Introduction to LandMentor

LandMentor provides the tools and training for public and private industry planners, architects, surveyors, and civil engineers to *easily* design profitable, efficient, beautiful, & sustainable developments.

LandMentor is the only stand-alone (non-modular) solution intended to improve upon both CAD and GIS based technology. It brings about a new era of higher level communication in both 2D and 3D deliverables.

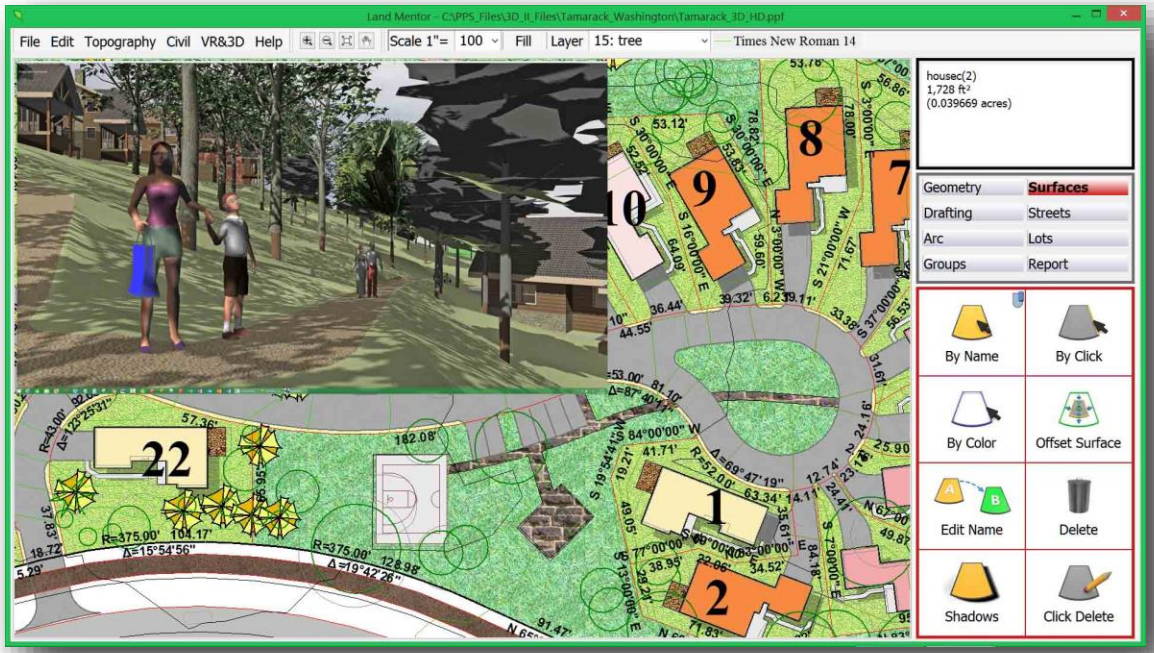


Figure 1 A development in LandMentor with a Virtual Reality inset showing the steep slopes

The education in the LandMentor textbooks expands upon class training, thus classes are not intended to replace these manuals, but to provide a jump-start to production. It is also recommended that new users review the text books if able BEFORE classes begin. These text books along with the classes will produce better results for the ultimate end users – *those that will work, dwell, and enjoy life in **LandMentor** designed development*.

Prior to **LandMentor,** design was done using CAD to produce lines and arcs for a drawing. Look around you – do you see lines and arcs? *No.* You see surfaces that represent the man-made elements of our built environment.

LandMentor represents a new era where analysis, design and presentation is based on *surfaces*.

Land Planning (prior to the computer era)

One of the first design tool advancements was the **Rapidograph** (pictured) that would allow precise line widths.

Before CAD, planning was hand-drawn (imprecise) sketches. A surveyor or engineer modified the design to conform to exact specifications for construction.

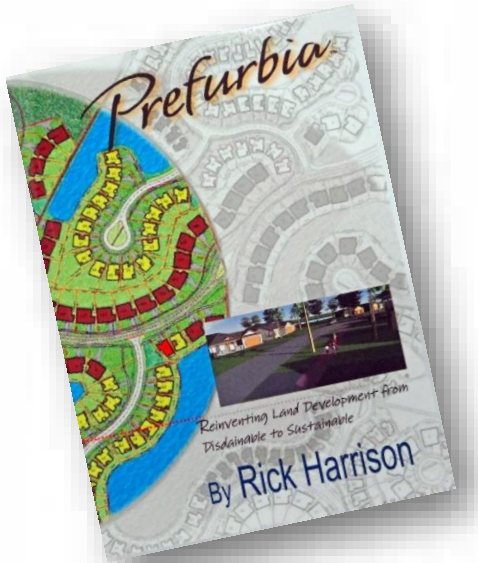
There was no quick way to determine surface areas (and types) to measure the efficiency of a design.

CAD (Computer Aided Drafting) allowed the same hand-sketching on a computer screen – *still without usable accuracy*. The free-hand CAD sketch contains tens of thousands (in many cases millions) of drawing entities, all at dubious locations. This creates a major headache for surveyors or engineers who must check and correct the enormous amount of information.

To make matters worse, there is a tendency to use inaccurate site data easily obtained from MapQuest, Google Earth, Bing Maps, and a variety of other sources. To obtain accurate data it must come from the land surveyor, but instead, many 'planners' cut and paste from vague online sources thinking they are reliable for base information.

There are many *automated* subdividing software on the market that reduce design of 'subdivisions' to minutes. This mindless cookie-cutter automation is the opposite of this system which represents a comprehensive single solution to create sustainable and exciting neighborhoods, not quick inefficient plats.

In many ways, the planner using automated CAD or GIS and relying on free internet data was a step backward in productivity!



LandMentor was created to solve major industry problems caused by CAD and GIS based systems. More important, **LandMentor** provides spatial information critical to decision making required to achieve a more sustainable development.

Sustainability is well defined in the book Prefurbia, included with **LandMentor**.

While Prefurbia suggests certain styles to develop land, **LandMentor** is not restricted by any style or method.

The Empowered Sustainable Planner

A 'sustainable planner' *must* be familiar with basic principles of architecture related to the site, civil engineering and land surveying. They must also be able to communicate site plan elements and ideas in an understandable manner for all involved in growth and redevelopment. This is why **LandMentor** includes a basic education in these fields along with other aspects of growth such as financial projections, site architecture, precision mapping, landscape architecture and much more.

If a planner (or architect) understands why a feature or function is critical for engineering or surveying it eliminates the need for consultants to fix the data generated by the land planner, and builds industry collaboration. Since most surveyors and engineers also act as planners, this system serves their basic needs better than CAD while teaching them to be better planners and work with architects more intimately.

The quick transformation from a 2D to a 3D virtual environment solves a major problem in land development communication – the complexity and costs associated with 3D is eliminated with this system.

How LandMentor differs from CAD, CDIS and GIS…

CAD has been around since the early 1980's as a *drafting tool* - requiring add-on packages. Both CAD and GIS (Geographic Information Systems) require a separate data structure for engineering and surveying calculations. Neither CAD nor GIS is well suited for precision surface generation.

They are inherently limited technologies for land surveying, site engineering and land planning requirements.

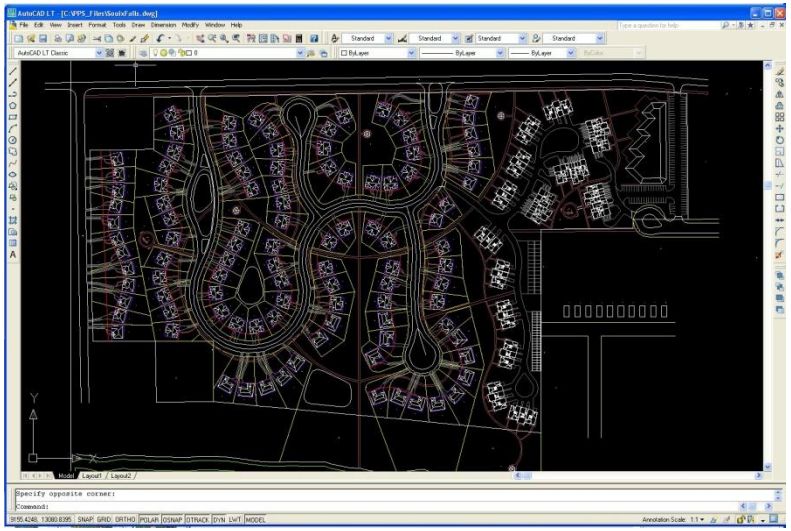


Figure 2 A site plan in CAD is difficult to decipher

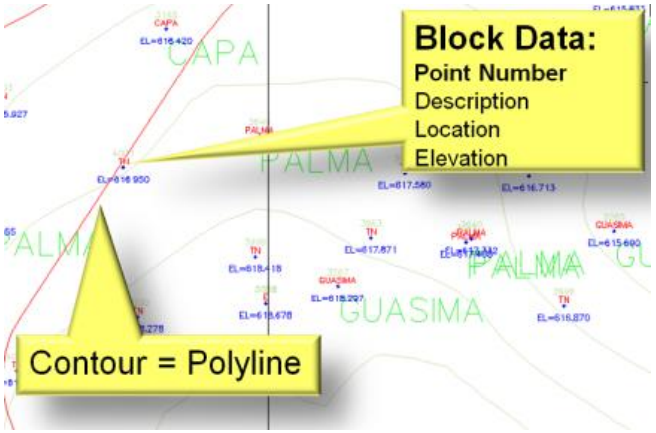


Figure 3 Calculations in CAD require a separate data structure

CAD data structures of lines, arcs and polylines are treated internally as separate drawing commands detached from each other. For example, if there were ten individual lines that come to the same point (location), there are ten separate pairs of the same coordinate stacked on top of each other. Nothing in CAD relates to exactly what a point represents – is it a lot corner, a building corner, or on the centerline of a street? A CAD "add-on" software hides these inefficiencies, but they still exist. The opportunity for error increases because of data separation.

Why not GIS?

Geographic Information Systems *have been popular since the early 1990's.* While GIS is a coordinate based system, the most popular systems rely on simple polygons (shapes). The 'shapes' (surfaces) of individual parcels are represented by a continuous series of coordinates. This would all be fine if there was no *curved* property.

