FINAL TECHNICAL REPORT

ST. LOUIS, MISSOURI AREA SURFICIAL MATERIALS DATABASE

External Grant Award Number 05-HQ-GR-0019

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Keywords: Geotechnical, Surficial Deposits, Database

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TABLE OF CONTENTS

FIGURES AND TABLES

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TECHNICAL ABSTRACT

This outcome of this project has been to populate a geotechnical surficial material database for the St. Louis, Missouri area to be used to for the St. Louis Area Earthquake Hazard Mapping Project (SLAEHMP). The SLAEHMP project area includes the metropolitan region of Missouri and Illinois and is one of two urban hazards mapping projects that are the focus of the USGS Earthquake Hazard Program five-year Science Plan in the Central and Eastern United States (http://earthquake.usgs.gov/regional/ceus/urban_map/st_louis/index.php). The data will be used for mapping earthquake hazards in twenty-two quadrangles in the Missouri part of the SLAEHMP area.

The database includes records from 4115 borings located in the City of St. Louis, St. Louis County, parts of St. Charles County and the northern part of Jefferson County. The boring records were obtained from agencies that are responsible for large construction projects and include both field and laboratory soils data typical of geotechnical borings. These data include 1970 borings with standard penetration test data (13,901 records) and water level measurements from 1262 borings. Bedrock was intercepted in 2984 borings. The database has been used to compile a surficial materials geologic map for the Wentzville 7.5' Quadrangle as part of the SLAEHMP project.

Based upon an existing Microsoft Access geotechnical database, the data tables are easily imported into a geographic information system (GIS). Each boring has a unique identification number that relates the records between tables and back to the source documents. The borings all have projected coordinates in Universal Transverse Mercator, North American Datum Zone 15. These locations are as reported and have not been field checked during the course of this project. Individual borings have an entry record for each depth interval recorded on the source logs. This aspect of the database takes full advantage of logs that offer greater detail in materials variability and stratigraphy.

NON-TECHNICAL SUMMARY

This project has made significant progress toward compiling a soil materials database for the St. St. Louis, Missouri area to be used to for the St. Louis Area Earthquake Hazard Mapping Project (SLAEHMP). The SLAEHMP area includes the metropolitan region of Missouri and Illinois and is one of two urban hazards mapping projects that is the focus of the USGS Earthquake Hazard Program five-year Science Plan in the Central and Eastern United States (http://earthquake.usgs.gov/regional/ceus/urban_map/st_louis/index.php). The data are from 4115 existing public source boring records and include data typically used for the design of foundations at large construction projects. These types of data are also used to estimate the potential site-soil response during earthquakes. Earthquake hazard maps produced in part from these data will depict potential shaking and liquefaction hazards. Such maps are needed for local communties, businesses, homeowners and emergency responders to plan and prepare for a future earthquake event. This database is similar to the database developed for the USGS Memphis urban seismic hazard-mapping project, but represents a collection of boring records from a much larger area. The Missouri portion of this project alone is about 3300 km^2. This database has been shared with other workers in the central United States, been made available to the practicing engineering community in the St. Louis, Missouri, area and used to compile a surficial material geological map for the SLAEHMP.

PROJECT BACKGROUND

This data compilation and entry project focused on acquiring data from agencies that have readily accessible boring files and were willing to release their records for public use. Several public agencies indicated a willingness to cooperate by supplying boring logs for the database compilation to be used in the SLAEHMP. During 2004 and 2005 records for 4115 geotechnical borings were located (Figure 1), scanned into a digital image format and entered into a Microsoft Access database. The database has spatial attributes and can be accessed and analyzed through GIS software to map surficial material characteristics that contribute to earthquake hazards. There are no public databases of geotechnical borings in Missouri, nor do any of the record sources maintain data in a database format. And, while other geological and well log spatial databases have been compiled for Missouri by the Division of Geology and Land Survey (DGLS), this is the first effort to build a comprehensive geotechnical database from multiple sources. As to be expected, each contributing source agency has their own record keeping system and the compilation of this data would not have been possible without their cooperation.

The Missouri Department of Transportation (MoDOT) data collection is mostly in one office in Jefferson City, Missouri, and represents the most geographically widespread collection of boring records. Their records were also filed in a manner that simplified locating borings from areas that fell within the SLAEHMP. Some records were also stored at the MoDOT District 6 office in St. Louis. Data were also acquired from the St. Louis Metropolitan Sewer District (MSD). MSD consider their files to be public record and have a large amount of data available for St. Louis City and St. Louis County that was obtained for waste-water treatment related construction projects. MSD files included boring data and maps from U.S. Corps of Engineers drilling projects along the Mississippi River. The Bi-State Development Corporation, who operates the

MetroLink commuter rail in the St. Louis Area, also has construction related boring data that were made available for the project. A large amount of boring records remains to be compiled at MSD and with other sources in the St. Louis region.

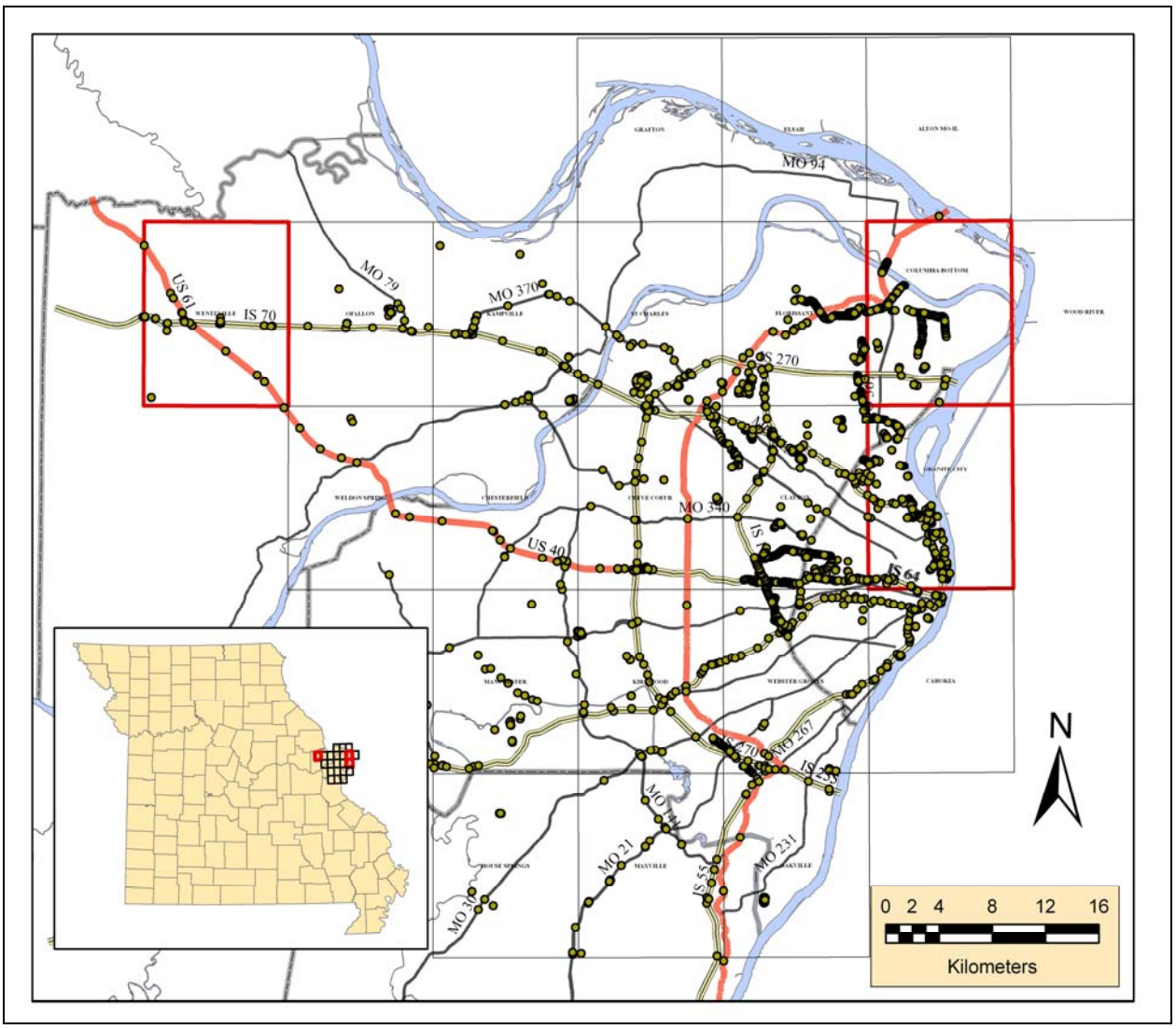

Figure 1. Missouri portion of the SLAEHMP and geotechnical database boring locations. Quadrangles shown in red are planned to be detailed hazard maps. The boring locations shown represent 4115 borings that are in the database.

The project plan did not include evaluating data within a GIS system. However, it became apparent early on that in order to evaluate available borings, some level of GIS analysis would be needed to obtain more accurate boring locations, and to evaluate the coverage or distribution of boring data in any given area, in light of known geologic map data. This aspect of acquiring data for targeted map areas became more important as the SLAEHMP project has evolved.

Due to low levels of funding available for earthquake hazard mapping, the SLAEHMP Technical Work Group decided in 2005 to focus on four quadrangles for detailed mapping efforts, and produce generalized regional scale hazard maps for the remaining quadrangles. Three of these 7.5' quadrangles (Wentzville, Columbia Bottom, and Granite City) fall partially or completely in Missouri. Data collection and entry efforts focused on these quadrangles in the latter part of the 2005 project year. As a result of this focused data collection effort, the database contains records for 653 borings in the Granite City and Columbia Bottom 7.5' quadrangles.

An additional factor guiding the collection of boring records was the known surficial materials distribution. A large number of records, more than were obtained, are available for the mapped alluvial fill portions of major stream valleys. While these largely cohesionless materials represent some potential level of liquefaction hazard, the SLAEHMP region also has cohesive materials that may be highly susceptible to seismic amplification. Rather than enter large amounts of data for materials, whose distribution is fairly well defined, data entry focused on areas where little data, either map or borings had been previously available. This approach refined the search and entry of data to focus on those areas that appeared to have relatively thick surficial materials, with unknown physical characteristics, in developed and developing areas.

BOREHOLE LOCATION COORDINATES

All locations are in Universal Transverse Mercator, North American Datum 1983 (UTM NAD83) coordinates. Borehole locations were provided from the source agencies or were obtained from the maps and diagrams in the source documents. It was not possible to obtain unique coordinates for many MoDOT borings. Instead, the borings are grouped into a single point based on a MoDOT GIS shapefile of bridge and culvert locations rather than the unique borehole locations for that structure. Locations based on that shapefile will show the same coordinates for every boring completed for that structure. A small number of MoDOT borings were supplied with unique UTM NAD83 coordinates.

The remainder of the borings were located using the source document maps and diagrams and were plotted in GIS software with digital topographic map and digital air photos as references. Fields for the boring coordinates were generated and extracted automatically to the GIS file. The GIS file was imported to the database and coordinate fields appended to the appropriate database tables.

