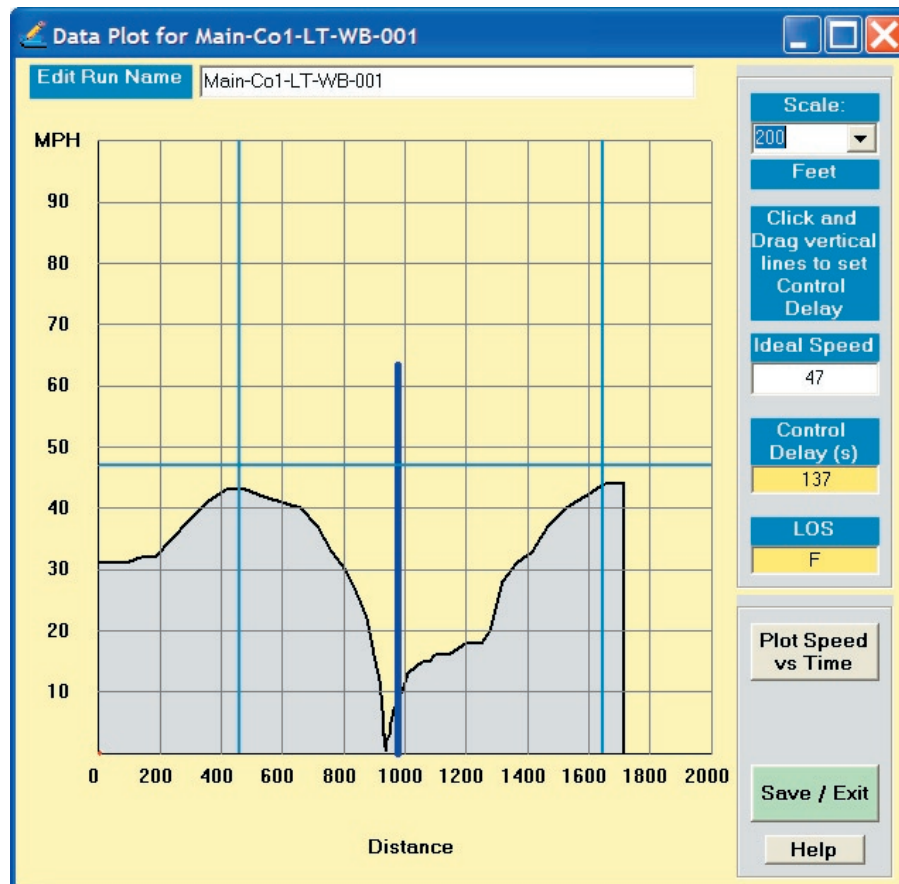
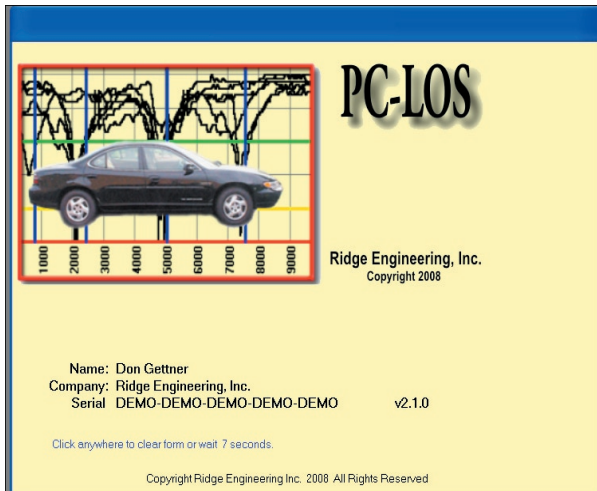


PC-LOS

Measure LOS Directly



PC-LOS User's Guide



The Level Of Service (*LOS*) grading scale is a concept that drives a significant amount of traffic data generation, funding and research. The concise and intuitive LOS letter grade can be enlightening to the seasoned traffic engineer and the general public alike.

An LOS grade depends solely upon the amount of control delay experienced by vehicles as they travel through a given intersection. Control delay includes all of the delay experienced by a vehicle due to congestion at an intersection (that's the time spent decelerating on approach, time spent stopped and time spent accelerating back up to a free-flow speed). The standard procedure used to arrive at a value for control delay involves a very long equation, the terms of which depend upon a couple dozen different traffic data measurements. Some of these measurements are rather

simple, such as cycle length or turning movement volumes. These values are often measured in the field and can be used to calculate LOS. Other factors depend on values that are rarely measured in the field and educated guesses are used in the LOS calculations. It is reasonable to ask, "*Why not just go ahead and measure delay in the field to directly arrive at an LOS grade?*"

Ridge Engineering, Inc. already has an array of existing travel time data collection software (*GPS2LT, GPS2PDA, OBD2LT, OBD2PDA*) which can be utilized to collect Level Of Service data. PC-LOS is the software that downloads, edits and organizes field data into LOS studies. PC-LOS then can print a report showing summaries and details included in the LOS study.

Glossary of Terms

Control Delay: The overall delay experienced by a vehicle at a given intersection, including deceleration, stopped and acceleration phases.

Control Points: In PC-LOS, these points mark the beginning and end of the control delay for a given run.

Ideal Speed: The speed at which a vehicle would travel through an intersection if it experienced no delay whatsoever.

Run File: A run is one pass through an intersection. Each run is stored in one file, using the same format as run files in PC-Travel. You can use existing run files you collected to use with PC-Travel or you can collect runs specifically for PC-LOS. They have the file extension **.rd2**.

Study File: A study is a collection of runs from the same intersection. These files are created by PC-LOS and they have a **.ldf** file extension. Study files contain organizational information about run files.

How to Install PC-LOS

Installation Procedure

Begin the installation by placing the PC-Travel Software Suite CD into your CD drive. If your CD drive is configured for Autoplay, the Installation Options program will start after a few seconds. Otherwise, click on the **Start** button on your Windows desktop. Select **Run** from the list of options and type the command line **X:\setup.exe**, where X is the letter of your CD drive. Press **OK** and you will see the Installation Options for the program.

