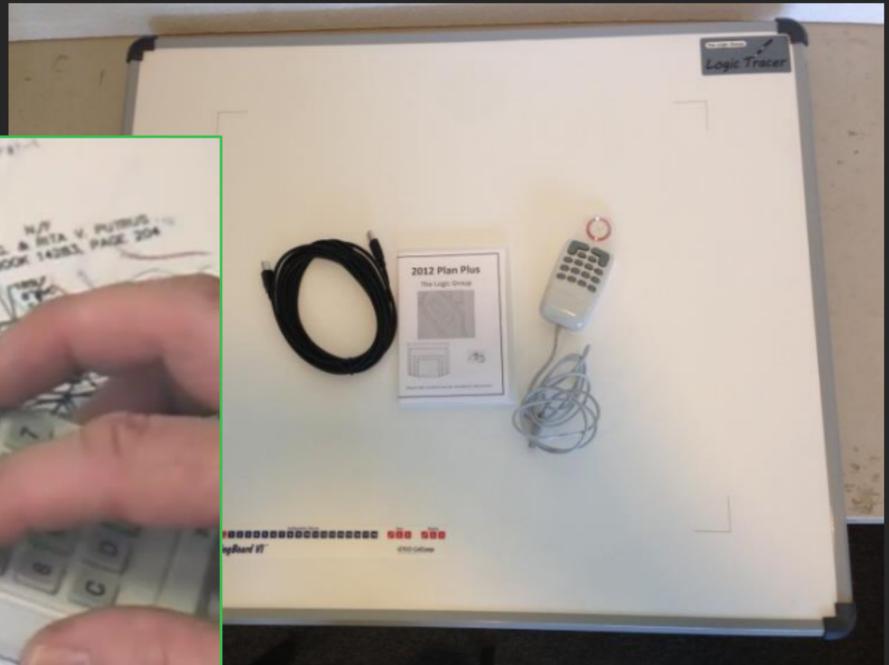
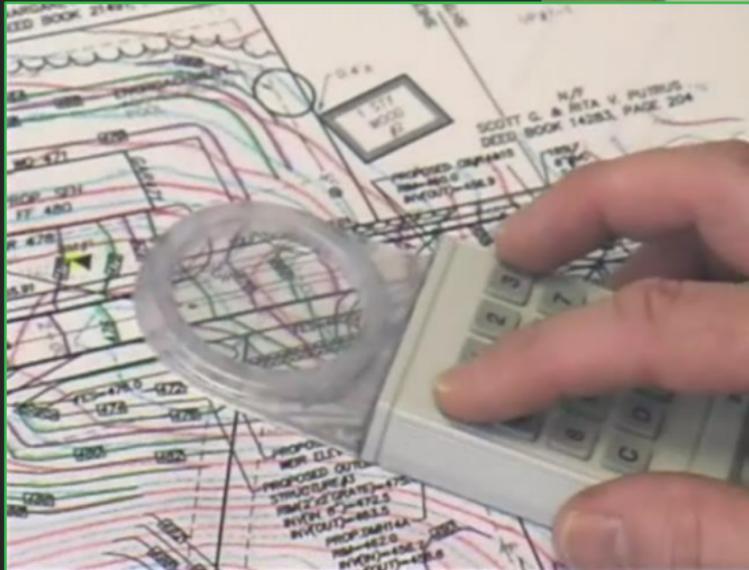