DATABASE DESIGN CHARACTERISTICS

The database used for this project is a modified version of a Microsoft Access 97 database with entry forms prepared for MoDOT by Tom Hertel and Hal Baker of DGLS. The data table design and field definitions are shown in **Appendix A**. The database has startup and entry screens (Figures 2 and 3) that guide and control data entry, and complete some field calculations. All records are identified by a unique ***Borehole_Id*** that links associated records in multiple data tables (Figure 4). The tables also include ***Design_No*** and ***Structure_No*** fields, which are keyed

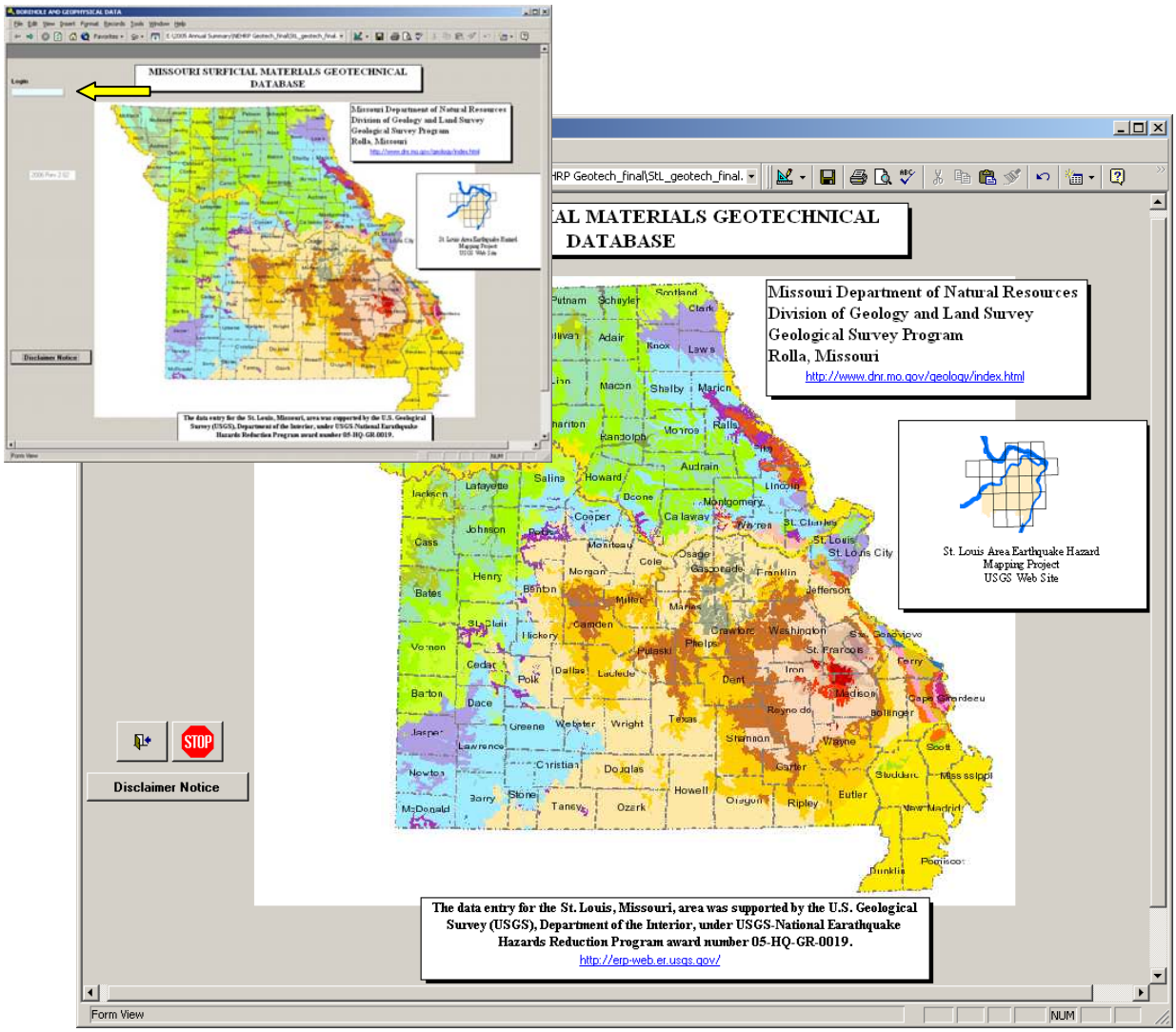

Figure 2. Surficial Material Database Startup Screen. Enter any character in the login box (yellow arrow) to open the data entry or edit screens, or bypass to the data tables by selecting the Stop button. Entry forms are not enabled in the release version to prevent accidental corruption of records.

to the file names of the scanned images of the source documents. **Appendix B** describes how to retrieve the source documents from the scanned files using these unique identification numbers.

Boring logs record material descriptions and lab data intervals as depth below the surface. In the database tables, each described depth interval is a separate record. A boring log may have one or multiple depth intervals depending on the location, the purpose of the boring, or the detail recorded in the field and the number of collected samples. This aspect of the database makes maximum use of logs that record considerable stratigraphic and physical property variability.

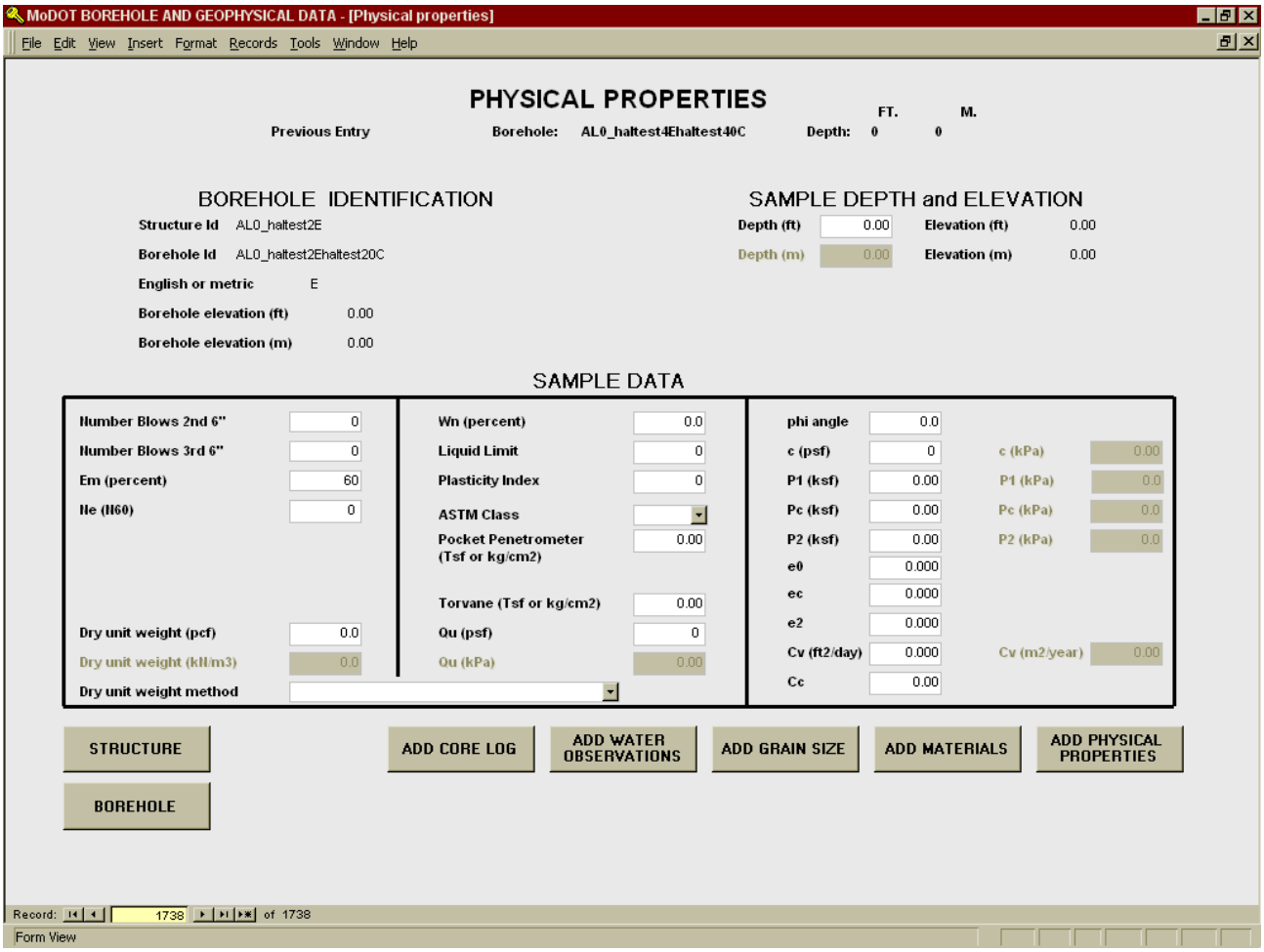

FIGURE 3. PHYSICAL PROPERTIES TABLE ENTRY FORM. The data entry is guided and simplified by the entry forms layout. Controls and functions built into the forms also prevents the entry of out of range variables, complete calculations such as SPT N60 values, and convert between English and metric unit systems.

Data Tables

The list below is a summary of the database objects. Data table objects are shown as all lower case letters. Tables with a prefix label of "**export**_…" that are abbreviated versions of the data tables listed below and are intended for use with GIS system files. The original database was not designed for use with GIS software, so the length or field name uniqueness was not an issue. These GIS export enabled tables have field names that have been shortened or renamed so that the first eight characters are unique. Look-up tables are shown in all upper case letters. See Appendix A for complete definitions of tables and fields in the database.

Table 1. Data Tables Summary

borehole – contains unique identification numbers, location, elevation, depth information and the boring equipment used.

corelog – rock core data.

dynamic soil properties – soil laboratory or field data for shear wave velocity, strain, modulus and damping. The data set currently only contains shear wave velocity data from seismic cone penetrometer borings.

grain size – laboratory determined grain size data.

materials – field descriptions of materials encountered during boring.

physical_properties – field and laboratory boring data, including standard penetration values, pocket penetrometer, torvane shear, liquid limits, plasticity index, and moisture content.

structure – information about the location of the project associated with boring data. Unique identification numbers are generated in this table.

water – water level data.

Data Entry

The fields in the data tables shown above were populated through entry screen forms. As indicated above, the data entry screen fields control and simplify data entry by having clearly marked text boxes for data variables and have validation rules built into the database design. This design serves as an error checking measure where pre-defined limits are known for various types of data. For example, Liquid Limits values must be a positive integer between 0 and 150. The software blocks an out-of range value and the user is alerted with an error dialog box. Data entry also followed a standard process. After prioritizing locations and borings, each log was printed from the scanned image. As the values were typed into the entry screen, that section of the paper log was marked to check and correct the entry if necessary, to keep track of progress, and avoid duplication errors.

