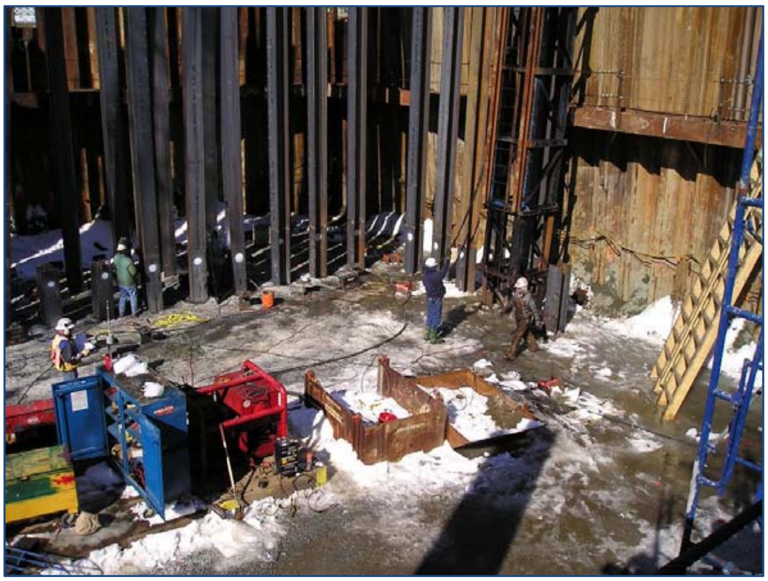
16 State House Station
Augusta, Maine 04333

Transportation Research Division



Technical Report 14-01, Phase 1

Development and Evaluation of Pile "High Strain Dynamic Test Database" to Improve Driven Capacity Estimates

Phase 1 Report *January 2014*

Technical Report Documentation Page

1. Report No. ME 14-01, Phase I	2.	3. Recipient's Accession No.
4. Title and Subtitle Development and Evaluation of Pile "High Strain Dynamic Test Database" to Improve Driven Capacity Estimates: Phase I Report		5. Report Date January 2014 6.
7. Author(s) Thomas Sandford, PhD, P.E. and Cameron Stuart, EIT		8. Performing Organization Report No.
9. Performing Organization Name and Address University of Maine, Orono, ME 04469		10. Project/Task/Work Unit No. 11. Contract © or Grant (G) No.
12. Sponsoring Organization Name and Address Maine Department of Transportation		13. Type of Report and Period Covered 14. Sponsoring Agency Code
15. Supplementary Notes		

16. Abstract (Limit 200 words)

The Maine Department of Transportation (MaineDOT) has noted poor correlation between predicted pile resistances calculated using commonly accepted design methods and measured pile resistance from dynamic pile load tests (also referred to as high strain dynamic tests) conducted in accordance with ASTM D-4945. This report details Phase I of a two phase project that aims to analyze dynamic load test data for piles driven into Maine soils in order to improve calculation methods used in the design phase. The purpose of Phase I was to collect and compile information about pile driving projects from around the state into a comprehensive database. The MaineDOT can designers can then search the database for projects and/or piles of interest. The finished database includes information about the project location, pile material and dimensions, driving system, soil materials and strengths, and pile capacities determined from testing.

17. Document Analysis/Descriptors		18. Availability Statement	
19. Security Class (this report)	20. Security Class (this page)	21. No. of Pages 29	22. Price

Development and Evaluation of Pile "High Strain Dynamic Test Database" to Improve Driven Capacity Estimates: Phase I Report

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1. Introduction

The Maine Department of Transportation (MaineDOT) has noted poor correlation between predicted pile resistances calculated using commonly accepted design methods and measured pile resistance from dynamic pile load tests (also referred to as high strain dynamic tests) conducted in accordance with ASTM D-4945. This report details Phase I of a two phase project that aims to analyze dynamic load test data for piles driven into Maine soils in order to improve calculation methods used in the design phase. The purpose of Phase I was to collect and compile information about pile driving projects from around the state into a comprehensive database. The MaineDOT can designers can then search the database for projects and/or piles of interest. The finished database includes information about the project location, pile material and dimensions, driving system, soil materials and strengths, and pile capacities determined from testing.

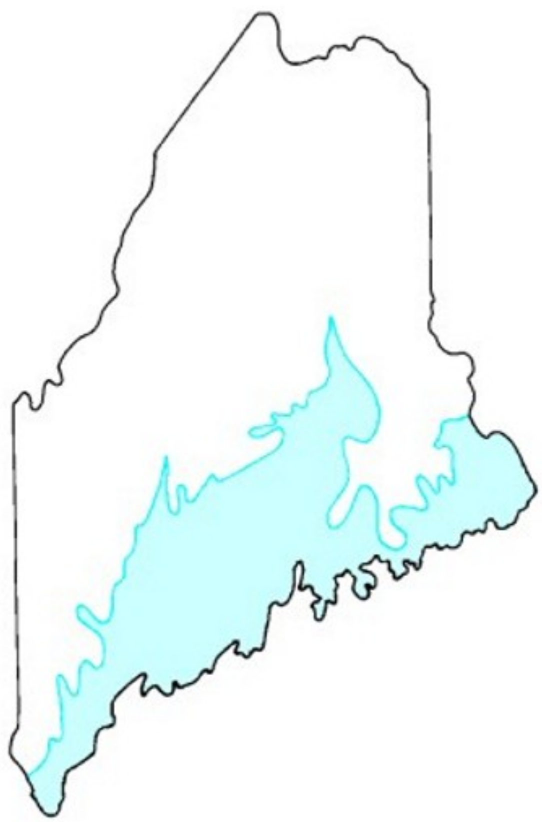
2. Geological Soil and Rock Profile of Maine

Soil profiles around the state vary greatly, and are composed of soils deposited by glacial deposition or marine precipitation or both. Some soil may also have been deposited from rivers, lakes, or ocean bottom sediments. The deposits range in thickness, and do not occur in all portions of the state. For example, the coastal region of Maine has the most diverse subsurface composition in the state. The typical soil profile along the coast is characterized in ascending order as “till, ice-contact stratified drift, sub-aqueous outwash, silt and clay of the Presumpscot Formation, and sub-aerial outwash” (Smith 1985). However, in the western portions of the state there are soil profiles that consist of entirely glacial till.

2.1. Formation of Glacial Soils

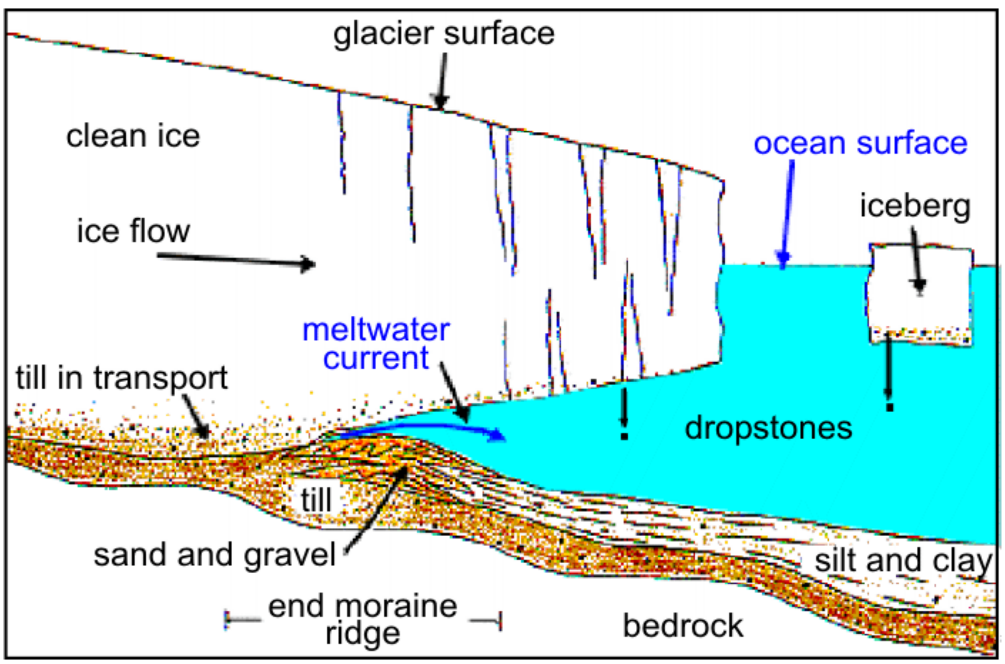
Approximately 35,000 years ago the Late Wisconsinan glaciers began moving into Maine in a South Easterly direction. As the glacier moved towards the coast it deposited glacial till material over the existing soil surface. Approximately 21,000 years ago global warming caused the glaciers to begin retreating (Maine Geological Survey 2005). The retreating glacial ice formed end moraines and eskers composed of glacial tills up to 31 miles inland (Caldwell et al 1985).

