

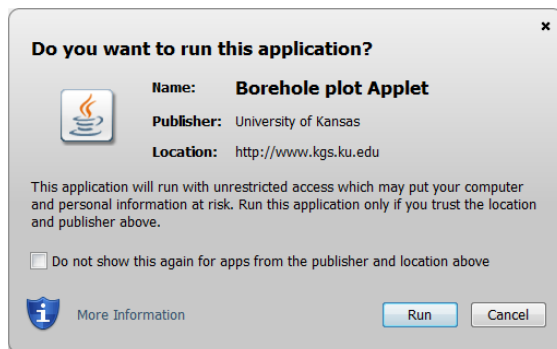
Borehole Plot Java Applet

by John R. Victorine

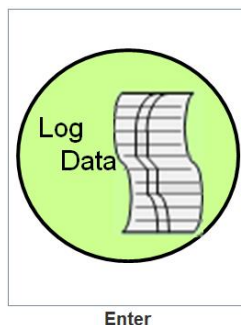
Introduction

The Borehole plot web app has 2 sources for importing well data, 1) the user's PC or 2) the Kansas Geological Survey (KGS) Server & ORACLE Database. This program allows the user to import Log Data.

There will be occasions when the user would like to inspect the contents of a LAS file. So, for example, the user may wish to find the identity of the well, the types of logs, depth range, well or log parameters. Alternatively, the user can suspect that the file is not coded correctly in LAS format if the Import LAS function fails, and wishes to examine the file to troubleshoot the problem. The LAS file is an ASCII file and can be read by any text editor, i.e. Notepad, WordPad, TextPad, etc.



To access Borehole plot web applet web site go to <http://www.kgs.ku.edu/PRS/Ozark/Software/Borehole/>. At the top of the web page there is a menu "Main Page|Applet|Help|Copyright & Disclaimer". Select the "Applet" menu option a "Warning - Security" Dialog will appear. The program has to be able to read from the user's PC and access the Kansas Geological Survey (KGS) Database and File Server, ORACLE requires this dialog. The program does not save your files to KGS, but allows you to access the KGS for well information that may be missing in your Kansas logs. The program does not use Cookies or any hidden software it only reads the LAS for the Borehole Plot Session. The blue shield on the warning dialog is a symbol that the Java web app is created by a trusted source, which is the University of Kansas. Select the "Run" Button, which will show the Borehole Plot "Enter" Panel illustrated below,



Loading Well Data

Click the "Borehole Plot Enter" Icon Button, which will show the "Load Data" Dialog. The dialog below displays an example of the Wellington KGS 1-32 well data loaded from the PC Data icon buttons with the data in the tables above. The icon buttons in the Data Source Panel assists the user in loading well data into the Borehole Plot Applet.

Dialog Buttons:

Continue— Load and create a borehole plot.

Clear— Clear loaded data from this dialog

Exit— Exit Program

Data Source Panel

Load a Log ASCII Standard (LAS) File from the Kansas Geological Survey (KGS) Database and Server or from the user's PC

Data Loaded Panel

Positive feedback to user to verify what source data was loaded.

Calipers Panel

Shows the user how many azimuth and radius values were loaded. The program presently only assumes one azimuth value and that the caliper arms are symmetric around the tool. The angle is computed from 360° divided by the number of caliper arms.

Data Source Panel

The Data Source Panel provides two methods of importing data into the Borehole Plot Web App. The Kansas Geological Survey (KGS) Database & File Server and the user's PC. A number of icon buttons are provided to assist the user in importing the specific data type of interest. When the user selects the icon button a search dialog is provided specific to the data type. Although the order of the specific data columns is not important, the "Mnemonics" of the data column is. Each data type in GEMINI Tools web apps have a data mnemonic list that will be presented later as each icon search dialog is presented.



Read Log ASCII Standard (LAS) Files from the Kansas Geological Survey

This button allows the user access to the LAS version 2.0 files stored on the Kansas Geological Survey database and server.



