Pavement Management – Book 2

The Lucity pavement management modeling program is used to perform budget and maintenance forecasting. This helps you determine when and where to perform pavement rehabilitation, which rehabilitation techniques to use, and the ideal budget needed to accomplish your maintenance goals. Here are two training work books to help you go through this process.

- Workbook 1 – Explains and demonstrates the relationships between the Street Segment, Pavement Subsegment, and Pavement Supersegment modules. These are the three inventory modules required to complete a model run. Then, this workbook focuses on setting up pavement standards to help predict pavement condition over. Finally it goes into creating Field Inspection and Pavement Maintenance records for the street subsegments. These are used to determine the pavements' current conditions and PCI values, which are also required to complete the modeling process.
- Workbook 2 – This book is about the actual pavement models. It demonstrates how to setup the Model Run parameters, run a model, view and interpret model run results, export model run results, and view results in the Supersegments module.

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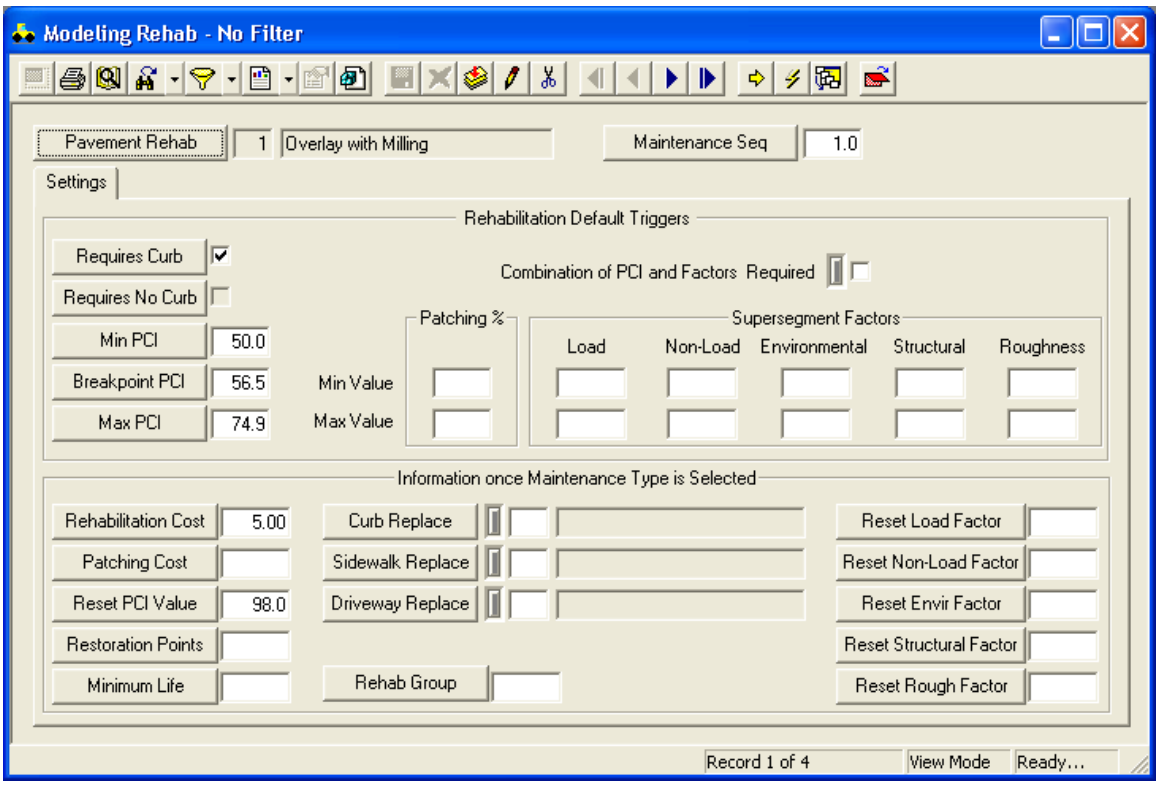
Model Run Parameters

The pavement management modules provide you with five modeling setup modules. These modules allow you to set up your budgets, indicate miscellaneous costs, create a planning table for forced street selections, create a variety of rehabilitation techniques, and match-up your rehab techniques with your pavement types and classifications. In the following pages, we'll go over a series of step-by-step examples to demonstrate the five available modules. While you can set up the parameters in any order you choose, we suggest you use the order we've outlined below. After entering information into these setup tables, you can then run different modeling scenarios to determine how much budget is actually needed to keep the segment network at a desired condition. The Model Runs will then select street segments for rehabilitation based on the parameters you set up.

Rehabilitation Techniques

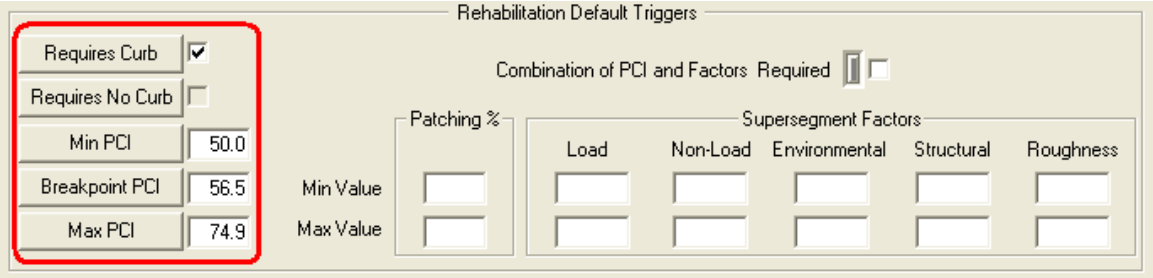
The *Rehab Techniques* module allows you to define rehabilitation methods for your street pavement repairs. This module forms a library of different rehab techniques which can then be linked to pavement/classification combinations in the *Pavement Standards* module. The model runs review the settings in this module to determine which street segments to select for rehabilitation and what rehab techniques to use.

1. Open **Transportation>>Pavement Manager>>Modeling>>Model Setup>>Rehab Techniques** from the Lucity main menu.
2. Click *GO* to bypass the filter. The *Modeling Rehab* module will open.
   - Click the *Add* button  at the top of the module toolbar to access a blank



record.

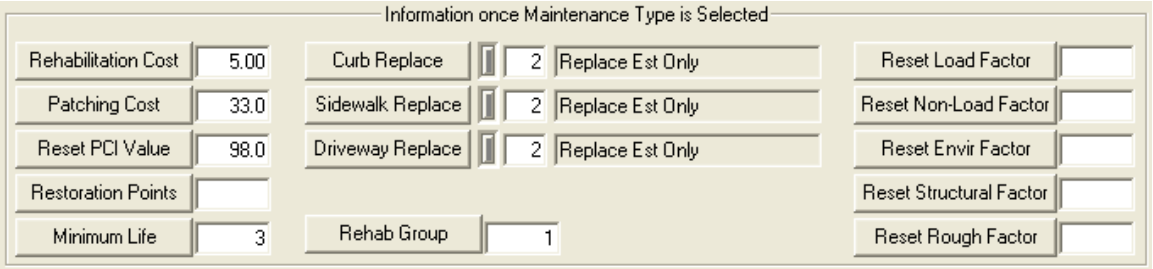
3. Create a unique name for the rehab technique in the header. Make sure it's something recognizable as you'll be selecting this technique from pick lists in later modules.
   - In our example, we've created a technique for Pavement Overlay with Milling. Other techniques may include Pavement Overlay, Seal Coat, Reconstruction, etc.
4. Indicate the Maintenance Sequence number in the header. This indicates the order in which the model will process selected supersegments for the model year. The lower the number, the more likely this rehab method will be selected.
5. Set the Rehabilitation Default Triggers. These settings are used by the system to determine which rehab technique is appropriate for individual streets.



   - In our example, we've indicated that this technique requires a curb, meaning that this technique will not be selected unless the individual street segment has a curb length greater than zero.
   - Additionally, in order for this technique to be selected for a particular street, the street's PCI (as calculated in the *Field Inspections* module) must fall between the Minimum PCI and Maximum PCI values.
     - As you can see here, we've set the Min PCI to 50 and Max PCI to 74.9. In order for a street segment to be selected for this technique, its PCI must fall between these two numbers.
     - The field inspection module was covered in workbook 1.
   - If a street's PCI falls between the Minimum PCI and Breakpoint PCI, it is considered to be in a Key Zone. During the model runs, streets that fall in a Key Zone have a higher rehabilitation priority and will be selected before other streets.
     - As you can see above, we've set the Min PCI to 50 and Breakpoint PCI to 56.5. If a street's PCI falls between these two numbers, it will be considered a Key Zone street.

6. Set the Information Once Selected. This data will be used in model run calculations and will then update settings in the *Pavement* modules after the run is complete.
   - Indicate the rehabilitation and patching costs for this technique. These costs will be used in the model run's budget calculations.
   - Enter the Reset PCI value. Once rehab is complete, the PCI will be upgraded to the value indicated here

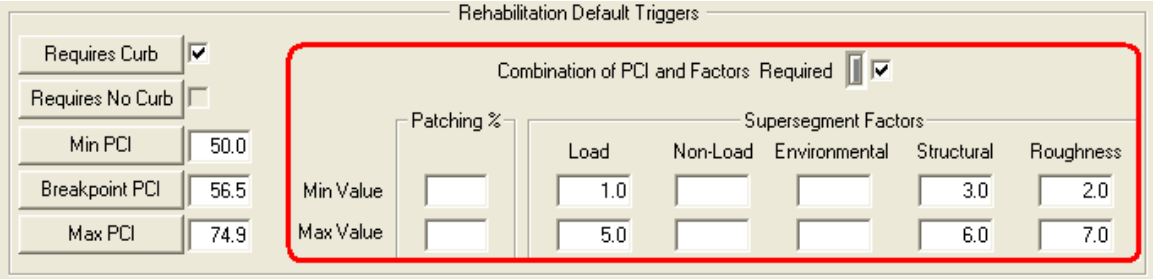
- If desired, enter Restoration Points. This is the number of points that a selected supersegment's PCI will be raised if this rehab method is selected. This is not required, but will override the Reset PCI Value if one exists.
- Enter the Minimum Life. Once a model selects this rehab, the street cannot be reselected until the minimum number of years is reached.
- Enter a Rehab Group number for similar rehab techniques. You'll also indicate the rehab group number in the *Rehab per Pavement/Classification* module. These groups are then used in the *Budget* module where you can designate the available budget percentage for each rehab technique. We'll discuss this process a bit later.
- Choose one of the three replacement options for curbs, sidewalks, and driveways. These fields allow you to determine if costs to repair or replace these features will be included in the model run.
    - No Replacement – No miscellaneous costs for this rehab type will be used.
    - Replace Est Only – The miscellaneous cost for this rehab type will equal the Supersegment Replacement Est * Misc. Cost for the feature.
    - Total Replacement – The miscellaneous cost for this rehab type will equal the Total Length * Misc. Cost for the feature.
- Enter the reset ratings for the next model year if this rehab type is selected. These are only used if Factors are helping to determine maintenance activities.



7. The Supersegment Factors and Patching percentages are not required; however, if you wish for the rehab techniques to be selected using both PCI and Factors, or PCI, Factors, and Patching percentages complete the following:
    - Mark the Combination of PCI and Factors Required checkbox.
    - Indicate the minimum and maximum ratings values and percentages. This technique will be selected if a street's ratings fall within the range indicated here and the PCI range indicated previously.

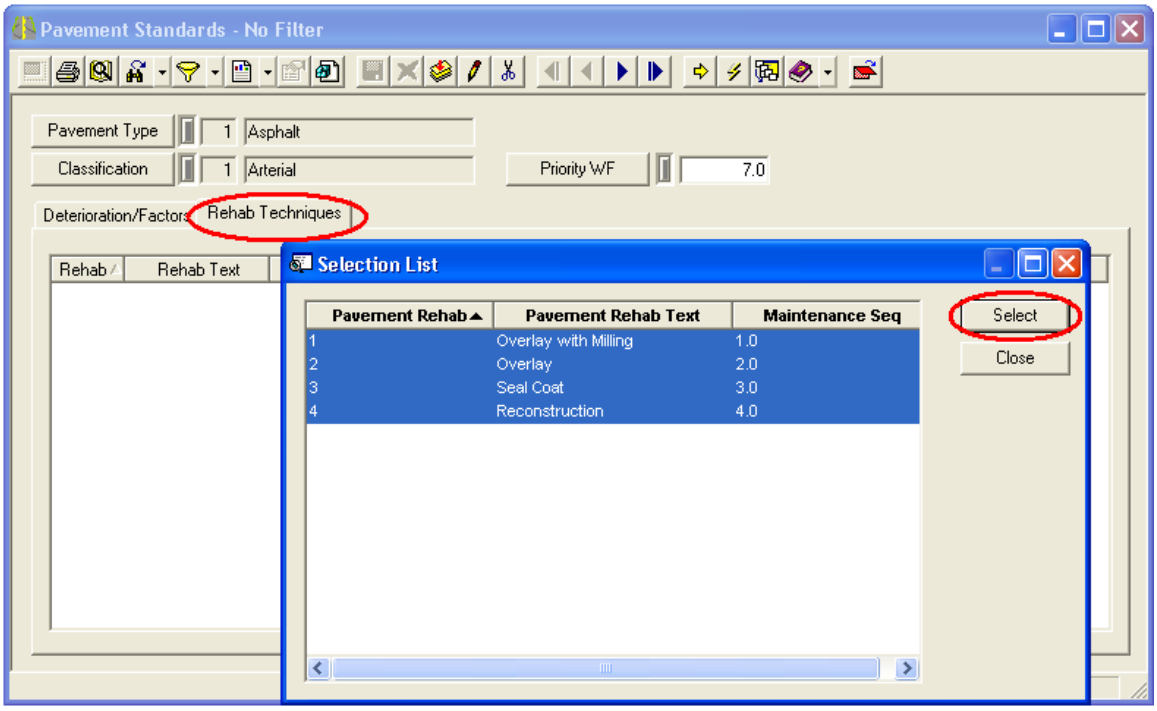
Rehab per Pavement/Classification

The *Rehab per Pavement/Classification* module identifies each unique pavement type, street classification, and rehab technique combination. These records will be used by the model runs to help determine the maintenance sequence, which segments to select for rehabilitation, and what rehab techniques to use.

