**EXAMPLE APPLICATION AND TROUBLESHOOTING FOR MULTI-SITE VOLUME AND EXTENT TOOL**.

***More information regarding this Tool can be found in Section 4.2 of the User Manual.***

**Step 1. Compile Key Site-Specific LNAPL Data**

Assume LNAPL is present in five monitoring wells with these characteristic:

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Monitoring Well | Date | Latitude | Longitude | Top of LNAPL in Well  (m bgs) | Bottom of LNAPL in Well  (m bgs) | LNAPL Gradient  (m / m) |
| MW-1 | 2009-06-25 | 30.472461 | -94.348803 | 2.32 | 2.52 | 0.0086 |
| MW-2 | 2009-06-25 | 30.472469 | -94.348603 | 2.81 | 2.92 | 0.0086 |
| MW-3 | 2009-06-25 | 30.472297 | -94.348789 | 2.81 | 2.86 | 0.0086 |
| MW-4 | 2009-06-25 | 30.472383 | -94.348703 | 2.74 | 3.36 | 0.0086 |
| MW-5 | 2009-06-25 | 30.472275 | -94.348592 | 2.64 | 2.84 | 0.0086 |

**Where to get these data for your site:**

**Latitude/Longitude**

There are several options to obtain high resolution latitude/longitude data for each monitoring well:

1. Use surveying data from an official survey of the wells.
2. Obtain a site map, georeference the map in an GIS system, and obtain the lat/long data.
3. Estimate monitoring locations in a Google Earth map, add Placemarks and get lat/long in decimal degrees (see image below). A crude way to convert a map with local coordinates to lat/long decimal coordinates is to:
   1. put a transparency (viewgraph) or a translucent tracing paper (vellum) over the map with the monitoring wells;
   2. with a pen, mark a few key landmarks that will show up in Google Earth aerial photo imagery (crossroads, buildings, streams, etc.) on the transparency/vellum;
   3. mark the monitoring wells on the transparency/vellum with a pen;
   4. tape the transparency/vellum over your computer monitor, rotate the transparency/vellum if needed to align to the landmarks, and change the zoom in Google Earth to match the landmarks;
   5. use Google Earth Placeholders to get the lat/long in decimal degrees. You can change the Google Earth Placemark lat/longs to decimal lat/longs in Google Earth preferences.
4. If you have data in degrees/min/sec, convert to decimal degrees at web sites like this: <https://www.latlong.net/degrees-minutes-seconds-to-decimal-degrees>

**Top of LNAPL, Bottom of LNAPL**

These data are obtained by gaging of LNAPL thickness using interface probes in monitoring wells and adjusting the top and bottom elevations to meters below ground surface (bgs).

**LNAPL Gradient**

This is calculated using a map of the top of the LNAPL elevation and estimating the LNAPL gradient in meters of LNAPL drop per meter of LNAPL run at each monitoring well.

**Step 2. Compile Key Stratigraphic Information at Your Site**

Using data from geologic boring logs, enter in the top elevation (in meters bgs) and the bottom elevation (in meters bgs) for each soil type layer that is with or near the vertical interval where LNAPL is found in the well.

For this example site, the following stratigraphy data were obtained from the geologic boring logs.

|  |  |  |  |
| --- | --- | --- | --- |
| Monitoring Well 1 | Top of Layer  (m bgs) | Bottom of Layer (m bgs) | Soil Type |
| MW-1 | 1 | 5 | Sandy loam |
| MW-1 | 5 | 9 | Sand |
| MW-1 | 9 | 11 | Clay |
| Monitoring Well 2 | Top of Layer  (m bgs) | Bottom of Layer (m bgs) | Soil Type |
| MW-2 | 1 | 5 | Sandy loam |
| MW-2 | 5 | 9 | Sand |
| MW-2 | 9 | 11 | Clay |
| Monitoring Well 3 | Top of Layer  (m bgs) | Bottom of Layer (m bgs) | Soil Type |
| MW-3 | 1 | 5 | Sandy loam |
| MW-3 | 5 | 10 | Sand |
| MW-3 | 10 | 11 | Clay |
| Monitoring Well 4 | Top of Layer  (m bgs) | Bottom of Layer (m bgs) | Soil Type |
| MW-4 | 1 | 5 | Sandy loam |
| MW-4 | 5 | 8 | Silt loam |
| MW-4 | 8 | 11 | Clay |
| Monitoring Well 5 | Top of Layer  (m bgs) | Bottom of Layer (m bgs) | Soil Type |
| MW-5 | 1 | 5 | Sandy loam |
| MW-5 | 5 | 9 | Sand |
| MW-5 | 9 | 11 | Clay |

**Troubleshooting Note**: Click on the button labeled “Learn more about soil classification systems” to get more information about soil stratigraphic data.