Figure 1: Delineation of the Marine Limit at 13,000 to 12,500 BP (Maine Geological Survey 2005)



The retreat of the glacial ice fronts left the ground heavily compressed, and allowed for the sea water to move inland. The ocean moved inland about 95 miles creating a boundary known as the marine limit (Caldwell et al 1985). The extent of the marine limit at about 13,000 to 12,500 before present (Schnitker and Borns 1987) is show in **Error! Reference source not found.**. The marine advancement is denoted by the shaded portion of the state. This inland advancement of the sea and deposition of soil from the retreating glaciers led to the deposition of marine clay and silts. The large boulders, gravels and sands were deposited near the glacial-marine interface by the glacial melt-water, while the smaller clay and silt particles were deposited further out to sea and covered the previously deposited till.

Figure 2: Glacial Deposition Processes (Maine Geological Survey 2005) from Thompson (1987)



2.2. Recent Deposits: Post Glacial Soils

Some soils encountered across the state were deposited after the glaciers had fully retreated. There are layers of sands and clays deposited across the state from sedimentation in marine and fresh water environments. The marine deposits tend to be loose fine sands, weak clays, and decaying organic matter (i.e. shell fragments, decaying plant life etc.). Soils from marine deposition typically have low strength values. Rivers deposit gravels and coarse sands upstream near the mountainous regions of the state, and they deposit fine sands and silts closer to the coast. The strengths of these deposits depend on their composition, but are generally weaker than the soils deposited during glaciations. Lake deposits are similar to the marine depositions, however can be found in spots across the state.

2.3. Major Soil Classifications

To maintain serviceability of the database and perform calculations in an efficient manner it is necessary to combine soil types into generalized categories. Soil layers are categorized with other layers that share similar properties and behavioral characteristics. The soils are categorized as either cohesive (i.e. clays and loose wet silts), granular (i.e. sands, gravels, dense or sandy silts), till, and bedrock. The following sections describe theses categories in more detail providing derivation limits and generalized properties of the soils.

2.3.1. Cohesive Soils and the Presumpscot Formation

Although there are many different cohesive soil deposits throughout the state, the most common is the Presumpscot Formation. This deposit is composed of predominantly silt and clay, however, near the marine limit it can contain an appreciable about of fine sand. It is almost exclusively found within the boundary of the marine limit formed during the most recent deglaciation. The thickness of this formation varies greatly due to the heterogeneous surface topography at the time of deposition. There are some areas of the coastal region void of the clay due to large peaks in topography during the time of marine advancement. These peaks formed islands with the high sea level, which prevented the clay from being deposited in these locations. The Presumpscot Formation has been observed be up to 98 feet think, and is believed to have maximum thicknesses of over 200 feet in spots (Thompson 1987). As the glacial front retreated, the weight of the ice dissipated and the bedrock rose. This uplifted the clay layer above sea level, causing the sea water to subside towards its present level.

The Presumpscot Formation has been found to be composed of 5-40% clay, 20-80% silt, and 10-50% sand (Schnitker and Borns 1987). Most commonly the silt and clay grain sizes are dominant at about 60% and 30% of the total layer respectively. The formation has low undrained shear strengths due to its deposition in marine conditions with subsequent uplifting. Table 1 presents undrained shear strengths and the ratio of undrained shear strength to overburden pressure for a site in Portland, Maine. As the table shows, the strength of the clay decreases as from the top of the layer to a depth of about 40 feet. From 40 feet down the strength of the clay increases. The high strength at the top of the layer can be explained by the desiccation of the clay upon uplifting. As the clay was thrust upward, the pore water at the top of the layer dissipated creating a stiff crust-like layer above the clay. This does not occur everywhere, but is fairly common in the state within the marine limit. Laboratory test have shown that the remolded shear strength of the deposit is 15-35% of the undisturbed shear strength (Andrews 1987).

Table 1: Undrained Shear Strengths of Presumpscot Clays in Portland Maine (Andrews 1987)

Depth (feet)	Su (psf)	Su/p
Top of layer	< 2000	N/A
30	420	.41
40	335	.24
50	445	.23
60	555	.23
70	645	.23
80	750	.23

The post-glacial cohesive layers deposited by lake, river, and ocean bottom sedimentation, are also clumped into this cohesive soil category. Upon analysis of the boring logs provided by

MaineDOT, it is evident that these deposits behave similarly to the Presumpscot Formation (excluding the stiff crust), and exhibit similar strength values. These deposits are not confined within the marine limit and may be found throughout the state.

2.3.2. Granular Soils

The granular soils category comprises of gravel, sands, and sandy silts with little to no cohesion values. The deposition methods of the soils included in this category vary greatly, but due to their structures and negligible cohesion values they exhibit similar behavior. Some sands and gravels are deposited in eskers that develop within the tunnels formed by glacial melt-water. Eskers are easily identified as they developed as narrow ridges that protrude above the ground surface. The esker ridges tend to snake in the direction of the receding glacial front. Others sands and gravels were deposited in glacial outwash formations that created more widespread layering. Outwash formations are glacial melt-water soils that were deposited at the head of the glacial front. These soils can typically be found within the marine limit. Post-glacial deposits (depositional processes described in Section 2.2) are also lumped into this general granular soil classification.

The strength of granular soils can vary greatly from deposit to deposit, but as stated above they mostly behave in a similar manner. They generally drain better than cohesive soils, and pore pressure build up is not a significant factor. The loss of strength in when driving piles through granular soils is also much less than the strength loss observed when driving through cohesive soils. The effective friction angle of loose fine grained sands is expected to be smaller than that of dense gravel. The angularity of the soil grains, the depositional process, grain size distribution, and past loading will all affect the measured effective friction angle of the soil.

2.3.3. Till

Glacial till in Maine is a widespread deposit throughout the state and is the main constituent in the soil above the aforementioned marine limit. The deposit is a well graded and unsorted material. It is composed of soil particles ranging in size from boulders to fine silt and clay particles. The till material was carried throughout the glacier, the tills that were deposited from the base of the glaciers are referred to as basal till. This type of till often called “hard pan” is very dense and overconsolidated due to weight of the glacier resting above. This dense till intuitively has poor permeability. The tills that were carried near the surface of the glacier were deposited due to melting and thus are less dense than basal till. This type of till is referred to as ablation till. This till is loose with fair permeability. Although these tills have different properties, their composition is very difficult to predict from site to site. For this reason the basal till and ablation till are combined into a single till grouping in the database.

The effective friction angle of the till grouping ranges from 32° to 38° with a corresponding soil cohesion values range of 0.0 to 0.4 tons per square foot (Linell and Shea 1960). These values are for till that has been passed through the #4 sieve, so in till where larger particles are present it is expected that the strength of the soil will increase slightly. The peak strength of the soil occurs at a strain of 2% for non plastic till and 20% strain for till with appreciable fines (Linell and Shea 1960).

2.3.4. Bedrock

The type of bedrock that lays beneath these soil layers varies in composition across the state. The bedrock at the top of the state has experienced only a slight amount of metamorphism, but it transitions to highly metamorphosed rock toward the southern portions of the state. The metamorphic bedrock tends to consist of gneiss and schist, and is found with at varying grades of metamorphism throughout the majority of the state. The lowly metamorphosed bedrock in the northern portion of the state consists of sandstone, slate, and limey shale. There are also areas in the state with intrusive igneous bedrock. The igneous rock in the state is mostly granite and can be found along the coast and in the mountainous regions of the state. It is mostly concentrated in Oxford, Androscoggin, Cumberland, Hancock, and Washington counties as well as around the Katahdin mountain region.

The compressive strength of bedrock governs the end bearing capacity of a pile. Generally a pile driven to high quality intact bedrock will be provided with enough compressive strength to safely transmit the load from pile. However, when low quality rock with an appreciable about of fractures and weathering could provide less bearing capacity than expected. Typically it can be expected that high quality igneous or metaphoric rock with little to no weathering will be stronger than carbonate and sedimentary bedrock with the same physical appearance.