Read Log ASCII Standard (LAS) Files from the User's PC

This button allows the user to search for LAS version 2.0 & 3.0 files stored on the user's PC

Log ASCII Standard (LAS) File Read

This version will read up to 3 Log ASCII Standard (LAS) Files, version 2.0 & 3.0. This read process does not necessarily distinguish between the two versions. The LAS java Read classes follow the rules set up by the Canadian Well Logging Society for both versions.

Data Loaded Panel

The Data Loaded Panel provides a visual feedback that the data type was loaded, by the file names of the files that were accessed to load the data and by the data type that is loaded. The data type is important in that it shows where the data came from. The KGS data has the ORACLE Database from which the LAS file location is retrieved from as a XML (Extensible Markup Language) data stream that is constructed using the ORACLE PL/SQL. The LAS File can be downloaded automatically from the KGS Server in the program or from the user's PC. This program allows the user to import up to 3 Log ASCII Standard (LAS) version 2.0 or 3.0 files, but for this program generally there really is only one LAS File.

Importing KGS (Database & Server) Data

KGS (Database & Server) - Importing Well Data

The Kansas Geological Survey (KGS) has a good collection of well data stored in the ORACLE Database and File Server as Files Log ASCII Standard (LAS) version 3.0 Files. In this example the user will download the well data available from the KGS, Log data (LAS version 2.0 File) Data. The ORACLE Database is accessed by making Stored Procedure PL/SQL calls to the ORACLE Database from which an Extensible Markup Language (XML) data stream is created containing the well data that is passed back to the web app making the request.



Left Click on the “Well Data” Icon Button in the Data Source Panel of the Load Data Dialog.

LTCI	API-Number	Well Name	Operator
L_	15-191-22770	Wellington KGS 2-32	Berexco LLC
LT_	15-191-22591	WELLINGTON KGS 1-32	BEREXCO LLC
LT_	15-191-22590	WELLINGTON KGS 1-28	BEREXCO LLC

Search for Well Data in KGS Database Search By:

- **API-Number** – The user can search the KGS Database for well data by API-Number. The Format for the API is SS-CCC-99999 where
 - SS – Two Digit State Code
 - CCC – Three Digit County Code
 - 99999 – 5 Digit Well Number
- **Lease Name** – The user can search for well data by lease partial phrase, i.e. “Wellington KGS”, which will look for all wells with that phrase.
- **Township-Range-Section** – Search for a list of wells by a specific area.

List of Kansas Wells that match the search criteria.

LAS File Data Button – Load Log ASCII Standard (LAS) version 2.0 Files

This will display the “Search for Data on KGS Server” Dialog, see above image. This dialog allows the user to search the KGS database for well data. In this example, the well of interest will be the Wellington KGS 1-32, this well contains Log Data (LAS version 2.0 File) with 6 caliper tool.

As the Summary image suggests there are 3 methods for searching for the well data within this dialog,

- By API-Number – KGS has a specific format for the API-Number, i.e.SS-CCC-99999 where SS is the state code for Kansas 15, CCC is the county code for Wellington KGS 1-32 it is 191 for Sumner County and the 5-Digit Well Number for Wellington KGS 1-32 it is 22591.

- By Partial Lease Name – The stored procedure used to retrieve the well header information allows the user to enter a partial phrase, in this example Wellington KGS. The program places a ‘%’ in front and back of the phrase and sends the request to the Database, i.e. “%Wellington KGS%”.

Search By:

☐ API-Number
 ☒ Lease name
 ☐ Township Range Section

Enter Lease (Drop Well Number, Not Case Sensitive):

Wellington KGS

Search

- By Township Range Section – This search is by location in Kansas, this search also allows the user to enter just the Township and Range to search for wells, e.g. to look for the Wellington KGS 1-32, enter Township as 31 set the S (South) Radio button and Range as 1 set the W (West) Radio button. The section can be left as 0 or enter 32, which should narrow down the list of wells.

