

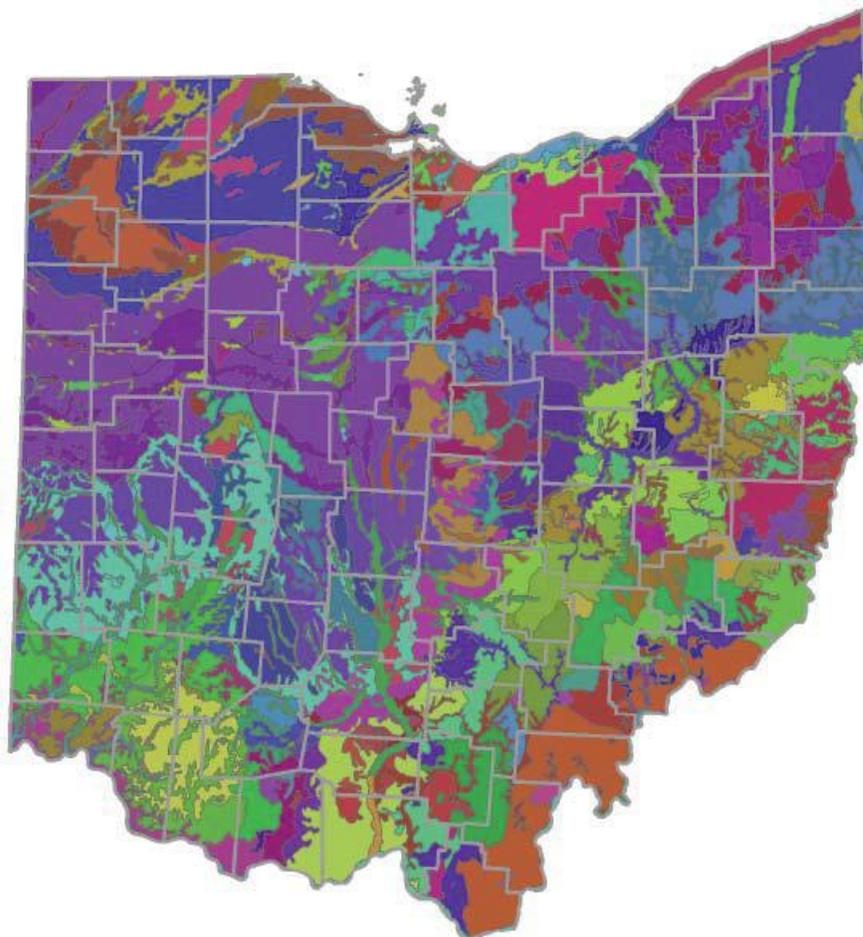


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Evaluation of Background Metal Soil
Concentrations in Summit County –
Akron Area

DEVELOPED IN SUPPORT OF
THE OHIO VOLUNTARY ACTION PROGRAM

Summary Report



*Generalized soil map for the State of Ohio
Ohio Department of Natural Resources

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Acknowledgements

This summary report was developed by a workgroup representing Ohio EPA staff from the Division of Environmental Response and Revitalization (DERR) and environmental consultants, some of whom are Certified Professionals (CPs) for Ohio EPA's Voluntary Action Program (VAP).

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Disclaimer

This summary report document was developed solely for sites participating in the Ohio Voluntary Action Program, DERR, Ohio EPA. Use of this summary report for other Ohio EPA programs or state agencies may not be appropriate.

The summary report serves as a tool in the aid 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
bgs	Below ground surface
CBT	Camp Butler Boy Scout Reservation
CMN	Camp Manatoc Boy Scout Reservation
C _v	Coefficient of variation
DDP	Adell Durbin City Park, Stow
DERR	Division of Environmental Response and Revitalization
FMP	Firestone Summit Metro Park
ft	Feet
FP-XRF	Field Portable X-ray Fluorescence
FRM	Furnace Run Summit Metro Park
GMP	Goodyear Heights Summit Metro Park
GOF	Goodness-of-fit
HSP	Hudson Springs City Park, Hudson
KM	Kaplan-Meier
mg/kg	Milligram per kilogram
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
SGP	Southgate City Park
SIFU	Site Investigation Field Unit
SRM	Sand Run Summit Metro Park
TAL	Target Analyte List
TBA	Targeted Brownfields Assessment
TCVP	Center Valley City Park, Twinsburg
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

EXECUTIVE SUMMARY

Ohio EPA Division of Environmental Response and Revitalization (DERR) sampled and analyzed surface soils at 10 Akron-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 Summit County are provided in tabular format as part of this report. Final and representative background concentrations of metals in Summit County are as follows:

Arsenic	13.5 mg/kg
Barium	107 mg/kg
Cadmium	0.672 mg/kg
Chromium	19.0 mg/kg
Lead	22.7 mg/kg
Mercury	0.066 mg/kg
Nickel	22.6 mg/kg
Selenium	1.05 mg/kg
Thallium	0.35 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 Summit County and Akron-area brownfield properties being assessed and remediated under the Ohio VAP. For the purposes of this investigation, “Summit County – Akron area urban soils” means surficial soils within the City of Akron 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 Akron-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 Summit County as described on the “General Soil Map, Summit County, Ohio” of the *Soil Survey of Summit 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 Akron-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 AKRON-AREA SOIL TYPES

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

1. “Mahoning-Ellsworth association: Nearly level to gently sloping, somewhat poorly drained and moderately well drained soils that formed in moderately fine textured glacial till.”
2. “Ellsworth-Mahoning association: Gently sloping to steep, moderately well drained and somewhat poorly drained soils that formed in moderately fine textured glacial till.”
3. “Rough Broken land association: Very steep land types and soils.”
4. “Rittman-Wadsworth association: Nearly level to moderately steep, moderately well drained and somewhat poorly drained soils that have a fragipan; formed in medium-textured and moderately fine textured glacial till.”
5. “Canfield-Wooster association: Gently sloping to moderately steep, moderately well drained and well drained soils that have a fragipan; formed in medium-textured glacial till.”
6. “Chili association: Nearly level to steep, well-drained soils formed in sandy gravely glacial outwash.”
7. “Sebring-Canadice association: Nearly level, poorly drained soils formed in silty and clayey lacustrine materials.”
8. “Glenford-Fitchville association: nearly level to moderately steep, moderately well drained and somewhat poorly drained soils formed in silty lacustrine material.”
9. “Carlisle association: Nearly level, very poorly drained soils formed in organic materials.”
10. “Chagrin-Holly-Lobdell association: Nearly level, well drained, poorly drained and moderately well drained soils formed in medium-textured recent alluvium.”

The majority of the land surface of Summit County is dominated by glacial deposits of Wisconsin Age (USDA, 1974). Soils in Summit 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 Akron-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 Summit 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. 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). At a few locations auger refusal was encountered on very stiff to hard or heaving clays before reaching the target depth of four feet, and the sampling interval was slightly smaller (e.g., ground surface to 3.0 feet), but was never less than two feet. Locations where auger refusal occurred included Firestone Metro Park (3.0 ft.), Furnace Run Metro Park (2.5 ft.), and Sand Run Metro Park (3.0 ft.).

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., DDP-1, CMN,-1, CBT-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 Summit 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 Tables 3A and 3B.

8.0 AKRON-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 arsenic data set only. The 95% upper tolerance limit was used as the representative background concentrations for the barium, chromium, lead, mercury, nickel, selenium, and thallium data sets. The maximum value was used in the cadmium data set.

A summary of the background determination results for Summit 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 Summit 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 3.08 to 15.3 mg/kg with no non-detects. There were 100 valid data points, with no outliers removed. The data set mean was calculated to be 8.76 mg/kg, with a standard deviation of 2.64 mg/kg. The 95% UTL was determined to be 13.3 mg/kg. The VAP UL was determined to be 13.5 mg/kg. This value is determined to be the representative soil background concentration for arsenic because the data are normally distributed.

8.2 Barium

Concentrations of barium ranged from 18.6 to 106 mg/kg with no non-detects. There were no outliers removed. The data set mean was calculated to be 49.6 mg/kg, with a standard deviation of 22.1 mg/kg. The VAP UL for was determined to be 93.8 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 107 mg/kg. This value is determined to be the representative soil background concentration for barium.

8.3 Cadmium

Detected concentrations of cadmium ranged from 0.205 to 0.672 mg/kg. There were 100 valid data points with no outliers removed. There were 91 non-detects, or 91%, of the final data set. Due to the elevated number of non-detections in the overall data set no meaningful statistics could be performed on the cadmium data. Therefore, the cadmium representative background concentration was determined to be the maximum concentration of the dataset which is 0.672 mg/kg.

8.4 Chromium

Concentrations of chromium ranged from 3.87 to 19.9 mg/kg with no non-detects. There were 100 valid data points with no outliers removed. The data set mean was calculated to be 10.9 mg/kg, with a standard deviation of 4.35 mg/kg. The VAP UL was determined to be 19.6 mg/kg. The VAP UL cannot be used as the representative concentration because the data have a nonparametric distribution. The 95% UTL with 95% coverage was determined to be 19.0 mg/kg. This value is determined to be the representative soil background concentration for chromium.

8.5 Lead

Detected concentrations of lead ranged from 9.31 to 26.7 mg/kg. There were 96 valid data points, after the removal of four outliers. There were no non-detects in the data set. The data set mean was calculated to be 15.4 mg/kg, with a standard deviation of 3.45 mg/kg. The VAP UL was determined to be 26.7 mg/kg which cannot be used as the data set is not normally distributed. The 95% UTL with 95% coverage was determined to be 22.7 mg/kg. This value is determined to be the representative soil background concentration for lead.

8.6 Mercury

Concentrations of mercury ranged from 0.0135 to 0.0663 mg/kg. There were 100 valid data points with no outliers removed. There were two non-detects in the data set. The data set mean was calculated to be 0.034 mg/kg, with a standard deviation of 0.012 mg/kg. The VAP UL was determined to be 0.068 mg/kg which cannot be used as the data set is not normally distributed. The 95% UTL with 95% coverage was determined to be 0.066 mg/kg. This value is determined to be the representative soil background concentration for lead.

8.7 Nickel

Detected concentrations of nickel ranged from 6.59 to 25.1 mg/kg. There were 100 valid data points, with no outliers removed. There were no non-detects in the data set. The data set mean was calculated to be 13.5 mg/kg, with a standard deviation of 4.97 mg/kg. The VAP UL was determined to be 23.4 mg/kg which cannot be used as the data set is not normally distributed. The 95% UTL with 95% coverage was determined to be 22.6 mg/kg. This value is determined to be the representative soil background concentration for nickel.

8.8 Selenium

Detected concentrations of selenium ranged from 0.067 to 1.66 mg/kg. There were 100 valid data points with no outliers removed. There were 20 non-detects, or 20%, of the final data set. The VAP UL was determined to be 0.728 mg/kg which cannot be used as the data set is non-normally distributed. The 95% UTL with 95% coverage was determined to be 1.05 mg/kg. This value is determined to be the representative soil background concentration for selenium.

8.9 Thallium

Concentrations of thallium ranged from 0.0758 to 0.383 mg/kg with no non-detects. There were 100 valid data points with no outliers. The data set mean was calculated to be 0.187 mg/kg, with a standard deviation of 0.064 mg/kg. The VAP UL was determined to be 0.315 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 0.35 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 Summit 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 Summit 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.

The following results are the background upper limits for metal soil concentrations in Summit County – Akron Area:

Arsenic	13.5 mg/kg
Barium	107 mg/kg
Cadmium	0.672 mg/kg
Chromium	19.0 mg/kg
Lead	22.7 mg/kg
Mercury	0.066 mg/kg
Nickel	22.6 mg/kg
Selenium	1.05 mg/kg
Thallium	0.35 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

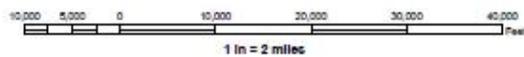
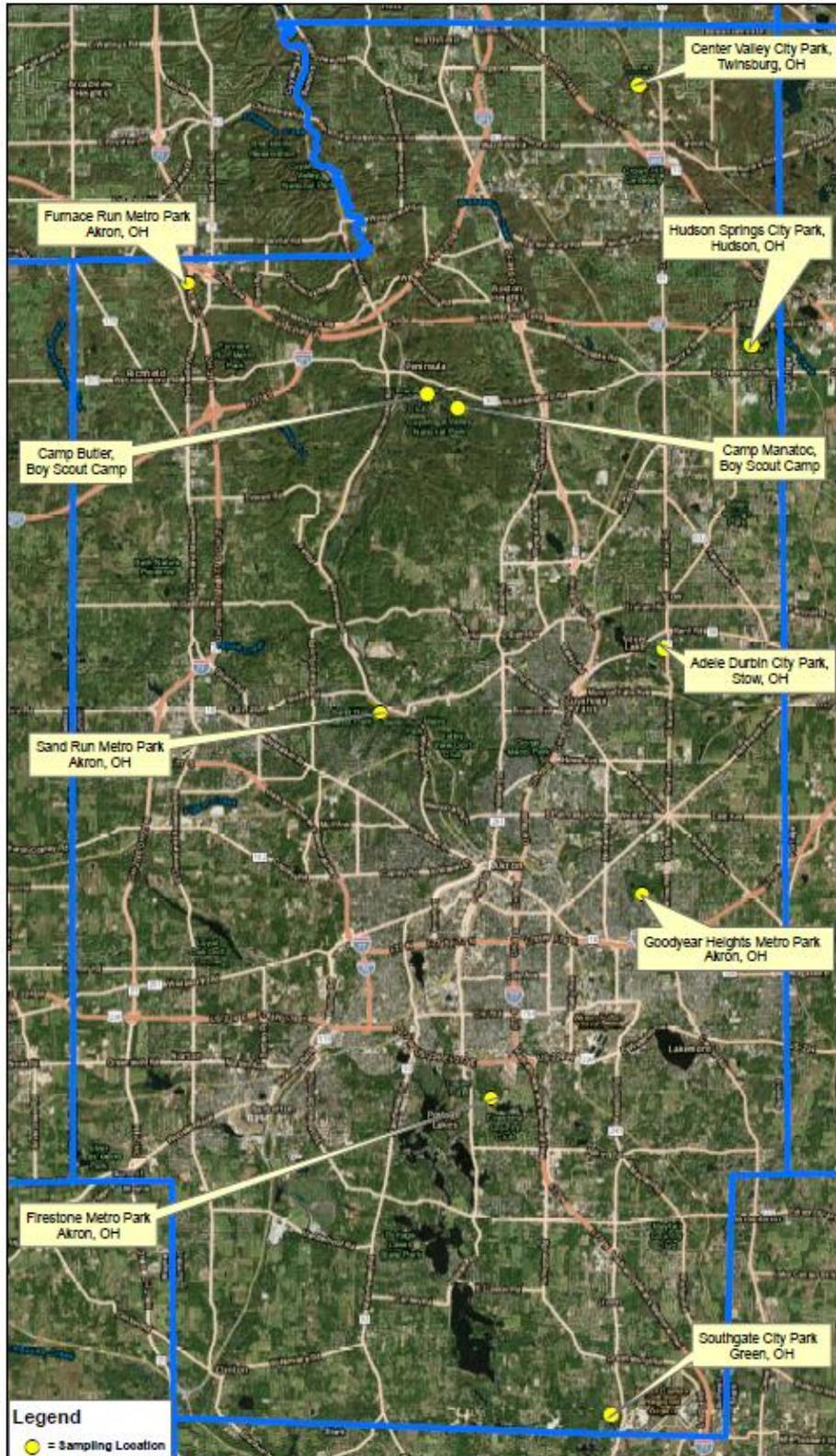
ASTM D4318, Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils

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 Summit 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



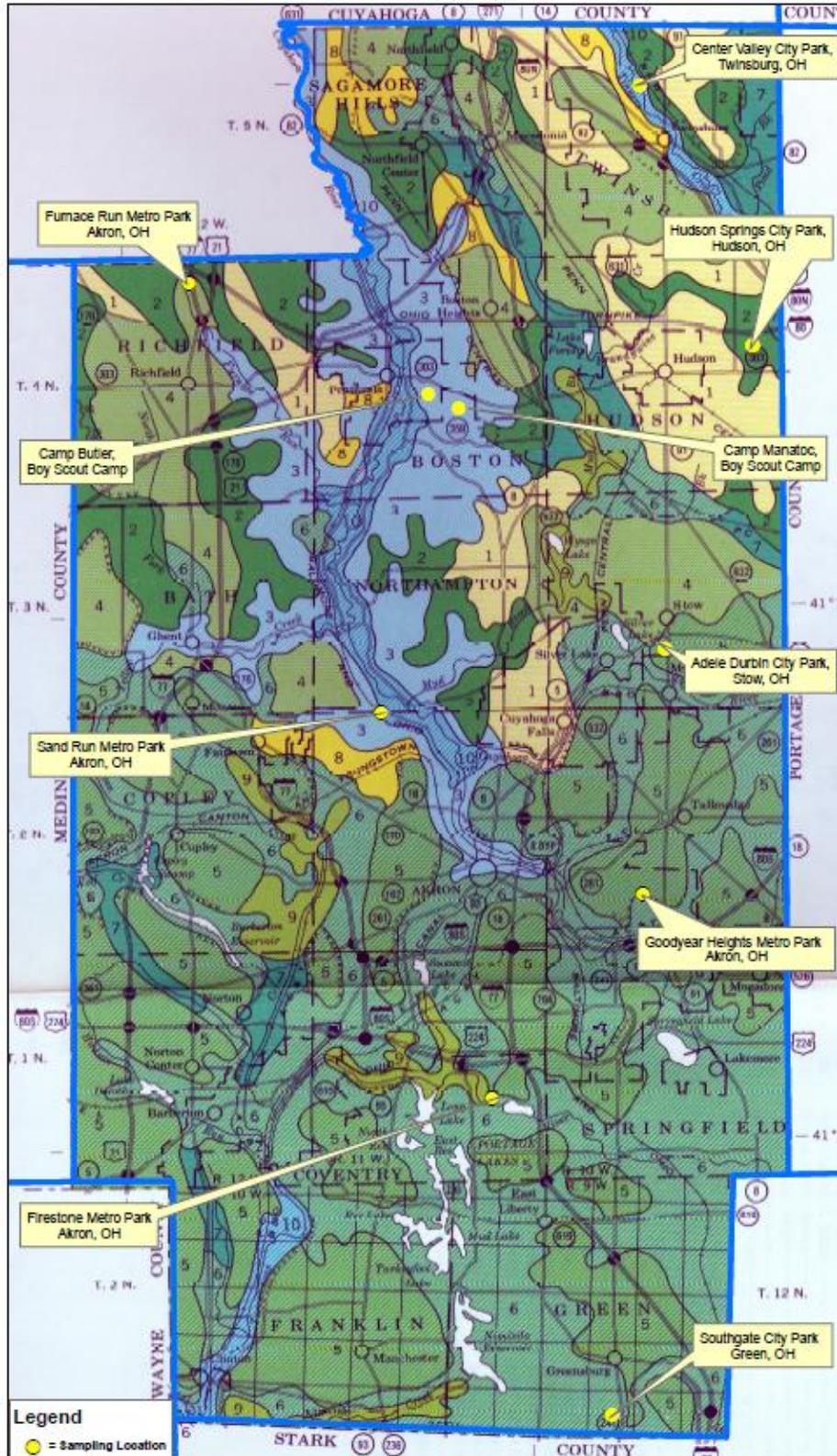


Figure 2: General Soils Map, Summit County, Ohio

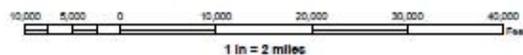


TABLE 1A
Soil Sampling Property Information Summary: Locations, Settings & Topography

Sampled Property	Property Abbreviation (Sample ID)	Location			Setting	Topography
		Address	Latitude	Longitude		
Adell Durbin City Park, Stow	DDP	3300 Darrow Road, Stow, OH 44224	41.153944	-81.442186	suburban	gently to moderately sloping upland
Camp Manatoc Boy Scout Reservation	CMN	1075 Truxell Road, Peninsula, OH 44264	41.227500	-81.526170	rural	moderately to steeply sloping upland
Camp Butler Boy Scout Reservation	CBT	880 West Streetsboro Road Peninsula, OH 44264	41.221890	-81.532020	rural	gently to moderately sloping upland
Center Valley City Park, Twinsburg	TCVP	Darrow Road, Twinsburg, OH 44087	41.330385	-81.449974	suburban	level to gently sloping stream terrace
Firestone Summit Metro Park	FMP	2400 Harrington Road, Akron, OH 44319	41.013263	-81.515602	suburban	sloping floodplain lobe
Furnace Run Summit Metro Park	FRM	4955 Townsend Road, Richfield, OH 44286	41.269573	-81.637438	suburban	level floodplain
Goodyear Heights Summit Metro Park	GMP	2077 Newton Street, Akron, OH 44305	41.076558	-81.452395	suburban to urban	moderately sloping upland
Hudson Springs City Park, Hudson	HSP	7095 Stow Road, Hudson, OH 44224	41.248245	-81.404345	suburban	moderately to steeply sloping upland
Sand Run Summit Metro Park	SRM	1337 Merriman Road, Akron, OH 44313	41.134310	-81.559782	suburban	level to gently sloping upland
Southgate City Park, Green	SGP	5300 Massillon Road, North Canton, OH 44720	40.913889	-81.467699	suburban	moderately sloping upland

TABLE 1B
Soil Sampling Property Information Summary: Soil Mapping Units, Classification and Parent Materials

Sampled Property	Preliminary Soil Boring ¹ & Location			Soil Mapping Units, Classification and Parent Material			
	PSB	Latitude ²	Longitude ²	Mapping Unit	USCS	USDA	Parent Material
Adell Durbin City Park, Stow	DDP-1	41.153944	-81.442186	Wooster silt loam (WuB)	lean clay (CL)	loam	glacial till
Camp Manatoc Boy Scout Reservation	CMN-1	41.227500	-81.526170	Geeburg silt loam (GbC2)	lean clay (CL)	silt loam	clayey lacustrine
Camp Butler Boy Scout Reservation	CBT-1	41.221890	-81.532020	Geebrug silt loam (GbC2)	lean clay (CL)	silty clay loam	clayey lacustrine
Center Valley City Park, Twinsburg	TCVP-1	41.330385	-81.449974	Fitchville silt loam (FcA)	sandy lean clay (CL)	loam	silty lacustrine
Firestone Summit Metro Park	FMP-1	41.013263	-81.515602	Conotton-Oshtemo complex (CyD)	well-graded sand with silt and gravel (SW-SM)	extremely gravelly loamy sand	sand and gravel glacial outwash
Furnace Run Summit Metro Park	FRM-1	41.269573	-81.637438	Tioga loam (TG)	silt with sand (ML)	silt loam	recent floodplain alluvium
Goodyear Heights Summit Metro Park	GMP-1	41.076558	-81.452395	Wooster silt loam (WuD2)	lean clay with sand (CL)	silt loam	glacial till
Hudson Springs City Park, Hudson	HSP-1	41.248245	-81.404345	Ellsworth silt loam (EIC)	lean clay with sand (CL)	clay loam	glacial till
Sand Run Summit Metro Park	SRM-1	41.134310	-81.559782	Olmstead loam (Od)	clayey sand (SC)	sandy loam	silty/clayey glacial outwash
Southgate City Park, Green	SGP-1	40.913889	-81.467699	Chili loam (CnC)	sandy silty clay (CL-ML)	loam	silty/clayey glacial outwash

Note:

- 1 One preliminary soil boring (PSB) was installed at each sampling 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 are for the approximate center of area from which soil samples were collected

TABLE 2
Summary of Geotechnical Testing Results for Summit County Background Soils

Soil Sample	Soil Parent Material	Unified Soil Classification System (USCS)							USDA Soil Classification System					
		USCS Soil Type	Particle Size Distribution				Atterberg Limits			USDA Soil Type ¹	Particle Size Distribution			
			% Gravel (>4.75 mm)	% Sand (≠4.75 mm, >0.075 mm)	% Silt (≠0.075 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)
DDP-1	glacial till	lean clay (CL)	1.70	29.00	50.29	19.02	31	17	14	loam	3.45	32.21	45.33	19.02
CMN-1	clayey lacustrine	lean clay (CL)	0.35	4.55	72.66	22.44	39	22	17	silt loam	1.04	10.41	66.11	22.44
CBT-1	clayey lacustrine	lean clay (CL)	0.21	3.77	62.59	33.43	34	23	11	silty clay loam	0.00	6.47	59.98	33.55
TCVP-1	silty lacustrine	sandy lean clay (CL)	0.12	40.30	42.82	16.75	26	17	9	loam	0.71	45.37	37.17	16.75
FMP-1	sand and gravel glacial outwash	well-graded sand with silt and gravel (SW-SM)	45.68	48.73	3.35	2.24	NP	NP	NP	extremely gravelly loamy sand	68.00	26.64	3.12	2.24
FRM-1	recent floodplain alluvium	silt with sand (ML)	9.36	19.15	49.70	21.79	44	27	17	silt loam	13.47	19.31	45.43	21.79
GMP-1	glacial till	lean clay with sand (CL)	0.93	22.58	60.87	15.62	28	17	11	silt loam	2.47	27.93	53.97	15.62
HSP-1	glacial till	lean clay with sand (CL)	6.06	20.96	46.04	26.94	38	20	18	clay loam	8.83	21.87	42.36	26.94
SRM-1	silty/clayey glacial outwash	clayey sand (SC)	1.10	57.51	30.11	11.28	29	21	8	sandy loam	5.47	57.81	25.44	11.28
SGP-1	silty/clayey glacial outwash	sandy silty clay (CL-ML)	1.77	32.09	49.38	16.76	24	17	7	loam	3.01	37.82	42.42	16.76

Note:

1 USDA soil types are based on the laboratory analysis of the sand, silt and clay fractions only (normalized to 100% with the gravel fraction removed)

Table 3
Background Statistics for Summit 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% UPL	Units	Comments
Arsenic	10	0	0%	100	15.3	8.76	2.64	Normal	13.5	13.3	9.15	mg/kg	Normal distribution, use VAP UL
Barium	10	0	0%	100	106	49.6	22.1	Lognormal	93.8	107	54.5	mg/kg	-
Cadmium ⁽¹⁾	10	0	91%	100	0.672	-	-	-		-	-	mg/kg	> 90% non-detect, use max value
Chromium	10	0	0%	100	19.9	10.9	4.35	Nonparametric	19.6	19.0	11.7	mg/kg	No distinct dist., use non-parametric
Lead	10	4	0%	96	26.7	15.4	3.45	Lognormal	30.8	22.7	16.0	mg/kg	Four outliers removed
Mercury	10	0	2%	100	0.066	0.034	0.012	Lognormal	0.068	0.066	0.036	mg/kg	Two ND, good lognormal dist.
Nickel	10	0	0%	100	25.1	13.5	4.97	Nonparametric	23.4	22.6	14.3	mg/kg	No distinct dist., use non-parametric
Selenium	10	0	20%	100	1.66	0.364	0.285	Lognormal	0.728	1.05	0.42	mg/kg	20 ND, good lognormal dist.
Thallium	10	0	0%	100	0.383	0.187	0.064	Lognormal	0.315	0.35	0.20	mg/kg	-

(1) Maximum observed value was used 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
DDP	Adell Durbin City Park, Stow
CMN	Camp Manatoc Boy Scout Reservation
CBT	Camp Butler Boy Scout Reservation
TCVP	Center Valley City Park, Twinsburg
FMP	Firestone Summit Metro Park
FRM	Furnace Run Summit Metro Park
GMP	Goodyear Heights Summit Metro Park
HSP	Hudson Springs City Park, Hudson
SRM	Sand Run Summit Metro Park
SGP	Southgate City Park

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

Sample	Location		DDP	CMN	CBT	TCVP	FMP	FRM	GMP	HSP	SRM	SGP
	Units											
1	mg/kg		9.53	9.00	9.75	7.32	8.76	5.58	7.34	9.57	3.72	8.01
2	mg/kg		11.5	5.55	5.40	8.22	8.43	12.3	7.39	8.72	6.67	6.97
3	mg/kg		10.5	8.06	12.6	11.1	11.6	7.74	10.4	7.90	6.71	7.73
4	mg/kg		11.1	7.38	11.6	9.30	7.85	11.7	6.95	11.1	3.08	10.5
5	mg/kg		11.3	7.45	7.57	6.18	9.33	9.58	15.3	9.90	15.0	8.56
6	mg/kg		12.7	8.91	11.7	6.73	3.95	10.1	9.02	11.5	6.81	12.0
7	mg/kg		9.5	8.33	12.1	8.90	5.63	4.64	7.68	9.39	7.00	7.58
8	mg/kg		10.8	6.16	6.74	9.33	7.71	10.6	8.54	9.47	4.38	7.30
9	mg/kg		8.28	9.78	8.24	11.1	3.29	9.44	9.98	8.87	8.98	11.5
10	mg/kg		8.68	8.98	8.99	10.6	3.96	10.5	11.8	8.89	8.12	8.62

