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Federal Highway Administration

TRAFFIC NOISE MODEL 3.0

GETTING STARTED WALKTHROUGH

FHWA-HEP-20-010
FEDERAL HIGHWAY ADMINISTRATION
OFFICE OF NATURAL ENVIRONMENT
Washington, D.C.

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13. ABSTRACT (Maximum 200 words) The Federal Highway Administration (FHWA) with the assistance of the Volpe Center Acoustics Facility finalized the Traffic Noise Model (TNM®) version 3.0. This step-by-step guide introduces users to some of the basic concepts in highway-related noise modeling by using TNM 3.0. It provides detailed steps to create a basic project with two roadways, two receivers, a building row and one perturbable barrier. This guide supplements the information found in the Help Menu inside TNM 3.0.			
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SI* (MODERN METRIC) CONVERSION FACTORS				
APPROXIMATE CONVERSIONS TO SI UNITS				
Symbol	When You Know	Multiply By	To Find	Symbol
LENGTH				
in	inches	25.4	millimeters	mm
ft	feet	0.305	meters	m
yd	yards	0.914	meters	m
mi	miles	1.61	kilometers	km
AREA				
in²	square inches	645.2	square millimeters	mm ²
ft²	square feet	0.093	square meters	m ²
yd²	square yard	0.836	square meters	m ²
ac	acres	0.405	hectares	ha
mi²	square miles	2.59	square kilometers	km ²
VOLUME				
fl oz	fluid ounces	29.57	milliliters	mL
gal	gallons	3.785	liters	L
ft³	cubic feet	0.028	cubic meters	m ³
yd³	cubic yards	0.765	cubic meters	m ³
NOTE: volumes greater than 1000 L shall be shown in m ³				
MASS				
oz	ounces	28.35	grams	g
lb	pounds	0.454	kilograms	kg
T	short tons (2000 lb)	0.907	megagrams (or "metric ton")	Mg (or "t")
oz	ounces	28.35	grams	g
TEMPERATURE (exact degrees)				
°F	Fahrenheit	5 (F-32)/9 or (F-32)/1.8	Celsius	°C
ILLUMINATION				
fc	foot-candles	10.76	lux	lx
fl	foot-Lamberts	3.426	candela/m ²	cd/m ²
FORCE and PRESSURE or STRESS				
lbf	poundforce	4.45	newtons	N
lbf/in²	poundforce per square inch	6.89	kilopascals	kPa

SI* (MODERN METRIC) CONVERSION FACTORS				
APPROXIMATE CONVERSIONS FROM SI UNITS				
Symbol	When You Know	Multiply By	To Find	Symbol
LENGTH				
mm	millimeters	0.039	inches	in
m	meters	3.28	feet	ft
m	meters	1.09	yards	yd
km	kilometers	0.621	miles	mi
AREA				
mm²	square millimeters	0.0016	square inches	in ²
m²	square meters	10.764	square feet	ft ²
m²	square meters	1.195	square yards	yd ²
ha	hectares	2.47	acres	ac
km²	square kilometers	0.386	square miles	mi ²
VOLUME				
mL	milliliters	0.034	fluid ounces	fl oz
L	liters	0.264	gallons	gal
m³	cubic meters	35.314	cubic feet	ft ³
m³	cubic meters	1.307	cubic yards	yd ³
mL	milliliters	0.034	fluid ounces	fl oz
MASS				
g	grams	0.035	ounces	oz
kg	kilograms	2.202	pounds	lb
Mg (or "t")	megagrams (or "metric ton")	1.103	short tons (2000 lb)	T
g	grams	0.035	ounces	oz
TEMPERATURE (exact degrees)				
°C	Celsius	1.8C+32	Fahrenheit	°F
ILLUMINATION				
lx	lux	0.0929	foot-candles	fc
cd/m²	candela/m ²	0.2919	foot-Lamberts	fl
FORCE and PRESSURE or STRESS				
N	newtons	0.225	poundforce	lbf
kPa	Kilopascals	0.145	poundforce per square inch	lbf/in ²

*SI is the symbol for the International System of Units. Appropriate rounding should be made to comply with Section 4 of ASTM E380. (Revised March 2003)

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PURPOSE

This guide introduces some of the basic concepts in highway-related noise modeling by using TNM 3.0. It includes detailed steps to create a basic project with two roadways, two receivers, a building row and one perturbable barrier.