Search By:

☐ API-Number
 ☐ Lease name
 ☒ Township Range Section

Section:

Township: ☐ N ☒ S

Range: ☒ W ☐ E

Search

The user only needs to enter the above data and select the “Search” Button to display the list of Wells in the Kansas Database that match the search criteria. In the image below the Lease Name “Wellington KGS” was entered to search for all wells in Kansas with the Phrase “Wellington KGS” in it. The user searches through the list until they find the well of interest. In this example it is the Wellington KGS 1-32, which is highlighted.

Search for Data on KGS Server

Search for Data in Kansas Geological Survey Database:

Search By:

☐ API-Number
 ☒ Lease name
 ☐ Township Range Section

Enter Lease (Drop Well Number, Not Case Sensitive):

Wellington KGS

Search

List of Oil & Gas Wells:

LTCI	API-Number	Well Name	Operator
L_I	15-191-22770	Wellington KGS 2-32	Berexco LLC
LT_I	15-191-22591	WELLINGTON KGS 1-32	BEREXCO LLC
LT_	15-191-22590	WELLINGTON KGS 1-28	BEREXCO LLC

Load Data:

LAS File Data

Close

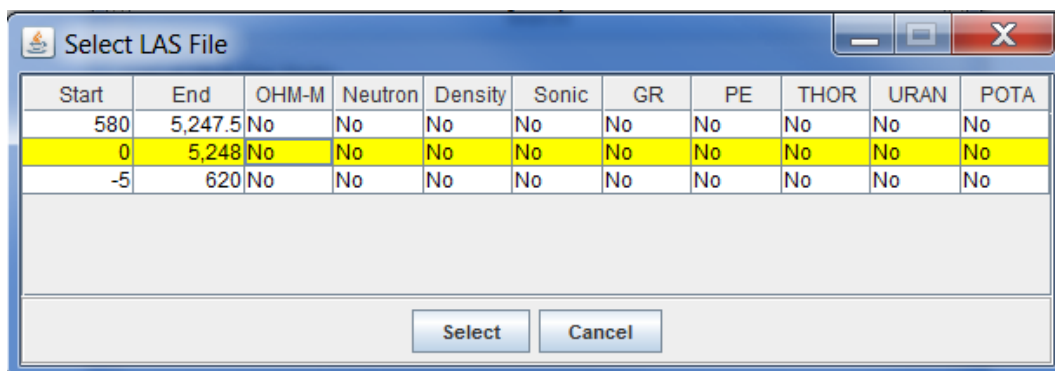
Notice that the LTCI represents the type of data that the well contains. It is a visual aid that lets the user see what is available before trying to download the data. If you require a LAS file you would want to see an L in that column. The LTCI labels stand for the following,

- L – Log ASCII Standard (LAS) version 2.0 Files
- T – Tops Data (Stratigraphic Unit Horizons)
- C – Measured Core Data
- I – Core Joint Photographic Experts Group (JPEG) Image Files

This dialog allows the user to now download only the LAS File Data.

