weight of Tare (g)	95.42	Weight of Tare (g)	NA
Weight of Water (g)	27.50	Weight of Water (g)	NA
Weight of Dry Specimen (g)	445.58	Weight of Dry Specimen (g)	NA
Moisture Content (%)	**6.2**	**Moisture Content (%)**	**NA**

Wet Weight of -3/4" Sample (g)	NA	Weight of the Dry Specimen (g)	445.58
Dry Weight of -3/4" Sample (g)	11.80	Weight of - #200 material (g)	433.78
Wet Weight of +3/4" Sample (g)	NA	Weight of + #200 material (g)	11.80
Dry Weight of +3/4" Sample (g)	0.00		
Total Dry Weight of Sample (g)	NA		

Sieve Size	Sieve Opening	Weight of Soil Retained	Percent Retained	Accumulated Percent Retained		Percent Finer	Accumulated Percent Finer
	(mm)	(g)	(%)	(%)		(%)	(%)
12"	300	0.00	0.00	0.00		100.00	**100.00**
6"	150	0.00	0.00	0.00		100.00	**100.00**
3"	75	0.00	0.00	0.00		100.00	**100.00**
2"	50	0.00	0.00	0.00		100.00	**100.00**
1 1/2"	37.5	0.00	0.00	0.00		100.00	**100.00**
1"	25.0	0.00	0.00	0.00		100.00	**100.00**
3/4"	19.0	0.00	0.00	0.00		100.00	**100.00**
1/2"	12.5	0.00	0.00	0.00		100.00	**100.00**
3/8"	9.50	0.00	0.00	0.00		100.00	**100.00**
#4	4.75	0.00	0.00	0.00		100.00	**100.00**
#10	2.00	0.16	0.04	0.04		99.96	**99.96**
#20	0.85	1.15	0.26	0.29		99.71	**99.71**
#40	0.425	2.79	0.63	0.92		99.08	**99.08**
#60	0.250	2.79	0.63	1.55		98.45	**98.45**
#140	0.106	3.48	0.78	2.33		97.67	**97.67**
#200	0.075	1.43	0.32	2.65		97.35	**97.35**
Pan	-	433.78	97.35	100.00		-	-

Tested By	RAL	Date	1/23/15	Checked By	KC	Date	2/3/15

DCN: CT-SSA DATE: 3/18/13 REVISION: 11

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HYDROMETER ANALYSIS

ASTM D 422-63 (2007)

Client:	Microbac Laboratories	Boring No.:	10/27/14
Client Reference:	Hamilton Co. Background Soils	Depth (ft):	NA
Project No.:	2015-057-001	Sample No.:	FP-01
Lab ID:	2015-057-001-002	Soil Color:	BROWN

Elapsed Time		R Measured	Temp.	Composite Correction	R Corrected	N	K Factor	Diameter	N'
(min)			(°C)			(%)		(mm)	(%)
0		NA	NA	NA	NA	NA	NA	NA	NA
2		51.5	21.9	6.31	45.2	85.9	0.01314	0.0260	**83.6**
5		45.5	21.9	6.31	39.2	74.5	0.01314	0.0175	**72.5**
15		35.5	21.9	6.31	29.2	55.5	0.01314	0.0110	**54.0**
30		30.5	21.9	6.31	24.2	46.0	0.01314	0.0081	**44.8**
60		26.0	22.0	6.27	19.7	37.5	0.01313	0.0059	**36.5**
250		20.5	21.7	6.38	14.1	26.8	0.01317	0.0030	**26.1**
1440		16.5	21.6	6.41	10.1	19.2	0.01319	0.0013	**18.7**

Soil Specimen Data		Other Corrections		
Tare No.	520			
Weight of Tare & Dry Material (g)	150.09	a - Factor	0.99	
Weight of Tare (g)	93.01			
Weight of Deflocculant (g)	5.0	Percent Finer than # 200	97.35	
Weight of Dry Material (g)	52.08			
		Specific Gravity	2.7	Assumed

Note: *Hydrometer test is performed on - # 200 sieve material.*

Tested By TO Date 1/26/15 Checked By KC Date 2/3/15

ATTERBERG LIMITS

ASTM D 4318-10

Client:	Microbac Laboratories	Boring No.:	10/27/14
Client Reference:	Hamilton Co. Background Soils	Depth (ft):	NA
Project No.:	2015-057-001	Sample No.:	FP-01
Lab ID:	2015-057-001-002	Soil Description:	BROWN LEAN CLAY

Note: The USCS symbol used with this test refers only to the minus No. 40 sieve material. See the "Sieve and Hydrometer Analysis" graph page for the complete material description .

(Minus No. 40 sieve material, Airdried)

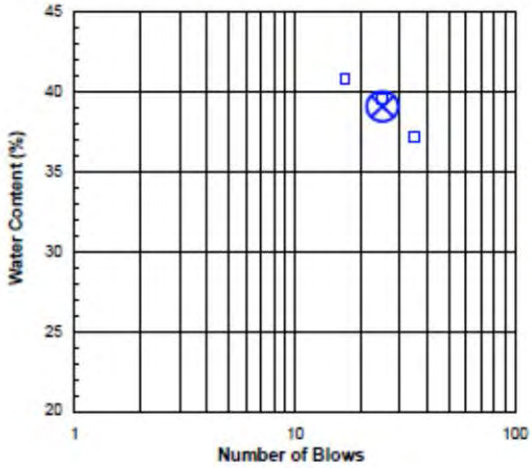
Liquid Limit Test	1	2	3	
				M
Tare Number	1287	43	53	U
Wt. of Tare & Wet Sample (g)	38.58	44.79	44.65	L
Wt. of Tare & Dry Sample (g)	32.46	37.50	37.17	T
Wt. of Tare (g)	15.99	19.05	18.83	I
Wt. of Water (g)	6.1	7.3	7.5	P
Wt. of Dry Sample (g)	16.5	18.5	18.3	O
				I
Moisture Content (%)	**37.2**	**39.5**	**40.8**	N
Number of Blows	**35**	**25**	**17**	T

Plastic Limit Test	1	2	Range
Tare Number	1245	1254	
Wt. of Tare & Wet Sample (g)	22.17	22.30	
Wt. of Tare & Dry Sample (g)	21.08	21.26	
Wt. of Tare (g)	15.86	16.23	
Wt. of Water (g)	1.1	1.0	
Wt. of Dry Sample (g)	5.2	5.0	
Moisture Content (%)	**20.9**	**20.7**	**0.2**

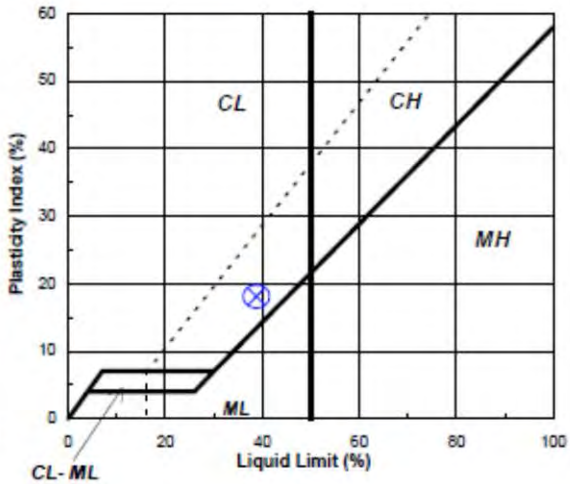
Note: The acceptable range of the two Moisture contents is ± 2.6

Test Results	
Liquid Limit (%)	**39**
Plastic Limit (%)	**21**
Plasticity Index (%)	**18**
USCS Symbol	**CL**

Flow Curve



Plasticity Chart



Tested By	*TO*	*Date*	*1/30/15*	*Checked By*	*KC*	*Date*	*2/3/15*

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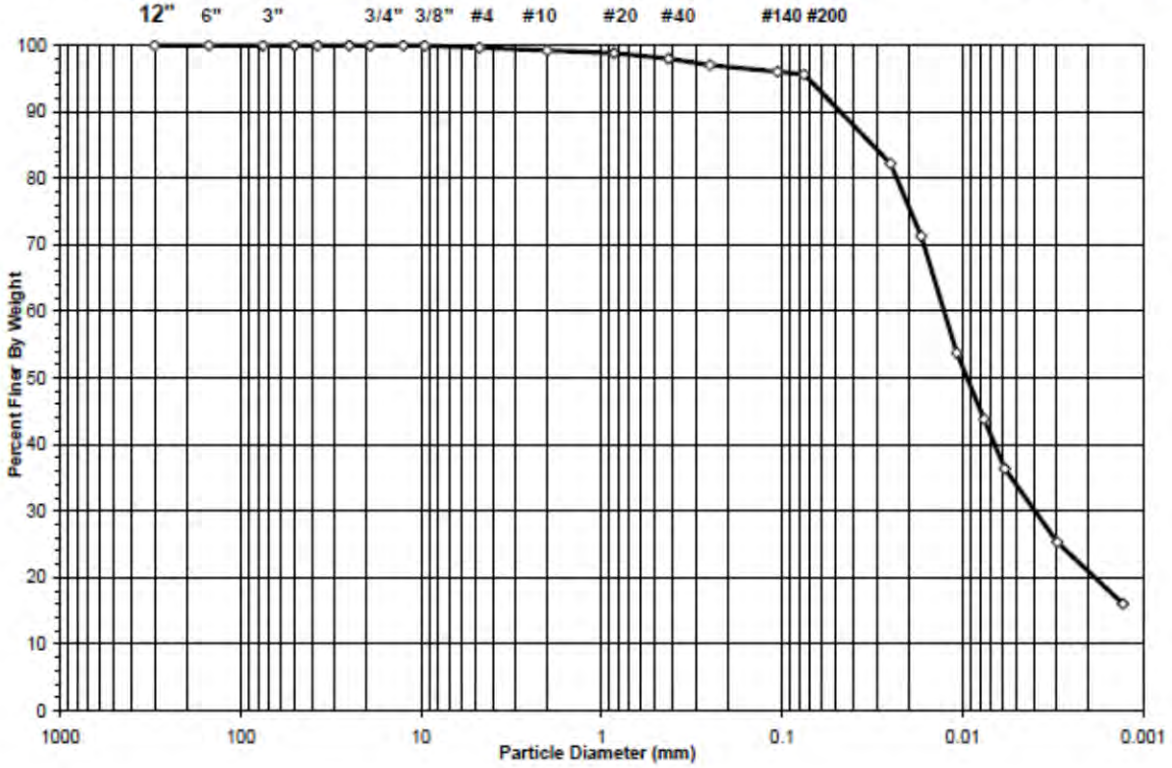
SIEVE AND HYDROMETER ANALYSIS
ASTM D 422-63 (2007)

Client:	Microbac Laboratories	Boring No.:	10/28/14
Client Reference:	Hamilton Co. Background Soils	Depth (ft):	NA
Project No.:	2015-057-001	Sample No.:	MAF-01
Lab ID:	2015-057-001-003	Soil Color:	BROWN

	SIEVE ANALYSIS			HYDROMETER	
USCS	cobbles	gravel	sand	silt and clay fraction	
USDA	cobbles	gravel	sand	silt	clay



USCS Summary		
Sieve Sizes (mm)		**Percentage**
Greater Than #4	*Gravel*	0.30
#4 To #200	*Sand*	4.02
Finer Than #200	*Silt & Clay*	95.68

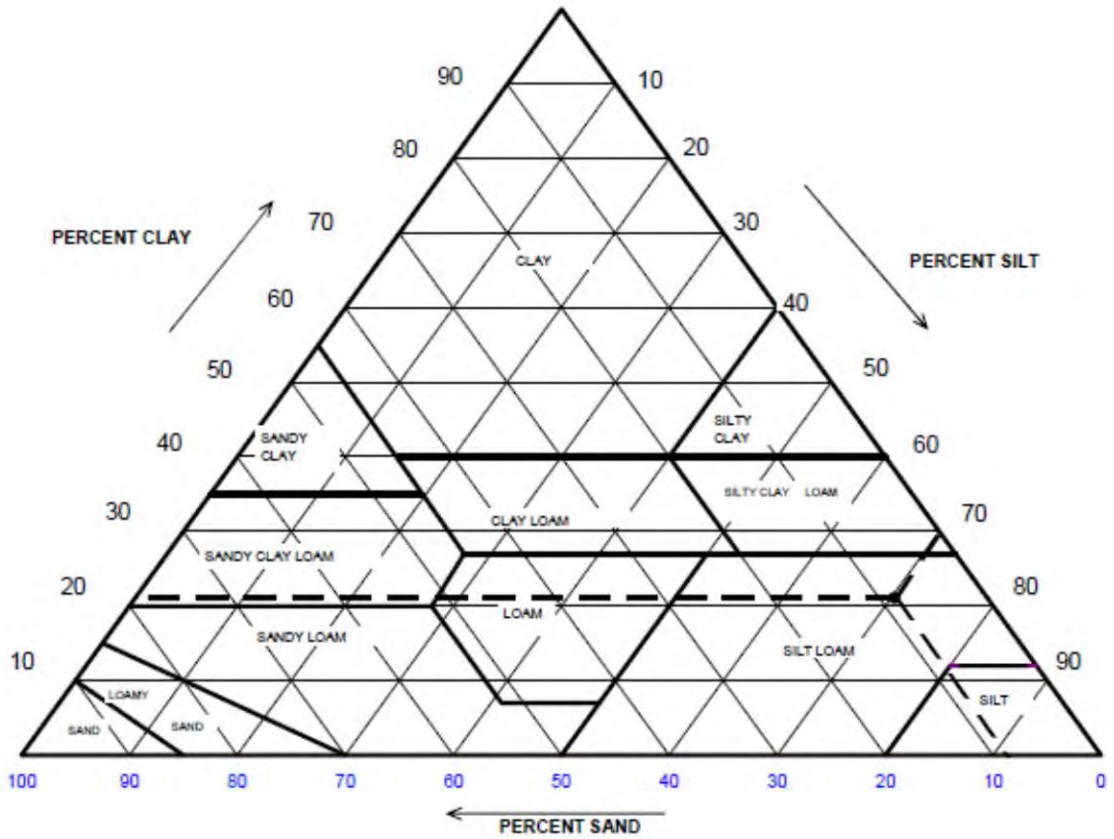
USCS Symbol *CL, TESTED*

USCS Classification *LEAN CLAY*

DCN: CT-83A DATE: 3/18/13 REVISION: 11

USDA CLASSIFICATION CHART

Client:	Microbac Laboratories	Boring No.:	10/28/14
Client Reference:	Hamilton Co. Background Soils	Depth (ft):	NA
Project No.:	2015-057-001	Sample No.:	MAF-01
Lab ID:	2015-057-001-003	Soil Color:	BROWN



Particle Size (mm)	Percent Finer (%)	USDA SUMMARY	Actual Percentage (%)	Corrected % of Minus 2.0 mm material for USDA Classificat. (%)
		Gravel	0.72	**0.00**
2	99.28	*Sand*	8.55	**8.61**
0.05	90.73	*Silt*	69.83	**70.34**
0.002	20.90	*Clay*	20.90	**21.05**

USDA Classification: ***SILT LOAM***

DCN: CT-83A DATE: 3/18/13 REVISION: 11

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WASH SIEVE ANALYSIS

ASTM D 422-63 (2007)

Client:	Microbac Laboratories	Boring No.:	10/28/14
Client Reference:	Hamilton Co. Background Soils	Depth (ft):	NA
Project No.:	2015-057-001	Sample No.:	MAF-01
Lab ID:	2015-057-001-003	Soil Color:	BROWN

Moisture Content of Passing 3/4" Material		Water Content of Retained 3/4" Material	
Tare No.	967	Tare No.	NA
Wt. of Tare & Wet Specimen (g)	553.70	Wt. of Tare & Wet Specimen (g)	NA
Wt. of Tare & Dry Specimen (g)	538.00	Wt. of Tare & Dry Specimen (g)	NA
Weight of Tare (g)	100.74	Weight of Tare (g)	NA
Weight of Water (g)	15.70	Weight of Water (g)	NA
Weight of Dry Specimen (g)	437.26	Weight of Dry Specimen (g)	NA
Moisture Content (%)	**3.6**	**Moisture Content (%)**	**NA**

Wet Weight of -3/4" Sample (g)	NA	Weight of the Dry Specimen (g)	437.26
Dry Weight of -3/4" Sample (g)	18.88	Weight of - #200 material (g)	418.38
Wet Weight of +3/4" Sample (g)	NA	Weight of + #200 material (g)	18.88
Dry Weight of +3/4" Sample (g)	0.00		
Total Dry Weight of Sample (g)	NA		

Sieve Size	Sieve Opening	Weight of Soil Retained	Percent Retained	Accumulated Percent Retained		Percent Finer	Accumulated Percent Finer
	(mm)	(g)	(%)	(%)		(%)	(%)
12"	300	0.00	0.00	0.00		100.00	**100.00**
6"	150	0.00	0.00	0.00		100.00	**100.00**
3"	75	0.00	0.00	0.00		100.00	**100.00**
2"	50	0.00	0.00	0.00		100.00	**100.00**
1 1/2"	37.5	0.00	0.00	0.00		100.00	**100.00**
1"	25.0	0.00	0.00	0.00		100.00	**100.00**
3/4"	19.0	0.00	0.00	0.00		100.00	**100.00**
1/2"	12.5	0.00	0.00	0.00		100.00	**100.00**
3/8"	9.50	0.00	0.00	0.00		100.00	**100.00**
#4	4.75	1.32	0.30	0.30		99.70	**99.70**
#10	2.00	1.82	0.42	0.72		99.28	**99.28**
#20	0.85	2.02	0.46	1.18		98.82	**98.82**
#40	0.425	3.36	0.77	1.95		98.05	**98.05**
#60	0.250	4.29	0.98	2.93		97.07	**97.07**
#140	0.106	4.40	1.01	3.94		96.06	**96.06**
#200	0.075	1.67	0.38	4.32		95.68	**95.68**
Pan	-	418.38	95.68	100.00		-	-

Tested By	RAL	Date	1/23/15	Checked By	KC	Date	2/3/15

DCN: CT-63A DATE: 3/18/13 REVISION: 11

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HYDROMETER ANALYSIS

ASTM D 422-63 (2007)

Client:	Microbac Laboratories	Boring No.:	10/28/14
Client Reference:	Hamilton Co. Background Soils	Depth (ft):	NA
Project No.:	2015-057-001	Sample No.:	MAF-01
Lab ID:	2015-057-001-003	Soil Color:	BROWN

Elapsed Time		R Measured	Temp.	Composite Correction	R Corrected	N	K Factor	Diameter	N'
(min)			(°C)			(%)		(mm)	(%)
0		NA	NA	NA	NA	NA	NA	NA	NA
2		55.5	21.9	6.31	49.2	86.0	0.01314	0.0249	**82.2**
5		49.0	21.9	6.31	42.7	74.6	0.01314	0.0169	**71.4**
15		38.5	21.9	6.31	32.2	56.2	0.01314	0.0107	**53.8**
33		32.5	21.9	6.31	26.2	45.8	0.01314	0.0076	**43.8**
60		28.0	22.0	6.27	21.7	38.0	0.01313	0.0058	**36.3**
250		21.5	21.7	6.38	15.1	26.4	0.01317	0.0030	**25.3**
1440		16.0	21.6	6.41	9.6	16.8	0.01319	0.0013	**16.0**

Soil Specimen Data		Other Corrections		
Tare No.	963			
Weight of Tare & Dry Material (g)	162.72	a - Factor	0.99	
Weight of Tare (g)	101.06			
Weight of Deflocculant (g)	5.0	Percent Finer than # 200	95.68	
Weight of Dry Material (g)	56.66			
		Specific Gravity	2.7	Assumed

Note: *Hydrometer test is performed on - # 200 sieve material.*

Tested By TO Date 1/26/15 Checked By KC Date 2/3/15

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ATTERBERG LIMITS

ASTM D 4318-10

Client:	Microbac Laboratories	Boring No.:	10/28/14
Client Reference:	Hamilton Co. Background Soils	Depth (ft):	NA
Project No.:	2015-057-001	Sample No.:	MAF-01
Lab ID:	2015-057-001-003	Soil Description:	**BROWN LEAN CLAY**

Note: The USCS symbol used with this test refers only to the minus No. 40 sieve material. See the "Sieve and Hydrometer Analysis" graph page for the complete material description .