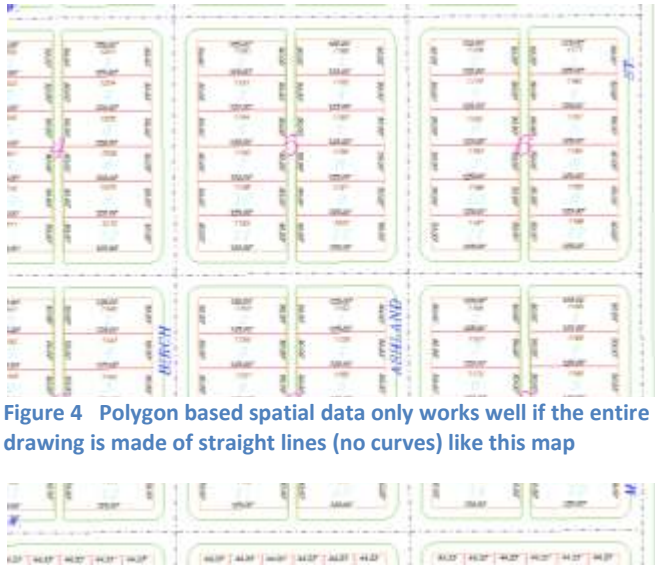


Figure 4 Polygon based spatial data only works well if the entire drawing is made of straight lines (no curves) like this map

Many GIS maps are produced from aerial photographs, transferred, or traced data, thus the accuracy will be questionable. Another problem is that a map in GIS can be stretched – this is called 'rubber sheeting'.

If the base map originally had accurate curve information, and someone *stretched* the map in various directions, there would be no true arcs. **A 'stretched map' is useless for precision layout.**

Since all shapes and parcels are shown by a polygon, in order to create curves that look smooth, it is not unusual for each curve to contain 40 coordinate pairs! Imagine using GIS on a beautiful neighborhood with curved streets and walks - how complex the base information would be. Also, the GIS system is a data base tied to a map and is <u>not</u> intended for precision geometric design. Thus, like CAD, the information for precise calculations would be in addition to and not within the GIS base data structure.

To learn more information, see Surveying and Mapping, beginning on page 440.

Why not CDIS?

CDIS (Coordinate Design & Information System developed by Land innovation, Inc. and later used in SiteComp) is a point and 'figure' (figures are entities) based system that was more suitable for engineering and surveying than CAD.

Within CDIS, the drawing maintains individual point numbering to separate surveying and civil design functions. If points are stacked in CDIS, they must often be manually edited. CDIS is more complex to use than **LandMentor**.

Note: *The creators of* **LandMentor** *also created CDIS in the 1980's.*

Why have point numbers at all?

There were no 'point numbers' in the land development profession until the advent of land surveying software. The days before computers existed were simplistic and in many ways *easier*. Why not go back to the simplicity of the past? While **LandMentor** does indicate 'point numbers', it is strictly to make those familiar with point based systems more comfortable, and provide communication to-and-from the surveyor's data collector.

For land surveyors concerned about the initial legal surveyed information, **LandMentor** (when reading raw coordinates or raw data from a data collector) will retain the original point coordinates AND description – the critical legal information.

See page 427 to learn more about land surveying with ***LandMentor****.*

What is coordinate geometry?

Every object on earth can be defined at a specific location - North and East of a reference point.

The earth is approximately 20,500 miles in circumference, or about 131,472,000 million feet around. Working in this large range of numbers, determining the corner of the room you are sitting in would be excessive. For example, the corner of your room might be at some 'Earth' coordinate of:

North	56,453,125.12425
East	89,143,189.45341

These huge numbers are difficult to work with, so…

Coordinate geometry using an assumed system

Many surveyors and engineers simply make up an *assumed coordinate system*, allowing them to design using less-bulky numbers. As an example, an *assumed system* might start at coordinate location of, 5,000N and 5,000E (north and east), a lot corner location would look like: 3,125.124 North and 3,189.453 East. Also, what was used for bearing (direction angle) reference for 'north' was also often 'assumed'.

Most coordinate geometry for engineering and surveying jobs in the past used 'assumed coordinates and bearings'. Thus, the geometric records of one site is not necessarily related to adjacent properties. Since, angle reference of individual site surveys were (typically) assumed, it is why a survey on one tract may show a boundary line as N 11 56'34" E, and that same line on the adjacent tract surveyed years later may read N 12 02'23" E, even though they are in fact the same line and the same direction!

For more information and education see page 440.

Coordinate geometry using a government based system:

Today, many site boundaries are tied to a 'state plane' system. This localized system places all sites on a common coordinate basis. To use a *State Plane System*, the surveyor before GPS (Global Positioning Systems) had to find known monuments with pre-defined coordinates, but these could be miles away from the site. To make matters even more complex, some coordinate systems take into account the curvature of the earth. There were several different methods to calculate that – all with slightly different results! **LandMentor** uses simple flat plane coordinates.

LandMentor is ideal for general land surveying tasks and general civil engineering needs. It is assumed that the actual surveyed site data and topography originates from a dedicated software and done by a technician fluent in coordinate geometry.

Why use coordinate geometry?

Coordinate geometry is used to determine boundary limits and locations of structures (buildings, paved areas, etc.) in relationship to each other. If each item is located in a particular coordinate on the ground, **LandMentor** can not only compute its distance to other structures and property lines, but also design new structures that are within *legally* allowed limitations. This way you can be assured that designs meet local requirements. More important is that precise coordinate geometry is the basis for the *surface based design* and 3D presentations of **LandMentor.**

The evolution of coordinate geometry

Just a few decades ago, there were no computers. All tedious math (geometry) was done manually. A land surveying technician used trigonometry to locate items on a site based upon field angles and distances. Using a hand drawn sketch, they indicated what the object was and its location (coordinate). Mistakes were common. It took days to work out a simple survey in the office. Needless to say, one could not get too complex with the initial survey or the finished plat because the time was the largest roadblock. The 'calculation sheets' looked something like the example shown here and were considered legal documents.

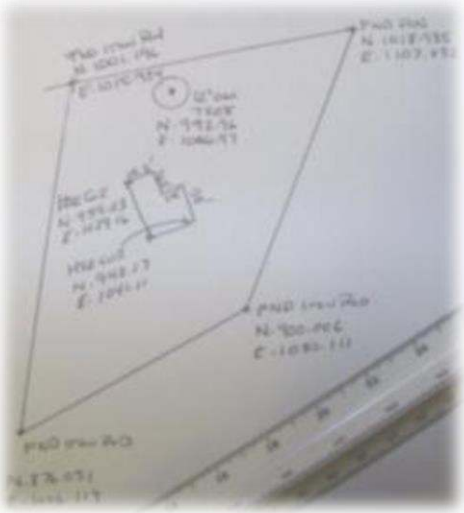


Figure 5 A hand drawn calculation sheet.

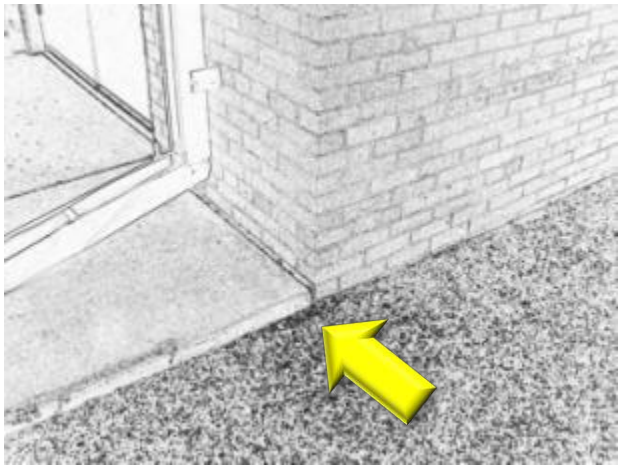
The 1970's digital scientific computers had enough memory and speed to be useable for surveying and civil engineering – such as the HP-85 to the right.

Before CADD, software systems used HPGL (Hewlett Packard Graphics Language) as the basis for automated drafting using the slow pen plotters.

At first, the computers were used to output coordinates when bearings and distances were entered, drastically cutting data input time and decreasing errors.

When computers had enough memory to store coordinate pairs, 'point number' geometry was established.

The problem with 'point number geometry'



The diagram to the right depicts a house corner which is also the corner of a concrete patio. That 'single point' is the corner (intersection) of two different structures. When computers began to have enough memory to keep track of the coordinates, the 'single point' was assigned a number.

For example, the corner of the 'house-patio' point at location 5,121.453N and 8,564.982E could be assigned a point (memory location), say 56.

The 56 means it's the 56th point in memory. As memory grew in size, more points could be stored. Eventually, there was enough memory to store the elevation, and then more memory to save a description of the point: **house-patio**.

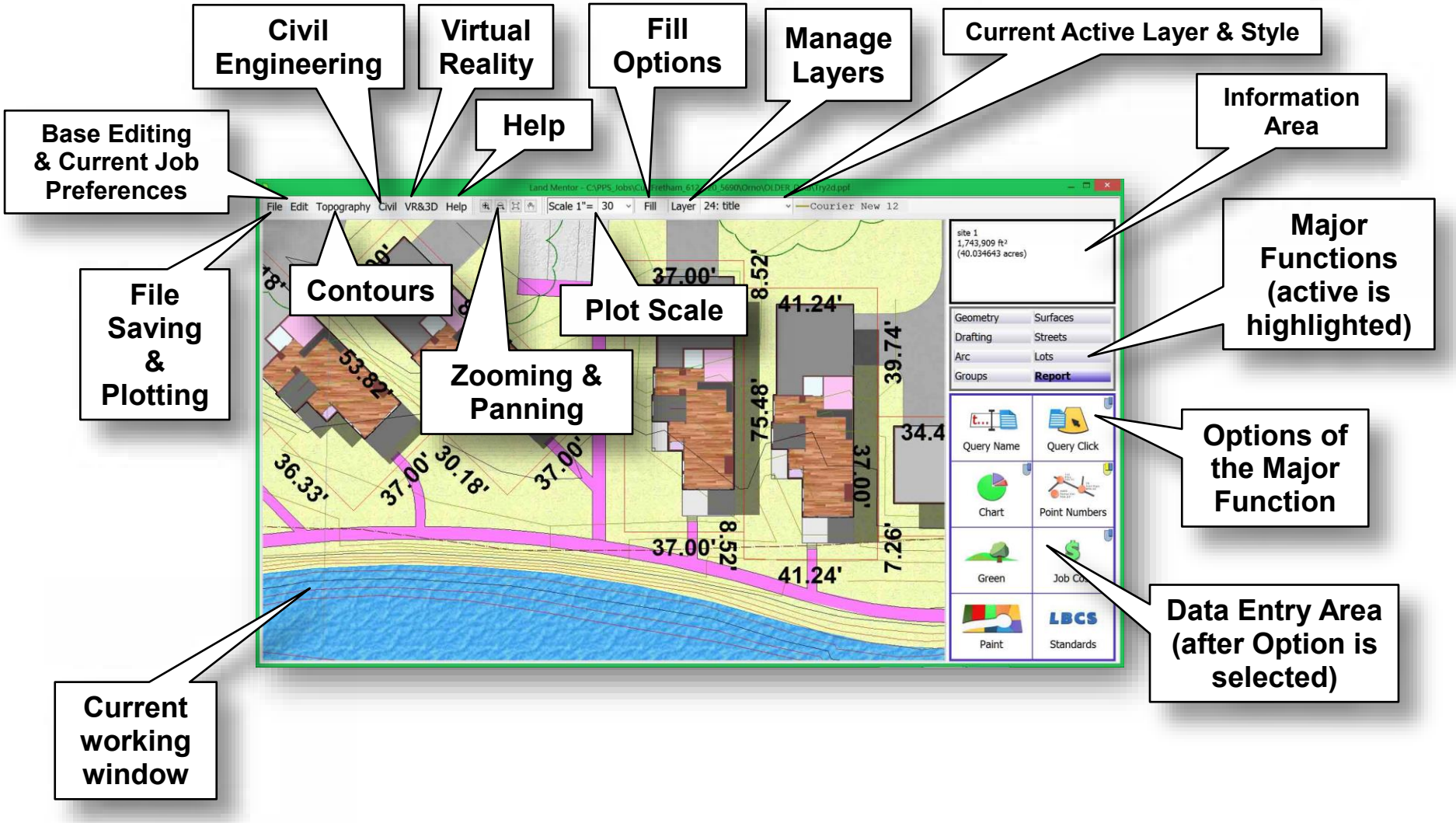
Today's coordinate geometry systems contain the four critical data structures to build information:

The Northing	(Y coordinate)
The Easting	(X coordinate)
The Elevation	(Z coordinate)
The Description	(what the point represents)

Today, point numbering in CAD has gotten out of control, with a typical file containing hundreds of thousands of points – LandMentor uses positional geometry eliminating the complexity of point number management.

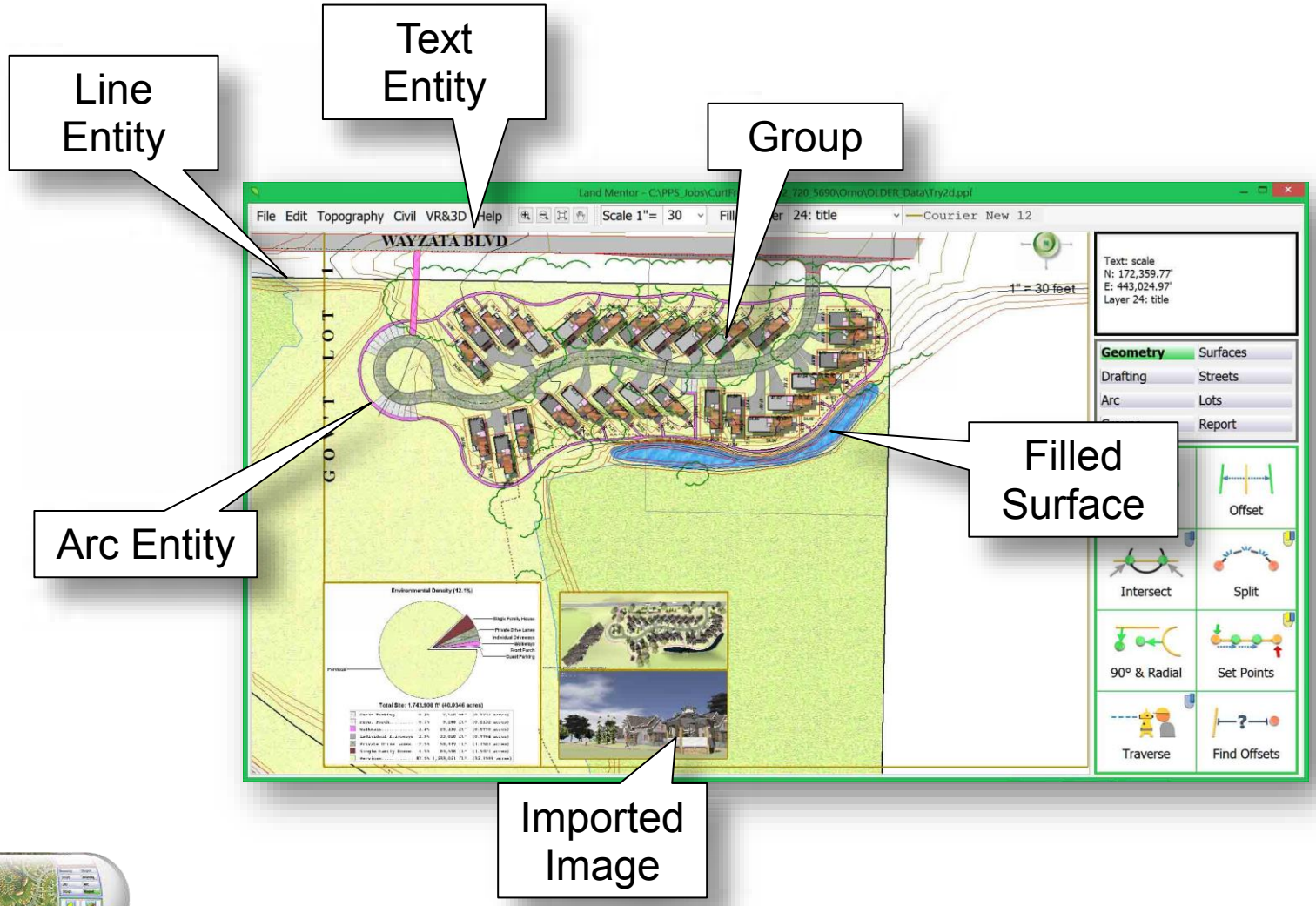
The LandMentor dashboard

The dashboard (user interface) is designed to be easy to read yet flexible with the fewest possible button presses and mouse clicks to complete most tasks. This means large buttons with few pull-down features.



Data Structures

To keep it simple, there are very few computational and drawing elements within **LandMentor**. This shortens the learning curve. The following are basic elements that build site plans:



Data structure continued:

Line A line drawn between two points (points can be at different elevations).

Arc An arc that originates at a point then curves counter-clockwise around a center point to an end point.

Note: The above two entities have the intelligence for annotation (bearing, distance and curve data).

Polyline Begins at a point then the line goes through a series of points to an end point. **While polylines are the basis for most GIS software systems, they should be avoided in LandMentor**.

Text A unique entity for text – does not consume points. Text can be straight or curved.

Surface A definition of an open or closed series of lines and arcs that define property and alignment. A CAD system does not have a 'surface' entity, but a GIS system does in the form of a 'shape'. A CDIS system calls a surface as a parcel. A CDIS 'Parcel' and a **LandMentor** 'Surface' are similar in configuration.

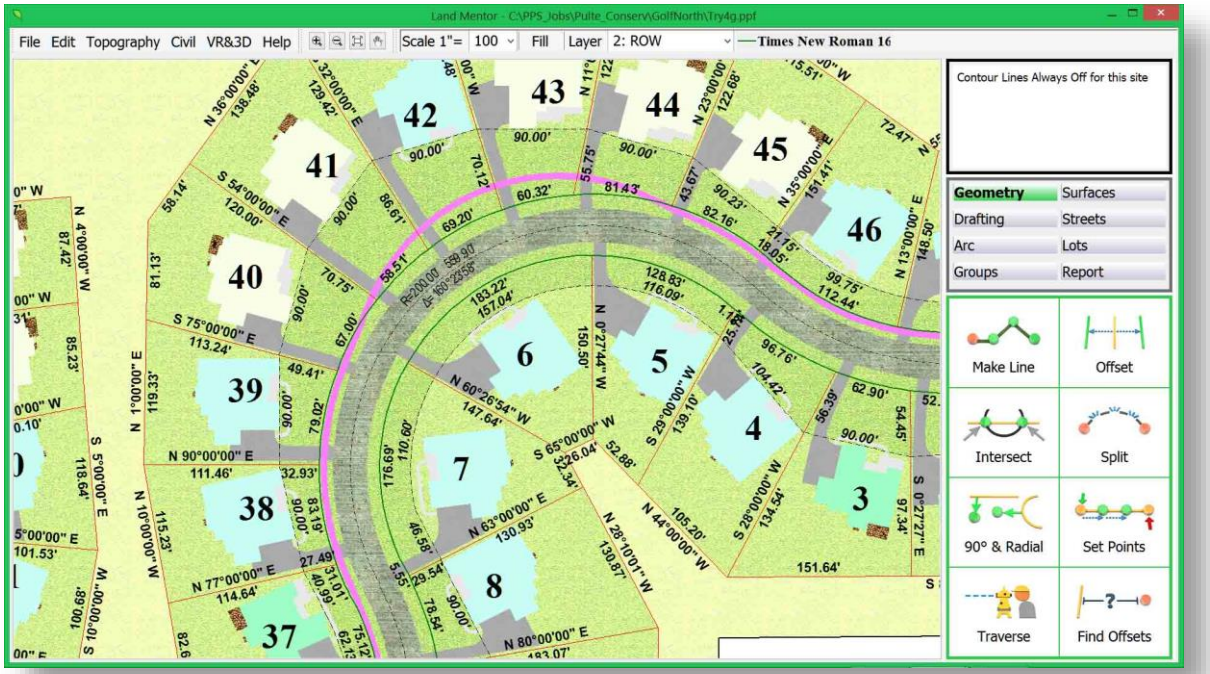
DTM An optional contour DTM (Digital Terrain Model to compute contoured land surface) is an underlying data structure that enables **LandMentor** to perform topographical functions such as contour generation, slope shading, drainage flow maps, etc. **LandMentor** Virtual Reality must have a topographical site surface for its operation, even a fake flat surface is OK.

Layer **LandMentor** layers are similar to CAD, GIS, and CDIS. **LandMentor** has more functions tied to layers than CAD. Layers are a way to separate types of lines such as centerline, lot lines, buildings, etc.

VR Interactive Virtual Reality is similar to a video game. When a Virtual Reality is created, it can be automatically saved in a **LandMentor** file.

3D Model To embellish a 'virtual' site plan, **LandMentor** has the ability to import 3D Models such as people, trees, vehicles, etc. from a Collada (.dae format) file. Typically, these are found in SketchUp libraries.