Load KGS Well Data – LAS File Data

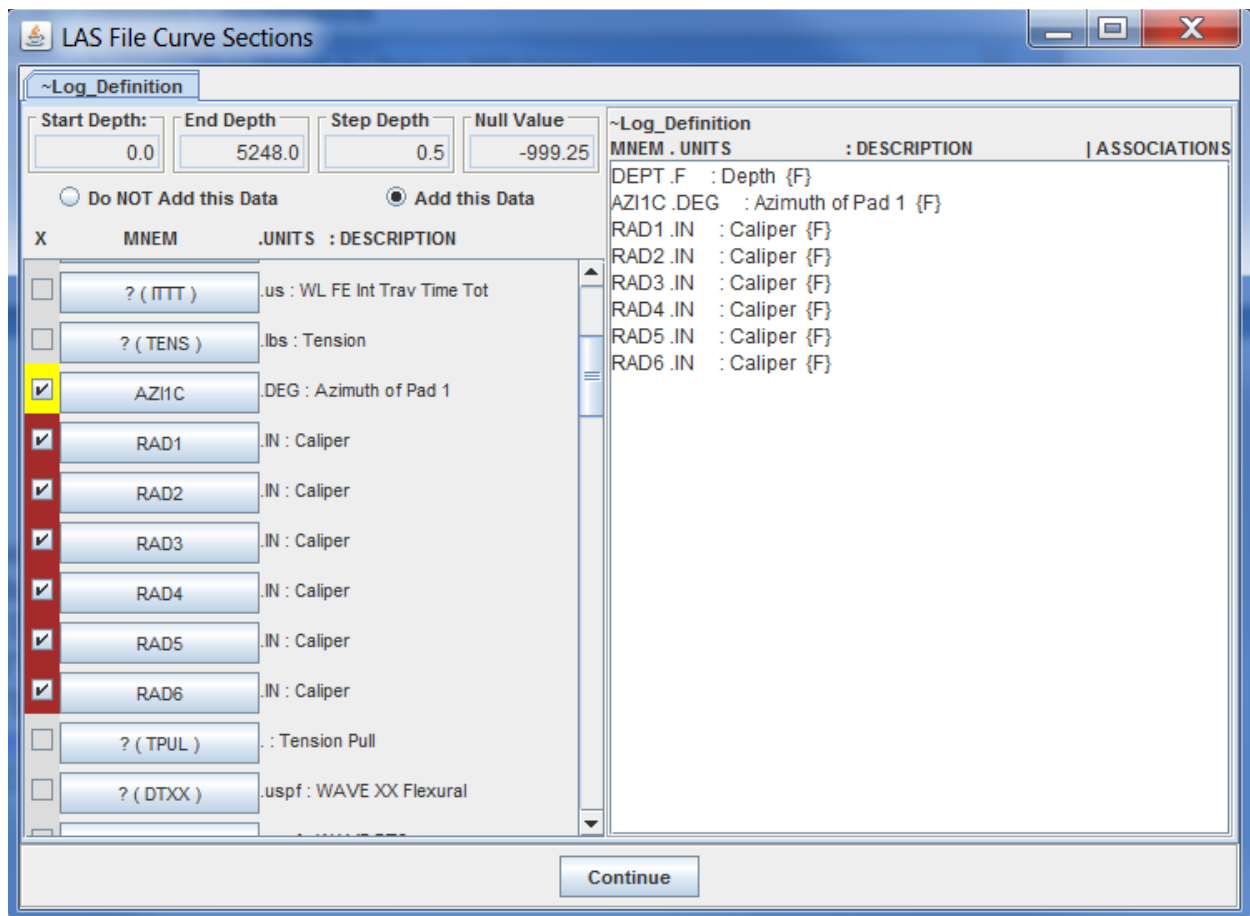
The “Search for Data on KGS Server” Dialog allows the user to download data from the KGS Database & Server to the web app. The “LAS File Data” Button will display the “Select LAS File” Dialog with a list of LAS version 2.0 Files that are available.



In this example there are three LAS files available, with a table suggesting the log data type in the file. In the beginning of the GEMINI Project (2000-2003) a precursor to the GEMINI Tools the KGS populated the Tool Types from every log that was in the KGS Server at that time. Unfortunately KGS has not maintain that table for wells uploaded after 2003 so the LAS File may have “No” for all the log types, which is not accurate. The user will need to open or download the file or search for the Well on the KGS Master List of Oil and Gas Wells in Kansas Web Page (<http://www.kgs.ku.edu/Magellan/Qualified/index.html>) to see what is in the File Header before deciding to download data from this program. The Table above identifies the following log types,

- OHM-M – Resistivity Logs
- Neutron – Neutron Porosity Log
- Density – Bulk Density and/or Density Porosity Log
- Sonic – Acoustic Transit Time and/or Sonic Porosity Log
- GR – Gamma Ray (API units) Log
- PE – Photoelectric Factor Log
- THOR – Thorium Concentration
- URAN – Uranium Concentration
- POTA – Potassium Concentration)

In this example the second log contains the data needed, highlight the second log and click on the “Select” Button to display the “LAS File Curve Sections” Dialog. The “LAS File Curve Sections” Dialog allows the user to map unknown LAS Curve Mnemonics to the KGS “Standard” Curve Mnemonics so they will be plotted in the LAS File Viewer Plot. This program reads the “LAS Tool Curve Mnemonics map to KGS Standard Mnemonics” XML File (http://www.kgs.ku.edu/software/gemini/data/las_standard_tools.xml), which will automatically maps the Curve Mnemonics from the LAS file to one of 31 KGS “Standard” Curve Mnemonics.