Database Editing and Error Checking

The database has built in editing forms that may be used to correct entries, or add new values. The data tables were periodically checked for errors by examining the range of values paying particular attention to the extreme low and high ranges, and checking the values against the source document. An additional final review of the data was through a GIS analysis of the boring data. This step identified values or fields that appeared not to fit with the next nearest borings. For example, the data may be queried to determine the depth of artificial fill based on material descriptions. Any value that included cinders, concrete, rubble, bricks, or a number of

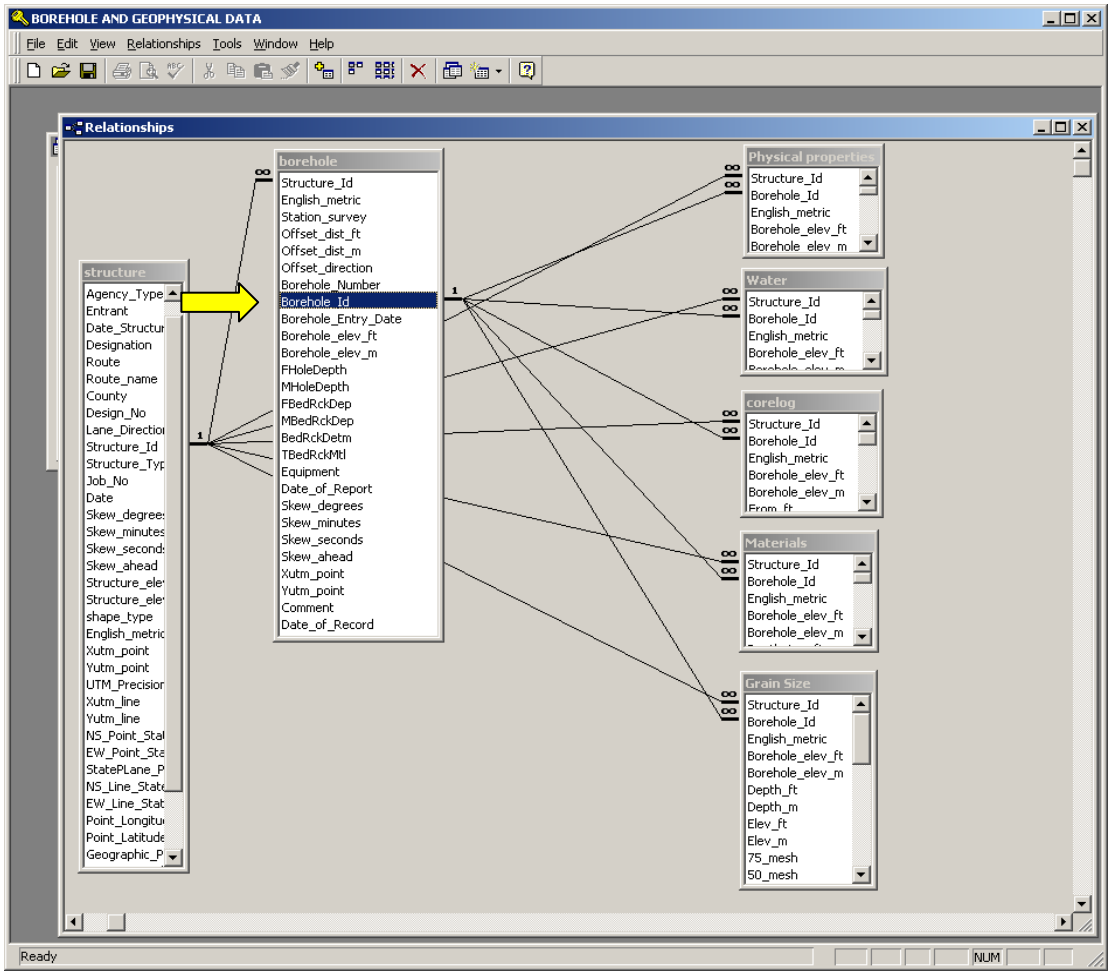

Figure 4. Database Relationships. The unique identification numbers between tables and records is based on the Structure and Borehole identification numbers. The Borehole Id numbers are derived automatically from the "Structure Id." The Structure Id is also the file name used for all related scanned boring documents. Tables designed for export to GIS files are not shown in this view.

other values, represents a sequence of artificial fill. One location had nearly 30 meters of artificial fill. The source log and documents showed that the boring was in an old limestone quarry. Similar searches for out of range values were completed for descriptive and physical property fields though this GIS approach.

Data Limitations

Users of this data must be aware that the original intent of the data was for a specific site investigation, and no attempt was made during this project to field check or correct source document records. All records, locations, laboratory and field data were entered as is. The source documents rarely discuss data collection standards, or describe quality assurance and quality checking. During this project every effort was made to faithfully enter log descriptions and data exactly as it was recorded. This was not always possible as some logs used non-standard or unrecognizable terms, or had variables that were out of range values. Often these could be understood as typographical or transcription errors. However, if the record could not be easily deciphered it was simply not entered. A disclaimer is included in the database and is reproduced below.

Disclaimer

Although the data in this data set have been compiled by the Missouri Department of Natural Resources, no warranty, expressed or implied, is made by the department as to the accuracy of the data and related materials. The act of distribution shall not constitute any such warranty, and no responsibility is assumed by the department in the use of these data or related materials. Nor is any warranty or responsibility assumed by the organizations, suppliers, or contractors for any the data.

The data records contained in this database were collected from a number of agencies and sources including the Missouri Department of Transportation (MoDOT). MoDOT gives the following warnings: Persons using this information are cautioned that the materials shown are determined by the equipment noted and accuracy of the "log of materials" is limited thereby and by judgement of the operator. THIS INFORMATION IS FOR MoDOT DESIGN PURPOSES ONLY.

Acknowledgement of the Missouri Department of Natural Resources, Division of Geology and Land Survey (DGLS) would be appreciated for products derived from this data. The data were gathered for specific purposes for site specific projects and cannot be used for engineering purposes at offsite locations. This data set is not designed for use as a primary regulatory tool in permitting or siting decisions, but may be used as a reference source. Users are responsible for the appropriate application of this data.

Most of the borings were acquired as part of an engineering subsurface investigation to determine site soil conditions, physical properties and thickness for structural design and were never intended to be used with a geological mapping project or for analysis beyond the project site. Therefore, few logs have stratigraphic context and most often do not identify mappable units that might be present throughout a larger map area. For example, loess and even alluvium are rarely identified in boring logs. Examination of specific boring records, review of available mapping, and field review would be required to determine the genetic origin of many materials described in the database. This is not an inconsequential matter if geologic hazard maps are going to be based on the physical characteristics of mappable surficial material geologic units.

RESULTS

Records were acquired and entered for 4115 soil borings in the Missouri portion of the SLAEHMP project area (Figure 1 and Plate 1, Figure 2). The data are summarized in Table 1 and in map views on Plate 1. Complete definitions of the tables and fields are shown in Appendix A. Plate 1, Figure 2 shows all 4115 borings classified by total depth. Bedrock was intercepted in 2984 borings (Plate 1, Figure 3 Depth to Bedrock) and 50 borings intercepted bedrock at depths of 30 meters or greater. Eight of these were borings located in areas that are outside of major stream alluvial areas. As stated above these were existing boring and soils laboratory data that were originally acquired for construction projects. The amount of data in each record varies considerably between borings and project sites. A special effort, related to SLAEHMP project goals, included the focused acquisition of data to complete high-resolution earthquake hazards maps for the Granite City and Columbia Bottom quadrangles. Out of the 4115 total borings, 653 are in these two quadrangles.

Table 2. Summary of boring data the St. Louis, Missouri Area Surficial Materials Database.

RECORD TYPE	TOTAL	RECORD TYPE	TOTAL
Number of Borings	4115	**ASTM Soil Class.**	6814
Material Description Entries	22625	**Weight Percent Water**	10036
SPT N60 Values (from 1970 borings)	13901	**Water Level Measurements**	1262
Pocket Penetrometer	9661	**Grain Size Data**	195
Torvane Shear	2685	**Rock Core Log Records**	4577
Unconfined Compressive Strength	2652	**Dynamic Soil Properties**	86
Liquid Limits	2032	**Cone Penetrometer/Seismic Cone Penetrometer Logs**	67
Plasticity Index	1985		

Data Use and Classification

An example of the use of the database and its spatial characteristics to screen surficial material characteristics, particularly with respect to physical properties that bear on earthquake hazards, is shown on Plate 1, Figures 4 through 6. These illustrations show the boring data classified using 1997 NEHRP Soil Profile Site Soil Class E characteristics (FEMA, 1998a and 1998b). Site Class E class soils must have at least 3 meters of cohesive soils, with either;

(1) shear wave velocity of 180 meter/second or lower, or
(2) undrained shear strength of <50 kPa (unconfined compressive strength <~100kPa), or
(3) a combination of physical properties characteristics including N60 <15, Plasticity Index >20, and weight percent water >40%.

The data were first sorted based on standard penetration test N60 values (Plate 1, Figure 4). The values shown are from depths of 3 meters or more. The second sort of the data used those records that had both N60 data (15 or less) from depths of 3 meters or greater, symbolized by Plasticity Index values (Plate 1, figure 5). The group of borings that had both N60 of 15 or less and Plasticity Index of 20 or greater are shown on the map as green squares. Plate 1, Figure 6, shows all weight percent water records. Finally, these data were further reduced to only include

records that have N60 values of 15 or less, Plasticity Index >20, and weight percent water 40 or greater (shown as red squares).

The exercise above also offers considerable insight to the variability of surficial materials properties and thickness. Surficial material map units in the project area vary from gravelly alluvium and cohesive slackwater deposits, to glacial till and lacustrine deposits and thin stony residual bedrock soils (Goodfield, 1965; Lutzen and Rockaway, 1971; Allen and Ward, 1978; Curry and Grimley, 2006).

This database has also been used to compile the Wentzville 7.5' surficial material geological map (Palmer and Siemens, 2006, attached as Appendix C). The map area has thick glacial till (over 36 meters), and fine- and coarse-grained alluvium, and areas where surficial materials are equal or less than 3 meters thick. The Wentzville 7.5' geologic hazard map will be compiled from the surficial material map and these data.

Ideally, geologic hazard maps are based on surficial material geologic maps whose units have consistent and predictable physical properties. Determining the variability of these physical properties within mappable surficial material units is the key to accurate high-resolution hazard maps.

RECOMMENDATIONS FOR FURTHER WORK

Additional boring data are available for the St. Louis region from a number of private and public sources. Due to the time frame for this project, data compilation focused on source agencies that have large amounts of data from across the region and have records stored in a central location. In particular, the Metropolitan Sewer District has large amounts of boring and project maps that would shed additional light on the location of articial fill in urban and developing areas in St. Louis. The Missouri Department of Transportation also is continuing to obtain new borings in the St. Louis area including major transportation corridors. However, some of the developed portions of the SLAEHMP area have few borings, and relatively high population density. Efforts to acquire additional data should seek data from the several quadrangles shown in Plate 1 Figure 2 that have little data.

PUBLICATIONS

St. Louis, Missouri Area Surficial Material Database and Earthquake Hazard Mapping, James R. Palmer, Thomas Mesko, Kevin James, and Jere Cadoret (abs.); Seismological Society of America - Eastern Section, Program and Abstracts, 77th Annual Meeting, 115 p.

DATA AVAILABILITY

The records collected for this study includes scanned logs, in Acrobat *.pdf format and data from the logs that have been entered into Microsoft Access 97. The scanned records and the database may be obtained by contacting Patrick Mulvany (patrick.mulvany@dnr.mo.gov, or office phone

at 573-368-2139) at the Missouri Department of Natural Resources, Geological Survey and Resource Assessment Division.

ACKNOWLEDGEMENTS

Compilation of this database would have been impossible without the generous cooperation of a number of individuals and organizations. Tom Fennessey, Phil Ruffus and Rob Lauer provided details on Missouri Department of Transportation borings including new files and locations. Marie Collins, Jeff Burley, and especially Marilyn Szigeti and Marla Wiggins at the St. Louis Metropolitan Sewer District were invaluable for tracking down records that are in the Columbia Bottom and Granite City quadrangles. Morris Berk at Bi-State Development Agency provided boring logs associated with the MetroLink light rail projects.

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Palmer, J.R., and M.A. Siemens, 2006, Surficial material geologic map of the Wentzville 7.5-minute Quadrangle, St. Charles County, Missouri; Missouri Department of Natural Resources, Division of Geology and Land Survey, Open file map OFM-06-518-GS, scale 1:24,000. One sheet.