This guide will walk you through the steps to:

- Set project defaults
- Create a new project
- Understand the main areas of the interface
- Add TNM objects to the project
- Compute levels and view reports for input heights
- Use the **Barrier Analysis** tool

Note that this walkthrough is not an exhaustive review of all functionality. **To increase accessibility, this walkthrough does not utilize any tools that require an ESRI runtime license.** Additional details can be found by searching appropriate areas of the **Help Menu** inside TNM 3.0.

SETTING DEFAULT APPLICATION SETTINGS

To start, we want to set some default settings that each project will start with. After launching TNM 3.0, go to the **Settings** tab and select **Application Settings** to set default settings. This will open a new dialog where project defaults can be entered. Details on each of these interfaces can be found in the **Help Menu** by searching for the particular item. Enter appropriate information for each field. Click the **Save Settings** button to save these default settings. The figure below shows example default inputs.

The screenshot shows the 'Application Settings' dialog box with the 'Project Defaults' tab selected. The dialog contains several input fields and dropdown menus for configuring project settings. The fields are as follows:

Field Name	Value
Organization:	DOT
Contract:	Demonstration
Analysis By:	J. Smith
Units Of Measure:	English
Traffic:	LAeq1h: Volumes, Speeds
Report Metric:	LAeq
Relative Humidity (%):	50
Temperature (°F):	68
Ground Type:	Pavement

At the bottom of the dialog, there are two buttons: 'Cancel' on the left and 'Save Settings' on the right.

Figure 1 Application Settings dialog box

CREATING A NEW PROJECT

With these default settings in place, we can create a new project that will inherit these settings. Click on the left-most tab (the tab showing a globe icon of the “world”). Select **New Project** to open a new input window. The **New Project** dialog box will open. This window allows you to set some information about your new project. The first three fields, **Organization**, **Contract** and **Analysis By**, allow entry of general data about the project. The next field, **Type**, allows you to select between three options: **Cartesian**, **Geographic** and **Projected**. You should use **Cartesian** when the input coordinate data are in orthogonal coordinates without any reference to a particular projection. This will enable options in the **Project Settings** fields (**Category**, **System** and **Units**) that are appropriate for studies in either English or Metric units without projection data. You should use **Geographic** or **Projected** when your data are in spherical coordinates, e.g. latitude, longitude and elevation (for Geographic) or derived from projections that are designed to minimize map deformations near a particular location (for Projected). Details on each of these interfaces can be found in the **Help Menu** by searching for the particular item. For this example, enter the options shown in the figure below and then press the **Create** button.

The image shows a 'New Project' dialog box with the following fields and values:

- Organization: DOT
- Contract: Demonstration
- Analysis By: J. Smith
- Type: Cartesian Geographic Projected
- Category: StatePlaneNad1983Feet
- System: NAD1983StatePlaneVirginiaNorthFIPS4501Feet
- Units: Foot_US
- Units Of Measure: English (Applies to length, distance, and speed.)
- Traffic: LAeq1h: Volumes, Speeds
- Report Metric: LAeq
- Relative Humidity (%): 50
- Temperature (°F): 68
- Ground Type: Hard Soil
- LOS Distance Limit [ft]: 500
- Name: Demonstration_Project
- Description: This project demonstrates the steps involved in using TNM 3.0 for a simple study.

Figure 2 New Project dialog box

After the **Create** button is pressed, the default **Project View** will be opened. See the figure below. There are five main areas in the application when it opens in its default view: 1) **TNM Toolbar**, 2) **Edit Pane** (Edit and Search tabs), 3) **View Pane** (Plan View, 3D View, Section View and Report View tabs), 4) **Legend Pane**, and 5) **Object Details Pane**. We will show some example uses of each these next. Further details on each of these can be found in the help menu by searching for the particular item.