The Installation Options allow you to do a number of things in addition to installing PC-LOS. You can view a copy of this manual, register your copy of the software and check out other Ridge Engineering products. To begin installing PC-LOS, click on Install PC-LOS.

Note: *If you downloaded the installation program from the PC-Travel.com support site, then unzip the file you downloaded to a convenient folder and run the Setup.exe file.*

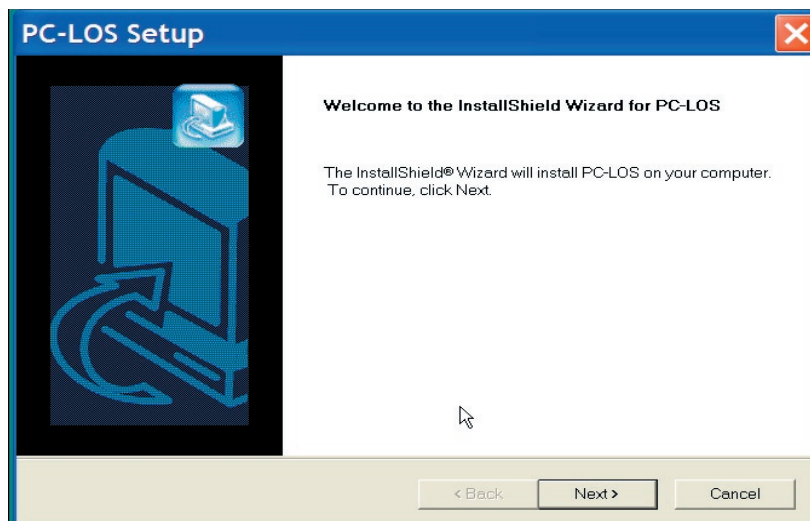


Figure 1.1 — Welcome Screen

The **Welcome** screen reminds you to be sure all other programs are closed before proceeding with the installation. During the installation, files used by the program will be copied to your computer, including some Windows system files. If other programs are open and using some of the files that need to be installed, an error can occur. Make sure you close any programs that obviously are running (especially virus checkers) before you install this or any Windows-based software.

The next screen contains the license information for the program. Please read this information. You must accept the provisions of the license in order to proceed and use the program. The program's license allows you to install the program on multiple computers provided they are in the same location and being used by employees of the entity that purchased the license. This is a very liberal license — many program licenses do not allow you to install the program on more than one computer. We ask that you respect the licensing policy and not abuse the use of this program. If you agree to the license, click Yes to continue.

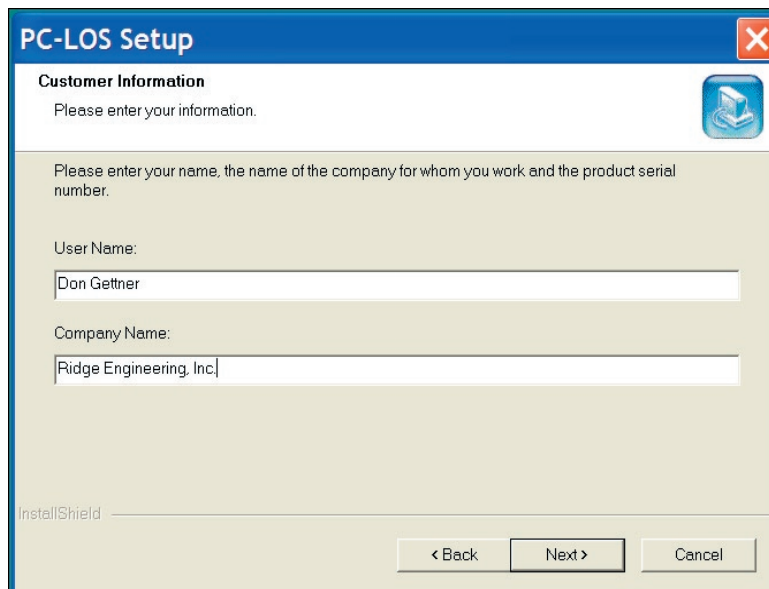


Figure 1.2 — Customer Information

The next screen asks for the User Name, Company Name and Serial Number. The serial number can be found on the back of your CD case, or it may have been emailed to you when you ordered the software. When entering the numbers be sure to include the dashes. If the serial number is entered incorrectly, you will not be allowed to proceed with the installation. Once the information has been entered, click the Next button to continue.

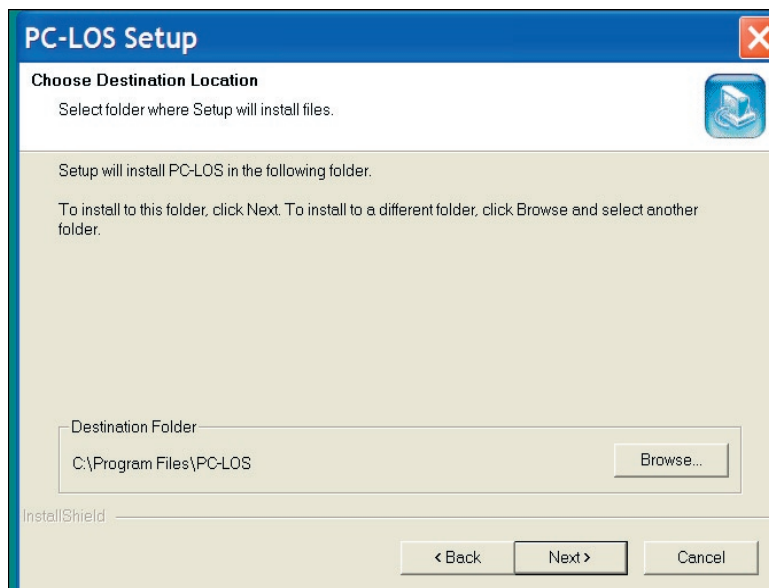


Figure 1.3 — Program Destination

Note: The default serial number is DEMO-DEMO-DEMO-DEMO-DEMO. If you leave this serial number as is then the software will be installed in Demo mode, which will allow you to run the software and see how it works. You can enter a proper serial number at any time in the PC-LOS software.