APPENDIX A

TABLES AND FIELD DESCRIPTIONS

The tables in the database, including look-up tables, are listed below. Field definitions are only shown for the data tables. Each database object is shown in either upper case or lower case text. Data tables are shown with lower case letters, while look-up tables are in upper case. For tables that have depth interval information, each depth interval is a separate record.

Agency: Name of data source and code to identify program setup.

ASTM_class: look-up table; soil classification using the Unified Soil Classification system, described in American Society for Testing and Materials International, ASTM D 2487.

borehole: data table with 27 fields that contain borehole information, location and equipment used.

> **Structure_Id**, Source document and Unique number identifying structure for link to other tables, For MoDOT created automatically by data entry program by combining Designation, route, design_# and direction, or otherwise entered directly from the source document.
>
> **English_metric**, Identity of measurement system, English (E), Metric (M), automatically entered from structure table
>
> **Station_survey**, Centerline survey station number for boring in survey notation
>
> **Offset_dist_ft**, Offset perpendicular or on skew from centerline station to boring in feet
>
> **Offset_dist_m**, Offset perpendicular or on skew from centerline station to boring in meters
>
> **Offset_direction**, Offset perpendicular or on skew from centerline station to boring in meters
>
> **Borehole_Number**, Agency Identifier for borehole --- NOT USED for MoDOT but used for other Agencies to Build UNIQUE Borehole_ID
>
> **Borehole_Id**, Unique number identifying borehole for link to other tables, for MoDOT created automatically by data entry program by combining Structure_Id, Station_survey, Offset_dist_ft (or _m) and Offset_direction; Otherwise Project_ID, Job_Id and Borehole_Number
>
> **Borehole_Entry_Date**, When Borehole was entered into system.
>
> **Borehole_elev_ft**, elevation of ground surface at borehole in feet

(borehole table continued)

Borehole_elev_m, elevation of ground surface at borehole in meters

FholeDepth, Depth of hole in feet.

MholeDepth, Depth of hole in meters.

FbedRckDep, Depth to bedrock in feet. Blank when boring terminates above bedrock.

MbedRckDep, Depth to bedrock in meters. Blank when boring terminates above bedrock.

BedRckDetm, How depth to bedrock was determined. Blank when boring terminates above bedrock.

TbedRckMtl, Top of bedrock material type. Blank when boring terminates above bedrock.

Equipment, Drilling equipment type being used

Date_of_Report, Date of report

Skew_degrees, MoDOT site survey data

Skew_minutes, MoDOT site survey data

Skew_seconds, MoDOT site survey data

Skew_ahead, MoDOT site survey data

Xutm_point, UTM easting in meters, NAD 83, Zone 15. The locations are as reported and have not been field verified.

Yutm_point, UTM northing in meters, NAD 83, Zone 15. The locations are as reported and have not been field verified.

Comment, Remarks from Report or from Entrant. Maximum of 250 characters.

Date_of_Record, Date Created or Changed. Automatically generated.

CONSISTENCY: Look up table for field identified material characteristic. **corelog**: rock core data table. 23 fields.

Structure_Id, Unique number identifying structure for link to other tables, default from structure table

Borehole_Id, Unique number identifying borehole for link to other tables, default from borehole table.

English_metric, Identity of measurement system, default from structure table

Borehole_elev_ft, elevation of ground surface at borehole in feet, default from borehole table

Borehole_elev_m, elevation of ground surface at borehole in meters, default from borehole table

From_ft, Depth at top of core run in feet

From_m, Depth at top of core run in meters

Elev_from_ft, calculated elevation at top of core run, Borehole elevation in feet – depth

Elev_from_m, calculated elevation at top of core run, Borehole elevation in meters – depth

To_ft, Depth at bottom of core run in feet

To_m, Depth at bottom of core run in meters

Elev_to_ft, calculated elevation at bottom of core run, Borehole elevation in feet – depth

Elev_to_m, calculated elevation at bottom of core run, Borehole elevation in meters– depth

Run_ft, Length of core run in feet

Run_m, Length of core run in meters

Recovered_ft, Length of core recovered in feet

Recovered_m, Length of core recovered in meters

Loss_ft, Length of core lost in feet

(corelog table continued)

Loss_m, Length of core lost in meters

Recovery_percent, Percent of core recovered, calculated (run - recovery)

RQD_percent, Rock quality designation in percent

Comment, Remarks from Report or from Entrant. Maximum of 250 characters

Date_of_Record, Date Created or Changed AUTOMATICALLY GENERATED

COUNTY: look-up table with county Federal Information Processing Standards(FIPS) code for counties and county names

DRY WEIGHT METHODS: look-up table for method used to measure soil weight.

dynamic soil properties: data table with lab and field data. ***Currently the table only has Seismic Cone Penetrometer determined shear wave velocity data***.

Structure_Id, unique number identifying structure for link to other tables, select from list

English_metric, Identity of number system, English (E), Metric (M), enter correct unit type before entering each suite of data

Borehole_Id, borehole in which transmitter is located for cross-hole test or where borehole samples were collected for laboratory tests, select from list

Borehole_or_site_xutm, UTM NAD 1983 Zone 15, x coordinate for borehole or site

Borehole_or_site_yutm, UTM, NAD 1983 Zone 15 y coordinate for borehole or site

Borehole_elev_ft, elevation of ground surface at borehole in feet

Borehole_elev_m, elevation of ground surface at borehole in meters

Depth_ft, depth of sample in feet

Depth_m, depth of sample in meters

Sample_elev_ft, elevation in feet calculated, Borehole elevation – depth

(***dynamic soil properties continued***)

Sample_elev_m, elevation in meters calculated, Borehole elevation – depth
type_swv_test, type of shear wave velocity test

Vs_e, shear wave velocity in ft/s

Vs_m, shear wave velocity in m/s

receiver_borehole_id_1, borehole in which receiver 1 is located for cross-hole test, select from list

receiver_borehole_id_2, borehole in which receiver 2 is located for cross-hole test, select from list

type_low_strain_test, type of low strain test conducted

Gmax_e, maximum shear modulus in kips/square foot

Gmax_m, maximum shear modulus in kilonewtons/square meter

Dmax, damping ratio

type_strain_dependent_test, type of strain dependent test for shear modulus and damping

shear_strain_1, measured % strain for shear modulus data

shear_strain_2, measured % strain for shear modulus data

shear_strain_3, measured % strain for shear modulus data

shear_strain_4, measured % strain for shear modulus data

shear_strain_5, measured % strain for shear modulus data

shear_strain_6, measured % strain for shear modulus data

shear_strain_7, measured % strain for shear modulus data

shear_strain_8, measured % strain for shear modulus data

shear_strain_9, measured % strain for shear modulus data

(***dynamic soil properties continued***)

shear_strain_10, measured % strain for shear modulus data

G_1_e, measured shear modulus in kips/square foot

G_2_e, measured shear modulus in kips/square foot

G_3_e, measured shear modulus in kips/square foot

G_4_e, measured shear modulus in kips/square foot

G_5_e, measured shear modulus in kips/square foot

G_6_e, measured shear modulus in kips/square foot

G_7_e, measured shear modulus in kips/square foot

G_8_e, measured shear modulus in kips/square foot

G_9_e, measured shear modulus in kips/square foot

G_10_e, measured shear modulus in kips/square foot

G_1_m, measured shear modulus in kilonewtons/square meters

G_2_m, measured shear modulus in kilonewtons/square meters

G_3_m, measured shear modulus in kilonewtons/square meters

G_4_m, measured shear modulus in kilonewtons/square meters

G_5_m, measured shear modulus in kilonewtons/square meters

G_6_m, measured shear modulus in kilonewtons/square meters

G_7_m, measured shear modulus in kilonewtons/square meters

G_8_m, measured shear modulus in kilonewtons/square meters

G_9_m, measured shear modulus in kilonewtons/square meters

G_10_m, measured shear modulus in kilonewtons/square meters
damping_strain_1, measured % strain for damping data

damping_strain_2, measured % strain for damping data

(***dynamic soil properties continued***)

damping_strain_3, measured % strain for damping data

damping_strain_4, measured % strain for damping data

damping_strain_5, measured % strain for damping data

damping_strain_6, measured % strain for damping data

damping_strain_7, measured % strain for damping data

damping_strain_8, measured % strain for damping data

damping_strain_9, measured % strain for damping data

damping_strain_10, measured % strain for damping data

Comment, Remarks from Report or from Entrant. Maximum of 250 characters

Geologic Origin, look-up table for materials table field

grain size: grain size data table

Structure_Id, unique number identifying structure for link to other tables, select from list

Borehole_Id, Unique number identifying borehole for link to other tables, default from borehole table.

English_metric, Identity of measurement system, English (E), Metric (M), enter correct unit type before entering each suite of data

Borehole_elev_ft, elevation of ground surface at borehole in feet

Borehole_elev_m, elevation of ground surface at borehole in meters

Depth_ft, depth of sample in feet

Depth_m, depth of sample in meters

Elev_ft, elevation in feet calculated, Borehole elevation – depth

(*grain size table continued*)

Elev_m, elevation in meters calculated, Borehole elevation – depth

75_mesh, percent passing size from sieves

50_mesh, percent passing size from sieves

37point5_mesh, percent passing size from sieves

25_mesh, percent passing size from sieves

19_mesh, percent passing size from sieves

9point5_mesh, percent passing size from sieves

4point75_mesh, percent passing size from sieves

2point36_mesh, percent passing size from sieves

2_mesh, percent passing size from sieves

1point18_mesh, percent passing size from sieves

9point5_mesh, percent passing size from sieves

point60_mesh, percent passing size from sieves

point425_mesh, percent passing size from sieves

point30_mesh, percent passing size from sieves

point15_mesh, percent passing size from sieves

point075_mesh, percent passing size from sieves

point02_mesh, percent passing size from sieves

point002_mesh, percent passing size from sieves

point01_mesh, percent passing size from sieves

silt_percent, calculated percent passing the .075mm sieve - percent passing the 0.002mm sieve

clay_percent, calculated percent passing the 0.002mm sieve

minus200-0point075percent, calculated percent passing the 0.075mm sieve

Comment, Remarks from Report or from Entrant. Maximum of 250 characters

Date_of_Record, Date Created or Changed AUTOMATICALLY GENERATED

INFRASTRUCTURE_MoDOT, look-up table of Missouri Department of Transportation structure types.

INFRASTRUCTURE_MSD**, look-up table of St. Louis Metropolitan Sewer District structure types.**

INFRASTRUCTURE_CORP, look-up table of U.S. Corps of Engineers structure types.

INTERSTATE ROUTES, look-up table of Missouri Department of Transportation route numbers

LANE DIRECTION, look-up table for highway lane directions.

LOW STRAIN TEST, look-up table of test types.

MATERIAL TYPE, look-up table of materials types

materials, materials description data table.