Annotations of lines and arcs

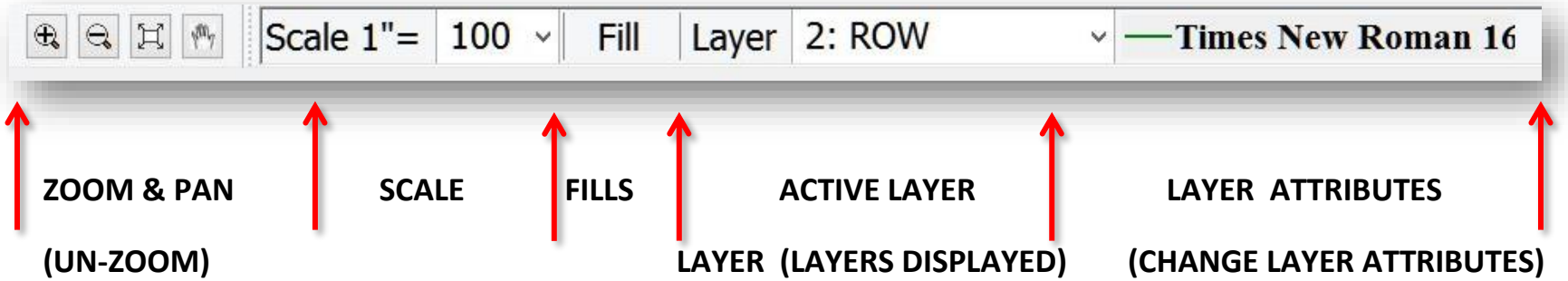


Lines and arcs internally contain a variety of standard annotations (bearing and distance information) as shown above. It is possible to have total control over the look of annotation, however, advanced training is required. The default annotation selection should suffice for most needs.

LandMentor line work is also the geometry (not true with CAD and GIS), thus the annotation will always be correct. If the annotation appears wrong (the bearing and/or distance), you must revise the line work because *you* made the error! Note that any font can be used for annotation.

The top menu bar

The top menu bar sets the zoom controls as well as the scale and layer selection commands:

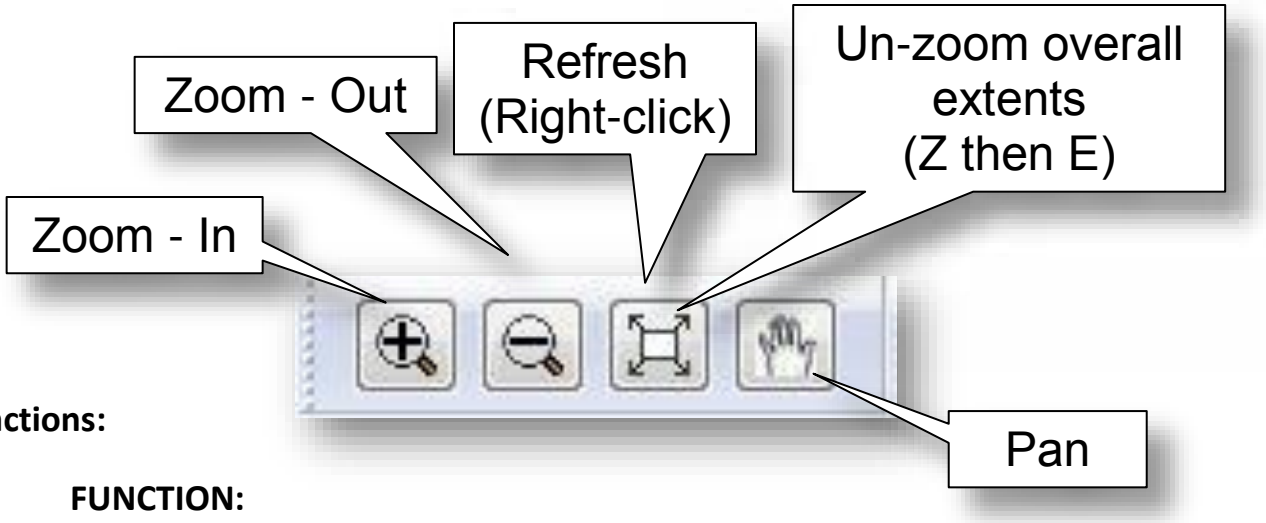


None of the above features can revise the general settings of the software – they can only revise the settings within the job file that you are currently working within.

Layer allows you to 'activate' the layers seen and used for calculations.

*To set or change overall settings, you must select **Global Preferences** (see page 299) under the **File** pull-down.*

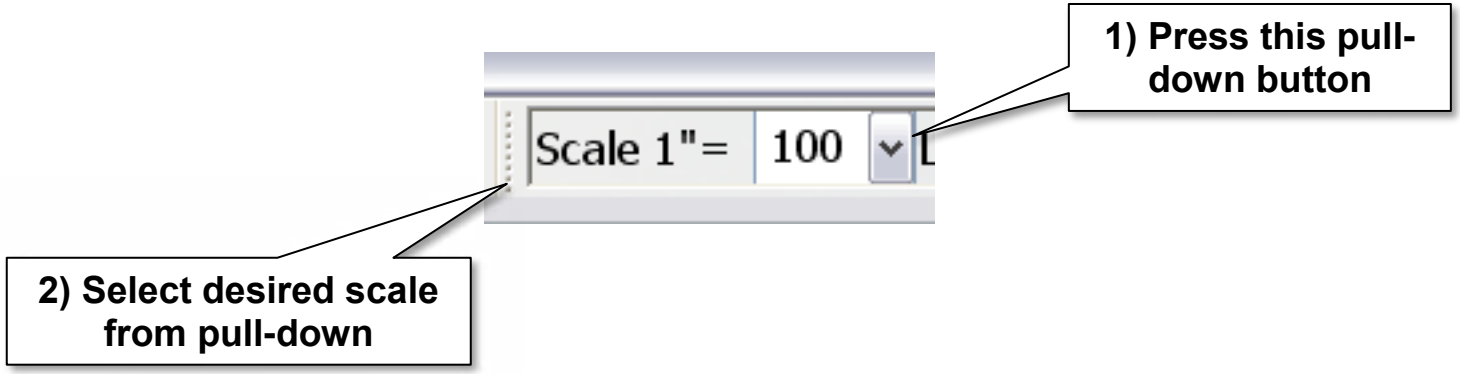
The zoom, un-zoom and pan



Additional "Hot-Key" Display functions:

HOT KEYS:	**FUNCTION:**
Press Z then E	Un-zooms to overall extents of the drawing (fits drawing on the entire screen).
Press Z then P	Zooms to previous display.
Press Alt – Z	Refreshes the current screen.
Press Z	Allows you to zoom in using the mouse cursor – holding down the mouse left button to define a corner, then releasing the left button for opposite corner.
Press P	This will allow a screen PAN, which moves the drawing from one location to another location by dragging the cursor.
Press Shift C	This will center the screen on the location where you click the mouse.

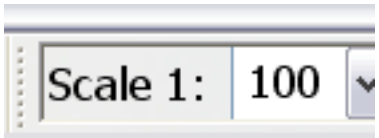
Setting Scale



Scale is the measurement used to size your drawing for external plotting of your site. In theory, if you were never to plot to an external plotter or printer, then scale will not matter in **LandMentor**.

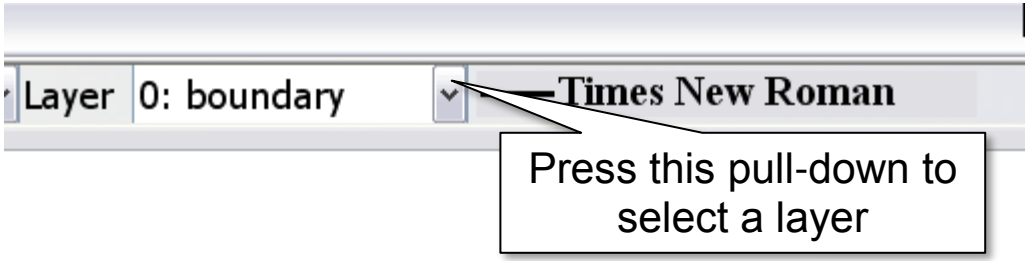
If the scale desired is not shown on the pull down, you can click on the number indicated to highlight and revise it to the proper scale.

LandMentor can operate in Metric or English scales. When in metric scale the scale button above changes to:



Understanding layers

Layers are used to separate data types, such as property lines, street right-of-way, lots, buildings, walks, trees, etc. The current layer displayed will be assigned to the next entity created. For example, the display shows layer 0 (zero) set to boundary. The next line, arc or text will be placed on that layer.



Set Layers (pressing [**Layer**] or pressing the [`] keyboard button) controls what is seen and which entities and points can be snapped. Unique to **LandMentor** is the ability to only snap to points on active layers for geometric purposes.