TNM 3.0 Getting Started

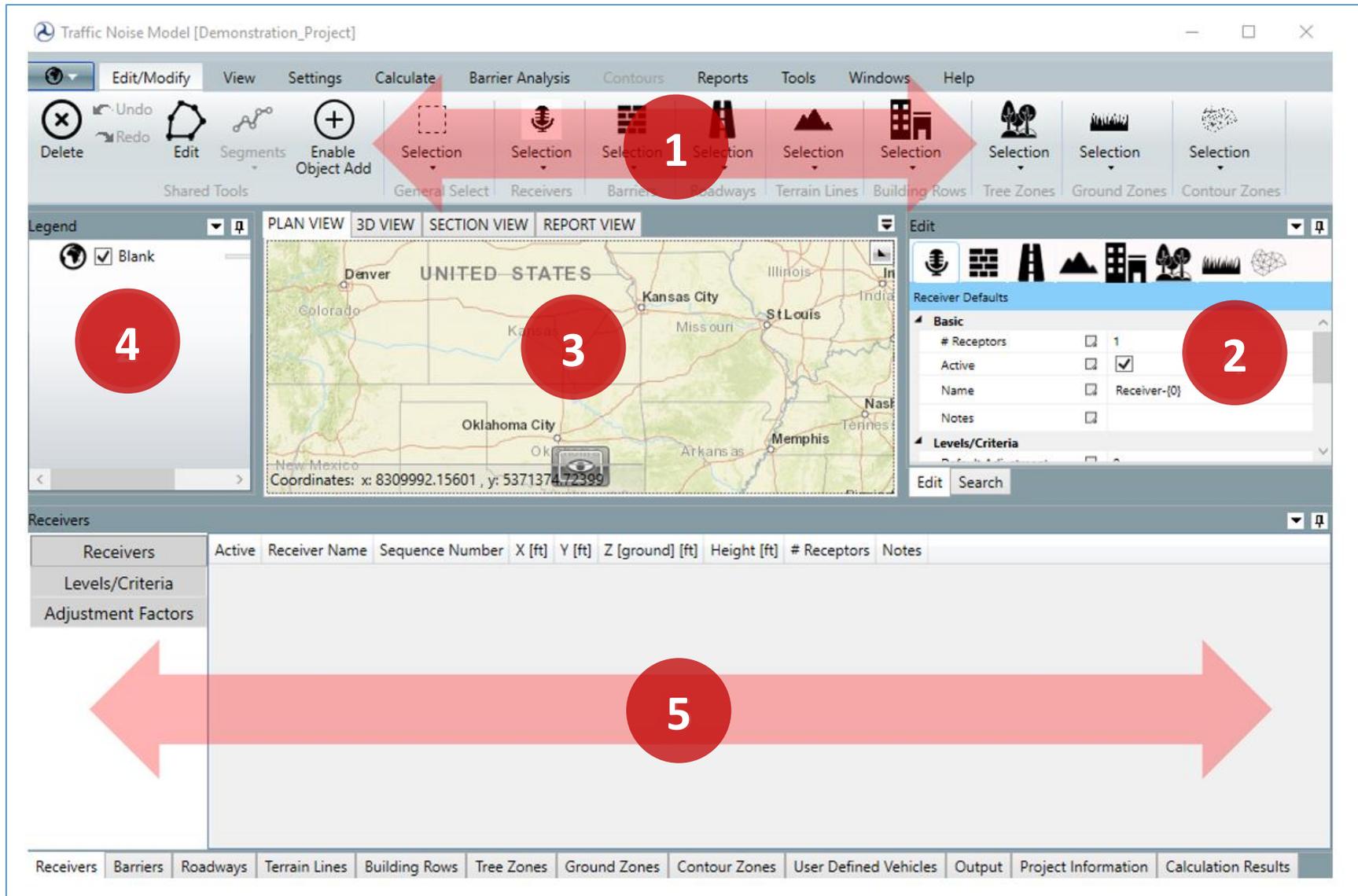


Figure 3 Default Project View

INPUTTING AND REVIEWING OBJECTS

TNM TOOLBAR – EDIT MODIFY TAB

(The **TNM Toolbar** is found at the top of the application and is used to perform various functions in TNM. You can minimize or maximize the toolbar by right clicking and selecting **Minimize the Ribbon**. **TNM Toolbar** details can be found in the **Help Menu** under **TNM Toolbar**.)

To start adding TNM objects to the project, go to **Edit/Modify** in the **TNM Toolbar** and click on the **Enable Object Add** button.

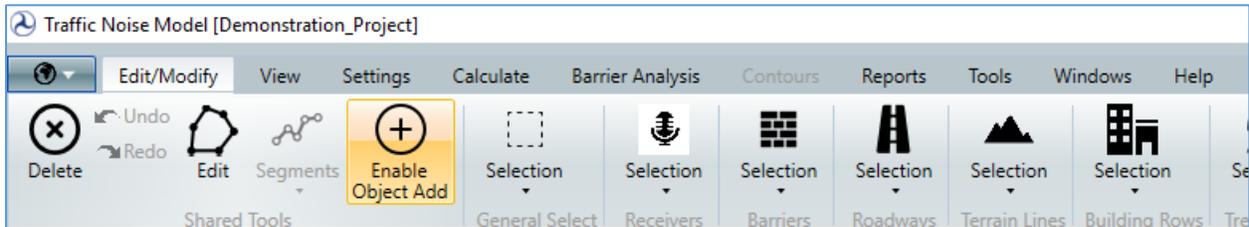


Figure 4 TNM Toolbar

EDIT PANE

(The **Edit Pane** is found on the right side of the application below the **TNM Toolbar** and contains information about object defaults that are used when creating new objects and allows you to select an object type to add to the project. **Edit Pane** details can be found in the help menu under **Edit Pane**.)