3. Overview of the Database

The database was populated from dynamic testing reports provided by the MaineDOT. The reports contain information about the pile(s) being tested, the driving system, the PDA reading, and both CASE and CAPWAP capacity estimates. Information from each of these categories were collected and input to the database. The dynamic tests were conducted on piles from piers and abutments from bridge projects throughout the state. Table 2 presents a list of the bridge projects included in the database as of August 31, 2012

Date	Project ID	Location	Date	Project ID	Location	Date	Project ID	Location
20060105	10119.00	Alna-Newcastle	20090709	12633.00	Gardiner	19940912	116.00	Portland
20020515	7626.00	Ashland	20010419	7956.00	Georgetown	20110502	15106.00	Portland
20090626	15600.00	Auburn	20010319	7959.00	Georgetown	20040308	7598.30	Portland
20100706	17092.00	Auburn	20091210	15619.00	Gilead	20030610	10160.00	Pownal
20010119	7738.00	Auburn	20080401	8150.00	Gorham	20040629	8973.00	Salem
20030820	556.20	Augusta	20080310	8151.00	Gorham	20050419	10091.00	Sangerville
20030403	556.22	Augusta	20100630	15096.00	Grand Lake Stream	20100202	15609.00	South Berwick
20030903	556.24	Augusta	20050902	10106.00	Jackman	20110304	16749.00	South Berwick
19980217	2393.20	Bath	20041020	9005.00	Kennebunk	20080214	10988.00	South Portland
20050601	10516.11	Bethel	20050721	10183.00	Kingfield	20070119	5143.00	South Portland
20040227	7492.00	Biddeford	20080421	11069.00	Leeds	20070213	5143.00	South Portland
20000420	7570.00	Biddeford	20060626	11069.00	Leeds	20100211	16745.00	South Thomaston
20101215	12630.00	Boothbay	20040513	10189.00	Lisbon	20091218	15610.00	Standish
20030613	10144.00	Bridgeton	20090826	15100.00	Lisbon	19990803	4976.00	Taunton & Raynham Grant
19960503	1665.00	Brunswick	20040823	10085.00	Mattamiscontis	20040212	7965.00	Verona Island
20000425	7567.00	Brunswick	20080331	10086.00	Medway	20040209	7965.00	Verona Island
20070809	8483.32	Calais	20110420	16716.00	Monmouth	20040717	10053.00	Washburn
20030827	10103.00	Canaan	20080918	13405.00	Moro Plantation	20050408	10169.00	Wells
20110705	15618.00	Canaan	20111011	11060.00	Naples	20110928	17085.00	Wilton
20110928	18202.00	Carrabassett Valley	20090707	12635.00	New Portland	20050120	10172.00	Yarmouth
20110920	18206.00	Carrabassett Valley	20110607	15625.00	Newport	20010724	4259.00	Yarmouth
20030724	8986.00	Carthage	20090512	6900.00	Norridgewock	20070420	14523.00	York
20090414	15623.00	Etna	19990709	6863.00	North Yarmouth	20070222	14523.10	York
20100503	15094.00	Falmouth	20030102	7574.00	Ogunquit	20091119	15110.00	York
20100813	15095.00	Fryeburg	20090528	11043.00	Old Town	20110110	15112.00	York
20120417	17872.00	Fryeburg	20070731	12661.00	Old Town	20030320	8983.00	York
20050823	8988.56	Fryeburg	20090513	10014.00	Poland			

There was typically at least one pile tested at end of drive per abutment or pile group, however, larger projects sometimes included multiple tests on the same structure. Some piles did not reach acceptable capacities in which case redrive tests were conducted to ensure that the capacities were met, and the pile was not damaged. Steel H-piles are commonly used in areas where glacial till is prevalent, while cylindrical steel piles are commonly used near the coast where sands and glacial till are more prevalent.

The database contains the following information from each report (where applicable):

Project Identification

- Electronic file name of the report
- Date of testing
- MaineDOT project identification number
- Project Location
- Structure the pile is located in
- Pile identification number

Pile Information

- Type (material & shape)
- Size
- Batter (horizontal to vertical slope or plumb)
- Length (feet)

Hammer and Driving Information

- Hammer Type
- Make
- Model
- Hammer weight (pounds)
- Stroke (feet)
- Fuel setting
- Transfer energy (kip-feet)
- Blow count (blow per inch)

PDA Information

- Type of test (end of drive, beginning of restrike, etc.)
- Driven pile depth (feet)
- Stress at the top of the pile (ksi)
- Stress at the pile toe (ksi)

Pile Capacity

- CASE capacity
- CAPWAP total capacity
- CAPWAP skin friction
- CAPWAP end bearing

Soil Profiles

- Soil Type
- Depth to top of layer (feet)
- Depth to bottom of layer (feet)
- Strength of layer
    - Average standard penetration test value
    - Field vane values for clays (where applicable)

4. Capabilities of the Database

Upon opening the database file, the user will be brought to the "Welcome" page which allows the user to search or add new data to the database. The "Search" button activates a search form that allows the user to filter through the test information. This function filters through the test information and returns all data matching the user's criteria to "Results" in the same workbook. The search tool was written in Excel Visual Basic for Applications (VBA) which is available in most versions of Microsoft Excel. The code is essentially composed of user created macros that have been modified to loop through the rows and columns of the database to meet the needs of the search tool. The code is written in general enough terms that it can search though any new rows of data added to the database. This allows the user to add data as new tests are conducted. The first step in the search process is to select the data of interest from the list at the top of the form. Figure 3 illustrates how to select the "Data of Interest" from the database's search tool. For this example project ID, location, structure, and pile ID were selected from the list. After the "Search" button is clicked, the data displayed on the "Results" page will correspond to the search parameters. Figure 4 shows the "Results" page for the data selected in Figure 3. The user can then filter the selected data by date, text, or numerical values.

Figure 3: Selecting Data of Interest in the Database

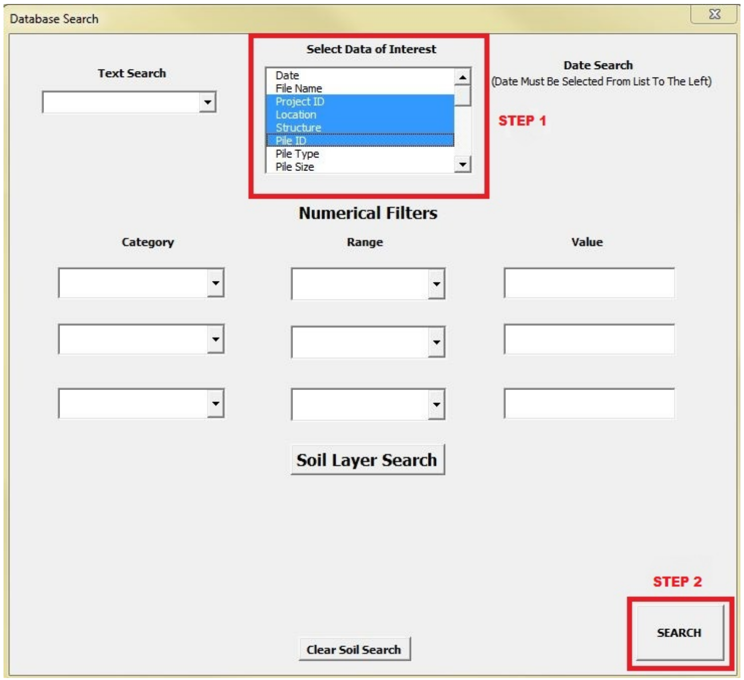
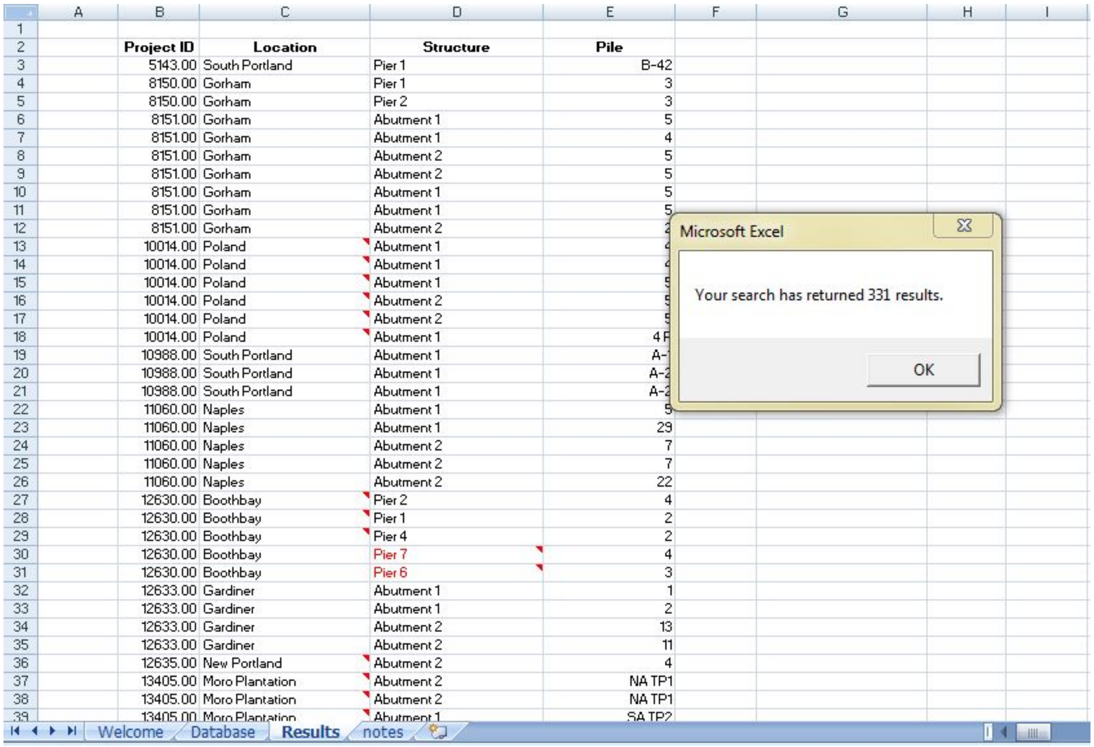