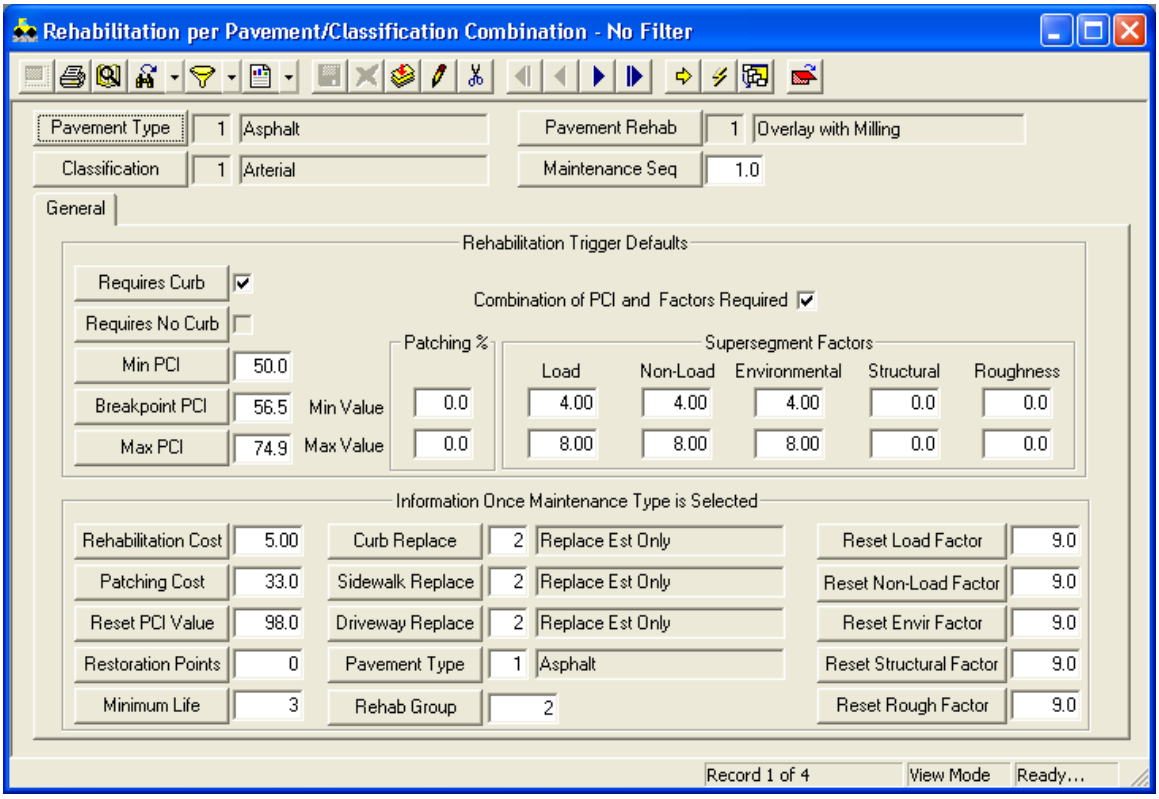


On page 18 of workbook 1 we discussed how the *Pavement Standards* module is used to set up your pavement types and classifications, as well as associate rehab techniques with the pavement/classification combinations. To accomplish this, you'll use the Rehab Techniques tab. It allows you to quickly define links between the modules and automatically create records for each pavement type, classification, and rehab combination in the *Rehab per Pavement/Classification* module. This greatly reduces the laborious task of manually creating these records in earlier software versions.

1. Go back to the *Pavement Standards* module.
   - For our example, we'll continue using the Asphalt/Arterial combination.
2. On the Rehab Techniques tab, right click in the grid and select *Add Record*.
3. The Selection List will display all of the records you created in the *Rehab Techniques* module. Highlight one or multiple options and click *Select*. The techniques will be added to the grid.
   - As you can see below, in addition to Overlay with Milling we've also defined Overlay, Seal Coat, and Reconstruction techniques.
   - We will select all four techniques to associate with the Asphalt/Arterial record.



4. Once you have added Rehab Techniques to the *Pavement Standards* module, records will be automatically created by the system for each unique combination. You can see these new records in the *Rehab per Pavement/Classification* module.
   - To access these records, you can double click on a listing in the grid.
   - Or, you can open **Transportation>>Pavement Manager>>Modeling>>Model Setup>>Rehab per Pavement/Classifications** from the Lucity main menu.



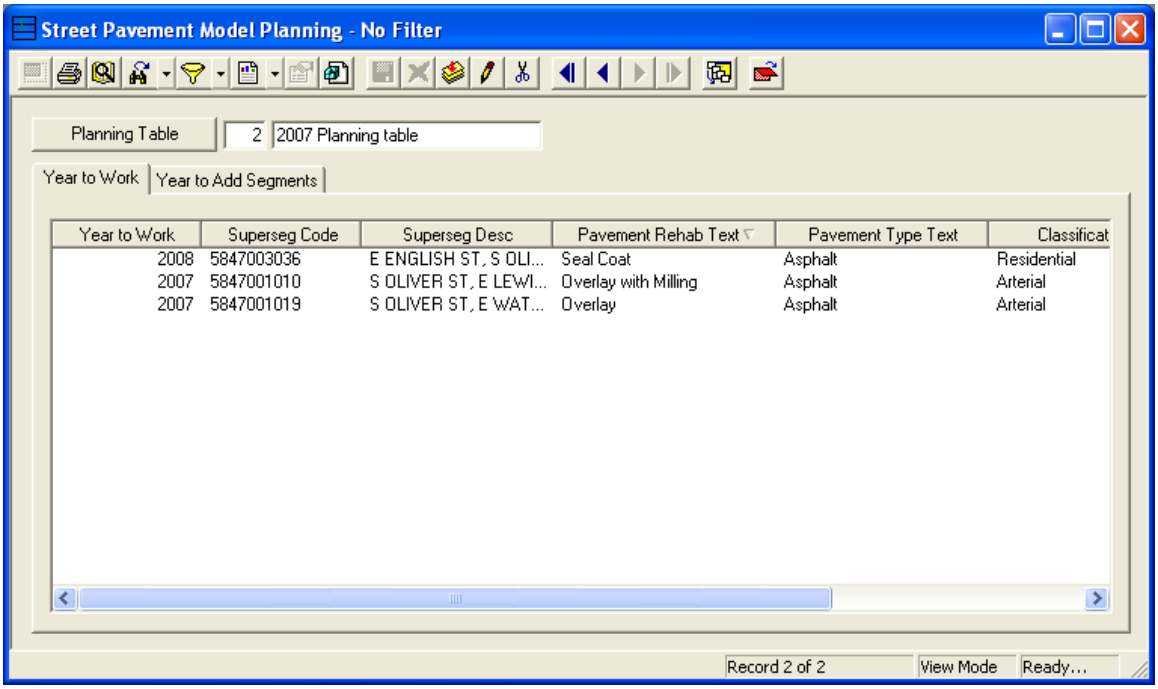
5. The header fields identify the Pavement/Classification/Rehab combination.
   - Since we used the Asphalt/Arterial *Pavement Standards* record and selected all four available rehab techniques, four *Rehab per Pavement/Classification* records were created. These new combinations include: Asphalt/Arterial/Overlay with Milling (displayed above), Asphalt/Arterial/Overlay, Asphalt/Arterial/Seal Coat, and Asphalt/Arterial/Reconstruction.
   - The possible combinations are limitless. For example, they may include Concrete, Composite, or Gravel pavements, and Arterial, Residential, or Collector streets coupled with each of these four rehab techniques.
6. The data in the General tab is carried over from the corresponding *Rehab Technique* record. You can edit these fields as needed.
7. In addition, you can determine which Pavement Type the supersegment will be reset to if this rehab is selected in the model. The system will automatically assume the same pavement type as in the header unless you indicate otherwise.
8. Adjust the Rehab Group number. This is used to group similar rehab techniques. In our example, all Overlay with Milling records have been given a group ID of 2.

When we discuss the *Budget* module later, you'll see how this group number is used.

Planning Table

The *Street Pavement Model Planning* module allows you to identify your highest priority street segments. These segments will be selected for rehabilitation before any others are chosen. You can create forced street selections using the *Year to Work* table as well as load or create subsets. Using the *Year to Add Segments* table, you can add street segments to your planning table before they're even built. We'll go over some step-by-step examples to explain this module in detail.

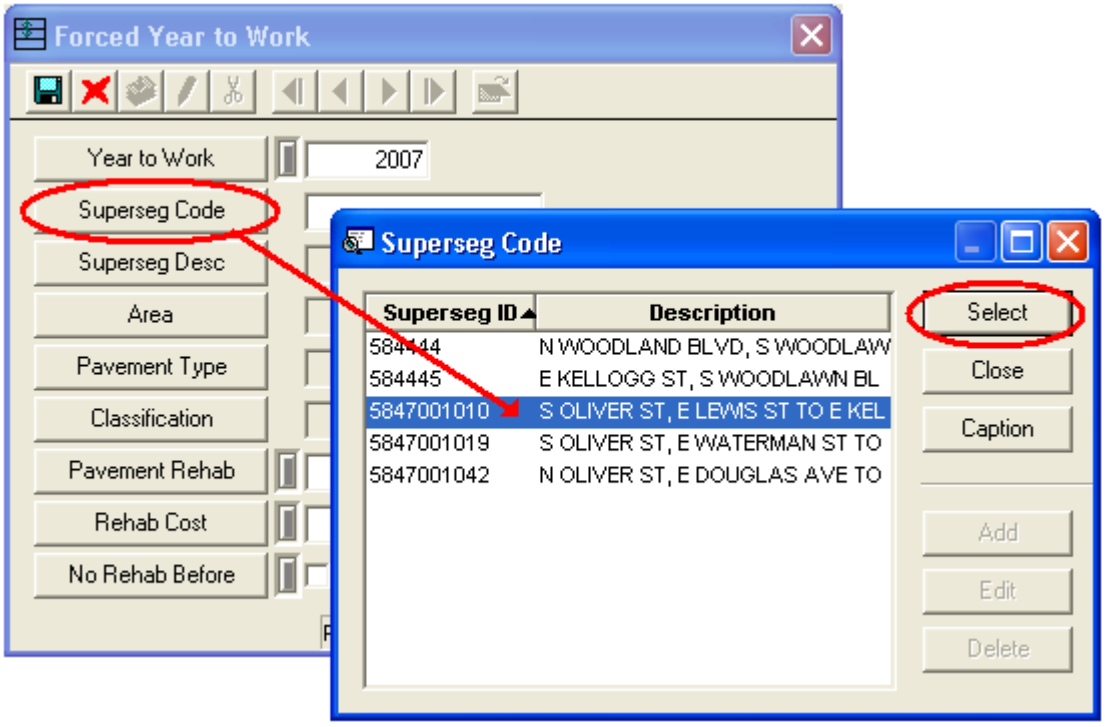
1. Open **Transportation>>Pavement Manager>>Modeling>>Model Setup>>Planning Table** from the Lucity main menu.
2. Click *GO* to bypass the filter. The *Street Pavement Model Planning* module will open.
3. Click the *Add* button  at the top of the module toolbar to create a new record. You'll need to enter a unique name to identify your planning table record.
   - For example, we've identified this record as the "2007 Planning Table".



4. Create a *Year to Work* record. This feature allows you to dictate which supersegments will be selected in certain years of the model run. The records you add here are forced selections and will be chosen for rehabilitation before all others. For example, you may have a street that your city council has indicated must be

repaired in the next year. By adding this street to the planning table, you can make sure that it is selected for rehabilitation at the proper time.

- Right click in the Year to Work grid and select *Add Record*.
- Enter the year in which this supersegment will be selected for rehabilitation. In our example, we've chosen 2007.
- Click on the Superseg Code button to select from the pick list. This list comes from the Supersegments module. The supersegments module is covered in workbook 1.



- Once you've selected a supersegment code, the system will fill in the description, area, pavement type, and classification from the corresponding record.
- Select a rehab technique from the pick list. Here, we've chosen Overlay with Milling. This is the rehab technique we created earlier in this workbook.
- Enter a Rehabilitation Cost. If you enter a value here, it will be used in the model run. If no value is entered, the system will calculate the street's cost on its own.
- Check the No Rehab Before box if you want to ensure that this street is not selected for rehabilitation before the forced year to work.
- Save the record. Our completed example appears below.

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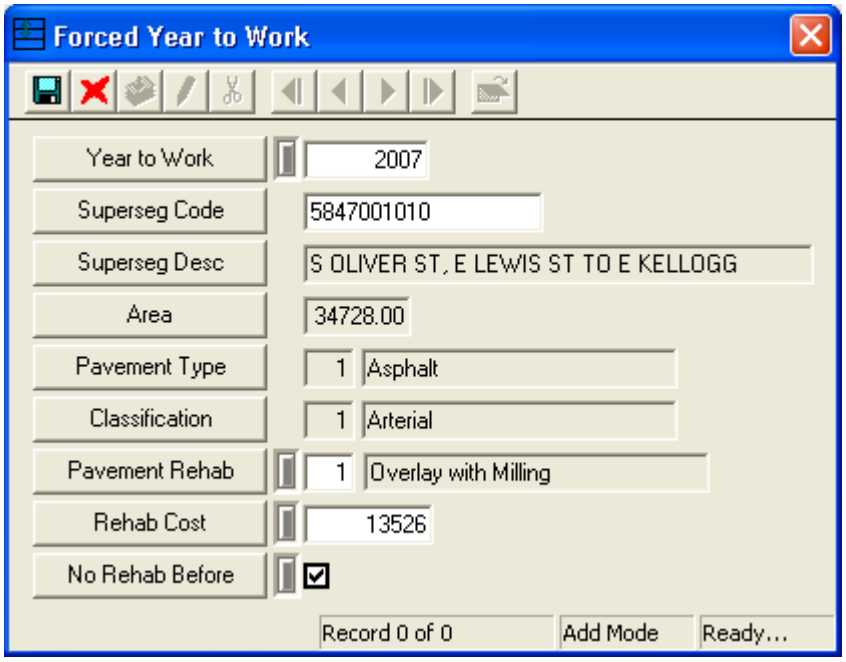
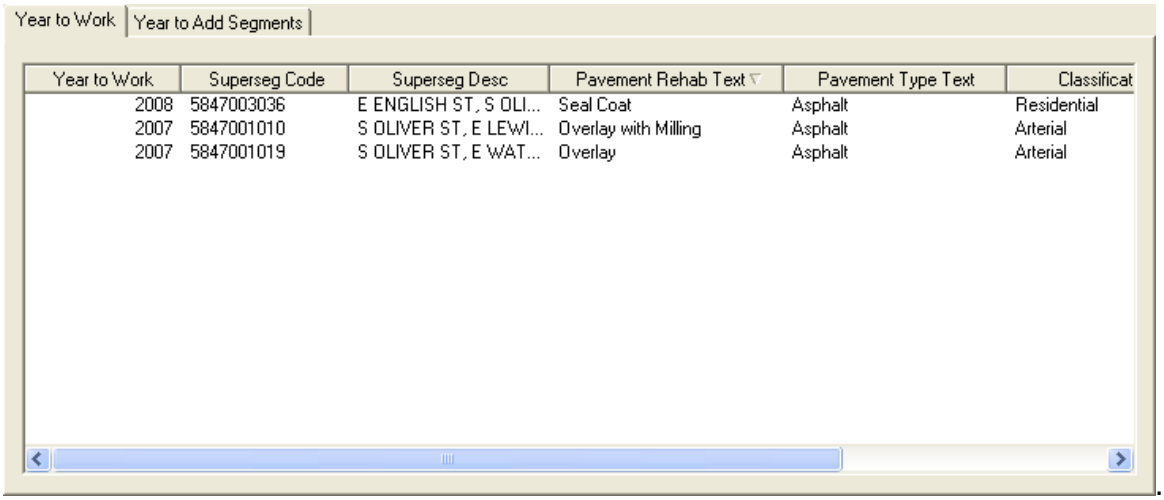