The Choose Destination Location screen is used to select the folder where PC-LOS will be installed. The default folder is C:\Program Files\PC-LOS, but you can change this if you like. Click the Browse button and navigate to the folder you want. Once the directory listed is correct, click Next to continue.

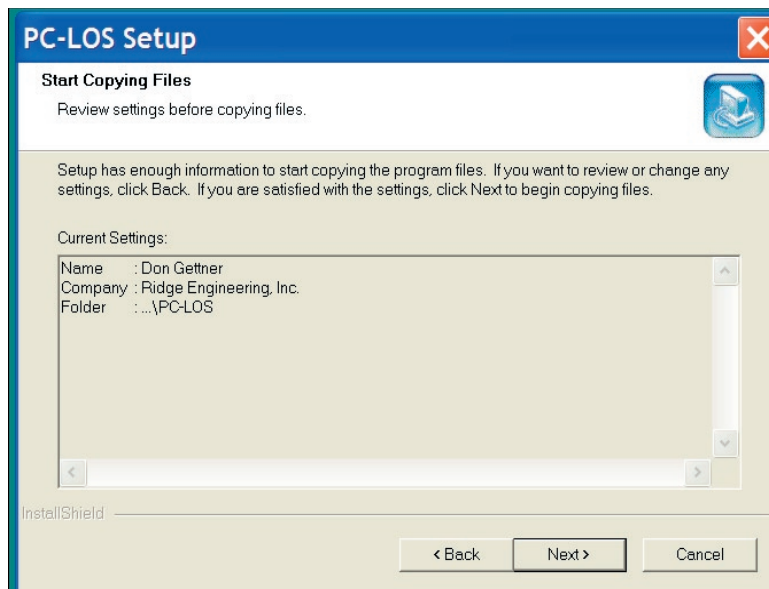


Figure 1.4 — Ready To Install

Once the installation program has enough information, the files will be copied from the CD to your computer. Click **Ok** to start the installation. You'll then see a screen that tells you the installation has completed. You may be asked if you want to re-start your computer now. If you get this message, you should re-start your computer before you try to run the program. This will allow any of the System files that were copied during the installation to be loaded properly.

How To Collect Data For PC-LOS

PC-LOS is used to find the Level of Service at a signalized intersection. This is done by measuring the Control Delay at the intersection, which is the basis for LOS. Control Delay is defined as all of the delay experienced by a vehicle as it approaches, enters, and leaves an intersection. Previously LOS was based on Stop Delay, which is the amount of time a vehicle is physically stopped (or essentially stopped) as it passes through an intersection. Stop Delay is relatively easy to measure in the field, there are various techniques that are used to measure the actual or estimated stop delay. Control Delay is much more complicated problem, however, since the delay can start considerably before the intersection and end considerably after the intersection, making it almost impossible for technicians at the intersection to measure it.

Control Delay was adapted because it was intuitively clear that a vehicle that has to slow down considerably, but not necessarily stop completely, experiences delay that should somehow be considered when evaluating the operation of a signalized intersection. But little attention was given to the problem of how to measure it. In fact, the standard way to do a LOS study is to use the HCM methodology (Highway Capacity Manual) which estimates the control delay from a large list of variables such as turning movement counts, physical geometry, and other traffic engineering parameters. These parameters are almost as difficult as Control Delay to measure, with the result that most engineers use default values or "engineering judgement" for many of the parameters. To some this is fine; to others it is a problem.

Control Delay is the difference between the actual travel time it took to travel through the intersection and the time it would have taken if there were no delay at all (no traffic, and a green light). You can measure the actual travel time by using the same field data collection techniques you use with PC-Travel. The basic idea is simple—measure the speed of the vehicle each second as the vehicle drives through the intersection. You can tell from the graph of that data if the vehicle experienced any delay, and you can measure that delay as well by comparing how long it actually took to what it would have taken if the vehicle drove at a constant speed.

Strategy For Data Collection

1- Pick Time For Data Collection

LOS studies are worst case scenarios. The question normally is "how bad does the delay get". This means you want to collect the data when the traffic is the worst, meaning during a peak hour. It could be a morning peak or an afternoon peak. You don't always know which is highest so you may have to collect data during both.

2- Pick Lanes/Movements

You also usually (but not always) want to measure the one or two worst movements that cause the greatest delays. These will either be a through movement or a left turn movement. You don't always know which movement is the worst, but generally you can narrow it down to two or three. These are generally called the **critical lanes** or **critical movements** (we use critical lanes in the PC-LOS software for no special reason).

3- Plan Driving Route

Once you know when you should collect your data and which lanes (movements) you should collect you can plan your strategy for how to drive through the intersection to maximize the number of data runs you collect.

The basic idea is simple-you want to drive through the intersection in the critical lanes as many times as possible while the traffic is bad. This can be tricky since it means you have to drive through the intersection, then usually make a U-Turn as soon as possible to get back to the intersection so you can go through it again.

Plan your driving pattern in advance so that you will minimize the amount of time you are driving but not collecting data. A typical pattern might be:

- 1- Drive NB, Thru then U-Turn
- 2- Drive SB, Thru then U-Turn
- 3- Drive NB, Left then U-Turn
- 4- Drive WB, Thru then U-Turn
- 5- Drive EB, Left then U-Turn

This brings you back to your starting point. You have made two NB Thru runs, one SB Thru run, one WB Thru run, one EB Left run. There were no right turns (which normally aren't useful). You can continue this pattern as long as the traffic stays relatively heavy.