The Logic Group Plan

Planimetering Software

for the Oil and Gas Industry

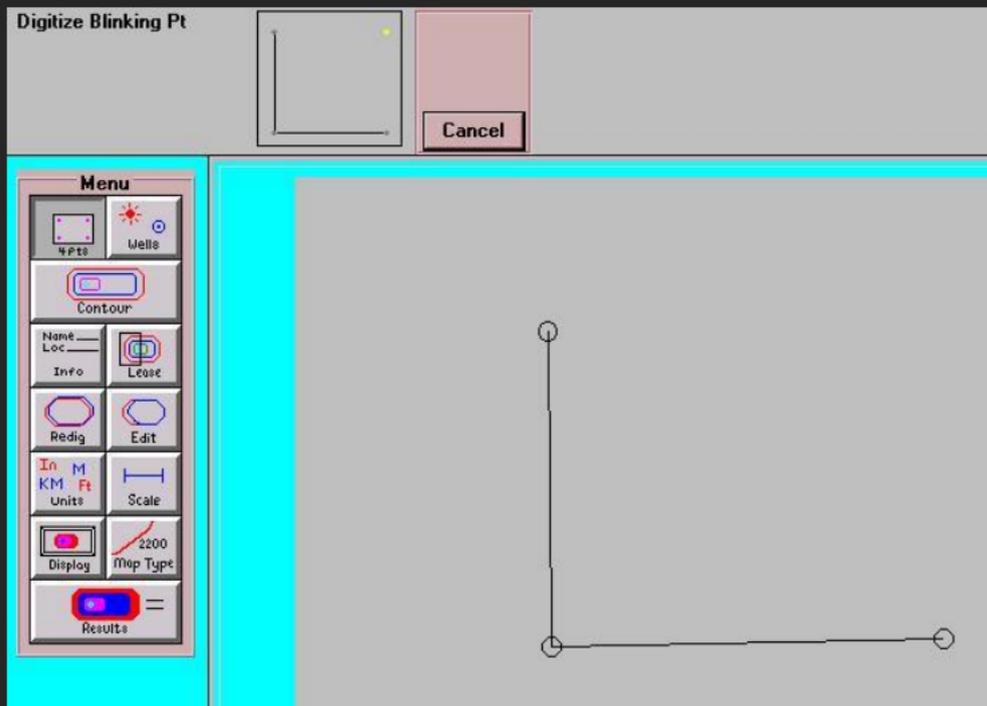
This Plan example illustrates using a digitizing board to define contours



Place the map on the digitizing tablet and start the Plan Software.

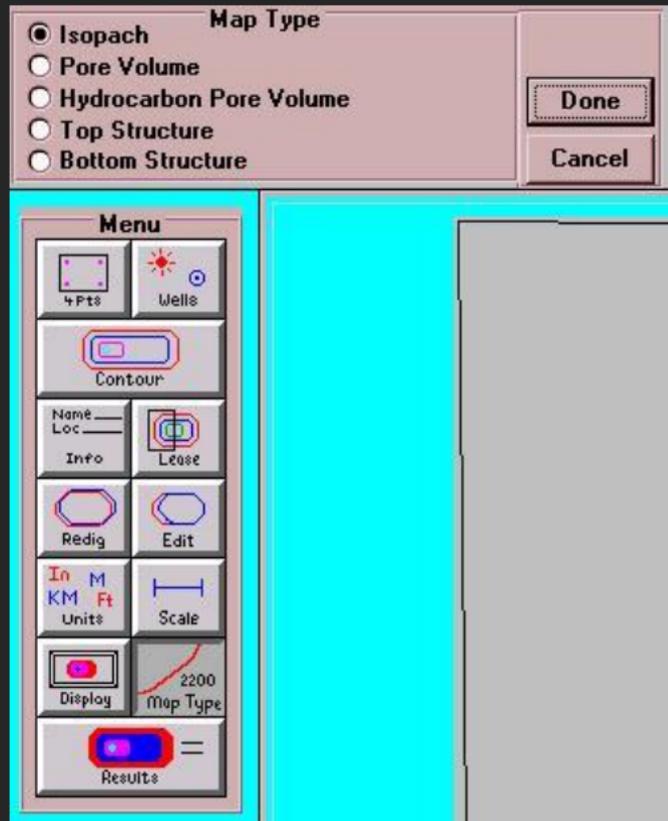
Digitize the four corners of the map.