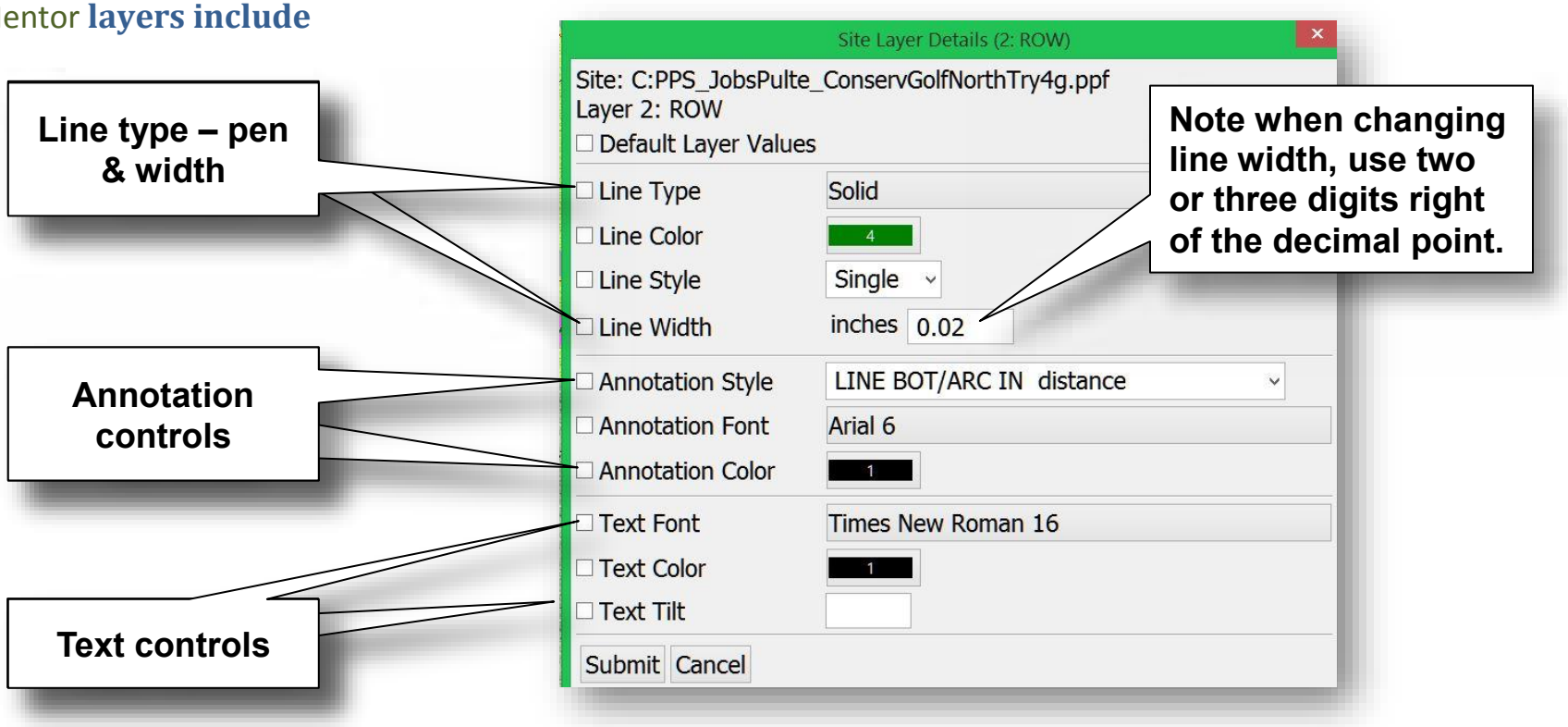
Automated descriptions by layer name

Points in* LandMentor *are four dimensional – they all have a north and east position as well as an elevation. If the elevation is 0 (zero), it will be ignored for DTM (contouring) purposes. The point also has a description automatically tied to it. If the point is on the **boundary** layer – it will automatically be described as: **boundary**. If on the **lot** layer, it's described as: **lot** If the point is located on entities that join it to many layers, it will use the highest numbered layer. For example, if it's on layer 0 (boundary), layer 2 (ROW) and also layer 3 (lot), it will be described as: lot.

Layer attributes

LandMentor comes with *default layers* that were designated for land planning situations. The default layers are just a suggestion. If you do not like the selection, then feel free to customize your own. These instructions will be based upon the default layering system. To access this selection box, click on the text to the right of the layer name.

LandMentor layers include



The default attributes will be automatically selected when the layer is activated. You can individually change attributes within an active layer by checking the box next to the item to change. In most instances, the box is automatically checked when the attribute senses a change.

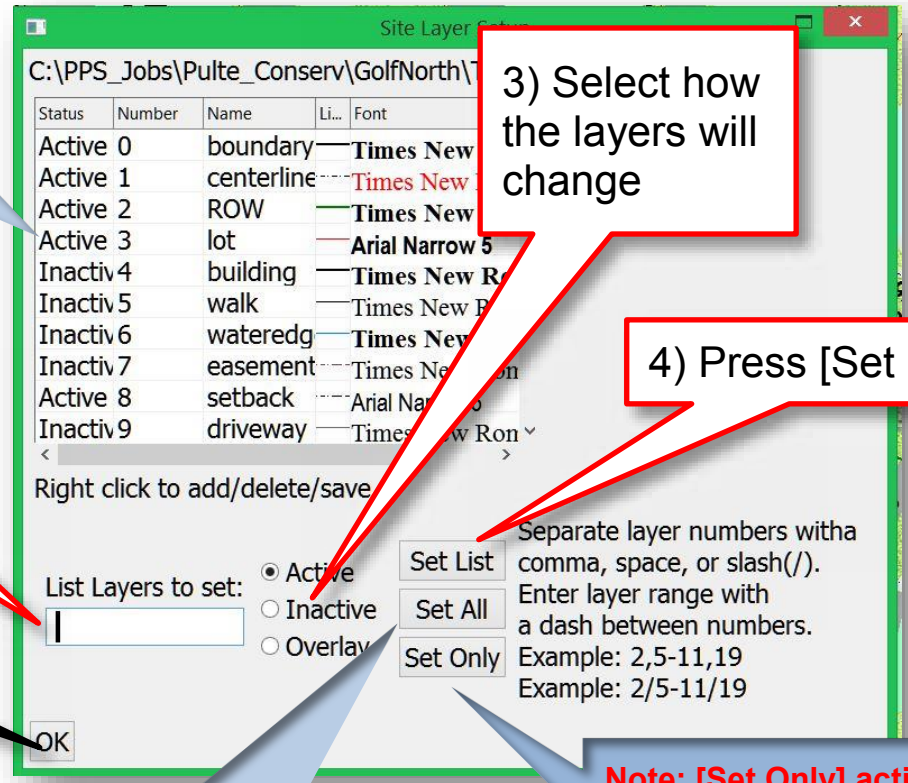
Activating layers

1) Press Layer or [`] button

Scale: 100 Layer: 0: boundary

Note: Inactive does not display entity,

- Active displays entity.
- Overlay displays but you cannot snap to entity.



3) Select how the layers will change

4) Press [Set List]

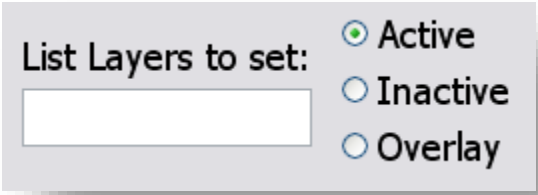
2) Enter the layers you want to change here

5) Press [OK]

Note: [Set All] changes entire list to Active, Inactive or Overlay

Note: [Set Only] activates the layers manually entered, then refreshes the screen.

Manually entering active layers



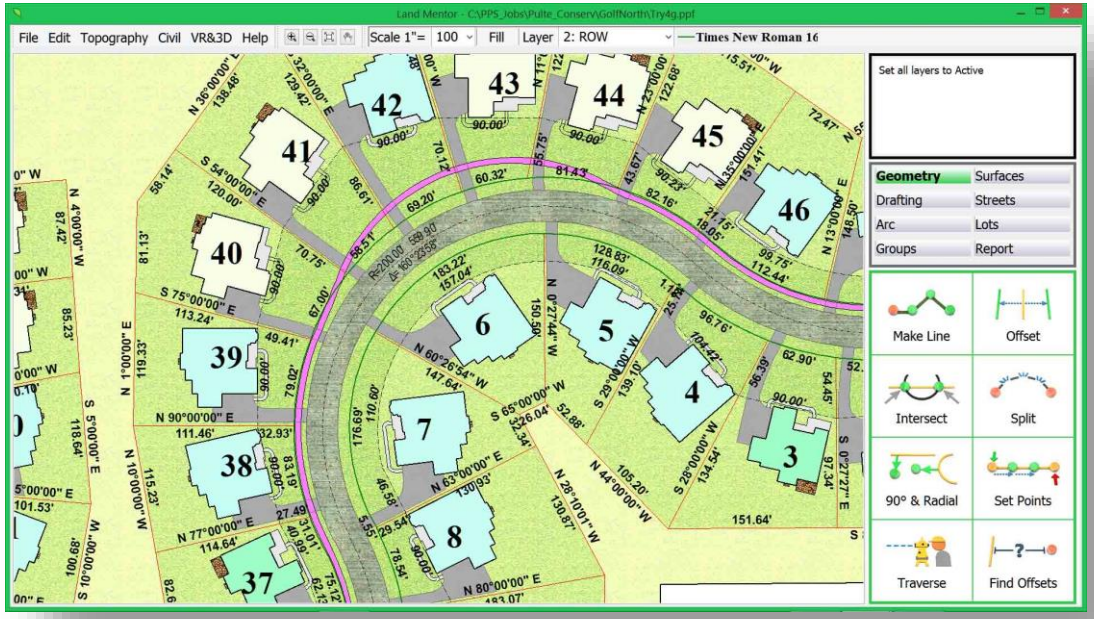
Example: You want to deactivate Layer 5 – in the box above, type in: **5** and press **Inactive, [Set List], [OK]**

Example: To overlay Layers 1,4 and 10 – in the box above, type in: **1,4,10** and press **Overlay, [Set List], [OK]**

Example: To deactivate Layers 5 and 20 through 30 and layer 40 through 50 and layer 66

– in the box above type in: **5,20-30,40-50,66** and press **Inactive, [Set List], [OK]**

This screen shows all the layers active:



This screen shows only the home perimeter, pave edge and walk edge layers active:

Notes:

Many layers do not appear, yet because of the representation (coloring) of the surfaces, you can still see most (or all) of the drawing – even though the display only shows very few lines. The lines shown will either be active or overlaid. The only way to tell the difference is to try to snap to an entity or point. If it can be snapped to, you can revise it, build from it, or use it for the generation of new surfaces.

To activate ALL layers quickly press [Q] (hot key for quick activation). Press [Q] again for previous setting.