(Minus No. 40 sieve material, Airdried)

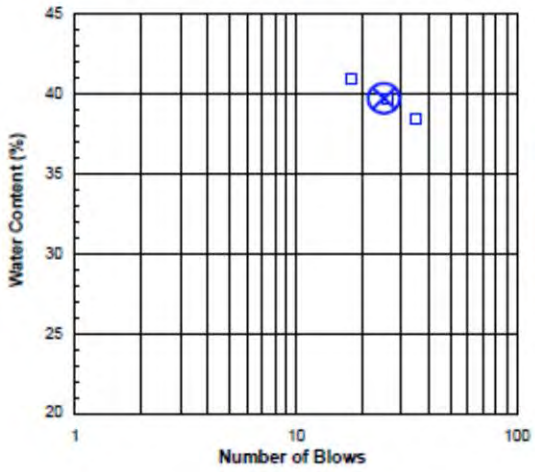
Liquid Limit Test	**1**	**2**	**3**	
				M
Tare Number	1263	439	2294	**U**
Wt. of Tare & Wet Sample (g)	38.18	36.98	40.10	**L**
Wt. of Tare & Dry Sample (g)	32.12	31.07	34.43	**T**
Wt. of Tare (g)	17.30	16.16	19.68	**I**
Wt. of Water (g)	6.1	5.9	5.7	**P**
Wt. of Dry Sample (g)	14.8	14.9	14.8	**O**
				I
Moisture Content (%)	**40.9**	**39.6**	**38.4**	**N**
Number of Blows	**18**	**26**	**35**	**T**

Plastic Limit Test	**1**	**2**	**Range**
Tare Number	327	1242	
Wt. of Tare & Wet Sample (g)	26.43	20.52	
Wt. of Tare & Dry Sample (g)	25.44	19.58	
Wt. of Tare (g)	20.05	14.25	
Wt. of Water (g)	1.0	0.9	
Wt. of Dry Sample (g)	5.4	5.3	
Moisture Content (%)	**18.4**	**17.6**	**0.7**

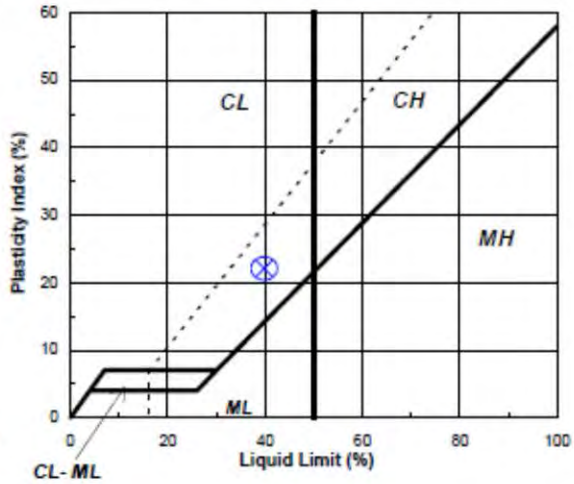
Note: The acceptable range of the two Moisture contents is ± 2.6

Test Results	
Liquid Limit (%)	**40**
Plastic Limit (%)	**18**
Plasticity Index (%)	**22**
USCS Symbol	**CL**

Flow Curve



Plasticity Chart

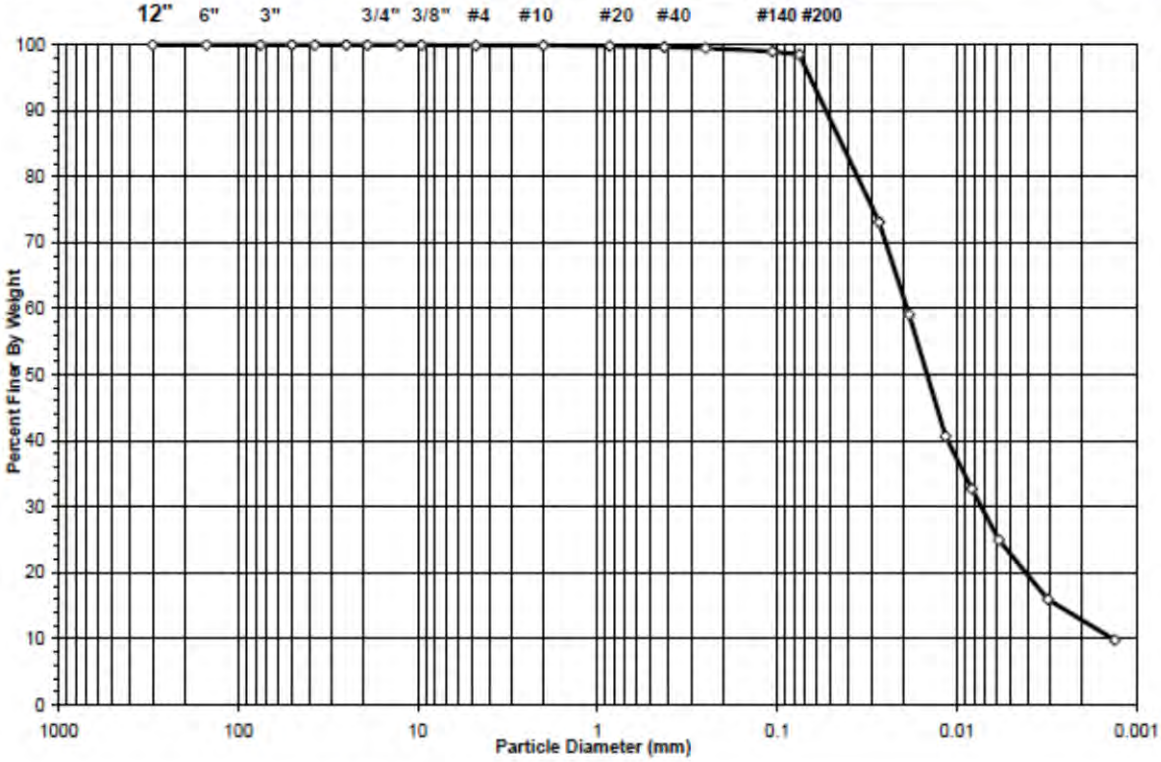


Tested By	*RAL*	*Date*	*1/30/15*	*Checked By*	*KC*	*Date*	*2/3/15*		

SIEVE AND HYDROMETER ANALYSIS
ASTM D 422-63 (2007)

Client:	Microbac Laboratories	Boring No.:	10/28/14
Client Reference:	Hamilton Co. Background Soils	Depth (ft):	NA
Project No.:	2015-057-001	Sample No.:	SHAW-01
Lab ID:	2015-057-001-004	Soil Color:	BROWN

	SIEVE ANALYSIS			*HYDROMETER*	
USCS	cobbles	gravel	sand	silt and clay fraction	
USDA	cobbles	gravel	sand	silt	clay



Sieve Sizes (mm)	USCS Summary	Percentage
Greater Than #4	*Gravel*	0.06
#4 To #200	*Sand*	1.44
Finer Than #200	*Silt & Clay*	98.50

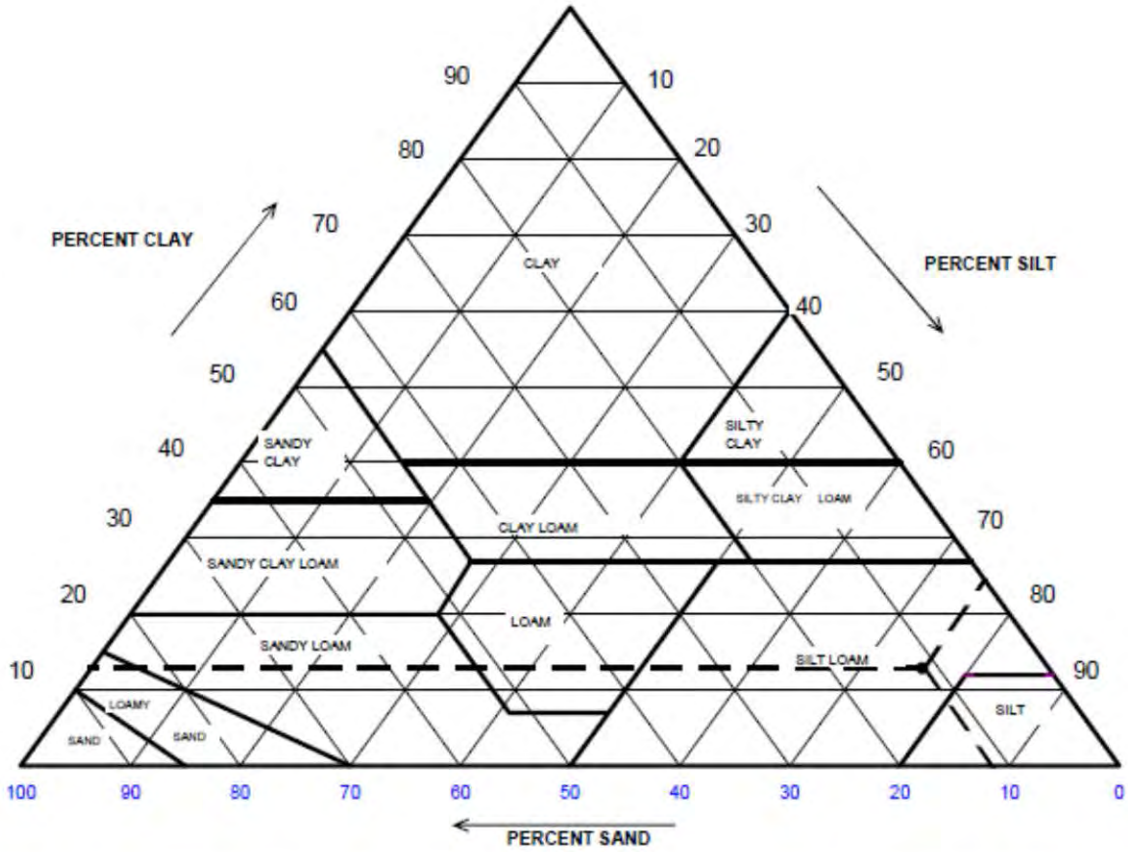
USCS Symbol *CL, TESTED*

USCS Classification *LEAN CLAY*

DCN: CT-83A DATE: 3/18/13 REVISION: 11

USDA CLASSIFICATION CHART

Client:	Microbac Laboratories	Boring No.:	10/28/14
Client Reference:	Hamilton Co. Background Soils	Depth (ft):	NA
Project No.:	2015-057-001	Sample No.:	SHAW-01
Lab ID:	2015-057-001-004	Soil Color:	BROWN



Particle Size (mm)	Percent Finer (%)	USDA SUMMARY	Actual Percentage (%)	Corrected % of Minus 2.0 mm material for USDA Classificat. (%)
		Gravel	0.11	**0.00**
2	99.89	*Sand*	11.46	**11.47**
0.05	88.43	*Silt*	75.59	**75.67**
0.002	12.84	*Clay*	12.84	**12.86**

USDA Classification: ***SILT LOAM***

DCN: CT-83A DATE: 3/18/13 REVISION: 11

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WASH SIEVE ANALYSIS

ASTM D 422-63 (2007)

Client:	Microbac Laboratories	Boring No.:	10/28/14
Client Reference:	Hamilton Co. Background Soils	Depth (ft):	NA
Project No.:	2015-057-001	Sample No.:	SHAW-01
Lab ID:	2015-057-001-004	Soil Color:	BROWN

Moisture Content of Passing 3/4" Material		Water Content of Retained 3/4" Material	
Tare No.	929	Tare No.	NA
Wt. of Tare & Wet Specimen (g)	552.60	Wt. of Tare & Wet Specimen (g)	NA
Wt. of Tare & Dry Specimen (g)	517.90	Wt. of Tare & Dry Specimen (g)	NA
Weight of Tare (g)	100.65	Weight of Tare (g)	NA
Weight of Water (g)	34.70	Weight of Water (g)	NA
Weight of Dry Specimen (g)	417.25	Weight of Dry Specimen (g)	NA
Moisture Content (%)	**8.3**	**Moisture Content (%)**	**NA**

Wet Weight of -3/4" Sample (g)	NA	Weight of the Dry Specimen (g)	417.25
Dry Weight of -3/4" Sample (g)	6.27	Weight of - #200 material (g)	410.98
Wet Weight of +3/4" Sample (g)	NA	Weight of + #200 material (g)	6.27
Dry Weight of +3/4" Sample (g)	0.00		
Total Dry Weight of Sample (g)	NA		

Sieve Size	Sieve Opening	Weight of Soil Retained	Percent Retained	Accumulated Percent Retained		Percent Finer	Accumulated Percent Finer
	(mm)	(g)	(%)	(%)		(%)	(%)
12"	300	0.00	0.00	0.00		100.00	**100.00**
6"	150	0.00	0.00	0.00		100.00	**100.00**
3"	75	0.00	0.00	0.00		100.00	**100.00**
2"	50	0.00	0.00	0.00		100.00	**100.00**
1 1/2"	37.5	0.00	0.00	0.00		100.00	**100.00**
1"	25.0	0.00	0.00	0.00		100.00	**100.00**
3/4"	19.0	0.00	0.00	0.00		100.00	**100.00**
1/2"	12.5	0.00	0.00	0.00		100.00	**100.00**
3/8"	9.50	0.00	0.00	0.00		100.00	**100.00**
#4	4.75	0.25	0.06	0.06		99.94	**99.94**
#10	2.00	0.19	0.05	0.11		99.89	**99.89**
#20	0.85	0.37	0.09	0.19		99.81	**99.81**
#40	0.425	0.65	0.16	0.35		99.65	**99.65**
#60	0.250	0.75	0.18	0.53		99.47	**99.47**
#140	0.106	1.83	0.44	0.97		99.03	**99.03**
#200	0.075	2.23	0.53	1.50		98.50	**98.50**
Pan	-	410.98	98.50	100.00		-	**-**

Tested By	RAL	Date	1/23/15	Checked By	KC	Date	2/3/15

DCN: CT-G3A DATE: 3/18/13 REVISION: 11

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HYDROMETER ANALYSIS

ASTM D 422-63 (2007)

Client:	Microbac Laboratories	Boring No.:	10/28/14
Client Reference:	Hamilton Co. Background Soils	Depth (ft):	NA
Project No.:	2015-057-001	Sample No.:	SHAW-01
Lab ID:	2015-057-001-004	Soil Color:	BROWN

Elapsed Time		R Measured	Temp.	Composite Correction	R Corrected	N	K Factor	Diameter	N'
(min)			(°C)			(%)		(mm)	(%)
0		NA	NA	NA	NA	NA	NA	NA	NA
2		48.0	21.9	6.31	41.7	74.2	0.01314	0.0270	**73.1**
5		40.0	21.9	6.31	33.7	60.0	0.01314	0.0183	**59.1**
15		29.5	21.9	6.31	23.2	41.3	0.01314	0.0115	**40.7**
31		25.0	21.9	6.31	18.7	33.3	0.01314	0.0082	**32.8**
66		20.5	22.0	6.27	14.2	25.3	0.01313	0.0058	**25.0**
250		15.5	21.7	6.38	9.1	16.2	0.01317	0.0031	**16.0**
1440		12.0	21.6	6.41	5.6	10.0	0.01319	0.0013	**9.8**

Soil Specimen Data		**Other Corrections**		
Tare No.	976			
Weight of Tare & Dry Material (g)	161.65	a - Factor	0.99	
Weight of Tare (g)	101.05			
Weight of Deflocculant (g)	5.0	Percent Finer than # 200	98.50	
Weight of Dry Material (g)	55.6			
		Specific Gravity	2.7	Assumed

Note: *Hydrometer test is performed on - # 200 sieve material.*

Tested By TO Date 1/26/15 Checked By KC Date 2/3/15

DCN: CT-S3A DATE: 3/18/13 REVISION: 11

Sievehyd.xls

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ATTERBERG LIMITS

ASTM D 4318-10

Client:	Microbac Laboratories	Boring No.:	10/28/14
Client Reference:	Hamilton Co. Background Soils	Depth (ft):	NA
Project No.:	2015-057-001	Sample No.:	SHAW-01
Lab ID:	2015-057-001-004	Soil Description:	**BROWN SILT**

Note: The USCS symbol used with this test refers only to the minus No. 40 sieve material. See the "Sieve and Hydrometer Analysis" graph page for the complete material description .