Structure_Id, unique number identifying structure for link to other tables, default from structure table

Borehole_Id, Unique number identifying borehole for link to other tables, default from borehole table

English_metric, Identity of measurement system, default from structure table

Borehole_elev_ft, elevation of ground surface at borehole in feet, default from borehole table

Borehole_elev_m, elevation of ground surface at borehole in meters, default from borehole table

(*materials table continued*)

Depth_top_ft, depth at top of stratum in feet

Depth_top_m, depth at top of stratum in meters

Elev_top_ft, calculated elevation in feet at top of stratum, Borehole elevation – depth

Depth_base_ft, depth at base of stratum in feet

Depth_base_m, depth at base of stratum in meters

Elev_base_ft, calculated elevation in feet at base of stratum, Borehole elevation – depth

Elev_base_m, calculated elevation in meters at base of stratum, Borehole elevation – depth

Geologic_Origin, Interpreted material genetic origin or source, when identified on the boring logs

Material_1, first material (noun) in description

Material_2, second material (noun) in description or adjective modifying first material (see instruction manual)

Material_3, third material (noun) in description or second noun if adjective was used as Material 2

Consistency, consistency of fine grained unconsolidated materials (very soft, soft, medium, stiff, very stiff, hard)-Material 1 only

Consistency_range, range of consistency of fine grained unconsolidated materials (very soft, soft, medium, stiff, very stiff, hard)-Material 1 only

Relative_density, relative density of coarse grained unconsolidated materials (very loose, loose, medium, dense, very dense)-Material 1 only
Relative_density_range, range of relative density of coarse grained unconsolidated materials (very loose, loose, medium, dense, very dense)-Material 1 only

Moisture_condition, moisture condition of unconsolidated material (dry, moist, wet)
Comment, Remarks from Report or from Entrant. Maximum of 250 characters.

Date_of_Record, Date Created or Changed AUTOMATICALLY GENERATED

MOISTURE CONDITION: look-up table for material moisture condition.

physical properties: data table of field and laboratory determined soil physical properties

Structure_Id, unique number identifying structure for link to other tables, default from structure table

Borehole_Id, Unique number identifying borehole for link to other tables, default from borehole table

English_metric, Identity of measurement system, default from structure table

Borehole_elev_ft, elevation of ground surface at borehole in feet, default from borehole table

Borehole_elev_m, elevation of ground surface at borehole in meters, default from borehole table

Depth_ft, depth of sample in feet

Depth_m, depth of sample in meters

Sample_elev_ft, elevation calculated, Borehole elevation – depth in feet

Sample_elev_m, elevation calculated, Borehole elevation – depth in meters

Blows_2, Standard penetration test, blows for second 6 inches

Blows_3, Standard penetration test, blows for third 6 inches

Nm, Standard penetration test, sum of blows from second and third 6 inches, calculated by program

Em, Standard penetration test, automatic hammer efficiency in %, default = 60

Ne_N60, N-value corrected to standard 60% SPT efficiency, refusal default to 100, calculate N60=(Em/60)xNm

PP, pocket penetrometer in kg/cm2 (same as TSF)

Torvane, torvane in kg/cm2 (same as TSF)

Qu_psf, unconfined compressive strength in pounds/sq. ft

(*physical properties table continued*)

Qu_metric, unconfined compressive strength in kilopascals

c_psf, drained shear strength in pounds/sq. ft

c_metric, drained shear strength in kilopascals

phi_angle, angle of internal friction

Cc, compression index

Cv_e, coefficient of consolidation, English (ft2/day)

Cv_m, coefficient of consolidation, metric (m2/year)

P1_e, pressure, English (kips/sf)

P1_m, pressure, metric (kPa)

Pc_e, preconsolidation pressure, English (kips/sf)

Pc_m, preconsolidation pressure, metric (kPa)

P2_e, pressure, English (kips/sf)

P2_m, pressure, metric (kPa)

e0, initial void ratio, may be on sheets as e0 or e1

ec, void ratio

e2, initial void ratio, may be on sheets as e0 or e1

less_than_200_percent, percent that passes a No. 200 (75micron) sieve; also calculate corresponding value and enter in grain size table

clay_percent, smaller than .002mm; also calculate corresponding value and enter in grain size table

silt_percent, smaller than .075mm and larger than .002mm; also calculate corresponding value and enter in grain size table

LL, liquid limit

PI, plasticity index

(physical properties table continued)

ASTM_class, ASTM or USCS class *from lab data*

Wn_percent, water content (percent)

Dry_unit_weight_english, dry unit weight (pcf)

Dry_unit_weight_metric, dry unit weight (kN/m3-kilonewtons per square meter)

Dry_unit_weight_method, method used to estimate dry weight

Comment, Remarks from Report or from Entrant. Maximum of 250 characters.

Date_of_Record, Date Created or Changed AUTOMATICALLY GENERATED

RELATIVE DENSITY: look-up table for density terms

SHEAR WAVE VELOCITY TESTS: look-up table for shear wave velocity test types

STRAIN DEPENDENT SHEAR TEST: look-up table for test type

structure: data table describing the project or structure that boring data are associated with and source agency identification.

Agency: Source of Data. These include: Missouri Department of Transportation (MoDOT), St. Louis Metropolitan Sewer District (MSD), St. Louis Bistate Development Agency (Metrolink), U, S. Army Corps of Engineers (CORPS OF ENGINEERS), and various environmental or geotechnical companies**.**

Agency_Type: Code for Form Setup (See Agency Table for Values)

Entrant: Person Entering the Information (Defaults to login ID); tom, Tom Mesko; KJ, Kevin James; jrc, Jere R. Cadoret, rlj, Rusty, L. Jones.

Date_Structure_Entered: Date Structure Entered into Database (Defaults to Entry Date)

Designation: For MoDOT: 2 char. Abbreviation for type of highway, US, Interstate (IS), State (MO), etc. otherwise Not Used (See Structure Type)

Route: For MoDOT: Primary hwy route # associated with feature (bridge, etc.)

(structure table continued)

Route_name: For MoDOT: Name of highway, route or street otherwise up to 34 Character Name of Infrastructure. Rp=Ramp.

County: County name

Design_No: Design Number (AKA Structure Number), DO NOT INCLUDE DASHES otherwise Up to 20 Characters of Project Code for Type of Infrastructure

Lane_Direction: For MoDOT: Divided hwy lane direction; E,W,N,S; U if undivided (default)

Structure_Id: Unique number for link to other tables. For MoDOT: created automatically by combining Designation, Route, design_# and direction, otherwise up to 30 characters Structure Identifier (MAY BE FULL PROJECT ID).

Structure_Type: For MoDOT: Bridge, culvert, retaining wall

Job_No: Job Number (AKA Project Number); If both, enter Job Number, include spaces and blanks

Date: Date of work from boring log. If more than one, enter date from first page.

Skew_degrees: bridge angle degrees (0-60); right angles, radially, none, other or blank default to 0

Skew_minutes: bridge angle minutes (0-60); right angles, radially, none, other or blank default to 0

Skew_seconds: bridge angle seconds (0-60): right angles, radially, none, other or blank default to 0

Skew_ahead: Left ahead (L), Right ahead (R), Other (O), right angles, radially, none, or blank default to blank

Structure_elev_ft: Structure_elev_ft

Structure_elev_m: elevation in meters

shape_type: point, line

English_metric: Identity of original measurement system, English (E), Metric (M)

(structure table continued)

Xutm_point: UTM easting in meters, NAD 83, Zone 15. All locations are as reported and have not been field checked. Blank where borings have unique xy.

Yutm_point: UTM northing in meters, NAD 83, Zone 15. All locations are as reported and have not been field checked. Blank where borings have unique xy.

UTM_Precision: Precision in meters to which point location has been obtained. All locations are as reported and have not been field checked. (*Currently, there are no precision report data associated with any supplied location information.)*

Xutm_line: UTM easting in meters, NAD 83, 2nd point for line feature, Zone 15. All locations are as reported and have not been field checked.

Yutm_line: UTM northing in meters, NAD 83, 2nd point for line feature, Zone 15. All locations are as reported and have not been field checked.

NS_Point_StatePlane: North-South State Plane (Zone determined by County). *(This data set only has coordinates in UTM NAD 1983, Zone 15 to date.)*

EW_Point_StatePlate: East-West State Plane (Zone determined by County) *(This data set only has coordinates in UTM NAD 1983 Zone 15, to date.)*

StatePLane_Precision: Precision in meters to which point location has been obtained. *(This data set only has coordinates in UTM NAD 1983 Zone 15, to date.)*

NS_Line_StatePlane: North-South State Plane (Zone determined by County). *(This data set only has coordinates in UTM NAD 1983 Zone 15, to date.)*

EW_Line_StatePlane: North-South State Plane (Zone determined by County). *(This data set only has coordinates in UTM NAD 1983 Zone 15, to date.)*

Point_Longitude: Geographic coordinates in Decimal Degrees. *(This data set only has coordinates in UTM NAD 1983 Zone 15, to date.)*

Point_Latitude: Geographic coordinates in Decimal Degrees. *(This data set only has coordinates in UTM NAD 1983 Zone 15, to date.)*

Geographic_Precision: Percent.

Line_Longitude: Geographic coordinates in Decimal Degrees. *(This data set only has coordinates in UTM NAD 1983 Zone 15, to date.)*

Line_Latitude: Geographic coordinates in Decimal Degrees. *(This data set only has coordinates in UTM NAD 1983 Zone 15, to date.)*

Comment: Remarks on Structure not included above. Remarks from Report or from Entrant. Maximum of 250 characters.

Date_of_Record: Date Created or Changed. Automatically generated.

STRUCTURE TYPE: look-up table

US ROUTES: look-up table

water: data table for groundwater level data.

Structure_Id: unique number identifying structure for link to other tables, default from structure table

Borehole_Id: Unique number identifying borehole for link to other tables, default from borehole table

English_metric: Identity of measurement system, default from structure table

Borehole_elev_ft: elevation of ground surface at borehole in feet, default from borehole table

Borehole_elev_m: elevation of ground surface at borehole in meters, default from borehole table

Depth_hole_open_ft: depth to bottom of open hole in feet

Depth_hole_open_m: depth to bottom of open hole in meters

Elev_hole_open_ft: elevation of bottom of open hole in feet

Elev_hole_open_m: elevation of bottom of open hole in meters

Depth_to_water_ft: depth to water in feet last observation

Depth_to_water_m: depth to water in meters last observation

Elev_water_ft: elevation of water in feet last observation

Elev_water_m: elevation of water in meters last observation

Date_last: date of final observation

Time_change_hrs: time since boring completion in decimal hours

Comment: Remarks from Report or from Entrant. Maximum of 250 characters.

Date_of_Record: Date Created or Changed. Automatically generated.

Geographic Information System Export Tables

The database also has seven data table objects that have been abbreviated for export to Geographic Information System (GIS) files. Some versions of GIS software will not directly import MS Access 97 tables where the first part of a field name is too similar to other field names. For example, the **borehole** table has fields named **Borehole_Number**, **Borehole_Id**, **Borehole_Entry_Date**, **Borehole_elev_ft**, **Borehole_elev_m.** When a table is imported to some GIS software the field names will be truncated to **Borehol1 Borehol2, Borehol3 and Borehol4.** The original database was not necessarily planned for incorporation into a GIS system, and more current versions of MS Access will import to GIS software directly without shortening field names. Each record in the export tables has UTM NAD 1983, Zone 15 X-Y coordinates.

export_borehole: borehole data table shortened to 15 fields.

Struc_Id: Unique number identifying structure for link to other tables, For MoDOT created automatically by data entry program by combining Designation, route, design_# and direction. Otherwise entered directly

Eng_met: Identity of measurement system, English (E), Metric (M), automatically entered from structure table

Bh_Num: Agency Identifier For Bolehole --- NOT USED for MoDOT Used for other Agencies to Build UNIQUE Borehole_ID

Bh_Id: Unique number identifying borehole for link to other tables. For MoDOT created automatically by data entry program by combining Structure_Id, Station_survey, Offset_dist_ft (or _m) and Offset_direction; Otherwise ProjectID, JobId and BoreHole_Number

BhDate: When Borehole was entered into system.

ft_Hole_Elev: elevation of ground surface at borehole in feet

m_Hole_Elev: elevation of ground surface at borehole in meters

ft_Hole_Depth: Depth of hole in feet

m_Hole_Depth: Depth of hole in meters.