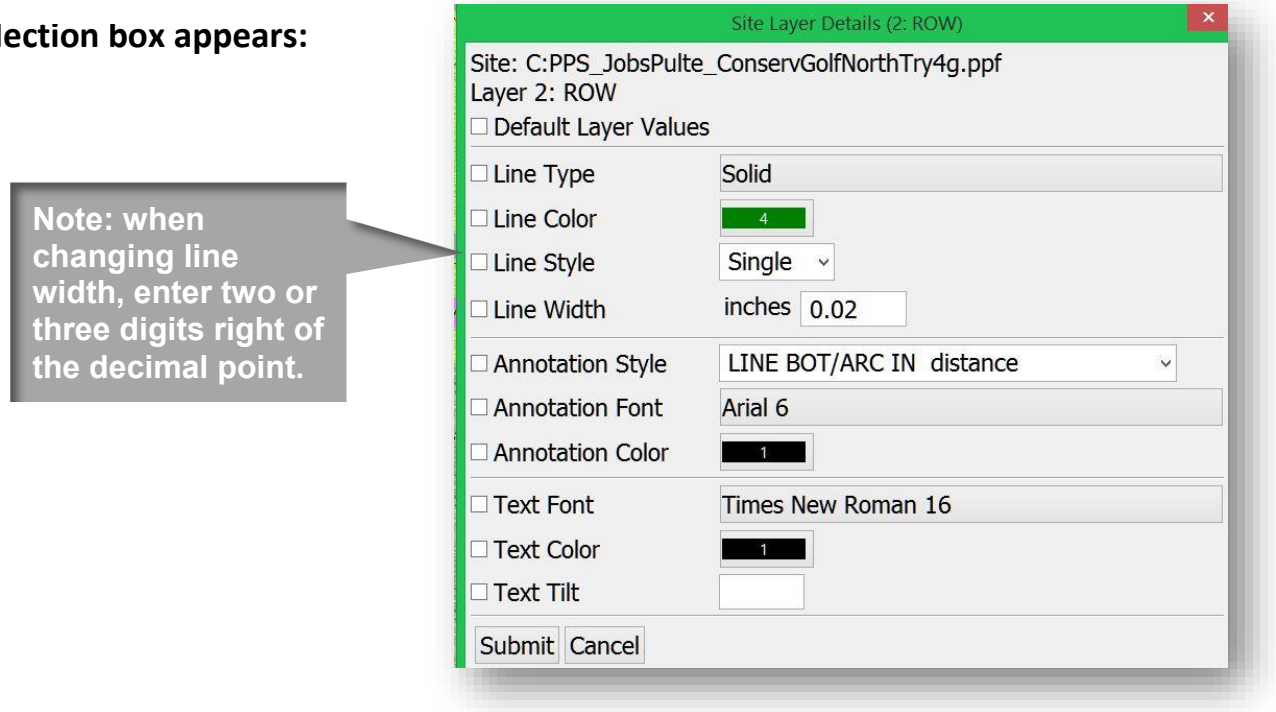
Photographic effect

All layers are inactive with the above drawing, thus no line work appears. You can still see the majority of the details. What you are looking at is just a small part of the surface (spatial) information within the drawing: the obvious is the lawn, the trees, the pond surface, walks, street paving and rooftops.

Surfaces create an image for the drawing and they also define area. Thus, surfaces provide a check on the geometry because if there is a gap in the perimeter the surface will not close, the surface cannot fill with a color, thus you have not connected the line work completely. Because surfaces are also defined as pervious or impervious, they can automatically determine environmental impacts of impervious area using the **LandMentor** 'Green', charting, and job costing features (see Report).

Changing the attributes of the active layer

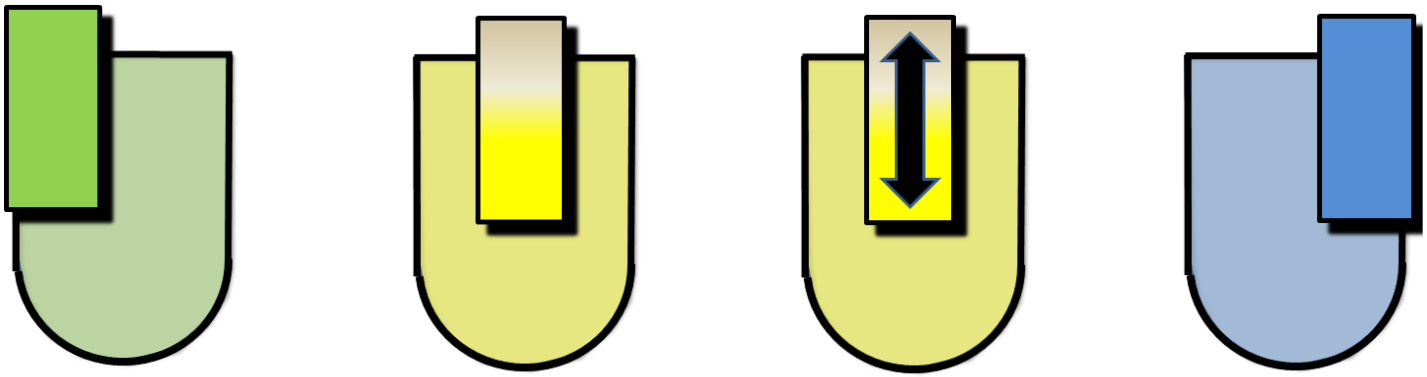
A pop-up selection box appears:



Change anything you want on the selection box and it will change all the entities on the active layer to those settings. The check box should automatically change – if it does not then check the box to assure the change is to be made. The changes will appear on the next screen refresh.

Using the three button mouse

Throughout **LandMentor** you will see the following symbols used to indicate which buttons on the 3 button mouse which is required for most functions:

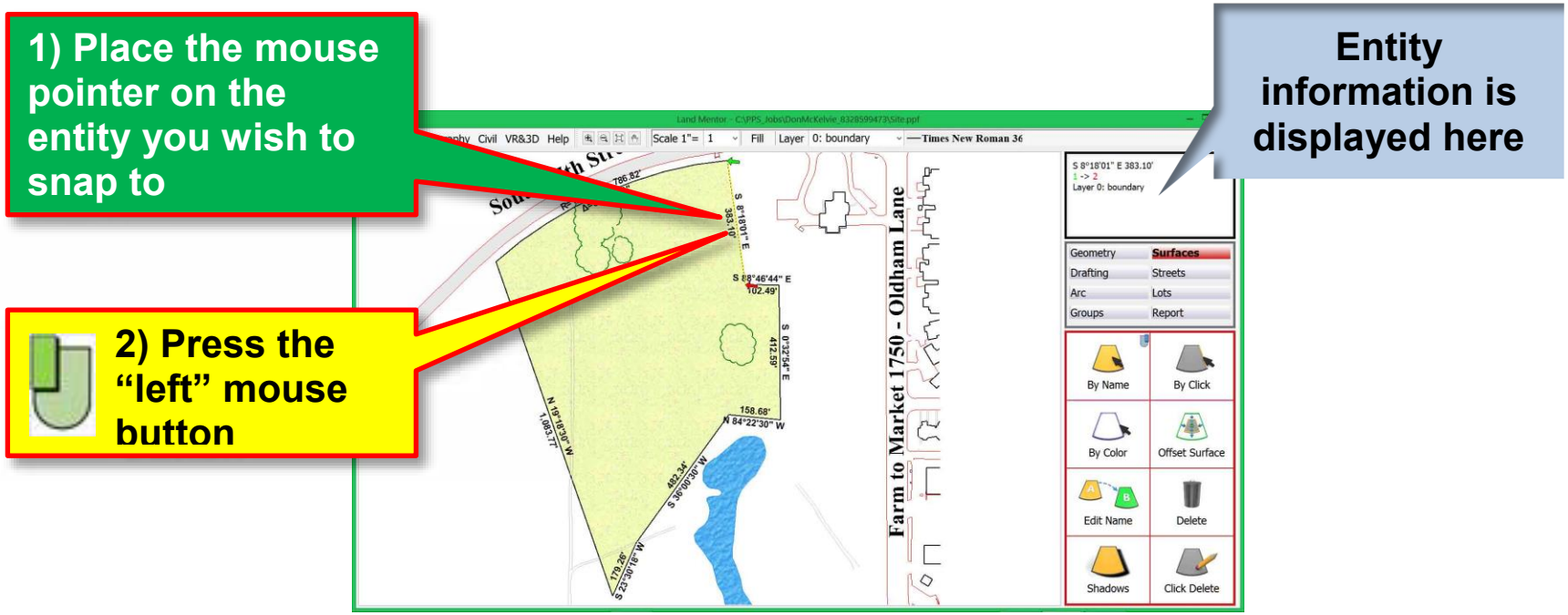


The green mouse indicates a press of the left button, and a blue mouse indicates a press of the right button. There are two different symbols for the mouse middle button (yellow). The one on the left indicates a button press, and the other indicates the feature is available by scrolling the rotary mouse middle button.

Snapping to entities on your site plan

Move the mouse pointer to touch the drawing entity, then press the mouse left button.

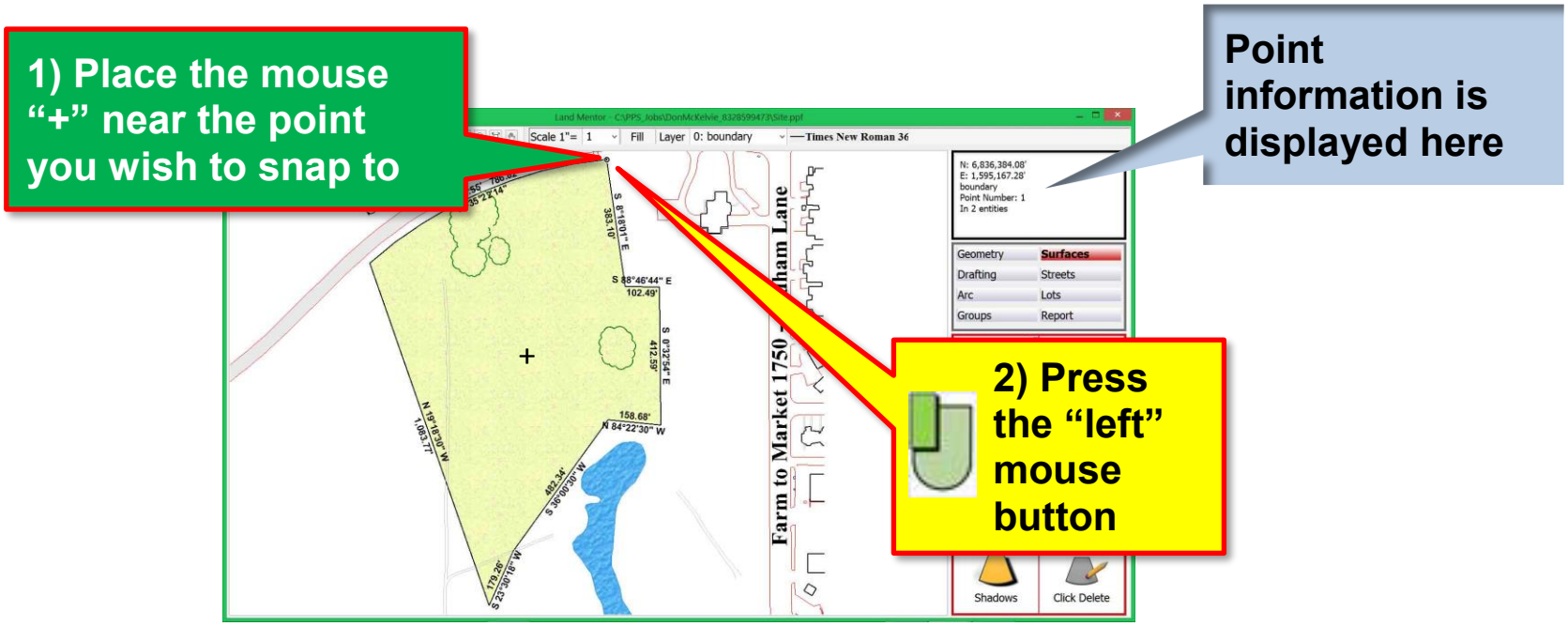
In the example below, the upper left line was snapped to – the line will highlight when snapped.