Notes:
mg/kg = milligrams per kilogram

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

Sample	Location		DDP	CMN	CBT	TCVP	FMP	FRM	GMP	HSP	SRM	SGP
	Units											
1	mg/kg		53.9	42.0	31.8	31.1	21.7	80.5	100	47.0	56.3	32.0
2	mg/kg		36.9	45.0	29.9	27.8	28.2	80.5	93.2	63.0	67.2	45.2
3	mg/kg		43.5	46.0	37.8	25.9	26.0	87.4	82.8	44.9	63.0	33.6
4	mg/kg		69.7	42.2	32.0	23.6	21.8	90.2	84.3	41.2	64.8	27.5
5	mg/kg		39.5	65.0	28.9	23.3	38.1	81.9	88.5	48.8	55.0	31.5
6	mg/kg		51.8	44.7	27.1	26.1	18.6	111	106	47.8	70.7	21.8
7	mg/kg		47.6	38.0	32.4	24.9	21.4	89.5	78.1	46.4	77.7	38.4
8	mg/kg		44.8	52.1	35.8	40.9	27.9	79.7	50.9	55.5	49.1	28.5
9	mg/kg		46.6	38.2	34.4	25.4	34.4	72.2	81.2	51.3	84.2	24.0
10	mg/kg		57.4	44.0	35.8	33.2	52.2	86.9	86.2	33.9	75.0	34.1

Notes:
mg/kg = milligrams per kilogram

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

Sample	Location		DDP	CMN	CBT	TCVP	FMP	FRM	GMP	HSP	SRM	SGP
	Units											
1	mg/kg		<0.477	<0.444	<0.427	<0.451	<4.09	<0.493	<0.443	<0.440	0.672	<0.432
2	mg/kg		<0.437	<0.433	<0.460	<0.430	0.263	<0.462	<0.443	<0.476	<0.427	<0.449
3	mg/kg		<0.415	<0.469	0.234	<0.472	<0.405	<0.482	<0.454	<0.467	<0.442	<0.431
4	mg/kg		<0.459	<0.438	<0.456	<0.453	<0.408	<0.525	<0.465	<0.432	<0.479	<0.427
5	mg/kg		<0.426	0.237	<0.440	<0.468	<0.382	<0.523	<0.479	<0.437	0.449	<0.446
6	mg/kg		<0.420	<0.454	<0.419	<0.455	0.205	<0.495	<0.481	<0.444	<0.469	<0.425
7	mg/kg		<0.469	<0.433	0.219	<0.442	<0.409	<0.513	<0.429	<0.433	<0.452	<0.476
8	mg/kg		<0.468	<0.460	<0.481	<0.470	0.228	0.242	<0.436	<0.456	<0.433	<0.459
9	mg/kg		<0.476	<0.439	<0.435	<0.460	<0.417	<0.467	<0.484	<0.481	0.328	<0.455
10	mg/kg		<0.423	<0.441	<0.455	<0.411	<0.416	<0.464	<0.434	<0.452	0.327	<0.447

Notes:
mg/kg – milligrams per kilogram

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

Sample	Location		DDP	CMN	CBT	TCVP	FMP	FRM	GMP	HSP	SRM	SGP
	Units											
1	mg/kg		10.2	18.5	14.9	12.1	3.87	12.1	9.56	16.4	5.72	7.85
2	mg/kg		10.8	15.9	12.3	8.20	5.28	12.4	7.05	19.9	7.18	9.61
3	mg/kg		9.26	17.5	18.6	9.39	4.49	12.9	7.45	16.0	5.92	7.90
4	mg/kg		8.19	17.2	17.0	8.14	3.95	12.4	8.36	15.3	4.91	9.69
5	mg/kg		9.46	16.9	12.5	6.61	6.37	11.1	8.55	17.3	10.6	8.65
6	mg/kg		9.46	18.3	14.0	8.35	4.31	11.3	9.49	17.7	5.44	6.93
7	mg/kg		8.22	17.1	15.3	8.98	4.60	12.9	10.6	19.6	6.07	8.45
8	mg/kg		9.34	16.1	16.4	15.5	4.19	10.7	9.39	18.4	6.61	9.61
9	mg/kg		11.7	17.1	13.3	8.98	6.25	12.6	8.30	18.3	5.19	8.82
10	mg/kg		10.1	19.0	13.8	11.1	8.95	12.3	7.95	11.3	6.91	8.28

Notes:

mg/kg – milligrams per kilogram

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

Sample	Location		DDP	CMN	CBT	TCVP	FMP	FRM	GMP	HSP	SRM	SGP
	Units											
1	mg/kg		16.3	14.6	15.2	13.3	10.5	17.6	17.3	19.1	13.3	11.5
2	mg/kg		12.9	15.8	13.4	14.3	13.2	17.3	14.6	23.9	22.1	11.5
3	mg/kg		16.1	17.6	16.2	14.5	11.2	19.5	28.5	18.1	12.6	11.8
4	mg/kg		17.5	14.4	14.8	13.7	9.31	16.5	14.4	16.4	12.6	13.7
5	mg/kg		13.8	17.6	14.0	12.1	14.2	18.8	33.6	18.2	13.5	11.7
6	mg/kg		16.3	15.0	14.3	11.9	12.2	18.2	18.5	24.1	16.9	11.4
7	mg/kg		12.7	14.5	15.4	14.2	10.2	17.1	16.5	21.6	15.6	12.4
8	mg/kg		15.1	17.7	13.7	16.1	11.0	19.4	14.2	25.0	10.1	12.7
9	mg/kg		16.6	15.7	15.2	13.0	11.4	15.2	24.5	21.8	19.2	14.5
10	mg/kg		13.5	14.5	16.7	13.5	12.6	18.2	29.9	17.6	26.7	13.0

Notes:

mg/kg – milligrams per kilogram

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

Sample	Location		DDP	CMN	CBT	TCVP	FMP	FRM	GMP	HSP	SRM	SGP
	Units											
1	mg/kg		0.0241	0.0365	0.0201	0.0352	0.0282	0.0388	0.0170	0.0444	0.0262	0.0198
2	mg/kg		0.0269	0.0366	0.0330	0.0393	0.0279	0.0433	0.0208	0.0438	0.0165	0.0216
3	mg/kg		0.0273	0.0422	0.0442	0.0356	0.0235	0.0573	0.0386	0.0498	0.0111	0.0235
4	mg/kg		0.0282	0.0345	0.0396	0.0259	0.0223	0.0621	0.0184	0.0485	0.0155	0.0249
5	mg/kg		0.0258	0.0449	0.0337	0.0275	0.0292	0.0663	0.0428	0.0420	0.0207	0.0207
6	mg/kg		0.0333	0.0402	0.0381	0.0343	0.0180	0.0299	0.0318	0.0584	0.0425	0.0292
7	mg/kg		0.0324	0.0366	0.0328	0.0263	0.0145	0.0511	0.0267	0.0518	0.0135	0.0246
8	mg/kg		0.0282	0.0339	0.0353	0.0346	0.0186	0.0523	0.0234	0.0571	0.0112	0.0215
9	mg/kg		0.0312	0.0383	0.0371	0.0273	0.0233	0.0438	0.0379	0.0543	0.0538	0.0185
10	mg/kg		0.0321	0.0319	0.0415	0.0331	0.0259	0.0581	0.0429	0.0450	0.0630	0.0238

Notes:

mg/kg – milligrams per kilogram

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

Sample	Location		DDP	CMN	CBT	TCVP	FMP	FRM	GMP	HSP	SRM	SGP
	Units											
1	mg/kg		8.66	24.8	17.1	16.2	8.54	17.8	13.0	17.4	7.18	7.96
2	mg/kg		11.3	17.6	13.4	9.83	10.3	20.1	10.4	22.6	9.17	9.41
3	mg/kg		9.52	20.2	25.1	11.0	8.73	20.3	10.9	16.3	8.61	7.39
4	mg/kg		7.42	19.0	19.1	12.0	7.61	20.2	11.8	19.0	7.33	8.97
5	mg/kg		9.58	20.2	14.8	7.12	12.4	17.9	12.2	18.4	9.31	8.00
6	mg/kg		10.1	20.2	17.9	10.0	8.53	19.9	13.1	22.3	8.33	8.22
7	mg/kg		6.59	19.1	18.9	9.64	8.61	21.3	14.0	19.0	10.0	9.89
8	mg/kg		8.04	18.2	19.5	20.6	10.6	16.6	11.9	20.8	7.49	10.3
9	mg/kg		7.73	20.5	14.7	11.7	10.2	19.5	11.0	11.8	9.46	9.43
10	mg/kg		9.95	19.9	15.8	15.5	11.4	19.6	11.2	7.96	9.90	9.75

Notes:

mg/kg – milligrams per kilogram

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

Sample	Location		DDP	CMN	CBT	TCVP	FMP	FRM	GMP	HSP	SRM	SGP
	Units											
1	mg/kg		0.270	<0.236	<0.242	0.233	0.542	0.476	0.694	0.222	0.407	0.206
2	mg/kg		0.216	<0.242	<0.251	0.161	0.459	0.724	0.790	0.227	0.356	0.129
3	mg/kg		0.345	<0.248	<0.250	0.229	0.343	0.571	1.14	0.287	0.386	0.249
4	mg/kg		0.384	<0.241	<0.254	0.184	0.260	0.864	0.906	0.321	0.297	0.310
5	mg/kg		0.344	<0.242	<0.240	0.159	0.430	0.836	1.13	0.268	0.336	0.193
6	mg/kg		0.308	<0.244	<0.246	0.183	0.254	0.625	0.976	0.197	0.569	0.262
7	mg/kg		0.238	<0.247	<0.240	0.293	0.336	0.485	0.693	0.236	0.397	0.288
8	mg/kg		0.259	0.120	<0.246	<0.240	0.279	0.736	0.808	0.250	0.483	0.155
9	mg/kg		0.295	<0.241	<0.235	0.235	0.262	0.521	0.759	0.224	0.630	0.240
10	mg/kg		0.322	<0.240	<0.241	0.273	0.293	0.844	0.921	0.212	0.619	0.296

Notes:

mg/kg – milligrams per kilogram

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

Sample	Location		DDP	CMN	CBT	TCVP	FMP	FRM	GMP	HSP	SRM	SGP
	Units											
1	mg/kg		0.146	0.272	0.215	0.145	0.150	0.110	0.180	0.255	0.086	0.145
2	mg/kg		0.138	0.177	0.143	0.174	0.177	0.164	0.190	0.280	0.084	0.186
3	mg/kg		0.139	0.235	0.301	0.217	0.137	0.167	0.264	0.196	0.091	0.202
4	mg/kg		0.196	0.210	0.252	0.203	0.109	0.208	0.164	0.371	0.095	0.217
5	mg/kg		0.202	0.231	0.188	0.110	0.162	0.194	0.383	0.265	0.095	0.141
6	mg/kg		0.183	0.226	0.250	0.127	0.088	0.193	0.259	0.283	0.136	0.165
7	mg/kg		0.167	0.281	0.253	0.189	0.089	0.135	0.181	0.247	0.140	0.191
8	mg/kg		0.139	0.218	0.186	0.211	0.088	0.208	0.244	0.303	0.130	0.132
9	mg/kg		0.140	0.265	0.173	0.233	0.076	0.126	0.228	0.328	0.096	0.166
10	mg/kg		0.167	0.212	0.211	0.200	0.081	0.197	0.281	0.224	0.124	0.145

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

Camp Butler – Boys Scouts (CBT)

880 West Streetsboro Road
 Peninsula, OH 44264
 Summit County, NEDO

Project No./Type: NA/County Soil Background

**DERR-SIFU
 Soil Boring Log**

CBT--PSB
 Page 1 of 1

LAT/LONG and/or LOCATION DESCRIPTION: Lat 41.227500° / Long -81.526170°, in hardwood trees; approx 210' west of Oil & Gas well; level hilltop

GROUND ELEVATION: ~855 ft. a.m.s.l. **TOC ELEVATION:** NA **DRILLING SERVICES:** Ohio EPA SIFU
START DATE: 11/21/13 **COMPLETION DATE:** 11/21/13 **DRILLER:** Kelvin Jones, Jeff Martin, Ed Link; Mike Bolas--NEDO
DRILLING & SAMPLING METHODS: Hand Auger **LOGGED BY:** Kelvin Jones, Jeff Martin

GROUND WATER LEVELS

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

Date	Time	Depth (ft)	Notes

NOTES: Preliminary Soil Boring (PSB) & Laboratory sampling both performed on cool, fall day (~40-50 F); rainy, no wind.

OHIO EPA GEOPROBE LOG - OHIO EPA GEOPROBE LOG.GDT - 12/04/14 15:40 - G:\SUMMIT_CO_BACKGROUND_SOILS_STUDY\SC-GINT_SOIL_BORING_LOGS\CBT-CAMP_BUTLER.GFI

DEPTH (ft)	CORING		SAMPLING			REMARKS	GRAPHIC LOG	USCS	MATERIAL DESCRIPTION
	Core Type	Core Interval/Recovery (ft)	Sample Interval (ft)	Sample Purpose/ID	PID (ppmv)				
0.0-0.5	HA	0.5	0.0 - 2.0	XRF screening, CBT-1, 0.0 - 2.0 ft., COMPOSITE	NA	1		CL	USCS Clay (USDA Clay Loam): brown, medium plasticity
0.5-1.0	HA	0.5						CL	same as above
1.0-1.5	HA	0.5						CL	same as above
1.5-2.0	HA	0.5						CL	same as above
2.0-2.5	HA	0.5						CL	same as above
2.5-3.0	HA	0.5						CL	same as above, but yellowish-brown with a greyish tint to soil
3.0-3.5	HA	0.5						CL	same as above
3.5-4.0	HA	0.5						CL	same as above
<p>Soil analytical and geotechnical testing samples CBT-1 through CBT-10 were collected on 2013-11-21. CBT-1 was collected adjacent to the CBT-PSB location, and CBT-2 through CBT-10 were collected at random locations within a 15 ft. radius of CBT-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 Ti added. In addition, sample CBT-1 was submitted to Geotechnics of Pittsburgh, PA for sieve and hydrometer analyses, Atterberg limits, and USDA and USCS laboratory soil classification.</p>									

REMARKS:
 1. Homogenized soil from 0.0-2.0 ft deep (sampling location CBT-1) consists of USCS Lean Clay (CL) / USDA Silty Clay Loam, based on lab analysis.

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

Ohio Environmental Protection Agency 4675 Homer-Ohio Lane Groveport, OH 43125 Telephone: (614) 836-8760, Fax: (614) 836-8795 Edward.Link@epa.ohio.gov			Camp Manatoc -- Boys Scouts (CMN) 1075 Truxell Road Peninsula, OH 44264 Summit County, NEDO Project No./Type: NA/County Soil Background			DERR-SIFU Soil Boring Log CMN--PSB Page 1 of 1			
LAT/LONG and/or LOCATION DESCRIPTION: Lat 41.221890° / Long -81.532020°, in hardwoods, approx 380' due west of Camp Butler Manatoc Memorial									
GROUND ELEVATION: ~860 ft. a.m.s.l.			TOC ELEVATION: NA			DRILLING SERVICES: Ohio EPA SIFU			
START DATE: 11/21/13			COMPLETION DATE: 11/21/13			DRILLER: Kelvin Jones, Jeff Martin, Ed Link; Mike Bolas--NEDO			
DRILLING & SAMPLING METHODS: Hand Auger						LOGGED BY: Kelvin Jones, Jeff Martin			
GROUND WATER LEVELS									
DIAMETER (in): ~2			TOTAL DEPTH (ft): 4			REFUSAL (ft): NA			
NOTES: Preliminary Soil Boring (PSB) & Laboratory sampling both performed on cool, fall day (~40-50 F); rainy, no wind; overcast.									
DEPTH (ft)	CORING		SAMPLING			REMARKS	GRAPHIC LOG	USCS	MATERIAL DESCRIPTION
	Core Type	Core Interval/Recovery (ft)	Sample Interval (ft)	Sample Purpose/ID	PID (ppmv)				
1	HA	0.0-0.5 0.5	0.0 - 2.0	XRF screening, CMN-1, 0.0 - 2.0 ft., COMPOSITE	NA	1	CL	USCS Clay (USDA Clay Loam): brown, medium plasticity	
	HA	0.5-1.0 0.5				0.5'	CL	same as above	
	HA	1.0-1.5 0.5				1'	CL	same as above	
	HA	1.5-2.0 0.5				1.5'	CL	same as above	
2	HA	2.0-2.5 0.5				2'	CL	same as above	
	HA	2.5-3.0 0.5				2.5'	CL	same as above, but some grey tint	
	HA	3.0-3.5 0.5				3'	CL	same as above	
	HA	3.5-4.0 0.5				3.5'	CL	same as above	
4	HA	4.0-4.5 0.5				4'	CL	same as above	
<p>Soil analytical and geotechnical testing samples CMN-1 through CMN-10 were collected on 2013-11-21. CMN-1 was collected adjacent to the CMN-PSB location, and CMN-2 through CMN-10 were collected at random locations within a 15 ft. radius of CMN-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 CMN-1 was submitted to Geotechnics of Pittsburgh, PA for sieve and hydrometer analyses, Atterberg limits, and USDA and USCS laboratory soil classification.</p>									
REMARKS: 1. Homogenized soil from 0.0-2.0 ft deep (sampling location CMN-1) consists of USCS Lean Clay (CL) / USDA Silt Loam, based on lab analysis.									
SURVEY BENCHMARK & DATUM: Trimble Sub-meter GPS, Pathfinder conversion software, Google Maps, ArcGIS									

OHIO EPA GEOPROBE LOG - 12/20/14 15:47 - GISUMMIT_CO_BACKGROUND_SOILS_STUDY/SC-GINT_SOIL_BORING_LOGS/SCBT-CAMP_MANATOC.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

Adele Durbin Park, City of Stow (DDP)
 3300 Darrow Road
 Stow, OH 44224
 Summit County, NEDO
 Project No./Type: NA/County Soil Background

DERR-SIFU
Soil Boring Log

DDP--PSB
 Page 1 of 1

LAT/LONG and/or LOCATION DESCRIPTION: Lat 41.153944° / Long -81.442186°, in woods; approx 275' due north of radio tower (& parking lot)
GROUND ELEVATION: ~1090 ft. a.m.s.l. **TOC ELEVATION:** NA **DRILLING SERVICES:** Ohio EPA SIFU
START DATE: 5/7/14 **COMPLETION DATE:** 5/7/14 **DRILLER:** Kelvin Jones, Jeff Martin, Ed Link; Mike Bolas--NEDO
LOGGED BY: Kelvin Jones, Jeff Martin

DRILLING & SAMPLING METHODS: Hand Auger

GROUND WATER LEVELS			
Date	Time	Depth (ft)	Notes

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

NOTES: Preliminary Soil Boring (PSB) & Laboratory sampling both performed on spring day (~65-72 degrees F); sunny/partly cloudy, slight wind.

DEPTH (ft)	CORING		SAMPLING			REMARKS	GRAPHIC LOG	USCS	MATERIAL DESCRIPTION
	Core Type	Core Interval/ Recovery (ft)	Sample Interval (ft)	Sample Purpose/ID	PID (ppmv)				
0.0-0.5	HA	0.0-0.5	0.0 - 2.0	XRF screening, DDP-1, 0.0 - 2.0 ft., COMPOSITE	NA	1		CL	USCS Clay (USDA Sandy Clay Loam): dark brown, low plasticity
0.5-1.0	HA	0.5						CL	same as above, but yellowish-brown
1.0-1.5	HA	0.5						CL	same as above, but medium plasticity
1.5-2.0	HA	0.5						CL	same as above, but brown; trace
2.0-2.5	HA	0.5						CL	same as above
2.5-3.0	HA	0.5						CL	same as above
3.0-3.5	HA	0.5						CL	same as above
3.5-4.0	HA	0.5						CL	same as above
4.0	HA	0.5						CL	same as above
4.0	HA	0.5						CL	same as above

REMARKS:
 1. Homogenized soil from 0.0-2.0 ft deep (sampling location DDP-1) consists of USCS Sandy Lean Clay (CL) / USDA Loam, based on lab analysis.

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

OHIO EPA GEOPROBE LOG - OHIO EPA GEOPROBE LOG.GDT - 12/03/14 16:03 - G:\SUMMIT_CO_BACKGROUND_SOILS_STUDY\BC-GINT_SOIL_BORING_LOGS\DDP-ADELE_DURBIN.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	Firestone Metro Park (FMP) 2400 Harrington Road Akron, OH 44319 Summit County, NEDO	DERR-SIFU Soil Boring Log FMP--PSB Page 1 of 1
	Project No./Type: NA/County Soil Background	

LAT/LONG and/or LOCATION DESCRIPTION: Lat 41.013263° / Long -81.515602°, in woods; ~420' NW of Firestone's Tuscarawas Shelter building																			
GROUND ELEVATION: ~990 ft. a.m.s.l.	TOC ELEVATION: NA	DRILLING SERVICES: Ohio EPA SIFU																	
START DATE: 6/10/14	COMPLETION DATE: 6/10/14	DRILLER: K. Jones, G. Armstrong, E. Link; Mike Bolas--NEDO																	
DRILLING & SAMPLING METHODS: Hand Auger		LOGGED BY: Kelvin Jones, Jeff Martin																	
GROUND WATER LEVELS																			
DIAMETER (in): ~2	TOTAL DEPTH (ft): 3	REFUSAL (ft): 3	<table border="1"> <thead> <tr> <th>Date</th> <th>Time</th> <th>Depth (ft)</th> <th>Notes</th> </tr> </thead> <tbody> <tr><td> </td><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td><td> </td></tr> </tbody> </table>	Date	Time	Depth (ft)	Notes												
Date	Time	Depth (ft)	Notes																
NOTES: Preliminary Soil Boring (PSB) & Laboratory sampling both performed on late spring day (~70-80 degrees F); overcast.																			

DEPTH (ft)	CORING		SAMPLING			REMARKS	GRAPHIC LOG	USCS	MATERIAL DESCRIPTION	
	Core Type	Core Interval/ Recovery (ft)	Sample Interval (ft)	Sample Purpose/ID	PID (ppmv)					
0.0-0.5	HA	0.0-0.5	0.0 - 2.0	XRF screening, FMP-1, 0.0 - 2.0 ft., COMPOSITE	NA	1		USCS Sand (USDA Small Gravel): dark brown, low plasticity		
0.5-1.0	HA	0.5				2			0.5	same as above, brown
1.0-1.5	HA	0.5				1			1	same as above
1.5-2.0	HA	0.5				1.5			1.5	same as above
2.0-2.5	HA	0.5				2			2	same as above
2.5-3.0	HA	0.5				2.5			2.5	same as above
3.0	HA	0.5	3	3	3	Refusal at 3'. There were three attempts to get past the 3' [obstruction]. No samples taken from 3-4'.				

REMARKS:

- Homogenized soil from 0.0-2.0 ft deep (sampling location FMP-1) consists of USCS Well-graded Sand with Silt & Gravel (SW-SM) / USDA Loamy Sand, based on lab analysis.
- Note on Preliminary Reconnaissance Form: "gravel bank outwash".

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

OHIO EPA GEOPROBE LOG - OHIO EPA GEOPROBE LOG - 12/31/14 08:03 - G:\SUMMIT_CO_BACKGROUND_SOILS_STUDY\SC-GINT_SOIL_BORING_LOGS\FMP-FIRESTONE.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

Goodyear Heights Metro Park (GMP)
 2077 Newton Street
 Akron, OH 44305
 Summit County, NEDO
 Project No./Type: NA/County Soil Background

DERR-SIFU
Soil Boring Log
GMP--PSB
 Page 1 of 1

LAT/LONG and/or LOCATION DESCRIPTION: Lat 41.076558° / Long -81.452395°, in woods, approx. 230' due north of dead end in Culver St. @ park

GROUND ELEVATION: ~1030 ft. a.m.s.l. **TOC ELEVATION:** NA **DRILLING SERVICES:** Ohio EPA SIFU

START DATE: 6/10/14 **COMPLETION DATE:** 6/10/14 **DRILLER:** K. Jones, G. Armstrong, E. Link; Mike Bolas--NEDO

DRILLING & SAMPLING METHODS: Hand Auger **LOGGED BY:** Kelvin Jones, Jeff Martin

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

NOTES: Preliminary Soil Boring (PSB) & Laboratory sampling both performed on late spring day (~70-80 degrees F); overcast.

GROUND WATER LEVELS			
Date	Time	Depth (ft)	Notes

DEPTH (ft)	CORING		SAMPLING		REMARKS	GRAPHIC LOG	USCS	MATERIAL DESCRIPTION
	Core Type	Core Interval/Recovery (ft)	Sample Interval (ft)	Sample Purpose/ID				
1	HA	0.0-0.5 0.5	0.0 - 2.0	XRF screening, GMP-1, 0.0 - 2.0 ft., COMPOSITE	NA	[Hatched Pattern]	CL/ML	USCS Silty Clay (USDA Clay Loam): dark brown, very moist; medium plasticity; smooth grit
	HA	0.5-1.0 0.5					CL/ML	same as above, but yellowish-brown
	HA	1.0-1.5 0.5					CL/ML	same as above
	HA	1.5-2.0 0.5					CL/ML	same as above
2	HA	2.0-2.5 0.5	0.0 - 2.0	XRF screening, GMP-1, 0.0 - 2.0 ft., COMPOSITE	NA	[Hatched Pattern]	CL/ML	USCS Sandy Clay (USDA Sandy Clay): yellowish-brown; medium plasticity; gravel present
	HA	2.5-3.0 0.5					CL/ML	same as above
	HA	3.0-3.5 0.5					CL/ML	same as above
	HA	3.5-4.0 0.5					CL/ML	same as above

REMARKS:
 1. Homogenized soil from 0.0-2.0 ft deep (sampling location GMP-1) consists of USCS Lean Clay with Sand (CL) / USDA Silt Loam, based on lab analysis.

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

OHIO EPA GEOPROBE LOG - 15/15 13:35 - G SUMMIT_CO_BACKGROUND_SOILS_STUDY/SC-GINT_SOIL_BORING_LOGS/GMP--GOODYEAR.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

South Gate Park, City of Green (SGP)
 5300 Massillon Road
 North Canton, OH 44720
 Summit County, NEDO
 Project No./Type: NA/County Soil Background

DERR-SIFU
Soil Boring Log

SGP--PSB
 Page 1 of 1

LAT/LONG and/or LOCATION DESCRIPTION: Lat: 40.913889° / Long: -81.467699°, in woods; ~600' WSW of lodge; ~40' NNE of Southgate Way Trail

GROUND ELEVATION: ~1130 ft. a.m.s.l. **TOC ELEVATION:** NA **DRILLING SERVICES:** Ohio EPA SIFU

START DATE: 5/7/14 **COMPLETION DATE:** 5/7/14 **DRILLER:** Kelvin Jones, Jeff Martin, Ed Link; Mike Bolas--NEDO

DRILLING & SAMPLING METHODS: Hand Auger **LOGGED BY:** Kelvin Jones, Jeff Martin

GROUND WATER LEVELS

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

Date	Time	Depth (ft)	Notes

NOTES: Preliminary Soil Boring (PSB) & Laboratory sampling both performed on spring day (~68-72 degrees F); partly cloudy, slight wind.

OHIO EPA GEOPROBE LOG (DOT - 1203114 09-38 - GISUMMIT_CO_BACKGROUND_SOILS_STUDY)BC-GINT_SOIL_BORING_LOGSSSGR-SOUTH_GATE.GRI

DEPTH (ft)	CORING		SAMPLING		REMARKS	GRAPHIC LOG	USCS	MATERIAL DESCRIPTION	
	Core Type	Core Interval/ Recovery (ft)	Sample Interval (ft)	Sample Purpose/ID					PID (ppmv)
0.0-0.5	HA	0.0-0.5 0.5	0.0 - 2.0	XRF screening, SGP-1, 0.0 - 2.0 ft., COMPOSITE	NA	[Hatched Pattern]	CU/ML	USCS Sandy Clay (USDA Sandy Clay Loam): brown, low plasticity	
0.5-1.0	HA	0.5-1.0 0.5					0.5'	CU/ML	same as above, but medium plasticity
1.0-1.5	HA	1.0-1.5 0.5					1'	CU/ML	same as above
1.5-2.0	HA	1.5-2.0 0.5					1.5'	CU/ML	USCS Sandy Clay (USDA Silty Clay Loam): brown, medium plasticity
2.0-2.5	HA	2.0-2.5 0.5					2'	CU/ML	same as above
2.5-3.0	HA	2.5-3.0 0.5					2.5'	CU/ML	same as above
3.0-3.5	HA	3.0-3.5 0.5					3'	CU/ML	same as above
3.5-4.0	HA	3.5-4.0 0.5					3.5'	CU/ML	same as above
4.0	HA		4'	CU/ML					

Soil analytical and geotechnical testing samples SGP-1 through SGP-10 were collected on 2014-05-07. SGP-1 was collected adjacent to the SGP-PSB location, and SGP-2 through SGP-10 were collected at random locations within a 15 ft. radius of SGP-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 SGP-1 was submitted to Geotechnics of Pittsburgh, PA for sieve and hydrometer analyses, Atterberg limits, and USDA and USCS laboratory soil classification.