(Minus No. 40 sieve material, Airdried)

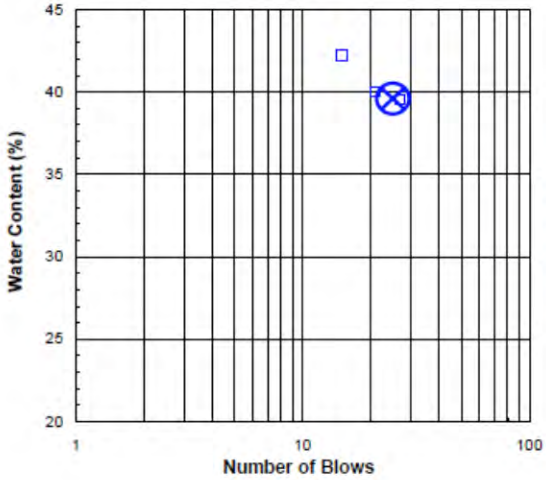
Liquid Limit Test	**1**	**2**	**3**	
				M
Tare Number	347	454	35	**U**
Wt. of Tare & Wet Sample (g)	42.55	39.04	43.24	**L**
Wt. of Tare & Dry Sample (g)	35.85	32.14	35.87	**T**
Wt. of Tare (g)	18.88	14.88	18.40	**I**
Wt. of Water (g)	6.7	6.9	7.4	**P**
Wt. of Dry Sample (g)	17.0	17.3	17.5	**O**
				I
Moisture Content (%)	**39.5**	**40.0**	**42.2**	**N**
Number of Blows	**27**	**21**	**15**	**T**

Plastic Limit Test	**1**	**2**	**Range**
Tare Number	457	1293	
Wt. of Tare & Wet Sample (g)	19.19	27.14	
Wt. of Tare & Dry Sample (g)	17.77	25.75	
Wt. of Tare (g)	12.63	20.77	
Wt. of Water (g)	1.4	1.4	
Wt. of Dry Sample (g)	5.1	5.0	
Moisture Content (%)	**27.6**	**27.9**	**-0.3**

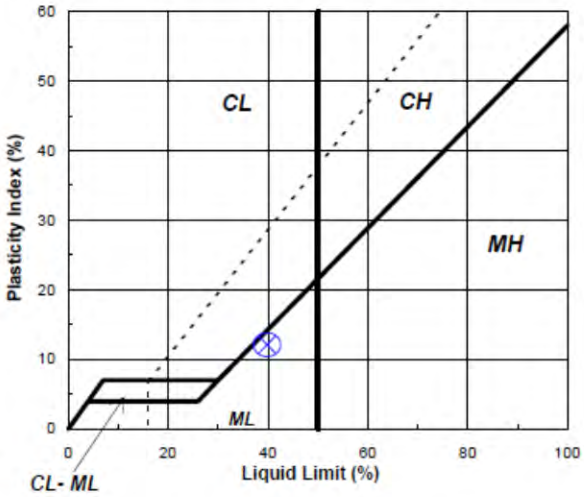
Note: The acceptable range of the two Moisture contents is ± 2.6

Test Results	
Liquid Limit (%)	**40**
Plastic Limit (%)	**28**
Plasticity Index (%)	**12**
USCS Symbol	**ML**

Flow Curve



Plasticity Chart

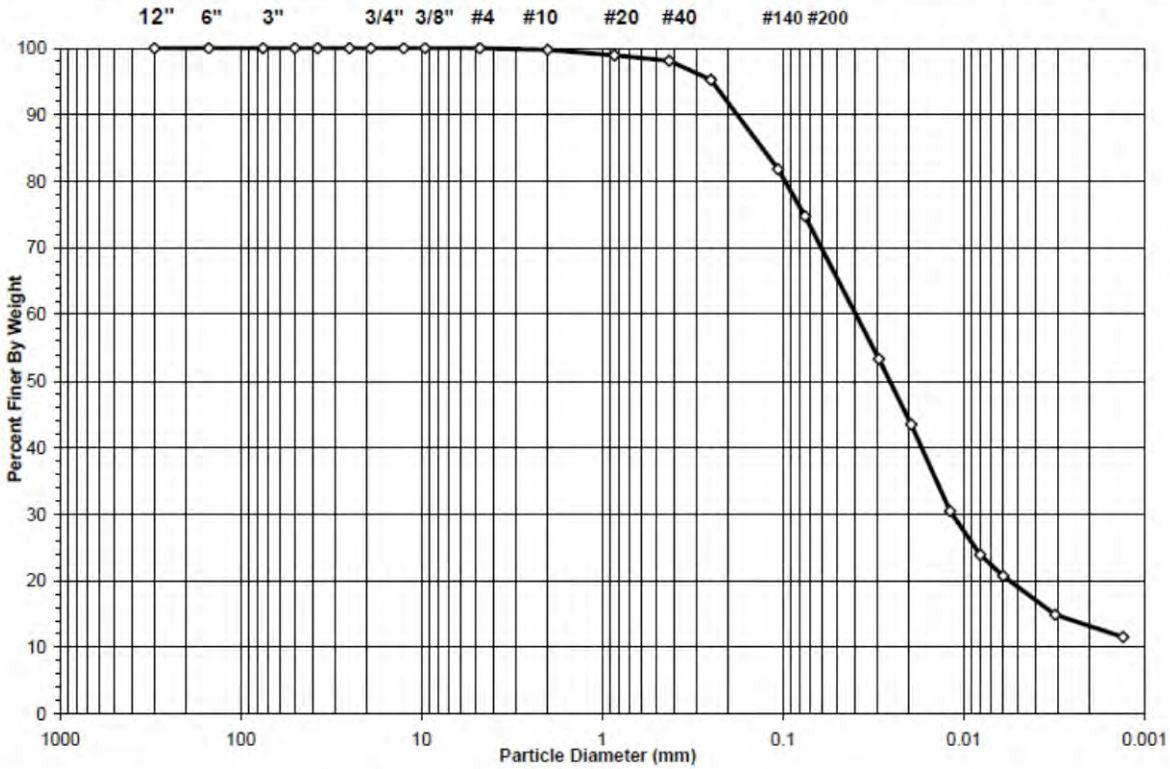


Tested By TO *Date* *1/30/15* *Checked By* KC *Date* 2/3/15

SIEVE AND HYDROMETER ANALYSIS
ASTM D 422-63 (2007)

Client:	Microbac Laboratories	Boring No.:	12/17/14
Client Reference:	Hamilton Co. Background Soils	Depth (ft):	NA
Project No.:	2015-057-001	Sample No.:	AV-01
Lab ID:	2015-057-001-005	Soil Color:	BROWN

	SIEVE ANALYSIS					HYDROMETER
USCS	cobbles	gravel		sand		silt and clay fraction
USDA	cobbles	gravel		sand	silt	clay



USCS Summary

Sieve Sizes (mm)		Percentage
Greater Than #4	*Gravel*	0.00
#4 To #200	*Sand*	25.20
Finer Than #200	*Silt & Clay*	74.80

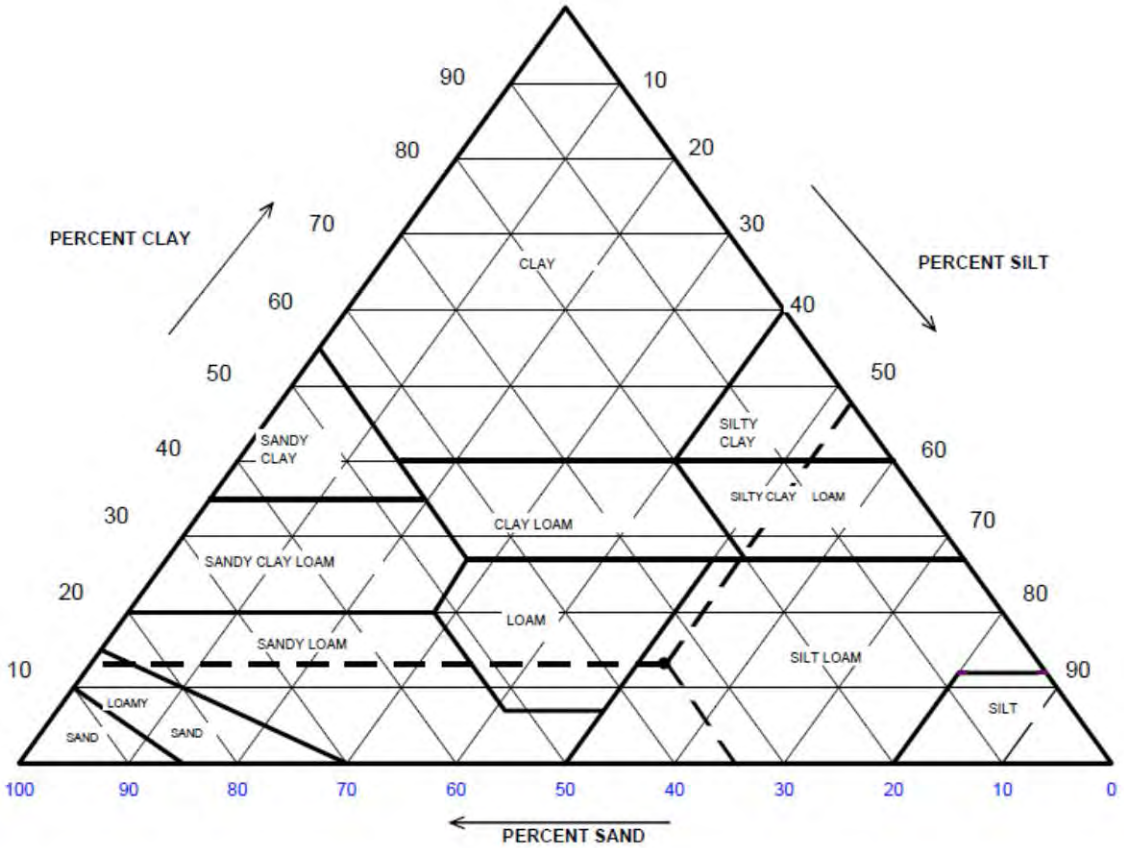
USCS Symbol *CL, TESTED*

USCS Classification *LEAN CLAY WITH SAND*

DCN: CT-S3A DATE: 3/18/13 REVISION: 11

USDA CLASSIFICATION CHART

Client:	Microbac Laboratories	Boring No.:	12/17/14
Client Reference:	Hamilton Co. Background Soils	Depth (ft):	NA
Project No.:	2015-057-001	Sample No.:	AV-01
Lab ID:	2015-057-001-005	Soil Color:	BROWN



Particle Size	Percent Finer	USDA SUMMARY	Actual Percentage	Corrected % of Minus 2.0 mm material for USDA Classificat.
(mm)	(%)		(%)	(%)
		Gravel	0.24	**0.00**
2	99.76	*Sand*	34.22	**34.31**
0.05	65.54	*Silt*	52.34	**52.47**
0.002	13.20	*Clay*	13.20	**13.23**

USDA Classification: ***SILT LOAM***

DCN: CT-S3A DATE: 3/18/13 REVISION: 11

WASH SIEVE ANALYSIS

ASTM D 422-63 (2007)

Client:	Microbac Laboratories	Boring No.:	12/17/14
Client Reference:	Hamilton Co. Background Soils	Depth (ft):	NA
Project No.:	2015-057-001	Sample No.:	AV-01
Lab ID:	2015-057-001-005	Soil Color:	BROWN

Moisture Content of Passing 3/4" Material		Water Content of Retained 3/4" Material	
Tare No.	972	Tare No.	NA
Wt. of Tare & Wet Specimen (g)	648.40	Wt. of Tare & Wet Specimen (g)	NA
Wt. of Tare & Dry Specimen (g)	601.80	Wt. of Tare & Dry Specimen (g)	NA
Weight of Tare (g)	100.90	Weight of Tare (g)	NA
Weight of Water (g)	46.60	Weight of Water (g)	NA
Weight of Dry Specimen (g)	500.90	Weight of Dry Specimen (g)	NA
Moisture Content (%)	**9.3**	**Moisture Content (%)**	**NA**

Wet Weight of -3/4" Sample (g)	NA	Weight of the Dry Specimen (g)	500.90
Dry Weight of -3/4" Sample (g)	126.22	Weight of - #200 material (g)	374.68
Wet Weight of +3/4" Sample (g)	NA	Weight of + #200 material (g)	126.22
Dry Weight of +3/4" Sample (g)	0.00		
Total Dry Weight of Sample (g)	NA		

Sieve Size	Sieve Opening	Weight of Soil Retained	Percent Retained	Accumulated Percent Retained		Percent Finer	Accumulated Percent Finer
	(mm)	(g)	(%)	(%)		(%)	(%)
12"	300	0.00	0.00	0.00		100.00	**100.00**
6"	150	0.00	0.00	0.00		100.00	**100.00**
3"	75	0.00	0.00	0.00		100.00	**100.00**
2"	50	0.00	0.00	0.00		100.00	**100.00**
1 1/2"	37.5	0.00	0.00	0.00		100.00	**100.00**
1"	25.0	0.00	0.00	0.00		100.00	**100.00**
3/4"	19.0	0.00	0.00	0.00		100.00	**100.00**
1/2"	12.5	0.00	0.00	0.00		100.00	**100.00**
3/8"	9.50	0.00	0.00	0.00		100.00	**100.00**
#4	4.75	0.00	0.00	0.00		100.00	**100.00**
#10	2.00	1.21	0.24	0.24		99.76	**99.76**
#20	0.85	4.21	0.84	1.08		98.92	**98.92**
#40	0.425	4.03	0.80	1.89		98.11	**98.11**
#60	0.250	14.39	2.87	4.76		95.24	**95.24**
#140	0.106	67.13	13.40	18.16		81.84	**81.84**
#200	0.075	35.25	7.04	25.20		74.80	**74.80**
Pan	-	374.68	74.80	100.00		-	**-**

Tested By	RAL	Date	1/23/15	Checked By	KC	Date	2/3/15

DCN: CT-S3A DATE: 3/18/13 REVISION: 11

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HYDROMETER ANALYSIS

ASTM D 422-63 (2007)

Client:	Microbac Laboratories	Boring No.:	12/17/14
Client Reference:	Hamilton Co. Background Soils	Depth (ft):	NA
Project No.:	2015-057-001	Sample No.:	AV-01
Lab ID:	2015-057-001-005	Soil Color:	BROWN

Elapsed Time		R Measured	Temp.	Composite Correction	R Corrected	N	K Factor	Diameter	N'
(min)			(°C)			(%)		(mm)	(%)
0		NA	NA	NA	NA	NA	NA	NA	NA
2		39.0	21.9	6.31	32.7	71.2	0.01314	0.0292	**53.3**
5		33.0	21.9	6.31	26.7	58.2	0.01314	0.0194	**43.5**
15		25.0	21.9	6.31	18.7	40.7	0.01314	0.0119	**30.5**
34		21.0	21.9	6.31	14.7	32.0	0.01314	0.0081	**23.9**
63		19.0	22.0	6.27	12.7	27.7	0.01313	0.0060	**20.7**
250		15.5	21.7	6.38	9.1	19.9	0.01317	0.0031	**14.9**
1440		13.5	21.6	6.41	7.1	15.4	0.01319	0.0013	**11.6**

Soil Specimen Data		**Other Corrections**		
Tare No.	979			
Weight of Tare & Dry Material (g)	148.37	a - Factor	0.99	
Weight of Tare (g)	97.93			
Weight of Deflocculant (g)	5.0	Percent Finer than # 200	74.80	
Weight of Dry Material (g)	45.44			
		Specific Gravity	2.7	Assumed

Note: *Hydrometer test is performed on - # 200 sieve material.*

Tested By TO Date 1/26/15 Checked By KC Date 2/3/15

DCN: CT-S3A DATE: 3/18/13 REVISION: 11

Sievehyd.xls

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ATTERBERG LIMITS

ASTM D 4318-10

Client:	Microbac Laboratories	Boring No.:	12/17/14
Client Reference:	Hamilton Co. Background Soils	Depth (ft):	NA
Project No.:	2015-057-001	Sample No.:	AV-01
Lab ID:	2015-057-001-005	Soil Description:	**BROWN LEAN CLAY**

Note: The USCS symbol used with this test refers only to the minus No. 40 sieve material. See the "Sieve and Hydrometer Analysis" graph page for the complete material description .

(Minus No. 40 sieve material, Airdried)

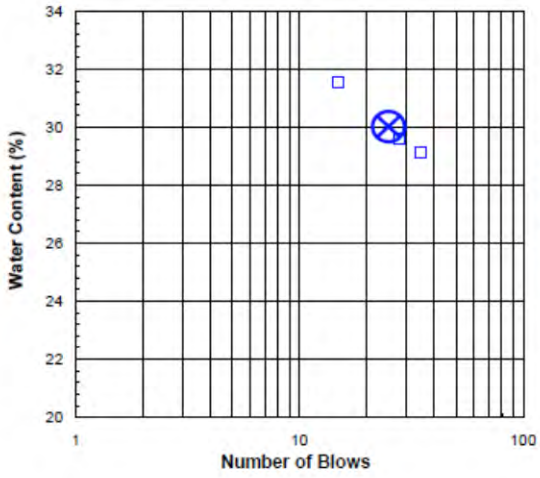
Liquid Limit Test	**1**	**2**	**3**	
				M
Tare Number	301	374	296	**U**
Wt. of Tare & Wet Sample (g)	39.26	35.87	39.37	**L**
Wt. of Tare & Dry Sample (g)	34.33	30.98	34.73	**T**
Wt. of Tare (g)	18.70	14.45	18.78	**I**
Wt. of Water (g)	4.9	4.9	4.6	**P**
Wt. of Dry Sample (g)	15.6	16.5	16.0	**O**
				I
Moisture Content (%)	**31.5**	**29.6**	**29.1**	**N**
Number of Blows	**15**	**28**	**35**	**T**

Plastic Limit Test	**1**	**2**	**Range**
Tare Number	449	1256	
Wt. of Tare & Wet Sample (g)	29.52	19.02	
Wt. of Tare & Dry Sample (g)	28.86	18.35	
Wt. of Tare (g)	23.30	12.77	
Wt. of Water (g)	0.7	0.7	
Wt. of Dry Sample (g)	5.6	5.6	
Moisture Content (%)	**11.9**	**12.0**	**-0.1**

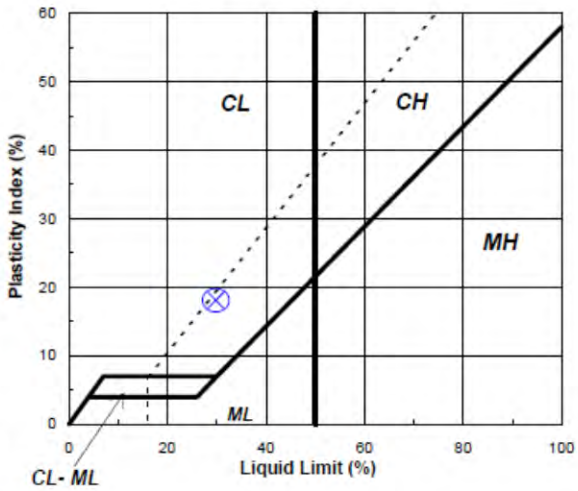
Note: The acceptable range of the two Moisture contents is ± 2.6

Test Results	
Liquid Limit (%)	**30**
Plastic Limit (%)	**12**
Plasticity Index (%)	**18**
USCS Symbol	**CL**

Flow Curve



Plasticity Chart



Tested By	*RAL*	*Date*	*1/30/15*	*Checked By*	*KC*	*Date*	*2/3/15*

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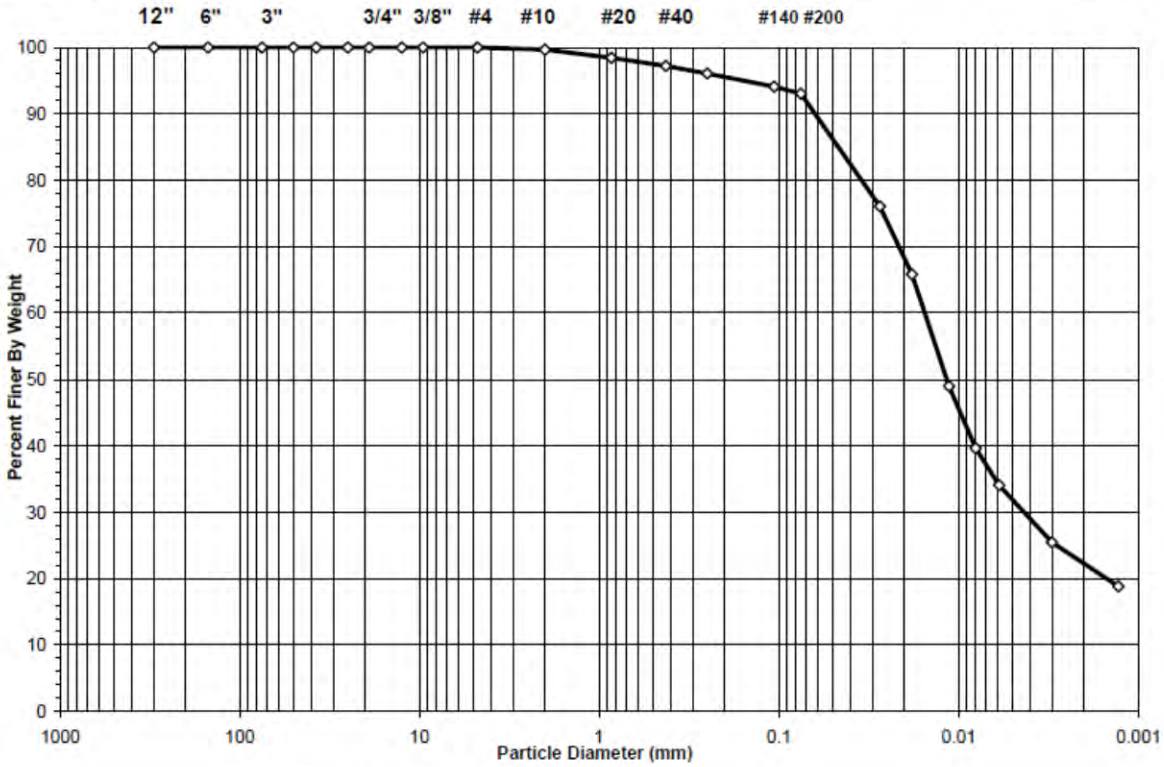
SIEVE AND HYDROMETER ANALYSIS
ASTM D 422-63 (2007)