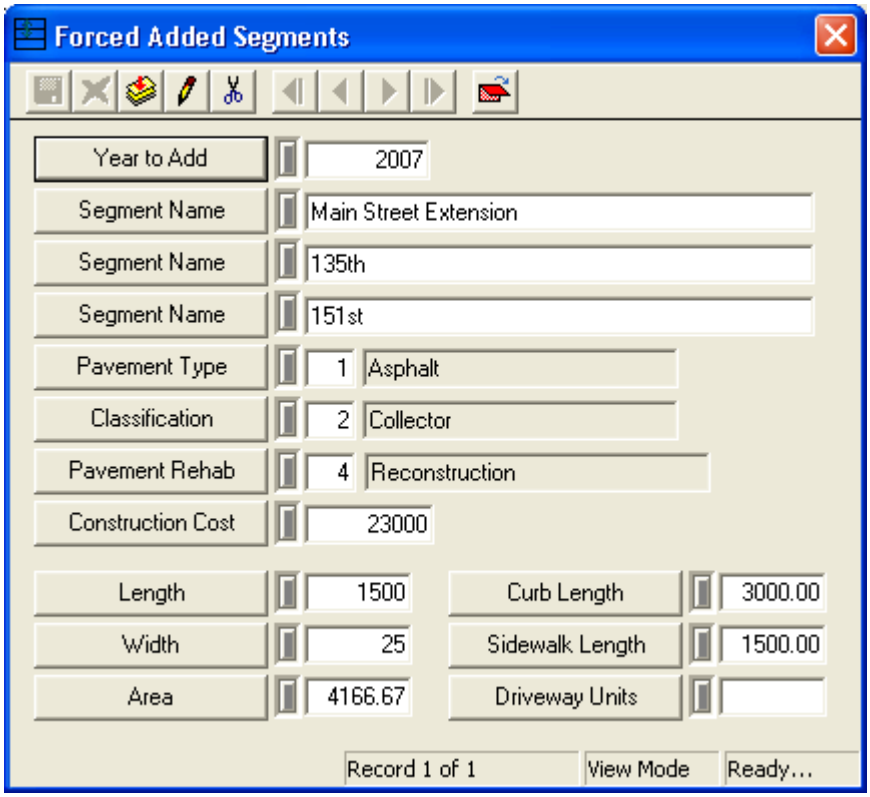
- Each supersegment added to the *Year to Work* table will appear in the grid. Below you can see the forced year to work, supersegment information, rehab technique, pavement type, and classification. Remember, the model runs will select these streets for rehabilitation prior to any others in the segment network. They will be marked as Forced Selections to help you identify their results.



Create a *Year to Add Segments* record. This feature allows you to add street segments to your model runs that do not currently exist in the segment network, but will be built at a future date. For example, assume that your city is building an extension to an existing street later this year. It needs to be included in the modeling program for budgeting purposes. This way, when the model is run, the system can ensure that enough money is put aside for the planned street.

- Right click in the Year to Add Segments grid and select *Add Record*.

- Enter the year the segment will be added to the model run. The segment will be a forced selection in this model year. Every year thereafter, the segment will be treated like any other in the segment network.
- Enter the Supersegment name, From Street, and To Street.
- Select the pavement type, classification, strength, and pavement rehab technique from the pick lists. Remember, we discussed these setup modules in workbook 1.
- Enter the Construction Cost. This will be used for budgeting in the model runs.
- Enter the length and width of the street segment as well as the number of driveway units. The curb length, sidewalk length, and pavement area will all be calculated by the system; however, you can edit these values as needed.



- In our example, we're building an extension to Main Street between 135th St. and 151st St. This will be an asphalt collector street and has been budgeted to be built in 2007. It will be 1500 ft long by 25 ft wide. By including this record in the planning table, we can ensure that it will be built as planned, with the proper amount of money set aside in the budget. In addition, it will be included in the analysis for all future years of the model run.

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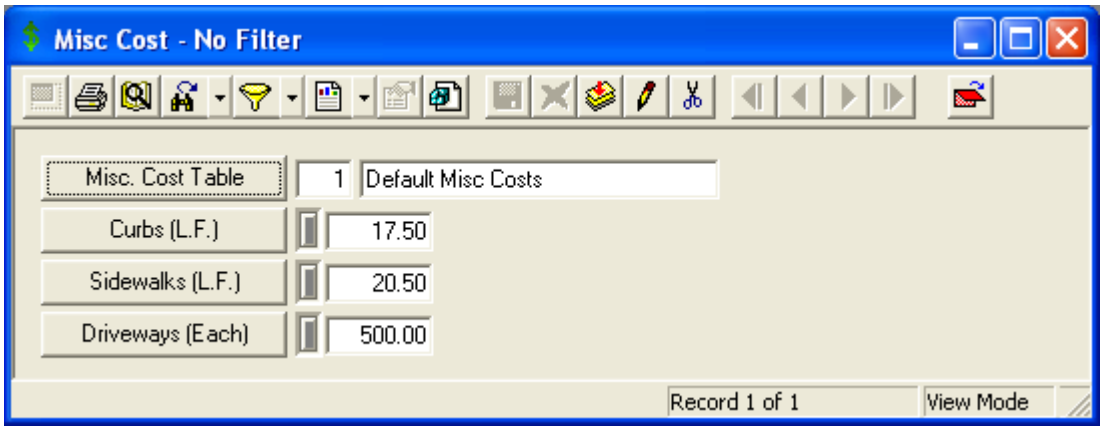
Miscellaneous Costs

This module allows you to set up miscellaneous costs to repair sidewalks, curbs, and driveways. The model runs will determine which street segments to select for rehabilitation based partially on the costs set up here.

1. Open **Transportation>>Pavement Manager>>Modeling>>Model Setup>>Miscellaneous Costs** from the Lucity main menu.
2. Click *GO* to bypass the filter. The *Miscellaneous Costs* module will open.



- Enter a unique name for this miscellaneous cost. Make sure it's something you can recognize as you'll need to select it from a pick list in the model run.
- Indicate the cost to repair each curb, sidewalk, and driveway unit.
- In our example, we've recorded the standard costs including supplies and repair for sidewalks, curbs, and driveways. Our costs are calculated by linear feet, but you can choose to set up your costs in any way you wish. Here, we've determined that it costs $17.50 to repair each linear foot of curb, $20.50 for each linear foot of sidewalk, and $500 for each driveway unit.

Budgets

One of the most important setup tables in our pavement modeling program is the *Budgets* module. This module allows you to create your budget, determine whether it is based on cost or PCI, and indicate the number of years the budget will be used. By setting up these features, you are able to use your model runs to determine how much budget is actually needed to keep the segment network at a desired condition.

1. Open **Transportation>>Pavement Manager>>Modeling>>Model Setup>>Budgets** from the Lucity Main menu.
2. Click *GO* to bypass the filter. The *Street Pavement Modeling Budget Scenarios* module will open.

3. Using this module, you can create two distinct kinds of pavement modeling budgets: A cost based budget or a PCI based budget. In the following pages, we'll go over step-by-step examples for both of these budget types.

Cost Based Budget

This option allows you to create a monetary budget for pavement rehabilitation. The amount you set aside here for repairs will be used to run the model. The system will stop selecting segments for rehabilitation once the budget limit is reached. For example, you may use this option if your city council determines a monetary budget amount each year. Then, using this budget, the model runs will determine how many streets in your network can be rehabilitated.

1. Create a unique name to identify your budget. You'll want to make sure it is descriptive enough to identify it in the pick list when you run the model.
   - We've named our monetary budget, "$1,000,000 5 Year". As you'll see in the following steps, we'll be setting up a one-million dollar budget per year for a five-year period.
2. Enter the starting annual budget amount, budget inflation rate, contingency percent, and cost inflation rate.
   - Our initial budget is $1,000,000 with an inflation rate of 3%. This setting will increase the budget amount available by 3% each year.
   - We've also set a contingency percent of 20 and a cost inflation rate of 3%. This will reflect the increasing cost of materials and supplies in each budget year.
3. Enter the initial budget date and the number of years the budget will run.
   - Here, we've indicated that this budget will begin on the first of the year and run for a period of five years.
   4. Enter the model stop point. This dollar amount is the point at which the model will end its run and stop selecting segments for rehabilitation.

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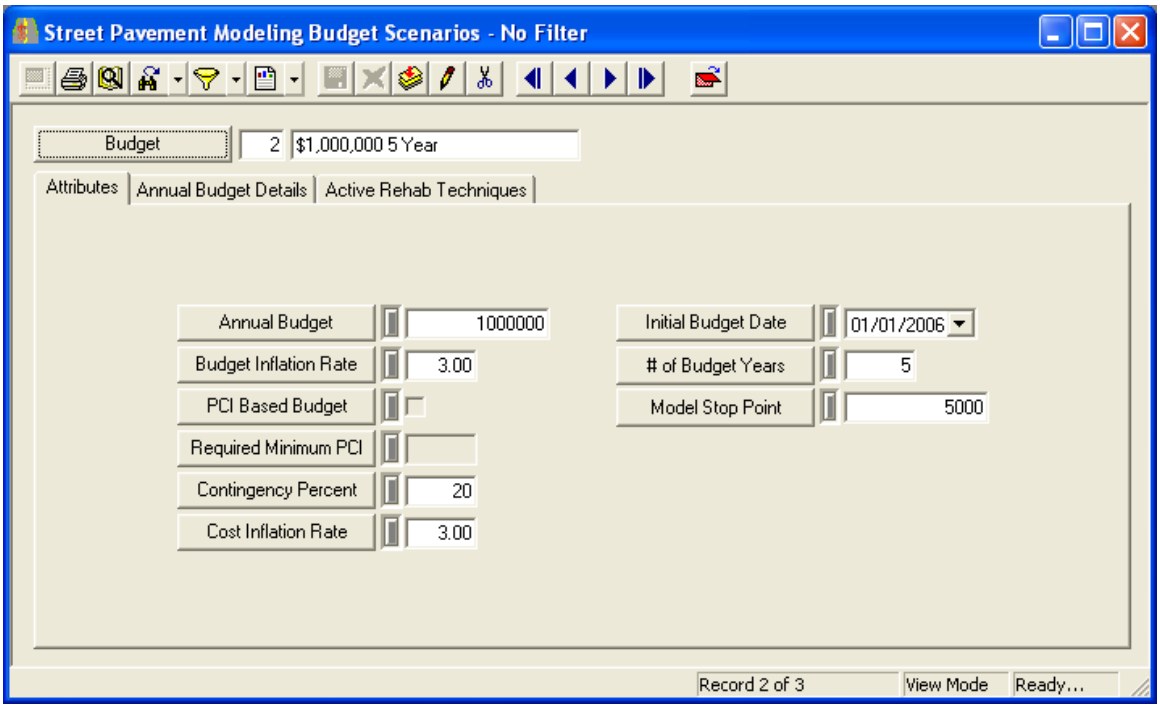

- In our example, we've entered $5,000. This prevents the model from having to go through an analysis of every segment.

5. Once you save your changes to the Attributes tab, the Annual Budget Details grid will be automatically populated by the system. As you can see below, the grid displays each budget year along with its projected amount available.
   - Remember, on the Attributes tab, we indicated that this budget would run for five years, beginning on 1/1/2006. The system has created budget amounts for 2006-2010 to reflect these settings.
   - The amount available is increased each year based on the budget inflation rate you entered into the Attributes tab. As you can see below, the budget for 2006 begins at $1,000,000. By 2010, the system has calculated $1,125,509 for the projected budget amount.

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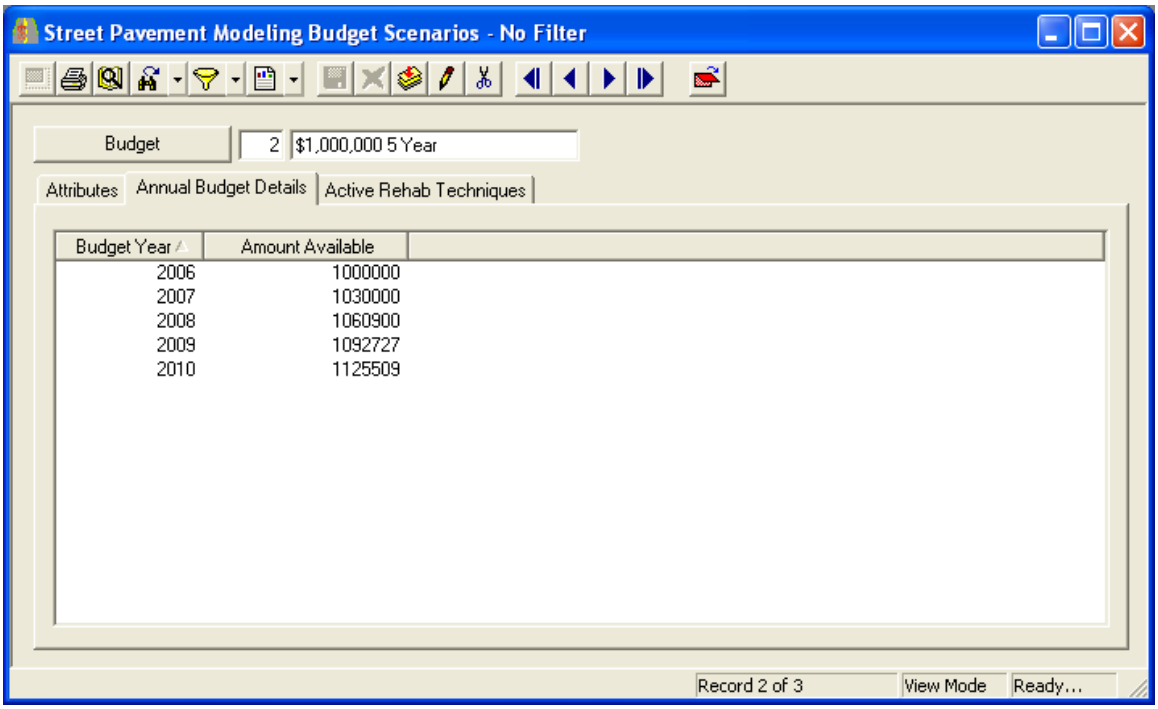

6. You can choose to adjust the budget amount available for each year. This is useful if you know exactly how much budget will be available in certain years.
   - For example, assume your city knows that an additional $45,000 will be made available in 2007. Follow the steps below to add this amount to the Annual Budget Details grid.
   - Highlight the 2007 budget year in the Annual Budget Details grid. Then, right click and select *Edit Record*.
   - In the dialog box, change the Amount Available in the field provided.
     - As you can see below, we've adjusted 2007's budget to $1,045,000.
   - Save and close the record. The 2007 budget will be adjusted as specified. No other budget amounts will be affected by this change.