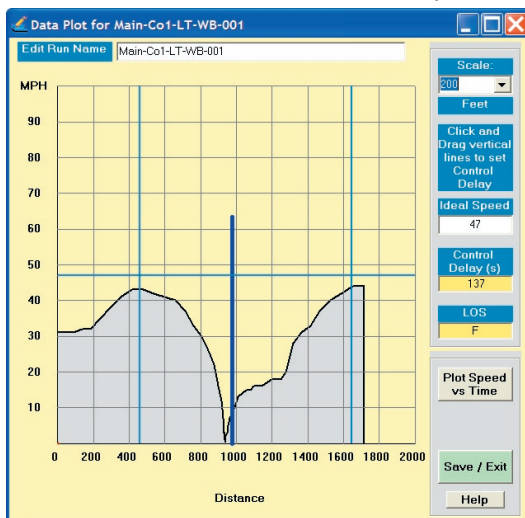
Of course you want to think about which movements are the most important and try to derive a pattern that maximizes the number of those runs.

You can use any of the data collection systems available for PC-Travel data collection to collect your LOS data. Most users will use GPS2LT or GPS2PDA to collect the data since that is the preferred method to collect travel time data now with PC-Travel version 2 (this is to take advantage of the mapping features that are in the newer PC-Travel version 2.x software). However, if you use Jamar TDC boards or OBD Interfaces to collect your travel time data you can use that here.

Refer to Chapter 2 of the *PC-Travel Reference Manual* for complete details on how to collect field data; the techniques used in PC-LOS data collection are identical.

Marking the Stop Bar During Data Collection

It sometimes is useful to know where the delay occurred relative to the intersection, was it backed up before the intersection or was there some delay after the intersection. It is difficult to tell from the speed plot you see when



you set the control points. If you mark a Node at the stop bar when you go through the intersection, the software will plot a line at that point on the Spd vs Distance graph. That is the thick line in the center of the plot on the image shown here. You can see that the vehicle stopped right near the stop bar and then slowly accelerated as it went through the intersection.

This is purely optional and doesn't affect the data statistics in any way. Marking nodes while driving through the intersection is tricky so you may want to have another person in the vehicle if you plan to mark the nodes like this.

Now that you know how to collect your PC-LOS data you can learn how to process it.

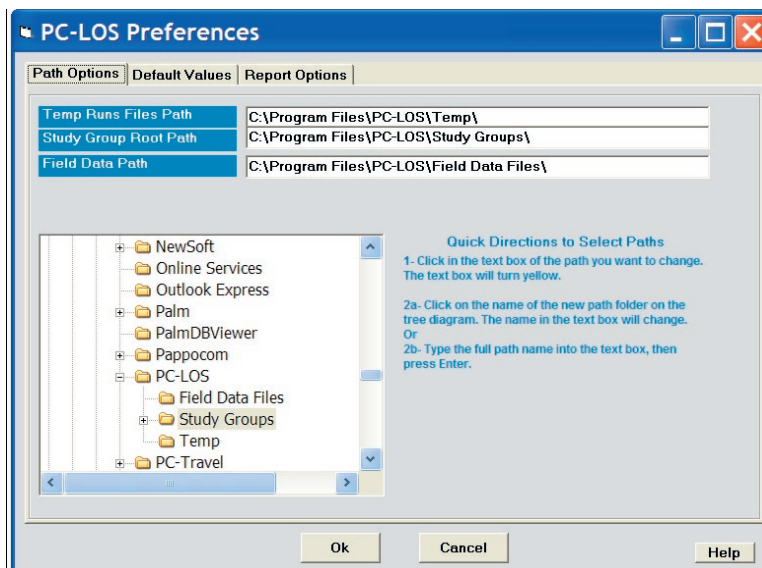
Tutorial #1 - An Introduction to PC-LOS

This tutorial will guide you through the basics of the PC-LOS software.

Note: The first time you run PC-LOS, the software loads the Preferences screens so that the various settings can be checked and edited. From then on, the program starts with the Startup Options screen. This tutorial starts with the Preferences screen, assuming that you just installed the program. You may skip this section if it doesn't apply to you.

Run the program. The first screen you will see is a little message box that tells you that since this is the first time you have run the program, you need to check the settings. Click **OK**. You will then see the **Preferences** screen.

The Preferences screen has three tabs at the top of the window: **Path Options**, **Default Values**, and **Report Options**. The first tab, Path Options, is shown first.



If you selected the default installation directory, then you will see the same paths shown in the screen shot above. The program uses three basic directories:

1 – Temp

This directory holds the run files that you processed from the field data. These files are normally renamed and moved to a different directory.

2 – Study Group Root

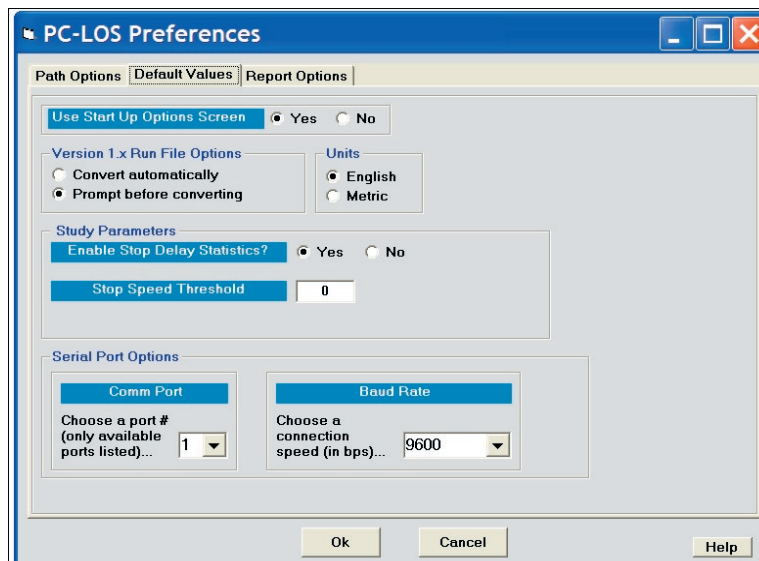
This is the base directory where all of the travel time run and study data is stored. **A Study Group is a collection of related runs and studies that are stored together.** For the computer savvy, each Study Group is a directory under the Study Group Root directory.

3 – Field Data Path

This is the directory where the data you collected in the field is stored before it is processed into runs.

If you want to change the paths, then follow the Quick Directions on the screen. You probably won't need to change them, however.