Figure 4: Results of Selected Data of Interest



	A	B	C	D	E
1					
2		Project ID	Location	Structure	Pile
3		5143.00	South Portland	Pier 1	B-42
4		8150.00	Gorham	Pier 1	3
5		8150.00	Gorham	Pier 2	3
6		8151.00	Gorham	Abutment 1	5
7		8151.00	Gorham	Abutment 1	4
8		8151.00	Gorham	Abutment 2	5
9		8151.00	Gorham	Abutment 2	5
10		8151.00	Gorham	Abutment 1	5
11		8151.00	Gorham	Abutment 1	5
12		8151.00	Gorham	Abutment 2	[illegible]
13		10014.00	Poland	Abutment 1	[illegible]
14		10014.00	Poland	Abutment 1	[illegible]
15		10014.00	Poland	Abutment 1	[illegible]
16		10014.00	Poland	Abutment 2	[illegible]
17		10014.00	Poland	Abutment 2	[illegible]
18		10014.00	Poland	Abutment 1	4 [illegible]
19		10988.00	South Portland	Abutment 1	A-[illegible]
20		10988.00	South Portland	Abutment 1	A-[illegible]
21		10988.00	South Portland	Abutment 1	A-[illegible]
22		11060.00	Naples	Abutment 1	5
23		11060.00	Naples	Abutment 1	29
24		11060.00	Naples	Abutment 2	7
25		11060.00	Naples	Abutment 2	7
26		11060.00	Naples	Abutment 2	22
27		12630.00	Boothbay	Pier 2	4
28		12630.00	Boothbay	Pier 1	2
29		12630.00	Boothbay	Pier 4	2
30		12630.00	Boothbay	Pier 7	4
31		12630.00	Boothbay	Pier 6	3
32		12633.00	Gardiner	Abutment 1	1
33		12633.00	Gardiner	Abutment 1	2
34		12633.00	Gardiner	Abutment 2	13
35		12633.00	Gardiner	Abutment 2	11
36		12635.00	New Portland	Abutment 2	4
37		13405.00	Moro Plantation	Abutment 2	NA TP1
38		13405.00	Moro Plantation	Abutment 2	NA TP1
39		13405.00	Moro Plantation	Abutment 1	SA TP2

The “Date Search” can filter for information before or after a specified date or all data that occurs within a given timeframe. It is important to note that for the “Date Search” filter to function properly it must be selected from the “Select Data of Interest” list. The data range input by the user must also be in a specific format that has the four digit year first followed by the two digit month and two digit day (YYYYMMDD). Figure 5 demonstrates how to find projects within a specified date range. In this example a list of pile tests conducted between January 1, 2008 and January 1, 2009 is desired. The first step is to select the data of interest, making sure to include “Date” as a selection. The second step is to enter 20080101 and 20090101 as the starting and ending date respectively. After clicking “Search,” the projects matching the criteria are returned to the “Results” tab. The results of the specified date search are shown in Figure 6.

Figure 5: Searching Database for a Selected Data Range

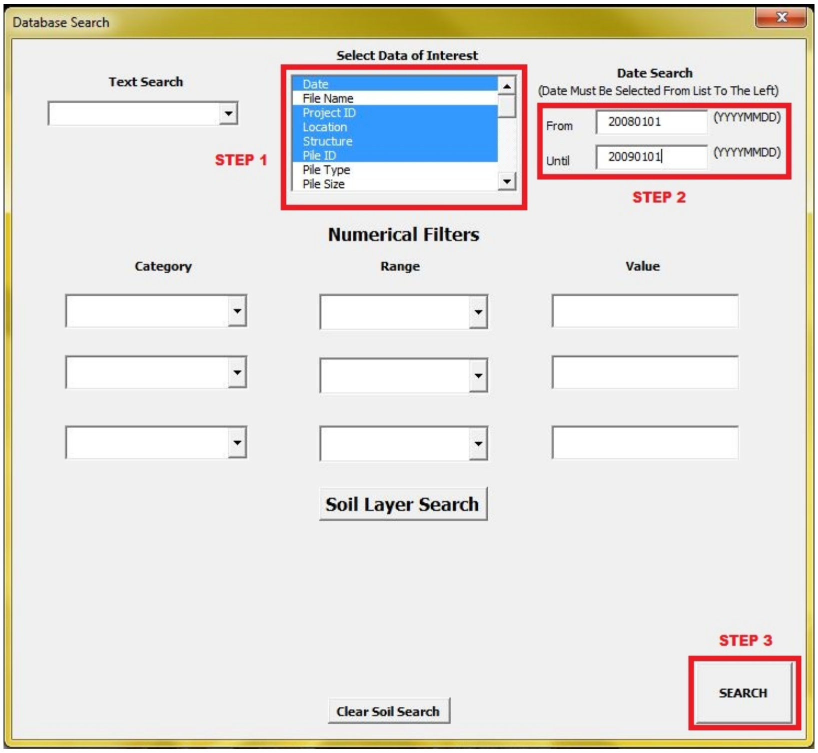
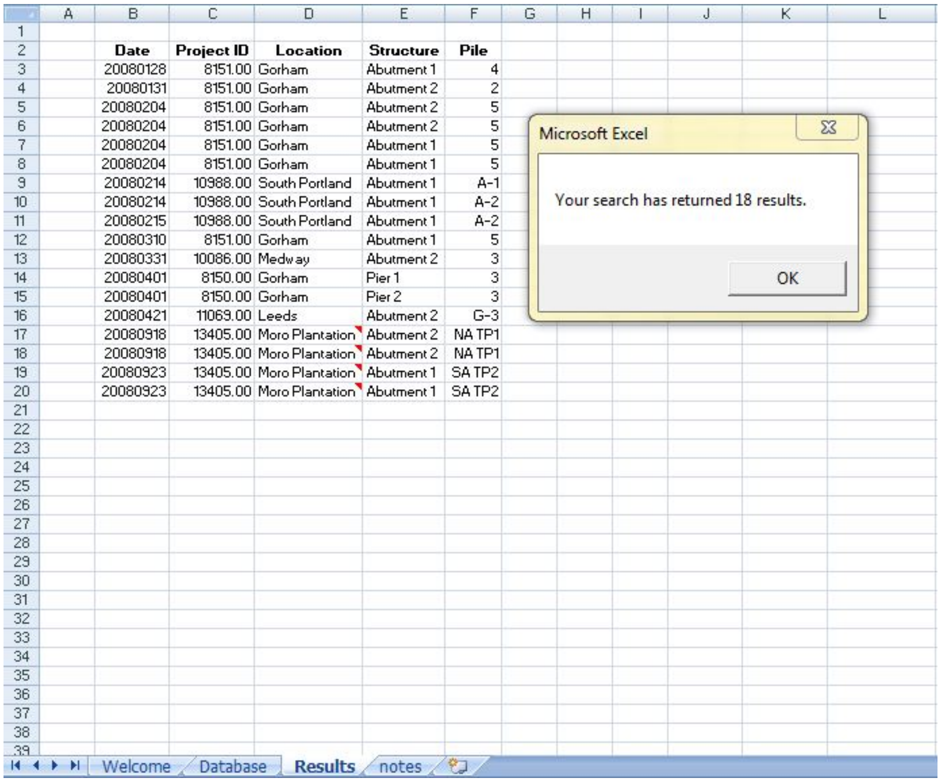