Client:	Microbac Laboratories	Boring No.:	11/25/14
Client Reference:	Hamilton Co. Background Soils	Depth (ft):	NA
Project No.:	2015-057-001	Sample No.:	DP-01
Lab ID:	2015-057-001-006	Soil Color:	BROWN

	SIEVE ANALYSIS					HYDROMETER
USCS	cobbles	gravel	sand			silt and clay fraction
USDA	cobbles	gravel	sand		silt	clay



USCS Summary

Sieve Sizes (mm)		Percentage
Greater Than #4	*Gravel*	0.01
#4 To #200	*Sand*	6.93
Finer Than #200	*Silt & Clay*	93.06

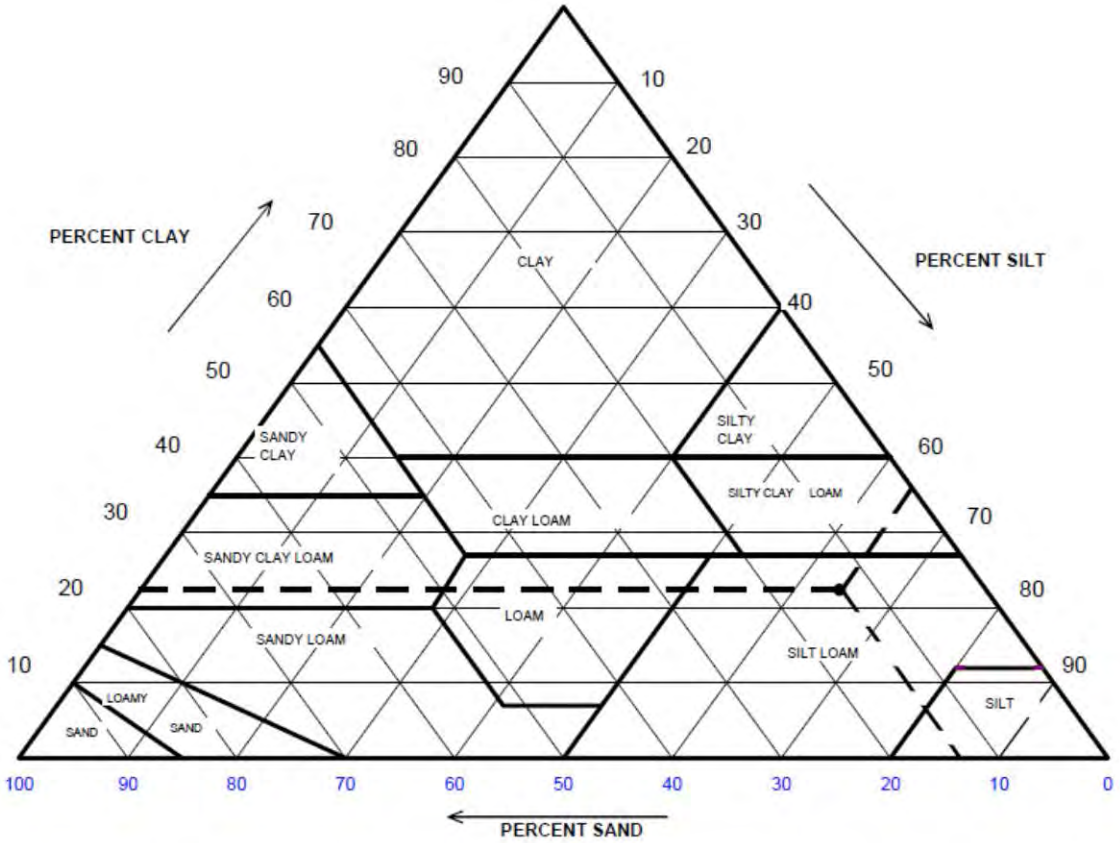
USCS Symbol ***CL, TESTED***

USCS Classification ***LEAN CLAY***

DCN: CT-S3A DATE: 3/18/13 REVISION: 11

USDA CLASSIFICATION CHART

Client:	Microbac Laboratories	Boring No.:	11/25/14
Client Reference:	Hamilton Co. Background Soils	Depth (ft):	NA
Project No.:	2015-057-001	Sample No.:	DP-01
Lab ID:	2015-057-001-006	Soil Color:	BROWN



Particle Size	Percent Finer	USDA SUMMARY	Actual Percentage	Corrected % of Minus 2.0 mm material for USDA Classificat.
(mm)	(%)		(%)	(%)
		Gravel	0.35	**0.00**
2	99.65	*Sand*	13.38	**13.43**
0.05	86.27	*Silt*	63.95	**64.17**
0.002	22.32	*Clay*	22.32	**22.40**

USDA Classification: ***SILT LOAM***

DCN: CT-S3A DATE: 3/18/13 REVISION: 11

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WASH SIEVE ANALYSIS

ASTM D 422-63 (2007)

Client:	Microbac Laboratories	Boring No.:	11/25/14
Client Reference:	Hamilton Co. Background Soils	Depth (ft):	NA
Project No.:	2015-057-001	Sample No.:	DP-01
Lab ID:	2015-057-001-006	Soil Color:	BROWN

Moisture Content of Passing 3/4" Material		Water Content of Retained 3/4" Material	
Tare No.	928	Tare No.	NA
Wt. of Tare & Wet Specimen (g)	491.80	Wt. of Tare & Wet Specimen (g)	NA
Wt. of Tare & Dry Specimen (g)	442.40	Wt. of Tare & Dry Specimen (g)	NA
Weight of Tare (g)	101.35	Weight of Tare (g)	NA
Weight of Water (g)	49.40	Weight of Water (g)	NA
Weight of Dry Specimen (g)	341.05	Weight of Dry Specimen (g)	NA
Moisture Content (%)	**14.5**	**Moisture Content (%)**	**NA**

Wet Weight of -3/4" Sample (g)	NA	Weight of the Dry Specimen (g)	341.05
Dry Weight of -3/4" Sample (g)	23.66	Weight of - #200 material (g)	317.39
Wet Weight of +3/4" Sample (g)	NA	Weight of + #200 material (g)	23.66
Dry Weight of +3/4" Sample (g)	0.00		
Total Dry Weight of Sample (g)	NA		

Sieve Size	Sieve Opening	Weight of Soil Retained	Percent Retained	Accumulated Percent Retained		Percent Finer	Accumulated Percent Finer
	(mm)	(g)	(%)	(%)		(%)	(%)
12"	300	0.00	0.00	0.00		100.00	**100.00**
6"	150	0.00	0.00	0.00		100.00	**100.00**
3"	75	0.00	0.00	0.00		100.00	**100.00**
2"	50	0.00	0.00	0.00		100.00	**100.00**
1 1/2"	37.5	0.00	0.00	0.00		100.00	**100.00**
1"	25.0	0.00	0.00	0.00		100.00	**100.00**
3/4"	19.0	0.00	0.00	0.00		100.00	**100.00**
1/2"	12.5	0.00	0.00	0.00		100.00	**100.00**
3/8"	9.50	0.00	0.00	0.00		100.00	**100.00**
#4	4.75	0.03	0.01	0.01		99.99	**99.99**
#10	2.00	1.15	0.34	0.35		99.65	**99.65**
#20	0.85	4.16	1.22	1.57		98.43	**98.43**
#40	0.425	4.05	1.19	2.75		97.25	**97.25**
#60	0.250	3.97	1.16	3.92		96.08	**96.08**
#140	0.106	6.80	1.99	5.91		94.09	**94.09**
#200	0.075	3.50	1.03	6.94		93.06	**93.06**
Pan	-	317.39	93.06	100.00		-	-

Tested By	RAL	Date	1/23/15	Checked By	KC	Date	2/3/15

DCN: CT-53A DATE: 3/18/13 REVISION: 11

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HYDROMETER ANALYSIS

ASTM D 422-63 (2007)

Client:	Microbac Laboratories	Boring No.:	11/25/14
Client Reference:	Hamilton Co. Background Soils	Depth (ft):	NA
Project No.:	2015-057-001	Sample No.:	DP-01
Lab ID:	2015-057-001-006	Soil Color:	BROWN

Elapsed Time		R Measured	Temp.	Composite Correction	R Corrected	N	K Factor	Diameter	N'
(min)			(°C)			(%)		(mm)	(%)
0		NA	NA	NA	NA	NA	NA	NA	NA
2		47.0	21.9	6.31	40.7	81.8	0.01314	0.0272	**76.1**
5		41.5	21.9	6.31	35.2	70.7	0.01314	0.0181	**65.8**
15		32.5	21.9	6.31	26.2	52.6	0.01314	0.0112	**49.0**
32		27.5	21.9	6.31	21.2	42.6	0.01314	0.0080	**39.6**
60		24.5	22.0	6.27	18.2	36.6	0.01313	0.0059	**34.1**
250		20.0	21.7	6.38	13.6	27.4	0.01317	0.0030	**25.5**
1440		16.5	21.6	6.41	10.1	20.3	0.01319	0.0013	**18.9**

Soil Specimen Data		Other Corrections		
Tare No.	952			
Weight of Tare & Dry Material (g)	156.72	a - Factor	0.99	
Weight of Tare (g)	102.45			
Weight of Deflocculant (g)	5.0	Percent Finer than # 200	93.06	
Weight of Dry Material (g)	49.27			
		Specific Gravity	2.7	Assumed

Note: *Hydrometer test is performed on - # 200 sieve material.*

Tested By TO Date 1/26/15 Checked By KC Date 2/3/15

DCN: CT-S3A DATE: 3/18/13 REVISION: 11

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ATTERBERG LIMITS

ASTM D 4318-10

Client:	Microbac Laboratories	Boring No.:	11/25/14
Client Reference:	Hamilton Co. Background Soils	Depth (ft):	NA
Project No.:	2015-057-001	Sample No.:	DP-1
Lab ID:	2015-057-001-006	Soil Description:	**BROWN LEAN CLAY**

Note: The USCS symbol used with this test refers only to the minus No. 40 sieve material. See the "Sieve and Hydrometer Analysis" graph page for the complete material description .

(Minus No. 40 sieve material, Airdried)

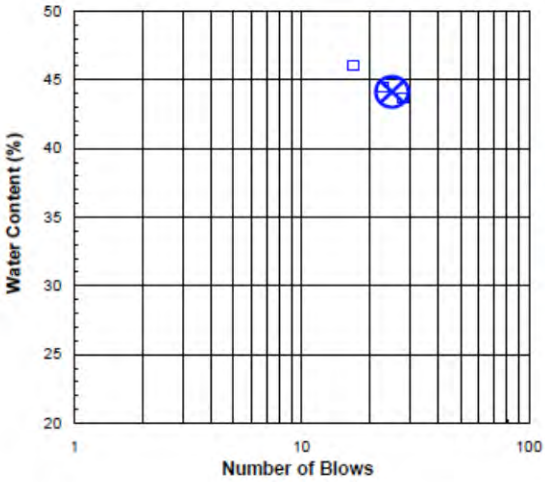
Liquid Limit Test	**1**	**2**	**3**	
Tare Number	1233	292	396	**MULTIPOINT**
Wt. of Tare & Wet Sample (g)	42.73	43.47	42.78	
Wt. of Tare & Dry Sample (g)	36.12	36.28	34.87	
Wt. of Tare (g)	20.96	20.09	17.68	
Wt. of Water (g)	6.6	7.2	7.9	
Wt. of Dry Sample (g)	15.2	16.2	17.2	
Moisture Content (%)	**43.6**	**44.4**	**46.0**	
Number of Blows	**28**	**23**	**17**	

Plastic Limit Test	**1**	**2**	**Range**
Tare Number	143	1291	
Wt. of Tare & Wet Sample (g)	26.13	23.69	
Wt. of Tare & Dry Sample (g)	25.06	22.61	
Wt. of Tare (g)	19.95	17.53	
Wt. of Water (g)	1.1	1.1	
Wt. of Dry Sample (g)	5.1	5.1	
Moisture Content (%)	**20.9**	**21.3**	**-0.3**

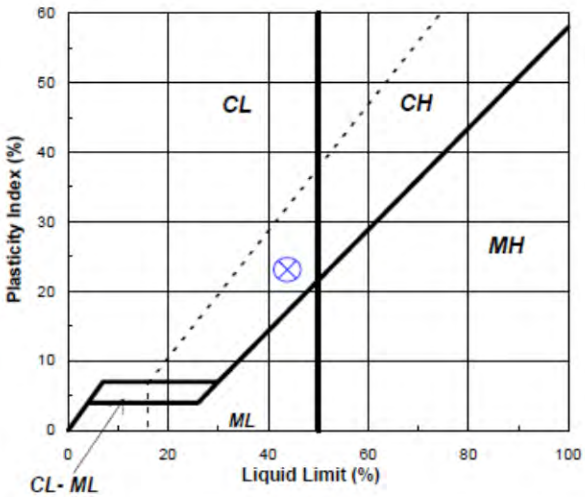
Note: The acceptable range of the two Moisture contents is ± 2.6

Test Results	
Liquid Limit (%)	**44**
Plastic Limit (%)	**21**
Plasticity Index (%)	**23**
USCS Symbol	**CL**

Flow Curve



Plasticity Chart



Tested By TO *Date* *1/30/15* *Checked By* KC *Date* 2/3/15

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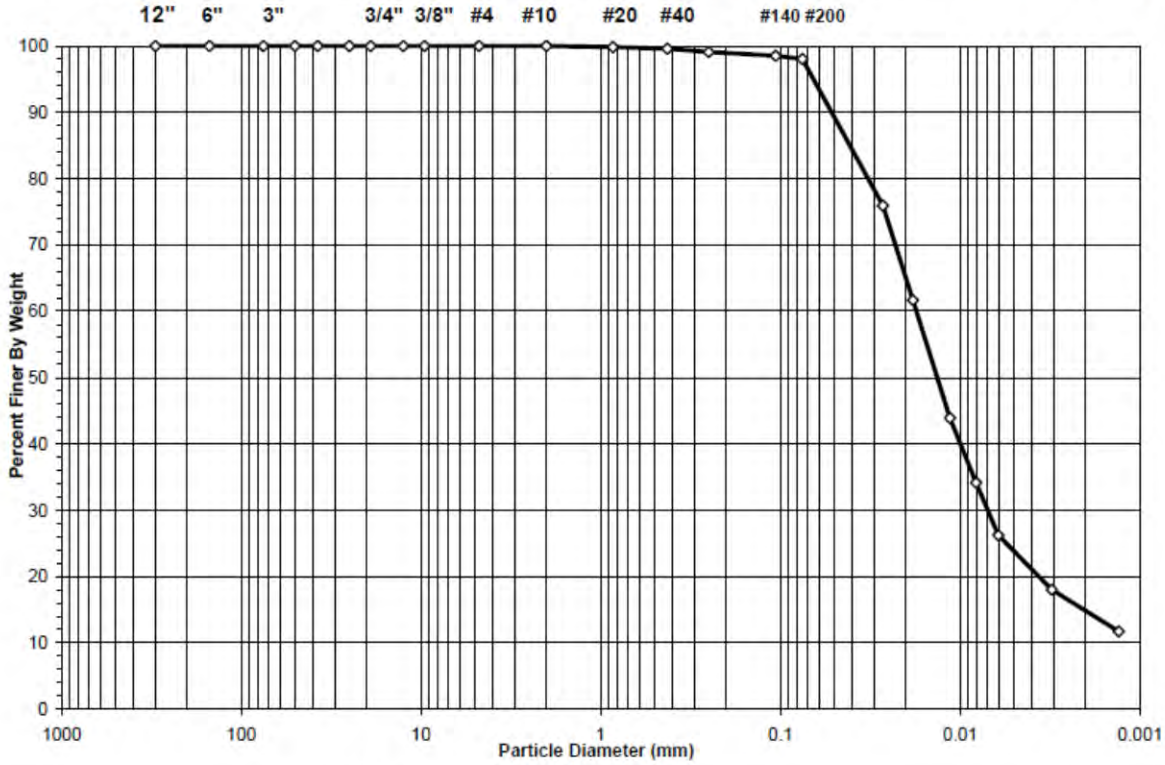
SIEVE AND HYDROMETER ANALYSIS
ASTM D 422-63 (2007)

Client:	Microbac Laboratories	Boring No.:	10/28/14
Client Reference:	Hamilton Co. Background Soils	Depth (ft):	NA
Project No.:	2015-057-001	Sample No.:	MWW-1
Lab ID:	2015-057-001-007	Soil Color:	BROWN

	SIEVE ANALYSIS				HYDROMETER	
USCS	cobbles	gravel	sand		silt and clay fraction	
USDA	cobbles	gravel	sand		silt	clay



USCS Summary

Sieve Sizes (mm)		Percentage
Greater Than #4	*Gravel*	0.00
#4 To #200	*Sand*	1.99
Finer Than #200	*Silt & Clay*	98.01