Click on the second tab labeled **Default Values**.



The items on the screen are parameters that are used in the software. These values are the default values that are used when a study is first created. Normally, you will set these values once and then not worry about them again.

Some of the parameters have an obvious meaning. Some don't. Don't worry what the various parameters mean for now. They will make more sense later after you have seen some more of the program. Just accept the default values for now.

You can also check the settings in the Report Options tab. They are fairly obvious from the descriptions, but again, don't worry if it isn't obvious what a particular setting is for.

Click **Ok** at the bottom of the screen to display the **Startup Options** screen.

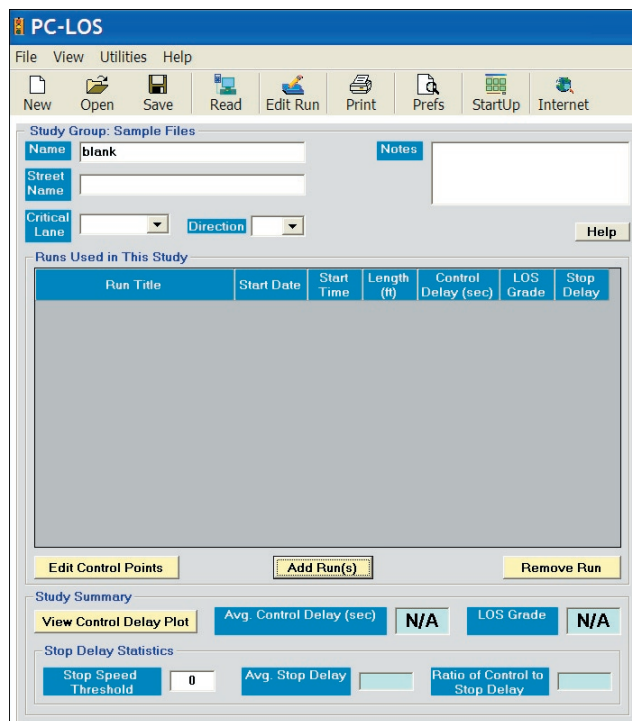
This tutorial will assume that you have collected runs at an intersection and processed them in PC-LOS or PC-Travel. These runs are stored in the Samples folder under PC-LOS and were installed with the program.

Starting a New PC-LOS Study



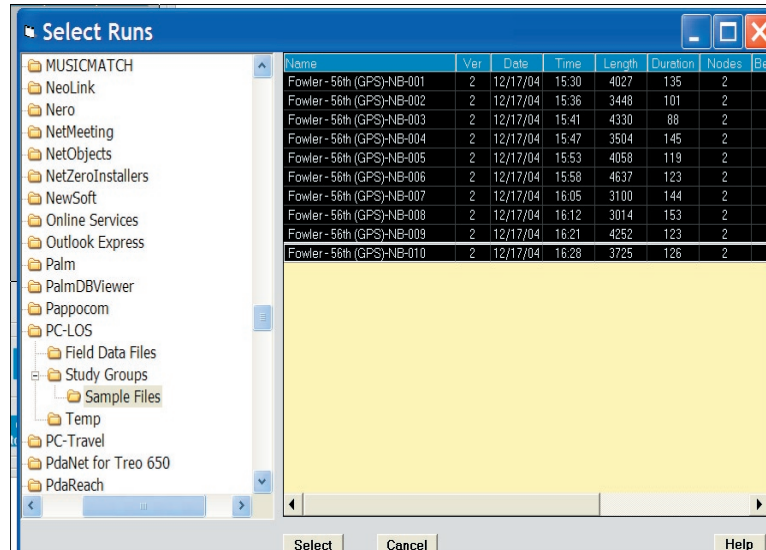
Shown here is the **Start-Up** screen for PC-LOS. You will see it directly after the splash screen that displays your registration information. This screen acts as a jump-off point for the various functions of the program. With the buttons on this screen, you can access or create study files, manage run files or process field data generated by any one of the three travel time collection schemes (*you know which one you've got*).

Click the **Start a New LOS Study** button.

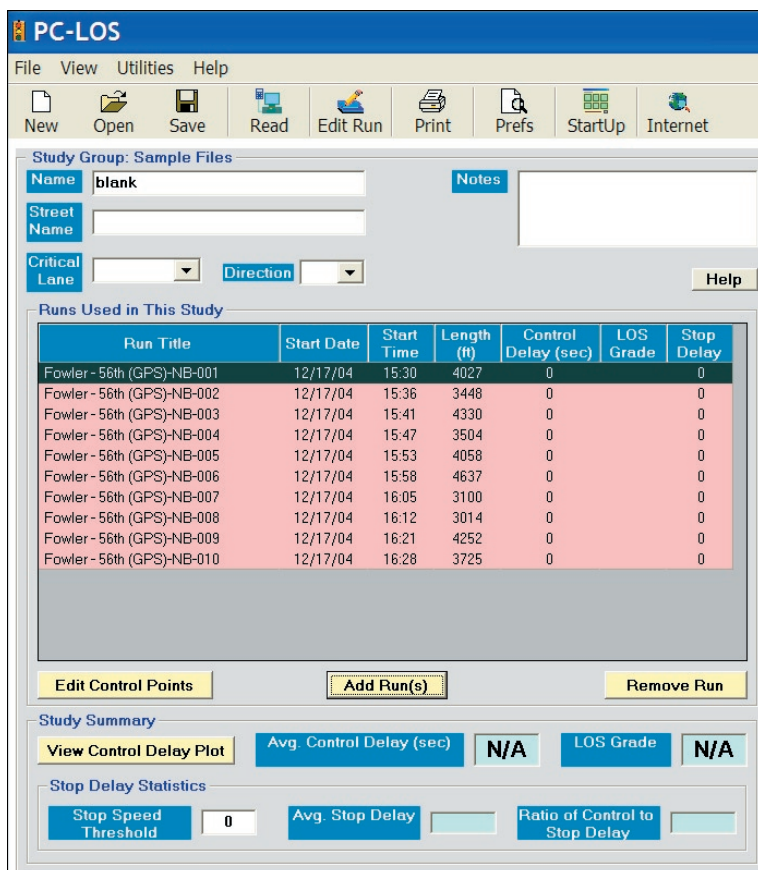


This brings up the **Study Summary** screen shown here. We will explore this screen in detail as we go through this tutorial. For now, click on the **Add Runs** button in the center of the screen.