REMARKS:
 1. Homogenized soil from 0.0-2.0 ft deep (sampling location SGP-1) consists of USCS Sandy Silty Clay (CL-ML) / USDA Loam, based on lab analysis.

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

Ohio Environmental Protection Agency 4675 Homer-Ohio Lane Groveport, OH 43125 Telephone: (614) 836-8760, Fax: (614) 836-8795 Edward.Link@epa.ohio.gov	Center Valley Pk., Twinsburg City (TCVP) 10231 Ravenna Road Twinsburg, OH 44087 Summit County, NEDO	DERR-SIFU Soil Boring Log TCVP--PSB Page 1 of 1
	Project No./Type: NA/County Soil Background	

LAT/LONG and/or LOCATION DESCRIPTION: Lat 41.330385° / Long -81.449974°, in woods; flat area; ~360' NE of bike trail bridge over Tinkers Creek		
GROUND ELEVATION: ~965 ft. a.m.s.l.	TOC ELEVATION: NA	DRILLING SERVICES: Ohio EPA SIFU
START DATE: 5/7/14	COMPLETION DATE: 5/7/14	DRILLER: Kelvin Jones, Jeff Martin, Ed Link; Mike Bolas--NEDO
DRILLING & SAMPLING METHODS: Hand Auger		LOGGED BY: Kelvin Jones, Jeff Martin

DIAMETER (in): ~2	TOTAL DEPTH (ft): 4	REFUSAL (ft): NA	Date	Time	Depth (ft)	Notes
NOTES: Preliminary Soil Boring (PSB) & Laboratory sampling both performed on spring day (~60-65 degrees F); overcast, slight wind.						

DEPTH (ft)	CORING		SAMPLING		REMARKS	GRAPHIC LOG	USCS	MATERIAL DESCRIPTION
	Core Type	Core Interval/ Recovery (ft)	Sample Interval (ft)	Sample Purpose/ID				
0.0-0.5	HA	0.0-0.5 0.5	0.0 - 1.0	XRF screening, TCVP-1, 0.0 - 1.0 ft., COMPOSITE	NA		SW	USCS Sand (USDA Sandy Loam): dark brown, low plasticity
0.5-1.0	HA	0.5					SW	USCS Sand (USDA Silty Sandy Loam): brown, medium plasticity
1.0-1.5	HA	0.5					SW	same as above
1.5-2.0	HA	0.5					CL/ML	USCS Clay (USDA Sandy Clay Loam): brown, medium plasticity
2.0-2.5	HA	0.5					CL/ML	same as above
2.5-3.0	HA	0.5					CL/ML	same as above, but low plasticity; gravel present
3.0-3.5	HA	0.5					CL/ML	same as above, but medium plasticity
3.5-4.0	HA	0.5					CL/ML	same as above
<p>Soil analytical and geotechnical testing samples TCVP-1 through TCVP-10 were collected on 2014-05-07. TCVP-1 was collected adjacent to the TCVP-PSB location, and TCVP-2 through TCVP-10 were collected at random locations within a 15 ft. radius of TCVP-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 TCVP-1 was submitted to Geotechnics of Pittsburgh, PA for sieve and hydrometer analyses, Atterberg limits, and USDA and USCS laboratory soil classification.</p>								

REMARKS:
 1. Homogenized soil from 0.0-2.0 ft deep (sampling location TCVP-1) consists of USCS Sandy Lean Clay (CL) / USDA Loam, based on lab analysis.

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

OHIO EPA GEOPROBE LOG - OHIO EPA GEOPROBE LOG.GDT - 12/31/14 11:09 - G:\SUMMIT_CO_BACKGROUND_SOILS_STUDY\SC-GINT_SOIL_BORING_LOGS\TCVP-CENTER_VALLEY.GPJ

APPENDIX B

FP-XRF SOIL ANALYTICAL SCREENING RESULTS



FP-XRF Screening Results for Metals, Evaluation of Background Metal Soil Concentrations in Summit County

Innov-X Tube-Based Alpha Series™ Handheld XRF Analyzer: analytical results in parts-per-million (ppm), LOD = Level of Detection (ppm)

Sample Location	Sample Identification	Sample Depth (ft)	Sampling Date	Screening (Analysis) Date	Reading Number	Titanium (LOD 10-100)	Chromium (LOD 10-100)	Manganese (LOD 10-100)	Iron (LOD 10-100)	Cobalt (LOD 10-100)	Nickel (LOD 10-100)	Copper (LOD 10-100)
Quality Assurance / Quality Control (QA/QC)	Pass Internal Standardization	N/A	N/A	05/27/14	1	Pass	Pass	Pass	Pass	Pass	Pass	Pass
	Pass Internal Standardization	N/A	N/A	12/01/14	1	Pass	Pass	Pass	Pass	Pass	Pass	Pass
	SiO ₂ Blank	N/A	N/A	05/27/14	1	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD
	SiO ₂ Blank	N/A	N/A	12/01/14	1	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD
Adele Durbin City Park, Stow	DDP	0.0-2.0	5/7/14	05/27/14	1	4,376.79	<LOD	289.54	24,474.99	<LOD	<LOD	<LOD
					2	5,048.55	<LOD	291.31	24,291.91	<LOD	63.48	40.13
Camp Butler, Boy Scouts of America	CBT	0.0-2.0	11/21/13	05/27/14	1	4,066.11	<LOD	184.50	24,923.33	158.14	<LOD	<LOD
					2	3,734.36	<LOD	142.32	24,968.12	<LOD	<LOD	<LOD
Camp Manatoc, Boy Scouts of America	CMN	0.0-2.0	11/21/13	05/27/14	1	5,091.78	<LOD	299.90	25,229.61	<LOD	<LOD	<LOD
					2	5,143.35	<LOD	265.27	24,751.27	<LOD	57.56	<LOD
Center Valley City Park, Twinsburg	TCVP	0.0-1.0	5/7/14	05/27/14	1	4,466.88	145.45	<LOD	25,464.80	<LOD	<LOD	41.38
					2	4,269.77	<LOD	170.23	25,383.75	<LOD	<LOD	<LOD
Firestone Summit Metro Park	FMP	0.0-2.0	6/10/14	12/01/14	1	2,673.61	171.47	701.34	24,525.97	<LOD	<LOD	<LOD
					2	NA	NA	NA	NA	NA	NA	NA
Furnace Run Summit Metro Park	FRM	0.0-2.0	6/10/14	12/01/14	1	5,243.22	<LOD	720.12	36,106.58	214.84	<LOD	36.24
					2	NA	NA	NA	NA	NA	NA	NA
Goodyear Summit Metro Park	GMP	0.0-2.0	6/10/14	12/01/14	1	4,072.97	<LOD	757.87	19,111.09	<LOD	<LOD	<LOD
					2	NA	NA	NA	NA	NA	NA	NA
Hudson Springs City Park, Hudson	HSP	0.0-2.0	5/7/14	05/27/14	1	4,455.41	<LOD	274.80	28,349.27	<LOD	<LOD	<LOD
					2	4,408.85	<LOD	235.14	28,213.22	<LOD	<LOD	26.25
Sand Run Summit Metro Park	SRM	0.0-2.0	6/10/14	12/01/14	1	2,783.28	137.24	228.56	14,644.39	<LOD	<LOD	<LOD
					2	2,479.28	151.06	161.01	13,936.04	<LOD	<LOD	33.30
South Gate City Park, Green	SGP	0.0-2.0	5/7/14	05/27/14	1	3,848.96	<LOD	244.74	21,125.28	<LOD	<LOD	38.88
					2	4,052.85	<LOD	238.82	20,325.71	<LOD	<LOD	<LOD
QA/QC	SiO ₂ Blank	N/A	N/A	05/27/14	2	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD
QA/QC	SiO ₂ Blank	N/A	N/A	12/01/14	2	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD

NA - Not Applicable or Not Analyzed

FP-XRF Screening Results for Metals, Evaluation of Background Metal Soil Concentrations in Summit County

Innov-X Tube-Based Alpha Series™ Handheld XRF Analyzer: analytical results in parts-per-million (ppm), LOD = Level of Detection (ppm)

Sample Location	Sample Identification	Sample Depth (ft)	Sampling Date	Screening (Analysis) Date	Reading Number	Zinc (LOD 10-100)	Arsenic (LOD 10-100)	Selenium (LOD 10-100)	Rubidium (LOD 10-100)	Strontium (LOD 10-100)	Zirconium (LOD 10-100)	Molybdenum (LOD 10-100)
Quality Assurance / Quality Control (QA/QC)	Pass Internal Standardization	N/A	N/A	05/27/14	1	Pass	Pass	Pass	Pass	Pass	Pass	Pass
	Pass Internal Standardization	N/A	N/A	12/01/14	1	Pass	Pass	Pass	Pass	Pass	Pass	Pass
	SiO ₂ Blank	N/A	N/A	05/27/14	1	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD
	SiO ₂ Blank	N/A	N/A	12/01/14	1	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD
Adele Durbin City Park, Stow	DDP	0.0-2.0	5/7/14	05/27/14	1	69.79	10.54	<LOD	69.69	72.18	274.11	<LOD
					2	60.63	11.69	<LOD	63.33	59.70	261.47	<LOD
Camp Butler, Boy Scouts of America	CBT	0.0-2.0	11/21/13	05/27/14	1	59.80	9.82	<LOD	79.38	78.99	297.45	<LOD
					2	57.46	11.63	<LOD	78.38	79.70	292.42	<LOD
Camp Manatoc, Boy Scouts of America	CMN	0.0-2.0	11/21/13	05/27/14	1	56.87	8.01	<LOD	104.74	76.19	259.06	<LOD
					2	47.95	10.05	<LOD	102.09	77.62	243.33	<LOD
Center Valley City Park, Twinsburg	TCVP	0.0-1.0	5/7/14	05/27/14	1	67.90	12.14	<LOD	63.65	82.26	342.06	<LOD
					2	59.18	10.25	<LOD	64.51	84.32	293.19	<LOD
Firestone Summit Metro Park	FMP	0.0-2.0	6/10/14	12/01/14	1	102.27	22.67	<LOD	33.97	92.23	179.36	<LOD
					2	NA	NA	NA	NA	NA	NA	NA
Furnace Run Summit Metro Park	FRM	0.0-2.0	6/10/14	12/01/14	1	118.82	20.28	<LOD	110.75	72.38	260.79	<LOD
					2	NA	NA	NA	NA	NA	NA	NA
Goodyear Summit Metro Park	GMP	0.0-2.0	6/10/14	12/01/14	1	72.93	<LOD	<LOD	65.63	77.78	367.96	<LOD
					2	NA	NA	NA	NA	NA	NA	NA
Hudson Springs City Park, Hudson	HSP	0.0-2.0	5/7/14	05/27/14	1	75.88	12.76	<LOD	97.00	92.36	223.32	<LOD
					2	75.82	8.24	<LOD	97.26	82.98	223.02	<LOD
Sand Run Summit Metro Park	SRM	0.0-2.0	6/10/14	12/01/14	1	67.53	8.09	<LOD	45.01	66.61	205.13	<LOD
					2	58.39	8.10	<LOD	44.04	76.92	235.50	<LOD
South Gate City Park, Green	SGP	0.0-2.0	5/7/14	05/27/14	1	55.77	9.64	<LOD	56.48	61.49	311.28	<LOD
					2	65.34	15.48	<LOD	54.53	65.33	348.27	<LOD
QA/QC	SiO ₂ Blank	N/A	N/A	05/27/14	2	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD
QA/QC	SiO ₂ Blank	N/A	N/A	12/01/14	2	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD

NA - Not Applicable or Not Analyzed

FP-XRF Screening Results for Metals, Evaluation of Background Metal Soil Concentrations in Summit County

Innov-X Tube-Based Alpha Series™ Handheld XRF Analyzer: analytical results in parts-per-million (ppm), LOD = Level of Detection (ppm)

Sample Location	Sample Identification	Sample Depth (ft)	Sampling Date	Screening (Analysis) Date	Reading Number	Silver (LOD 60-160)	Cadmium (LOD 60-160)	Tin (LOD 60-160)	Antimony (LOD 60-160)	Mercury (LOD 10-100)	Lead (LOD 10-100)
Quality Assurance / Quality Control (QA/QC)	Pass Internal Standardization	N/A	N/A	05/27/14	1	Pass	Pass	Pass	Pass	Pass	Pass
	Pass Internal Standardization	N/A	N/A	12/01/14	1	Pass	Pass	Pass	Pass	Pass	Pass
	SiO ₂ Blank	N/A	N/A	05/27/14	1	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD
	SiO ₂ Blank	N/A	N/A	12/01/14	1	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD
Adele Durbin City Park, Stow	DDP	0.0-2.0	5/7/14	05/27/14	1	<LOD	<LOD	<LOD	<LOD	<LOD	17.58
					2	68.55	<LOD	<LOD	<LOD	<LOD	19.07
Camp Butler, Boy Scouts of America	CBT	0.0-2.0	11/21/13	05/27/14	1	<LOD	<LOD	<LOD	<LOD	<LOD	21.63
					2	<LOD	<LOD	<LOD	<LOD	<LOD	17.59
Camp Manatoc, Boy Scouts of America	CMN	0.0-2.0	11/21/13	05/27/14	1	<LOD	<LOD	<LOD	<LOD	<LOD	25.26
					2	<LOD	<LOD	<LOD	<LOD	<LOD	19.20
Center Valley City Park, Twinsburg	TCVP	0.0-1.0	5/7/14	05/27/14	1	<LOD	<LOD	<LOD	<LOD	<LOD	17.77
					2	<LOD	<LOD	<LOD	<LOD	<LOD	25.06
Firestone Summit Metro Park	FMP	0.0-2.0	6/10/14	12/01/14	1	<LOD	NA	NA	NA	<LOD	9.90
					2	NA	NA	NA	NA	NA	NA
Furnace Run Summit Metro Park	FRM	0.0-2.0	6/10/14	12/01/14	1	47.52	NA	NA	NA	<LOD	24.72
					2	NA	NA	NA	NA	NA	NA
Goodyear Summit Metro Park	GMP	0.0-2.0	6/10/14	12/01/14	1	<LOD	NA	NA	NA	<LOD	34.83
					2	NA	NA	NA	NA	NA	NA
Hudson Springs City Park, Hudson	HSP	0.0-2.0	5/7/14	05/27/14	1	<LOD	<LOD	<LOD	<LOD	<LOD	19.33
					2	<LOD	<LOD	<LOD	<LOD	<LOD	24.67
Sand Run Summit Metro Park	SRM	0.0-2.0	6/10/14	12/01/14	1	46.30	NA	NA	NA	<LOD	19.63
					2	<LOD	NA	NA	NA	<LOD	16.46
South Gate City Park, Green	SGP	0.0-2.0	5/7/14	05/27/14	1	<LOD	<LOD	<LOD	<LOD	<LOD	19.42
					2	<LOD	<LOD	<LOD	<LOD	<LOD	10.43
QA/QC	SiO ₂ Blank	N/A	N/A	05/27/14	2	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD
QA/QC	SiO ₂ Blank	N/A	N/A	12/01/14	2	< LOD	NA	NA	NA	< LOD	< LOD

NA - Not Applicable or Not Analyzed

APPENDIX C

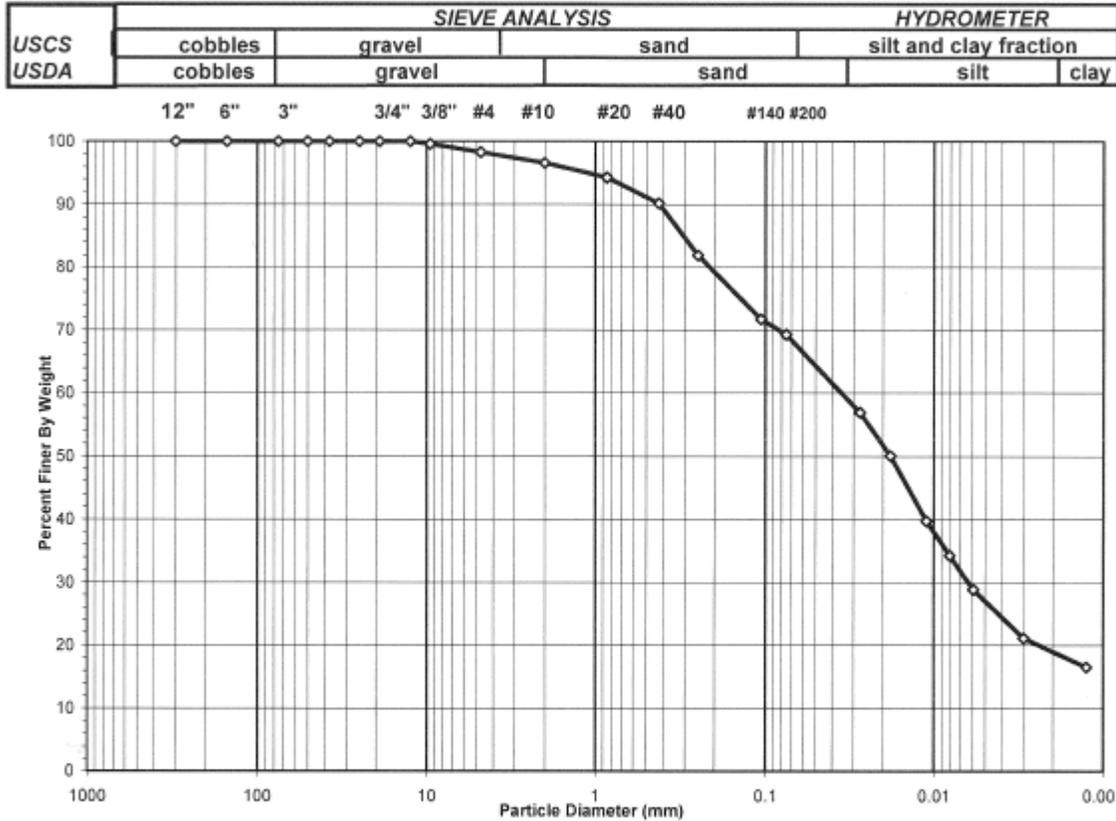
USCS AND USDA SOIL CLASSIFICATION AND TEXTURAL COMPOSITION ANALYSES





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

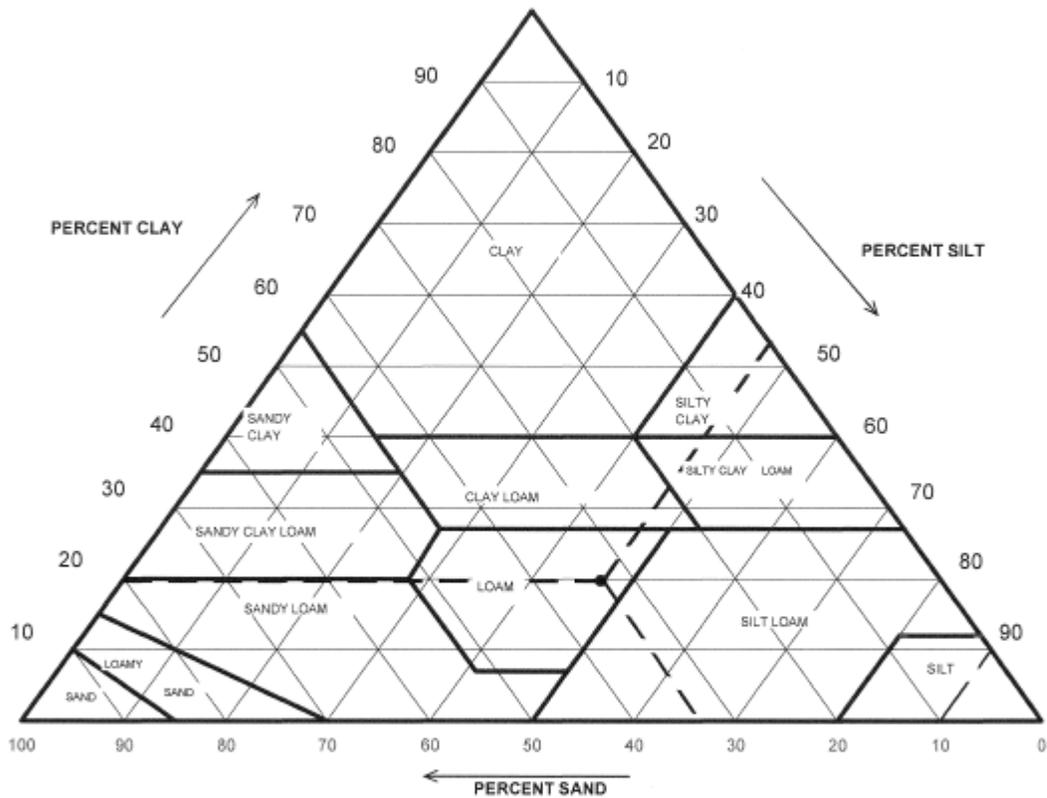
Client:	MICROBAC LABORATORIES	Boring No.:	Summit County
Client Reference:	OHIO EPA L14060033	Depth (ft):	Soil
Project No.:	2014-368-001	Sample No.:	DDP-1
Lab ID:	2014-368-001-001	Soil Color:	BROWN



USCS Summary		
Sieve Sizes (mm)		Percentage
Greater Than #4	<i>Gravel</i>	1.70
#4 To #200	<i>Sand</i>	29.00
Finer Than #200	<i>Silt & Clay</i>	69.31
USCS Symbol	CL, TESTED	
USCS Classification	SANDY LEAN CLAY	

USDA CLASSIFICATION CHART

Client:	MICROBAC LABORATORIES	Boring No.:	Summit County
Client Reference:	OHIO EPA L14060033	Depth (ft):	Soil
Project No.:	2014-368-001	Sample No.:	DDP-1
Lab ID:	2014-368-001-001	Soil Color:	BROWN



Particle Size (mm)	Percent Finer (%)	USDA SUMMARY	Actual Percentage (%)	Corrected % of Minus 2.0 mm material for USDA Classificat. (%)
2	96.55	Gravel	3.45	0.00
0.05	64.35	Sand	32.21	33.35
0.002	19.02	Silt	45.33	46.94
		Clay	19.02	19.70
		USDA Classification: LOAM		



WASH SIEVE ANALYSIS

ASTM D 422-63 (2007)

Client:	MICROBAC LABORATORIES	Boring No.:	Summit County
Client Reference:	OHIO EPA L14060033	Depth (ft):	Soil
Project No.:	2014-368-001	Sample No.:	DDP-1
Lab ID:	2014-368-001-001	Soil Color:	BROWN

Moisture Content of Passing 3/4" Material		Water Content of Retained 3/4" Material	
Tare No.	1454	Tare No.	NA
Wt. of Tare & Wet Specimen (g)	540.97	Wt. of Tare & Wet Specimen (g)	NA
Wt. of Tare & Dry Specimen (g)	455.49	Wt. of Tare & Dry Specimen (g)	NA
Weight of Tare (g)	138.27	Weight of Tare (g)	NA
Weight of Water (g)	85.48	Weight of Water (g)	NA
Weight of Dry Specimen (g)	317.22	Weight of Dry Specimen (g)	NA
Moisture Content (%)	26.9	Moisture Content (%)	NA

Wet Weight of -3/4" Sample (g)	NA	Weight of the Dry Specimen (g)	317.22
Dry Weight of -3/4" Sample (g)	97.36	Weight of - #200 material (g)	219.86
Wet Weight of +3/4" Sample (g)	NA	Weight of + #200 material (g)	97.36
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	1.36	0.43	0.43	99.57	99.57
#4	4.75	4.02	1.27	1.70	98.30	98.30
#10	2.00	5.55	1.75	3.45	96.55	96.55
#20	0.85	7.14	2.25	5.70	94.30	94.30
#40	0.425	13.22	4.17	9.86	90.14	90.14
#60	0.250	26.11	8.23	18.09	81.91	81.91
#140	0.106	32.15	10.13	28.23	71.77	71.77
#200	0.075	7.81	2.46	30.69	69.31	69.31
Pan	-	219.86	69.31	100.00	-	-

Tested By **JAM** Date **6/5/14** Checked By **KC** Date **6/16/14**



HYDROMETER ANALYSIS
ASTM D 422-63 (2007)

Client: MICROBAC LABORATORIES
 Client Reference: OHIO EPA L14060033
 Project No.: 2014-368-001
 Lab ID: 2014-368-001-001

Boring No.: Summit County
 Depth (ft): Soil
 Sample No.: DDP-1
 Soil Color: BROWN

Elapsed Time (min)	R Measured	Temp. (°C)	Composite Correction	R Corrected	N (%)	K Factor	Diameter (mm)	N'
0	NA	NA	NA	NA	NA	NA	NA	NA
2	46.0	22.7	4.61	41.4	82.1	0.01302	0.0272	56.9
5	41.0	22.7	4.61	36.4	72.2	0.01302	0.0180	50.0
15	33.5	22.7	4.61	28.9	57.3	0.01302	0.0110	39.7
30	29.5	22.7	4.61	24.9	49.4	0.01302	0.0080	34.2
60	25.5	22.9	4.55	20.9	41.6	0.01299	0.0058	28.8
250	20.0	22.7	4.61	15.4	30.5	0.01302	0.0030	21.2
1440	16.5	23.1	4.49	12.0	23.8	0.01296	0.0013	16.5

Soil Specimen Data	Other Corrections
Tare No. 963	
Weight of Tare & Dry Material (g) 156.68	a - Factor 0.99
Weight of Tare (g) 101.79	
Weight of Deflocculant (g) 5.0	Percent Finer than # 200 69.31
Weight of Dry Material (g) 49.89	Specific Gravity 2.7 Assumed

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



ATTERBERG LIMITS
ASTM D 4318-10

Client:	Microbac Laboratories	Boring No.:	Summit County
Client Reference:	OHIO EPA L14060033	Depth (ft):	SOIL
Project No.:	2014-368-001	Sample No.:	DDP-1
Lab ID:	2014-368-001-001	Soil Description:	BROWN LEAN CLAY (Minus No. 40 sieve material, Airdried)

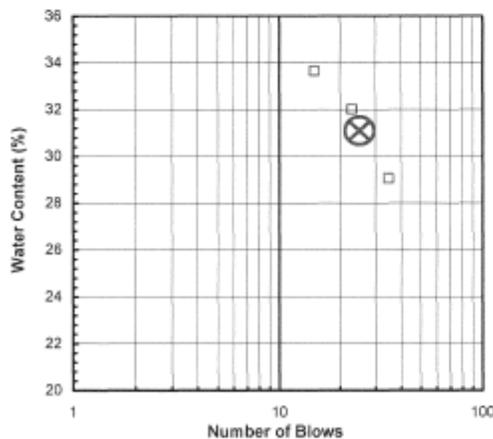
Note: The USCS symbol used with this test refers only to the minus No. 40 sieve material. See the "Sieve and Hydrometer Analysis" graph page for the complete material description.