Figure 6: Results of the Date Search



Date	Project ID	Location	Structure	Pile
20080128	8151.00	Gorham	Abutment 1	4
20080131	8151.00	Gorham	Abutment 2	2
20080204	8151.00	Gorham	Abutment 2	5
20080204	8151.00	Gorham	Abutment 2	5
20080204	8151.00	Gorham	Abutment 1	5
20080204	8151.00	Gorham	Abutment 1	5
20080214	10988.00	South Portland	Abutment 1	A-1
20080214	10988.00	South Portland	Abutment 1	A-2
20080215	10988.00	South Portland	Abutment 1	A-2
20080310	8151.00	Gorham	Abutment 1	5
20080331	10086.00	Medway	Abutment 2	3
20080401	8150.00	Gorham	Pier 1	3
20080401	8150.00	Gorham	Pier 2	3
20080421	11069.00	Leeds	Abutment 2	G-3
20080918	13405.00	Moro Plantation	Abutment 2	NA TP1
20080918	13405.00	Moro Plantation	Abutment 2	NA TP1
20080923	13405.00	Moro Plantation	Abutment 1	SA TP2
20080923	13405.00	Moro Plantation	Abutment 1	SA TP2

The database can be filtered by up to three numerical values (e.g. pile lengths greater than 120 feet with a measured CAPWAP skin friction greater than 200 kips that were driven using a hammer weight equal to 4100 lbs.). This example of numerically filtering the database is illustrated in Figure 7. The numerical filters work by first selecting the category that should be filtered. The categories are chosen from a drop down list in the first column. This places the search tool in the correct column of the database. The user then selects the data range of interest from dropdown lists in the second column. The search tool can find all data greater than or equal to, equal to, or less than or equal to a specified value within the selected category. These values must be input to the textboxes in the third column in English units as specified by the category selected. Figure 8 shows the results of the example using numerical filters. It should be noted that the selected numerical filter categories should not be chosen from the "Select Data of Interest" list. If it is selected, there will be duplication of filtered columns presented in the results. Figure 9 and Figure 10 show the input and output screens respectively for a duplication error when filtering by pile length.

Figure 7: Using Numerical Filters for Searching the Database

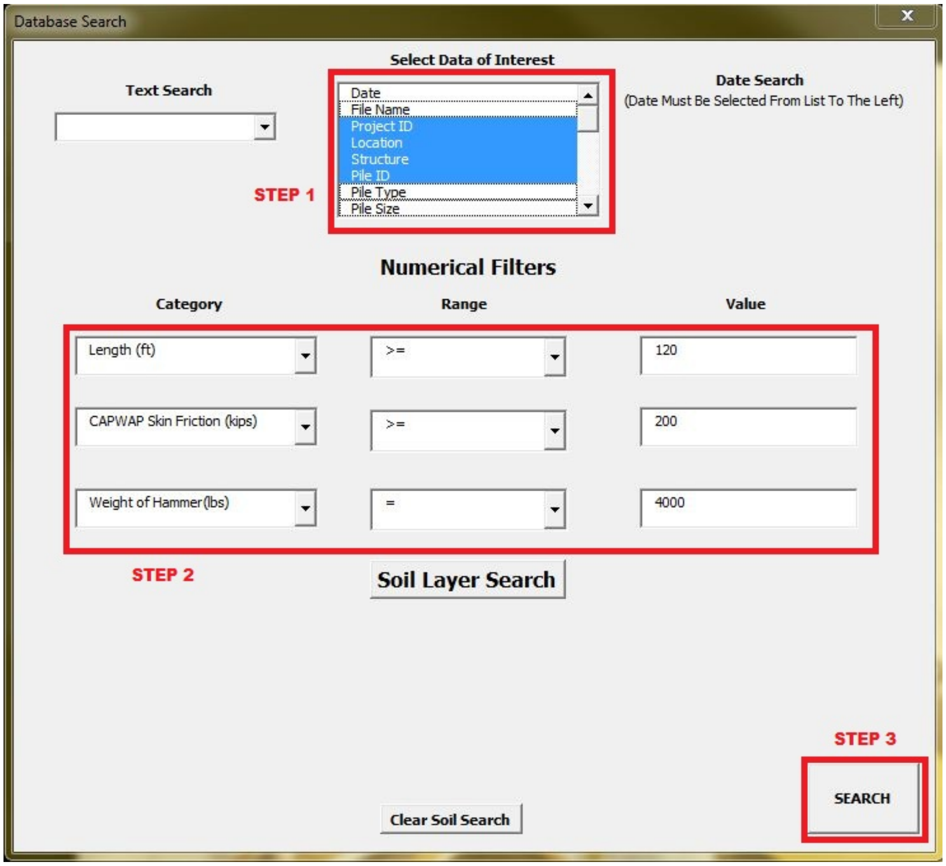
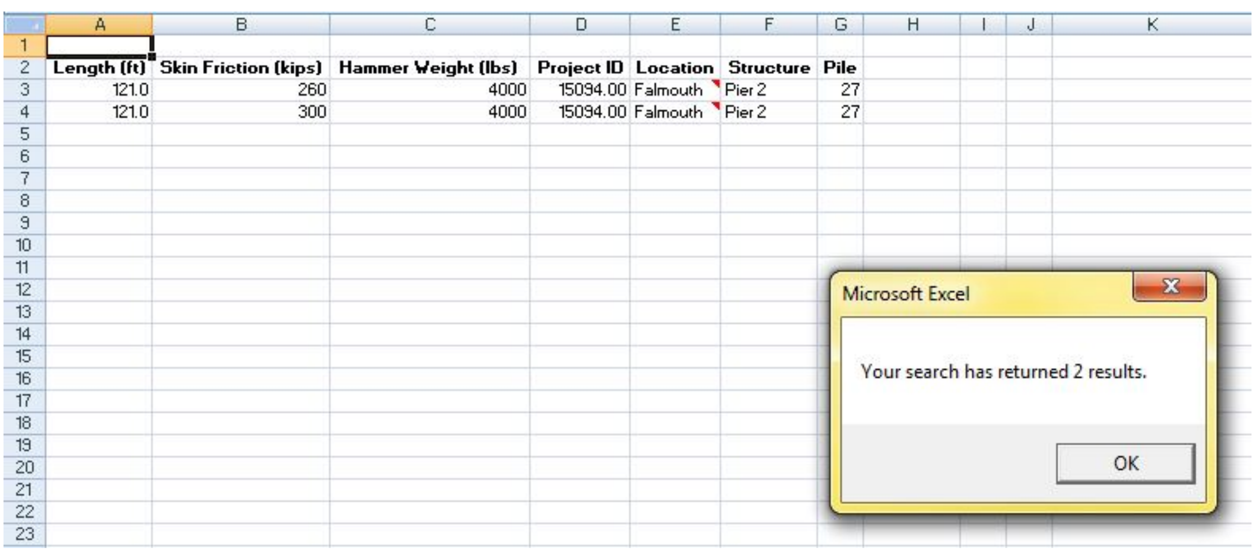


Figure 8: Results of Numerical Filtering



Length (ft)	Skin Friction (kips)	Hammer Weight (lbs)	Project ID	Location	Structure	Pile
121.0	260	4000	15094.00	Falmouth	Pier 2	27
121.0	300	4000	15094.00	Falmouth	Pier 2	27