As you can see, this log will have all the log types of interest, Azimuth for the first caliper pad and 6 caliper radius. If a curve Mnemonic is not recognized by the program it will place a “?” in front of the Mnemonic, e.g. ? (TENS) for the tension curve. If the user is satisfied with the automatic curve selection, which are checked and color coded, they only need to select the “Continue” Button at the bottom of the Dialog to import the file. Also note that this program is specific to the Caliper data types, specifically multiple caliper tools.

- Red – Caliper radius values
- Yellow – Azimuth for the specific caliper.

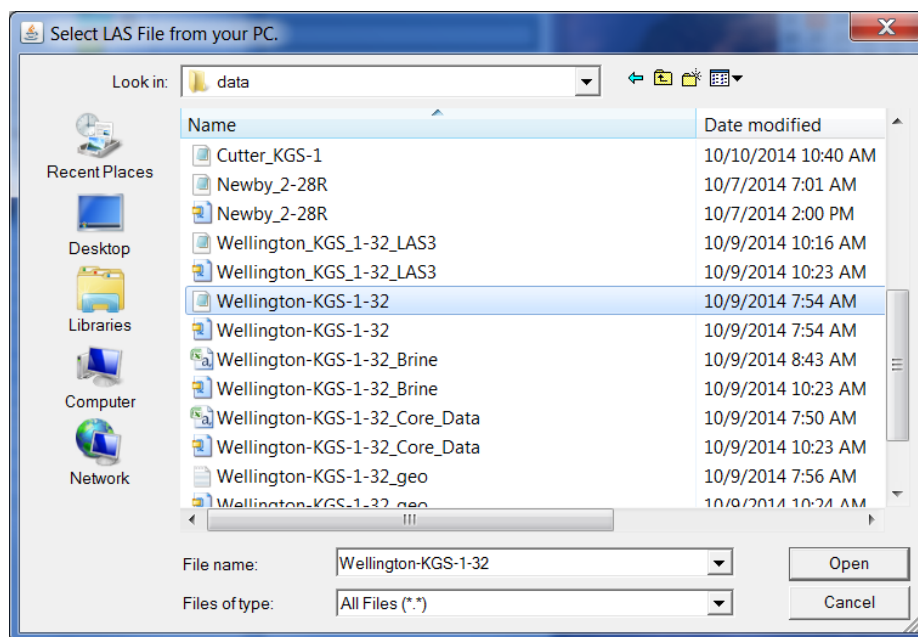
The color coding of the selected curves were added to also help the user visually recognize that a curve was selected or not.

Importing PC Data – Log ASCII Standard (LAS) version 2.0 & 3.0 Files

Most of the web apps will use the same input dialogs to import Log ASCII Standard (LAS) version 2.0 or 3.0 files. The Load Data Dialog is basically the same for most of the Web Apps, except they only load a subset of the total data types. In this example a LAS version 2.0 file is being imported into the web app.



Left Click on the “LAS File” Icon Button in the Data Source Panel of the Load Data Dialog. This will display the “Select LAS File from your PC” Dialog. This dialog allows the user to search their PC for the file of interest. In this example it is the LAS version 2.0 file Wellington-KGS-1-32.las, highlighted below. Select the Open button to display the “LAS File Curve Sections” Dialog.



The “LAS File Curve Sections” Dialog allows the user to map unknown LAS Curve Mnemonics to the KGS “Standard” Curve Mnemonics so they will be plotted in the LAS File Viewer Plot. This program reads the “LAS Tool Curve Mnemonics map to KGS Standard Mnemonics” XML File (http://www.kgs.ku.edu/software/gemini/data/las_standard_tools.xml), which will automatically maps the Curve Mnemonics from the LAS file to one of 31 KGS “Standard” Curve Mnemonics. If a curve Mnemonic is not recognized the program will place a “?” in front

of the Mnemonic, e.g. “?(BSZ)” for the “.in : Bit Size” Log Curve. If the user is satisfied with the automatic curve selections, which are checked and color coded, they only need to select the “Continue” Button at the bottom of the Dialog to import the file. The next section will take the user through a series of examples in changing the curve selections and mapping unknown curve mnemonics.