The program prompts for each corner as they are digitized. The map is rescaled and displayed on the screen. After digitizing the map can be taken off the tablet, returned at a later date, realigned, and changes made to the digitized map.



Set the map type as a isopach map

The program can digitize isopach, pore volume, hydrocarbon, and structure maps.



Set the map scale as 1000 ft/in

The scale can be input from the keyboard or digitized from the tablet. Scale units can be English, Metric, or user defined examples being mi/in, km/cm, m/m, 1:1000. Inputting the scale from the tablet can be useful when the exact scale is unknown, such as when a map has been reproduced several times. Digitize two points on the map (eg the scale, or two points on a known section length such as a mile lease), input the distance between the two points and the program will calculate the map scale.

Input Scale

Tablet
 Keyboard

Input Scale (ft/in/)

2 scales - X and Y

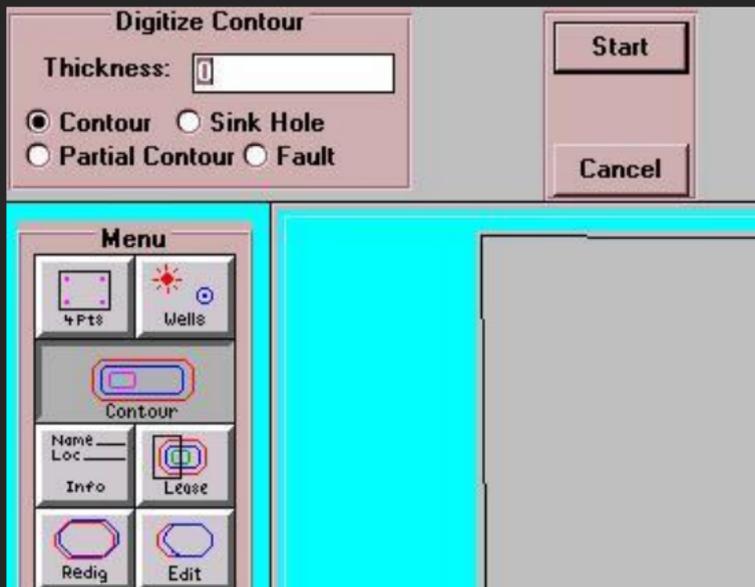
Done
Cancel

Menu

4 Pts	Wells
Contour	
Name Loc Info	Lease
Redig	Edit
In M KM Ft Units	Scale
Display	Map Type 2200
Results	

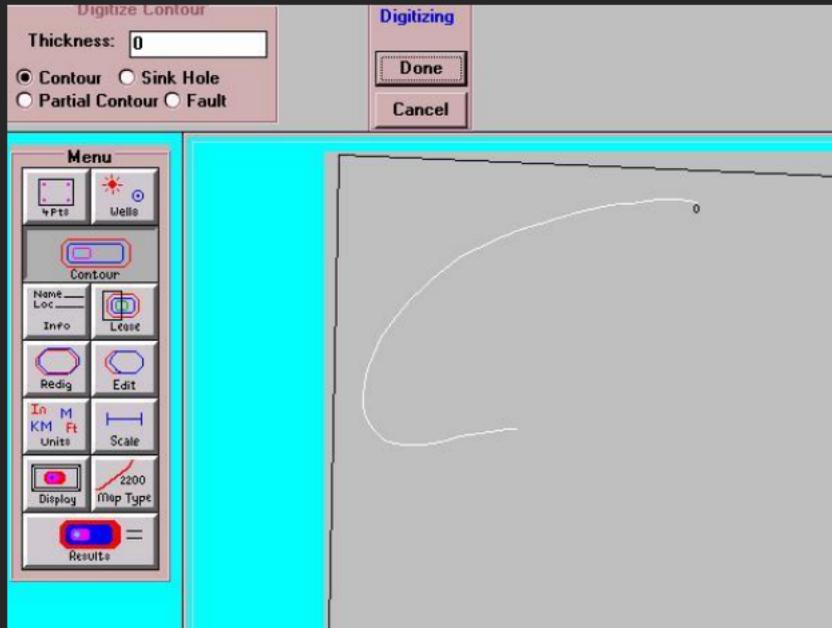
Click the contour button to digitize the contours