(export_borehole table continued)

ft_BedRckDep: Depth to bedrock in feet.

m_BedRckDep: Depth to bedrock in meters.

BedRckDetm: How depth to bedrock was determined. Derived, depth found by query of first interval of rock from materials table.

TbedRckMtl: Top of bedrock material type

Xutm_point: UTM easting in meters, NAD 83, Zone 15. The locations are as reported and have not been field verified.

Yutm_point: UTM northing in meters, NAD 83, Zone 15. The locations are as reported and have not been field verified.

export_corelog: rock core data table.

Struc_Id: Unique number identifying structure for link to other tables, For MoDOT created automatically by data entry program by combining Designation, route, design_# and direction. Otherwise entered directly

Bh_Id: Unique number identifying borehole for link to other tables. For MoDOT created automatically by data entry program by combining Structure_Id, Station_survey, Offset_dist_ft (or _m) and Offset_direction; Otherwise ProjectID, JobId and Borehole_Number

Eng_met: Identity of measurement system, English (E), Metric (M), automatically entered from structure table

ft_Bh_elev: elevation of ground surface at borehole in feet, default from borehole table

m_Bh_elev: elevation of ground surface at borehole in meters, default from borehole table

ft_From: Depth at top of core run in feet

m_From: Depth at top of core run in meters

ft_Elev_from: calculated elevation at top of core run, Borehole elevation – depth

m_Elev_from: calculated elevation at top of core run, Borehole elevation – depth

To_ft: Depth at bottom of core run in feet

(export_corelog table continued)

To_m: Depth at bottom of core run in meters

ft_Elev_to: calculated elevation at bottom of core run, Borehole elevation – depth

m_Elev_to: calculated elevation at bottom of core run, Borehole elevation – depth

Run_ft: Length of core run in feet

Run_m: Length of core run in meters

ft_Recovered: Length of core recovered in feet

m_Recovered: Length of core recovered in meters

ft_Loss: Length of core lost in feet

m_Loss: Length of core lost in meters

Recovery_percent: Percent of core recovered, calculated (run - recovery)

RQD_percent: Rock quality designation in percent

Comment: Remarks from Report or from Entrant. Maximum of 250 characters

Date_of_Record: Date Created or Changed automatically generated.

Xutm_point: UTM easting in meters, NAD 83, Zone 15. The locations are as reported and have not been field verified.

Yutm_point: UTM northing in meters, NAD 83, Zone 15. The locations are as reported and have not been field verified.

export_grain_size: grain size table.

Struc_Id, unique number identifying structure for link to other tables, select from list

Bh_Id, borehole in which transmitter is located for cross-hole test or where borehole samples were collected for laboratory tests, select from list

Eng_met, Identity of number system, English (E), Metric (M), enter correct unit type before entering each suite of data

(export_grain size table continued)

ft_Bh_elev, elevation of ground surface at borehole in feet

m_Borehole_elev, elevation of ground surface at borehole in meters

ft_Depth, depth of sample in feet

m_Depth, depth of sample in meters

ft_Elev, elevation in feet calculated, Borehole elevation – depth

m_Elev, elevation in meters calculated, Borehole elevation – depth

75_mesh, percent passing size from sieves

50_mesh, percent passing size from sieves

37point5_mesh, percent passing size from sieves

25_mesh, percent passing size from sieves

19_mesh, percent passing size from sieves

9point5_mesh, percent passing size from sieves

4point75_mesh, percent passing size from sieves

2point36_mesh, percent passing size from sieves

2_mesh, percent passing size from sieves

1point18_mesh, percent passing size from sieves

9point5_mesh, percent passing size from sieves

point60_mesh, percent passing size from sieves

point425_mesh, percent passing size from sieves

point30_mesh, percent passing size from sieves

point15_mesh, percent passing size from sieves

point075_mesh, percent passing size from sieves

(export_ grain size table continued)

point02_mesh, percent passing size from sieves

point002_mesh, percent passing size from sieves

point01_mesh, percent passing size from sieves
silt_percent, calculated percent passing the .075mm sieve - percent passing the 0.002mm sieve

clay_percent, calculated percent passing the 0.002mm sieve

minus200-0point075percent, calculated percent passing the 0.075mm sieve

Comment, Remarks from Report or from Entrant. Maximum of 250 characters

Date_of_Record, Date Created or Changed. Automatically generated.

Xutm_point: UTM easting in meters, NAD 83, Zone 15. The locations are as reported and have not been field verified.

Yutm_point: UTM northing in meters, NAD 83, Zone 15. The locations are as reported and have not been field verified.

export_materials: materials data table

Struc_Id, unique number identifying structure for link to other tables, default from structure table

Bh_Id, Unique number identifying borehole for link to other tables, default from borehole table

Eng_met, Identity of measurement system, default from structure table

ft_Bh_elev, elevation of ground surface at borehole in feet, default from borehole table

m_Bh_elev, elevation of ground surface at borehole in meters, default from borehole table

ft_Depth_top, depth at top of stratum in feet

m_Depth_top, depth at top of stratum in meters

(export_materials table continued)

ft_Elev_top, calculated elevation in feet at top of stratum, Borehole elevation - depth

m_Elev_top, calculated elevation at top of stratum, Borehole elevation – depth

ft_Depth_base, depth at base of stratum in feet

m_Depth_base, depth at base of stratum in meters
ft_Elev_base, calculated elevation in feet at base of stratum, Borehole elevation – depth

m_Elev_base, calculated elevation in meters at base of stratum, Borehole elevation – depth

Geo_Origin, Interpreted material genetic origin or source, where identified on the boring log

Mat_1, first material (noun) in description

Mat_2, second material (noun) in description or adjective modifying first material (see instruction manual)

Mat_3, third material (noun) in description or second noun if adjective was used as Material 2

Consist, consistency of fine grained unconsolidated materials (very soft, soft, medium, stiff, very stiff, hard)-Material 1 only

ConsistRg, range of consistency of fine grained unconsolidated materials (very soft, soft, medium, stiff, very stiff, hard)-Material 1 only

Rel_dens, relative density of coarse grained unconsolidated materials (very loose, loose, medium, dense, very dense)-Material 1 only

RelDensRg, range of relative density of coarse grained unconsolidated materials (very loose, loose, medium, dense, very dense)-Material 1 only

MoistCond, moisture condition of unconsolidated material (dry, moist, wet)

Xutm_point: UTM easting in meters, NAD 83, Zone 15. The locations are as reported and have not been field verified.

Yutm_point: UTM northing in meters, NAD 83, Zone 15. The locations are as reported and have not been field verified.

export_phys_prop, data table of field and laboratory determined soil physical properties

Struc_Id, unique number identifying structure for link to other tables, default from structure table

Bh_Id, Unique number identifying borehole for link to other tables, default from borehole table

Eng_met, Identity of number system, default from structure table

ft_Bh_elev, elevation of ground surface at borehole in feet, default from borehole table

m_Bh_elev, elevation of ground surface at borehole in meters, default from borehole table.

ft_Depth, depth of sample in feet

m_Depth, depth of sample in meters

Sample_elev_ft, elevation calculated, Borehole elevation – depth in feet

Sample_elev_m, elevation calculated, Borehole elevation – depth in meters

Blows_2, Standard penetration test, blows for second 6 inches

Blows_3, Standard penetration test, blows for third 6 inches

Nm, Standard penetration test, sum of blows from second and third 6 inches, calculated by program

Em, Standard penetration test, automatic hammer efficiency in %, default = 60

Ne_N60, N-value corrected to standard 60% SPT efficiency, refusal default to 100, calculate N60=(Em/60)xNm

PP, pocket penetrometer in kg/cm2 (same as TSF)

Torvane, torvane in kg/cm2 (same as TSF)

Qu_psf, unconfined compressive strength in pounds/sq. ft

Qu_metric, unconfined compressive strength in kilopascals

c_psf, drained shear strength in pounds/sq. ft

(export_physical properties table continued)

c_metric, drained shear strength in kilopascals

phi_angle, angle of internal friction

Cc, compression index

Cv_e, coefficient of consolidation, English (ft2/day)

Cv_m, coefficient of consolidation, metric (m2/year)

P1_e, pressure, English (kips/sf)

P1_m, pressure, metric (kPa)

Pc_e, preconsolidation pressure, English (kips/sf)

Pc_m, preconsolidation pressure, metric (kPa)

P2_e, pressure, English (kips/sf)

P2_m, pressure, metric (kPa)

e0, initial void ratio, may be on sheets as e0 or e1

ec, void ratio

e2, initial void ratio, may be on sheets as e0 or e1

less_than_200_percent, percent that passes a No. 200 (75micron) sieve; also calculate corresponding value and enter in grain size table

clay_percent, smaller than .002mm; also calculate corresponding value and enter in grain size table

silt_percent, smaller than .075mm and larger than .002mm; also calculate corresponding value and enter in grain size table

LL, liquid limit

PI, plasticity index

ASTM_class, ASTM or USCS class *from lab data*

(export_physical properties table continued)

Wn_percent, water content (percent)

Dry_unit_weight_english, dry unit weight (pcf)

Dry_unit_weight_metric, dry unit weight (kN/m3-kilonewtons per square meter)

Dry_unit_weight_method, method used to estimate dry weight

Comment, Remarks from Report or from Entrant. Maximum of 250 characters.

Date_of_Record, Date Created or Changed. Automatically generated

Xutm_point: UTM easting in meters, NAD 83, Zone 15. The locations are as reported and have not been field verified.

Yutm_point: UTM northing in meters, NAD 83, Zone 15. The locations are as reported and have not been field verified.

export_Vs: seismic cone penetrometer determined shear wave velocity data. Excerpted from the dynamic properties data table.

Struc_Id, unique number identifying structure for link to other tables, default from structure table

Eng_met, Identity of measurement system, default from structure table

Bh_Id, Unique number identifying borehole for link to other tables, default from borehole table

Xutm_point: UTM easting in meters, NAD 83, Zone 15. The locations are as reported and have not been field verified.

Yutm_point: UTM northing in meters, NAD 83, Zone 15. The locations are as reported and have not been field verified.

ft_Bh_elev, elevation of ground surface at borehole in feet, default from borehole table

m_Bh_elev, elevation of ground surface at borehole in meters, default from borehole table

ft_Depth, depth of sample in feet

(export_Vs table continued)

m_Depth, depth of sample in meters

ft_Sample_elev, elevation calculated, Borehole elevation - depth in feet

m_Sample_elev, elevation calculated, Borehole elevation - depth in meters

type_swv_test, type of shear wave velocity test; SCPT, ReMi, MASW, crosshole. *Only SCPT results are in the data table to date*.

Vs_e, shear wave velocity in ft/s

Vs_m, shear wave velocity in m/s

Comment, Remarks from Report or from Entrant. Maximum of 250 characters

export_water: water level data table

Struc_Id, unique number identifying structure or project for link to other tables, default from structure table

Bh_Id, Unique number identifying borehole for link to other tables, default from borehole table

Eng_met, Identity of measurement system, default from structure table

ft_Bh_elev, elevation of ground surface at borehole in feet, default from borehole table

m_Bh_elev, elevation of ground surface at borehole in meters, default from borehole table

ft_dpth_open, depth to bottom of open hole in feet

m_dpth_open, depth to bottom of open hole in meters

ft_Dpth_to_water, depth to water in feet last observation

m_Dpth_to_water, depth to water in meters last observation

ft_Elev_water, elevation of water in feet last observation

m_Elev_water, elevation of water in meters last observation

Date_last, date of final observation

Time_change_hrs, time since boring completion in decimal hours

Comment, Remarks from Report or from Entrant. Maximum of 250 characters.