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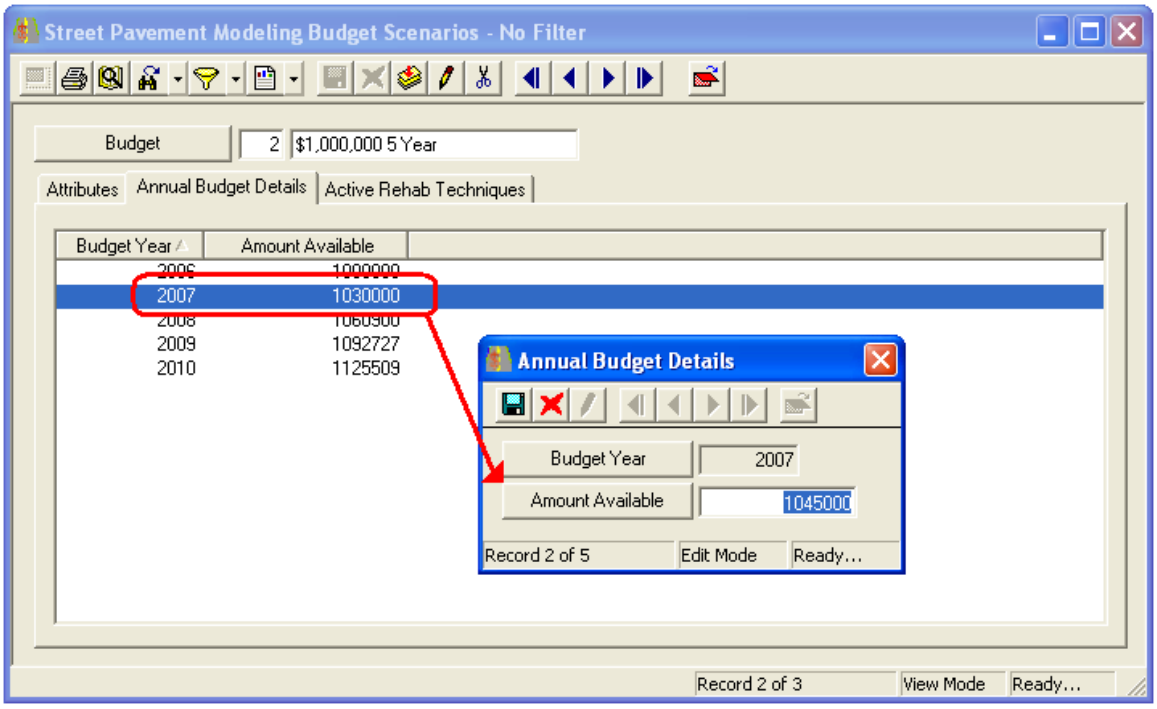

PCI Based Budget

This option allows you to indicate a minimum PCI (Pavement Condition Indices) value for your entire street segment network. When you run a model based on PCI, the system will determine the budget amount necessary to maintain a minimum PCI value for the entire system. The model run will calculate how much money is needed each year to maintain and rehabilitate your street segments to achieve that network PCI. For example, you may use this option if you have a flexible budget and your main goal is to keep your streets at a standard level of repair.

1. Create a unique name to identify your budget.
   - As you can see in the following example, we've named our budget "85 PCI Based Budget – 10 Years". In the following steps, we'll be creating a budget designed to maintain an average system PCI of 85 over a ten-year period.
2. Mark the PCI Based Budget checkbox. This will disable the Annual Budget field.
3. Enter the Required Minimum PCI. The model run will spend however much is needed to ensure that the segment network's minimum PCI is equal to or greater than this value.
   - In our example, we've chosen a required minimum PCI of 85. The model run will then spend the money needed to rehabilitate streets in your segment network to ensure that the minimum PCI does not fall below 85.
4. Enter a budget inflation rate, contingency percent, and cost inflation rate.
5. Enter an initial budget date and number of budget years for the model to run.

- In our example, we've set the initial budget date for the first of the year and allowed the model to run for ten years. Since this is a PCI based budget, this means that the segment network will have a minimum PCI of 85 for the next ten years.

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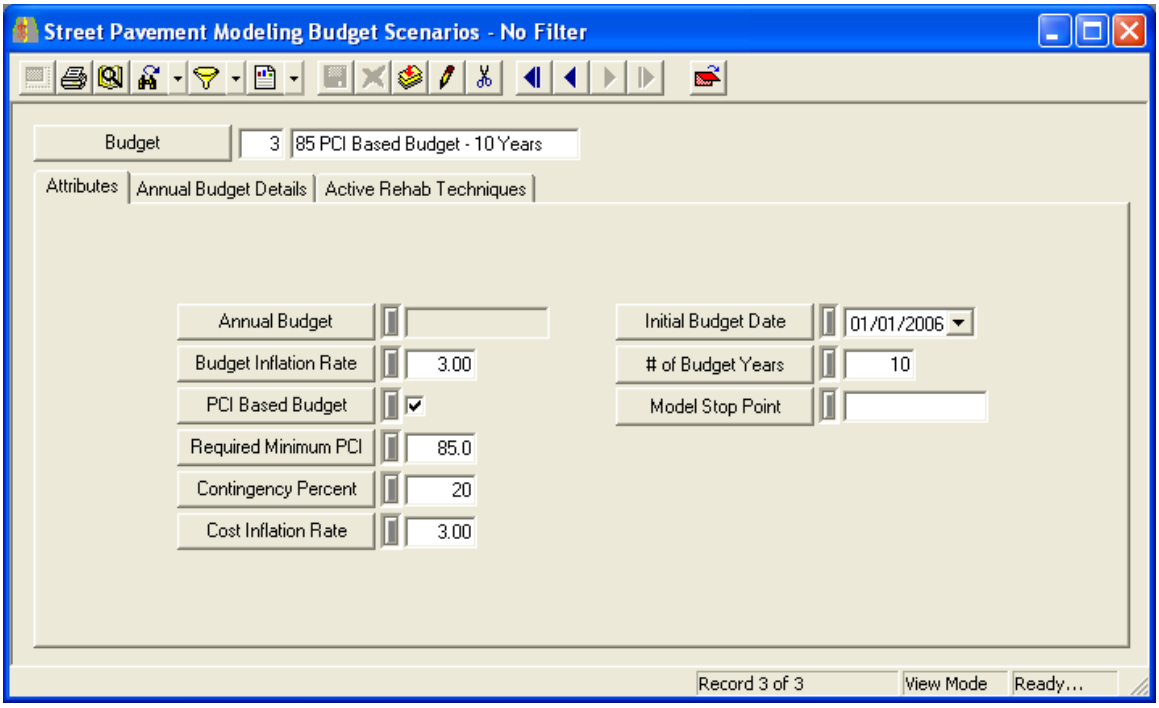

Once you save the record, the Annual Budget Details grid will be updated. For this type of budget, the grid will display each model year; however, it will not calculate an annual budget amount available.

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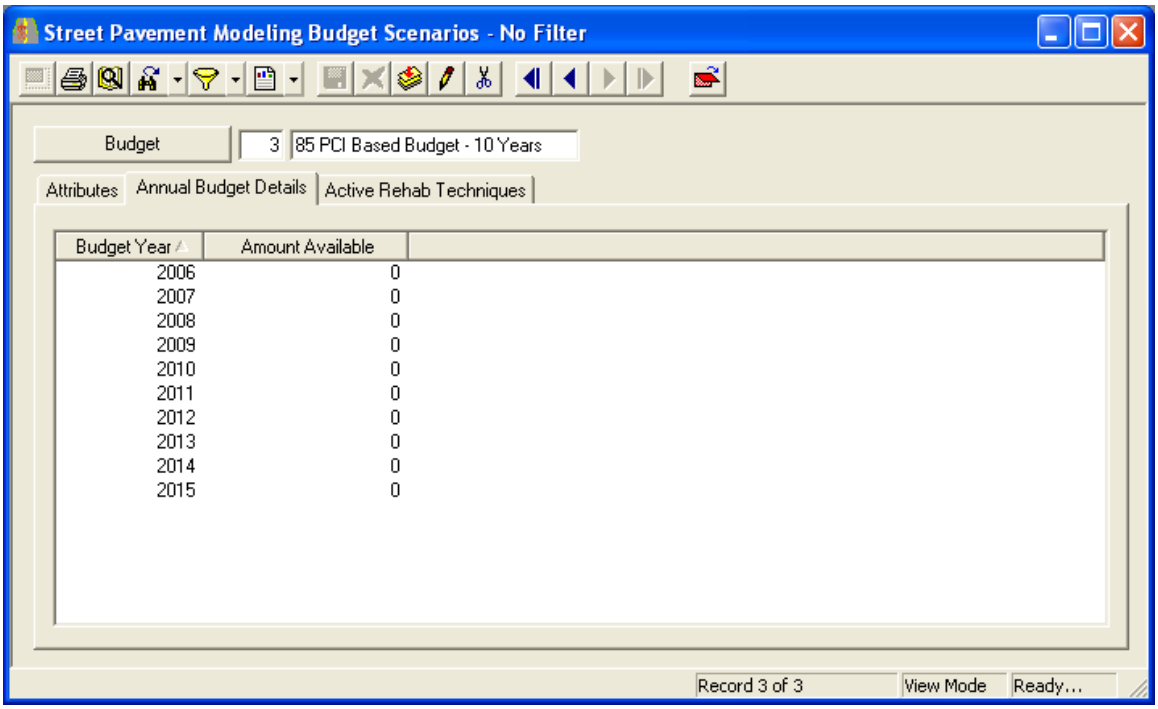

Active Rehab Techniques

For both the cost based budget and PCI based budget, you'll need to add pavement rehabilitation techniques to the Active Rehab Techniques tab. Remember, earlier in this workbook we created *Rehab Technique* records. You'll use this module to associate individual rehab techniques with specific budgets. When you run the model, you'll select one of the budgets defined here. In the course of the model run, only the associated rehab techniques can be used to rehabilitate the selected pavements.

1. First, you'll need to add rehab techniques to the record.
   - Right click in the grid and select *Add All Rehab Techniques*. By using this option, every record that exists in the *Rehab per Pavement/Classification* module will be added to the grid.
   - Alternatively, you can right click in the grid and select *Add Record*. The rehab technique selection list will be displayed. You can then hold down the SHIFT or CTRL key to highlight multiple selections.

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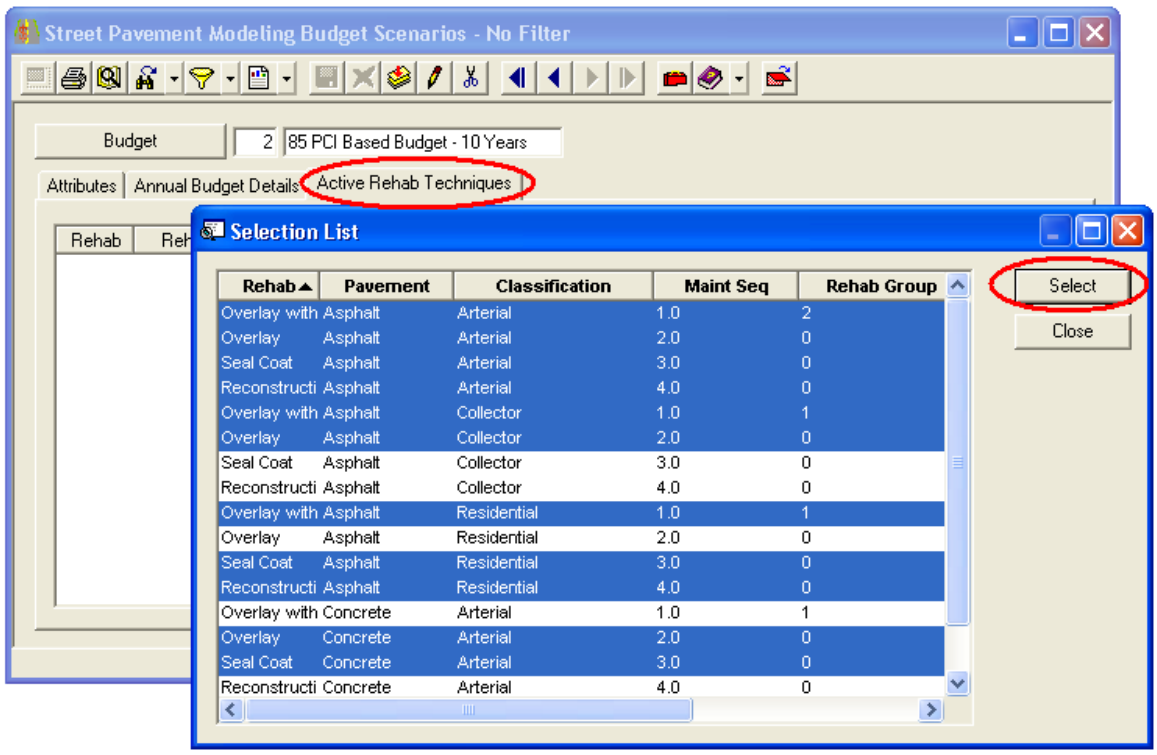

2. Once you add the rehab techniques to the record, you'll notice that the Rehab Group number appears in the grid.
   - Earlier in this workbook, we discussed how to alter this group number in the *Rehab per Pavement/Classification* module. You can also alter it here by highlighting a series of rehab techniques and then right clicking and selecting *Change Rehab Group*. In the prompt that follows, indicate the Rehab Group number you wish to apply to all selected records.

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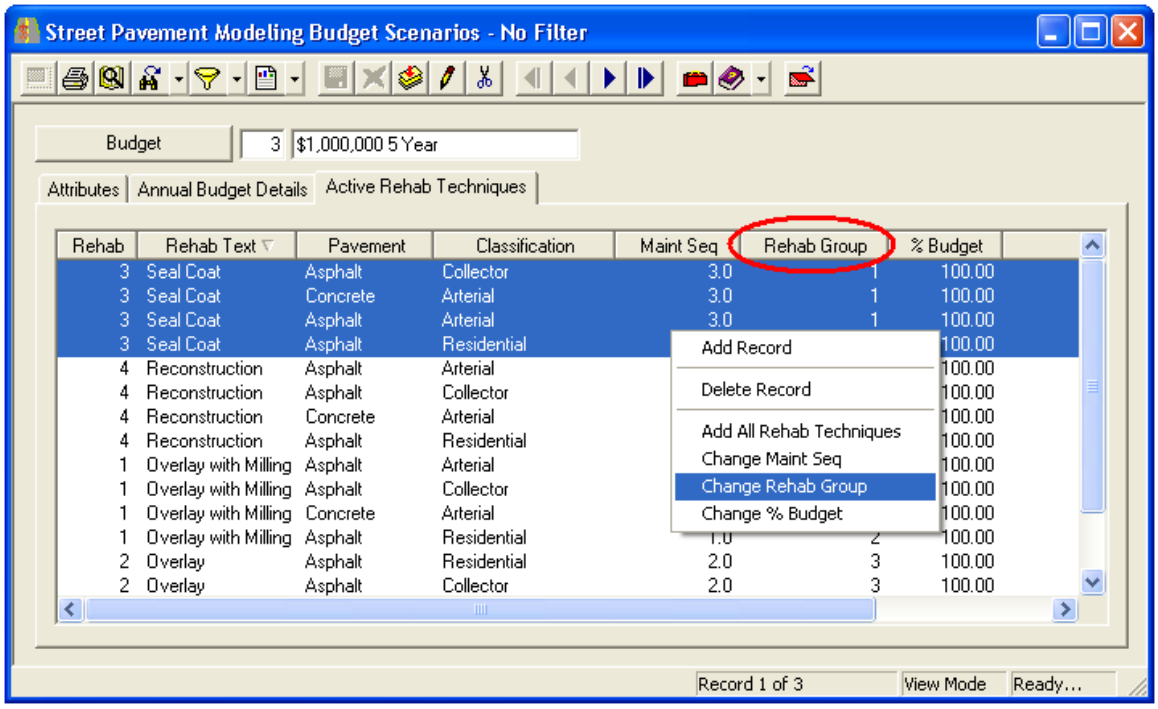

- The Rehab Group number allows you to associate similar rehab techniques. For example, we've created the following rehab groups.
  - 1 – Seal Coat
  - 2 – Overlay with Milling
  - 3 – Overlay
  - 4 – Reconstruction
- We've grouped the rehab techniques in this way so that we can adjust the maximum budget percentages that can be used for each type of repair.