Figure 9: Example of Duplication Error in Database Search

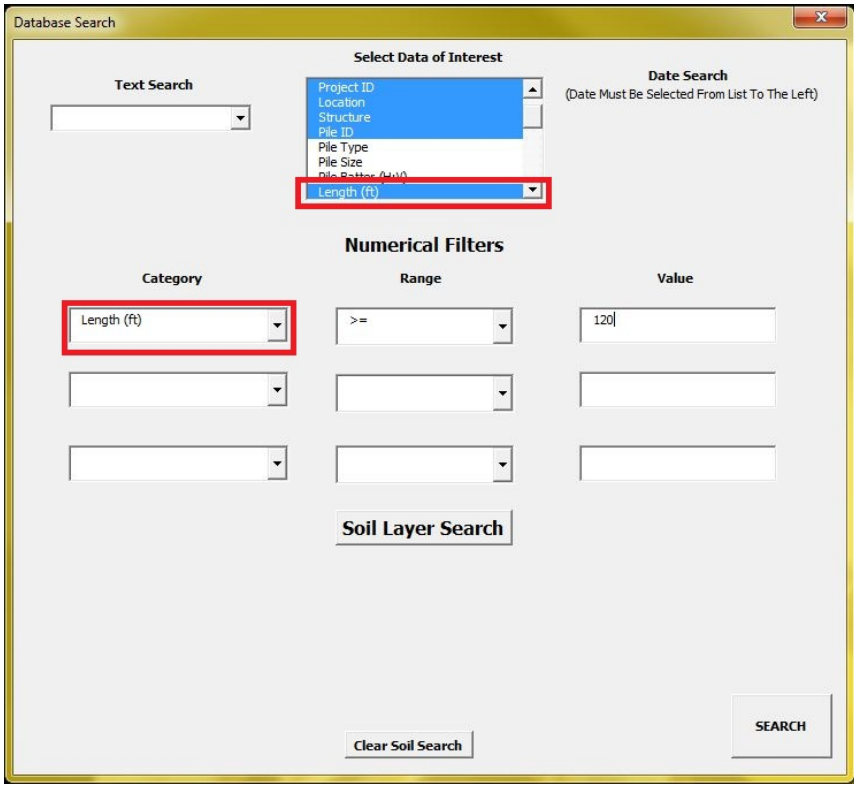
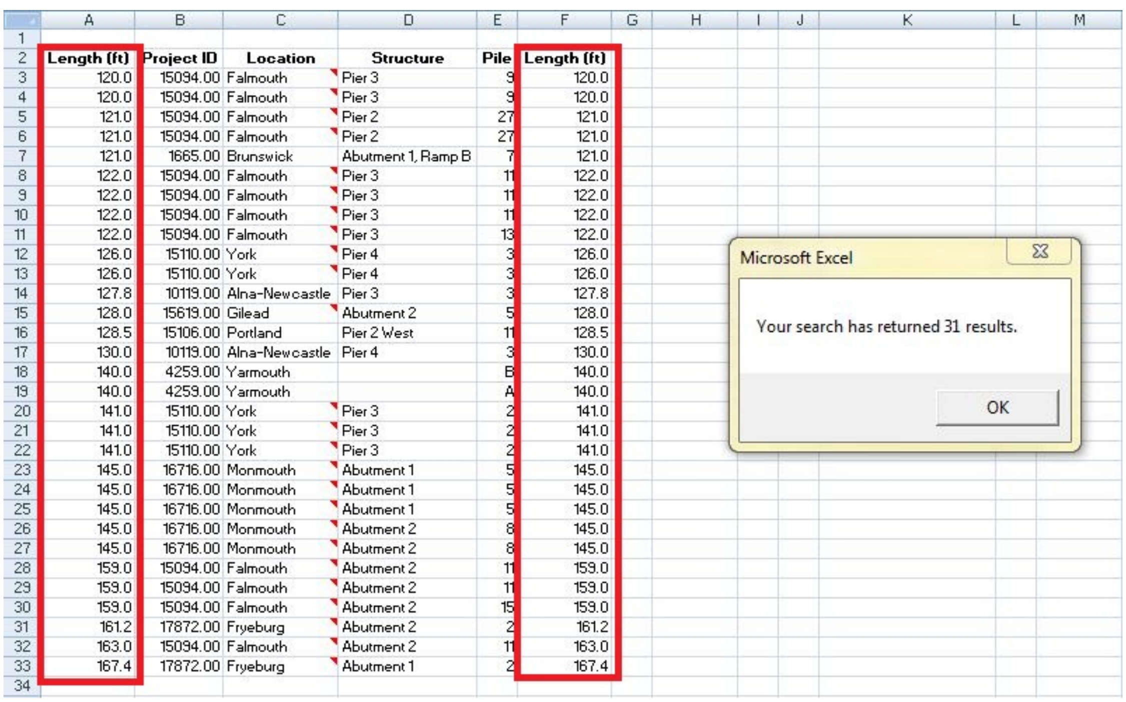


Figure 10: Results of the Duplication Error in Database Search



Length (ft)	Project ID	Location	Structure	Pile	Length (ft)
120.0	15094.00	Falmouth	Pier 3	9	120.0
120.0	15094.00	Falmouth	Pier 3	9	120.0
121.0	15094.00	Falmouth	Pier 2	27	121.0
121.0	15094.00	Falmouth	Pier 2	27	121.0
121.0	1665.00	Brunswick	Abutment 1, Ramp B	7	121.0
122.0	15094.00	Falmouth	Pier 3	11	122.0
122.0	15094.00	Falmouth	Pier 3	11	122.0
122.0	15094.00	Falmouth	Pier 3	11	122.0
122.0	15094.00	Falmouth	Pier 3	13	122.0
126.0	15110.00	York	Pier 4	3	126.0
126.0	15110.00	York	Pier 4	3	126.0
127.8	10119.00	Alna-Newcastle	Pier 3	3	127.8
128.0	15619.00	Gilead	Abutment 2	5	128.0
128.5	15106.00	Portland	Pier 2 West	11	128.5
130.0	10119.00	Alna-Newcastle	Pier 4	3	130.0
140.0	4259.00	Yarmouth		B	140.0
140.0	4259.00	Yarmouth		A	140.0
141.0	15110.00	York	Pier 3	2	141.0
141.0	15110.00	York	Pier 3	2	141.0
141.0	15110.00	York	Pier 3	2	141.0
145.0	16716.00	Monmouth	Abutment 1	5	145.0
145.0	16716.00	Monmouth	Abutment 1	5	145.0
145.0	16716.00	Monmouth	Abutment 1	5	145.0
145.0	16716.00	Monmouth	Abutment 2	8	145.0
145.0	16716.00	Monmouth	Abutment 2	8	145.0
159.0	15094.00	Falmouth	Abutment 2	11	159.0
159.0	15094.00	Falmouth	Abutment 2	11	159.0
159.0	15094.00	Falmouth	Abutment 2	15	159.0
161.2	17872.00	Fryeburg	Abutment 2	2	161.2
163.0	15094.00	Falmouth	Abutment 2	11	163.0
167.4	17872.00	Fryeburg	Abutment 1	2	167.4

The search form also contains a text search tool that allows for the user to search for specific words or identification tags (e.g. all projects in "Falmouth" or all piles installed "plumb"). This tool again requires the user to select the category in which to search for the chosen text. The text search tool is flexible and can return the selected text even if there are case changes. It can also return partial text searches. For example if "PoRt" is entered under the location category, the program will return results for South Portland, New Portland, Newport and Portland. Figure 11 and Figure 12 present the inputs and outputs respectively of the user defined search defined above. It should be noted that the selected text filter category should not be chosen from the "Select Data of Interest" list. If it is selected, there will be duplicate data presented in the results similar to the one shown in Figure 9 and Figure 10.