The program can digitize contours, sink hole contours, faults, and partial contours. A partial contour is when two contours overlap and only the differences have to be digitized. Sink hole contours are where the map is dipping lower. Faults can be digitized and then partial contours digitized around the faults



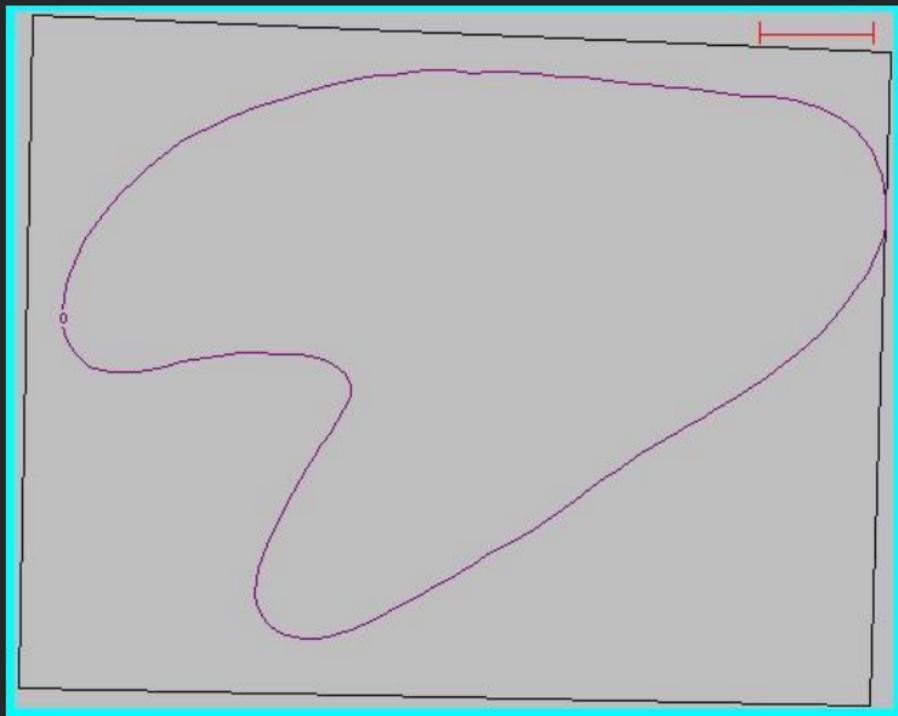
Digitize the 0 contour

As you digitize the contour is displayed on screen. The contour can be digitized by holding the button down and tracing the contour or by pushing the button every time you want a point taken. Most users prefer to hold the button down and trace. On a pen stylus, the point can be pressed for points or continuous digitizing.