3. To adjust the budget percentage you'll want to first sort the records by rehab group. Click on the Rehab Group column header and the records will appear in numerical order. Then, complete the following steps:
   - Hold down the SHIFT key to highlight all of the records in a single group. For example, we've highlighted all items in the Seal Coat Rehab Group #1. Then, right click and select *Change % Budget*.

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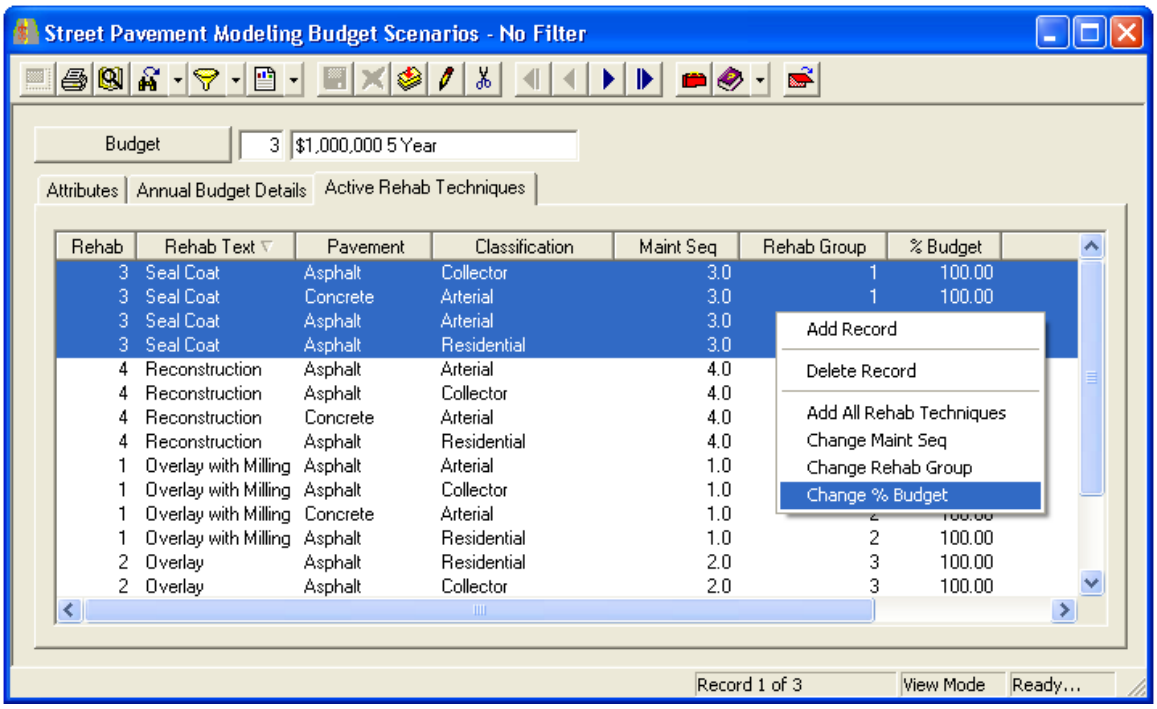
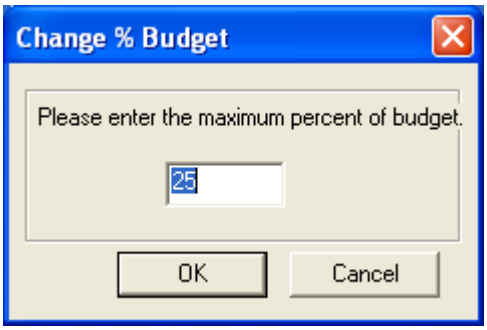
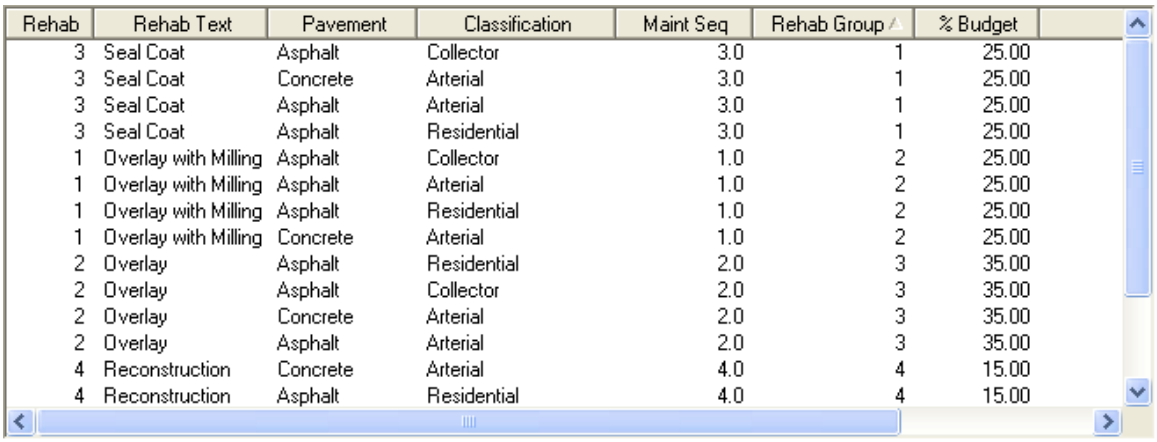


- Enter the budget amount in the field provided. For example, we've indicated that 25% of the total budget can be used for seal coat repairs.



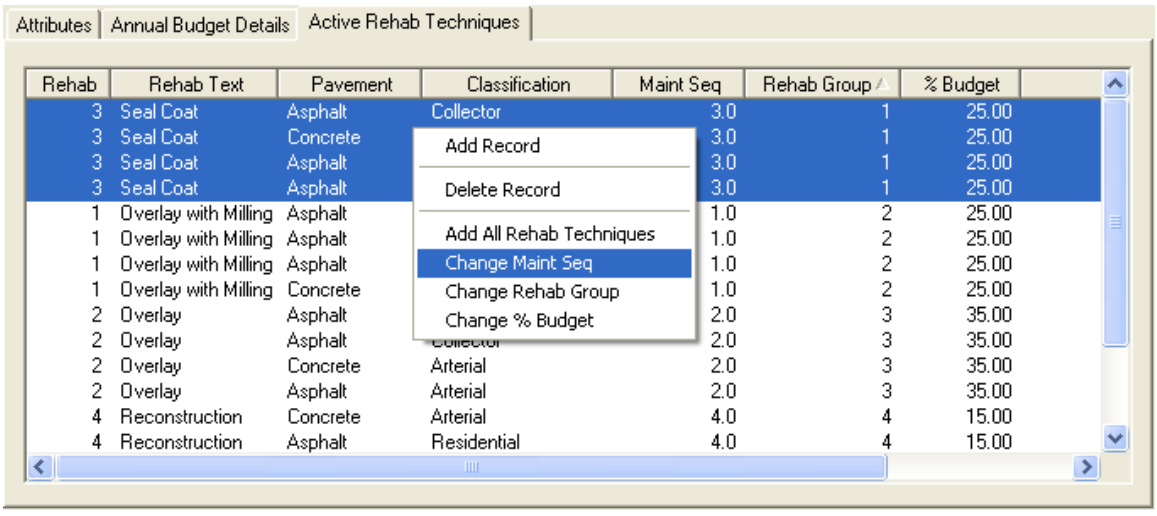
- Continue making budget changes for the remaining groups. In our example we've set the following maximum budget percents:
  - Seal Coat – Group 1 – 25%
  - Overlay with Milling – Group 2 – 25%
  - Overlay – Group 3 – 35%
  - Reconstruction – Group 4 – 15%



Rehab	Rehab Text	Pavement	Classification	Maint Seq	Rehab Group	% Budget
3	Seal Coat	Asphalt	Collector	3.0	1	25.00
3	Seal Coat	Concrete	Arterial	3.0	1	25.00
3	Seal Coat	Asphalt	Arterial	3.0	1	25.00
3	Seal Coat	Asphalt	Residential	3.0	1	25.00
1	Overlay with Milling	Asphalt	Collector	1.0	2	25.00
1	Overlay with Milling	Asphalt	Arterial	1.0	2	25.00
1	Overlay with Milling	Asphalt	Residential	1.0	2	25.00
1	Overlay with Milling	Concrete	Arterial	1.0	2	25.00
2	Overlay	Asphalt	Residential	2.0	3	35.00
2	Overlay	Asphalt	Collector	2.0	3	35.00
2	Overlay	Concrete	Arterial	2.0	3	35.00
2	Overlay	Asphalt	Arterial	2.0	3	35.00
4	Reconstruction	Concrete	Arterial	4.0	4	15.00
4	Reconstruction	Asphalt	Residential	4.0	4	15.00

- The program defaults to 100% for each rehab type. If you do not set a maximum budget percentage the program will use the entire budget amount needed to perform that type of rehabilitation. No limit will be imposed.

4. If you'd like, you can also change the maintenance sequence for one or more rehab techniques by right clicking in the grid and selecting *Change Maint Seq*.
   - Maintenance sequence values do not have to be unique. The lower the sequence number, the more likely that the rehabilitation technique will be selected.



Rehab	Rehab Text	Pavement	Classification	Maint Seq	Rehab Group	% Budget
3	Seal Coat	Asphalt	Collector	3.0	1	25.00
3	Seal Coat	Concrete	Arterial	3.0	1	25.00
3	Seal Coat	Asphalt	Arterial	3.0	1	25.00
3	Seal Coat	Asphalt	Residential	3.0	1	25.00
1	Overlay with Milling	Asphalt	Collector	1.0	2	25.00
1	Overlay with Milling	Asphalt	Arterial	1.0	2	25.00
1	Overlay with Milling	Asphalt	Residential	1.0	2	25.00
1	Overlay with Milling	Concrete	Arterial	1.0	2	25.00
2	Overlay	Asphalt	Residential	2.0	3	35.00
2	Overlay	Asphalt	Collector	2.0	3	35.00
2	Overlay	Concrete	Arterial	2.0	3	35.00
2	Overlay	Asphalt	Arterial	2.0	3	35.00
4	Reconstruction	Concrete	Arterial	4.0	4	15.00
4	Reconstruction	Asphalt	Residential	4.0	4	15.00

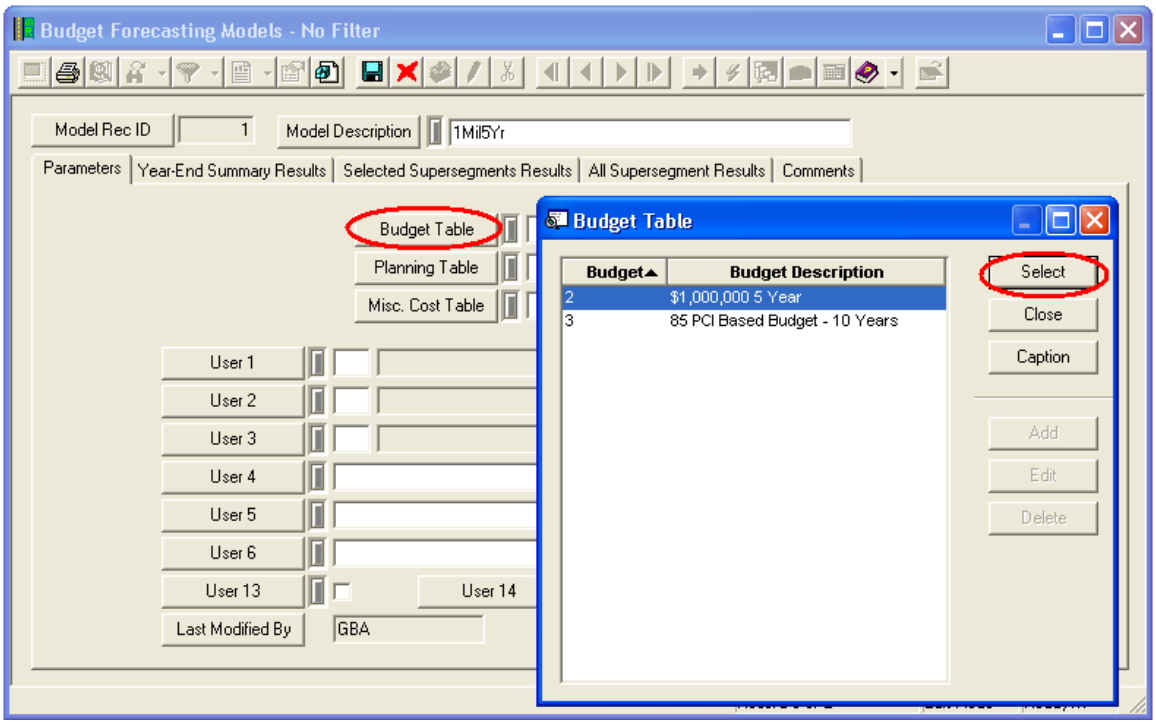
This completes the setup steps and parameters needed to run the model.

Create a Model Run

After setting up a street inventory, assigning subsegments to segments, setting up pavement standards and distresses, and setting up model runs, it is time to run a model.