Date_of_Record, Date Created or Changed. Automatically generated.

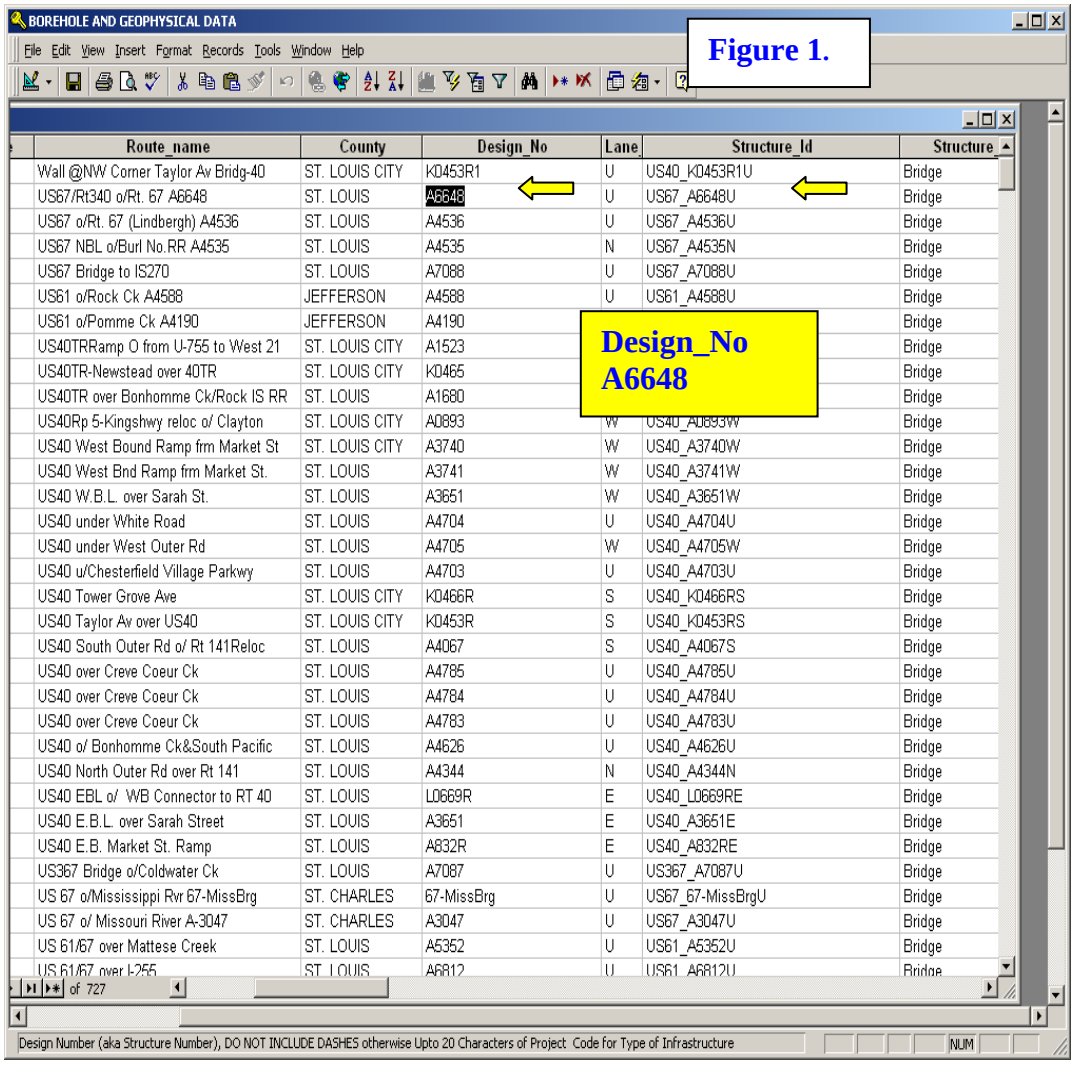
Xutm_point: UTM easting in meters, NAD 83, Zone 15. The locations are as reported and have not been field verified.

Yutm_point: UTM northing in meters, NAD 83, Zone 15. The locations are as reported and have not been field verified.

APPENDIX B

How to Locate Scanned Borehole Files

All boring Id numbers have a portion of their Id that is the same as the scanned document file name. These numbers are found in the data tables in either the field named "**Design_No**" or, "**Structure_Id**" depending on the original data source. There are instances where the "**Design_No**" record is blank and the "**Structure_Id**" became the source for the file and boring Id number. This section describes how to search the accompanying scanned log files using the **Design_No** or **Structure_Id** to find log images and any accompanying records.



Route_name	County	Design_No	Lane	Structure_Id	Structure
Wall @NW Corner Taylor Av Bridg-40	ST. LOUIS CITY	K0453R1	U	US40_K0453R1U	Bridge
US67/Rt340 o/Rt. 67 A6648	ST. LOUIS	A6648	U	US67_A6648U	Bridge
US67 o/Rt. 67 (Lindbergh) A4536	ST. LOUIS	A4536	U	US67_A4536U	Bridge
US67 NBL o/Burl No.RR A4535	ST. LOUIS	A4535	N	US67_A4535N	Bridge
US67 Bridge to IS270	ST. LOUIS	A7088	U	US67_A7088U	Bridge
US61 o/Rock Ck A4588	JEFFERSON	A4588	U	US61_A4588U	Bridge
US61 o/Pomme Ck A4190	JEFFERSON	A4190			Bridge
US40TRRamp O from U-755 to West 21	ST. LOUIS CITY	A1523			Bridge
US40TR-Newstead over 40TR	ST. LOUIS CITY	K0465			Bridge
US40TR over Bonhomme Ck/Rock IS RR	ST. LOUIS	A1680			Bridge
US40Rp 5-Kingshwy reloc o/ Clayton	ST. LOUIS CITY	A0893	W	US40_A0893W	Bridge
US40 West Bound Ramp frm Market St	ST. LOUIS CITY	A3740	W	US40_A3740W	Bridge
US40 West Bnd Ramp frm Market St.	ST. LOUIS	A3741	W	US40_A3741W	Bridge
US40 W.B.L. over Sarah St.	ST. LOUIS	A3651	W	US40_A3651W	Bridge
US40 under White Road	ST. LOUIS	A4704	U	US40_A4704U	Bridge
US40 under West Outer Rd	ST. LOUIS	A4705	W	US40_A4705W	Bridge
US40 u/Chesterfield Village Parkwy	ST. LOUIS	A4703	U	US40_A4703U	Bridge
US40 Tower Grove Ave	ST. LOUIS CITY	K0466R	S	US40_K0466RS	Bridge
US40 Taylor Av over US40	ST. LOUIS CITY	K0453R	S	US40_K0453RS	Bridge
US40 South Outer Rd o/ Rt 141Reloc	ST. LOUIS	A4067	S	US40_A4067S	Bridge
US40 over Creve Coeur Ck	ST. LOUIS	A4785	U	US40_A4785U	Bridge
US40 over Creve Coeur Ck	ST. LOUIS	A4784	U	US40_A4784U	Bridge
US40 over Creve Coeur Ck	ST. LOUIS	A4783	U	US40_A4783U	Bridge
US40 o/ Bonhomme Ck&South Pacific	ST. LOUIS	A4626	U	US40_A4626U	Bridge
US40 North Outer Rd over Rt 141	ST. LOUIS	A4344	N	US40_A4344N	Bridge
US40 EBL o/ WB Connector to RT 40	ST. LOUIS	L0669R	E	US40_L0669RE	Bridge
US40 E.B.L. over Sarah Street	ST. LOUIS	A3651	E	US40_A3651E	Bridge
US40 E.B. Market St. Ramp	ST. LOUIS	A832R	E	US40_A832RE	Bridge
US367 Bridge o/Coldwater Ck	ST. LOUIS	A7087	U	US367_A7087U	Bridge
US 67 o/Mississippi Rvr 67-MissBrg	ST. CHARLES	67-MissBrg	U	US67_67-MissBrgU	Bridge
US 67 o/ Missouri River A-3047	ST. CHARLES	A3047	U	US67_A3047U	Bridge
US 61/67 over Mattese Creek	ST. LOUIS	A5352	U	US61_A5352U	Bridge
US 61/67 over I-255	ST. LOUIS	A6812	U	US61_A6812U	Bridge

of 727

Figure 1. The database "**structure**" table and fields as scanned document source file names, are consistent with all MoDOT site records. The yellow arrows indicate the file names for the scanned logs.

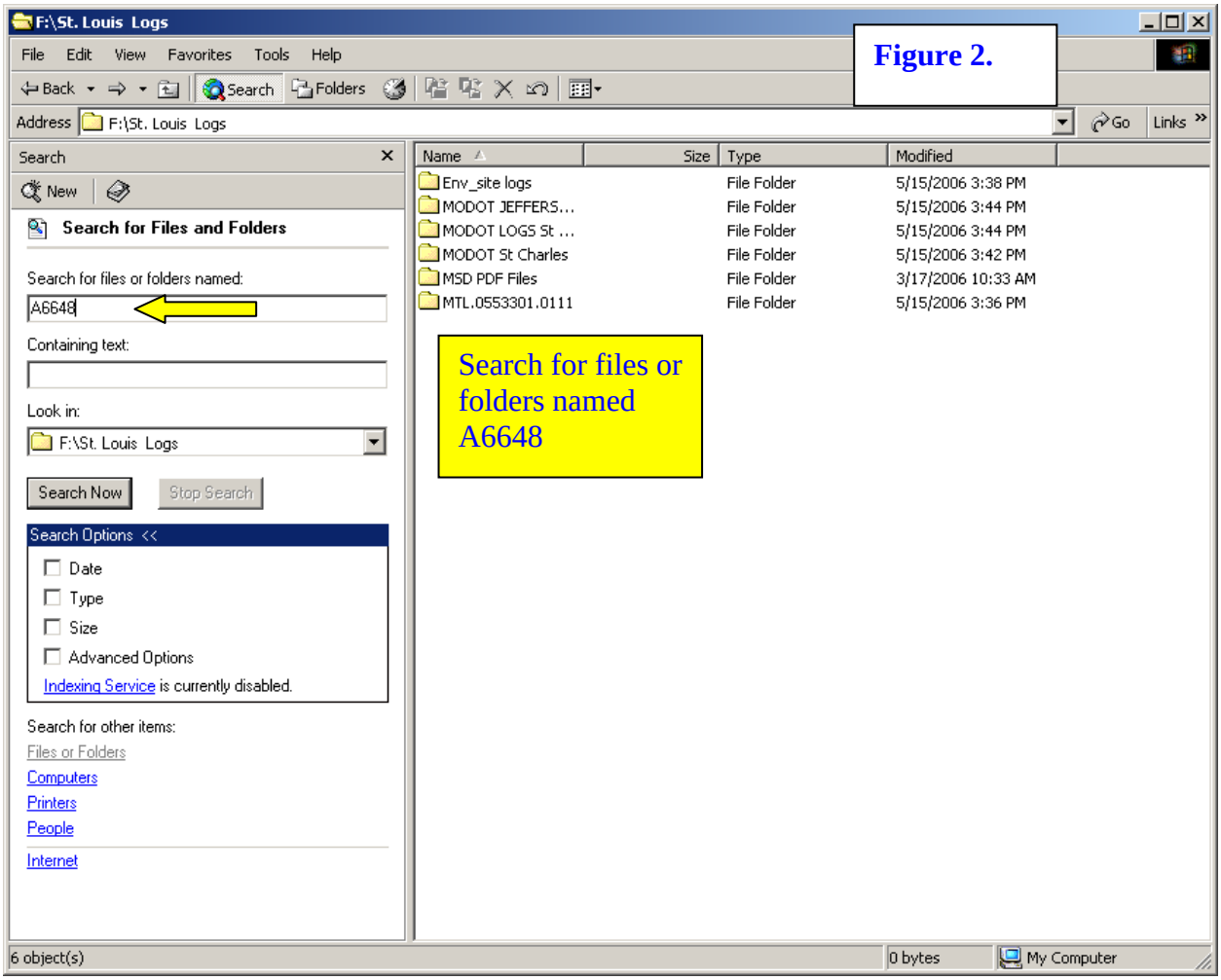


Figure 2. Type the "**Design_No**" in the Windows search dialog box to locate the files or folder with the scanned log records.