Liquid Limit Test	1	2	3	
Tare Number	310	1271	319	M
Wt. of Tare & Wet Sample (g)	40.03	42.05	38.50	U
Wt. of Tare & Dry Sample (g)	34.68	37.13	33.95	L
Wt. of Tare (g)	18.77	21.75	18.27	T
Wt. of Water (g)	5.4	4.9	4.6	I
Wt. of Dry Sample (g)	15.9	15.4	15.7	P
Moisture Content (%)	33.6	32.0	29.0	O
Number of Blows	15	23	35	I
				N
				T

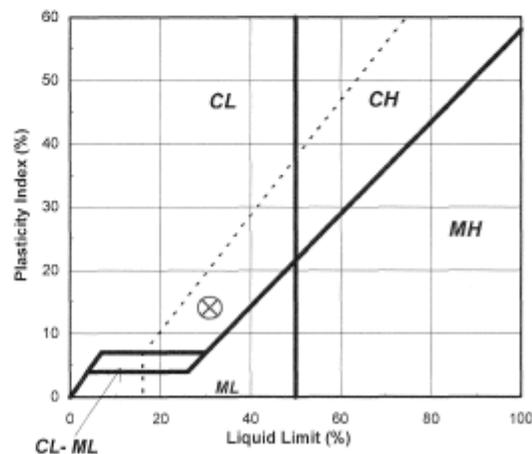
Plastic Limit Test	1	2	Range	Test Results	
Tare Number	1286	472		Liquid Limit (%)	31
Wt. of Tare & Wet Sample (g)	26.88	26.18		Plastic Limit (%)	17
Wt. of Tare & Dry Sample (g)	25.95	25.24		Plasticity Index (%)	14
Wt. of Tare (g)	20.66	19.68		USCS Symbol	CL
Wt. of Water (g)	0.9	0.9			
Wt. of Dry Sample (g)	5.3	5.6			
Moisture Content (%)	17.6	16.9	0.7		

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

Flow Curve



Plasticity Chart



Tested By	RAL	Date	6/10/14	Checked By	KC	Date	6/12/14
page 1 of 1	DCN:	CT-S4B	DATE:	3/18/13	REVISION:	4	3pt/limit.xls

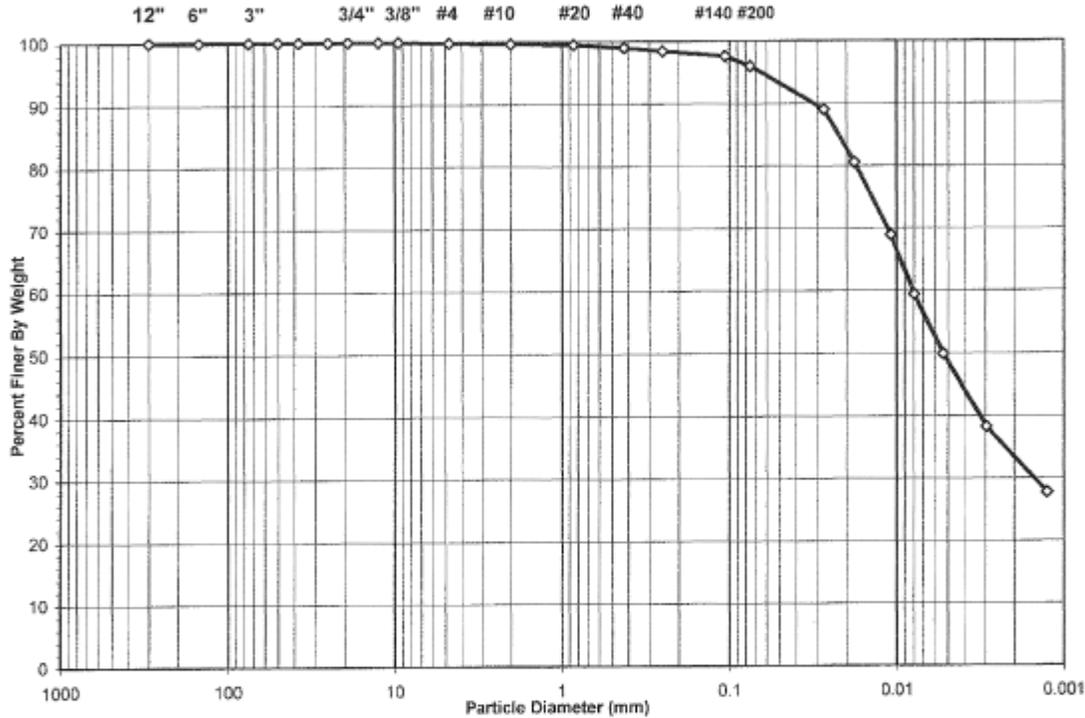
SIEVE AND HYDROMETER ANALYSIS
ASTM D 422-63 (2007)



Client: MICROBAC
 Client Reference: SUMMIT COUNTY L13120921
 Project No.: 2013-559-001
 Lab ID: 2013-559-001-002

Boring No.: NA
 Depth (ft): NA
 Sample No.: CBT-1
 Soil Color: BROWN

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

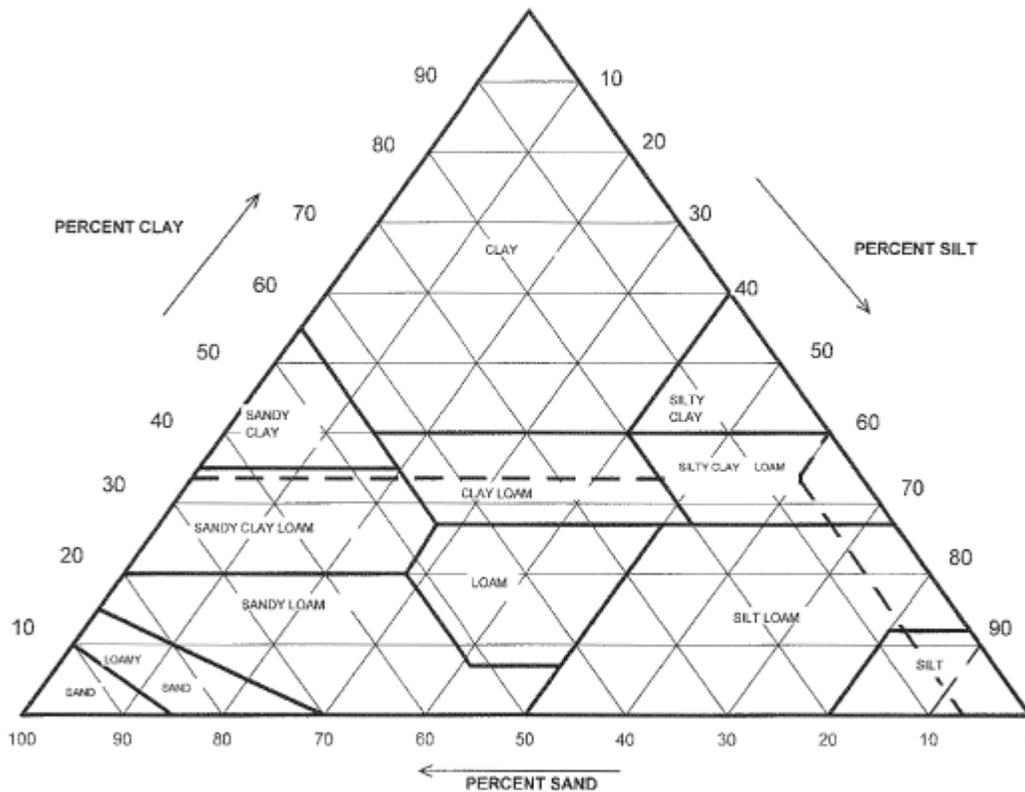


USCS Summary		
Sieve Sizes (mm)		Percentage
Greater Than #4	Gravel	0.21
#4 To #200	Sand	3.77
Finer Than #200	Silt & Clay	96.02
USCS Symbol	CL, TESTED	
USCS Classification	LEAN CLAY	

USDA CLASSIFICATION CHART

Client: MICROBAC
 Client Reference: SUMMIT COUNTY L13120921
 Project No.: 2013-559-001
 Lab ID: 2013-559-001-002

Boring No.: NA
 Depth (ft): NA
 Sample No.: CBT-1
 Soil Color: BROWN



Particle Size (mm)	Percent Finer (%)	USDA SUMMARY	Actual Percentage (%)	Corrected % of Minus 2.0 mm material for USDA Classificat. (%)
2	99.66	Gravel	0.34	0.00
0.05	93.21	Sand	6.45	6.47
0.002	33.43	Silt	59.78	59.98
		Clay	33.43	33.55
		USDA Classification:	SILTY CLAY LOAM	



WASH SIEVE ANALYSIS

ASTM D 422-63 (2007)

Client: MICROBAC	Boring No.: NA
Client Reference: SUMMIT COUNTY L13120921	Depth (ft): NA
Project No.: 2013-559-001	Sample No.: CBT-1
Lab ID: 2013-559-001-002	Soil Color: BROWN

Moisture Content of Passing 3/4" Material		Water Content of Retained 3/4" Material	
Tare No.	970	Tare No.	NA
Wt. of Tare & Wet Specimen (g)	689.10	Wt. of Tare & Wet Specimen (g)	NA
Wt. of Tare & Dry Specimen (g)	646.90	Wt. of Tare & Dry Specimen (g)	NA
Weight of Tare (g)	101.38	Weight of Tare (g)	NA
Weight of Water (g)	42.20	Weight of Water (g)	NA
Weight of Dry Specimen (g)	545.52	Weight of Dry Specimen (g)	NA
Moisture Content (%)	7.7	Moisture Content (%)	NA

Wet Weight of -3/4" Sample (g)	NA	Weight of the Dry Specimen (g)	545.52
Dry Weight of -3/4" Sample (g)	21.71	Weight of - #200 material (g)	523.81
Wet Weight of +3/4" Sample (g)	NA	Weight of + #200 material (g)	21.71
Dry Weight of +3/4" Sample (g)	0.00		
Total Dry Weight of Sample (g)	NA		

Sieve Size	Sieve Opening (mm)	Weight of Soil Retained (g)	Percent Retained (%)	Accumulated Percent Retained (%)	Percent Finer (%)	Accumulated Percent Finer (%)
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	1.14	0.21	0.21	99.79	99.79
#10	2.00	0.74	0.14	0.34	99.66	99.66
#20	0.85	0.92	0.17	0.51	99.49	99.49
#40	0.425	2.88	0.53	1.04	98.96	98.96
#60	0.250	2.84	0.52	1.56	98.44	98.44
#140	0.106	4.64	0.85	2.41	97.59	97.59
#200	0.075	8.55	1.57	3.98	96.02	96.02
Pan	-	523.81	96.02	100.00	-	-

Tested By **JP** Date **12/23/13** Checked By **KC** Date **12/30/13**

HYDROMETER ANALYSIS
ASTM D 422-63 (2007)



Client:	MICROBAC	Boring No.:	NA
Client Reference:	SUMMIT COUNTY L13120921	Depth (ft):	NA
Project No.:	2013-559-001	Sample No.:	CBT-1
Lab ID:	2013-559-001-002	Soil Color:	BROWN

Elapsed Time (min)	R Measured	Temp. (°C)	Composite Correction	R Corrected	N (%)	K Factor	Diameter (mm)	N' (%)
0	NA	NA	NA	NA	NA	NA	NA	NA
2	47.0	21.6	4.96	42.0	92.7	0.01319	0.0273	89.0
5	43.0	21.6	4.96	38.0	83.9	0.01319	0.0179	80.6
15	37.5	21.6	4.96	32.5	71.8	0.01319	0.0108	68.9
30	33.0	21.6	4.96	28.0	61.8	0.01319	0.0079	59.4
71	28.5	21.7	4.93	23.6	52.0	0.01317	0.0053	49.9
250	23.0	21.7	4.93	18.1	39.9	0.01317	0.0029	38.3
1440	18.0	21.8	4.90	13.1	28.9	0.01316	0.0013	27.7

Soil Specimen Data		Other Corrections	
Tare No.	952		
Weight of Tare & Dry Material (g)	152.42	a - Factor	0.99
Weight of Tare (g)	102.53		
Weight of Deflocculant (g)	5.0	Percent Finer than # 200	96.02
Weight of Dry Material (g)	44.89		
		Specific Gravity	2.7 Assumed

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

Tested By JP Date 12/23/13 Checked By KC Date 12/30/13

ATTERBERG LIMITS

ASTM D 4318-10

Client:	MICROBAC	Boring No.:	NA
Client Reference:	SUMMIT COUNTY L13120921	Depth (ft):	NA
Project No.:	2013-559-001	Sample No.:	CBT-1
Lab ID:	2013-559-001-002	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.

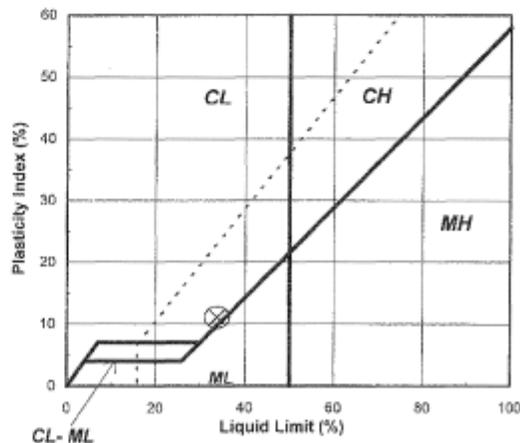
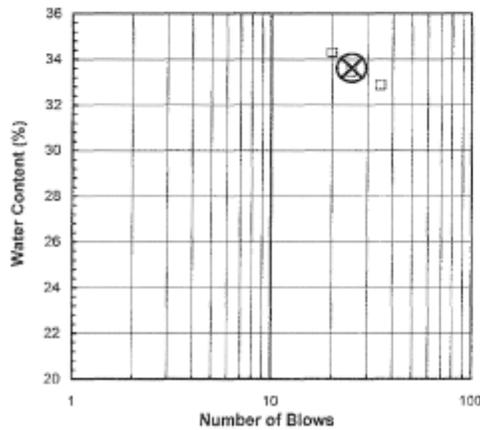
Liquid Limit Test	1	2	3	
Tare Number	471	1286	1252	M
Wt. of Tare & Wet Sample (g)	38.54	46.70	43.26	U
Wt. of Tare & Dry Sample (g)	32.78	40.14	37.02	L
Wt. of Tare (g)	15.25	20.53	18.82	T
Wt. of Water (g)	5.8	6.6	6.2	I
Wt. of Dry Sample (g)	17.5	19.6	18.2	P
				O
				I
Moisture Content (%)	32.9	33.5	34.3	N
Number of Blows	35	25	20	T

Plastic Limit Test	1	2	Range	Test Results
Tare Number	473	442		Liquid Limit (%)
Wt. of Tare & Wet Sample (g)	27.87	22.26		34
Wt. of Tare & Dry Sample (g)	26.65	21.09		Plastic Limit (%)
Wt. of Tare (g)	21.49	16.03		23
Wt. of Water (g)	1.2	1.2		Plasticity Index (%)
Wt. of Dry Sample (g)	5.2	5.1		11
				USCS Symbol
Moisture Content (%)	23.6	23.1	0.5	CL

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

Flow Curve

Plasticity Chart



Tested By TO Date 12/20/13 Checked By KC Date 12/23/13

page 1 of 1 DCN: CT-S4B DATE: 3/18/13 REVISION: 4 apr/mr.xls

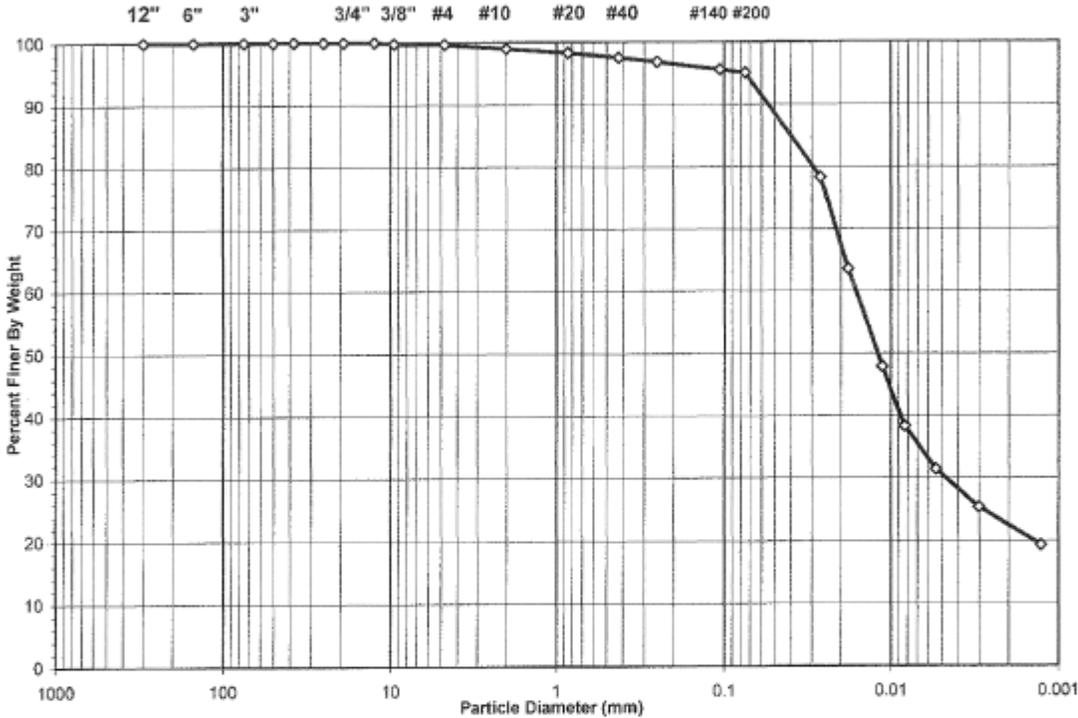
SIEVE AND HYDROMETER ANALYSIS
ASTM D 422-63 (2007)



Client: MICROBAC
 Client Reference: SUMMIT COUNTY L13120921
 Project No.: 2013-559-001
 Lab ID: 2013-559-001-001

Boring No.: NA
 Depth (ft): NA
 Sample No.: CMN-1
 Soil Color: BROWN

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

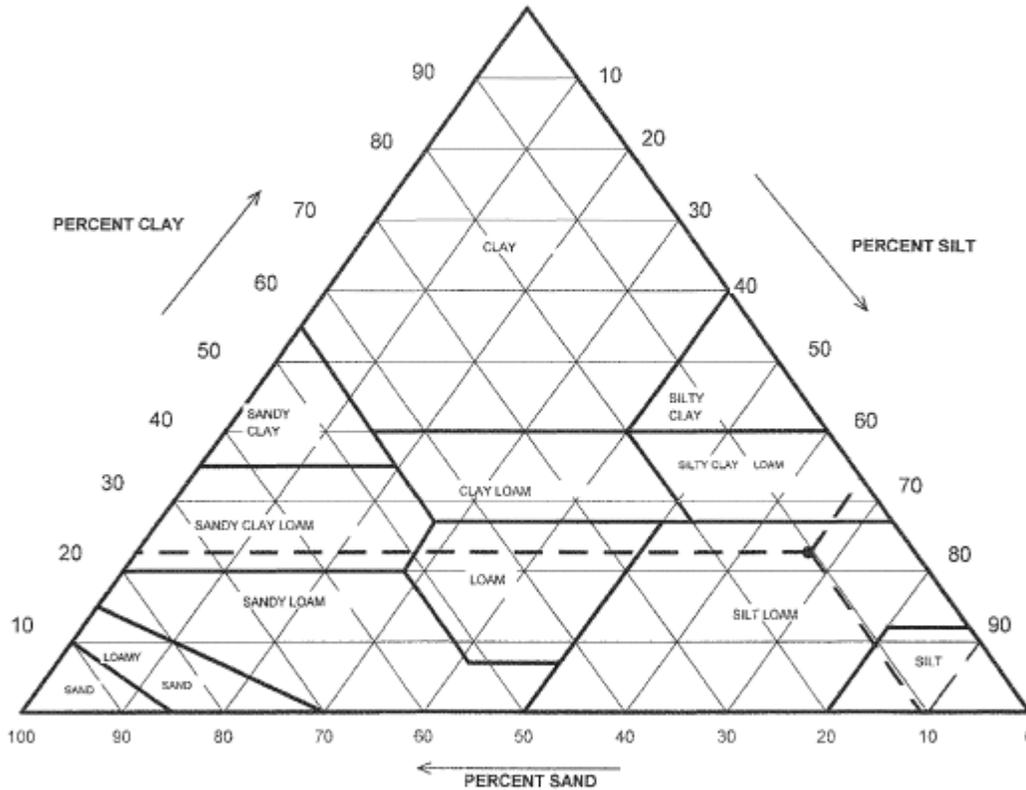


USCS Summary		
Sieve Sizes (mm)		Percentage
Greater Than #4	Gravel	0.35
#4 To #200	Sand	4.55
Finer Than #200	Silt & Clay	95.10
USCS Symbol	CL, TESTED	
USCS Classification	LEAN CLAY	

USDA CLASSIFICATION CHART

Client: MICROBAC
Client Reference: SUMMIT COUNTY L13120921
Project No.: 2013-559-001
Lab ID: 2013-559-001-001

Boring No.: NA
Depth (ft): NA
Sample No.: CMN-1
Soil Color: BROWN



Particle Size (mm)	Percent Finer (%)	USDA SUMMARY	Actual Percentage (%)	Corrected % of Minus 2.0 mm material for USDA Classificat. (%)
		Gravel	1.04	0.00
2	98.96	Sand	10.41	10.52
0.05	88.55	Silt	66.11	66.80
0.002	22.44	Clay	22.44	22.68
		USDA Classification:	SILT LOAM	



WASH SIEVE ANALYSIS

ASTM D 422-63 (2007)

Client: MICROBAC
 Client Reference: SUMMIT COUNTY L13120921
 Project No.: 2013-559-001
 Lab ID: 2013-559-001-001

Boring No.: NA
 Depth (ft): NA
 Sample No.: CMN-1
 Soil Color: BROWN

Moisture Content of Passing 3/4" Material		Water Content of Retained 3/4" Material	
Tare No.	976	Tare No.	NA
Wt. of Tare & Wet Specimen (g)	895.88	Wt. of Tare & Wet Specimen (g)	NA
Wt. of Tare & Dry Specimen (g)	806.10	Wt. of Tare & Dry Specimen (g)	NA
Weight of Tare (g)	101.54	Weight of Tare (g)	NA
Weight of Water (g)	89.78	Weight of Water (g)	NA
Weight of Dry Specimen (g)	704.56	Weight of Dry Specimen (g)	NA
Moisture Content (%)	12.7	Moisture Content (%)	NA

Wet Weight of -3/4" Sample (g)	NA	Weight of the Dry Specimen (g)	704.56
Dry Weight of -3/4" Sample (g)	34.54	Weight of -#200 material (g)	670.02
Wet Weight of +3/4" Sample (g)	NA	Weight of + #200 material (g)	34.54
Dry Weight of +3/4" Sample (g)	0.00		
Total Dry Weight of Sample (g)	NA		

Sieve Size	Sieve Opening (mm)	Weight of Soil Retained (g)	Percent Retained (%)	Accumulated Percent Retained (%)	Percent Finer (%)	Accumulated Percent Finer (%)
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	1.32	0.19	0.19	99.81	99.81
#4	4.75	1.14	0.16	0.35	99.65	99.65
#10	2.00	4.90	0.70	1.04	98.96	98.96
#20	0.85	4.63	0.66	1.70	98.30	98.30
#40	0.425	5.22	0.74	2.44	97.56	97.56
#60	0.250	5.04	0.72	3.16	96.84	96.84
#140	0.106	8.74	1.24	4.40	95.60	95.60
#200	0.075	3.55	0.50	4.90	95.10	95.10
Pan	-	670.02	95.10	100.00	-	-

Tested By JP Date 12/23/13 Checked By KC Date 12/30/13



HYDROMETER ANALYSIS
ASTM D 422-63 (2007)

Client:	MICROBAC	Boring No.:	NA
Client Reference:	SUMMIT COUNTY L13120921	Depth (ft):	NA
Project No.:	2013-559-001	Sample No.:	CMN-1
Lab ID:	2013-559-001-001	Soil Color:	BROWN

Elapsed Time (min)	R Measured	Temp. (°C)	Composite Correction	R Corrected	N (%)	K Factor	Diameter (mm)	N' (%)
0	NA	NA	NA	NA	NA	NA	NA	NA
2	50.0	21.6	4.96	45.0	82.4	0.01319	0.0265	78.3
5	41.5	21.6	4.96	36.5	66.8	0.01319	0.0182	63.5
15	32.5	21.6	4.96	27.5	50.4	0.01319	0.0113	47.9
30	27.0	21.6	4.96	22.0	40.3	0.01319	0.0083	38.3
74	23.0	21.7	4.93	18.1	33.0	0.01317	0.0054	31.4
250	19.5	21.7	4.93	14.6	26.6	0.01317	0.0030	25.3
1440	16.0	21.8	4.90	11.1	20.3	0.01316	0.0013	19.3

Soil Specimen Data		Other Corrections	
Tare No.	2327		
Weight of Tare & Dry Material (g)	155.25	a - Factor	0.99
Weight of Tare (g)	96.11		
Weight of Deflocculant (g)	5.0	Percent Finer than # 200	95.10
Weight of Dry Material (g)	54.14		
		Specific Gravity	2.7 Assumed

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

Tested By JP Date 12/23/13 Checked By KC Date 12/30/13

ATTERBERG LIMITS

ASTM D 4318-10

Client:	MICROBAC	Boring No.:	NA
Client Reference:	SUMMIT COUNTY L13120921	Depth (ft):	NA
Project No.:	2013-559-001	Sample No.:	CMN-1
Lab ID:	2013-559-001-001	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)

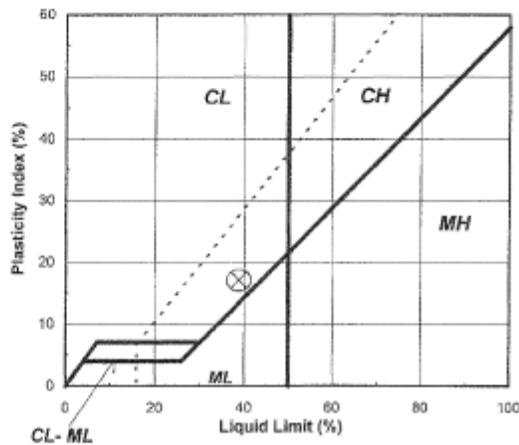
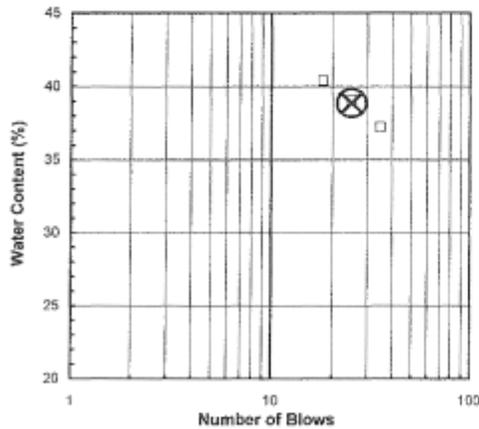
Liquid Limit Test	1	2	3	
Tare Number	1262	1254	446	M
Wt. of Tare & Wet Sample (g)	40.69	37.63	44.90	U
Wt. of Tare & Dry Sample (g)	33.88	30.30	37.83	L
Wt. of Tare (g)	14.84	11.53	20.31	T
Wt. of Water (g)	7.0	7.3	7.1	I
Wt. of Dry Sample (g)	18.8	18.8	17.5	P
				O
				I
Moisture Content (%)	37.2	39.1	40.4	N
Number of Blows	35	25	18	T

Plastic Limit Test	1	2	Range	Test Results
Tare Number	1272	1240		Liquid Limit (%) 39
Wt. of Tare & Wet Sample (g)	21.01	16.57		Plastic Limit (%) 22
Wt. of Tare & Dry Sample (g)	19.89	15.48		Plasticity Index (%) 17
Wt. of Tare (g)	14.85	10.43		USCS Symbol CL
Wt. of Water (g)	1.1	1.1		
Wt. of Dry Sample (g)	5.0	5.1		
Moisture Content (%)	22.2	21.6	0.6	

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

Flow Curve

Plasticity Chart



Tested By	TO	Date	12/20/13	Checked By	KC	Date	12/23/13
page 1 of 1	DCN:	CT-S4B	DATE:	3/18/13	REVISION:	4	3pt/limit.xls



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

Client: MICROBAC LABORATORIES
 Client Reference: OHIO EPA L14060033
 Project No.: 2014-368-001
 Lab ID: 2014-368-001-002

Boring No.: Summit County
 Depth (ft): Soil
 Sample No.: TCVP-1
 Soil Color: DARK BROWN

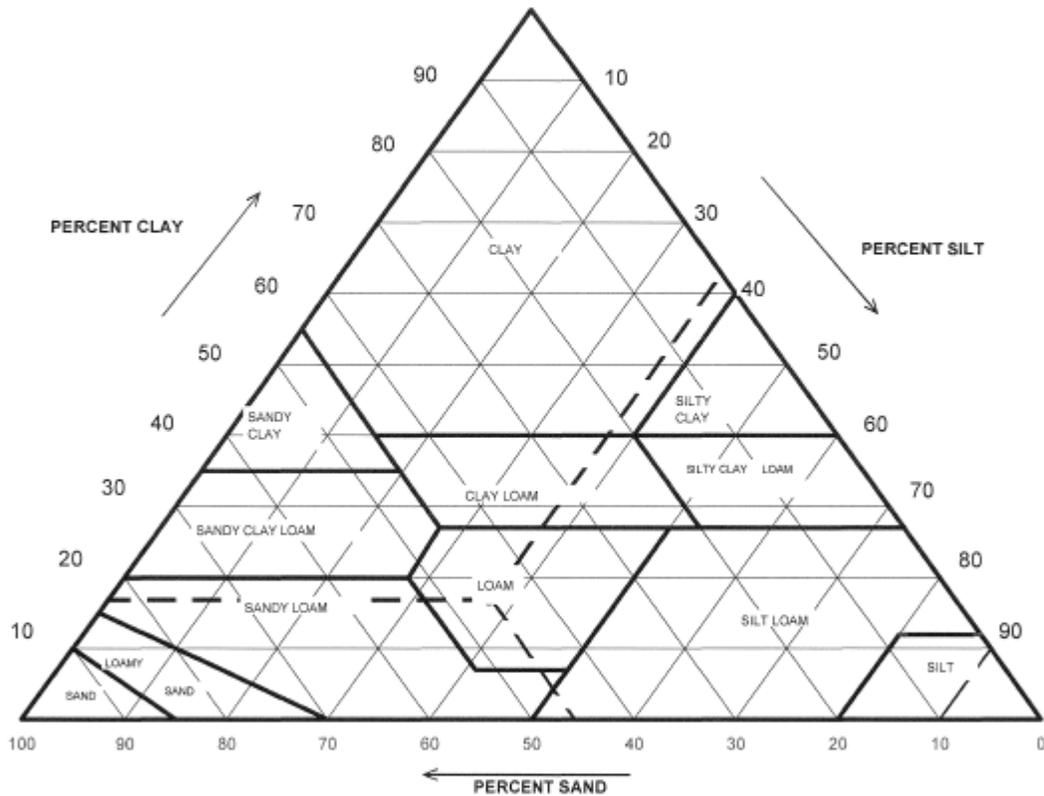


USCS Summary		
Sieve Sizes (mm)		Percentage
Greater Than #4	<i>Gravel</i>	0.12
#4 To #200	<i>Sand</i>	40.30
Finer Than #200	<i>Silt & Clay</i>	59.57
USCS Symbol	CL, TESTED	
USCS Classification	SANDY LEAN CLAY	