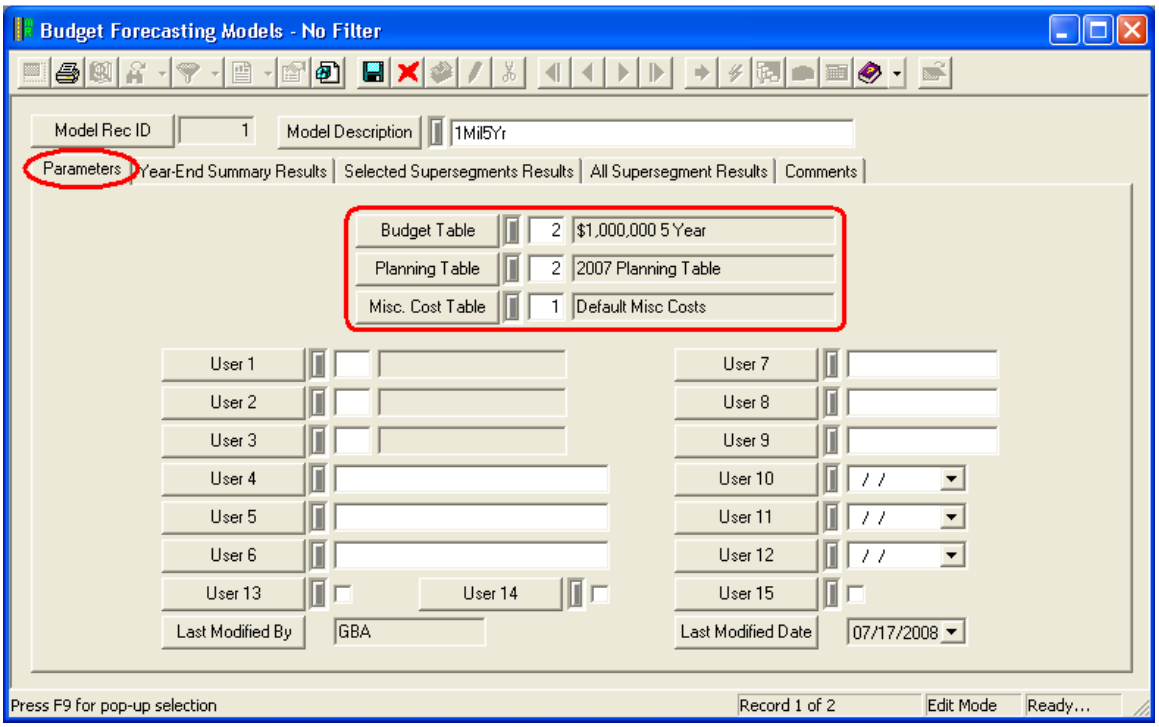
The modeling program allows you to create different scenarios to determine how much budget is actually needed to keep the segment network at a desired condition. The model runs you create will then select rated pavements for maintenance during different budget years. These selections are based on the parameters you learned how to set up in the previous section.

1. Open **Transportation>>Pavement Manager>>Modeling>>Model Runs** from the Lucity main menu.
2. Click *GO* to bypass the filter. The *Budget Forecasting Model* will open.
3. Click the Add button  at the top of the module toolbar to access a blank record.
   - Enter a unique name to identify the model run. As you can see in the example below, we've named this model run, "1Mil5Yr".
   - Using the field caption buttons, select the parameters for your model run from the Budget Table, Planning Table, and Miscellaneous Cost Table. You'll select from pick lists created in the *Model Setup* modules.

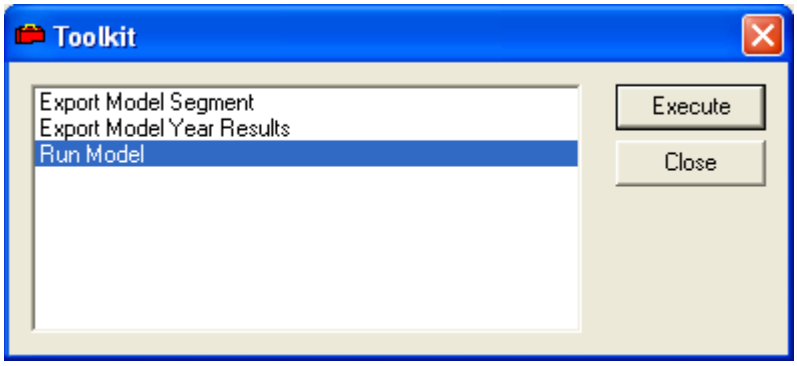


   - In our example, we've selected tables that were created in previous sections of this work book. Brief descriptions of these tables are listed below:

- Budget Table - $1,000,000 5 Year. As you may recall, this is a $1,000,000 a year budget that runs for five years.
- Planning Table – 2007 Planning Table. This table has three forced street selections and one forced year to add street segment. Remember, this planned street will be an extension of Main Street between 135th and 151st streets.
- Miscellaneous Cost Table – Default Misc. Costs. In this table, we set up default miscellaneous costs for repairs to sidewalks, curbs, and driveways.

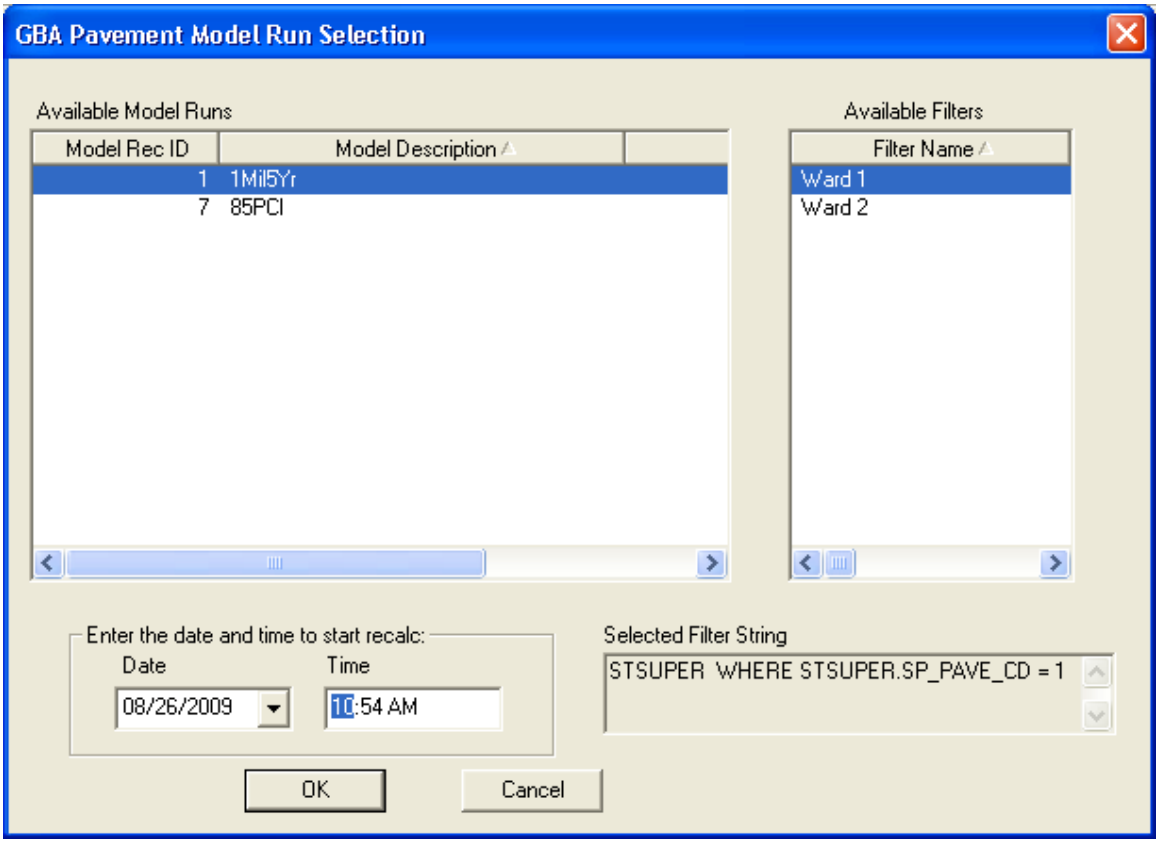


4. Now that you've set up the modeling parameters, you're ready to run the model.
   - Click on the Toolkit icon . Then, select Run Model and click *Execute*.

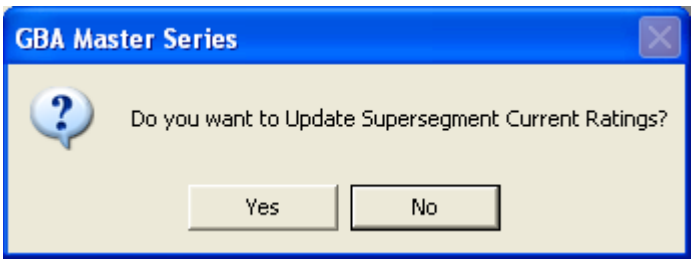


   - In the selection dialog, highlight the modeling scenario you wish to run from the Available Model Runs grid. In the example below, we've chosen the model run we just created, 1Mil5Yr.

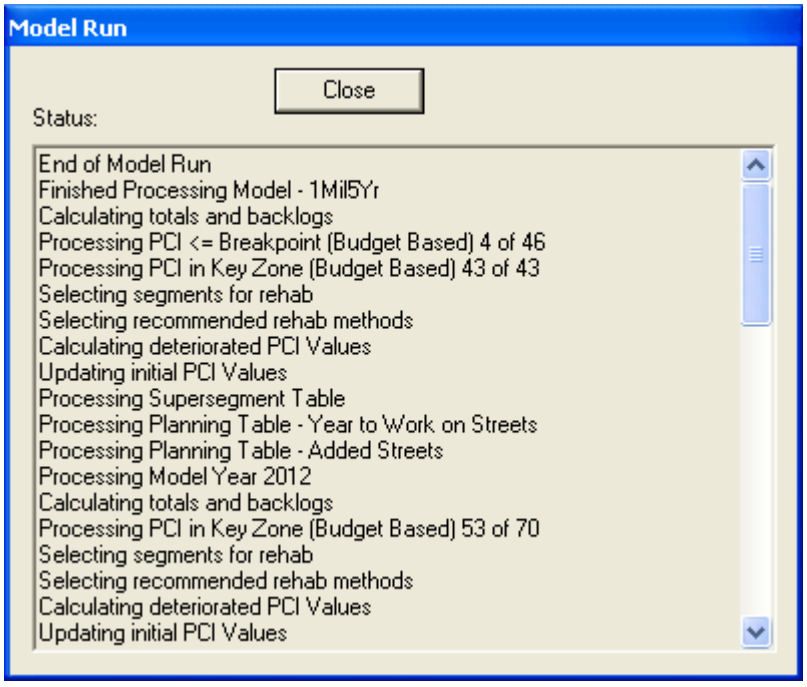
- Enter a date and time to start the model run. Depending on the number of segments in your network, this process can take some time to complete. As such, you may wish to run the model overnight.
- Select a filter from the Available Filters grid. These filters are defined in the *Supersegments* module. In our example, we have divided the supersegments into two wards. These break the segment network in our sample city into two distinct sections. In this modeling scenario, we've chosen to run the model on only one of these two sections. This helps limit the results and shorten the run time.



- Click *OK* once you have made your model run selections. You'll receive the following prompt asking if you wish to update the supersegment current ratings. Updating these ratings is beneficial if you have not updated this data in some time; however, it can be a time consuming process. If *Yes* is selected, each supersegment in the system is looped through with all gathered Subsegment, Segment, and Field Inspection information so that the current conditions of the supersegments can be updated. This would ensure that the model uses the most accurate PCI information.



- The Model Run will then begin processing. If you chose to update Supersegment ratings, the Model Run will begin after that update is complete.]
- Note that the model is run on the machine where it was initiated. If you elected to run the model overnight, be certain that the computer remains turned on and logged into Lucity so that the model run process can be completed.
- You will see a tracking screen during this process (pictured below). This allows you to track the status of each run. The most recent activity is listed at the top. Once the Model Run is complete, the top line will read “End of Model Run”.



Model Run Process

To help you better understand the model run process that was just completed, we’ve listed the details below. These are the steps taken by the system to select street segments for rehabilitation.

Budget Method

1. The system checks to make sure that a Budget Table is included on the Parameters tab and that the table is complete in the *Budget Setup* module.
2. The model creates a supersegment record for the selected model year for every supersegment in the selected filter set.
   - The system will set a Supersegment's PCI to 100 if no other PCI is defined. This allows Supersegments with no field condition inspection information to be included in the model runs.
3. The system then adds streets from the *Planning Table* to the model run. This includes all *Year to Work* and *Year to Add* segments. It will keep adding all forced street selections for that model year regardless of how much money is in the budget.
   - These segments are marked as Forced Selections and the associated Rehab and Construction Costs are calculated. Remember, you defined these costs in the *Planning Table* records.
4. The model will then start processing all supersegments that were not affected by the Planning Table.
   - For every supersegment, the model identifies its length, area, surface type before maintenance, classification, PCI at the start of the analysis, total curb length, total sidewalk length, total driveway units, total estimated repairs (curb, sidewalk, and driveway), total patching estimates, and all load factors.
   - If the supersegment has a value in the Override PCI field, it will override both the blended and controlling PCI values (found in the *Supersegment* module, Condition tab).
   - The program then goes through every supersegment in the model and calculates the next year's PCI value (assuming that it is not selected). These will be the deteriorated PCI values for future model runs.
   - Next, the program goes through each supersegment and determines if it falls into any rehabilitation method. If so, the following information will be identified: The rehab technique, the rehab sequence number, whether or not the PCI was in a Key Zone, and the Rehab Group. The Restoration Points, Minimum Life, and Next Rehab Year are also noted. In addition, all costs are calculated.
5. Then, the remaining budget (after removing the segments from the *Planning Table*) is used to start the actual selection of the segments.
   - Going in Rehab sequence order (ascending) and then by order of Supersegment Priority (descending), the program first makes a pass through all supersegments that are in the Key Zone. Every time a supersegment is selected for rehab, the remaining budget is subtracted from the cost of performing that rehab technique. As long as sufficient funds remain in the budget, the program will continue with all Key Zone supersegments.
   - As each supersegment is processed for possible selection, the program also determines if it is part of a linked supersegment. If so, then the total cost of that segment and all supersegments linked to it is determined first. If the budget can handle these grouped costs, then that segment and all linked supersegments are selected at this time. Each supersegment selected as a Linked Supersegment will retain its own rehabilitation technique (linked supersegments do not have to

have the same rehab techniques). The total cost of rehab for all linked supersegments is then subtracted from the total remaining budget and the system continues to select segments.
    - If a supersegment or linked supersegment is selected, the Minimum Life field is added to the Budget Year to determine the Next Rehab Year.
6. If there is still money in the budget remaining after the Key Zone analysis, then the model will take another pass through the supersegments that have not yet been selected and begin selecting them in the order designated by sequence. Again, each time a supersegment is selected for rehab the remaining budget is subtracted from the cost of performing that rehab. The same criteria for selection as mentioned above apply here as well.
7. Once the program runs out of money in the budget, it will begin summing up its findings for the model year. The totals and backlog costs will be identified for the user in the *Year-End Summary Results* module.
    - Backlog Costs represent all supersegments that were in Key Zones but were not selected in the model run.
8. All supersegment values are then recorded in the *Segment Results* module.
9. If more than one model run was selected, the system will identify the following:
    - If a supersegment had been selected in the previous model year, then the system uses the PCI, surface type, and ratings after selection (defined in the *Rehab per Pavement/Classification* module) for the subsequent model runs.
    - If a supersegment was not selected, then the system uses the current values and the Post PCI if not selected.
10. Then, the model begins the process again.
    - If a selected supersegment has a restoration point set, then the new PCI will be calculated as the current PCI plus the restoration points. If there are no restoration points, then the system uses the Default Reset PCI (as defined in the *Rehab per Pavement/Classification* module).
    - As segments are selected in the model, the rehab technique can have a minimum life set in the *Rehab per Pavement/Classification* module. If this feature is used, then the next year that the segment can be selected for rehabilitation will be the year after the budget year plus the minimum life.
        - For example, if the rehabilitation method had a minimum life of 10 years and a segment was selected with that rehabilitation technique in budget year 2010, then the next time that segment could be selected would be 2021 (the year after 2010 + 10 = 2020). This value is shown as the Next Rehab Year. If the Next Rehab Year is less than or equal to the current budget year, the Forced Skip field will be set to True.