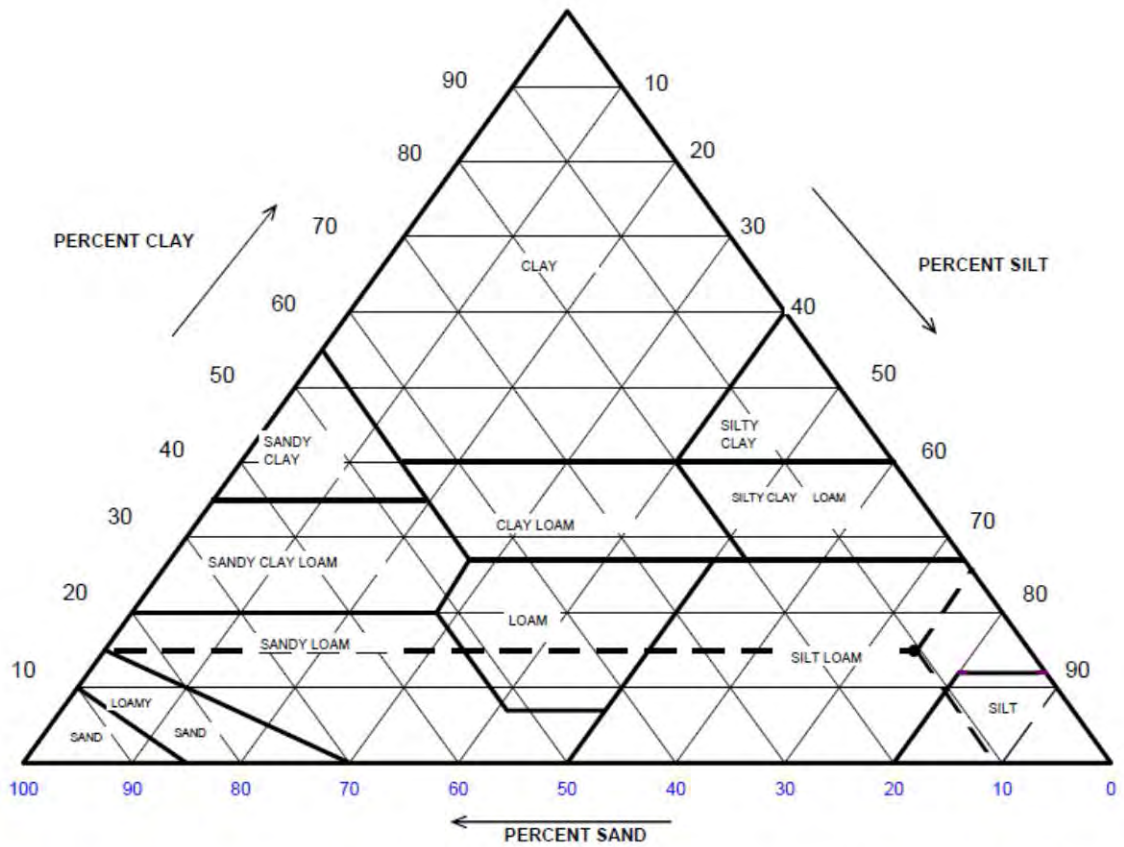
USCS Symbol ***CL, TESTED***

USCS Classification ***LEAN CLAY***

DCN: CT-S3A DATE: 3/18/13 REVISION: 11

USDA CLASSIFICATION CHART

Client:	Microbac Laboratories	Boring No.:	10/28/14
Client Reference:	Hamilton Co. Background Soils	Depth (ft):	NA
Project No.:	2015-057-001	Sample No.:	MWW-1
Lab ID:	2015-057-001-007	Soil Color:	BROWN



Particle Size	Percent Finer	USDA SUMMARY	Actual Percentage	Corrected % of Minus 2.0 mm material for USDA Classificat.
(mm)	(%)		(%)	(%)
		Gravel	0.03	**0.00**
2	99.97	*Sand*	10.62	**10.63**
0.05	89.34	*Silt*	74.49	**74.52**
0.002	14.85	*Clay*	14.85	**14.85**

USDA Classification: ***SILT LOAM***

DCN: CT-53A DATE: 3/18/13 REVISION: 11

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WASH SIEVE ANALYSIS

ASTM D 422-63 (2007)

Client:	Microbac Laboratories	Boring No.:	10/28/14
Client Reference:	Hamilton Co. Background Soils	Depth (ft):	NA
Project No.:	2015-057-001	Sample No.:	MWW-1
Lab ID:	2015-057-001-007	Soil Color:	BROWN

Moisture Content of Passing 3/4" Material		Water Content of Retained 3/4" Material	
Tare No.	947	Tare No.	NA
Wt. of Tare & Wet Specimen (g)	642.40	Wt. of Tare & Wet Specimen (g)	NA
Wt. of Tare & Dry Specimen (g)	606.00	Wt. of Tare & Dry Specimen (g)	NA
Weight of Tare (g)	100.52	Weight of Tare (g)	NA
Weight of Water (g)	36.40	Weight of Water (g)	NA
Weight of Dry Specimen (g)	505.48	Weight of Dry Specimen (g)	NA
Moisture Content (%)	**7.2**	**Moisture Content (%)**	**NA**

Wet Weight of -3/4" Sample (g)	NA	Weight of the Dry Specimen (g)	505.48
Dry Weight of -3/4" Sample (g)	10.05	Weight of - #200 material (g)	495.43
Wet Weight of +3/4" Sample (g)	NA	Weight of + #200 material (g)	10.05
Dry Weight of +3/4" Sample (g)	0.00		
Total Dry Weight of Sample (g)	NA		

Sieve Size	Sieve Opening	Weight of Soil Retained	Percent Retained	Accumulated Percent Retained		Percent Finer	Accumulated Percent Finer
	(mm)	(g)	(%)	(%)		(%)	(%)
12"	300	0.00	0.00	0.00		100.00	**100.00**
6"	150	0.00	0.00	0.00		100.00	**100.00**
3"	75	0.00	0.00	0.00		100.00	**100.00**
2"	50	0.00	0.00	0.00		100.00	**100.00**
1 1/2"	37.5	0.00	0.00	0.00		100.00	**100.00**
1"	25.0	0.00	0.00	0.00		100.00	**100.00**
3/4"	19.0	0.00	0.00	0.00		100.00	**100.00**
1/2"	12.5	0.00	0.00	0.00		100.00	**100.00**
3/8"	9.50	0.00	0.00	0.00		100.00	**100.00**
#4	4.75	0.00	0.00	0.00		100.00	**100.00**
#10	2.00	0.17	0.03	0.03		99.97	**99.97**
#20	0.85	0.59	0.12	0.15		99.85	**99.85**
#40	0.425	1.50	0.30	0.45		99.55	**99.55**
#60	0.250	2.34	0.46	0.91		99.09	**99.09**
#140	0.106	2.97	0.59	1.50		98.50	**98.50**
#200	0.075	2.48	0.49	1.99		98.01	**98.01**
Pan	-	495.43	98.01	100.00		-	-

Tested By	RAL	Date	1/23/15	Checked By	KC	Date	2/3/15

DCN: CT-S3A DATE: 3/18/13 REVISION: 11

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HYDROMETER ANALYSIS

ASTM D 422-63 (2007)

Client:	Microbac Laboratories	Boring No.:	10/28/14
Client Reference:	Hamilton Co. Background Soils	Depth (ft):	NA
Project No.:	2015-057-001	Sample No.:	MWW-1
Lab ID:	2015-057-001-007	Soil Color:	BROWN

Elapsed Time		R Measured	Temp.	Composite Correction	R Corrected	N	K Factor	Diameter	N'
(min)			(°C)			(%)		(mm)	(%)
0		NA	NA	NA	NA	NA	NA	NA	NA
2		49.0	21.9	6.31	42.7	77.5	0.01314	0.0267	**75.9**
5		41.0	21.9	6.31	34.7	63.0	0.01314	0.0182	**61.7**
15		31.0	21.9	6.31	24.7	44.8	0.01314	0.0114	**43.9**
32		25.5	21.9	6.31	19.2	34.8	0.01314	0.0081	**34.1**
60		21.0	22.0	6.27	14.7	26.7	0.01313	0.0061	**26.2**
250		16.5	21.7	6.38	10.1	18.4	0.01317	0.0031	**18.0**
1440		13.0	21.6	6.41	6.6	12.0	0.01319	0.0013	**11.7**

Soil Specimen Data		Other Corrections		
Tare No.	1913			
Weight of Tare & Dry Material (g)	157.71	a - Factor	0.99	
Weight of Tare (g)	98.16			
Weight of Deflocculant (g)	5.0	Percent Finer than # 200	98.01	
Weight of Dry Material (g)	54.55			
		Specific Gravity	2.7	Assumed

Note: *Hydrometer test is performed on - # 200 sieve material.*

Tested By TO Date 1/26/15 Checked By KC Date 2/3/15

DCN: CT-S3A DATE: 3/18/13 REVISION: 11

Sievehyd.xls

ATTERBERG LIMITS

ASTM D 4318-10

Client:	Microbac Laboratories	Boring No.:	10/28/14
Client Reference:	Hamilton Co. Background Soils	Depth (ft):	NA
Project No.:	2015-057-001	Sample No.:	MWW-1
Lab ID:	2015-057-001-007	Soil Description:	**BROWN LEAN CLAY**

Note: The USCS symbol used with this test refers only to the minus No. 40 sieve material. See the "Sieve and Hydrometer Analysis" graph page for the complete material description . (Minus No. 40 sieve material, Airdried)

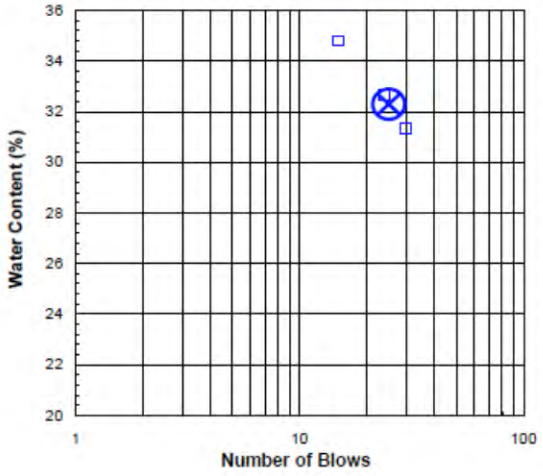
Liquid Limit Test	**1**	**2**	**3**	
				M
Tare Number	428	120	375	**U**
Wt. of Tare & Wet Sample (g)	33.88	38.15	34.79	**L**
Wt. of Tare & Dry Sample (g)	28.57	33.16	29.64	**T**
Wt. of Tare (g)	13.29	17.87	13.18	**I**
Wt. of Water (g)	5.3	5.0	5.2	**P**
Wt. of Dry Sample (g)	15.3	15.3	16.5	**O**
				I
Moisture Content (%)	**34.8**	**32.6**	**31.3**	**N**
Number of Blows	**15**	**24**	**30**	**T**

Plastic Limit Test	**1**	**2**	**Range**
Tare Number	386	1276	
Wt. of Tare & Wet Sample (g)	26.89	19.92	
Wt. of Tare & Dry Sample (g)	25.98	19.02	
Wt. of Tare (g)	20.63	13.85	
Wt. of Water (g)	0.9	0.9	
Wt. of Dry Sample (g)	5.4	5.2	
Moisture Content (%)	**17.0**	**17.4**	**-0.4**

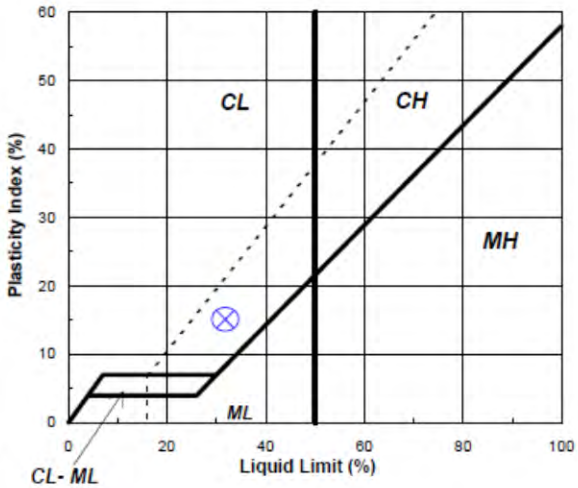
Note: The acceptable range of the two Moisture contents is ± 2.6

Test Results	
Liquid Limit (%)	**32**
Plastic Limit (%)	**17**
Plasticity Index (%)	**15**
USCS Symbol	**CL**

Flow Curve



Plasticity Chart



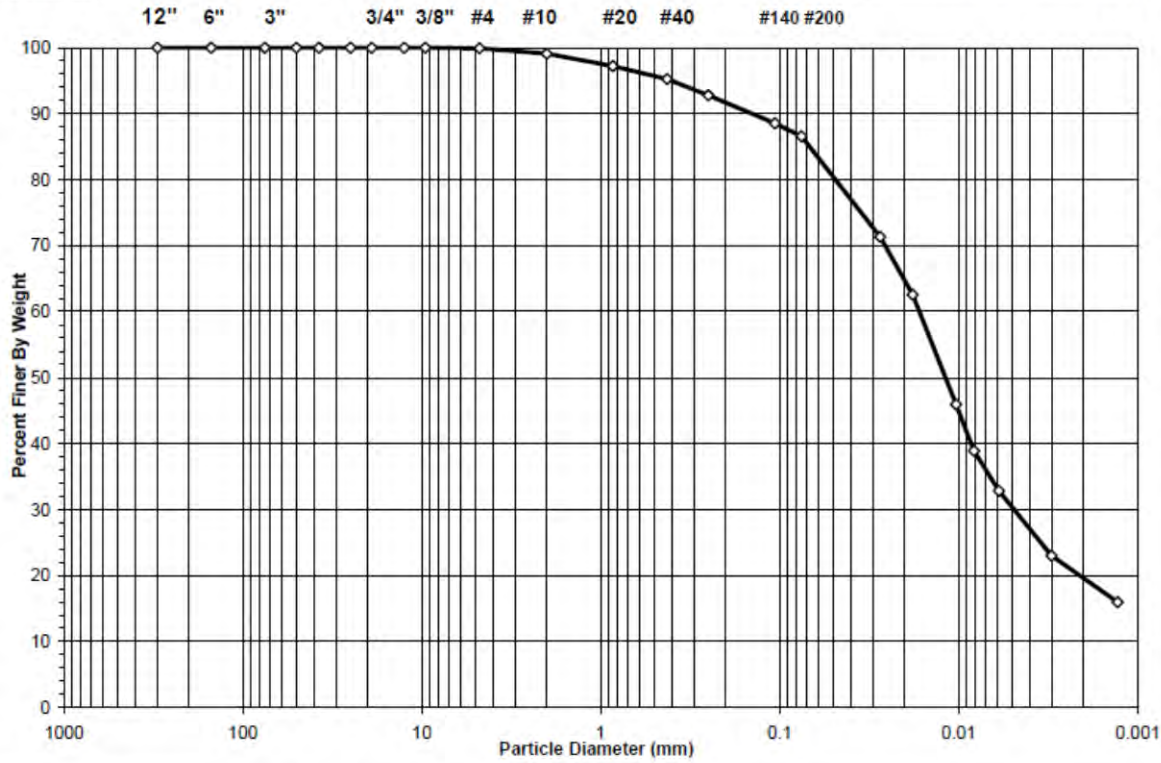
Tested By *RAL* *Date* *2/2/15* *Checked By* *KC* *Date* *2/3/15*

SIEVE AND HYDROMETER ANALYSIS

ASTM D 422-63 (2007)

Client:	Microbac Laboratories	Boring No.:	12/17/14
Client Reference:	Hamilton Co. Background Soils	Depth (ft):	NA
Project No.:	2015-057-001	Sample No.:	JHP-01
Lab ID:	2015-057-001-008	Soil Color:	BROWN

	SIEVE ANALYSIS			HYDROMETER	
USCS	cobbles	gravel	sand	silt and clay fraction	
USDA	cobbles	gravel	sand	silt	clay



USCS Summary		
Sieve Sizes (mm)		**Percentage**
Greater Than #4	*Gravel*	0.11
#4 To #200	*Sand*	13.34
Finer Than #200	*Silt & Clay*	86.55

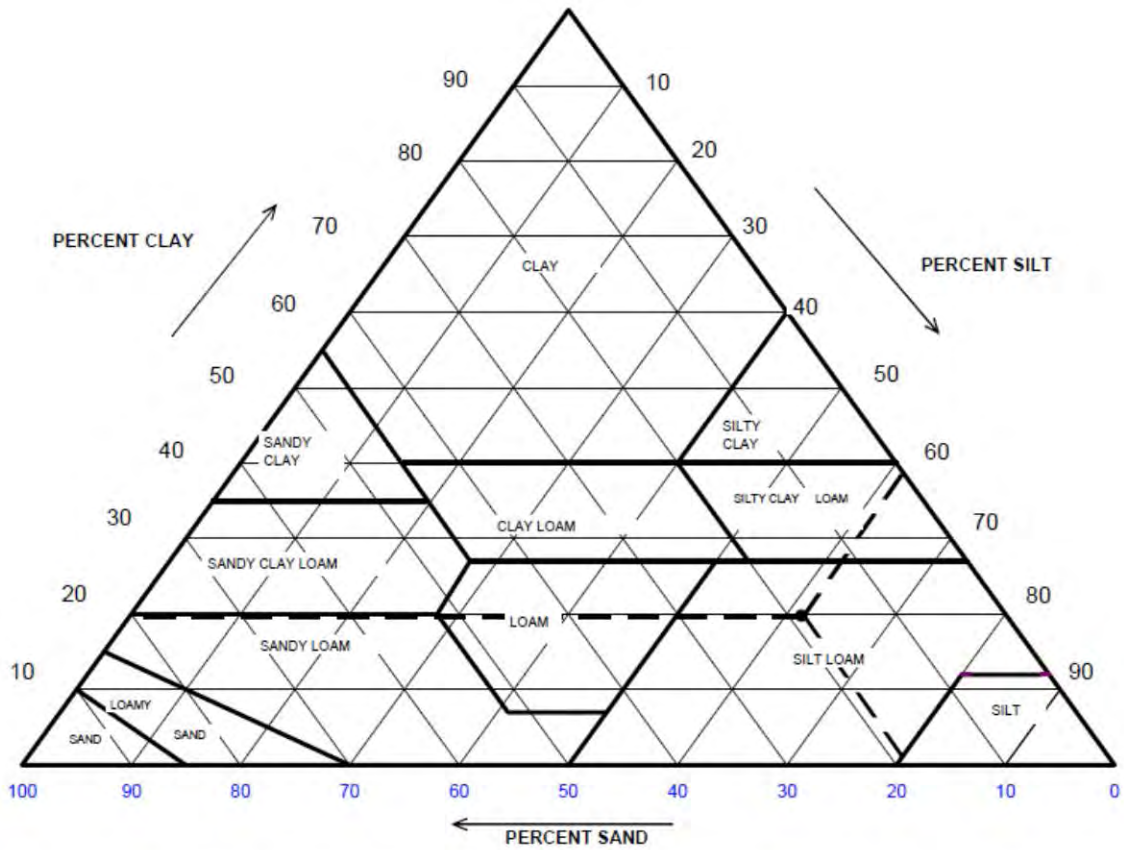
USCS Symbol ***CL, TESTED***

USCS Classification ***LEAN CLAY***

DCN: CT-S3A DATE: 3/18/13 REVISION: 11

USDA CLASSIFICATION CHART

Client:	Microbac Laboratories	Boring No.:	12/17/14
Client Reference:	Hamilton Co. Background Soils	Depth (ft):	NA
Project No.:	2015-057-001	Sample No.:	JHP-01
Lab ID:	2015-057-001-008	Soil Color:	BROWN



Particle Size	Percent Finer	USDA SUMMARY	Actual Percentage	Corrected % of Minus 2.0 mm material for USDA Classificat.
(mm)	(%)		(%)	(%)
		Gravel	0.94	**0.00**
2	99.06	*Sand*	18.59	**18.77**
0.05	80.47	*Silt*	60.87	**61.45**
0.002	19.60	*Clay*	19.60	**19.78**

USDA Classification: ***SILT LOAM***

DCN: CT-S3A DATE: 3/18/13 REVISION: 11

WASH SIEVE ANALYSIS

ASTM D 422-63 (2007)

Client:	Microbac Laboratories	Boring No.:	12/17/14
Client Reference:	Hamilton Co. Background Soils	Depth (ft):	NA
Project No.:	2015-057-001	Sample No.:	JHP-01
Lab ID:	2015-057-001-008	Soil Color:	BROWN