USDA CLASSIFICATION CHART

Client: MICROBAC LABORATORIES
 Client Reference: OHIO EPA L14060033
 Project No.: 2014-368-001
 Lab ID: 2014-368-001-002

Boring No.: Summit County
 Depth (ft): Soil
 Sample No.: TCVP-1
 Soil Color: DARK BROWN



Particle Size (mm)	Percent Finer (%)	USDA SUMMARY	Actual Percentage (%)	Corrected % of Minus 2.0 mm material for USDA Classificat. (%)
2	99.29	Gravel	0.71	0.00
0.05	53.92	Sand	45.37	45.69
0.002	16.75	Silt	37.17	37.43
		Clay	16.75	16.87
		USDA Classification: LOAM		



WASH SIEVE ANALYSIS

ASTM D 422-63 (2007)

Client:	MICROBAC LABORATORIES	Boring No.:	Summit County
Client Reference:	OHIO EPA L14060033	Depth (ft):	Soil
Project No.:	2014-368-001	Sample No.:	TCVP-1
Lab ID:	2014-368-001-002	Soil Color:	DARK BROWN

Moisture Content of Passing 3/4" Material		Water Content of Retained 3/4" Material	
Tare No.	1426	Tare No.	NA
Wt. of Tare & Wet Specimen (g)	796.64	Wt. of Tare & Wet Specimen (g)	NA
Wt. of Tare & Dry Specimen (g)	660.21	Wt. of Tare & Dry Specimen (g)	NA
Weight of Tare (g)	145.24	Weight of Tare (g)	NA
Weight of Water (g)	136.43	Weight of Water (g)	NA
Weight of Dry Specimen (g)	514.97	Weight of Dry Specimen (g)	NA
Moisture Content (%)	26.5	Moisture Content (%)	NA

Wet Weight of -3/4" Sample (g)	NA	Weight of the Dry Specimen (g)	514.97
Dry Weight of -3/4" Sample (g)	208.18	Weight of - #200 material (g)	306.79
Wet Weight of +3/4" Sample (g)	NA	Weight of + #200 material (g)	208.18
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	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	0.64	0.12	0.12	99.88	99.88
#10	2.00	3.01	0.58	0.71	99.29	99.29
#20	0.85	6.83	1.33	2.04	97.96	97.96
#40	0.425	24.61	4.78	6.81	93.19	93.19
#60	0.250	61.05	11.86	18.67	81.33	81.33
#140	0.106	89.25	17.33	36.00	64.00	64.00
#200	0.075	22.79	4.43	40.43	59.57	59.57
Pan	-	306.79	59.57	100.00	-	-

Tested By **JAM** Date **6/5/14** Checked By **KC** Date **6/16/14**



HYDROMETER ANALYSIS
ASTM D 422-63 (2007)

Client: MICROBAC LABORATORIES
 Client Reference: OHIO EPA L14060033
 Project No.: 2014-368-001
 Lab ID: 2014-368-001-002

Boring No.: Summit County
 Depth (ft): Soil
 Sample No.: TCVP-1
 Soil Color: DARK BROWN

Elapsed Time (min)	R Measured	Temp. (°C)	Composite Correction	R Corrected	N (%)	K Factor	Diameter (mm)	N' (%)
0	NA	NA	NA	NA	NA	NA	NA	NA
2	36.0	22.7	4.61	31.4	78.3	0.01302	0.0297	46.7
5	32.5	22.7	4.61	27.9	69.6	0.01302	0.0193	41.4
15	26.5	22.7	4.61	21.9	54.6	0.01302	0.0116	32.5
30	23.5	22.7	4.61	18.9	47.1	0.01302	0.0084	28.1
60	20.0	22.9	4.55	15.4	38.5	0.01299	0.0060	23.0
250	17.5	22.7	4.61	12.9	32.2	0.01302	0.0030	19.2
1440	14.0	23.1	4.49	9.5	23.7	0.01296	0.0013	14.1

Soil Specimen Data	Other Corrections
Tare No. 708	
Weight of Tare & Dry Material (g) 142.39	a - Factor 0.99
Weight of Tare (g) 97.71	
Weight of Deflocculant (g) 5.0	Percent Finer than # 200 59.57
Weight of Dry Material (g) 39.68	Specific Gravity 2.7 Assumed

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



ATTERBERG LIMITS
ASTM D 4318-10

Client:	Microbac Laboratories	Boring No.:	Summit County
Client Reference:	OHIO EPA L14060033	Depth (ft):	SOIL
Project No.:	2014-368-001	Sample No.:	TCVP-1
Lab ID:	2014-368-001-002	Soil Description:	DARK 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.

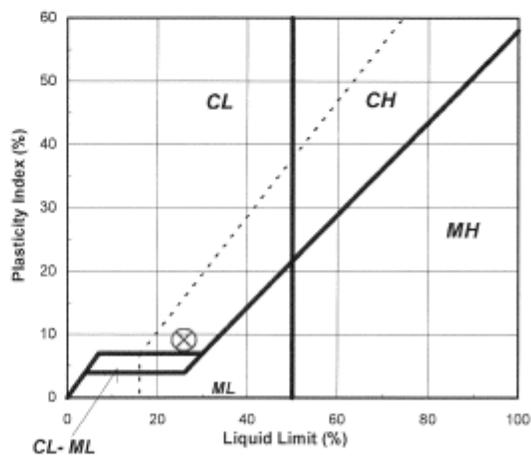
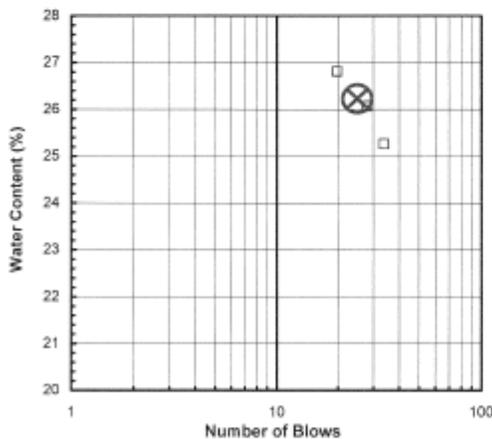
Liquid Limit Test	1	2	3	
Tare Number	147	274	1285	M
Wt. of Tare & Wet Sample (g)	42.90	42.00	32.38	U
Wt. of Tare & Dry Sample (g)	38.37	37.44	28.06	L
Wt. of Tare (g)	20.43	19.94	11.94	T
Wt. of Water (g)	4.5	4.6	4.3	I
Wt. of Dry Sample (g)	17.9	17.5	16.1	P
				O
				I
Moisture Content (%)	25.3	26.1	26.8	N
Number of Blows	34	28	20	T

Plastic Limit Test	1	2	Range	Test Results
Tare Number	442	1280		Liquid Limit (%) 26
Wt. of Tare & Wet Sample (g)	22.17	21.44		Plastic Limit (%) 17
Wt. of Tare & Dry Sample (g)	21.31	20.56		Plasticity Index (%) 9
Wt. of Tare (g)	16.02	15.37		USCS Symbol CL
Wt. of Water (g)	0.9	0.9		
Wt. of Dry Sample (g)	5.3	5.2		
Moisture Content (%)	16.3	17.0	-0.7	

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

Flow Curve

Plasticity Chart



Tested By JP Date 6/10/14 Checked By KC Date 6/12/14
 page 1 of 1 DCN: CT-S4B DATE: 3/18/13 REVISION: 4 3ptlimit.xls

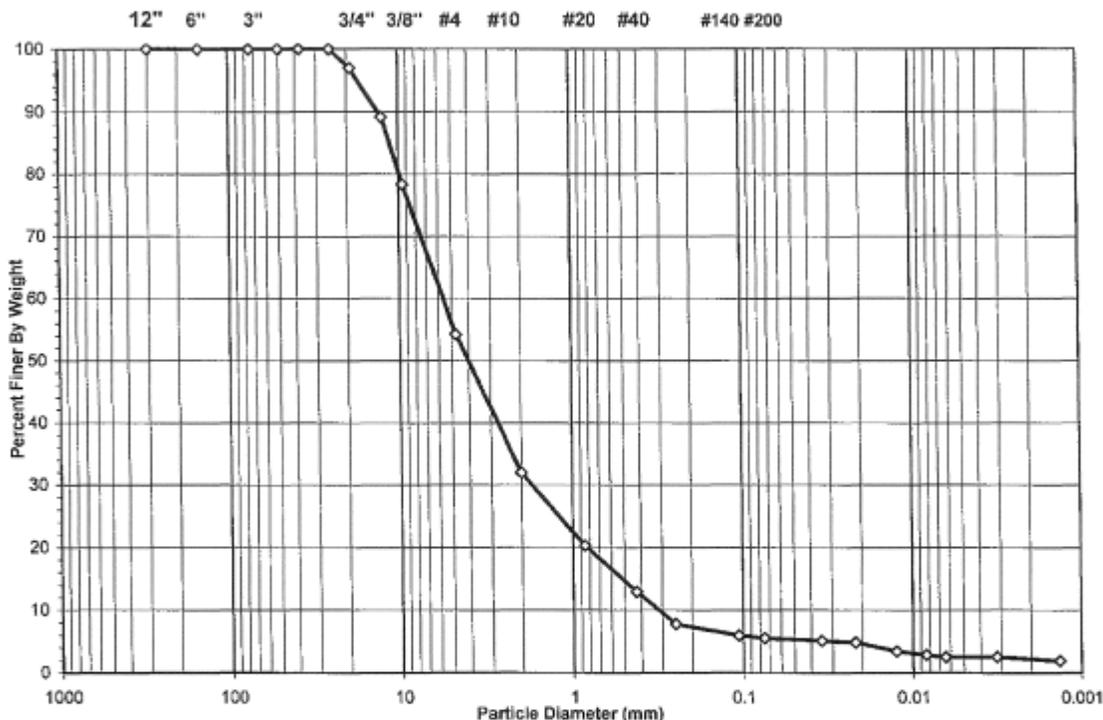
SIEVE AND HYDROMETER ANALYSIS
ASTM D 422-63 (2007)



Client: Microbac Laboratories, Inc.
 Client Reference: OH EPA-DERR VAP Summit Co. L14090859
 Project No.: 2014-039-002
 Lab ID: 2014-039-002-003

Boring No.: Background Soil
 Depth (ft): NA
 Sample No.: FMP-1
 Soil Color: DARK BROWN

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

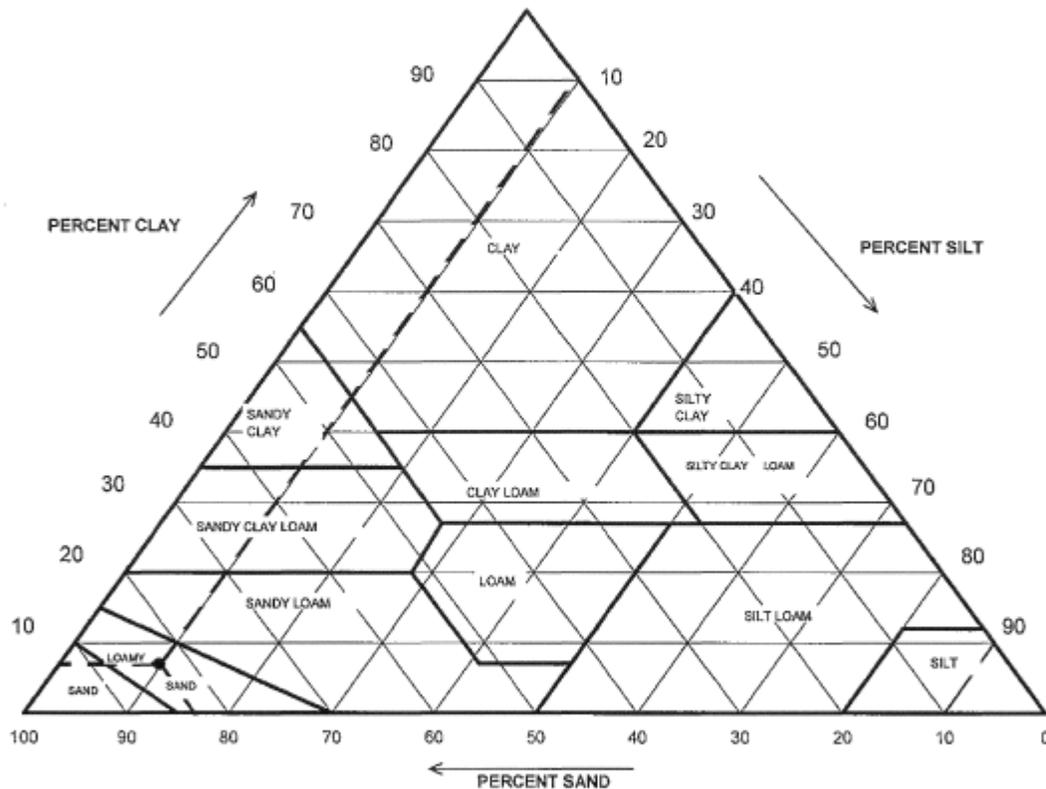


USCS Summary		
Sieve Sizes (mm)		Percentage
Greater Than #4	Gravel	45.68
#4 To #200	Sand	48.73
Finer Than #200	Silt & Clay	5.59
		D60 = 5.60
USCS Symbol	SW-SM, TESTED (NON-PLASTIC FINES)	D30 = 1.73 CC = 1.70
USCS Classification	WELL-GRADED SAND WITH SILT AND GRAVEL	D10 = 0.3130 CU = 17.88

USDA CLASSIFICATION CHART

Client: Microbac Laboratories, Inc.
 Client Reference: OH EPA-DERR VAP Summit Co. L14090859
 Project No.: 2014-039-002
 Lab ID: 2014-039-002-003

Boring No.: Background Soil
 Depth (ft): NA
 Sample No.: FMP-1
 Soil Color: DARK BROWN



Particle Size (mm)	Percent Finer (%)	USDA SUMMARY	Actual Percentage (%)	Corrected % of Minus 2.0 mm material for USDA Classificat. (%)
		Gravel	68.00	0.00
2	32.00	Sand	26.64	83.25
0.05	5.36	Silt	3.12	9.76
0.002	2.24	Clay	2.24	6.99
		USDA Classification:	LOAMY SAND	



WASH SIEVE ANALYSIS

ASTM D 422-63 (2007)

Client:	Microbac Laboratories, Inc.	Boring No.:	Background Soil
Client Reference:	OH EPA-DERR VAP Summit Co. L14090859	Depth (ft):	NA
Project No.:	2014-039-002	Sample No.:	FMP-1
Lab ID:	2014-039-002-003	Soil Color:	DARK BROWN

Moisture Content of Passing 3/4" Material		Water Content of Retained 3/4" Material	
Tare No.	2485	Tare No.	NA
Wt. of Tare & Wet Specimen (g)	1631.20	Wt. of Tare & Wet Specimen (g)	NA
Wt. of Tare & Dry Specimen (g)	1539.00	Wt. of Tare & Dry Specimen (g)	NA
Weight of Tare (g)	91.04	Weight of Tare (g)	NA
Weight of Water (g)	92.20	Weight of Water (g)	NA
Weight of Dry Specimen (g)	1447.96	Weight of Dry Specimen (g)	NA
Moisture Content (%)	6.4	Moisture Content (%)	NA

Wet Weight of -3/4" Sample (g)	NA	Weight of the Dry Specimen (g)	1447.96
Dry Weight of -3/4" Sample (g)	1323.91	Weight of - #200 material (g)	80.96
Wet Weight of +3/4" Sample (g)	NA	Weight of + #200 material (g)	1367.00
Dry Weight of +3/4" Sample (g)	43.09		
Total Dry Weight of Sample (g)	NA		

Sieve Size	Sieve Opening (mm)	Weight of Soil Retained (g)	Percent Retained (%)	Accumulated Percent Retained (%)	Percent Finer (%)	Accumulated Percent Finer (%)
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	43.09	2.98	2.98	97.02	97.02
1/2"	12.5	113.08	7.81	10.79	89.21	89.21
3/8"	9.50	157.09	10.85	21.63	78.37	78.37
#4	4.75	348.20	24.05	45.68	54.32	54.32
#10	2.00	323.20	22.32	68.00	32.00	32.00
#20	0.85	168.86	11.66	79.67	20.33	20.33
#40	0.425	107.01	7.39	87.06	12.94	12.94
#60	0.250	73.92	5.11	92.16	7.84	7.84
#140	0.106	26.62	1.84	94.00	6.00	6.00
#200	0.075	5.93	0.41	94.41	5.59	5.59
Pan	-	80.96	5.59	100.00	-	-

Tested By **RAL** Date **9/19/14** Checked By **KC** Date **9/26/14**

HYDROMETER ANALYSIS
ASTM D 422-63 (2007)



Client: Microbac Laboratories, Inc.
 Client Reference: OH EPA-DERR VAP Summit Co. L14090859
 Project No.: 2014-039-002
 Lab ID: 2014-039-002-003

Boring No.: Background Soil
 Depth (ft): NA
 Sample No.: FMP-1
 Soil Color: DARK BROWN

Elapsed Time (min)	R Measured	Temp. (°C)	Composite Correction	R Corrected	N (%)	K Factor	Diameter (mm)	N'
0	NA	NA	NA	NA	NA	NA	NA	NA
2	14.0	22.1	4.80	9.2	92.2	0.01311	0.0347	5.2
5	13.5	22.1	4.80	8.7	87.2	0.01311	0.0220	4.9
16	11.0	22.1	4.80	6.2	62.1	0.01311	0.0125	3.5
36	10.0	22.1	4.80	5.2	52.1	0.01311	0.0084	2.9
62	9.5	21.7	4.93	4.6	45.8	0.01317	0.0064	2.6
250	9.5	21.8	4.90	4.6	46.1	0.01316	0.0032	2.6
1440	8.5	21.4	5.02	3.5	34.8	0.01322	0.0013	1.9

Soil Specimen Data		Other Corrections	
Tare No.	929		
Weight of Tare & Dry Material (g)	115.86	a - Factor	0.99
Weight of Tare (g)	100.98		
Weight of Deflocculant (g)	5.0	Percent Finer than # 200	5.59
Weight of Dry Material (g)	9.88		
		Specific Gravity	2.7 Assumed

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

Tested By TO Date 9/23/14 Checked By KC Date 9/26/14

ATTERBERG LIMIT
ASTM D 4318-10



Client: Microbac Laboratories, Inc.
Client Reference: OH EPA-DERR VAP Summit Co. L14090859
Project No.: 2014-039-002
Lab ID: 2014-039-002-003

Boring No.: Background Soil
Depth (ft): NA
Sample No.: FMP-1
Visual: DARK BROWN SILT
(Minus No. 40 sieve material, Airdried)

**NON - PLASTIC
MATERIAL**

Tested By *PC* *Date* *9/17/14* *Checked By* *PC* *Date* *9/18/14*

DCN: CT-84C DATE: 3/20/13 REVISION: 3

\\GEO\SERVER\Data Drive\2014 GEOTECHNICAL PROJECTS\MICROBAC\2014-039-002 Ohio EPA-DERR\2014-039-002-003 NP Lim\XLS\Sheet1

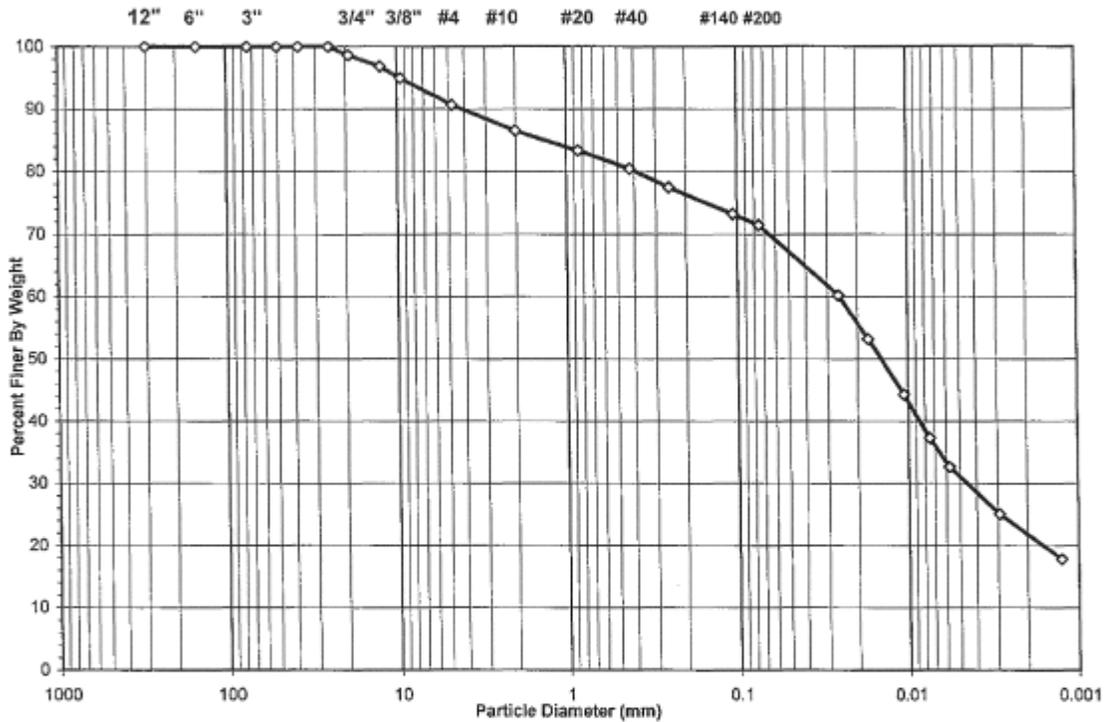
SIEVE AND HYDROMETER ANALYSIS
ASTM D 422-63 (2007)



Client: Microbac Laboratories, Inc.
 Client Reference: OH EPA-DERR VAP Summit Co. L14090859
 Project No.: 2014-039-002
 Lab ID: 2014-039-002-004

Boring No.: Background Soil
 Depth (ft): NA
 Sample No.: FRM-1
 Soil Color: BROWN

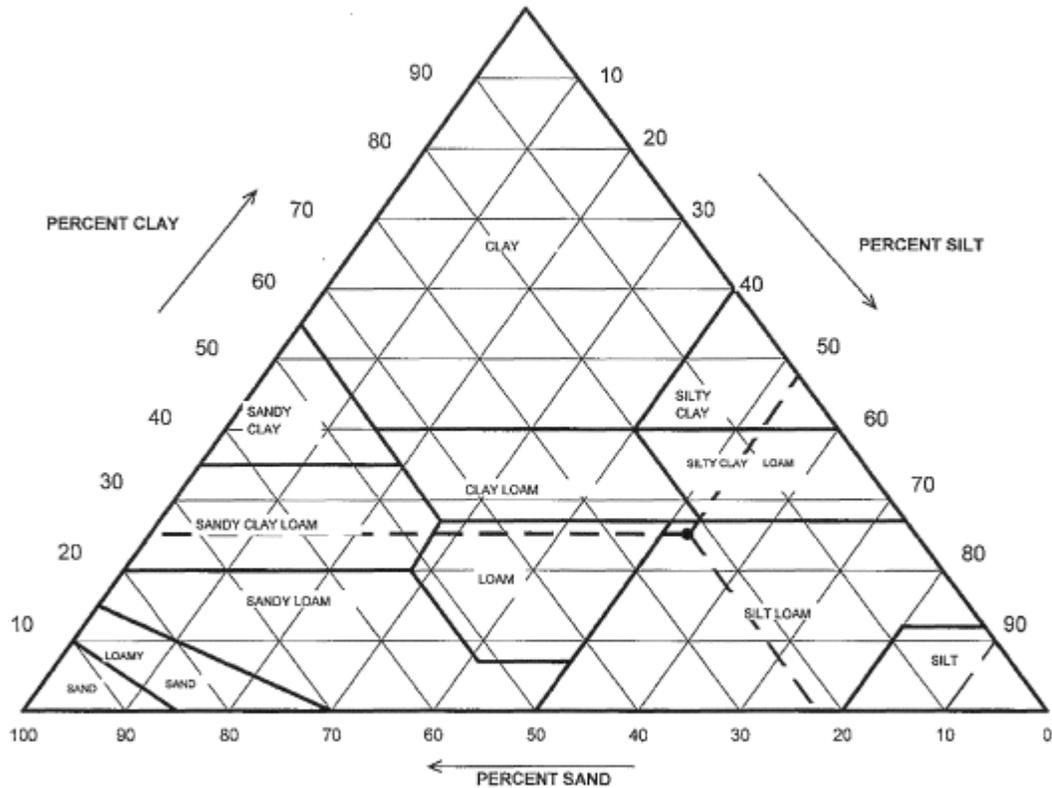
USCS USDA	SIEVE ANALYSIS					HYDROMETER	
	cobbles	gravel		sand		silt and clay fraction	
	cobbles	gravel		sand		silt	clay



USCS Summary		
Sieve Sizes (mm)		Percentage
Greater Than #4	Gravel	9.36
#4 To #200	Sand	19.15
Finer Than #200	Silt & Clay	71.49
USCS Symbol	ML, TESTED	
USCS Classification	SILT WITH SAND	

USDA CLASSIFICATION CHART

Client:	Microbac Laboratories, Inc.	Boring No.:	Background Soil
Client Reference:	OH EPA-DERR VAP Summit Co. L14090859	Depth (ft):	NA
Project No.:	2014-039-002	Sample No.:	FRM-1
Lab ID:	2014-039-002-004	Soil Color:	BROWN



Particle Size (mm)	Percent Finer (%)	USDA SUMMARY	Actual Percentage (%)	Corrected % of Minus 2.0 mm material for USDA Classificat. (%)
2	86.53	Gravel	13.47	0.00
0.05	67.22	Sand	19.31	22.32
0.002	21.79	Silt	45.43	52.50
		Clay	21.79	25.18
		USDA Classification:	SILT LOAM	



WASH SIEVE ANALYSIS
ASTM D 422-63 (2007)

Client:	Microbac Laboratories, Inc.	Boring No.:	Background Soil
Client Reference:	OH EPA-DERR VAP Summit Co. L14090859	Depth (ft):	NA
Project No.:	2014-039-002	Sample No.:	FRM-1
Lab ID:	2014-039-002-004	Soil Color:	BROWN

Moisture Content of Passing 3/4" Material		Water Content of Retained 3/4" Material	
Tare No.	664	Tare No.	NA
Wt. of Tare & Wet Specimen (g)	933.13	Wt. of Tare & Wet Specimen (g)	NA
Wt. of Tare & Dry Specimen (g)	745.70	Wt. of Tare & Dry Specimen (g)	NA
Weight of Tare (g)	95.84	Weight of Tare (g)	NA
Weight of Water (g)	187.43	Weight of Water (g)	NA
Weight of Dry Specimen (g)	649.86	Weight of Dry Specimen (g)	NA
Moisture Content (%)	28.8	Moisture Content (%)	NA

Wet Weight of -3/4" Sample (g)	NA	Weight of the Dry Specimen (g)	649.86
Dry Weight of -3/4" Sample (g)	176.46	Weight of - #200 material (g)	464.57
Wet Weight of +3/4" Sample (g)	NA	Weight of + #200 material (g)	185.29
Dry Weight of +3/4" Sample (g)	8.83		
Total Dry Weight of Sample (g)	NA		

Sieve Size	Sieve Opening (mm)	Weight of Soil Retained (g)	Percent Retained (%)	Accumulated Percent Retained (%)	Percent Finer (%)	Accumulated Percent Finer (%)
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	8.83	1.36	1.36	98.64	98.64
1/2"	12.5	11.89	1.83	3.19	96.81	96.81
3/8"	9.50	11.97	1.84	5.03	94.97	94.97
#4	4.75	28.15	4.33	9.36	90.64	90.64
#10	2.00	26.72	4.11	13.47	86.53	86.53
#20	0.85	20.94	3.22	16.70	83.30	83.30
#40	0.425	18.50	2.85	19.54	80.46	80.46
#60	0.250	19.20	2.95	22.50	77.50	77.50
#140	0.106	27.83	4.28	26.78	73.22	73.22
#200	0.075	11.26	1.73	28.51	71.49	71.49
Pan	-	464.57	71.49	100.00	-	-

Tested By RAL Date 9/19/14 Checked By KC Date 9/26/14

HYDROMETER ANALYSIS
ASTM D 422-63 (2007)



Client:	Microbac Laboratories, Inc.	Boring No.:	Background Soil
Client Reference:	OH EPA-DERR VAP Summit Co. L14090859	Depth (ft):	NA
Project No.:	2014-039-002	Sample No.:	FRM-1
Lab ID:	2014-039-002-004	Soil Color:	BROWN

Elapsed Time (min)	R Measured	Temp. (°C)	Composite Correction	R Corrected	N (%)	K Factor	Diameter (mm)	N' (%)
0	NA	NA	NA	NA	NA	NA	NA	NA
2	52.0	22.1	4.80	47.2	84.3	0.01311	0.0258	60.3
5	46.5	22.1	4.80	41.7	74.5	0.01311	0.0173	53.2
15	39.5	22.1	4.80	34.7	62.0	0.01311	0.0106	44.3
33	34.0	22.1	4.80	29.2	52.1	0.01311	0.0075	37.3
60	30.5	21.7	4.93	25.6	45.7	0.01317	0.0057	32.6
250	24.5	21.8	4.90	19.6	35.0	0.01316	0.0029	25.0
1440	19.0	21.4	5.02	14.0	25.0	0.01322	0.0013	17.8

Soil Specimen Data		Other Corrections	
Tare No.	1321		
Weight of Tare & Dry Material (g)	157.27	a - Factor	0.99
Weight of Tare (g)	96.84		
Weight of Deflocculant (g)	5.0	Percent Finer than # 200	71.49
Weight of Dry Material (g)	55.43	Specific Gravity	2.7 Assumed

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

Tested By TO Date 9/23/14 Checked By KC Date 9/26/14



ATTERBERG LIMITS
ASTM D 4318-10

Client:	Microbac Laboratories, Inc.	Boring No.:	Background Soil
Client Reference:	OH EPA-DERR VAP Summit Co. L14090859	Depth (ft):	NA
Project No.:	2014-039-002	Sample No.:	FRM-1
Lab ID:	2014-039-002-004	Soil Description:	BROWN SILT

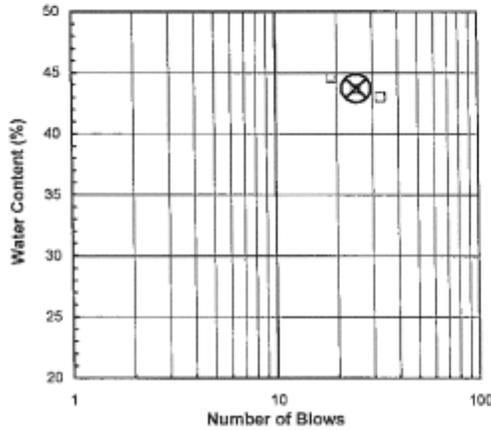
Note: The USCS symbol used with this test refers only to the minus No. 40 sieve material. See the "Sieve and Hydrometer Analysis" graph page for the complete material description.