Figure 11: Using a User Defined Text Search of the Database

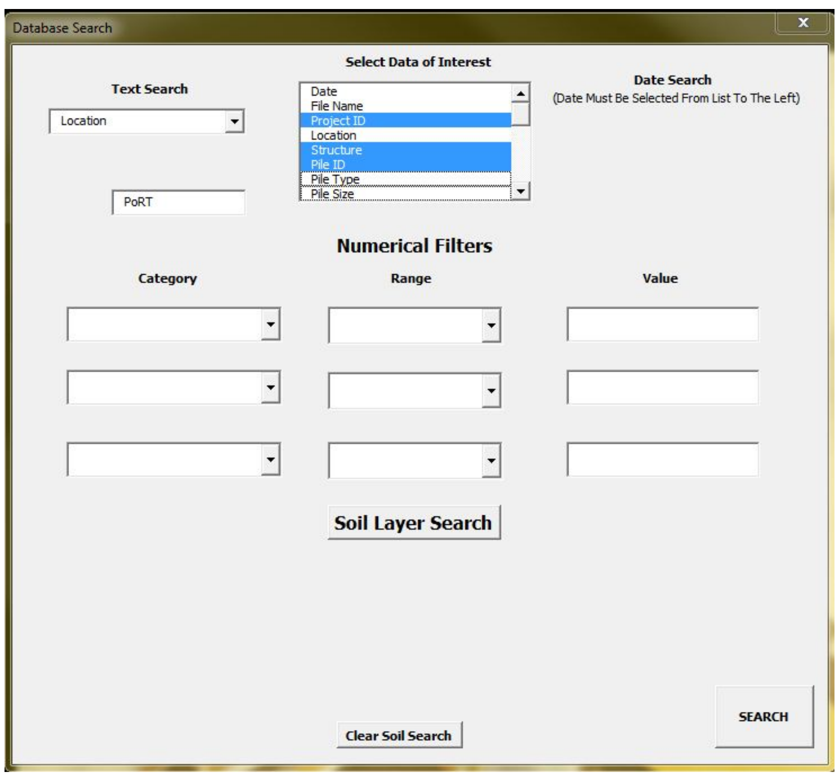
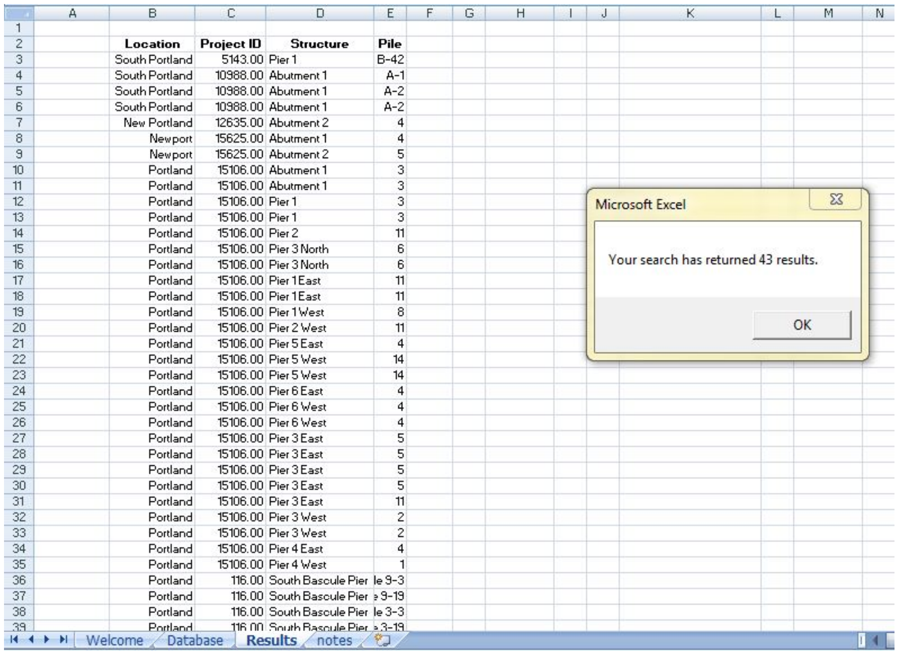


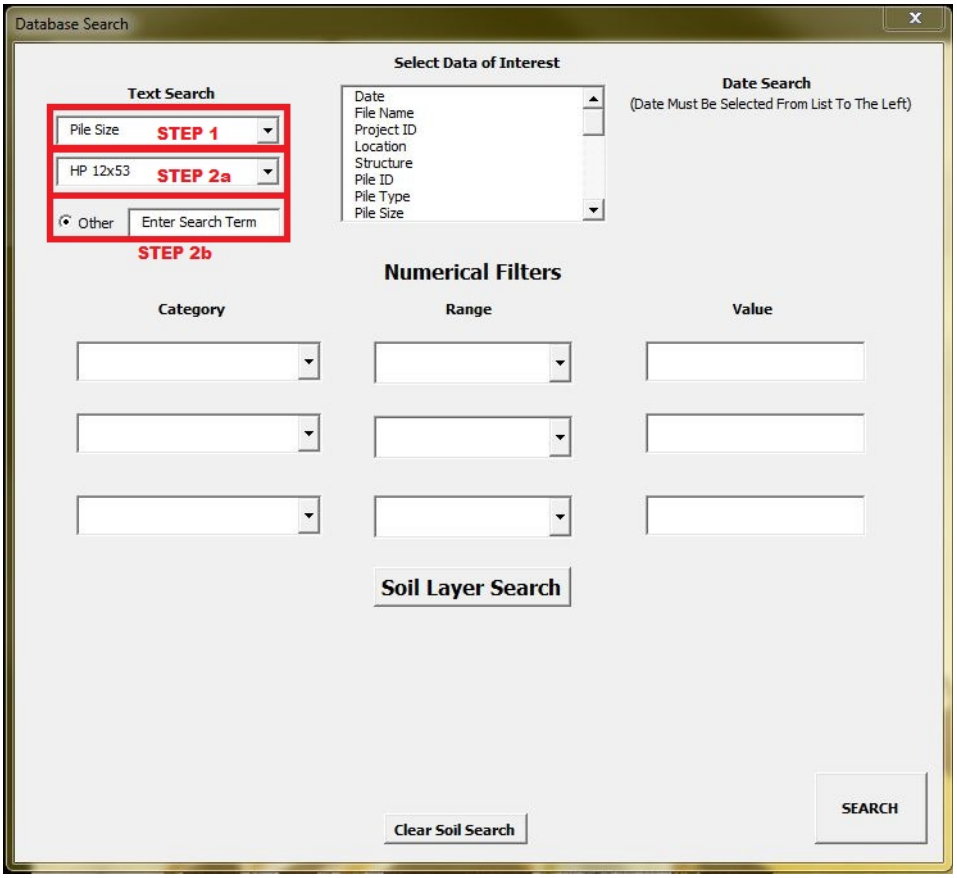
Figure 12: Results of User Defined Text Search



Location	Project ID	Structure	Pile
South Portland	5143.00	Pier 1	B-42
South Portland	10988.00	Abutment 1	A-1
South Portland	10988.00	Abutment 1	A-2
South Portland	10988.00	Abutment 1	A-2
New Portland	12635.00	Abutment 2	4
Newport	15625.00	Abutment 1	4
Newport	15625.00	Abutment 2	5
Portland	15106.00	Abutment 1	3
Portland	15106.00	Abutment 1	3
Portland	15106.00	Pier 1	3
Portland	15106.00	Pier 1	3
Portland	15106.00	Pier 2	11
Portland	15106.00	Pier 3 North	6
Portland	15106.00	Pier 3 North	6
Portland	15106.00	Pier 1 East	11
Portland	15106.00	Pier 1 East	11
Portland	15106.00	Pier 1 West	8
Portland	15106.00	Pier 2 West	11
Portland	15106.00	Pier 5 East	4
Portland	15106.00	Pier 5 West	14
Portland	15106.00	Pier 5 West	14
Portland	15106.00	Pier 6 East	4
Portland	15106.00	Pier 6 West	4
Portland	15106.00	Pier 6 West	4
Portland	15106.00	Pier 3 East	5
Portland	15106.00	Pier 3 East	5
Portland	15106.00	Pier 3 East	5
Portland	15106.00	Pier 3 East	5
Portland	15106.00	Pier 3 East	11
Portland	15106.00	Pier 3 West	2
Portland	15106.00	Pier 3 West	2
Portland	15106.00	Pier 4 East	4
Portland	15106.00	Pier 4 West	1
Portland	116.00	South Bascule Pier	le 9-3
Portland	116.00	South Bascule Pier	e 9-19
Portland	116.00	South Bascule Pier	le 3-3
Portland	116.00	South Bascule Pier	e 3-19

There are a few cases using the "Text Search" feature in which the user is provided a list of suggested search terms that covered all input data as of August 31, 2012. However, if new data is added to the database by MaineDOT, the suggested search terms may not apply. In this case the user can push the "other" button, and will be able search by entering a different keyword (NOTE: This new keyword will not be saved to the suggested search terms list). Figure 13 illustrates the methods for using the "Text Search" function. Step 2a shows the location of the suggested search terms, and Step 2b shows how to enter a user defined keyword for the search.