The arrow colors represent the direction the line or arc is drawn – green is the first point (start) and red the last point (finish). Note the upper right display will show the bearing and distance (on curves it will be the arc information), the point numbers will match the same color as the corresponding arrow, and the current layer number and name.

Snapping to coordinates (points)

The flip between entity snap and point snap is the mouse middle button. Press the middle button and the arrow pointer will be replaced with a + pointer – this indicates you are in point snap mode.

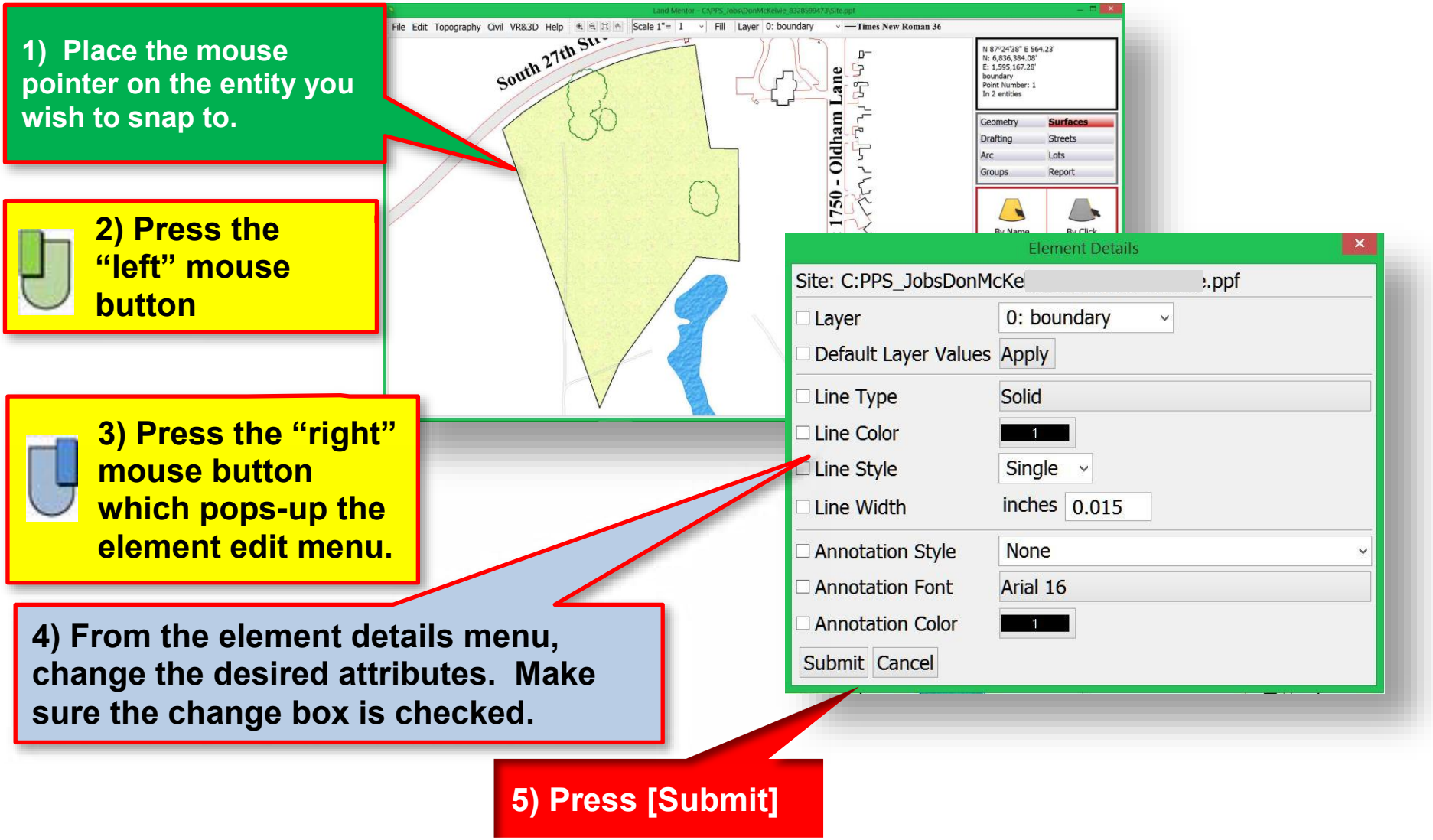


IMPORTANT:

In point snap mode, the only points that can be snapped are those on the active layers. This means you can use overlay to view lines that will influence your design, but those points on the overlay entities will be ignored. Accuracy of all **LandMentor** data is to a millionth of a foot.

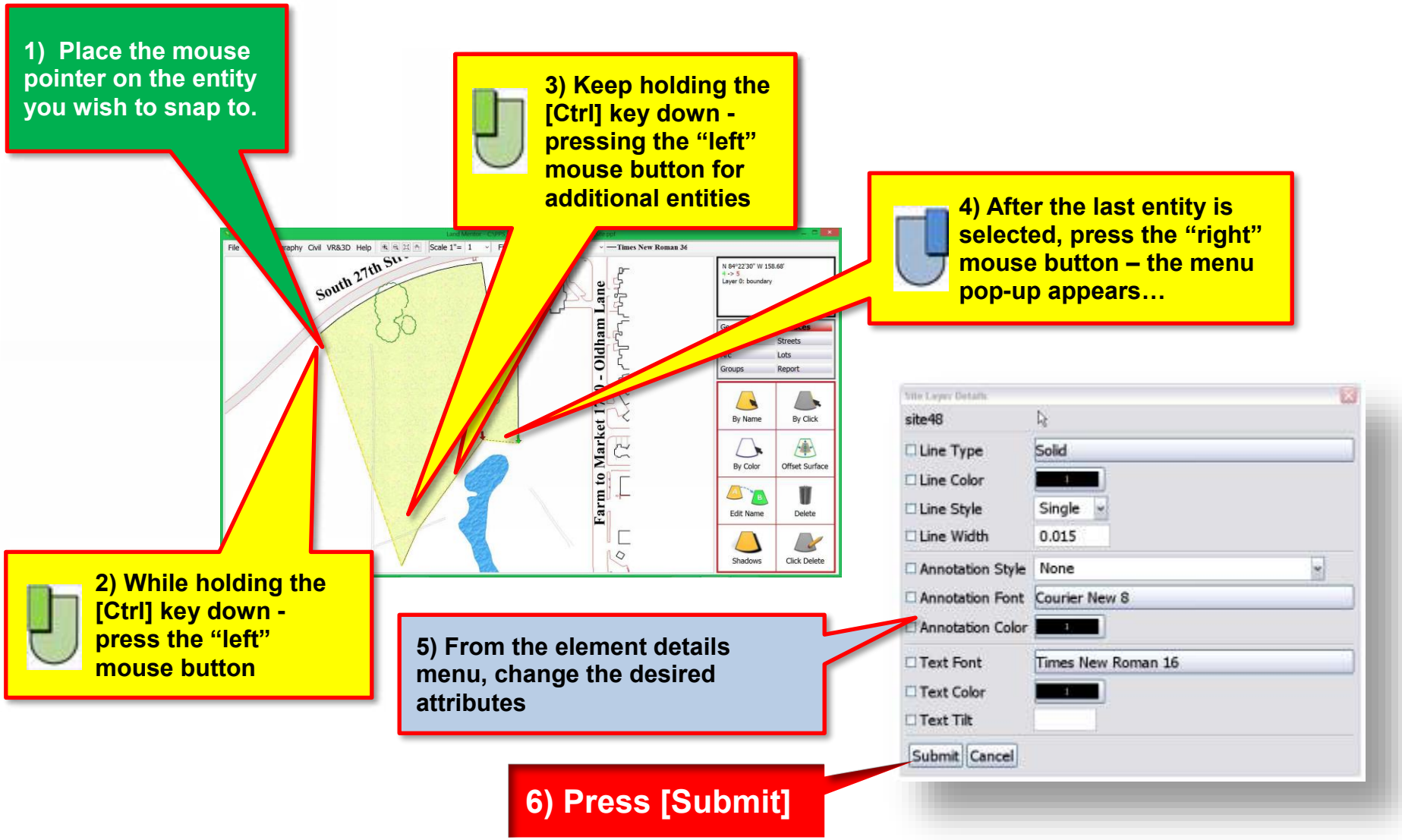
Editing an entity

To edit an individual entity after snapping to it, press the mouse right button (for this example we change the bearing from **None** to **Bearing on top, distance on bottom**).



Editing attributes of multiple entities

To edit multiple entities, hold the **[Ctrl]** key while **pressing the mouse left button** (for this example, we change the bearing from **None** to **Bearing and distance on top** on the remaining upper lines).



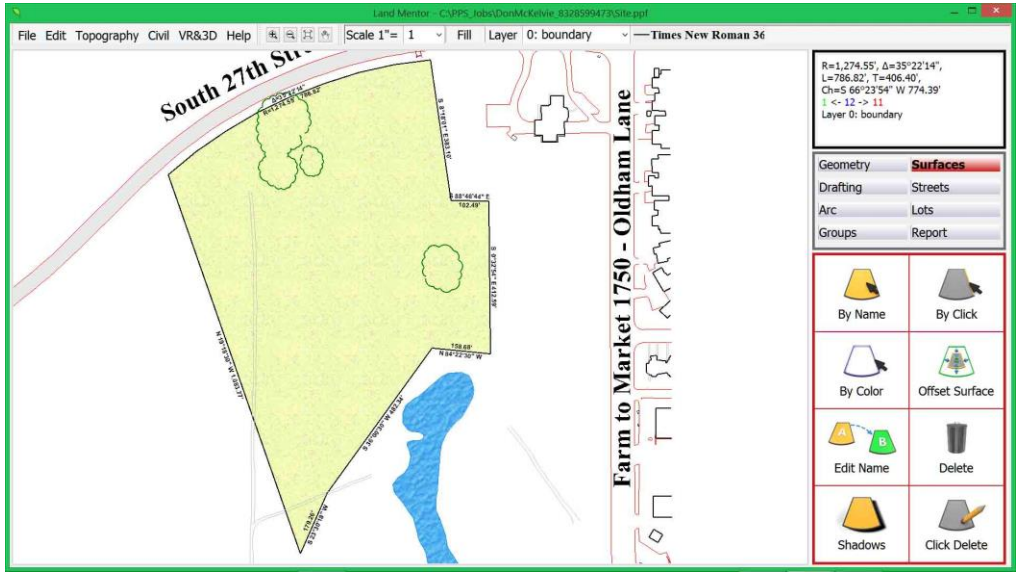
Notes concerning the editing of entities

The entity editing of the lines and arcs does not change the geometry of the line or arc.