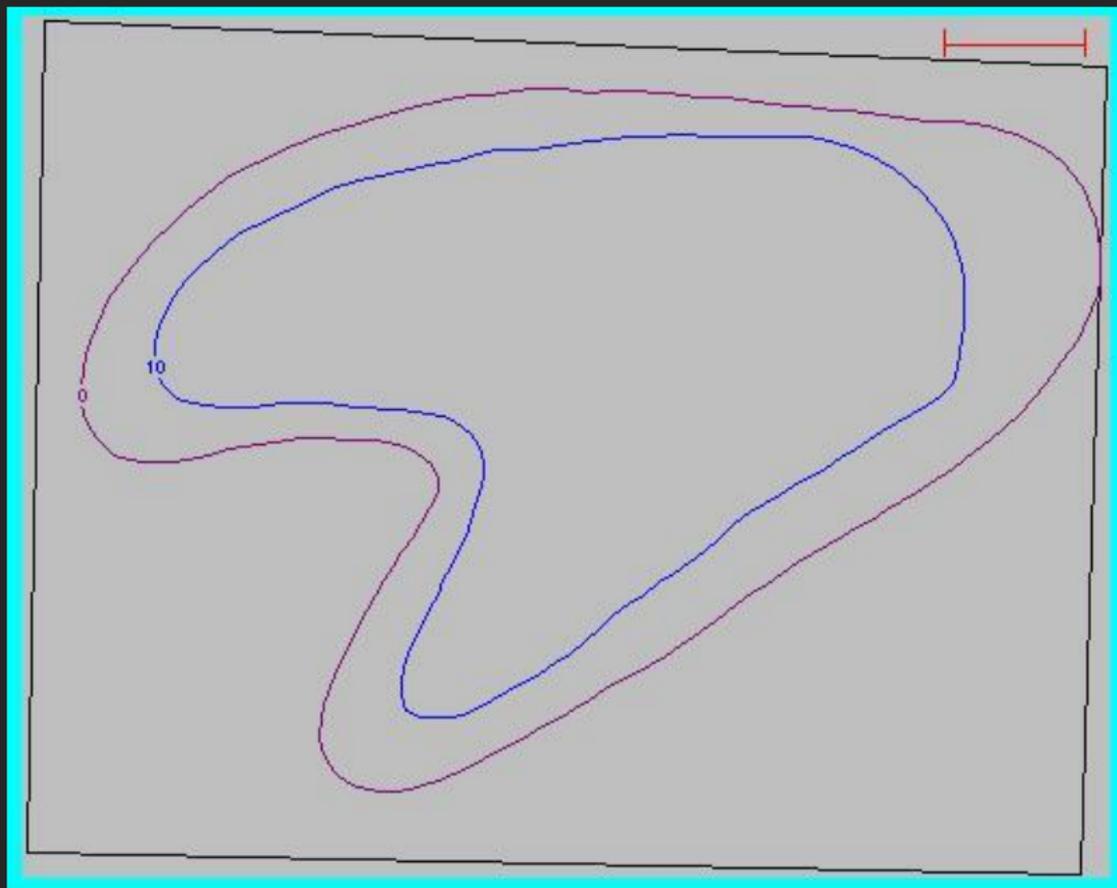


Finish tracing the 0 contour

When finished digitizing, click the done button and the program connects the starting and ending points to close the contour.



Digitize the next contour the 10' contour



Digitize the 20, 30, and 40 contours

This map has 2 hills and each of the contours are digitized separately.

Digitizing Window

Digitize Contour

Thickness:

Contour Sink Hole
 Partial Contour Fault

Menu

Contour	
Name Loc	
Info	
In KM	
M Ft	
Units	2200 Map Type

Name: Untitled.Pln Map Type: ISOPACH Scale: 1000 ft/in

Digitize the sink hole contours

This map has a sink hole where the map thins.

File Edit Setup Plan Plus Help

Digitizing Window

Digitize Contour

Thickness:

Contour Sink Hole
 Partial Contour Fault

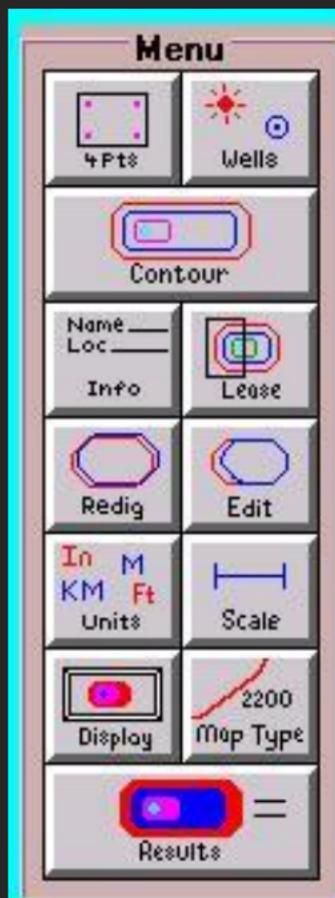
Start

Cancel

Menu

Contour	
Name	
Loc	Least
Info	
In	M
KM	Ft
Units	Scale
	2200
Map Type	

Name: Untitled.Pln Map Type: ISOPACH Scale: 1000 ft/in



Digitizing the map is finished, click Results option to continue.