**Step 3. Compile Key Data About LNAPL Properties**

**Where to get these data for your site or what typical values are useful:**

**Water density:** Typically enter 1 g/cm3 unless the groundwater is saline. You usually do not need to make a correction for temperature because temperature has a small effect on water density. Units: grams per cubic centimetre.

**Table

Description automatically generatedLNAPL Density, LNAPL Viscosity, LNAPL/Water Interfacial Tension:** Using values from Table 4.3 below from page 10 of Source Report A of the LA LNAPL Recoverability Study (excerpt below) or from values in the Engineering Toolbox (<https://www.engineeringtoolbox.com/fuels-densities-specific-volumes-d_166.html>), enter values from laboratory tests of the LNAPL at your site in the model. For this hypothetical case study, the LNAPL was gasoline, and the table above was used to provide these values:

**LNAPL Density:** 0.70 g/cm3

**LNAPL Viscosity:** 0.50 centipoise

**Air/Water Interfacial Tension:** use 70 dyn/cm

**LNAPL/Water Interfacial Tension:** use 50 dyn/cm.

**Air/Water Interfacial Tension:** use 25 dyn/cm

Text, letter

Description automatically generated**Residual Saturation Factor:** use 0.20, or for more accuracy, use the values in this table depending on soil type (ignore the names of the types of sand, such as “Ottawa” or “Swan Valley”)

**Step 4. Enter These Data in the Data Template**

1. Download the data template
2. On the “**Location\_Information” tab**, enter the following information for each location where you have LNAPL thickness data in a monitoring well
3. On the **“Stratigraphy” tab**, enter different soil type layers. If the USDA soil classification system is used to classify the soils, then the model automatically will use key soil capillarity data from published van Genuchten relationships; otherwise, you will have to enter the van Genuchten parameters for your soil types in the “Soil\_Types” tab.
4. As described above, you can skip the “**Soil\_Types” tab** if you are using USDA soil types Clay, Clay loam, Loam, Loamy sand, Silt, Silt loam, Silty clay, Silty clay loam, Sand, Sandy clay, Sandy clay loam, and Sandy loam). Otherwise enter the name of a soil type and enter the porosity, Ks, Theta, N, alpha, and M parameters.
5. In the **“Parameters” tab** Enter the key characteristics of the LNAPL. See the User Manual page 17 for values to use if you do not have laboratory tests of your LNAPL (these estimates will likely be close enough to get useful information from the model).

**Troubleshooting Note:** Ensure that all numerical values included in the template are stored inside the spreadsheet as numerical values, especially if values have been copied from other sources. If difficulties are encountered, redownload the data template and reenter the values.

**STEP 5. Run the Model and Pick the Output You Want to See**

1. Click the “Calculate” button in the bottom / middle of the input screen.
2. Choose a base map type
3. Select to result for one of these parameters:
   1. Graphical user interface, application, map

      Description automatically generated*LNAPL Specific Volume*
   2. *Mobile LNAPL Specific Volume*
   3. *Average LNAPL Relative Permeability*
   4. *Apparent Thickness of LNAPL*
   5. *Average LNAPL Hydraulic Conductivity*
   6. *Average LNAPL Transmissivity*
   7. *LNAPL Unit Flux*
   8. *Average LNAPL Seepage Velocity*

**Troubleshooting Note**: Interpolations of these results are also available in the Tool under the “Interpolation” tab. The area used for these interpolations can be decreased by using the draw tools in the upper left-hand corner. The area can be increased by including wells (real or fictional) that have no apparent LNAPL thickness in the monitoring well database.