Moisture Content of Passing 3/4" Material		Water Content of Retained 3/4" Material	
Tare No.	518	Tare No.	NA
Wt. of Tare & Wet Specimen (g)	508.50	Wt. of Tare & Wet Specimen (g)	NA
Wt. of Tare & Dry Specimen (g)	496.60	Wt. of Tare & Dry Specimen (g)	NA
Weight of Tare (g)	96.78	Weight of Tare (g)	NA
Weight of Water (g)	11.90	Weight of Water (g)	NA
Weight of Dry Specimen (g)	399.82	Weight of Dry Specimen (g)	NA
Moisture Content (%)	**3.0**	**Moisture Content (%)**	**NA**

Wet Weight of -3/4" Sample (g)	NA	Weight of the Dry Specimen (g)	399.82
Dry Weight of -3/4" Sample (g)	53.78	Weight of - #200 material (g)	346.04
Wet Weight of +3/4" Sample (g)	NA	Weight of + #200 material (g)	53.78
Dry Weight of +3/4" Sample (g)	0.00		
Total Dry Weight of Sample (g)	NA		

Sieve Size	Sieve Opening	Weight of Soil Retained	Percent Retained	Accumulated Percent Retained		Percent Finer	Accumulated Percent Finer
	(mm)	(g)	(%)	(%)		(%)	(%)
12"	300	0.00	0.00	0.00		100.00	**100.00**
6"	150	0.00	0.00	0.00		100.00	**100.00**
3"	75	0.00	0.00	0.00		100.00	**100.00**
2"	50	0.00	0.00	0.00		100.00	**100.00**
1 1/2"	37.5	0.00	0.00	0.00		100.00	**100.00**
1"	25.0	0.00	0.00	0.00		100.00	**100.00**
3/4"	19.0	0.00	0.00	0.00		100.00	**100.00**
1/2"	12.5	0.00	0.00	0.00		100.00	**100.00**
3/8"	9.50	0.00	0.00	0.00		100.00	**100.00**
#4	4.75	0.43	0.11	0.11		99.89	**99.89**
#10	2.00	3.33	0.83	0.94		99.06	**99.06**
#20	0.85	7.42	1.86	2.80		97.20	**97.20**
#40	0.425	7.97	1.99	4.79		95.21	**95.21**
#60	0.250	9.51	2.38	7.17		92.83	**92.83**
#140	0.106	17.02	4.26	11.43		88.57	**88.57**
#200	0.075	8.10	2.03	13.45		86.55	**86.55**
Pan	-	346.04	86.55	100.00		-	**-**

Tested By RAL Date 1/23/15 Checked By KC Date 2/3/15

DCN: CT-S3A DATE: 3/18/13 REVISION: 11

geotechnics
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HYDROMETER ANALYSIS

ASTM D 422-63 (2007)

Client:	Microbac Laboratories	Boring No.:	12/17/14
Client Reference:	Hamilton Co. Background Soils	Depth (ft):	NA
Project No.:	2015-057-001	Sample No.:	JHP-01
Lab ID:	2015-057-001-008	Soil Color:	BROWN

Elapsed Time		R Measured	Temp.	Composite Correction	R Corrected	N	K Factor	Diameter	N'
(min)			(°C)			(%)		(mm)	(%)
0		NA	NA	NA	NA	NA	NA	NA	NA
2		47.0	21.9	6.31	40.7	82.5	0.01314	0.0272	**71.4**
5		42.0	21.9	6.31	35.7	72.3	0.01314	0.0180	**62.6**
18		32.5	21.9	6.31	26.2	53.1	0.01314	0.0103	**45.9**
30		28.5	21.9	6.31	22.2	45.0	0.01314	0.0082	**38.9**
60		25.0	22.0	6.27	18.7	37.9	0.01313	0.0059	**32.8**
250		19.5	21.7	6.38	13.1	26.6	0.01317	0.0030	**23.0**
1440		15.5	21.6	6.41	9.1	18.4	0.01319	0.0013	**15.9**

Soil Specimen Data		**Other Corrections**		
Tare No.	1923			
Weight of Tare & Dry Material (g)	146.08	a - Factor	0.99	
Weight of Tare (g)	92.22			
Weight of Deflocculant (g)	5.0	Percent Finer than # 200	86.55	
Weight of Dry Material (g)	48.86			
		Specific Gravity	2.7	Assumed

Note: *Hydrometer test is performed on - # 200 sieve material.*

Tested By TO Date 1/26/15 Checked By KC Date 2/3/15

geotechnics
geotechnical & geosynthetic testing

ATTERBERG LIMITS

ASTM D 4318-10

Client:	Microbac Laboratories	Boring No.:	12/17/14
Client Reference:	Hamilton Co. Background Soils	Depth (ft):	NA
Project No.:	2015-057-001	Sample No.:	JHP-01
Lab ID:	2015-057-001-008	Soil Description:	**BROWN LEAN CLAY**

Note: The USCS symbol used with this test refers only to the minus No. 40 sieve material. See the "Sieve and Hydrometer Analysis" graph page for the complete material description . (Minus No. 40 sieve material, Airdried)

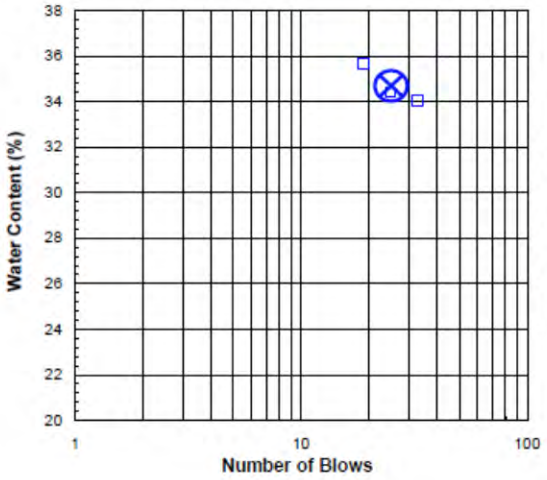
Liquid Limit Test	**1**	**2**	**3**	
Tare Number	394	1254	1265	**M U L T I P O I N T**
Wt. of Tare & Wet Sample (g)	35.14	37.22	38.51	
Wt. of Tare & Dry Sample (g)	29.79	31.85	33.05	
Wt. of Tare (g)	14.06	16.23	17.73	
Wt. of Water (g)	5.4	5.4	5.5	
Wt. of Dry Sample (g)	15.7	15.6	15.3	
Moisture Content (%)	**34.0**	**34.4**	**35.6**	
Number of Blows	**33**	**25**	**19**	

Plastic Limit Test	**1**	**2**	**Range**
Tare Number	412	449	
Wt. of Tare & Wet Sample (g)	25.61	29.91	
Wt. of Tare & Dry Sample (g)	24.55	28.84	
Wt. of Tare (g)	19.41	23.28	
Wt. of Water (g)	1.1	1.1	
Wt. of Dry Sample (g)	5.1	5.6	
Moisture Content (%)	**20.6**	**19.2**	**1.4**

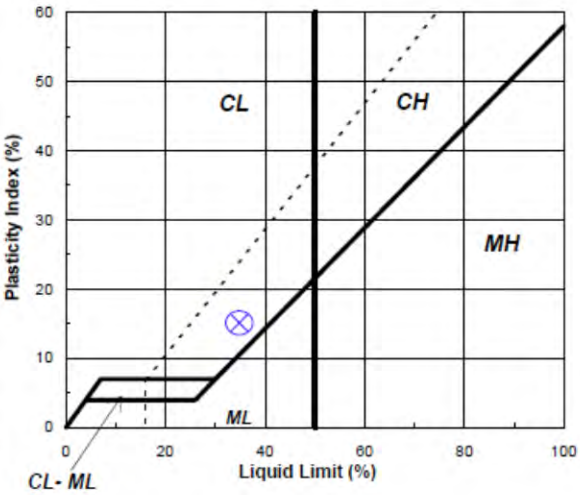
Note: The acceptable range of the two Moisture contents is ± 2.6

Test Results	
Liquid Limit (%)	**35**
Plastic Limit (%)	**20**
Plasticity Index (%)	**15**
USCS Symbol	**CL**

Flow Curve



Plasticity Chart

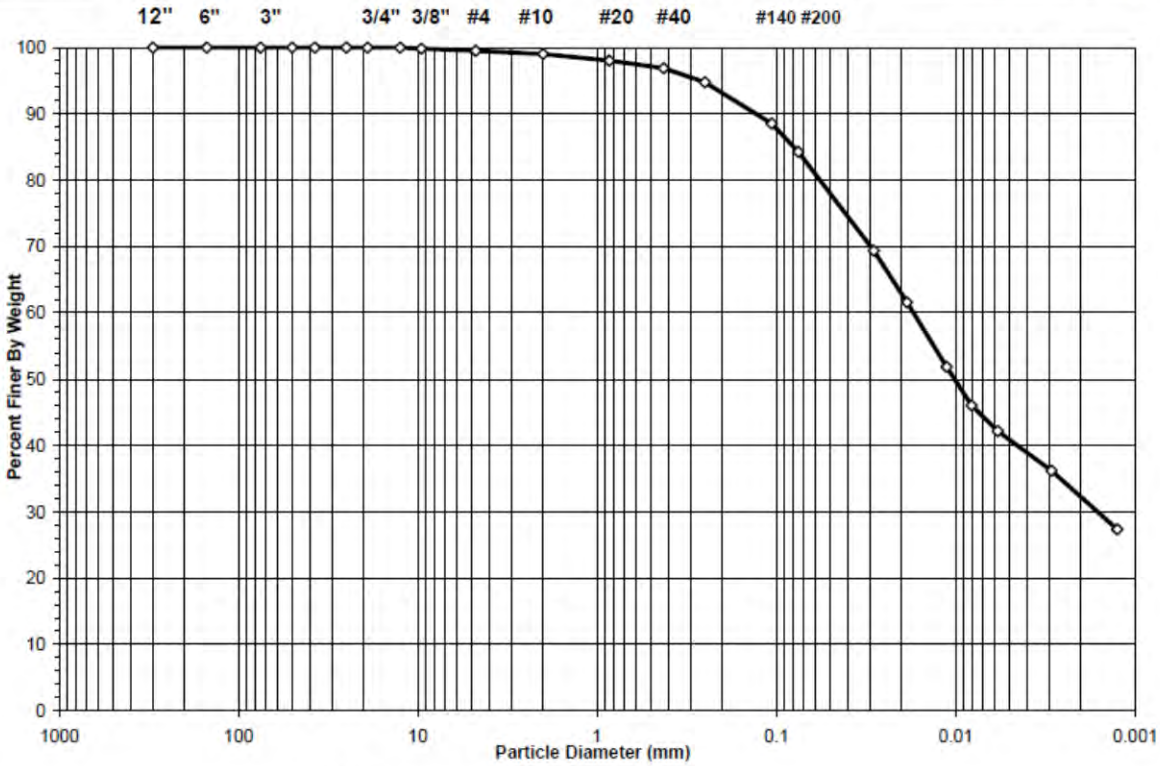


Tested By *JP* *Date* *2/2/15* *Checked By* *KC* *Date* *2/3/15*

SIEVE AND HYDROMETER ANALYSIS
ASTM D 422-63 (2007)

Client:	Microbac Laboratories	Boring No.:	11/25/14
Client Reference:	Hamilton Co. Background Soils	Depth (ft):	NA
Project No.:	2015-057-001	Sample No.:	WW-01
Lab ID:	2015-057-001-009	Soil Color:	BROWN

	SIEVE ANALYSIS					HYDROMETER
USCS	cobbles	gravel	sand			silt and clay fraction
USDA	cobbles	gravel	sand		silt	clay



USCS Summary		
Sieve Sizes (mm)		**Percentage**
Greater Than #4	*Gravel*	0.47
#4 To #200	*Sand*	15.22
Finer Than #200	*Silt & Clay*	84.31

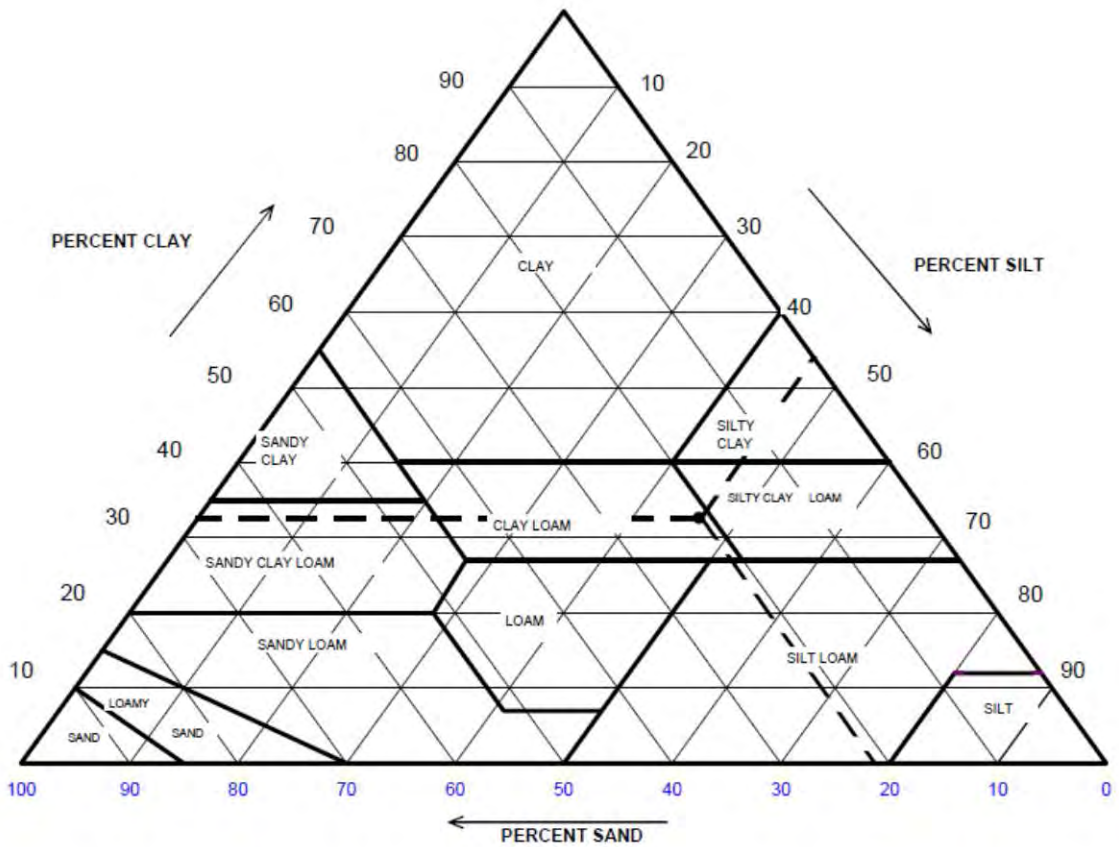
USCS Symbol ***CL, TESTED***

USCS Classification ***LEAN CLAY WITH SAND***

DCN: CT-S3A DATE: 3/18/13 REVISION: 11

USDA CLASSIFICATION CHART

Client:	Microbac Laboratories	Boring No.:	11/25/14
Client Reference:	Hamilton Co. Background Soils	Depth (ft):	NA
Project No.:	2015-057-001	Sample No.:	WW-01
Lab ID:	2015-057-001-009	Soil Color:	BROWN



Particle Size	Percent Finer	USDA SUMMARY	Actual Percentage	Corrected % of Minus 2.0 mm material for USDA Classificat.
(mm)	(%)		(%)	(%)
		Gravel	1.00	**0.00**
2	99.00	*Sand*	20.97	**21.18**
0.05	78.03	*Silt*	45.76	**46.22**
0.002	32.27	*Clay*	32.27	**32.59**

USDA Classification: ***CLAY LOAM***

DCN: CT-S3A DATE: 3/18/13 REVISION: 11

WASH SIEVE ANALYSIS

ASTM D 422-63 (2007)

Client:	Microbac Laboratories	Boring No.:	11/25/14
Client Reference:	Hamilton Co. Background Soils	Depth (ft):	NA
Project No.:	2015-057-001	Sample No.:	WW-01
Lab ID:	2015-057-001-009	Soil Color:	BROWN

Moisture Content of Passing 3/4" Material		Water Content of Retained 3/4" Material	
Tare No.	506	Tare No.	NA
Wt. of Tare & Wet Specimen (g)	454.90	Wt. of Tare & Wet Specimen (g)	NA
Wt. of Tare & Dry Specimen (g)	430.20	Wt. of Tare & Dry Specimen (g)	NA
Weight of Tare (g)	99.40	Weight of Tare (g)	NA
Weight of Water (g)	24.70	Weight of Water (g)	NA
Weight of Dry Specimen (g)	330.80	Weight of Dry Specimen (g)	NA
Moisture Content (%)	**7.5**	**Moisture Content (%)**	**NA**

Wet Weight of -3/4" Sample (g)	NA	Weight of the Dry Specimen (g)	330.80
Dry Weight of -3/4" Sample (g)	51.91	Weight of - #200 material (g)	278.89
Wet Weight of +3/4" Sample (g)	NA	Weight of + #200 material (g)	51.91
Dry Weight of +3/4" Sample (g)	0.00		
Total Dry Weight of Sample (g)	NA		

Sieve Size	Sieve Opening	Weight of Soil Retained	Percent Retained	Accumulated Percent Retained		Percent Finer	Accumulated Percent Finer
	(mm)	(g)	(%)	(%)		(%)	(%)
12"	300	0.00	0.00	0.00		100.00	**100.00**
6"	150	0.00	0.00	0.00		100.00	**100.00**
3"	75	0.00	0.00	0.00		100.00	**100.00**
2"	50	0.00	0.00	0.00		100.00	**100.00**
1 1/2"	37.5	0.00	0.00	0.00		100.00	**100.00**
1"	25.0	0.00	0.00	0.00		100.00	**100.00**
3/4"	19.0	0.00	0.00	0.00		100.00	**100.00**
1/2"	12.5	0.00	0.00	0.00		100.00	**100.00**
3/8"	9.50	0.63	0.19	0.19		99.81	**99.81**
#4	4.75	0.92	0.28	0.47		99.53	**99.53**
#10	2.00	1.75	0.53	1.00		99.00	**99.00**
#20	0.85	3.16	0.96	1.95		98.05	**98.05**
#40	0.425	3.78	1.14	3.10		96.90	**96.90**
#60	0.250	7.13	2.16	5.25		94.75	**94.75**
#140	0.106	20.63	6.24	11.49		88.51	**88.51**
#200	0.075	13.91	4.20	15.69		84.31	**84.31**
Pan	-	278.89	84.31	100.00		-	-

Tested By	RAL	Date	1/23/15	Checked By	KC	Date	2/3/15

DCN: CT-S3A DATE: 3/18/13 REVISION: 11

HYDROMETER ANALYSIS

ASTM D 422-63 (2007)

Client:	Microbac Laboratories	Boring No.:	11/25/14
Client Reference:	Hamilton Co. Background Soils	Depth (ft):	NA
Project No.:	2015-057-001	Sample No.:	WW-01
Lab ID:	2015-057-001-009	Soil Color:	BROWN