Contour Area

Height	ft2	acre
40	9,716	0.2230
30	501,900	11.5
20	3,194,025	73.3
10	13,371,872	307.0
0	21,692,044	498.0
Sink Holes		
0.1	165,068	3.7894
10	1,058,646	24.3

Volumetrics

Method	ft3	ac-ft
Trapezoid	279,211,054	6,410
Pyramid	269,149,024	6,179
Trap/Pyra	270,818,048	6,217
Quadratic	333,158,283	7,648
Step	170,775,104	3,920
Ratio	250,700,656	5,755
Simpson	278,640,608	6,397
3/8 Rule	270,945,536	6,220

Display

Full Map

 Δh of top contour = 5 ft

Untitled.Pln

Menu

Change Top h

Hydrocarbons

Print Report

Add Files

Volume Layers

C/L Area Report



Graph



Close

Results

The blue table on the left are the contour areas. The area of the 0 contour is 498 acres, the 10 contour 307 acres, etc. The scale units can be English Metric, mixed, or user defined, such as acres, M2, hectares, etc. The yellow table on the right is the map volume by 8 different methods which are described more fully on the next page. The volume by the trapezoid method was 6410 Ac-ft and by the pyramid method 6179 ac-ft. The units also can be changed. The delta-h of the top contour is the thickness above the highest contour (40') and used to compute extra volume above that contour.

Volumetric Methods

Plan has 8 methods for computing map volume as shown in the results. Each method is described below.

Method	ft3	ac-ft
Trapezoid	279,211,054	6,410
Pyramid	269,149,024	6,179
Trap/Pyra	270,818,048	6,217
Quadratic	333,158,283	7,648
Step	170,775,104	3,920
Ratio	250,700,656	5,755
Simpson	278,640,608	6,397
3/8 Rule	270,945,536	6,220

The three most commonly used methods used in the oil industry are the trapezoid method, the pyramid method and the combination Trap/Pyra method.

The **trapezoid method** is computed by averaging the areas of the layers and multiplying by the layer thickness. This method slightly overestimates the volume for an oilfield map.

The **pyramid method** is computed assuming a cone shape (frustrum) between the layers. This method slightly underestimates the volume for an oilfield map.

The **combination Trap/Pyra method** tries to compensate for the underestimating and overestimating of the above two methods. When the contour areas between layers are rapidly changing the trapezoid method is used to calculate the layer volume and when the contour areas are slowly changing the pyramid method is used to compute the layer volume.

The following methods are computed by Plan but generally result in less accurate volumes. The methods have been added to the program at the request of different users of the software and provide additional information and are useful in some applications.

The **Quadratic method** curves fits a quadratic equation through the h vs Area graph and calculates the volume by integrating the curve. Mathematically this is correct, but in reality the curve adds volume near the top of the map and adds volume around the edges resulting in volumes too large.

The **Step method** assumes a flat horizontal surface between contours similar to steps on a staircase, the computed volume is too small.

The **Ratio method** modifies the step method by adding volume between layers using a ratio of the layer areas, the computed volume is usually too small.

The **Simpson method** is a modification of the trapezoid method. The trapezoid method averages the area of two contours and multiplies by the layer thickness. The accuracy of the volume could be increased by performing a weighted average of three contours and multiplying by the thickness. Simpson integration is more accurate when there is hundreds or thousands of contours. For almost all oil-field maps there are too few contours for the Simpson method to be more accurate than the trapezoid method.