X	MNEM	.UNITS	DESCRIPTION
<input type="checkbox"/>	? (ITTT)		us : WL FE Int Trav Time Tot
<input type="checkbox"/>	? (TENS)	lbs	Tension
<input checked="" type="checkbox"/>	AZI1C	.DEG	Azimuth of Pad 1
<input checked="" type="checkbox"/>	RAD1	.IN	Caliper
<input checked="" type="checkbox"/>	RAD2	.IN	Caliper
<input checked="" type="checkbox"/>	RAD3	.IN	Caliper
<input checked="" type="checkbox"/>	RAD4	.IN	Caliper
<input checked="" type="checkbox"/>	RAD5	.IN	Caliper
<input checked="" type="checkbox"/>	RAD6	.IN	Caliper
<input type="checkbox"/>	? (TPUL)		: Tension Pull
<input type="checkbox"/>	? (DTXX)	uspf	WAVE XX Flexural

As you can see, this log will have all the log types of interest, Azimuth for the first caliper pad and 6 caliper radius. If a curve Mnemonic is not recognized by the program it will place a “?” in front of the Mnemonic, e.g. ? (TENS) for the tension curve. If the user is satisfied with the automatic curve selection, which are checked and color coded, they only need to select the “Continue” Button at the bottom of the Dialog to import the file. Also note that this program is specific to the Caliper data types, specifically multiple caliper tools.

- Red – Caliper radius values
- Yellow – Azimuth for the specific caliper.

The color coding of the selected curves were added to also help the user visually recognize that a curve was selected or not.

Select the Continue Button to read and parse the LAS log curves selected into the Borehole Plot Web App. Notice that the “Data Source Filenames:” Panel lists the LAS version 2.0 File that was just read in as well as the type of data, i.e. Log Data from LAS Data Type.

Load Data

Data Source

KGS (Database & Server) Well Data

PC (ASCII Data Files) Ver 2.0 & 3.0 LAS File

Data Loaded

Data Source Filenames:

Log ASCII Standard (LAS) Files:

1:

2: Wellington-KGS-1-32.las

3:

Data Type 3.0 LAS CSV KGS

Log Data YES

Calipers

Number of Calipers 6

Angle Between [deg] 60.0

Azimuth: ☒ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6

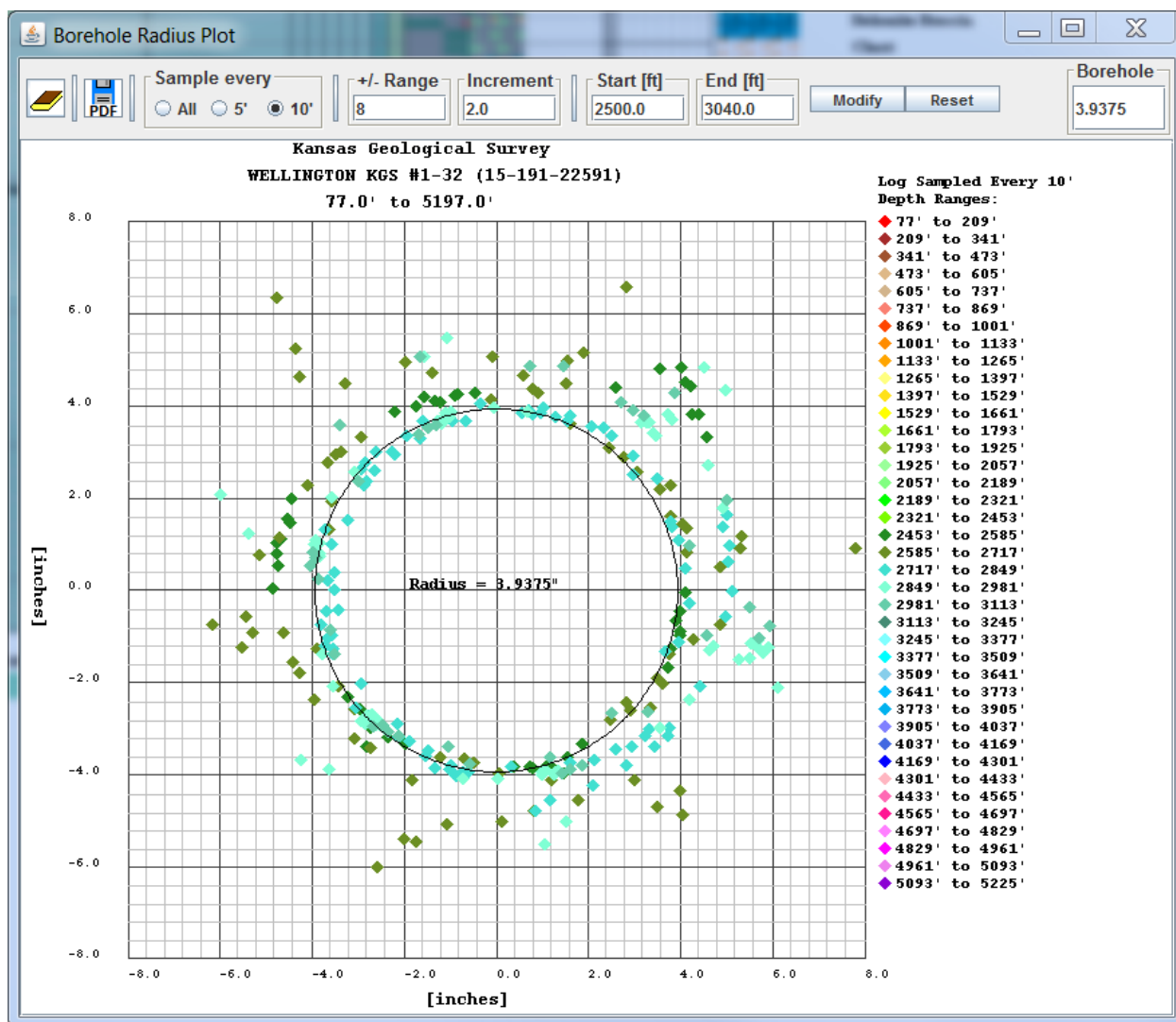
Radius: ☒ 1 ☒ 2 ☒ 3 ☒ 4 ☒ 5 ☒ 6

Continue Clear Exit

The Calipers panel will show the number of azimuth and radius curves that have been selected. This program presently only has one azimuth value, which is set to the first caliper pad and the other calipers azimuth is computed from the 1st azimuth. The program also assumes that the calipers are symmetric around the tool so 360° is divided by the number of calipers to get the angle between each caliper or in this case 60°. Select the Continue button to plot the caliper data.

Borehole Plot Dialog

The web app allows you to filter the log data every 5', 10' and all data the default is every 10 feet. The user can change the x-y axis by changing the "+/- Range" and the "Increment" text fields to change the plot grid scale, just enter the value you wish and tab out of the field. The grid pattern assumes that the borehole should be "circular" so the scale is set to visually reflect symmetry. The user can change the data that is being displayed by changing the "Start" and "End" text fields and selecting the Modify button, see image below. You can reset to the original depth range by selecting the Reset button. The black circle is the borehole reference, which is initially set to a standard bit size of 7 7/8" diameter (3.9375" radius). You can change the reference circle by inserting a different value in the "Borehole" text field and then tabbing out of the text field.



"Sample every" radio buttons – Allows the user to sample the log data file every 5 feet, 10 feet or display all the data.

" \pm Range" value is translated to lower limit of the X-Y Axis as a negative value and the upper limit of the X-Y Axis as a positive value, e.g. the X-Minimum = -8.0 and the X-Maximum = +8.0 and the same for the Y-Minimum = -8.0 and the Y-Maximum = +8.0. This keeps a square presentation of the plot area.