Elapsed Time		R Measured	Temp.	Composite Correction	R Corrected	N	K Factor	Diameter	N'
(min)			(°C)			(%)		(mm)	(%)
0		NA	NA	NA	NA	NA	NA	NA	NA
2		42.0	21.9	6.31	35.7	82.2	0.01314	0.0285	**69.3**
5		38.0	21.9	6.31	31.7	73.0	0.01314	0.0186	**61.6**
15		33.0	21.9	6.31	26.7	61.5	0.01314	0.0112	**51.8**
30		30.0	21.9	6.31	23.7	54.6	0.01314	0.0081	**46.0**
60		28.0	22.0	6.27	21.7	50.1	0.01313	0.0058	**42.2**
250		25.0	21.7	6.38	18.6	42.9	0.01317	0.0029	**36.2**
1440		20.5	21.6	6.41	14.1	32.5	0.01319	0.0013	**27.4**

Soil Specimen Data		**Other Corrections**		
Tare No.	2349			
Weight of Tare & Dry Material (g)	144.82	a - Factor	0.99	
Weight of Tare (g)	96.85			
Weight of Deflocculant (g)	5.0	Percent Finer than # 200	84.31	
Weight of Dry Material (g)	42.97			
		Specific Gravity	2.7	Assumed

Note: *Hydrometer test is performed on - # 200 sieve material.*

Tested By TO Date 1/26/15 Checked By KC Date 2/3/15

DCN: CT-53A DATE: 3/18/13 REVISION: 11

Sievehyd.xls

ATTERBERG LIMITS

ASTM D 4318-10

Client:	Microbac Laboratories	Boring No.:	11/25/14
Client Reference:	Hamilton Co. Background Soils	Depth (ft):	NA
Project No.:	2015-057-001	Sample No.:	WW-01
Lab ID:	2015-057-001-009	Soil Description:	**BROWN LEAN CLAY**

Note: The USCS symbol used with this test refers only to the minus No. 40 sieve material. See the "Sieve and Hydrometer Analysis" graph page for the complete material description . (Minus No. 40 sieve material, Airdried)

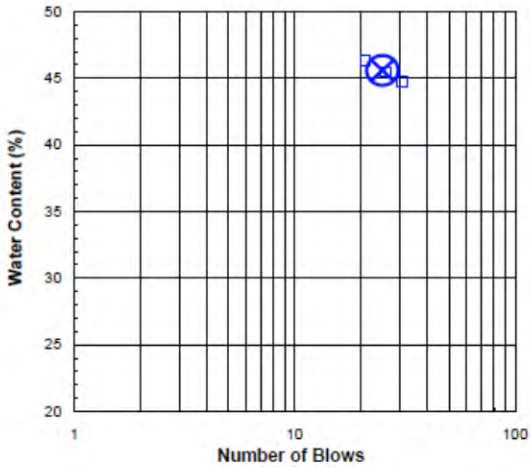
Liquid Limit Test	**1**	**2**	**3**	
				M
Tare Number	290	459	1293	**U**
Wt. of Tare & Wet Sample (g)	40.67	36.26	40.92	**L**
Wt. of Tare & Dry Sample (g)	34.36	29.74	34.54	**T**
Wt. of Tare (g)	20.24	15.39	20.75	**I**
Wt. of Water (g)	6.3	6.5	6.4	**P**
Wt. of Dry Sample (g)	14.1	14.4	13.8	**O**
				I
Moisture Content (%)	**44.7**	**45.4**	**46.3**	**N**
Number of Blows	**31**	**26**	**21**	**T**

Plastic Limit Test	**1**	**2**	**Range**
Tare Number	443	1280	
Wt. of Tare & Wet Sample (g)	21.54	21.58	
Wt. of Tare & Dry Sample (g)	20.44	20.40	
Wt. of Tare (g)	15.49	15.36	
Wt. of Water (g)	1.1	1.2	
Wt. of Dry Sample (g)	5.0	5.0	
Moisture Content (%)	**22.2**	**23.4**	**-1.2**

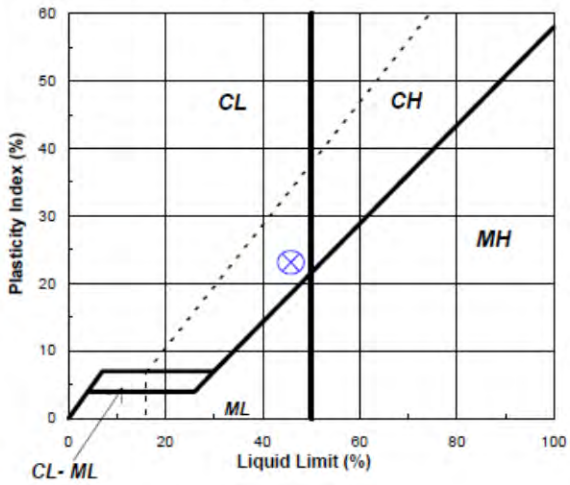
Note: The acceptable range of the two Moisture contents is ± 2.6

Test Results	
Liquid Limit (%)	**46**
Plastic Limit (%)	**23**
Plasticity Index (%)	**23**
USCS Symbol	**CL**

Flow Curve



Plasticity Chart



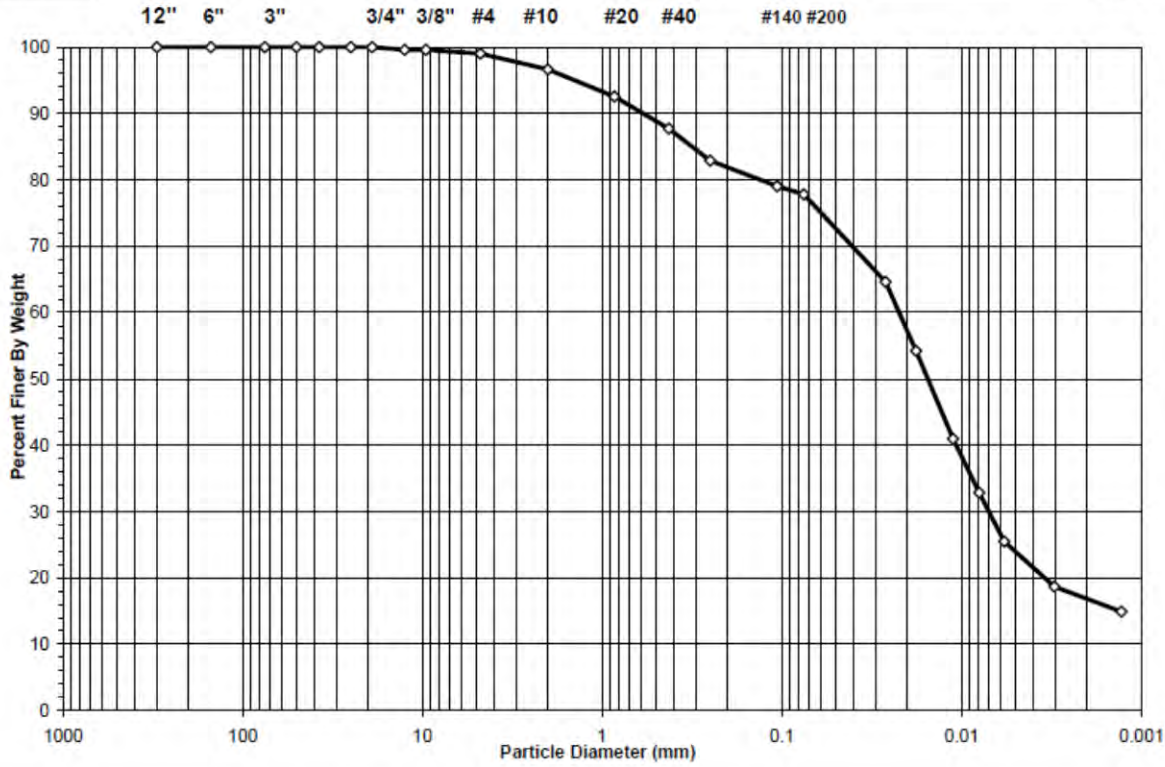
Tested By *JP* *Date* *2/2/15* *Checked By* *KC* *Date* 2/3/15

SIEVE AND HYDROMETER ANALYSIS

ASTM D 422-63 (2007)

Client:	Microbac Laboratories	Boring No.:	10/28/14
Client Reference:	Hamilton Co. Background Soils	Depth (ft):	NA
Project No.:	2015-057-001	Sample No.:	MMF-01
Lab ID:	2015-057-001-010	Soil Color:	BROWN

	SIEVE ANALYSIS					HYDROMETER
USCS	cobbles	gravel	sand			silt and clay fraction
USDA	cobbles	gravel	sand		silt	clay



USCS Summary		
Sieve Sizes (mm)		**Percentage**
Greater Than #4	*Gravel*	1.02
#4 To #200	*Sand*	21.15
Finer Than #200	*Silt & Clay*	77.83

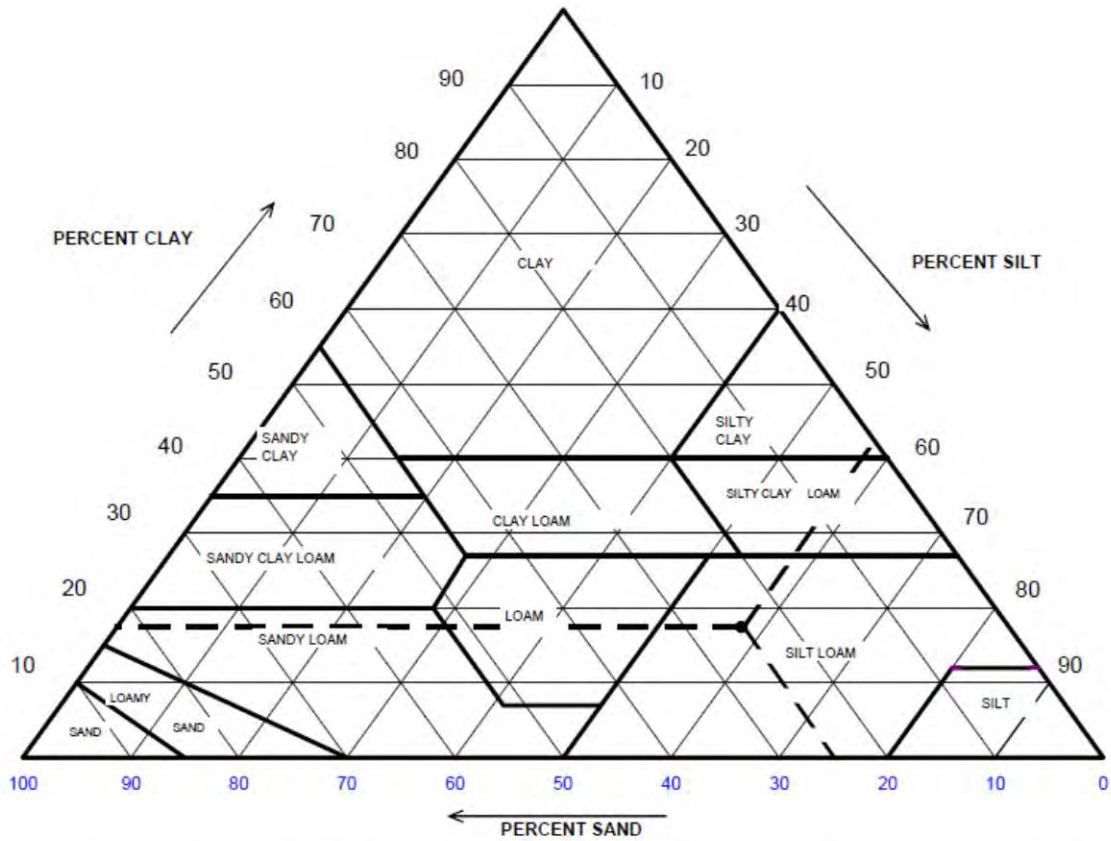
USCS Symbol ***CL, TESTED***

USCS Classification ***LEAN CLAY WITH SAND***

DCN: CT-S3A DATE: 3/18/13 REVISION: 11

USDA CLASSIFICATION CHART

Client:	Microbac Laboratories	Boring No.:	10/28/14
Client Reference:	Hamilton Co. Background Soils	Depth (ft):	NA
Project No.:	2015-057-001	Sample No.:	MMF-01
Lab ID:	2015-057-001-010	Soil Color:	BROWN



Particle Size	Percent Finer	USDA SUMMARY	Actual Percentage	Corrected % of Minus 2.0 mm material for USDA Classificat.
(mm)	(%)		(%)	(%)
		Gravel	3.39	**0.00**
2	96.61	*Sand*	23.92	**24.76**
0.05	72.69	*Silt*	55.83	**57.79**
0.002	16.86	*Clay*	16.86	**17.45**

USDA Classification: ***SILT LOAM***

DCN: CT-S3A DATE: 3/18/13 REVISION: 11

WASH SIEVE ANALYSIS

ASTM D 422-63 (2007)

Client:	Microbac Laboratories	Boring No.:	10/28/14
Client Reference:	Hamilton Co. Background Soils	Depth (ft):	NA
Project No.:	2015-057-001	Sample No.:	MMF-01
Lab ID:	2015-057-001-010	Soil Color:	BROWN

Moisture Content of Passing 3/4" Material		Water Content of Retained 3/4" Material	
Tare No.	2324	Tare No.	NA
Wt. of Tare & Wet Specimen (g)	618.50	Wt. of Tare & Wet Specimen (g)	NA
Wt. of Tare & Dry Specimen (g)	568.10	Wt. of Tare & Dry Specimen (g)	NA
Weight of Tare (g)	98.12	Weight of Tare (g)	NA
Weight of Water (g)	50.40	Weight of Water (g)	NA
Weight of Dry Specimen (g)	469.98	Weight of Dry Specimen (g)	NA
Moisture Content (%)	**10.7**	**Moisture Content (%)**	**NA**

Wet Weight of -3/4" Sample (g)	NA	Weight of the Dry Specimen (g)	469.98
Dry Weight of -3/4" Sample (g)	104.18	Weight of - #200 material (g)	365.80
Wet Weight of +3/4" Sample (g)	NA	Weight of + #200 material (g)	104.18
Dry Weight of +3/4" Sample (g)	0.00		
Total Dry Weight of Sample (g)	NA		

Sieve Size	Sieve Opening	Weight of Soil Retained	Percent Retained	Accumulated Percent Retained		Percent Finer	Accumulated Percent Finer
	(mm)	(g)	(%)	(%)		(%)	(%)
12"	300	0.00	0.00	0.00		100.00	**100.00**
6"	150	0.00	0.00	0.00		100.00	**100.00**
3"	75	0.00	0.00	0.00		100.00	**100.00**
2"	50	0.00	0.00	0.00		100.00	**100.00**
1 1/2"	37.5	0.00	0.00	0.00		100.00	**100.00**
1"	25.0	0.00	0.00	0.00		100.00	**100.00**
3/4"	19.0	0.00	0.00	0.00		100.00	**100.00**
1/2"	12.5	1.80	0.38	0.38		99.62	**99.62**
3/8"	9.50	0.00	0.00	0.38		99.62	**99.62**
#4	4.75	2.99	0.64	1.02		98.98	**98.98**
#10	2.00	11.15	2.37	3.39		96.61	**96.61**
#20	0.85	18.95	4.03	7.42		92.58	**92.58**
#40	0.425	22.68	4.83	12.25		87.75	**87.75**
#60	0.250	22.88	4.87	17.12		82.88	**82.88**
#140	0.106	17.91	3.81	20.93		79.07	**79.07**
#200	0.075	5.82	1.24	22.17		77.83	**77.83**
Pan	-	365.80	77.83	100.00		-	-

Tested By RAL Date 1/23/15 Checked By KC Date 2/3/15

DCN: CT-93A DATE: 3/18/13 REVISION: 11

geotechnics
geotechnical & geosynthetic testing

HYDROMETER ANALYSIS
ASTM D 422-63 (2007)

Client:	Microbac Laboratories	Boring No.:	10/28/14
Client Reference:	Hamilton Co. Background Soils	Depth (ft):	NA
Project No.:	2015-057-001	Sample No.:	MMF-01
Lab ID:	2015-057-001-010	Soil Color:	BROWN

Elapsed Time		R Measured	Temp.	Composite Correction	R Corrected	N	K Factor	Diameter	N'
(min)			(°C)			(%)		(mm)	(%)
0		NA	NA	NA	NA	NA	NA	NA	NA
2		50.0	21.9	6.31	43.7	83.0	0.01314	0.0264	**64.6**
5		43.0	21.9	6.31	36.7	69.7	0.01314	0.0179	**54.3**
15		34.0	21.9	6.31	27.7	52.6	0.01314	0.0111	**40.9**
32		28.5	21.9	6.31	22.2	42.2	0.01314	0.0079	**32.8**
65		23.5	22.0	6.27	17.2	32.7	0.01313	0.0057	**25.5**
250		19.0	21.7	6.38	12.6	24.0	0.01317	0.0030	**18.7**
1440		16.5	21.6	6.41	10.1	19.2	0.01319	0.0013	**14.9**

Soil Specimen Data		Other Corrections		
Tare No.	961			
Weight of Tare & Dry Material (g)	158.74	a - Factor	0.99	
Weight of Tare (g)	101.63			
Weight of Deflocculant (g)	5.0	Percent Finer than # 200	77.83	
Weight of Dry Material (g)	52.11			
		Specific Gravity	2.7	Assumed

Note: *Hydrometer test is performed on - # 200 sieve material.*

Tested By TO Date 1/26/15 Checked By KC Date 2/3/15

DCN: CT-S3A DATE: 3/18/13 REVISION: 11

Sievehyd.xls

ATTERBERG LIMITS

ASTM D 4318-10

Client:	Microbac Laboratories	Boring No.:	10/28/14
Client Reference:	Hamilton Co. Background Soils	Depth (ft):	NA
Project No.:	2015-057-001	Sample No.:	MMF-01
Lab ID:	2015-057-001-010	Soil Description:	**BROWN LEAN CLAY**

Note: The USCS symbol used with this test refers only to the minus No. 40 sieve material. See the "Sieve and Hydrometer Analysis" graph page for the complete material description .