This brings up the **Select Runs** screen.

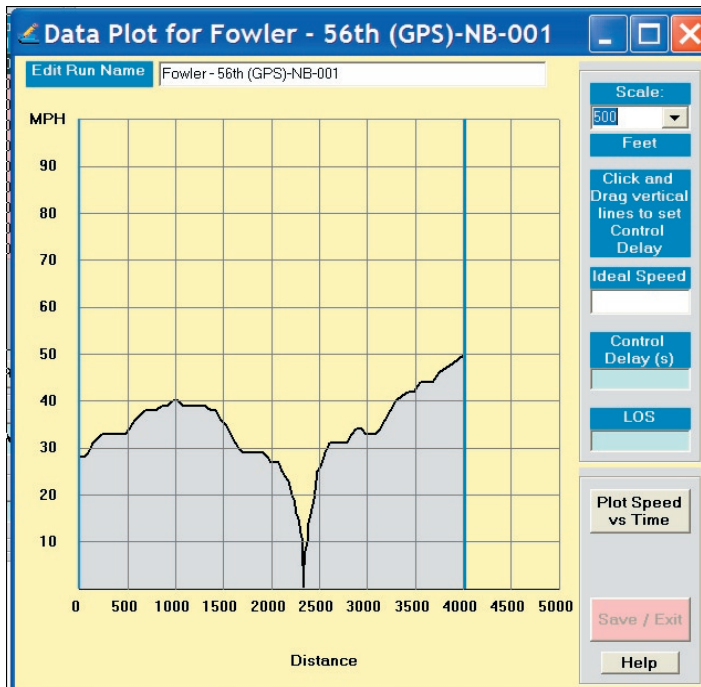


On the left side of the screen is the familiar folder tree with the current Study Group highlighted. On the right is the list of runs. We want all of the runs as part of our study so click on each one to select it. When you are done the screen should look like the one above. Click **Ok** to select these runs.



You are back to the Study Summary screen, but now the runs are shown in the middle of the screen. Notice the background color is a light red. This means the control points for these runs have not been set yet, so the software can't calculate any control delays. The next step is to set these control points for each run.

Setting Control Points for Each Run



PC-LOS calculates LOS for each run individually, then averages the delay for all the runs to arrive at an overall LOS. Click on the first run in the grid (*it's called Fowler-56th (GPS)-NB-001*). Now click the **Edit Control Points** button. You'll now see a speed profile for that run.

The program needs three things to arrive at an LOS value: the point where the control delay starts, the point where it ends, and an ideal speed value. While these values need to be set for each run in the study, doing so only takes a few clicks.

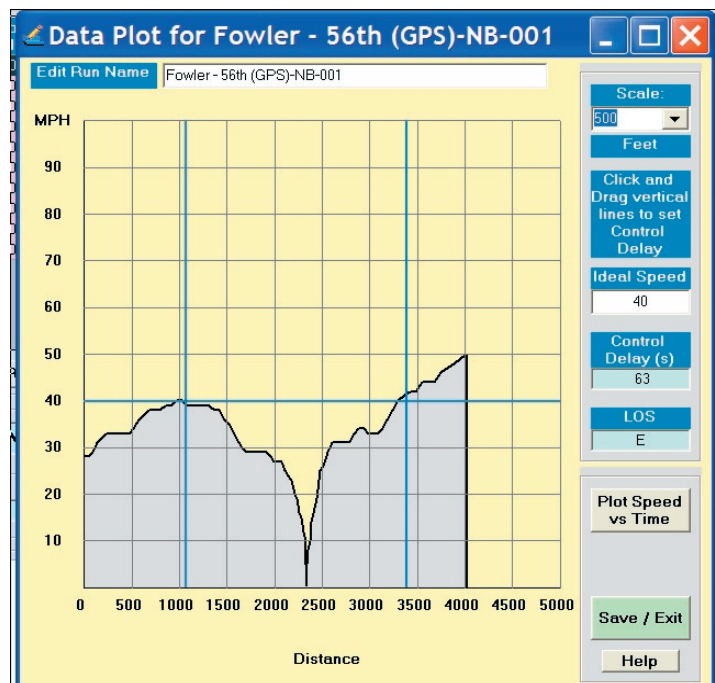
In this run you can see that the vehicle was traveling between 30-40 MPH before it ran into some congestion, probably caused by a red light and had to stop. Then the vehicle accelerated fairly quickly up to about 50 MPH.

Your goal is to mark the point where the control delay begins and ends for this run (*these are the **Control Points***). To do this, click-hold-drag the thin, blue vertical line on the left side of the graph over to the right. Somewhere between 500 and 1000 feet, the vehicle started to slow down, so let go of the mouse button to leave the marker line between those values. This marks the beginning point of your control delay interval.

You also need an end point to mark where the vehicle was able to regain a normal speed after clearing the intersection, which occurred at about 3200 feet on this graph. Click and drag the blue line on the right side of the speed plot over to the left a little and you're done setting the control points.

Your speed plot window should now look something like the screen illustrated here.

At this point, you'll notice that the **Save/Exit** button has turned green. This is your indication that you can move on from this screen, but we should discuss the **Ideal Speed** setting first, since it's also important in LOS calculation.