"Start [ft]" and **"End [ft]"** text fields allow the user to filter the data by depth range.


Modify

Enter Start and End Depth and select to plot data.

Reset

Reset to original depth range.

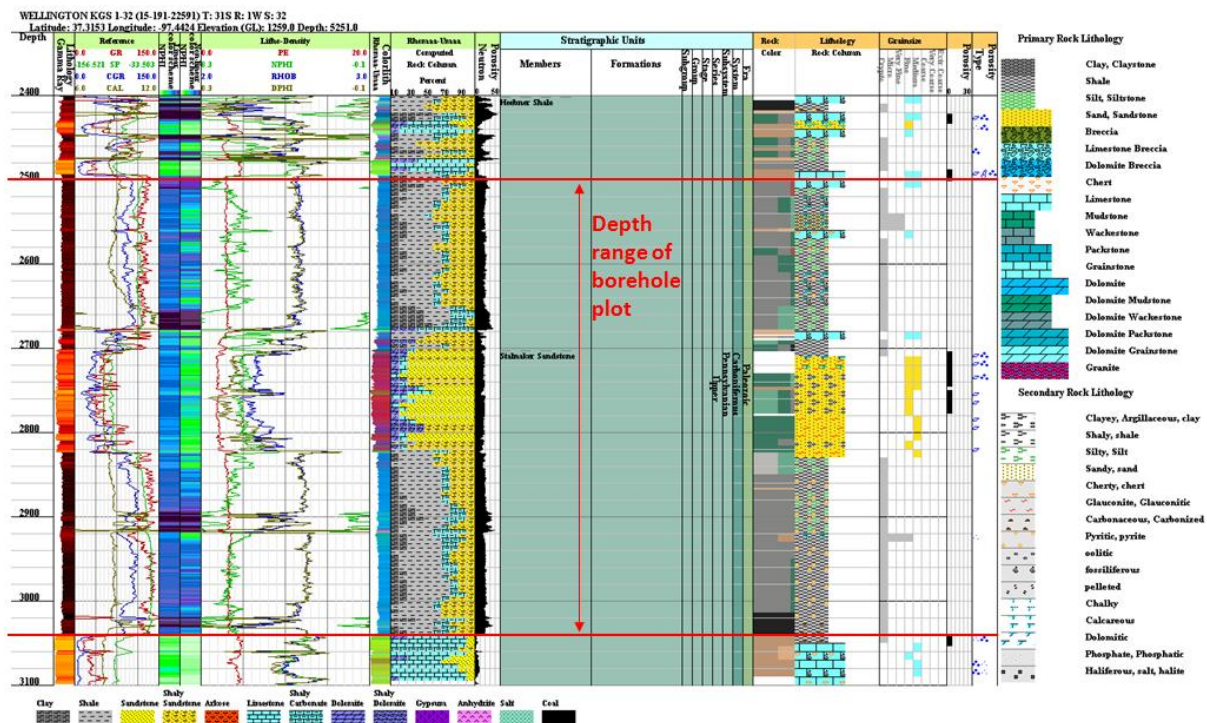


 Sample every: ☐ All ☐ 5' ☒ 10'
 +/- Range: Increment:
 Start [ft]: End [ft]:
 Borehole:

 Close Plot Dialog

 Create a PNG (Portable Network Graphics) Image of Plot

Borehole text field - Draws a reference circle on the data to represent the "true" borehole radius, e.g. default 3.9375" represents a standard drill bit size of 7 7/8. The user can change this value.

The LAS File Viewer (<http://www.kgs.ku.edu/stratigraphic/LAS/>) can plot the lithology depending on the log curves available. The image below is the profile plot for the Wellington KGS 1-32 over the depth range the borehole plot (2500' to 3040').



This program was designed to view compress the well log caliper data down to 2 dimensional plot. The program is designed to examine the borehole for weakness in the formation over the range of the log. In an induced seismic environment due to brine injections, it may be useful in identifying where and in which direction the formation may be sensitive to over pressure.