Liquid Limit Test	1	2	3	
Tare Number	143	279	1254	M
Wt. of Tare & Wet Sample (g)	42.45	40.94	40.05	U
Wt. of Tare & Dry Sample (g)	35.69	33.80	32.70	L
Wt. of Tare (g)	19.97	17.45	16.22	T
Wt. of Water (g)	6.8	7.1	7.3	I
Wt. of Dry Sample (g)	15.7	16.4	16.5	P
				O
				I
Moisture Content (%)	43.0	43.7	44.6	N
Number of Blows	33	25	19	T

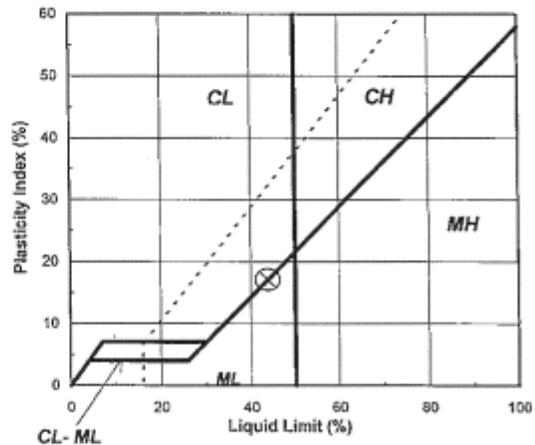
Plastic Limit Test	1	2	Range	Test Results
Tare Number	366	412		Liquid Limit (%) 44
Wt. of Tare & Wet Sample (g)	23.47	25.48		Plastic Limit (%) 27
Wt. of Tare & Dry Sample (g)	22.12	24.21		Plasticity Index (%) 17
Wt. of Tare (g)	17.09	19.42		USCS Symbol ML
Wt. of Water (g)	1.4	1.3		
Wt. of Dry Sample (g)	5.0	4.8		
Moisture Content (%)	26.8	26.5	0.3	

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

Flow Curve



Plasticity Chart



Tested By	JP	Date	9/25/14	Checked By	KC	Date	9/26/14
page 1 of 1	DCN:	CT-S48	DATE:	3/18/13	REVISION:	4	SpLimit.xls

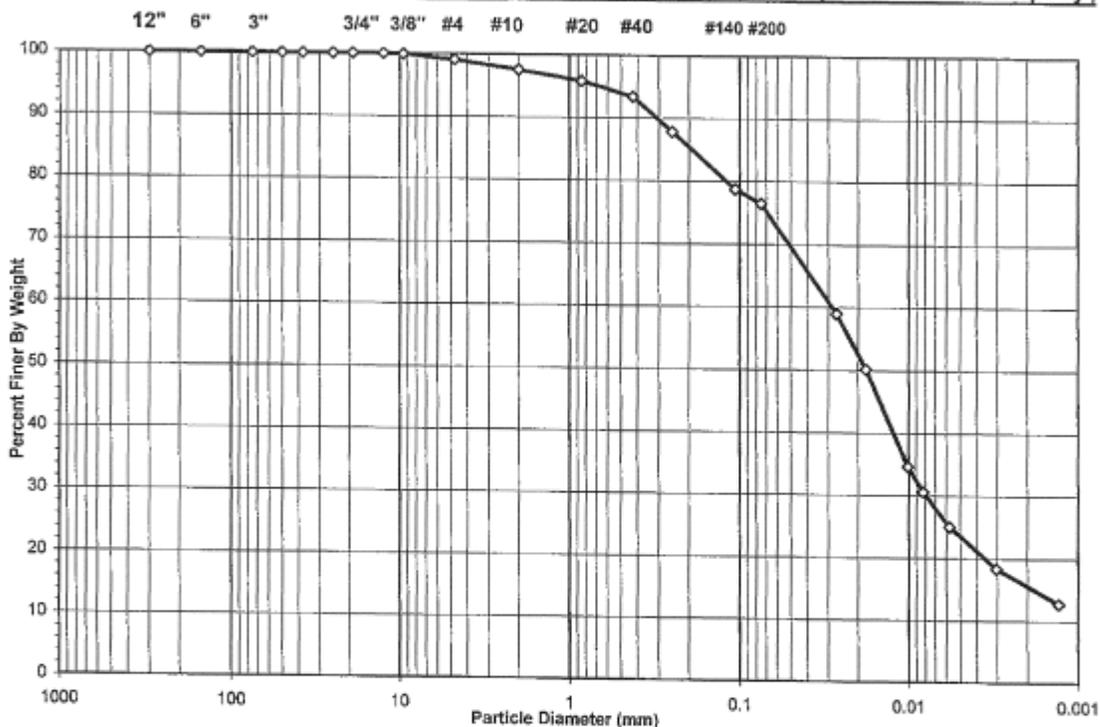
SIEVE AND HYDROMETER ANALYSIS
ASTM D 422-63 (2007)



Client: Microbac Laboratories, Inc.
 Client Reference: OH EPA-DERR VAP Summit Co. L14090859
 Project No.: 2014-039-002
 Lab ID: 2014-039-002-001

Boring No.: Background Soil
 Depth (ft): NA
 Sample No.: GMP-1
 Soil Color: BROWN

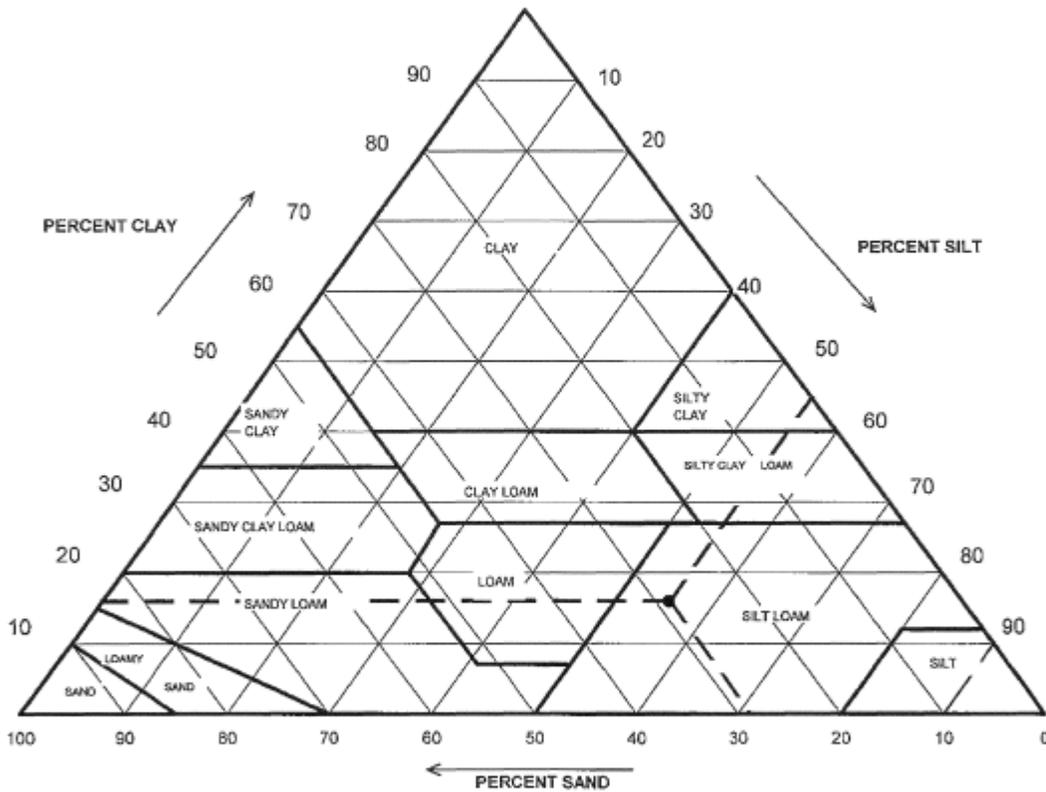
USCS USDA	SIEVE ANALYSIS					HYDROMETER	
	cobbles	gravel	sand		silt and clay fraction		
	cobbles	gravel	sand		silt	clay	



USCS Summary		
Sieve Sizes (mm)		Percentage
Greater Than #4	Gravel	0.93
#4 To #200	Sand	22.58
Finer Than #200	Silt & Clay	76.49
USCS Symbol	CL, TESTED	
USCS Classification	LEAN CLAY WITH SAND	

USDA CLASSIFICATION CHART

Client:	Microbac Laboratories, Inc.	Boring No.:	Background Soil
Client Reference:	OH EPA-DERR VAP Summit Co. L14090859	Depth (ft):	NA
Project No.:	2014-039-002	Sample No.:	GMP-1
Lab ID:	2014-039-002-001	Soil Color:	BROWN



Particle Size (mm)	Percent Finer (%)	USDA SUMMARY	Actual Percentage (%)	Corrected % of Minus 2.0 mm material for USDA Classificat. (%)
2	97.53	Gravel	2.47	0.00
0.05	69.60	Sand	27.93	28.64
0.002	15.62	Silt	53.97	55.34
		Clay	15.62	16.02
		USDA Classification:	SILT LOAM	



WASH SIEVE ANALYSIS
ASTM D 422-63 (2007)

Client:	Microbac Laboratories, Inc.	Boring No.:	Background Soil
Client Reference:	OH EPA-DERR VAP Summit Co. L14090859	Depth (ft):	NA
Project No.:	2014-039-002	Sample No.:	GMP-1
Lab ID:	2014-039-002-001	Soil Color:	BROWN

Moisture Content of Passing 3/4" Material		Water Content of Retained 3/4" Material	
Tare No.	656	Tare No.	NA
Wt. of Tare & Wet Specimen (g)	875.77	Wt. of Tare & Wet Specimen (g)	NA
Wt. of Tare & Dry Specimen (g)	718.20	Wt. of Tare & Dry Specimen (g)	NA
Weight of Tare (g)	94.52	Weight of Tare (g)	NA
Weight of Water (g)	157.57	Weight of Water (g)	NA
Weight of Dry Specimen (g)	623.68	Weight of Dry Specimen (g)	NA
Moisture Content (%)	25.3	Moisture Content (%)	NA

Wet Weight of -3/4" Sample (g)	NA	Weight of the Dry Specimen (g)	623.68
Dry Weight of -3/4" Sample (g)	146.61	Weight of - #200 material (g)	477.07
Wet Weight of +3/4" Sample (g)	NA	Weight of + #200 material (g)	146.61
Dry Weight of +3/4" Sample (g)	0.00		
Total Dry Weight of Sample (g)	NA		

Sieve Size	Sieve Opening (mm)	Weight of Soil Retained (g)	Percent Retained (%)	Accumulated Percent Retained (%)	Percent Finer (%)	Accumulated Percent Finer (%)
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	0.75	0.12	0.12	99.88	99.88
#4	4.75	5.06	0.81	0.93	99.07	99.07
#10	2.00	9.61	1.54	2.47	97.53	97.53
#20	0.85	10.27	1.65	4.12	95.88	95.88
#40	0.425	15.32	2.46	6.58	93.42	93.42
#60	0.250	34.83	5.58	12.16	87.84	87.84
#140	0.106	56.73	9.10	21.26	78.74	78.74
#200	0.075	14.04	2.25	23.51	76.49	76.49
Pan	-	477.07	76.49	100.00	-	-

Tested By RAL Date 9/19/14 Checked By KC Date 9/26/14

HYDROMETER ANALYSIS
ASTM D 422-63 (2007)



Client:	Microbac Laboratories, Inc.	Boring No.:	Background Soil
Client Reference:	OH EPA-DERR VAP Summit Co. L14090859	Depth (ft):	NA
Project No.:	2014-039-002	Sample No.:	GMP-1
Lab ID:	2014-039-002-001	Soil Color:	BROWN

Elapsed Time (min)	R Measured	Temp. (°C)	Composite Correction	R Corrected	N (%)	K Factor	Diameter (mm)	N' (%)
0	NA	NA	NA	NA	NA	NA	NA	NA
2	48.5	22.1	4.80	43.7	77.1	0.01311	0.0268	59.0
5	42.0	22.1	4.80	37.2	65.6	0.01311	0.0180	50.2
19	30.5	22.1	4.80	25.7	45.3	0.01311	0.0101	34.7
30	27.5	22.1	4.80	22.7	40.0	0.01311	0.0082	30.6
65	23.5	21.7	4.93	18.6	32.8	0.01317	0.0058	25.1
250	18.5	21.8	4.90	13.6	24.0	0.01316	0.0030	18.4
1440	14.5	21.4	5.02	9.5	16.7	0.01322	0.0013	12.8

Soil Specimen Data		Other Corrections	
Tare No.	700		
Weight of Tare & Dry Material (g)	150.47	a - Factor	0.99
Weight of Tare (g)	89.36		
Weight of Deflocculant (g)	5.0	Percent Finer than # 200	76.49
Weight of Dry Material (g)	56.11	Specific Gravity	2.7 Assumed

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

Tested By TO Date 9/23/14 Checked By KC Date 9/26/14
page 4 of 4 DCN: CT-93A DATE: 3/18/13 REVISION: 11 Sievehyd.xls

ATTERBERG LIMITS
ASTM D 4318-10

Client:	Microbac Laboratories, Inc.	Boring No.:	Background Soil
Client Reference:	OH EPA-DERR VAP Summit Co. L14090859	Depth (ft):	NA
Project No.:	2014-039-002	Sample No.:	GMP-1
Lab ID:	2014-039-002-001	Soil Description:	BROWN LEAN CLAY

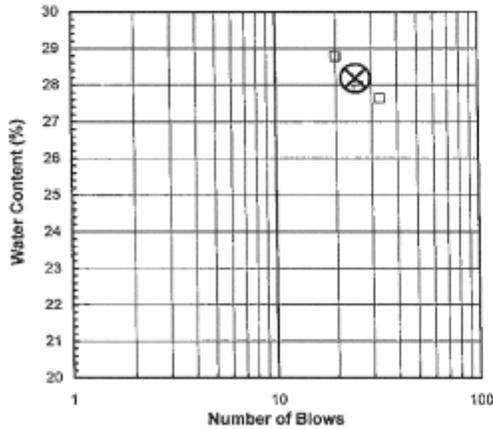
Note: The USCS symbol used with this test refers only to the minus No. 40 sieve material. See the "Sieve and Hydrometer Analysis" graph page for the complete material description. (Minus No. 40 sieve material, Airdried)

Liquid Limit Test	1	2	3	
Tare Number	115	2294	1253	M
Wt. of Tare & Wet Sample (g)	41.39	41.33	31.50	U
Wt. of Tare & Dry Sample (g)	36.58	36.60	26.63	L
Wt. of Tare (g)	19.17	19.68	9.70	T
Wt. of Water (g)	4.8	4.7	4.9	I
Wt. of Dry Sample (g)	17.4	16.9	16.9	P
				O
				I
Moisture Content (%)	27.6	28.0	28.8	N
Number of Blows	33	26	20	T

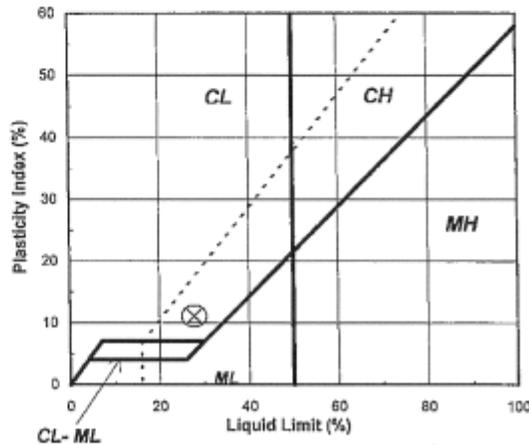
Plastic Limit Test	1	2	Range	Test Results
Tare Number	472	1236		Liquid Limit (%) 28
Wt. of Tare & Wet Sample (g)	26.42	19.62		Plastic Limit (%) 17
Wt. of Tare & Dry Sample (g)	25.47	18.52		Plasticity Index (%) 11
Wt. of Tare (g)	19.68	12.19		USCS Symbol CL
Wt. of Water (g)	1.0	1.1		
Wt. of Dry Sample (g)	5.8	6.3		
Moisture Content (%)	16.4	17.4	-1.0	

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

Flow Curve



Plasticity Chart





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

Client: MICROBAC LABORATORIES
 Client Reference: OHIO EPA L14060033
 Project No.: 2014-368-001
 Lab ID: 2014-368-001-003

Boring No.: Summit County
 Depth (ft): Soil
 Sample No.: HSP-1
 Soil Color: DARK BROWN

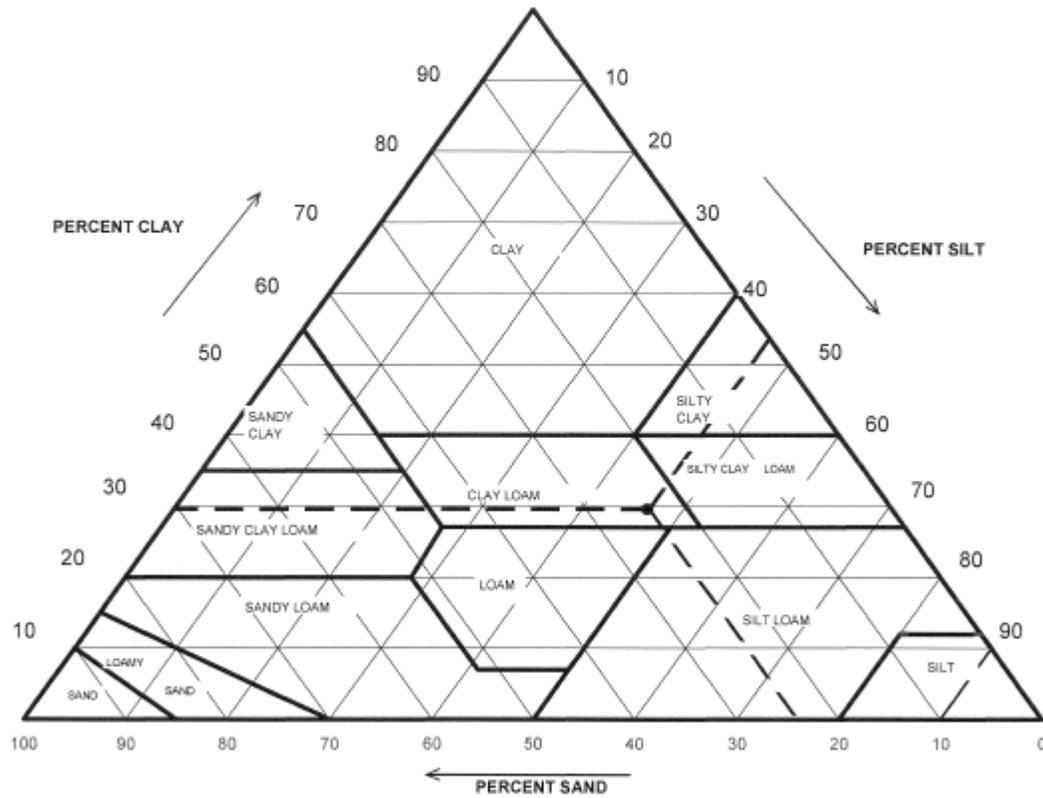


USCS Summary		
Sieve Sizes (mm)		Percentage
Greater Than #4	Gravel	6.06
#4 To #200	Sand	20.96
Finer Than #200	Silt & Clay	72.98
USCS Symbol	CL, TESTED	
USCS Classification	LEAN CLAY WITH SAND	

USDA CLASSIFICATION CHART

Client: MICROBAC LABORATORIES
 Client Reference: OHIO EPA L14060033
 Project No.: 2014-368-001
 Lab ID: 2014-368-001-003

Boring No.: Summit County
 Depth (ft): Soil
 Sample No.: HSP-1
 Soil Color: DARK BROWN



Particle Size (mm)	Percent Finer (%)	USDA SUMMARY	Actual Percentage (%)	Corrected % of Minus 2.0 mm material for USDA Classificat. (%)
2	91.17	Gravel	8.83	0.00
0.05	69.30	Sand	21.87	23.99
0.002	26.94	Silt	42.36	46.47
		Clay	26.94	29.55
		USDA Classification: CLAY LOAM		



WASH SIEVE ANALYSIS

ASTM D 422-63 (2007)

Client: MICROBAC LABORATORIES
 Client Reference: OHIO EPA L14060033
 Project No.: 2014-368-001
 Lab ID: 2014-368-001-003

Boring No.: Summit County
 Depth (ft): Soil
 Sample No.: HSP-1
 Soil Color: DARK BROWN

Moisture Content of Passing 3/4" Material		Water Content of Retained 3/4" Material	
Tare No.	1424	Tare No.	NA
Wt. of Tare & Wet Specimen (g)	760.70	Wt. of Tare & Wet Specimen (g)	NA
Wt. of Tare & Dry Specimen (g)	641.81	Wt. of Tare & Dry Specimen (g)	NA
Weight of Tare (g)	145.88	Weight of Tare (g)	NA
Weight of Water (g)	118.89	Weight of Water (g)	NA
Weight of Dry Specimen (g)	495.93	Weight of Dry Specimen (g)	NA
Moisture Content (%)	24.0	Moisture Content (%)	NA

Wet Weight of -3/4" Sample (g)	NA	Weight of the Dry Specimen (g)	495.93
Dry Weight of -3/4" Sample (g)	134.00	Weight of - #200 material (g)	361.93
Wet Weight of +3/4" Sample (g)	NA	Weight of + #200 material (g)	134.00
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	18.77	3.78	3.78	96.22	96.22
3/8"	9.50	3.83	0.77	4.56	95.44	95.44
#4	4.75	7.46	1.50	6.06	93.94	93.94
#10	2.00	13.74	2.77	8.83	91.17	91.17
#20	0.85	13.34	2.69	11.52	88.48	88.48
#40	0.425	13.25	2.67	14.19	85.81	85.81
#60	0.250	17.91	3.61	17.80	82.20	82.20
#140	0.106	33.70	6.80	24.60	75.40	75.40
#200	0.075	12.00	2.42	27.02	72.98	72.98
Pan	-	361.93	72.98	100.00	-	-

Tested By JAM Date 6/5/14 Checked By KC Date 6/16/14



HYDROMETER ANALYSIS
ASTM D 422-63 (2007)

Client: MICROBAC LABORATORIES
 Client Reference: OHIO EPA L14060033
 Project No.: 2014-368-001
 Lab ID: 2014-368-001-003

Boring No.: Summit County
 Depth (ft): Soil
 Sample No.: HSP-1
 Soil Color: DARK BROWN

Elapsed Time (min)	R Measured	Temp. (°C)	Composite Correction	R Corrected	N (%)	K Factor	Diameter (mm)	N'
0	NA	NA	NA	NA	NA	NA	NA	NA
2	48.5	22.7	4.61	43.9	87.1	0.01302	0.0266	63.6
5	44.5	22.7	4.61	39.9	79.2	0.01302	0.0175	57.8
15	39.0	22.7	4.61	34.4	68.2	0.01302	0.0106	49.8
30	35.5	22.7	4.61	30.9	61.3	0.01302	0.0077	44.7
60	32.0	22.9	4.55	27.4	54.5	0.01299	0.0056	39.8
250	25.5	22.7	4.61	20.9	41.5	0.01302	0.0029	30.3
1440	20.0	23.1	4.49	15.5	30.8	0.01296	0.0012	22.5

Soil Specimen Data		Other Corrections	
Tare No.	932		
Weight of Tare & Dry Material (g)	153.72	a - Factor	0.99
Weight of Tare (g)	98.84		
Weight of Deflocculant (g)	5.0	Percent Finer than # 200	72.98
Weight of Dry Material (g)	49.88		
		Specific Gravity	2.7 Assumed

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



ATTERBERG LIMITS

ASTM D 4318-10

Client:	Microbac Laboratories	Boring No.:	Summit County
Client Reference:	OHIO EPA L14060033	Depth (ft):	SOIL
Project No.:	2014-368-001	Sample No.:	HSP-1
Lab ID:	2014-368-001-003	Soil Description:	DARK BROWN LEAN CLAY

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

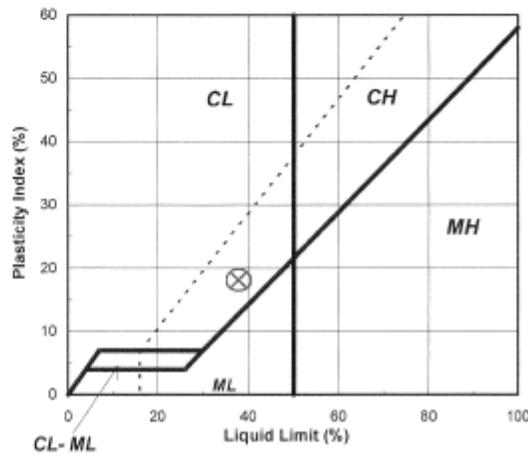
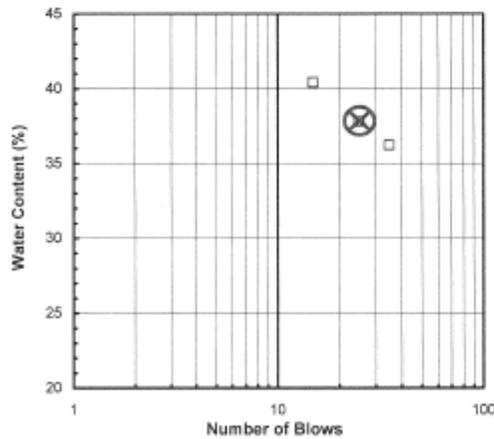
Liquid Limit Test	1	2	3	
Tare Number	290	1241	1279	M
Wt. of Tare & Wet Sample (g)	41.46	38.85	35.08	U
Wt. of Tare & Dry Sample (g)	35.36	33.08	29.48	L
Wt. of Tare (g)	20.25	17.80	14.00	T
Wt. of Water (g)	6.1	5.8	5.6	I
Wt. of Dry Sample (g)	15.1	15.3	15.5	P
				O
				I
Moisture Content (%)	40.4	37.8	36.2	N
Number of Blows	15	25	35	T