Setting the Ideal Speed

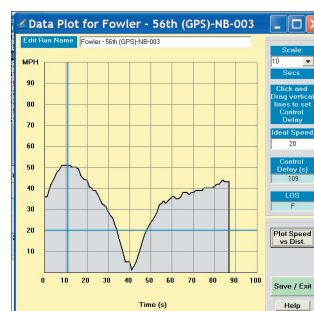
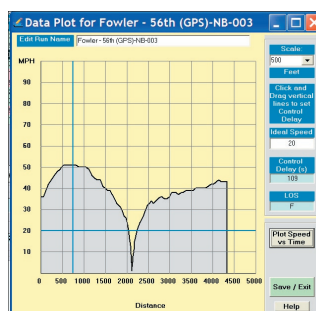
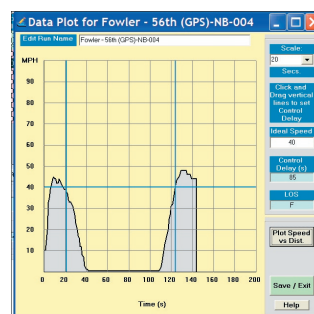
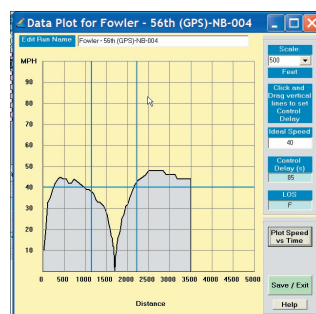
Once you've set both of the control points, a horizontal blue marker line will be shown. It is the **Ideal Speed** line and it represents the speed at which a vehicle would travel through this intersection if it experienced zero delay. By default, the program averages the speeds at the two control points to arrive at an ideal speed value, but you can change it to whatever you'd like (*the speed limit is often a good value to use*). To change the ideal speed manually, just click and drag the horizontal blue line up and down or type a number in the text box on the right that's labeled **Ideal Speed**. Once you are happy with the ideal speed value, click the **Save/Exit** button (*which should be green*) to return to the **Study Summary** screen.

Once back on the **Study Summary** screen, you'll notice that the run has turned green in the grid. The idea now is to repeat this process for all 10 runs in the study so that all of them are green.

Other Features of the Run Details Screen

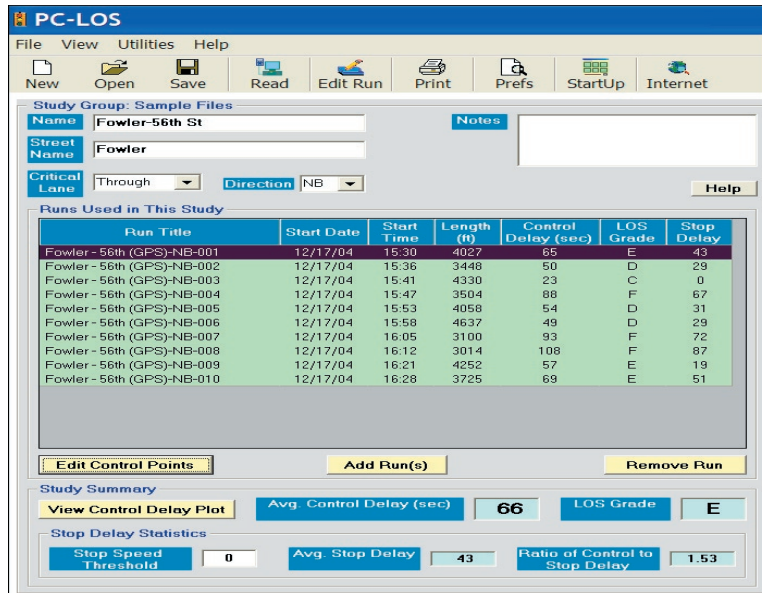
Using the text box at the top of the screen you can edit the name of the run file. Once you set your control points, values for Control Delay and LOS will be inserted into the blue boxes on the right. You can change the position of each control point along with the ideal speed setting and watch how those changes affect the amount of control delay and the LOS grade. If you're having trouble picking the proper placement for the control points, you can change the scale of the graph to zoom in. Use the drop down box at the top right of the screen to select a new scale.

Each time you open the **Run Details** screen, the speed profile is plotted with respect to distance. It is also possible to view the speeds relative to time. Just click the button called **Plot Speed vs Time**. Viewing the speed plot with respect to time allows you to get a better feel for how long the vehicle was stopped on that particular run. The speed plots below show when this can make a difference. The two runs on the left show distance. Both speeds drop to zero and the profiles look similar overall. The real discrepancy is visible in the time plots on the right. In the first run the vehicle was stopped for about 70 seconds, while in the second run, the car was only stopped for a few seconds.



PC-LOS Study Summary

Once you have added runs to your study and set control points for those runs, the statistics for the runs are calculated and shown on the **Study Summary** screen.



Run Statistics:

Control Delay, **LOS**, **Stop Delay** are calculated from the control points and Ideal Speed you set in the Run Details screen. The stats are shown for each run in the last three columns of the grid.

Study Statistics:

One run doesn't tell you much about the operation of an intersection. You need multiple runs through the same intersection at about the same time so that you can find statistics that are meaningful. The more runs you have the better the statistics will be.

Average Control Delay is the average of the numbers in the Control Delay column of the grid. This is the most important statistic generated by PC-LOS.

LOS is the grade level associated with the Average Control Delay based on the table published in the Highway Capacity Manual. The LOS is a letter from A to F.

Stop Delay Statistics

LOS used to be based on Stop Delay and many software programs still use Stop Delay as an input. PC-LOS can find the Stop Delay easily since it can count the number of seconds when the vehicle was stopped while going through an intersection. You can Enable or Disable generating and showing the Stop Delay Statistics in the Preferences:Default Value screen. Assuming the Stop Delay Statistics are enabled you will see:

Stop Speed Threshold: You can set what to consider 'stopped' to be. Usually this is set to 0 MPH but you can set it to 2, 3 or 5 or whatever you want.