Figure 13: Other Methods for Using the Text Search Function



The database search tool also has the ability to filter by one or two soil layers. For example, to filter by the soil layer the user simply clicks the "Soil Layer Search" button. The user then must select the soil layers of interest. Figure 14 shows a search for HP 12x53 piles drives through a cohesive and till layer. Figure 15 shows the output of the aforementioned search. The "Clear Soil Search" allows the user to clear the selected soil layers and start fresh.

Figure 14: Using the Soil Layer Search

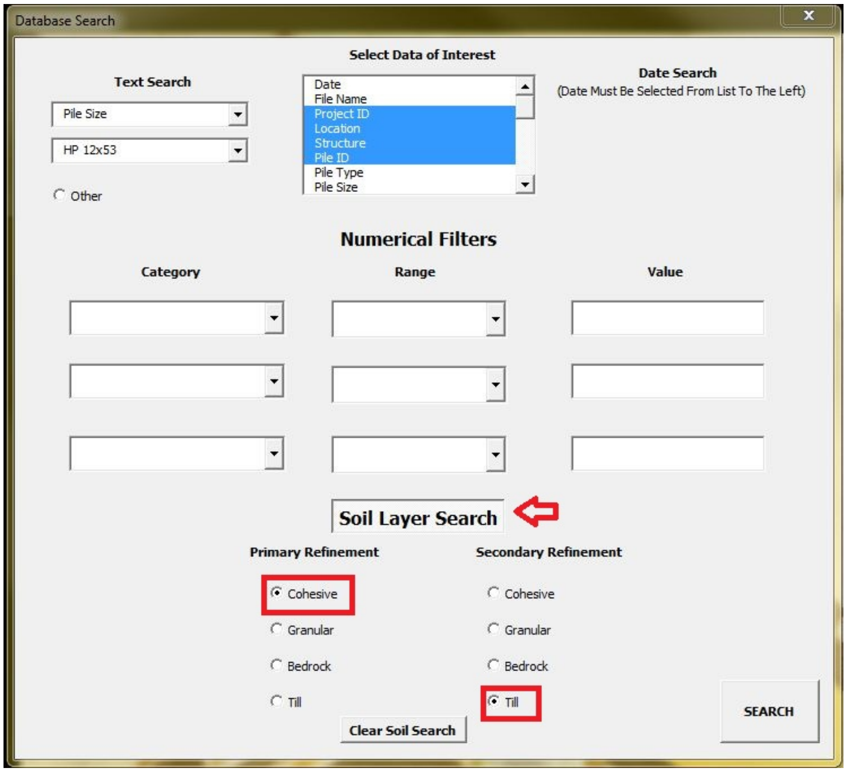
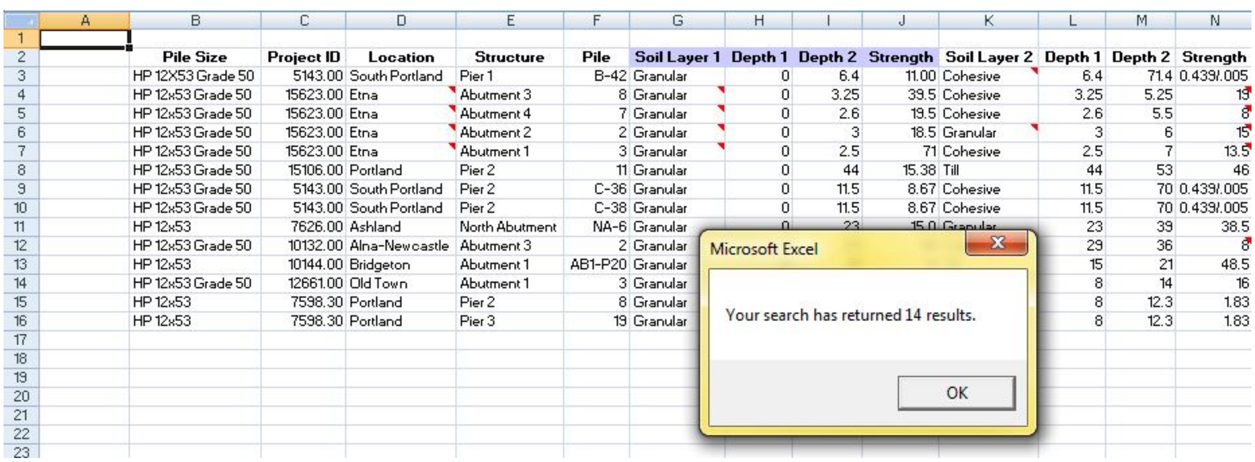


Figure 15: Results of the Soil Layer Search



	A	B	C	D	E	F	G	H	I	J	K	L	M	N
1														
2		Pile Size	Project ID	Location	Structure	Pile	Soil Layer 1	Depth 1	Depth 2	Strength	Soil Layer 2	Depth 1	Depth 2	Strength
3		HP 12X53 Grade 50	5143.00	South Portland	Pier 1	B-42	Granular	0	6.4	11.00	Cohesive	6.4	71.4	0.439/.005
4		HP 12x53 Grade 50	15623.00	Etna	Abutment 3	8	Granular	0	3.25	39.5	Cohesive	3.25	5.25	19
5		HP 12x53 Grade 50	15623.00	Etna	Abutment 4	7	Granular	0	2.6	19.5	Cohesive	2.6	5.5	8
6		HP 12x53 Grade 50	15623.00	Etna	Abutment 2	2	Granular	0	3	18.5	Granular	3	6	15
7		HP 12x53 Grade 50	15623.00	Etna	Abutment 1	3	Granular	0	2.5	71	Cohesive	2.5	7	13.5
8		HP 12x53 Grade 50	15106.00	Portland	Pier 2	11	Granular	0	44	15.38	Till	44	53	46
9		HP 12x53 Grade 50	5143.00	South Portland	Pier 2	C-36	Granular	0	11.5	8.67	Cohesive	11.5	70	0.439/.005
10		HP 12x53 Grade 50	5143.00	South Portland	Pier 2	C-38	Granular	0	11.5	8.67	Cohesive	11.5	70	0.439/.005
11		HP 12x53	7626.00	Ashland	North Abutment	NA-6	Granular	0	23	15.0	Granular	23	39	38.5
12		HP 12x53 Grade 50	10132.00	Alna-Newcastle	Abutment 3	2	Granular					29	36	8
13		HP 12x53	10144.00	Bridgeton	Abutment 1	AB1-P20	Granular					15	21	48.5
14		HP 12x53 Grade 50	12661.00	Old Town	Abutment 1	3	Granular					8	14	16
15		HP 12x53	7598.30	Portland	Pier 2	8	Granular					8	12.3	1.83
16		HP 12x53	7598.30	Portland	Pier 3	19	Granular					8	12.3	1.83

There are some limitations of the search tool for which the user should be aware. The order of the columns must not be changed and new columns cannot be added without changing the VBA code in Excel. The code, as written, does not self adapt to the addition of columns as it does with rows. If the columns are rearranged, the program will return results that do not match the search criteria. The Excel database must also be saved as a macro-enabled workbook (.xlsm) file format to access the programmed search and data addition forms.

The “New Data” button initiates a data input form that automatically populates the database. The form takes information about the project, pile, hammer and driving system, PDA data, pile capacity, and the soil layers. The Excel VBA code associated with the form unloads the data input to the form to the first unused row of the database. To find the first unused row of the database, the code searches through the first column of the database, and the first empty cell is the row that the data is inserted. This illustrates the need to have a date entered for each data set. All values entered into the “New Data” form should be entered in English units. The form indicates what unit should be used for each applicable item. If desired, data can also be input manually to the database. The size of the workbook is the only limiting factor in how much data can be added to the database.

5. Notice

The database delivered alongside this report has been tested for functionality in multiple versions of Microsoft Excel. It has also been tested for errors in the “Search” and “New Data” functions to ensure that the database is as straightforward to use as possible. However, differences in settings from one computer to another can result in a loss of functionality. If this occurs, or if you would like any changes made to the content of the database, do not hesitate to contact us.

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