Plastic Limit Test	1	2	Range	Test Results
Tare Number	305	1230		Liquid Limit (%) 38
Wt. of Tare & Wet Sample (g)	25.89	27.15		Plastic Limit (%) 20
Wt. of Tare & Dry Sample (g)	24.73	25.96		Plasticity Index (%) 18
Wt. of Tare (g)	19.13	20.09		USCS Symbol CL
Wt. of Water (g)	1.2	1.2		
Wt. of Dry Sample (g)	5.6	5.9		
Moisture Content (%)	20.7	20.3	0.4	

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

Flow Curve

Plasticity Chart

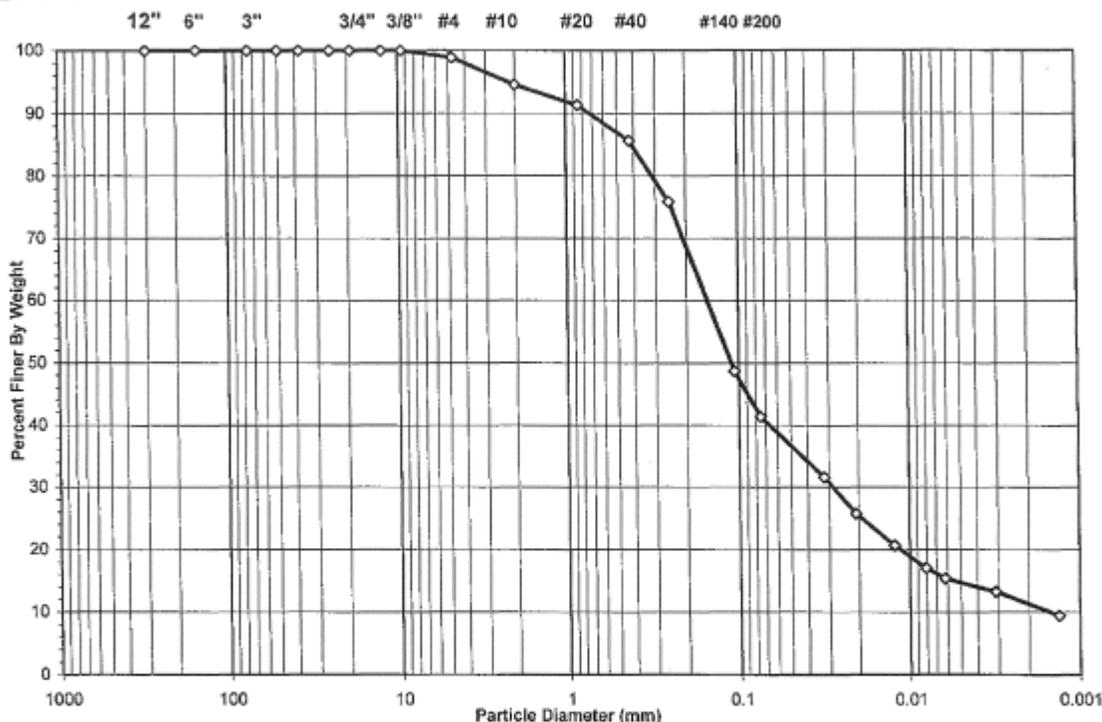


SIEVE AND HYDROMETER ANALYSIS
ASTM D 422-63 (2007)



Client:	Microbac Laboratories, Inc.	Boring No.:	Background
Client Reference:	OH EPA-DERR VAP Summit Co. L14090859	Depth (ft):	NA
Project No.:	2014-039-002	Sample No.:	SRM-1
Lab ID:	2014-039-002-002	Soil Color:	DARK BROWN

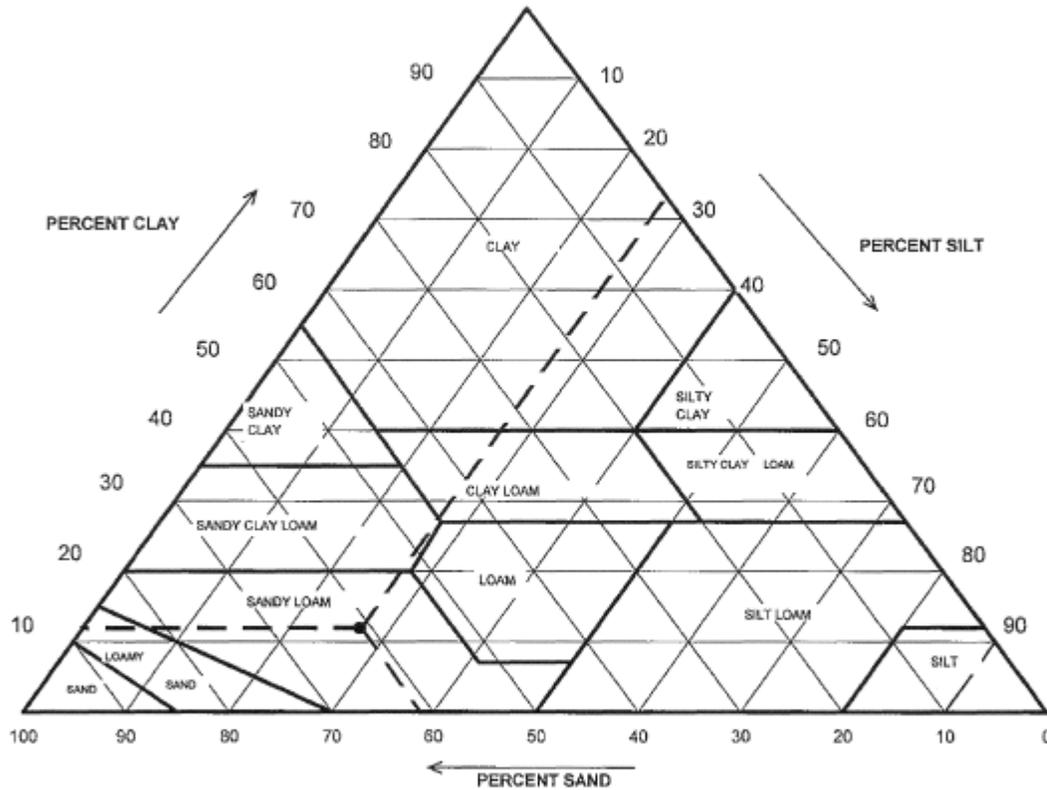
USCS	SIEVE ANALYSIS					HYDROMETER	
	cobbles	gravel		sand		silt and clay fraction	
USDA	cobbles	gravel		sand		silt	clay



USCS Summary		
Sieve Sizes (mm)		Percentage
Greater Than #4	Gravel	1.10
#4 To #200	Sand	57.51
Finer Than #200	Silt & Clay	41.39
USCS Symbol	SC, TESTED	
USCS Classification	CLAYEY SAND	

USDA CLASSIFICATION CHART

Client:	Microbac Laboratories, Inc.	Boring No.:	Background Soil
Client Reference:	OH EPA-DERR VAP Summit Co. L14090859	Depth (ft):	NA
Project No.:	2014-039-002	Sample No.:	SRM-1
Lab ID:	2014-039-002-002	Soil Color:	DARK BROWN



Particle Size (mm)	Percent Finer (%)	USDA SUMMARY	Actual Percentage (%)	Corrected % of Minus 2.0 mm material for USDA Classificat. (%)
		Gravel	5.47	0.00
2	94.53	Sand	57.81	61.15
0.05	36.72	Silt	25.44	26.91
0.002	11.28	Clay	11.28	11.93
		USDA Classification:	SANDY LOAM	



WASH SIEVE ANALYSIS

ASTM D 422-63 (2007)

Client:	Microbac Laboratories, Inc.	Boring No.:	Background Soil
Client Reference:	OH EPA-DERR VAP Summit Co. L14090859	Depth (ft):	NA
Project No.:	2014-039-002	Sample No.:	SRM-1
Lab ID:	2014-039-002-002	Soil Color:	DARK BROWN

Moisture Content of Passing 3/4" Material		Water Content of Retained 3/4" Material	
Tare No.	1092	Tare No.	NA
Wt. of Tare & Wet Specimen (g)	755.86	Wt. of Tare & Wet Specimen (g)	NA
Wt. of Tare & Dry Specimen (g)	589.70	Wt. of Tare & Dry Specimen (g)	NA
Weight of Tare (g)	99.82	Weight of Tare (g)	NA
Weight of Water (g)	166.16	Weight of Water (g)	NA
Weight of Dry Specimen (g)	489.88	Weight of Dry Specimen (g)	NA
Moisture Content (%)	33.9	Moisture Content (%)	NA

Wet Weight of -3/4" Sample (g)	NA	Weight of the Dry Specimen (g)	489.88
Dry Weight of -3/4" Sample (g)	287.13	Weight of - #200 material (g)	202.75
Wet Weight of +3/4" Sample (g)	NA	Weight of + #200 material (g)	287.13
Dry Weight of +3/4" Sample (g)	0.00		
Total Dry Weight of Sample (g)	NA		

Sieve Size	Sieve Opening (mm)	Weight of Soil Retained (g)	Percent Retained (%)	Accumulated Percent Retained (%)	Percent Finer (%)	Accumulated Percent Finer (%)
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	5.40	1.10	1.10	98.90	98.90
#10	2.00	21.41	4.37	5.47	94.53	94.53
#20	0.85	15.78	3.22	8.69	91.31	91.31
#40	0.425	27.75	5.66	14.36	85.64	85.64
#60	0.250	47.89	9.78	24.13	75.87	75.87
#140	0.106	133.07	27.16	51.30	48.70	48.70
#200	0.075	35.83	7.31	58.61	41.39	41.39
Pan	-	202.75	41.39	100.00	-	-

Tested By RAL Date 9/19/14 Checked By KC Date 9/26/14

HYDROMETER ANALYSIS
ASTM D 422-63 (2007)



Client:	Microbac Laboratories, Inc.	Boring No.:	Background Soil
Client Reference:	OH EPA-DERR VAP Summit Co. L14090859	Depth (ft):	NA
Project No.:	2014-039-002	Sample No.:	SRM-1
Lab ID:	2014-039-002-002	Soil Color:	DARK BROWN

Elapsed Time (min)	R Measured	Temp. (°C)	Composite Correction	R Corrected	N (%)	K Factor	Diameter (mm)	N'
0	NA	NA	NA	NA	NA	NA	NA	NA
2	26.5	22.1	4.80	21.7	76.4	0.01311	0.0321	31.6
5	22.5	22.1	4.80	17.7	62.3	0.01311	0.0208	25.8
15	19.0	22.1	4.80	14.2	50.0	0.01311	0.0123	20.7
36	16.5	22.1	4.80	11.7	41.2	0.01311	0.0081	17.0
62	15.5	21.7	4.93	10.6	37.2	0.01317	0.0062	15.4
250	14.0	21.8	4.90	9.1	32.0	0.01316	0.0031	13.3
1440	11.5	21.4	5.02	6.5	22.8	0.01322	0.0013	9.4

Soil Specimen Data		Other Corrections	
Tare No.	686		
Weight of Tare & Dry Material (g)	128.2	a - Factor	0.99
Weight of Tare (g)	95.07		
Weight of Deflocculant (g)	5.0	Percent Finer than # 200	41.39
Weight of Dry Material (g)	28.13		
		Specific Gravity	2.7 Assumed

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

ATTERBERG LIMITS

ASTM D 4318-10

Client:	Microbac Laboratories, Inc.	Boring No.:	Background Soil
Client Reference:	CH EPA-DERR VAP Summit Co. L14090859	Depth (ft):	NA
Project No.:	2014-039-002	Sample No.:	SRM-1
Lab ID:	2014-039-002-002	Soil Description:	DARK BROWN LEAN CLAY

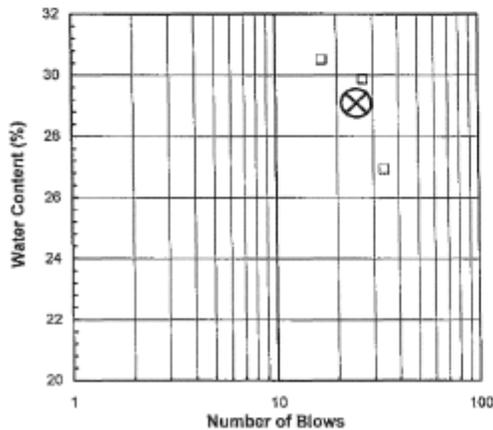
Note: The USCS symbol used with this test refers only to the minus No. 40 sieve material. See the "Sieve and Hydrometer Analysis" graph page for the complete material description.

Liquid Limit Test	1	2	3	
Tare Number	1233	2234	396	M
Wt. of Tare & Wet Sample (g)	41.27	37.40	38.80	U
Wt. of Tare & Dry Sample (g)	36.53	32.50	34.32	L
Wt. of Tare (g)	20.99	18.10	17.68	T
Wt. of Water (g)	4.7	4.9	4.5	I
Wt. of Dry Sample (g)	15.5	16.4	16.6	P
				O
				I
Moisture Content (%)	30.5	29.9	26.9	N
Number of Blows	17	27	34	T

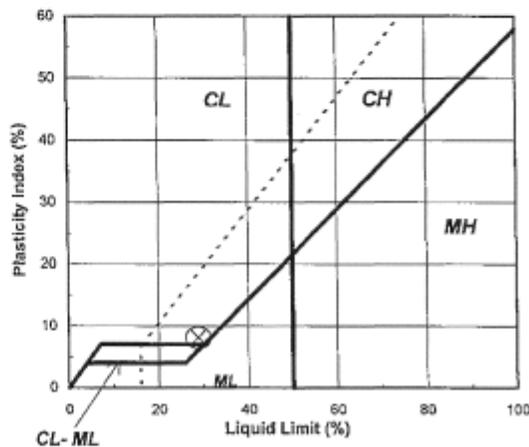
Plastic Limit Test	1	2	Range	Test Results
Tare Number	242	408		Liquid Limit (%) 29
Wt. of Tare & Wet Sample (g)	26.59	27.73		Plastic Limit (%) 21
Wt. of Tare & Dry Sample (g)	25.45	26.60		Plasticity Index (%) 8
Wt. of Tare (g)	20.09	21.22		USCS Symbol CL
Wt. of Water (g)	1.1	1.1		
Wt. of Dry Sample (g)	5.4	5.4		
Moisture Content (%)	21.3	21.0	0.3	

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

Flow Curve



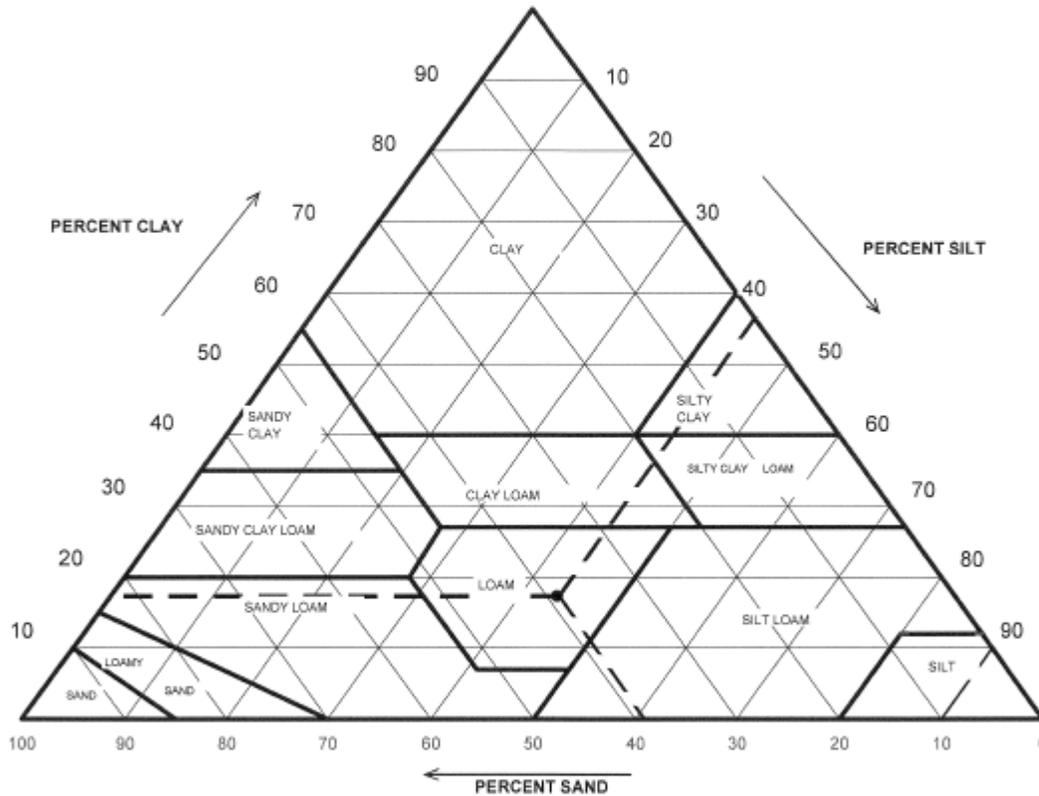
Plasticity Chart



Tested By RAL Date 9/25/14 Checked By KC Date 9/26/14
 page 1 of 1 DCN: CT-S4B DATE: 3/18/13 REVISION: 4 3pMmL.xls

USDA CLASSIFICATION CHART

Client:	MICROBAC LABORATORIES	Boring No.:	Summit County
Client Reference:	OHIO EPA L14060033	Depth (ft):	Soil
Project No.:	2014-368-001	Sample No.:	SGP-1
Lab ID:	2014-368-001-004	Soil Color:	BROWN



Particle Size (mm)	Percent Finer (%)	USDA SUMMARY	Actual Percentage (%)	Corrected % of Minus 2.0 mm material for USDA Classificat. (%)
		Gravel	3.01	0.00
2	96.99	Sand	37.82	38.99
0.05	59.18	Silt	42.42	43.74
0.002	16.76	Clay	16.76	17.28
		USDA Classification:	LOAM	



WASH SIEVE ANALYSIS
ASTM D 422-63 (2007)

Client:	MICROBAC LABORATORIES	Boring No.:	Summit County
Client Reference:	OHIO EPA L14060033	Depth (ft):	Soil
Project No.:	2014-368-001	Sample No.:	SGP-1
Lab ID:	2014-368-001-004	Soil Color:	BROWN

Moisture Content of Passing 3/4" Material		Water Content of Retained 3/4" Material	
Tare No.	1439	Tare No.	NA
Wt. of Tare & Wet Specimen (g)	493.29	Wt. of Tare & Wet Specimen (g)	NA
Wt. of Tare & Dry Specimen (g)	427.71	Wt. of Tare & Dry Specimen (g)	NA
Weight of Tare (g)	145.59	Weight of Tare (g)	NA
Weight of Water (g)	65.58	Weight of Water (g)	NA
Weight of Dry Specimen (g)	282.12	Weight of Dry Specimen (g)	NA
Moisture Content (%)	23.2	Moisture Content (%)	NA

Wet Weight of -3/4" Sample (g)	NA	Weight of the Dry Specimen (g)	282.12
Dry Weight of -3/4" Sample (g)	95.52	Weight of - #200 material (g)	186.60
Wet Weight of +3/4" Sample (g)	NA	Weight of + #200 material (g)	95.52
Dry Weight of +3/4" Sample (g)	0.00		
Total Dry Weight of Sample (g)	NA		

Sieve Size	Sieve Opening (mm)	Weight of Soil Retained (g)	Percent Retained (%)	Accumulated Percent Retained (%)	Percent Finer (%)	Accumulated Percent Finer (%)
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	1.20	0.43	0.43	99.57	99.57
#4	4.75	3.80	1.35	1.77	98.23	98.23
#10	2.00	3.48	1.23	3.01	96.99	96.99
#20	0.85	3.79	1.34	4.35	95.65	95.65
#40	0.425	8.84	3.13	7.48	92.52	92.52
#60	0.250	27.72	9.83	17.31	82.69	82.69
#140	0.106	36.12	12.80	30.11	69.89	69.89
#200	0.075	10.57	3.75	33.86	66.14	66.14
Pan	-	186.60	66.14	100.00	-	-

Tested By JAM Date 6/5/14 Checked By KC Date 6/16/14



HYDROMETER ANALYSIS
ASTM D 422-63 (2007)

Client: MICROBAC LABORATORIES
 Client Reference: OHIO EPA L14060033
 Project No.: 2014-368-001
 Lab ID: 2014-368-001-004

Boring No.: Summit County
 Depth (ft): Soil
 Sample No.: SGP-1
 Soil Color: BROWN

Elapsed Time (min)	R Measured	Temp. (°C)	Composite Correction	R Corrected	N (%)	K Factor	Diameter (mm)	N'
0	NA	NA	NA	NA	NA	NA	NA	NA
2	40.0	22.7	4.61	35.4	75.1	0.01302	0.0287	49.7
5	34.5	22.7	4.61	29.9	63.4	0.01302	0.0190	41.9
15	28.5	22.7	4.61	23.9	50.7	0.01302	0.0115	33.5
30	25.0	22.7	4.61	20.4	43.3	0.01302	0.0083	28.6
62	21.5	22.7	4.61	16.9	35.8	0.01302	0.0059	23.7
250	18.0	22.6	4.64	13.4	28.3	0.01303	0.0030	18.7
1440	15.0	22.7	4.61	10.4	22.0	0.01302	0.0013	14.6

Soil Specimen Data		Other Corrections	
Tare No.	672		
Weight of Tare & Dry Material (g)	148.75	a - Factor	0.99
Weight of Tare (g)	97.09		
Weight of Deflocculant (g)	5.0	Percent Finer than # 200	66.14
Weight of Dry Material (g)	46.66	Specific Gravity	2.7 Assumed

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



ATTERBERG LIMITS

ASTM D 4318-10

Client:	Microbac Laboratories	Boring No.:	Summit County
Client Reference:	OHIO EPA L14060033	Depth (ft):	SOIL
Project No.:	2014-368-001	Sample No.:	SGP-1
Lab ID:	2014-368-001-004	Soil Description:	BROWN SILTY CLAY

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

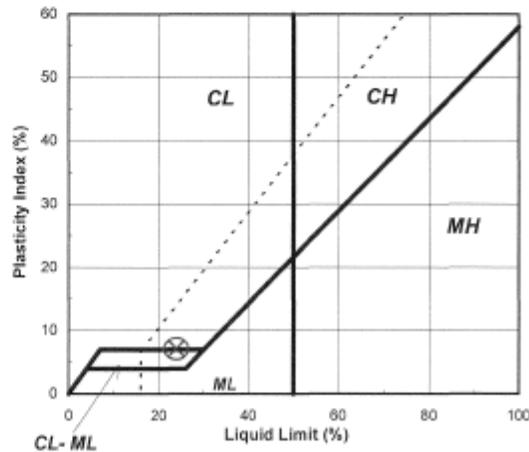
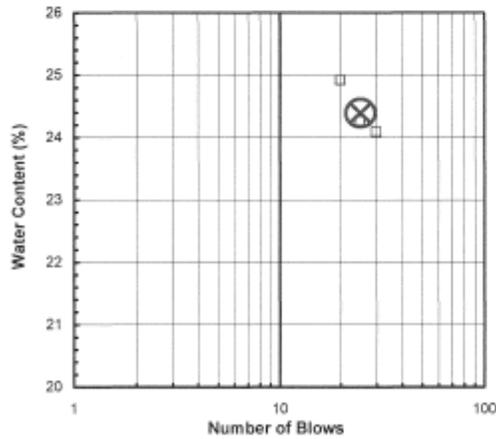
Liquid Limit Test	1	2	3	
Tare Number	315	1223	1245	M
Wt. of Tare & Wet Sample (g)	39.56	32.87	36.62	U
Wt. of Tare & Dry Sample (g)	35.49	28.56	32.48	L
Wt. of Tare (g)	18.59	10.79	15.86	T
Wt. of Water (g)	4.1	4.3	4.1	I
Wt. of Dry Sample (g)	16.9	17.8	16.6	P
				O
				I
Moisture Content (%)	24.1	24.3	24.9	N
Number of Blows	30	25	20	T

Plastic Limit Test	1	2	Range	Test Results	
Tare Number	1288	1278		Liquid Limit (%)	24
Wt. of Tare & Wet Sample (g)	19.10	22.90		Plastic Limit (%)	17
Wt. of Tare & Dry Sample (g)	18.17	21.96		Plasticity Index (%)	7
Wt. of Tare (g)	12.58	16.54		USCS Symbol	CL-ML
Wt. of Water (g)	0.9	0.9			
Wt. of Dry Sample (g)	5.6	5.4			
Moisture Content (%)	16.6	17.3	-0.7		

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

Flow Curve

Plasticity Chart



Tested By	JP	Date	6/10/14	Checked By	KC	Date	6/12/14
page 1 of 1	DCN:	CT-S4B	DATE:	3/18/13	REVISION:	4	3pt/limit.xls

APPENDIX D

PROUCL DATASET RUNS



	A	B	C	D	E	F	G	H	I	J	K	L	M
1	Normal UCL Statistics for Uncensored Full Data Sets												
2													
3	User Selected Options												
4	Date/Time of Computation		1/21/2015 1:14:26 PM										
5	From File		Summit_As.xls										
6	Full Precision		OFF										
7	Confidence Coefficient		95%										
8													
9													
10	total												
11													
12	General Statistics												
13	Total Number of Observations				99		Number of Distinct Observations				86		
14							Number of Missing Observations				0		
15	Minimum				3.08		Mean				8.763		
16	Maximum				15.3		Median				8.87		
17	SD				2.36		SD of logged Data				0.306		
18	Coefficient of Variation				0.27		Skewness				-0.0404		
19													
20	Normal GOF Test												
21	Shapiro Wilk Test Statistic				0.97		Normal GOF Test						
22	5% Shapiro Wilk P Value				0.44		Data appear Normal at 5% Significance Level						
23	Lilliefors Test Statistic				0.06		Lilliefors GOF Test						
24	5% Lilliefors Critical Value				0.08		Data appear Normal at 5% Significance Level						
25	Data appear Normal at 5% Significance Level												
26													
27	Assuming Normal Distribution												
28	95% Normal UCL						95% UCLs (Adjusted for Skewness)						
29	95% Student's-t UCL				9.15		95% Adjusted-CLT UCL (Chen-1995)				9.153		
30							95% Modified-t UCL (Johnson-1978)				9.157		
31													
32	Suggested UCL to Use												
33	95% Student's-t UCL				9.15								
34													
35	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.												
36	These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)												
37	and Singh and Singh (2003). However, simulation results will not cover all Real World data sets.												
38	For additional insight the user may want to consult a statistician.												
39													
40	Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be												
41	reliable. Chen's and Johnson's methods provide adjustments for positively skewed data sets.												
42													

	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	Date/Time of Computation		1/21/2015 1:17:10 PM										
5	From File		Summit_As.xls										
6	Full Precision		OFF										
7	Confidence Coefficient		95%										
8	Coverage		95%										
9	New or Future K Observations		1										
10													
11	total												
12													
13	General Statistics												
14	Total Number of Observations				99				Number of Distinct Observations				86
15	Minimum				3.08				First Quartile				7.385
16	Second Largest				15				Median				8.87
17	Maximum				15.3				Third Quartile				10.5
18	Mean				8.763				SD				2.367
19	Coefficient of Variation				0.27				Skewness				-0.0404
20	Mean of logged Data				2.129				SD of logged Data				0.306
21													
22	Critical Values for Background Threshold Values (BTVs)												
23	Tolerance Factor K (For UTL)				1.925				d2max (for USL)				3.206
24													
25	Normal GOF Test												
26	Shapiro Wilk Test Statistic				0.978				Normal GOF Test				
27	5% Shapiro Wilk P Value				0.445				Data appear Normal at 5% Significance Level				
28	Lilliefors Test Statistic				0.0619				Lilliefors GOF Test				
29	5% Lilliefors Critical Value				0.089				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				13.32				90% Percentile (z)				11.8
34	95% UPL (t)				12.71				95% Percentile (z)				12.66
35	95% USL				16.35				99% Percentile (z)				14.27
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	M				
1	Nonparametric UCL Statistics for Uncensored Full Data Sets																
2																	
3	User Selected Options																
4	Date/Time of Computation	1/21/2015 1:20:01 PM															
5	From File	Summit_Ba.xls															
6	Full Precision	OFF															
7	Confidence Coefficient	95%															
8	Number of Bootstrap Operations	2000															
9																	
10																	
11	TOTAL																
12																	
13	General Statistics																
14	Total Number of Observations	99					Number of Distinct Observations					93					
15							Number of Missing Observations					0					
16		Minimum					18.6					Mean			49.56		
17		Maximum					106					Median			44.8		
18		SD					22.05					Std. Error of Mean			2.216		
19		Coefficient of Variation					0.445					Skewness			0.707		
20		Mean of logged Data					3.807					SD of logged Data			0.44		
21																	
22	Nonparametric Distribution Free UCL Statistics																
23	Data appear Approximate Gamma Distributed at 5% Significance Level																
24																	
25	Assuming Normal Distribution																
26	95% Normal UCL						95% UCLs (Adjusted for Skewness)										
27	95% Student's-t UCL						53.24			95% Adjusted-CLT UCL (Chen-1995)			53.38				
28										95% Modified-t UCL (Johnson-1978)			53.27				
29																	
30	Nonparametric Distribution Free UCLs																
31	95% CLT UCL						53.21			95% Jackknife UCL			53.24				
32	95% Standard Bootstrap UCL						53.19			95% Bootstrap-t UCL			53.54				
33	95% Hall's Bootstrap UCL						53.24			95% Percentile Bootstrap UCL			53.11				
34	95% BCA Bootstrap UCL						53.07										
35	90% Chebyshev(Mean, Sd) UCL						56.21			95% Chebyshev(Mean, Sd) UCL			59.22				
36	97.5% Chebyshev(Mean, Sd) UCL						63.4			99% Chebyshev(Mean, Sd) UCL			71.61				
37																	
38	Suggested UCL to Use																
39	Data appear Approximate Gamma, May want to try Gamma Distribution																
40																	
41	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.																
42	These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)																
43	and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.																
44	For additional insight the user may want to consult a statistician.																
45																	