The **3/8 method** is another modification of the trapezoid method where 4 contours are used to compute a layer volume. The method has the same limitations as the Simpson method.

On the results page the hydrocarbon volume can be computed

The original oil in place (OOIP) can be computed and the original gas in place (OGIP) using either the Bgi, the gas formation volume factor, or the reservoir properties.

Contour Area

Height	ft2	acre
40	9,716	0.2230
30	501,900	11.5
20	3,194,025	73.3
10	13,371,872	307.0
0	21,692,044	498.0
Sink Holes		
0.1	165,068	3.7894
10	1,058,646	24.3

Volumetrics

Method	ft3	ac-ft
Trapezoid	279,211,054	6,410
Pyramid	269,149,024	6,179
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Quadratic	333,158,283	7,648
Step	170,775,104	3,920
Ratio	250,700,656	5,755
Simpson	278,640,608	6,397
3/8 Rule	270,945,536	6,220

Hydrocarbon Calculations

Vol = ac-ft
 ϕ = frac
So = frac
Bo = rb/STB
Rf = frac

Oil
 Gas - Bgi
 Gas - p, z, t

 Calculate

Display

Full Map

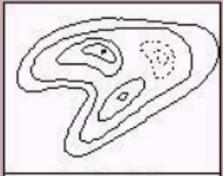


Menu

Change Top h
Hydrocarbons
Print Report
Add Files
Volume Layers
C/L Area Report

 Graph  Close

Δh of top contour = 5 ft



Untitled.Pln

Compute Oil Volumes

From the digitized map the volume was 6217 Ac-ft. The input porosity is .28, the oil saturation .63, the oil formation volume factor is 1.1, and an estimated recovery factor of .2. The computed oil in place is 7.7 MMBbls, the reserves using the input recovery factor is 1.5 MMbbls, the hydrocarbon pore volume is 1,244 bbl/ac ft, and the average map thickness is 12.5 feet. The scale units can be changed to English, Metric or user defined.

Hydrocarbon Calculations

Oil
 Gas - Bgi
 Gas - p, z, t

Calculate **Close**

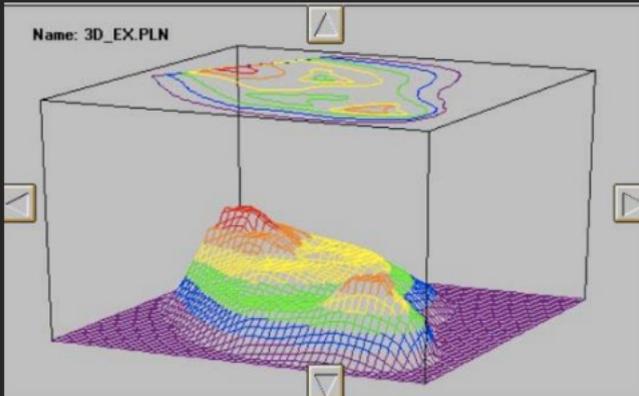
Vol = ac-ft
 ϕ = frac
So = frac
Bo = rb/STB
Rf = frac

OOIP = 7,734,947 bbl
Reserves = 1,546,989 bbl
HC / Vol = 1,244 bbl/ac-ft
have = 12.5 ft

Print the report and save the file

The report prints on 8.5 x 11 paper in color or black and white and contains a small copy of the map at the top of the page, the computed contour areas, map volumes, and hydrocarbons, and some optional user-input information.

The file can be saved for future use. If the four corners in the first step of the digitizing have been marked on the map, the map can be replaced on the tablet, realigned, and contours edited, changed, or added.



Plan Plus offers extra features such as the 3D image shown at the left.

For more information, to schedule an on-line DEMO, or to purchase Plan or Plan Plus, contact John Walsh at 512-656-8195 or john.walsh@logicgroup.com