PCI Method

The Model Run process for the PCI based budget is very similar to a monetary budget-based run.

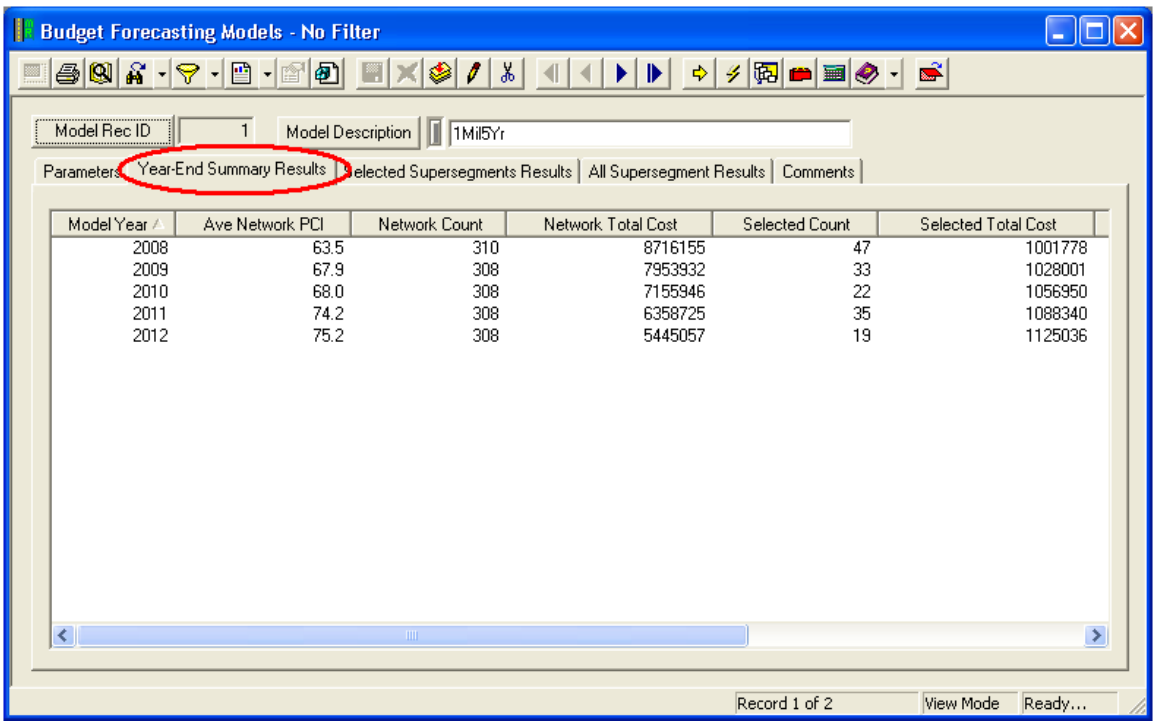
1. First, the system goes through all segments and determines the following: The correct maintenance activity for the segment, whether or not it is in a key zone, its rehab sequence number, and its supersegment priority.
2. Going in Rehab Sequence order (ascending) and then by order of Supersegment Priority (descending), the program first makes a pass through all supersegments that are in the Key Zone.
3. After all Key Zone segments have been processed, the remaining segments with PCI's less than or equal to the Breakpoint PCI are processed in the same order.
4. After each segment is selected for rehabilitation, the model calculates a new Average PCI for the system and compares it to the desired PCI. If the new Average PCI is lower than the desired value, the model keeps selecting segments until the new Average PCI is greater than or equal to the desired PCI.
5. The construction cost of each selected segment is totaled. These totals appear in the *Year-End Summary Results* for the model run.
6. Finally, the system handles linked supersegments as one supersegment. Therefore, as soon as the model run reaches one supersegment that has other linked supersegments, all of the linked supersegments will be selected together and the total PCI for the system is calculated and compared.

Model Run Results

Modeling results are stored in three separate modules: *Model Runs, Segment Results,* and *Year-End Summary Results*. In each of these locations, the completed model run results are displayed in easily accessible tables and grids. They show you the budget amount spent for street segment rehabilitation. Additionally, by showing rehab selections, priorities, and key zones, you are able to see how your budget is allocated.

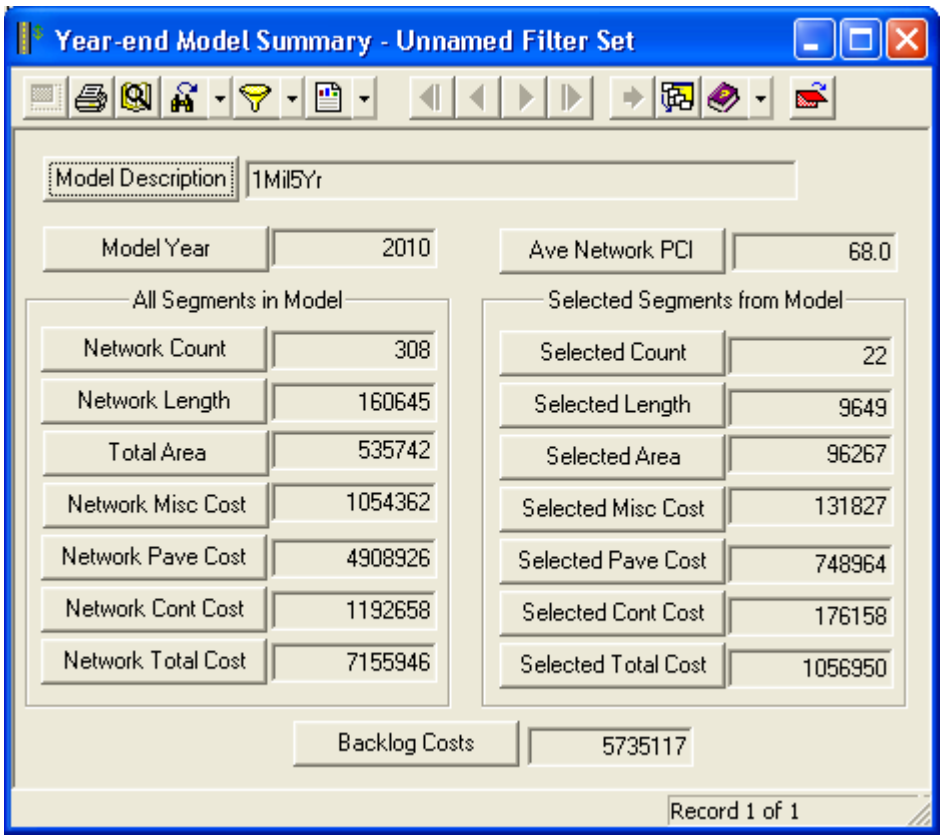
Year-End Summary Results

1. The Year-End Summary Results are displayed on the second tab of the *Model Run* module.
   - Here, you can see each model year listed (2008-2012), the average network PCI achieved, the network count, network total cost, selected count, and selected total cost.
   - This grid provides you with a general overview of the completed model run results.



2. For more detailed information on these overview results, you can access the *Year-End Summary Results* module.
   - Open **Transportation>>Pavement Manager>>Modeling>>Model Result Details>>Year-End Summary Results** from the Lucity main menu.
   - Click *GO* to bypass the filter and the following window will appear:

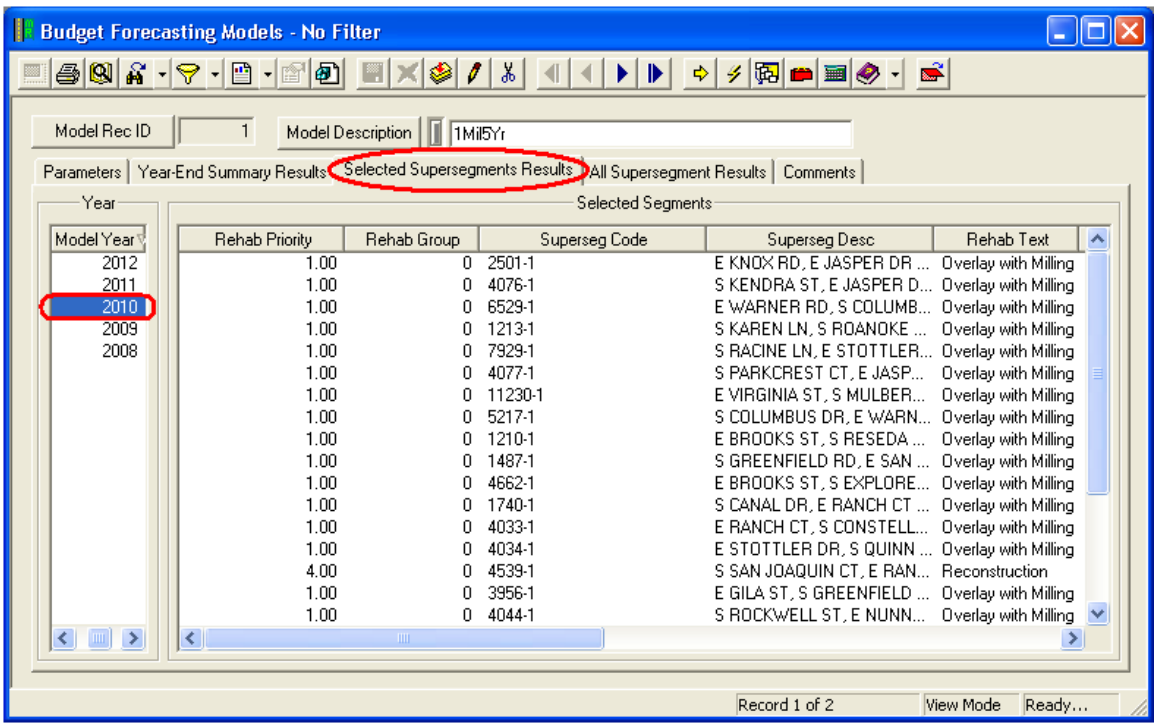
Notes:_____



- This is a read-only module that stores completed results for each year in the model run. You can use this module to set filters and print reports.
- As you can see above, this sample record contains the completed results for model year 2010. These results come from the 1Mil5Yr Model we just finished running.

Selected Supersegment Results

1. The Selected Supersegment results are displayed on the third tab of the *Model Runs* module.
   - On the left-hand side of the screen you can see each year in the model run (2008-2012). Highlight the year for the modeling results you wish to display. In our example below, we've highlighted 2010.
   - The remainder of the screen displays the model run results for the year you highlighted. It contains each supersegment selected for rehabilitation along with the rehab priority, rehab group number, supersegment code and description, rehab technique, surface type, classification, PCI values, costs, and dimensions.



All Supersegment Results

2. Results for all supersegments in the segment network are displayed on the fourth tab of the *Model Runs* module.
   - This tab displays modeling results for all of the supersegments in your system, whether or not they were selected for rehabilitation.
   - The data displayed for each supersegment includes the model year, supersegment code and description, whether it was selected for rehabilitation and whether that selection was forced, the rehab priority, whether it is in a key zone, the type of rehab needed, PCI values, costs, dimensions, and surface type.

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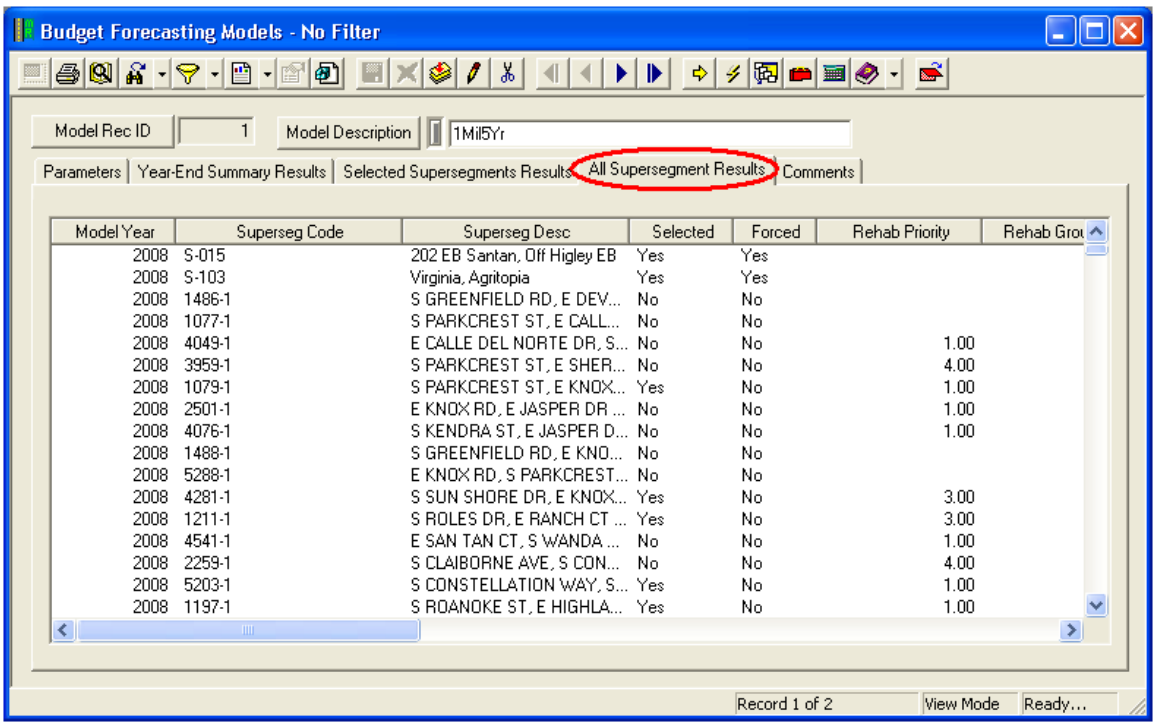

3. For more detailed information, you can access the *Segment Results* module.
   - Double click on any listing in the Selected Supersegment Results tab or All Supersegment Results tab, or
   - Open **Transportation>>Pavement Manager>>Modeling>>Model Result Details>>Segment Results** from the Lucity main menu.