	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	Date/Time of Computation			1/21/2015 1:21:45 PM									
4	From File			Summit_Ba.xls									
5	Full Precision			OFF									
6	Confidence Coefficient			95%									
7	Coverage			95%									
8	Number of Bootstrap Operations			2000									
9													
10	TOTAL												
11													
12	General Statistics												
13	Total Number of Observations			99		Number of Distinct Observations			93				
14	Minimum			18.6		First Quartile			32				
15	Second Largest			100		Median			44.8				
16	Maximum			106		Third Quartile			64.9				
17	Mean			49.56		SD			22.05				
18	Coefficient of Variation			0.445		Skewness			0.707				
19	Mean of logged Data			3.807		SD of logged Data			0.44				
20													
21	Critical Values for Background Threshold Values (BTVs)												
22	Tolerance Factor K (For UTL)			1.925		d2max (for USL)			3.206				
23													
24	Nonparametric Distribution Free Background Statistics												
25	Data appear Approximate Gamma Distribution at 5% Significance Level												
26													
27	Nonparametric Upper Limits for Background Threshold Values												
28	Order of Statistic, r			97		95% UTL with 95% Coverage			93.2				
29	Approximate f			1.702		Confidence Coefficient (CC) achieved by UTL			0.878				
30	95% Percentile Bootstrap UTL with 95% Coverage			93.2		BCA Bootstrap UTL with 95% Coverage			93.2				
31	95% UPL			89.5		90% Percentile			84.22				
32	90% Chebyshev UPL			116		95% Percentile			88.6				
33	95% Chebyshev UPL			146.2		99% Percentile			100.1				
34	95% USL			106									
35													
36	Note: The use of USL to estimate a BTV is recommended only when the data set represents a background												
37	data set free of outliers and consists of observations collected from clean unimpacted locations.												
38	The use of USL tends to provide a balance between false positives and false negatives provided the data												
39	represents a background data set and when many onsite observations need to be compared with the BTV.												
40													

	A	B	C	D	E	F	G	H	I	J	K	L	M
1	Nonparametric UCL Statistics for Uncensored Full Data Sets												
2													
3	User Selected Options												
4	Date/Time of Computation		1/21/2015 1:24:57 PM										
5	From File		Summit Cr.xls										
6	Full Precision		OFF										
7	Confidence Coefficient		95%										
8	Number of Bootstrap Operations		2000										
9													
10													
11	TOTAL												
12													
13	General Statistics												
14	Total Number of Observations				99				Number of Distinct Observations				84
15									Number of Missing Observations				0
16	Minimum				3.87				Mean				10.96
17	Maximum				19.9				Median				9.61
18	SD				4.346				Std. Error of Mean				0.437
19	Coefficient of Variation				0.397				Skewness				0.391
20	Mean of logged Data				2.311				SD of logged Data				0.42
21													
22	Nonparametric Distribution Free UCL Statistics												
23	Data appear Approximate Gamma Distributed at 5% Significance Level												
24													
25	Assuming Normal Distribution												
26	95% Normal UCL						95% UCLs (Adjusted for Skewness)						
27	95% Student's-t UCL			11.68			95% Adjusted-CLT UCL (Chen-1995)			11.69			
28							95% Modified-t UCL (Johnson-1978)			11.68			
29													
30	Nonparametric Distribution Free UCLs												
31	95% CLT UCL			11.67			95% Jackknife UCL			11.68			
32	95% Standard Bootstrap UCL			11.65			95% Bootstrap-t UCL			11.69			
33	95% Hall's Bootstrap UCL			11.67			95% Percentile Bootstrap UCL			11.7			
34	95% BCA Bootstrap UCL			11.67									
35	90% Chebyshev(Mean, Sd) UCL			12.27			95% Chebyshev(Mean, Sd) UCL			12.86			
36	97.5% Chebyshev(Mean, Sd) UCL			13.68			99% Chebyshev(Mean, Sd) UCL			15.3			
37													
38	Suggested UCL to Use												
39	Data appear Approximate Gamma, May want to try Gamma Distribution												
40													
41	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.												
42	These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)												
43	and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.												
44	For additional insight the user may want to consult a statistician.												
45													

	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	Date/Time of Computation 1/21/2015 1:26:25 PM												
4	From File Summit_Cr.xls												
5	Full Precision OFF												
6	Confidence Coefficient 95%												
7	Coverage 95%												
8	Number of Bootstrap Operations 2000												
9													
10	TOTAL												
11													
12	General Statistics												
13	Total Number of Observations				99		Number of Distinct Observations				84		
14	Minimum				3.87		First Quartile				8.045		
15	Second Largest				19.6		Median				9.61		
16	Maximum				19.9		Third Quartile				14.45		
17	Mean				10.96		SD				4.346		
18	Coefficient of Variation				0.397		Skewness				0.391		
19	Mean of logged Data				2.311		SD of logged Data				0.42		
20													
21	Critical Values for Background Threshold Values (BTVs)												
22	Tolerance Factor K (For UTL)				1.925		d2max (for USL)				3.206		
23													
24	Nonparametric Distribution Free Background Statistics												
25	Data appear Approximate Gamma Distribution at 5% Significance Level												
26													
27	Nonparametric Upper Limits for Background Threshold Values												
28	Order of Statistic, r				97		95% UTL with 95% Coverage				19		
29	Approximate f				1.702		Confidence Coefficient (CC) achieved by UTL				0.878		
30	95% Percentile Bootstrap UTL with 95% Coverage				19		BCA Bootstrap UTL with 95% Coverage				19.06		
31	95% UPL				18.5		90% Percentile				17.34		
32	90% Chebyshev UPL				24.06		95% Percentile				18.41		
33	95% Chebyshev UPL				30		99% Percentile				19.61		
34	95% USL				19.9								
35													
36	Note: The use of USL to estimate a BTV is recommended only when the data set represents a background												
37	data set free of outliers and consists of observations collected from clean unimpacted locations.												
38	The use of USL tends to provide a balance between false positives and false negatives provided the data												
39	represents a background data set and when many onsite observations need to be compared with the BTV.												
40													

	A	B	C	D	E	F	G	H	I	J	K	L	M
1	Lognormal UCL Statistics for Data Sets with Non-Detects												
2													
3	User Selected Options												
4	Date/Time of Computation		1/21/2015 1:29:17 PM										
5	From File		Summit Hq.xls										
6	Full Precision		OFF										
7	Confidence Coefficient		95%										
8	Number of Bootstrap Operations		2000										
9													
10	TOTAL												
11													
12	General Statistics												
13	Total Number of Observations				99				Number of Distinct Observations				90
14	Number of Detects				97				Number of Non-Detects				2
15	Number of Distinct Detects				88				Number of Distinct Non-Detects				2
16	Minimum Detect				0.0135				Minimum Non-Detect				0.0111
17	Maximum Detect				0.0663				Maximum Non-Detect				0.0112
18	Variance Detects				1.4767E-4				Percent Non-Detects				2.02%
19	Mean Detects				0.0342				SD Detects				0.0122
20	Median Detects				0.0331				CV Detects				0.355
21	Skewness Detects				0.574				Kurtosis Detects				-0.22
22	Mean of Logged Detects				-3.438				SD of Logged Detects				0.362
23													
24	Lognormal GOF Test on Detected Observations Only												
25	Lilliefors Test Statistic				0.056				Lilliefors GOF Test				
26	5% Lilliefors Critical Value				0.09				Detected Data appear Lognormal at 5% Significance Level				
27	Detected Data appear Lognormal at 5% Significance Level												
28													
29	Lognormal ROS Statistics Using Imputed Non-Detects												
30	Mean in Original Scale				0.0338				Mean in Log Scale				-3.457
31	SD in Original Scale				0.0124				SD in Log Scale				0.382
32	95% t UCL (assumes normality of ROS data)				0.0359				95% Percentile Bootstrap UCL				0.0357
33	95% BCA Bootstrap UCL				0.0359				95% Bootstrap t UCL				0.036
34	95% H-UCL (Log ROS)				0.0363								
35													
36	UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed												
37	KM Mean (logged)				-3.46				95% H-UCL (KM -Log)				0.0363
38	KM SD (logged)				0.387				95% Critical H Value (KM-Log)				1.789
39	KM Standard Error of Mean (logged)				0.0391								
40													
41	DL/2 Statistics												
42	DL/2 Normal						DL/2 Log-Transformed						
43	Mean in Original Scale				0.0336				Mean in Log Scale				-3.474
44	SD in Original Scale				0.0127				SD in Log Scale				0.436
45	95% t UCL (Assumes normality)				0.0358				95% H-Stat UCL				0.0369
46	DL/2 is not a recommended method, provided for comparisons and historical reasons												
47													
48	Suggested UCL to Use												
49	Data appear Gamma, May want to try Gamma Distribution												
50													
51	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.												
52	Recommendations are based upon data size, data distribution, and skewness.												
53	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).												
54	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.												
55													

	A	B	C	D	E	F	G	H	I	J	K	L	M
1	Lognormal Background Statistics for Data Sets with Non-Detects												
2	User Selected Options												
3	Date/Time of Computation 1/21/2015 1:31:11 PM												
4	From File Summit_Hg.xls												
5	Full Precision OFF												
6	Confidence Coefficient 95%												
7	Coverage 95%												
8	Different or Future K Observations 1												
9	Number of Bootstrap Operations 2000												
10													
11	TOTAL												
12													
13	General Statistics												
14	Total Number of Observations			99			Number of Distinct Observations			90			
15	Number of Detects			97			Number of Non-Detects			2			
16	Number of Distinct Detects			88			Number of Distinct Non-Detects			2			
17	Minimum Detect			0.0135			Minimum Non-Detect			0.0111			
18	Maximum Detect			0.0663			Maximum Non-Detect			0.0112			
19	Variance Detected			1.4767E-4			Percent Non-Detects			2.02%			
20	Mean Detected			0.0342			SD Detected			0.0122			
21	Mean of Detected Logged Data			-3.438			SD of Detected Logged Data			0.362			
22													
23	Critical Values for Background Threshold Values (BTVs)												
24	Tolerance Factor K (For UTL)			1.925			d2max (for USL)			3.206			
25													
26	Lognormal GOF Test on Detected Observations Only												
27	Lilliefors Test Statistic			0.056			Lilliefors GOF Test						
28	5% Lilliefors Critical Value			0.09			ected Data appear Lognormal at 5% Significance L						
29	Detected Data appear Lognormal at 5% Significance Level												
30													
31	Kaplan Meier (KM) Background Statistics Assuming Normal Distribution												
32	Mean			0.0338			SD			0.0124			
33	95% UTL95% Coverage			0.0576			95% KM UPL (t)			0.0544			
34	95% KM Chebyshev UPL			0.0881			90% KM Percentile (z)			0.0496			
35	95% KM Percentile (z)			0.0541			99% KM Percentile (z)			0.0626			
36	95% KM USL			0.0735									
37													
38	Background Lognormal ROS Statistics Assuming Lognormal Distribution Using Imputed Non-Detects												
39	Mean in Original Scale			0.0338			Mean in Log Scale			-3.457			
40	SD in Original Scale			0.0124			SD in Log Scale			0.382			
41	95% UTL95% Coverage			0.0658			95% BCA UTL95% Coverage			0.0621			
42	95% Bootstrap (%) UTL95% Coverage			0.0621			95% UPL (t)			0.0596			
43	90% Percentile (z)			0.0514			95% Percentile (z)			0.0591			
44	99% Percentile (z)			0.0767			95% USL			0.107			
45													
46	Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution												
47	KM Mean of Logged Data			-3.46			95% KM UTL (Lognormal)95% Coverage			0.0662			
48	KM SD of Logged Data			0.387			95% KM UPL (Lognormal)			0.06			
49	95% KM Percentile Lognormal (z)			0.0594			95% KM USL (Lognormal)			0.109			
50													
51	Background DL/2 Statistics Assuming Lognormal Distribution												
52	Mean in Original Scale			0.0336			Mean in Log Scale			-3.474			
53	SD in Original Scale			0.0127			SD in Log Scale			0.436			
54	95% UTL95% Coverage			0.0718			95% UPL (t)			0.0642			
55	90% Percentile (z)			0.0542			95% Percentile (z)			0.0635			
56	99% Percentile (z)			0.0855			95% USL			0.125			
57	DL/2 is not a Recommended Method. DL/2 provided for comparisons and historical reasons.												
58													
59	Note: The use of USL to estimate a BTV is recommended only when the data set represents a background												
60	data set free of outliers and consists of observations collected from clean unimpacted locations.												
61	The use of USL tends to provide a balance between false positives and false negatives provided the data												
62	represents a background data set and when many onsite observations need to be compared with the BTV.												
63													

	A	B	C	D	E	F	G	H	I	J	K	L	M
1	Lognormal UCL Statistics for Uncensored Full Data Sets												
2													
3	User Selected Options												
4	Time of Computation	1/21/2015 1:33:27 PM											
5	From File	Summit Pb.xls											
6	Full Precision	OFF											
7	Confidence Coefficient	95%											
8	Bootstrap Operations	2000											
9													
10													
11	ordered												
12													
13	General Statistics												
14	Total Number of Observations	96	Number of Distinct Observations									67	
15			Number of Missing Observations									0	
16		Minimum	9.31	Mean									15.43
17		Maximum	26.7	Median									14.61
18		SD	3.44	Std. Error of Mean									0.352
19		Coefficient of Variation	0.22	Skewness									1.049
20													
21	Lognormal GOF Test												
22	Shapiro Wilk Test Statistic	0.97	Shapiro Wilk Lognormal GOF Test										
23	5% Shapiro Wilk P Value	0.31	Data appear Lognormal at 5% Significance Level										
24	Lilliefors Test Statistic	0.07	Lilliefors Lognormal GOF Test										
25	5% Lilliefors Critical Value	0.091	Data appear Lognormal at 5% Significance Level										
26	Data appear Lognormal at 5% Significance Level												
27													
28	Lognormal Statistics												
29	Minimum of Logged Data	2.23	Mean of logged Data									2.714	
30	Maximum of Logged Data	3.28	SD of logged Data									0.212	
31													
32	Assuming Lognormal Distribution												
33	95% H-UCL	16.0	90% Chebyshev (MVUE) UCL									16.43	
34	95% Chebyshev (MVUE) UCL	16.8	97.5% Chebyshev (MVUE) UCL									17.53	
35	99% Chebyshev (MVUE) UCL	18.7											
36													
37	Nonparametric Distribution Free UCLs												
38	95% CLT UCL	16.0	95% Jackknife UCL									16.02	
39	95% Standard Bootstrap UCL	16	95% Bootstrap-t UCL									16.04	
40	95% Hall's Bootstrap UCL	16.0	95% Percentile Bootstrap UCL									15.99	
41	95% BCA Bootstrap UCL	16.0											
42	90% Chebyshev(Mean, Sd) UCL	16.4	95% Chebyshev(Mean, Sd) UCL									16.97	
43	97.5% Chebyshev(Mean, Sd) UCL	17.6	99% Chebyshev(Mean, Sd) UCL									18.93	
44													
45	Suggested UCL to Use												
46	Data appear Gamma. May want to try Gamma Distribution												
47													
48	Recommendations regarding the selection of a 95% UCL are provided to help the user to select the most appropriate												
49	recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and												
50	and Singh and Singh (2003). However, simulation results will not cover all Real World data sets.												
51	For additional insight the user may want to consult a statistician.												
52													

	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	Date/Time of Computation			1/21/2015 1:34:31 PM									
4	From File			Summit Pb.xls									
5	Full Precision			OFF									
6	Confidence Coefficient			95%									
7	Coverage			95%									
8	New or Future K Observations			1									
9	Number of Bootstrap Operations			2000									
10													
11	ordered												
12													
13	General Statistics												
14	Total Number of Observations			96			Number of Distinct Observations			67			
15	Minimum			9.31			First Quartile			13.15			
16	Second Largest			25			Median			14.6			
17	Maximum			26.7			Third Quartile			17.3			
18	Mean			15.43			SD			3.445			
19	Coefficient of Variation			0.223			Skewness			1.049			
20	Mean of logged Data			2.714			SD of logged Data			0.212			
21													
22	Critical Values for Background Threshold Values (BTVs)												
23	Tolerance Factor K (For UTL)			1.93			d2max (for USL)			3.196			
24													
25	Lognormal GOF Test												
26	Shapiro Wilk Test Statistic			0.975			Shapiro Wilk Lognormal GOF Test						
27	5% Shapiro Wilk P Value			0.31			Data appear Lognormal at 5% Significance Level						
28	Lilliefors Test Statistic			0.0719			Lilliefors Lognormal GOF Test						
29	5% Lilliefors Critical Value			0.0904			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			22.7			90% Percentile (z)			19.79			
34	95% UPL (t)			21.48			95% Percentile (z)			21.37			
35	95% USL			29.68			99% Percentile (z)			24.69			
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	M
1	Nonparametric UCL Statistics for Uncensored Full Data Sets												
2													
3	User Selected Options												
4	Date/Time of Computation	1/21/2015 1:37:39 PM											
5	From File	Summit_Ni.xls											
6	Full Precision	OFF											
7	Confidence Coefficient	95%											
8	Number of Bootstrap Operations	2000											
9													
10													
11	TOTAL												
12													
13	General Statistics												
14	Total Number of Observations	99					Number of Distinct Observations	85					
15							Number of Missing Observations	0					
16		Minimum	6.59				Mean	13.52					
17		Maximum	25.1				Median	11.8					
18		SD	4.97				Std. Error of Mean	0.499					
19		Coefficient of Variation	0.368				Skewness	0.466					
20		Mean of logged Data	2.537				SD of logged Data	0.367					
21													
22	Nonparametric Distribution Free UCL Statistics												
23	Data do not follow a Discernible Distribution (0.05)												
24													
25	Assuming Normal Distribution												
26	95% Normal UCL						95% UCLs (Adjusted for Skewness)						
27		95% Student's-t UCL	14.35				95% Adjusted-CLT UCL (Chen-1995)	14.36					
28							95% Modified-t UCL (Johnson-1978)	14.35					
29													
30	Nonparametric Distribution Free UCLs												
31		95% CLT UCL	14.34				95% Jackknife UCL	14.35					
32		95% Standard Bootstrap UCL	14.32				95% Bootstrap-t UCL	14.37					
33		95% Hall's Bootstrap UCL	14.35				95% Percentile Bootstrap UCL	14.36					
34		95% BCA Bootstrap UCL	14.42										
35		90% Chebyshev(Mean, Sd) UCL	15.02				95% Chebyshev(Mean, Sd) UCL	15.69					
36		97.5% Chebyshev(Mean, Sd) UCL	16.64				99% Chebyshev(Mean, Sd) UCL	18.49					
37													
38	Suggested UCL to Use												
39		95% Student's-t UCL	14.35				or 95% Modified-t UCL	14.35					
40													
41	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.												
42	These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)												
43	and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.												
44	For additional insight the user may want to consult a statistician.												
45													

	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	Date/Time of Computation 1/21/2015 1:39:11 PM												
4	From File Summit_Ni.xls												
5	Full Precision OFF												
6	Confidence Coefficient 95%												
7	Coverage 95%												
8	Number of Bootstrap Operations 2000												
9													
10	TOTAL												
11													
12	General Statistics												
13	Total Number of Observations			99	Number of Distinct Observations			85					
14	Minimum			6.59	First Quartile			9.445					
15	Second Largest			24.8	Median			11.8					
16	Maximum			25.1	Third Quartile			18.3					
17	Mean			13.52	SD			4.97					
18	Coefficient of Variation			0.368	Skewness			0.466					
19	Mean of logged Data			2.537	SD of logged Data			0.367					
20													
21	Critical Values for Background Threshold Values (BTVs)												
22	Tolerance Factor K (For UTL)			1.925	d2max (for USL)			3.206					
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			97	95% UTL with 95% Coverage			22.6					
29	Approximate Confidence Coefficient (CC) achieved by UTL			1.702	95% UTL with 95% Coverage			0.878					
30	95% Percentile Bootstrap UTL with 95% Coverage			22.6	BCA Bootstrap UTL with 95% Coverage			22.6					
31	95% UPL			21.3	90% Percentile			20.2					
32	90% Chebyshev UPL			28.5	95% Percentile			20.85					
33	95% Chebyshev UPL			35.29	99% Percentile			24.81					
34	95% USL			25.1									
35													
36	Note: The use of USL to estimate a BTV is recommended only when the data set represents a background												
37	data set free of outliers and consists of observations collected from clean unimpacted locations.												
38	The use of USL tends to provide a balance between false positives and false negatives provided the data												
39	represents a background data set and when many onsite observations need to be compared with the BTV.												
40													

	A	B	C	D	E	F	G	H	I	J	K	L	M
1	Lognormal UCL Statistics for Uncensored Full Data Sets												
2													
3	User Selected Options												
4	Date/Time of Computation		1/21/2015 1:43:48 PM										
5	From File		Summit_Se.xls										
6	Full Precision		OFF										
7	Confidence Coefficient		95%										
8	Number of Bootstrap Operations		2000										
9													
10													
11	LnROS_Se												
12													
13	General Statistics												
14	Total Number of Observations				100				Number of Distinct Observations				89
15									Number of Missing Observations				0
16	Minimum				0.0673				Mean				0.364
17	Maximum				1.66				Median				0.272
18	SD				0.285				Std. Error of Mean				0.0285
19	Coefficient of Variation				0.783				Skewness				1.784
20													
21	Lognormal GOF Test												
22	Shapiro Wilk Test Statistic				0.966				Shapiro Wilk Lognormal GOF Test				
23	5% Shapiro Wilk P Value				0.0641				Data appear Lognormal at 5% Significance Level				
24	Lilliefors Test Statistic				0.0674				Lilliefors Lognormal GOF Test				
25	5% Lilliefors Critical Value				0.0886				Data appear Lognormal at 5% Significance Level				
26	Data appear Lognormal at 5% Significance Level												
27													
28	Lognormal Statistics												
29	Minimum of Logged Data				-2.699				Mean of logged Data				-1.271
30	Maximum of Logged Data				0.507				SD of logged Data				0.721
31													
32	Assuming Lognormal Distribution												
33	95% H-UCL				0.422				90% Chebyshev (MVUE) UCL				0.45
34	95% Chebyshev (MVUE) UCL				0.49				97.5% Chebyshev (MVUE) UCL				0.544
35	99% Chebyshev (MVUE) UCL				0.652								
36													
37	Nonparametric Distribution Free UCLs												
38	95% CLT UCL				0.411				95% Jackknife UCL				0.411
39	95% Standard Bootstrap UCL				0.411				95% Bootstrap-t UCL				0.418
40	95% Hall's Bootstrap UCL				0.421				95% Percentile Bootstrap UCL				0.411
41	95% BCA Bootstrap UCL				0.42								
42	90% Chebyshev(Mean, Sd) UCL				0.449				95% Chebyshev(Mean, Sd) UCL				0.488
43	97.5% Chebyshev(Mean, Sd) UCL				0.541				99% Chebyshev(Mean, Sd) UCL				0.647
44													
45	Suggested UCL to Use												
46	95% H-UCL				0.422								
47													
48	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.												
49	These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)												
50	and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.												
51	For additional insight the user may want to consult a statistician.												
52													
53	ProUCL computes and outputs H-statistic based UCLs for historical reasons only.												
54	H-statistic often results in unstable (both high and low) values of UCL95 as shown in examples in the Technical Guide.												
55	It is therefore recommended to avoid the use of H-statistic based 95% UCLs.												
56	Use of nonparametric methods are preferred to compute UCL95 for skewed data sets which do not follow a gamma distribution.												
57													

	A	B	C	D	E	F	G	H	I	J	K	L	M
1	Lognormal UCL Statistics for Uncensored Full Data Sets												
2													
3	User Selected Options												
4	Time of Computation	1/21/2015 1:51:05 PM											
5	From File	Summit_TL.xls											
6	Full Precision	OFF											
7	Confidence Coefficient	95%											
8	Bootstrap Operations	2000											
9													
10													
11	TOTAL												
12													
13	General Statistics												
14	Total Number of Observations	99					Number of Distinct Observations	81					
15							Number of Missing Observations	0					
16		Minimum	0.0758				Mean	0.187					
17		Maximum	0.383				Median	0.186					
18		SD	0.0644				Std. Error of Mean	0.00647					
19		Coefficient of Variation	0.345				Skewness	0.516					
20													
21	Lognormal GOF Test												
22	Shapiro Wilk Test Statistic	0.963					Shapiro Wilk Lognormal GOF Test						
23	5% Shapiro Wilk P Value	0.0423					Data Not Lognormal at 5% Significance Level						
24	Lilliefors Test Statistic	0.0715					Lilliefors Lognormal GOF Test						
25	5% Lilliefors Critical Value	0.089					Data appear Lognormal at 5% Significance Level						
26	Data appear Approximate Lognormal at 5% Significance Level												
27													
28	Lognormal Statistics												
29	Minimum of Logged Data	-2.58					Mean of logged Data	-1.74					
30	Maximum of Logged Data	-0.96					SD of logged Data	0.361					
31													
32	Assuming Lognormal Distribution												
33	95% H-UCL	0.2					90% Chebyshev (MVUE) UCL	0.208					
34	95% Chebyshev (MVUE) UCL	0.218					97.5% Chebyshev (MVUE) UCL	0.231					
35	99% Chebyshev (MVUE) UCL	0.257											
36													
37	Nonparametric Distribution Free UCLs												
38	95% CLT UCL	0.197					95% Jackknife UCL	0.197					
39	95% Standard Bootstrap UCL	0.197					95% Bootstrap-t UCL	0.198					
40	95% Hall's Bootstrap UCL	0.197					95% Percentile Bootstrap UCL	0.198					
41	95% BCA Bootstrap UCL	0.198											
42	90% Chebyshev(Mean, Sd) UCL	0.206					95% Chebyshev(Mean, Sd) UCL	0.215					
43	97.5% Chebyshev(Mean, Sd) UCL	0.227					99% Chebyshev(Mean, Sd) UCL	0.251					
44													
45	Suggested UCL to Use												
46	Data appear Normal, May want to try Normal Distribution												
47													
48	Questions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate												
49	recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iyer												
50	and Singh and Singh (2003). However, simulation results will not cover all Real World data sets.												
51	For additional insight the user may want to consult a statistician.												
52													

	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	Date/Time of Computation 1/21/2015 1:55:27 PM												
4	From File Summit_TL.xls												
5	Full Precision OFF												
6	Confidence Coefficient 95%												
7	Coverage 95%												
8	Future K Observations 1												
9	Number of Bootstrap Operations 2000												
10													
11	TOTAL												
12													
13	General Statistics												
14	Total Number of Observations			99			Number of Distinct Observations			81			
15	Minimum			0.0758			First Quartile			0.14			
16	Second Largest			0.371			Median			0.186			
17	Maximum			0.383			Third Quartile			0.225			
18	Mean			0.187			SD			0.0644			
19	Coefficient of Variation			0.345			Skewness			0.516			
20	Mean of logged Data			-1.74			SD of logged Data			0.361			
21													
22	Critical Values for Background Threshold Values (BTVs)												
23	Tolerance Factor K (For UTL)			1.925			d2max (for USL)			3.206			
24													
25	Lognormal GOF Test												
26	Shapiro Wilk Test Statistic			0.963			Shapiro Wilk Lognormal GOF Test						
27	5% Shapiro Wilk P Value			0.0423			Data Not Lognormal at 5% Significance Level						
28	Lilliefors Test Statistic			0.0715			Lilliefors Lognormal GOF Test						
29	5% Lilliefors Critical Value			0.089			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			0.352			90% Percentile (z)			0.279			
34	95% UPL (t)			0.321			95% Percentile (z)			0.318			
35	95% USL			0.559			99% Percentile (z)			0.407			
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													