Annotations are dynamic – a change in the line end points or the arc information or bearing, and distance will automatically change.

Changing an entity to an inactive layer will make it disappear on the next screen refresh.

If you make some individual changes then change the same attributes by editing the entire layer (at a later time), all the changes will revert to those indicated by layer.



Note:

When selecting multiple entities or points, selecting the entity or point twice deselects it from the list.

Deleting items

To delete multiple entities or points, hold the **[Ctrl]** button down while selecting the entities or points.

Deleting a point will erase associated entities and shapes. However, be aware certain types of points have protection, such as the center point of curves.

Deleting an entity will not delete any points or shapes. While deleting entities, it is likely to leave 'unused points', which will show up as red 'diamonds' on the screen.

*To erase red diamond unused point symbols, press **[U].***

The 'undo' (rewind) function

Many functions can be un-done by pressing **[Ctrl] – [Z]**

Every time you execute a function by pressing **[Select]**, **[OK]**, or **[Enter]**, that function is set into a log which tracks commands. The .exe file uses the same name as your job file.

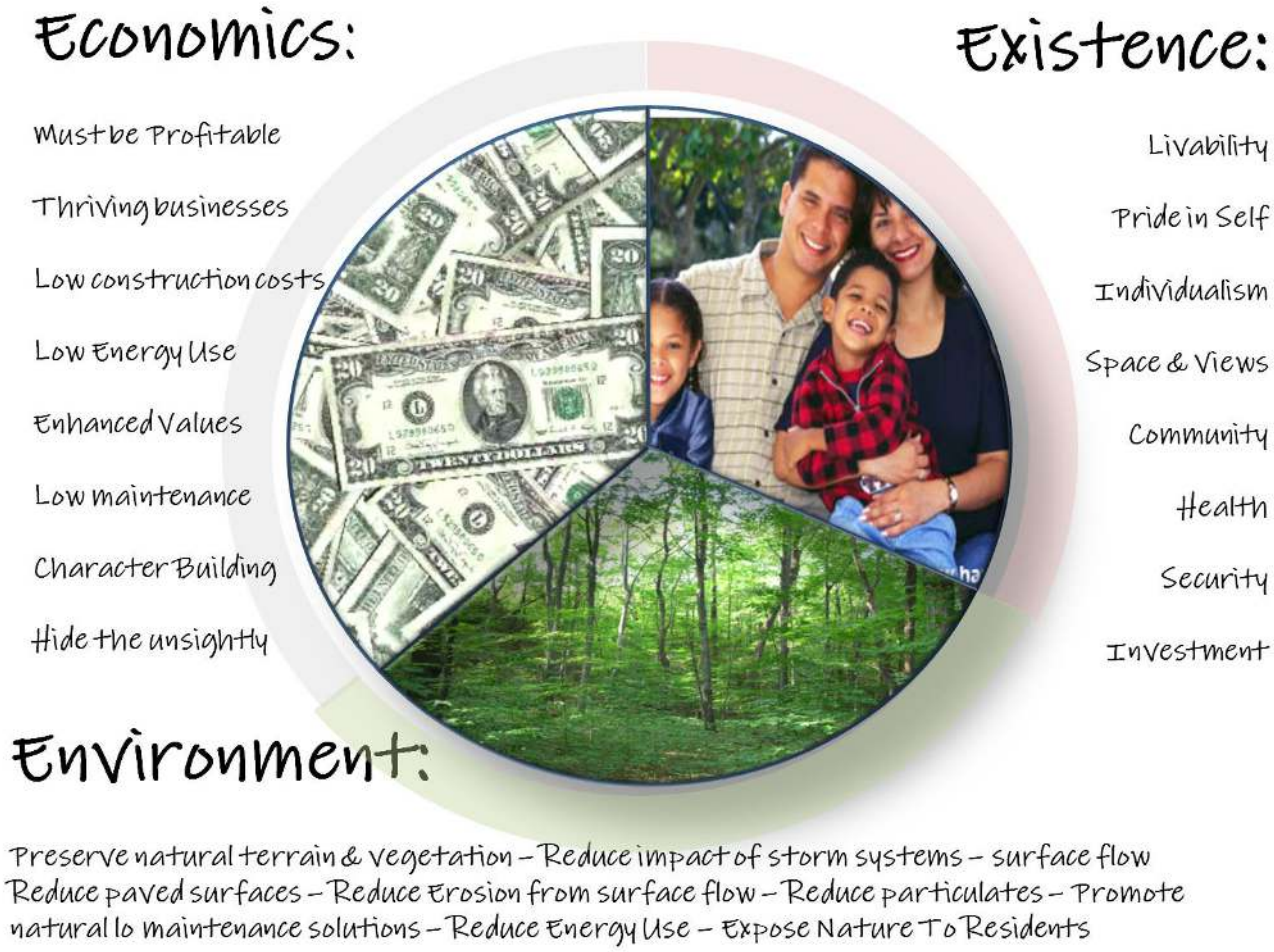
The .exe file tracks entries, so in theory, you could **repeat [Ctrl]-[Z]** all the way back to the initial entry. However, unlike CAD and GIS, there is much more information tied to a command than just simple line work, and as such, the intelligence if unintentionally erased could have dramatic consequences. So the undo is more of a 'rewind' to protect against unintentional deletion of critical data, not every function is able to be undone and must instead be erased using other features within LandMentor. After rewinding a feature, it may be necessary to refresh the screen, and floating unused points might appear.

Different flavors of neighborhood design for different tastes…

The above pictures show a conventional subdivision, a New Urban Neighborhood, and a Prefurbia Neighborhood (Coved with BayHomes). Prefurbia is a collection of new methods to design land development. Many of the sustainable design methods introduced in this manual are based upon Prefurbia, but only those methods that conform to standard ordinances are taught within this text book. While New Urban developments are usually associated with a grid pattern, they can also have patterns that are complex, as seen above.

Additional design elements for Prefurbia Neighborhood planning require a powerful design system. Applying low impact design techniques requires a new level of functionality that your **LandMentor** system provides.

Sustainable land development requires the balance of the 3-E's

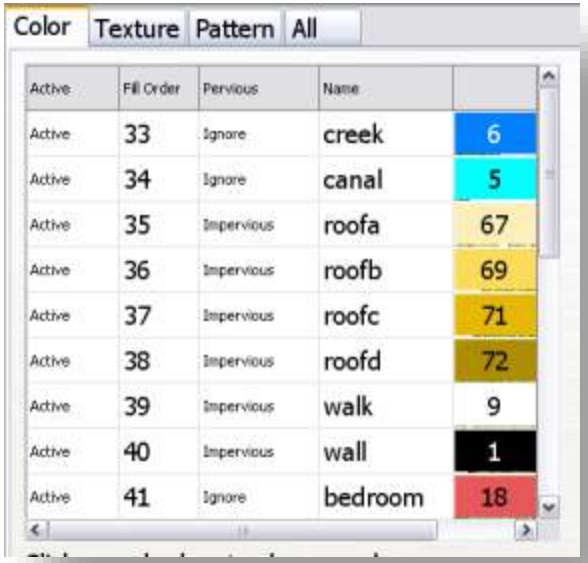


For more information, see page 58 of Prefurbia

Tools for sustainable design

The efficiency of planning determines the ability to create more sustainable growth. Design efficiency can be thought of as economic and environmental density. In **LandMentor**, these are the same thing.

The more efficient the design, the fewer negative impacts it will have on the economics and environment of the development, and the city.



Color | Texture | Pattern | All

Active	Fill Order	Pervious	Name	
Active	33	Ignore	creek	6
Active	34	Ignore	canal	5
Active	35	Impervious	roofa	67
Active	36	Impervious	roofb	69
Active	37	Impervious	roofc	71
Active	38	Impervious	roofd	72
Active	39	Impervious	walk	9
Active	40	Impervious	wall	1
Active	41	Ignore	bedroom	18

Today it is critical to run design scenarios to make sure you have the lowest possible environmental impacts using exact numbers.

LandMentor surfaces are represented by colors and textures, which are defined in the **Fill Setup** feature. In addition to the colors, you can select surfaces that are pervious, impervious or ignorable when using the "Green" button. You can chart environmental information and calculate some basic construction expenses, all from the features within **LandMentor**.

How simple is that?

Virtual Reality

LandMentor includes the ability to drape the site plan over a digital terrain model of the land surface and travel about the site similar to using a video game.

The **LandMentor** Virtual Reality uses a 'video gaming' engine for live action without the pain of manipulating a dedicated 3D CAD graphics system.

While the output may not be as elaborate as some (extra cost) programs, **LandMentor** is quite easy to use – almost effortless!

Default File Format

LandMentor saves all data including image files and virtual reality into a single file that is compact and transportable with one exception – the inclusion of Collada .dae files (typically 3D models from SketchUp) which can significantly increase file size. All default files will end with a **.ppf** extension.

When **LandMentor** saves a file it is a quick process, however, reading in a **LandMentor** file will take longer because the data structures and relationships of points to physical surfaces are reconstructed and checked for errors. On large jobs expect **LandMentor** to take several minutes to read in.

Based upon settings in Global Preferences (see page 299), LandMentor will back up your files with a .bak extension while you work. These files as well as event files (extension .evt) should be deleted after your work is complete.

Creating a file for survey data collector stakeout

LandMentor is a 'position and description', not a point number based technology. As you build your design using **LandMentor** the points are automatically populated with the name of the layer of the line(s) attached to the point, thus the describing of new points is automatic and seamless.

To save the points for stakeout, instead of using the default .ppf file format, you would select .txt output format and **LandMentor** will prompt you through the process of saving the points in a coordinate file for a data collector to use for stakeout, including a dialog box asking for descriptions of points to send to the file.

Recipes for sustainability within this textbook

In most sections of this textbook, there are methods that are taught that will create a more sustainable world. These methods are called *sustainable recipes*, and will be listed with a number, such as:

SUSTAINABLE RECIPE 1