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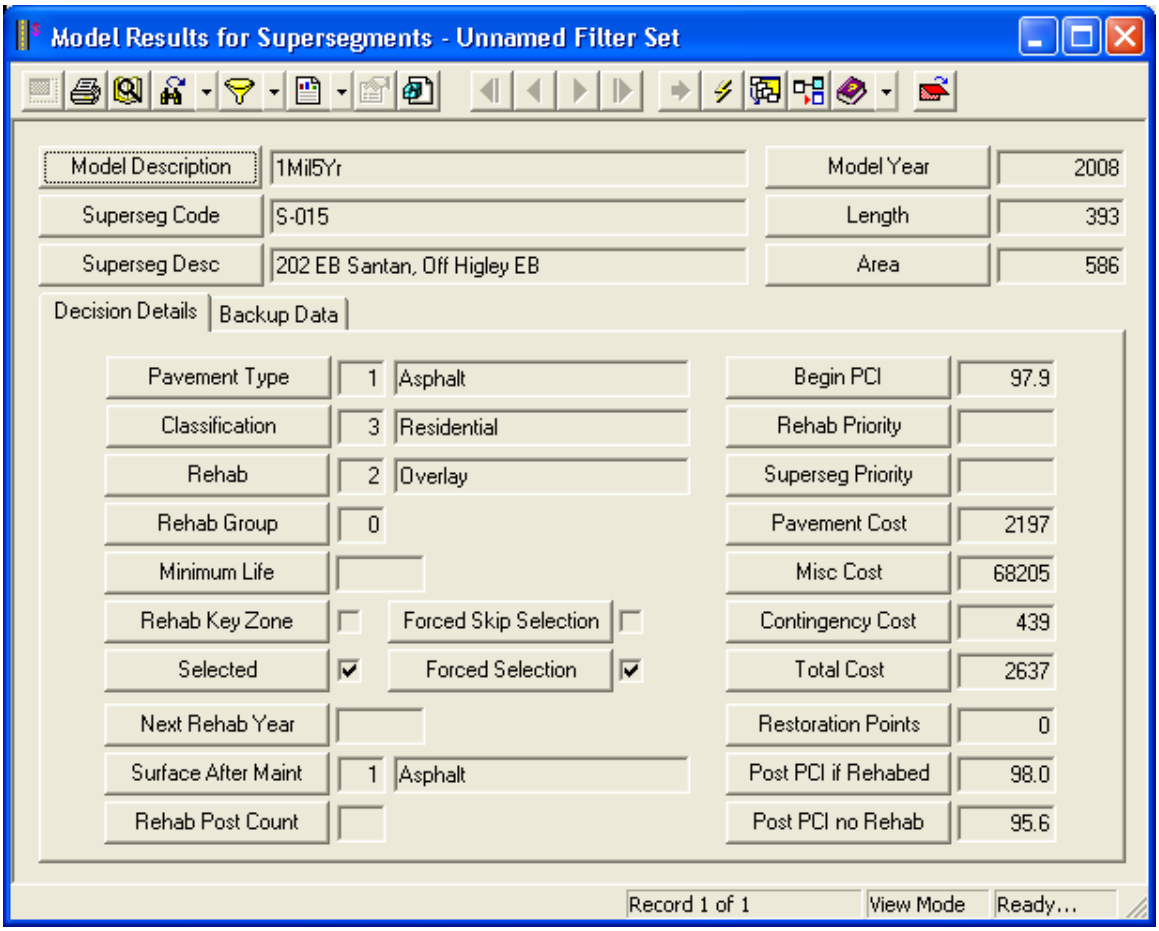
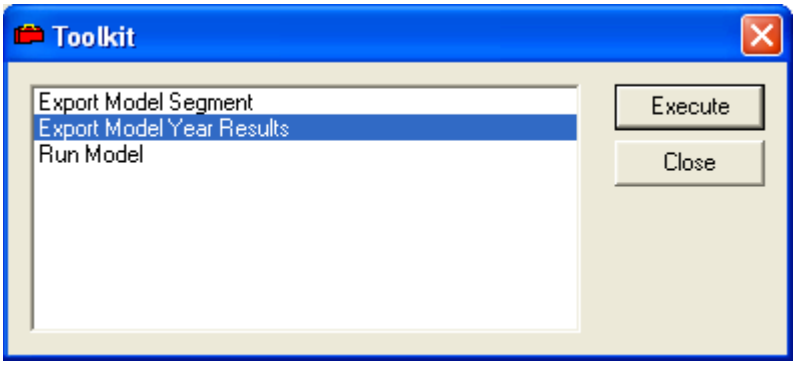


- This is a read-only module that stores completed results for each supersegment in the model run. You can use this module to set filters and print reports.
- The record's header contains identification information for the supersegment, model run, and model year.
- The Decision Details tab includes data on pavement type and classification, rehabilitation needs, PCI, priority, minimum life, restoration points, and costs. Additionally, this tab displays whether or not the segment was selected, and if so, the effect of the rehabilitation on PCI and the pavement surface.
- The Backup Data tab contains data on curbs, sidewalks, and driveway units that cross this supersegment. This includes length, replacement estimates, and ratings.

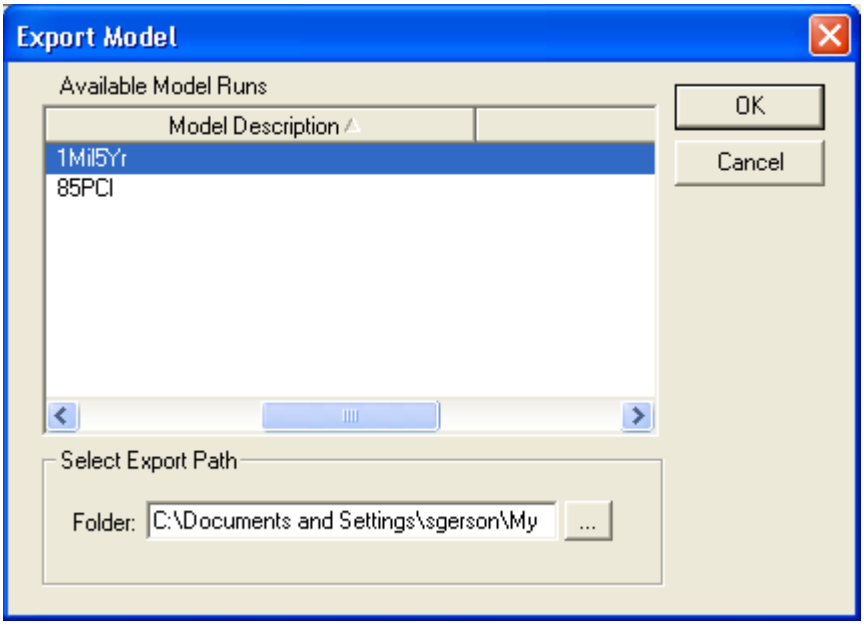
Export Model Run Results

You can use the Toolkit to export modeling results into an ASCII file. This ASCII file can then be used to create an Excel document that displays your model run results in an easy-to-use and transportable format.

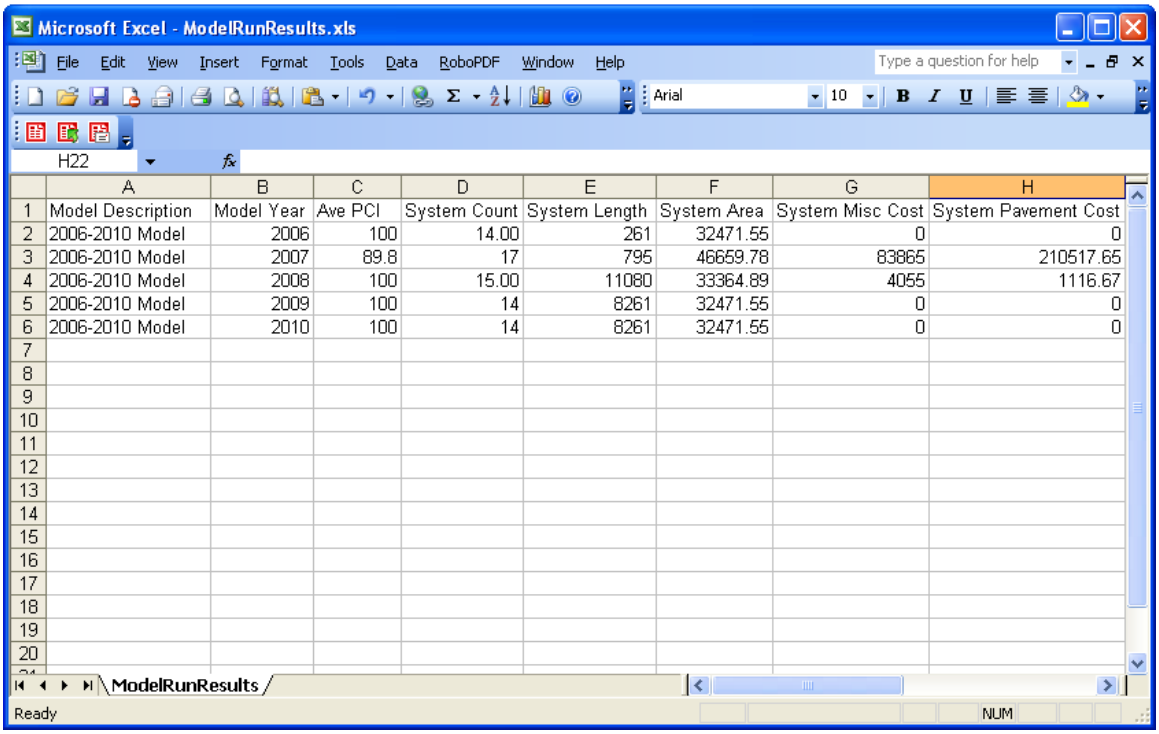
1. Create a file into which you can import the data. This could be a blank spreadsheet, Word document, etc. In our example, we've created a blank spreadsheet by simply opening up Microsoft Excel and then saving a blank sheet as "Exported Model Results.xls".
2. Click on the Toolkit icon  at the top of the module toolbar. Then, highlight Export Model Year Results and click *Execute*.



3. In the Export Model dialog, you'll need to select the model run whose results you wish to export and the file destination.
   - Highlight a model run in the Available Model Runs grid. In our example below, we've highlighted the 1Mil5Yr Model that we just created.
   - Using the  button, select an export path. Here, we've selected the spreadsheet we created in Excel.
   - Click *OK* when you are finished making your selections.



   - Below you can see a sample spreadsheet containing the exported model run results.
   - Keep in mind that you will probably need to rearrange the data in the spreadsheet after it has been exported by the program. This will help make it more readable and easier to use. Once you have finished arranging your spreadsheet, you can easily print or email the data.



	A	B	C	D	E	F	G	H
1	Model Description	Model Year	Ave PCI	System Count	System Length	System Area	System Misc Cost	System Pavement Cost
2	2006-2010 Model	2006	100	14.00	261	32471.55	0	0
3	2006-2010 Model	2007	89.8	17	795	46659.78	83865	210517.65
4	2006-2010 Model	2008	100	15.00	11080	33364.89	4055	1116.67
5	2006-2010 Model	2009	100	14	8261	32471.55	0	0
6	2006-2010 Model	2010	100	14	8261	32471.55	0	0

Model Results in the Supersegments Module

Now that you've completed the model runs, you can go back to the *Supersegments* record and see how the modules are integrated.

- The model run results for each supersegment appear on the Model Results tab.
- Below you can see our sample record, supersegment S-015. This contains the subsegment we created earlier 7934-2.
- The grid lists all model run details including the model year, whether or not this supersegment was selected for rehabilitation, whether or not it was in a key zone, the rehab technique used, the beginning PCI, total cost, and PCI resulting from the rehabilitation.

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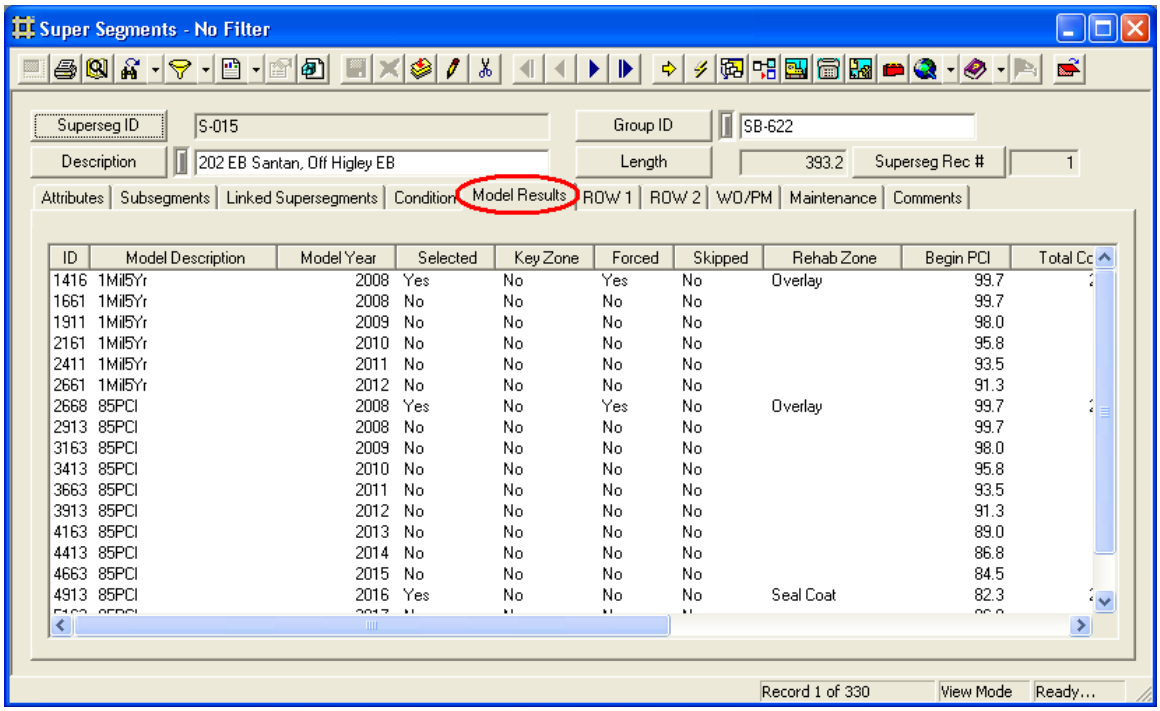
Super Segments - No Filter
Superseg ID
S-015
Group ID
SB-622
Description
202 EB Santan, Off Higley EB
Length
393.2
Superseg Rec #
1
Attributes
Subsegments
Linked Supersegments
Condition
Model Results
ROW 1
ROW 2
WO/PM
Maintenance
Comments
ID Model Description Model Year Selected Key Zone Forced Skipped Rehab Zone Begin PCI Total Cc
1416 1Mil5Yr 2008 Yes No Yes No Overlay 99.7
1661 1Mil5Yr 2008 No No No No 99.7
1911 1Mil5Yr 2009 No No No No 98.0
2161 1Mil5Yr 2010 No No No No 95.8
2411 1Mil5Yr 2011 No No No No 93.5
2661 1Mil5Yr 2012 No No No No 91.3
2668 85PCI 2008 Yes No Yes No Overlay 99.7
2913 85PCI 2008 No No No No 99.7
3163 85PCI 2009 No No No No 98.0
3413 85PCI 2010 No No No No 95.8
3663 85PCI 2011 No No No No 93.5
3913 85PCI 2012 No No No No 91.3
4163 85PCI 2013 No No No No 89.0
4413 85PCI 2014 No No No No 86.8
4663 85PCI 2015 No No No No 84.5
4913 85PCI 2016 Yes No No No Seal Coat 82.3
Record 1 of 330
View Mode
Ready...

Notes:_____