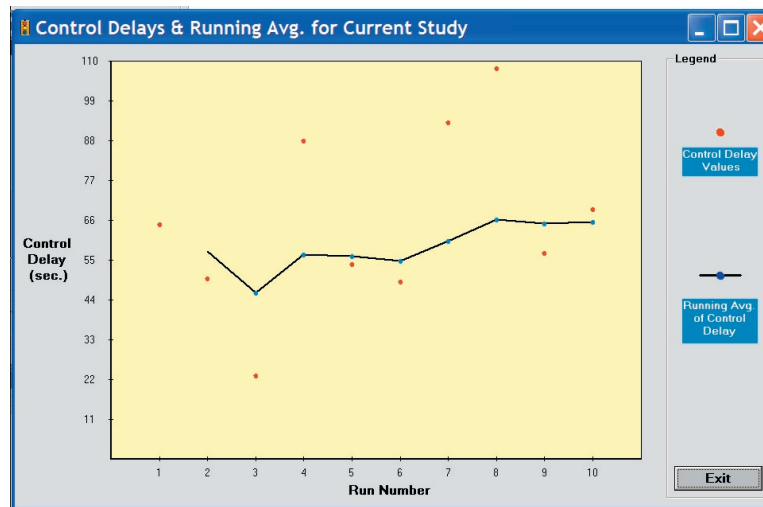
Average Stop Delay is the average of the numbers in the Stop Delay column in the grid.

Ratio of Control Delay To Stop Delay shows how the two stats compare. Since Control Delay is hard to measure in the field (with other techniques rather than what we do here) and Stop Delay is relatively easy to measure, some engineers have proposed collecting Stop Delay data and using a factor, usually 1.3, to estimate the Control Delay. If you are interested in this then you can use the ratio calculated here to test the idea.

Control Delay Plot

It is clear that you need several runs to get Control Delay statistics that are meaningful. However, it isn't clear just how many runs you need. The ITE has a procedure to estimate the number of travel time runs that are needed in travel time studies but there hasn't been any published procedures (that we are aware of, anyway) for measuring Control Delay in the field.

The Control Delay Plot will help give you an idea of whether you have collected enough runs. The basic idea is to plot the running average of the individual Control Delay measurements from the first to the last run. The running average will start to converge to a relatively small range of numbers after several runs and will continue to converge as more runs are averaged.



The graph shown here will make this a little clearer. The red dots are the Control Delay values for each run. The black line is the running average of the Control Delay values. It starts with run 2 and is between the values of run 1 and run 2, as you would expect. The next black dot is the average of runs 1,2 & 3. By the time you get to run 8 the values have converged to a value around 66 and it doesn't look like more runs will greatly change this. You can probably say that the Average Control Delay is close to 66. This isn't a very rigorous test but it does visually help you decide if you have enough runs to be confident in the results.

Save PC-LOS Study

Once you have set the control points for all of the runs and have checked the Control Delay Plot is reassure yourself that you have enough runs, then you can save this study.

The top of the screen has several text boxes you should fill in before you save the study:



The screenshot shows a dialog box titled "Study Group: Sample Files". It contains the following fields and controls:

- Name:** A text box containing "Fowler-56th St".
- Street Name:** A text box containing "Fowler".
- Critical Lane:** A dropdown menu with "Through" selected.
- Direction:** A dropdown menu with "NB" selected.
- Notes:** A large empty text area.
- Help:** A button located at the bottom right of the dialog.

Name: Enter the name you want to give this study. The name should be descriptive enough to help you select this study in the future.

Street: This typically is the name of the approach street, not the street you turned onto.

Critical Lane: Normally you will do a study with one Critical Lane, either a through movement or a left turn movement, whichever you think has the most delay.

Direction: Enter the direction you drove on the approach to the intersection.

Notes: Put anything you think might be helpful in the future when you open this study again. You could put in notes about the weather, or construction, or special traffic conditions.

Click the **Save** button on the toolbar to archive your PC-LOS study so that you may retrieve it at a later date.

Print Report

Once the study is saved you can print a report.

Click on the **Print** icon in the toolbar at the top of the screen. PC-LOS generates the report and shows you a preview on the screen as shown below.

The screenshot shows a 'Print Preview' window with a toolbar at the top containing 'Previous', 'Next', 'Zoom', 'Printer', 'Print', 'PDF', 'Close', and 'Help'. The main content area displays the following report:

Ridge Engineering, Inc.
Temple Terrace, FL
807-603-5844

Study Name : Fowler-56th St
Study Date : 6/18/2008
Page No. : 1

PC-LOS Study Summary

Study Results

Avg Control Delay	66.0	LOS Grade	E
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Stop Delay Results

Stop Spd Threshold	0	Avg Stop Delay	43	Ratio of Control to Stop Delay	1.53
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Runs Used in This Study

Run Title	Start Date	Start Time	Length	Control Delay	LOS Grade	Stop Delay
Fowler - 56th (GPS)-NB-001	12/17/04	15:30	4027	65	E	43
Fowler - 56th (GPS)-NB-002	12/17/04	15:36	3448	50	D	29
Fowler - 56th (GPS)-NB-003	12/17/04	15:41	4330	23	C	0
Fowler - 56th (GPS)-NB-004	12/17/04	15:47	3504	88	F	67
Fowler - 56th (GPS)-NB-005	12/17/04	15:53	4058	54	D	31
Fowler - 56th (GPS)-NB-006	12/17/04	15:58	4837	49	D	29
Fowler - 56th (GPS)-NB-007	12/17/04	16:05	3100	93	F	72
Fowler - 56th (GPS)-NB-008	12/17/04	16:12	3014	108	F	87
Fowler - 56th (GPS)-NB-009	12/17/04	16:21	4252	57	E	19
Fowler - 56th (GPS)-NB-010	12/17/04	16:28	3725	69	E	51

Notes:

You can choose to Print or save it to a PDF file so you can send it to someone.

This report shows the same information as the **Study Summary** screen. You can see the list of runs with the individual statistics for each run, plus the Average Control Delay, the LOS, and the Stop Delay statistics. This is a very basic report but it shows the key statistics of the study.

Conclusion

This tutorial was a brief introduction to PC-LOS, which is part of the PC-Travel Software Suite. PC-LOS was created due to conversations we had with customers of PC-Travel who wanted to measure LOS in the field. This software is the result, which should just be considered a first effort. If you have ideas on how we can expand PC-LOS to make it more useful then please let us know.