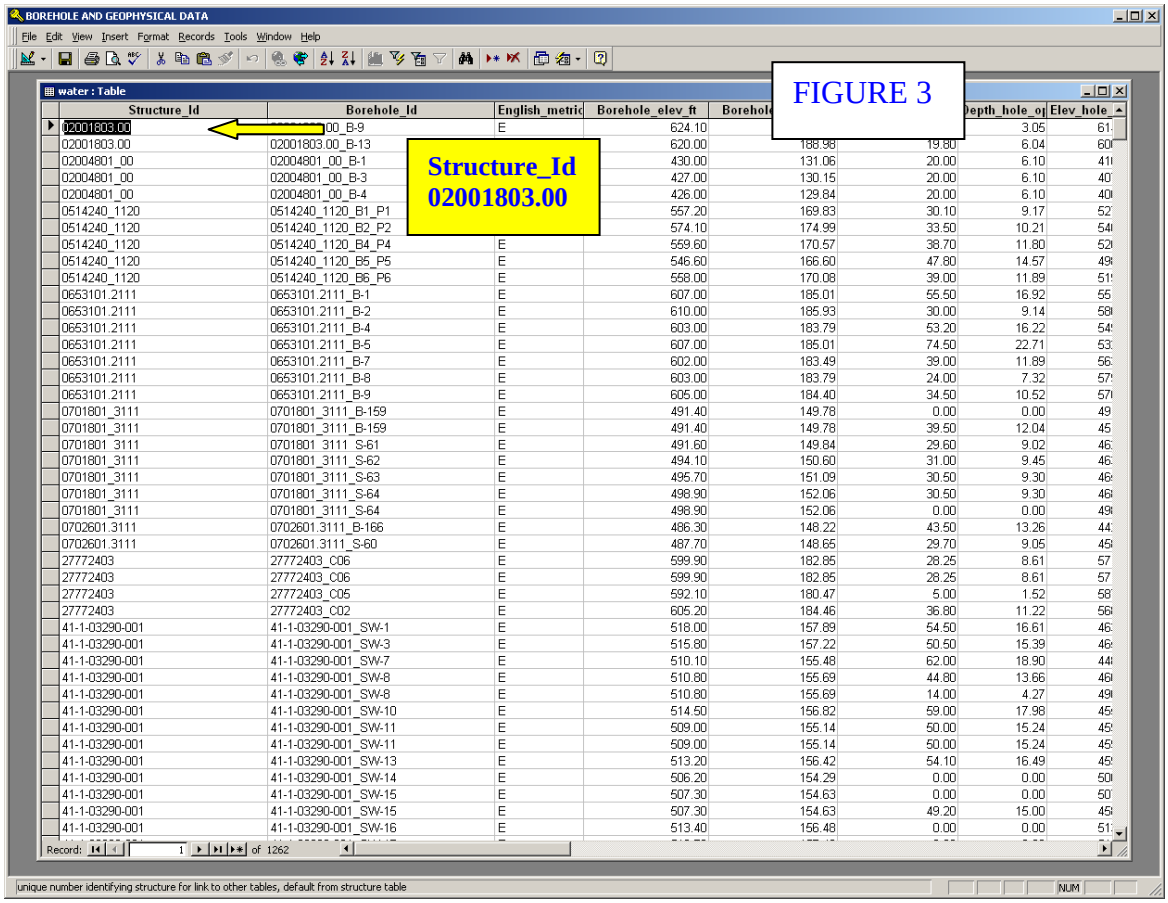


FIGURE 3. Some records do not have structure or design numbers in the "**structure"** table. In these cases the search for scanned log records must be based on the **structure_Id** from the **borehole** table. This illustration is from the **water** data table.

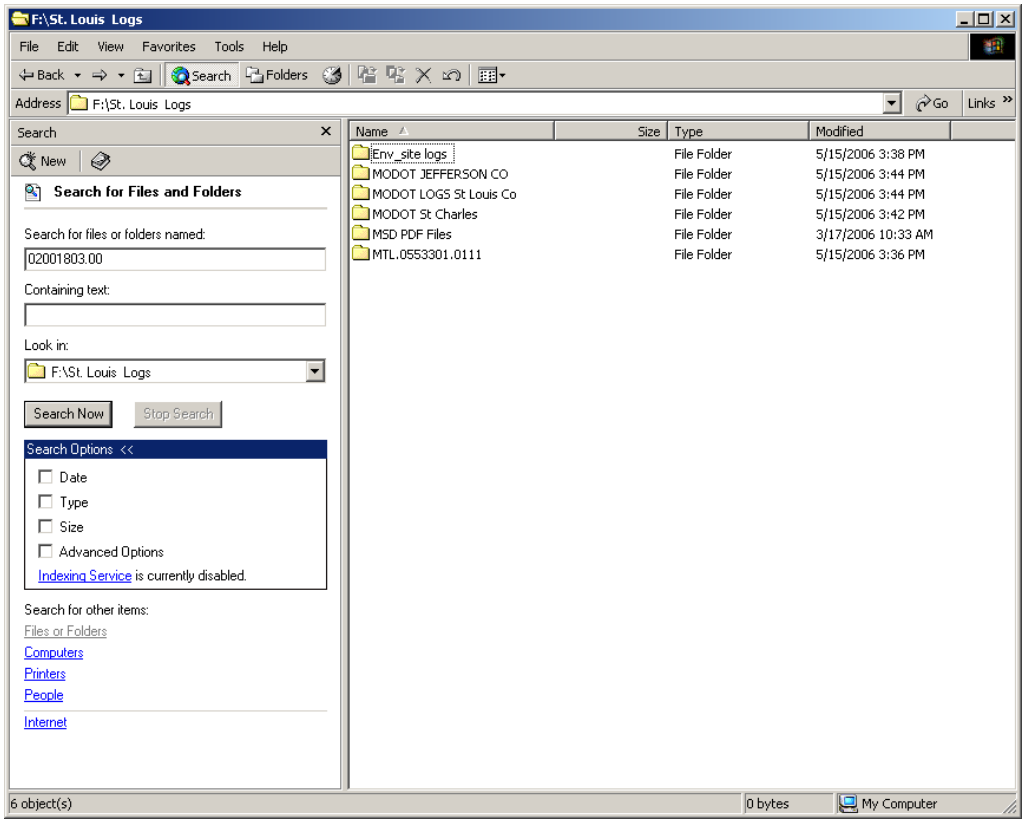


FIGURE 4. The search dialog box only contains the **Structure_Id** and all scanned log folders.

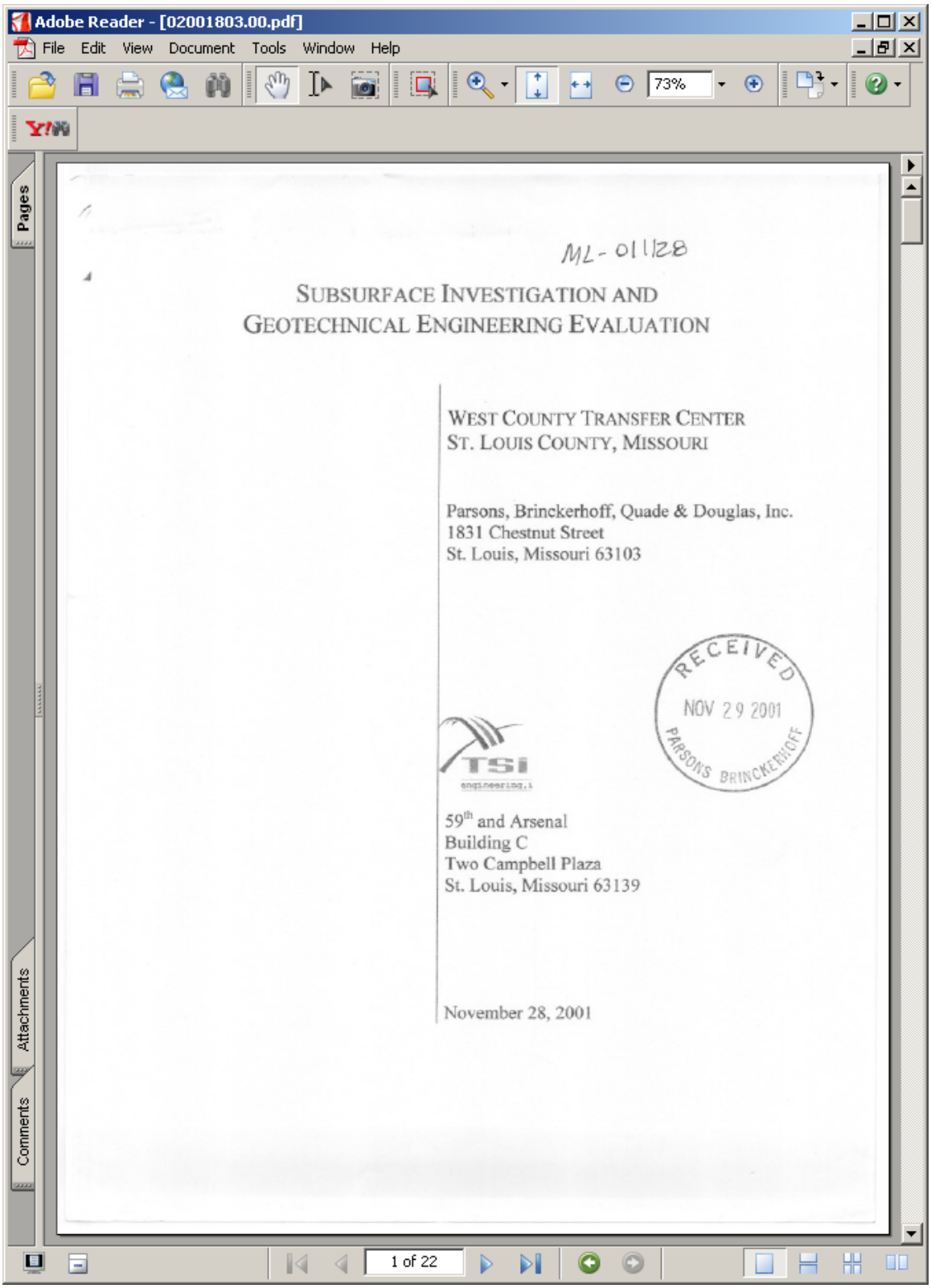


FIGURE 5. The search identifies the scanned source document portable document file (*.pdf).

APPENDIX C

SURFICIAL MATERIAL GEOLOGIC MAP OF THE WENTZVILLE 7.5-MINUTE QUADRANGLE, ST. CHARLES COUNTY, MISSOURI