(Minus No. 40 sieve material, Airdried)

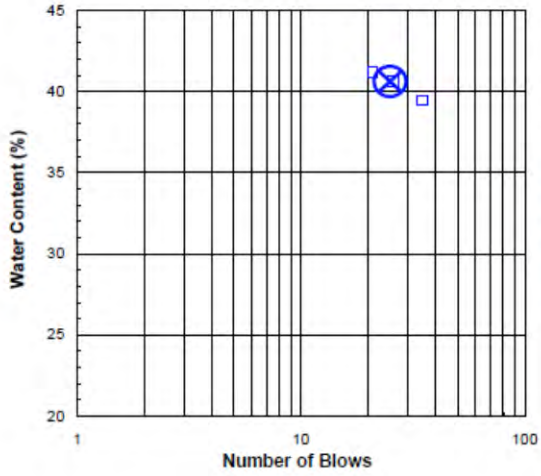
Liquid Limit Test	**1**	**2**	**3**	
				M
Tare Number	117	1255	2234	**U**
Wt. of Tare & Wet Sample (g)	40.63	33.83	37.99	**L**
Wt. of Tare & Dry Sample (g)	34.85	27.89	31.61	**T**
Wt. of Tare (g)	20.18	13.25	16.11	**I**
Wt. of Water (g)	5.8	5.9	6.4	**P**
Wt. of Dry Sample (g)	14.7	14.6	15.5	**O**
				I
Moisture Content (%)	**39.4**	**40.6**	**41.2**	**N**
Number of Blows	**35**	**26**	**21**	**T**

Plastic Limit Test	**1**	**2**	**Range**
Tare Number	1242	1246	
Wt. of Tare & Wet Sample (g)	20.40	28.52	
Wt. of Tare & Dry Sample (g)	19.31	27.45	
Wt. of Tare (g)	14.24	22.54	
Wt. of Water (g)	1.1	1.1	
Wt. of Dry Sample (g)	5.1	4.9	
Moisture Content (%)	**21.5**	**21.8**	**-0.3**

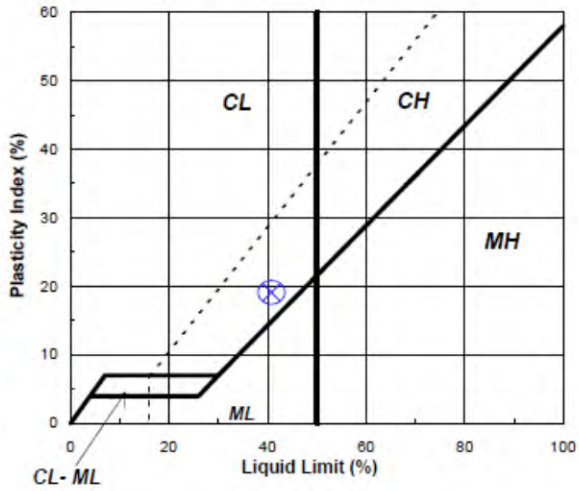
Note: The acceptable range of the two Moisture contents is ± 2.6

Test Results	
Liquid Limit (%)	**41**
Plastic Limit (%)	**22**
Plasticity Index (%)	**19**
USCS Symbol	**CL**

Flow Curve



Plasticity Chart



Tested By	*JP*	*Date*	*2/2/15*	*Checked By*	*KC*	*Date*	*2/3/15*

APPENDIX D

PROUCL DATASET RUNS

	A	B	C	D	E	F	G	H	I	J	K	L	M
1				Lognormal Background Statistics for Uncensored Full Data Sets									
2	User Selected Options												
3	e/Time of Computation			4/20/2015 3:27:25 PM									
4			From File	Ham_As_2.xls									
5			Full Precision	OFF									
6	Confidence Coefficient			95%									
7			Coverage	95%									
8	Future K Observations			1									
9	f Bootstrap Operations			2000									
10													
11	numvalue												
12													
13	General Statistics												
14			Total Number of Observations			97		Number of Distinct Observations				83	
15			Minimum			4.09		First Quartile				5.71	
16			Second Largest			13.6		Median				7.14	
17			Maximum			14.3		Third Quartile				9.33	
18			Mean			7.64		SD				2.334	
19			Coefficient of Variation			0.30		Skewness				0.75	
20			Mean of logged Data			1.99		SD of logged Data				0.295	
21													
22			Critical Values for Background Threshold Values (BTVs)										
23			Tolerance Factor K (For UTL)			1.92		d2max (for USL)				3.199	
24													
25			Lognormal GOF Test										
26			Shapiro Wilk Test Statistic			0.95		Shapiro Wilk Lognormal GOF Test					
27			5% Shapiro Wilk P Value			0.01		Data Not Lognormal at 5% Significance Level					
28			Lilliefors Test Statistic			0.08		Lilliefors Lognormal GOF Test					
29			5% Lilliefors Critical Value			0.09		Data appear Lognormal at 5% Significance Level					
30			Data appear Approximate Lognormal at 5% Significance Level										
31													
32			Background Statistics assuming Lognormal Distribution										
33			95% UTL with 95% Coverage			12.9		90% Percentile (z)				10.68	
34			95% UPL (t)			11.9		95% Percentile (z)				11.88	
35			95% USL			18.7		99% Percentile (z)				14.52	
36													
37	te: The use of USL to estimate a BTV is recommended only when the data set represents a backgrou												
38	data set free of outliers and consists of observations collected from clean unimpacted locations.												
39	he use of USL tends to provide a balance between false positives and false negatives provided the da												
40	presents a background data set and when many onsite observations need to be compared with the B												
41													

	A	B	C	D	E	F	G	H	I	J	K	L	M
1				Nonparametric Background Statistics for Uncensored Full Data Sets									
2	User Selected Options												
3	e/Time of Computation			4/20/2015 3:30:29 PM									
4			From File	Ham_Ba_2.xls									
5			Full Precision	OFF									
6	Confidence Coefficient			95%									
7			Coverage	95%									
8	f Bootstrap Operations			2000									
9													
10	numvalue												
11													
12	General Statistics												
13			Total Number of Observations			100		Number of Distinct Observations				93	
14			Minimum			48.8		First Quartile				56.48	
15			Second Largest			122		Median				63.45	
16			Maximum			129		Third Quartile				78.43	
17			Mean			69.6		SD				18.1	
18			Coefficient of Variation			0.26		Skewness				1.315	
19			Mean of logged Data			4.21		SD of logged Data				0.236	
20													
21			Critical Values for Background Threshold Values (BTVs)										
22			Tolerance Factor K (For UTL)			1.92		d2max (for USL)				3.21	
23													
24			Nonparametric Distribution Free Background Statistics										
25			Data do not follow a Discernible Distribution (0.05)										
26													
27			Nonparametric Upper Limits for Background Threshold Values										
28			Order of Statistic, r			98		95% UTL with 95% Coverage				118	
29			Approximate f			1.71		fidence Coefficient (CC) achieved by UTL				0.882	
30	entile Bootstrap UTL with 95% Coverage					118		BCA Bootstrap UTL with 95% Coverage				118	
31			95% UPL			113.8		90% Percentile				92.8	
32			90% Chebyshev UPL			124.2		95% Percentile				109.3	
33			95% Chebyshev UPL			148.9		99% Percentile				122.1	
34			95% USL			129							
35													
36	te: The use of USL to estimate a BTV is recommended only when the data set represents a backgrou												
37	data set free of outliers and consists of observations collected from clean unimpacted locations.												
38	e use of USL tends to provide a balance between false positives and false negatives provided the da												
39	resents a background data set and when many onsite observations need to be compared with the B												
40													

	A	B	C	D	E	F	G	H	I	J	K	L	M
1				Nonparametric Background Statistics for Uncensored Full Data Sets									
2	User Selected Options												
3	e/Time of Computation			4/20/2015 3:33:14 PM									
4	From File			Ham_Cr_2.xls									
5	Full Precision			OFF									
6	Confidence Coefficient			95%									
7	Coverage			95%									
8	f Bootstrap Operations			2000									
9													
10	numvalue												
11													
12	General Statistics												
13			Total Number of Observations			100			Number of Distinct Observations			82	
14			Minimum			6.57			First Quartile			8.983	
15			Second Largest			19.6			Median			12	
16			Maximum			24			Third Quartile			15.03	
17			Mean			12.1			SD			3.629	
18			Coefficient of Variation			0.29			Skewness			0.472	
19			Mean of logged Data			2.45			SD of logged Data			0.301	
20													
21			Critical Values for Background Threshold Values (BTVs)										
22			Tolerance Factor K (For UTL)			1.92			d2max (for USL)			3.21	
23													
24			Nonparametric Distribution Free Background Statistics										
25			Data do not follow a Discernible Distribution (0.05)										
26													
27			Nonparametric Upper Limits for Background Threshold Values										
28			Order of Statistic, r			98			95% UTL with 95% Coverage			18.8	
29			Approximate f			1.71			fidence Coefficient (CC) achieved by UTL			0.882	
30	entile Bootstrap UTL with 95% Coverage					18.8			BCA Bootstrap UTL with 95% Coverage			18.8	
31			95% UPL			18.1			90% Percentile			16.32	
32			90% Chebyshev UPL			23.0			95% Percentile			18.01	
33			95% Chebyshev UPL			28.0			99% Percentile			19.64	
34			95% USL			24							
35													
36	te: The use of USL to estimate a BTV is recommended only when the data set represents a backgrou												
37	data set free of outliers and consists of observations collected from clean unimpacted locations.												
38	e use of USL tends to provide a balance between false positives and false negatives provided the da												
39	resents a background data set and when many onsite observations need to be compared with the B												
40													

	A	B	C	D	E	F	G	H	I	J	K	L	M
1				Nonparametric Background Statistics for Uncensored Full Data Sets									
2	User Selected Options												
3	e/Time of Computation			4/20/2015 3:51:01 PM									
4	From File			Ham_Pb.xls									
5	Full Precision			OFF									
6	Confidence Coefficient			95%									
7	Coverage			95%									
8	f Bootstrap Operations			2000									
9													
10	numvalue												
11													
12	General Statistics												
13			Total Number of Observations			92			Number of Distinct Observations			74	
14			Minimum			11.4			First Quartile			15.2	
15			Second Largest			33.5			Median			18	
16			Maximum			34.2			Third Quartile			22.78	
17			Mean			19.2			SD			5.228	
18			Coefficient of Variation			0.27			Skewness			0.849	
19			Mean of logged Data			2.92			SD of logged Data			0.259	
20													
21			Critical Values for Background Threshold Values (BTVs)										
22			Tolerance Factor K (For UTL)			1.93			d2max (for USL)			3.181	
23													
24			Nonparametric Distribution Free Background Statistics										
25			Data do not follow a Discernible Distribution (0.05)										
26													
27			Nonparametric Upper Limits for Background Threshold Values										
28			Order of Statistic, r			90			95% UTL with 95% Coverage			32.9	
29			Approximate f			1.57			fidence Coefficient (CC) achieved by UTL			0.844	
30			entile Bootstrap UTL with 95% Coverage			32.9			BCA Bootstrap UTL with 95% Coverage			32.9	
31			95% UPL			28.6			90% Percentile			26.17	
32			90% Chebyshev UPL			34.9			95% Percentile			28.27	
33			95% Chebyshev UPL			42.1			99% Percentile			33.56	
34			95% USL			34.2							
35													
36	te: The use of USL to estimate a BTV is recommended only when the data set represents a backgrou												
37	data set free of outliers and consists of observations collected from clean unimpacted locations.												
38	he use of USL tends to provide a balance between false positives and false negatives provided the da												
39	resents a background data set and when many onsite observations need to be compared with the B												
40													

	A	B	C	D	E	F	G	H	I	J	K	L	M
1				Normal Background Statistics for Data Sets with Non-Detects									
2	User Selected Options												
3	e/Time of Computation			4/20/2015 3:35:56 PM									
4	From File			Ham_Hg_2.xls									
5	Full Precision			OFF									
6	Confidence Coefficient			95%									
7	Coverage			95%									
8	Future K Observations			1									
9													
10	Merc												
11													
12						General Statistics							
13						Total Number of Observations	98				Number of Distinct Observations	91	
14						Number of Missing Observations	2						
15						Number of Detects	88				Number of Non-Detects	10	
16						Number of Distinct Detects	82				Number of Distinct Non-Detects	9	
17						Minimum Detect	0.0121				Minimum Non-Detect	0.273	
18						Maximum Detect	0.0632				Maximum Non-Detect	0.301	
19						Variance Detected	1.0157E-4				Percent Non-Detects	10.2%	
20						Mean Detected	0.0335				SD Detected	0.0101	
21						Mean of Detected Logged Data	-3.445				SD of Detected Logged Data	0.321	
22													
23						Critical Values for Background Threshold Values (BTVs)							
24						Tolerance Factor K (For UTL)	1.927				d2max (for USL)	3.203	
25													
26						Normal GOF Test on Detects Only							
27						Shapiro Wilk Test Statistic	0.979				Normal GOF Test on Detected Observations Onl		
28						5% Shapiro Wilk P Value	0.493				etected Data appear Normal at 5% Significance Le		
29						Lilliefors Test Statistic	0.0695				Lilliefors GOF Test		
30						5% Lilliefors Critical Value	0.0944				etected Data appear Normal at 5% Significance Le		
31						Detected Data appear Normal at 5% Significance Level							
32													
33						Kaplan Meier (KM) Background Statistics Assuming Normal Distribution							
34						Mean	0.0335				SD	0.01	
35						95% UTL95% Coverage	0.0528				95% KM UPL (t)	0.0502	
36						95% KM Chebyshev UPL	0.0774				90% KM Percentile (z)	0.0463	
37						95% KM Percentile (z)	0.05				99% KM Percentile (z)	0.0568	
38						95% KM USL	0.0656						
39													
40						DL/2 Substitution Background Statistics Assuming Normal Distribution							
41						Mean	0.0446				SD	0.0345	
42						95% UTL95% Coverage	0.111				95% UPL (t)	0.102	
43						90% Percentile (z)	0.0888				95% Percentile (z)	0.101	
44						99% Percentile (z)	0.125				95% USL	0.155	
45						DL/2 is not a recommended method. DL/2 provided for comparisons and historical reasons							
46													
47						Note: The use of USL to estimate a BTV is recommended only when the data set represents a background							
48						data set free of outliers and consists of observations collected from clean unimpacted locations.							
49						The use of USL tends to provide a balance between false positives and false negatives provided the data							
50						represents a background data set and when many onsite observations need to be compared with the BTV.							
51													

	A	B	C	D	E	F	G	H	I	J	K	L	M
1	Normal Background Statistics for Uncensored Full Data Sets												
2													
3	User Selected Options												
4	e/Time of Computation			4/20/2015 3:47:24 PM									
5	From File			Ham_Ni.xls									
6	Full Precision			OFF									
7	Confidence Coefficient			95%									
8	Coverage			95%									
9	Future K Observations			1									
10													
11	numvalue												
12													
13	General Statistics												
14				Total Number of Observations		91		Number of Distinct Observations				60	
15				Minimum		6.7		First Quartile				9.785	
16				Second Largest		16.7		Median				11.2	
17				Maximum		17.2		Third Quartile				12.25	
18				Mean		11.17		SD				1.858	
19				Coefficient of Variation		0.166		Skewness				0.318	
20				Mean of logged Data		2.399		SD of logged Data				0.17	
21													
22	Critical Values for Background Threshold Values (BTVs)												
23				Tolerance Factor K (For UTL)		1.938		d2max (for USL)				3.177	
24													
25	Normal GOF Test												
26				Shapiro Wilk Test Statistic		0.969		Normal GOF Test					
27				5% Shapiro Wilk P Value		0.145		Data appear Normal at 5% Significance Level					
28				Lilliefors Test Statistic		0.0814		Lilliefors GOF Test					
29				5% Lilliefors Critical Value		0.0929		Data appear Normal at 5% Significance Level					
30	Data appear Normal at 5% Significance Level												
31													
32	Background Statistics Assuming Normal Distribution												
33				95% UTL with 95% Coverage		14.77		90% Percentile (z)				13.55	
34				95% UPL (t)		14.28		95% Percentile (z)				14.23	
35				95% USL		17.07		99% Percentile (z)				15.49	
36													
37	Note: The use of USL to estimate a BTV is recommended only when the data set represents a background												
38	data set free of outliers and consists of observations collected from clean unimpacted locations.												
39	The use of USL tends to provide a balance between false positives and false negatives provided the data												
40	represents a background data set and when many onsite observations need to be compared with the BTV.												
41													

	A	B	C	D	E	F	G	H	I	J	K	L
1	Normal Background Statistics for Uncensored Full Data Sets											
2												
3	User Selected Options											
4	e/Time of Computation			4/20/2015 3:54:17 PM								
5	From File			Ham_se.xls								
6	Full Precision			OFF								
7	Confidence Coefficient			95%								
8	Coverage			95%								
9	Future K Observations			1								
10												
11	numvalue											
12												
13	General Statistics											
14			Total Number of Observations			98		Number of Distinct Observations				90
15			Minimum			0.36		First Quartile				0.64
16			Second Largest			1.18		Median				0.76
17			Maximum			1.2		Third Quartile				0.86
18			Mean			0.76		SD				0.15
19			Coefficient of Variation			0.20		Skewness				0.15
20			Mean of logged Data			-0.29		SD of logged Data				0.21
21												
22	Critical Values for Background Threshold Values (BTVs)											
23			Tolerance Factor K (For UTL)			1.92		d2max (for USL)				3.20
24												
25	Normal GOF Test											
26			Shapiro Wilk Test Statistic			0.98		Normal GOF Test				
27			5% Shapiro Wilk P Value			0.9		Data appear Normal at 5% Significance Level				
28			Lilliefors Test Statistic			0.05		Lilliefors GOF Test				
29			5% Lilliefors Critical Value			0.08		Data appear Normal at 5% Significance Level				
30	Data appear Normal at 5% Significance Level											
31												
32	Background Statistics Assuming Normal Distribution											
33			95% UTL with 95% Coverage			1.06		90% Percentile (z)				0.96
34			95% UPL (t)			1.02		95% Percentile (z)				1.02
35			95% USL			1.27		99% Percentile (z)				1.13
36												
37	te: The use of USL to estimate a BTV is recommended only when the data set represents a backgrou											
38	data set free of outliers and consists of observations collected from clean unimpacted locations.											
39	e use of USL tends to provide a balance between false positives and false negatives provided the da											
40	resents a background data set and when many onsite observations need to be compared with the BT											
41												

	A	B	C	D	E	F	G	H	I	J	K	L	M
1				Lognormal Background Statistics for Uncensored Full Data Sets									
2	User Selected Options												
3	e/Time of Computation			4/20/2015 3:57:45 PM									
4			From File	Ham_TI_2.xls									
5			Full Precision	OFF									
6	Confidence Coefficient			95%									
7			Coverage	95%									
8	Future K Observations			1									
9	f Bootstrap Operations			2000									
10													
11	numvalue												
12													
13	General Statistics												
14			Total Number of Observations			95		Number of Distinct Observations				70	
15			Minimum			0.113		First Quartile				0.155	
16			Second Largest			0.309		Median				0.178	
17			Maximum			0.313		Third Quartile				0.202	
18			Mean			0.183		SD				0.0412	
19			Coefficient of Variation			0.225		Skewness				1.021	
20			Mean of logged Data			-1.722		SD of logged Data				0.214	
21													
22			Critical Values for Background Threshold Values (BTVs)										
23			Tolerance Factor K (For UTL)			1.932		d2max (for USL)				3.192	
24													
25			Lognormal GOF Test										
26			Shapiro Wilk Test Statistic			0.972		Shapiro Wilk Lognormal GOF Test					
27			5% Shapiro Wilk P Value			0.192		Data appear Lognormal at 5% Significance Level					
28			Lilliefors Test Statistic			0.0706		Lilliefors Lognormal GOF Test					
29			5% Lilliefors Critical Value			0.0909		Data appear Lognormal at 5% Significance Level					
30			Data appear Lognormal at 5% Significance Level										
31													
32			Background Statistics assuming Lognormal Distribution										
33			95% UTL with 95% Coverage			0.27		90% Percentile (z)				0.235	
34			95% UPL (t)			0.255		95% Percentile (z)				0.254	
35			95% USL			0.354		99% Percentile (z)				0.294	
36													
37	Note: The use of USL to estimate a BTV is recommended only when the data set represents a backgroun												
38	data set free of outliers and consists of observations collected from clean unimpacted locations.												
39	The use of USL tends to provide a balance between false positives and false negatives provided the data												
40	represents a background data set and when many onsite observations need to be compared with the BTV												
41													