In order to tell TNM that you wish to add a roadway to the project, select the **Roadway** button at the top of the **Edit Pane**. When selected, it will be outlined in blue as shown in the figure below. For the time being, leave the default values alone. These can be changed later when you want to add additional roadways.

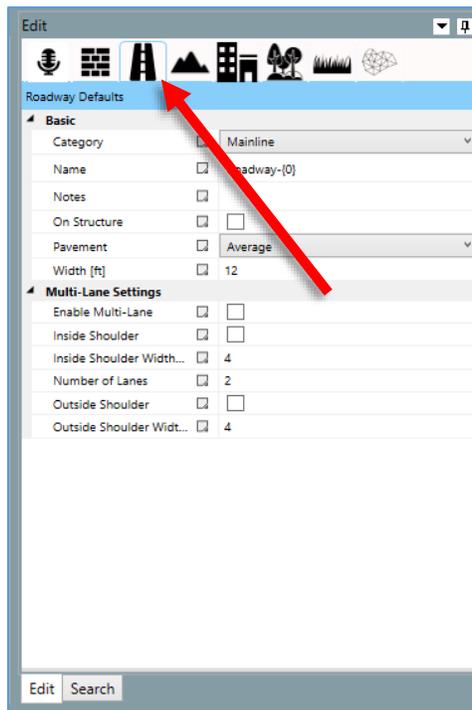


Figure 5 Edit Pane and Roadway button

VIEW PANE

(The **View Pane** displays the map and associated map data using different visualization methods. The **View Pane** is comprised of the following four sub-panes used to represent project data in various visualization forms: **Plan View**, **3D View**, **Section View**, and **Report View**. **View Pane** details can be found in the **Help Menu** under **View Pane**.)

Having already pressed **Enable Object Add** under **Edit/Modify** in the **TNM Toolbar** and having already selected the **Roadway** button in the **Edit Pane**, add a roadway to the project by clicking the left mouse button several times in the **Plan View** sub-pane of the **View pane** at several points along a displayed roadway as shown in the figures below, here moving south west to north east. Double click to stop creating new points for this roadway object.



Figure 6 Plan View in the View Pane, prior to adding objects

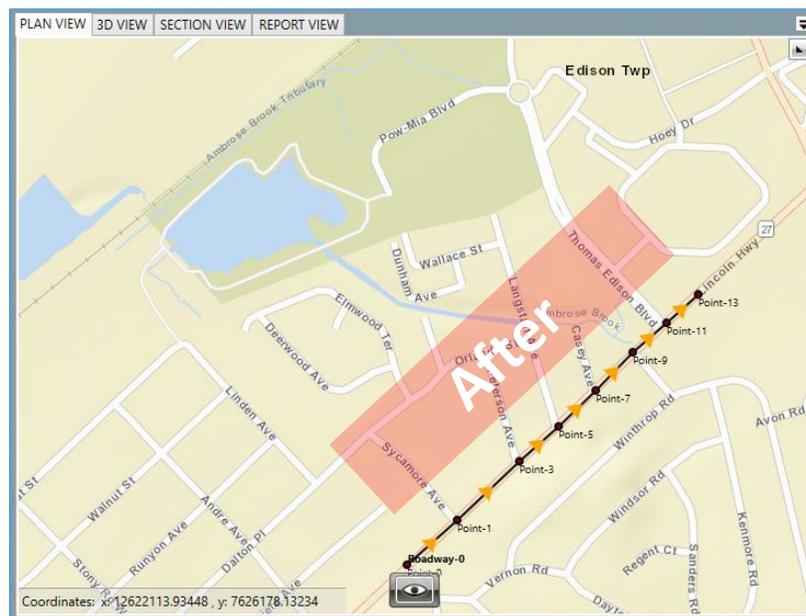


Figure 7 Plan View in the View Pane, after adding a roadway object

Note, one can move around in the **Plan View** by clicking on the left mouse button while hovering over an area of the map that does not have any TNM objects and then moving the mouse, e.g. left to right or up and down. One can zoom in or out in the **Plan View**, making it easier to see object details or easier to see large areas of the map by scrolling with the scroll wheel on the mouse. One can also change the type of map displayed by hovering the mouse over the “eye” icon in the center southern area of the **Plan View**. For example, after pan and zooming and selecting the aerial view, the map now looks like that shown in the next figure.

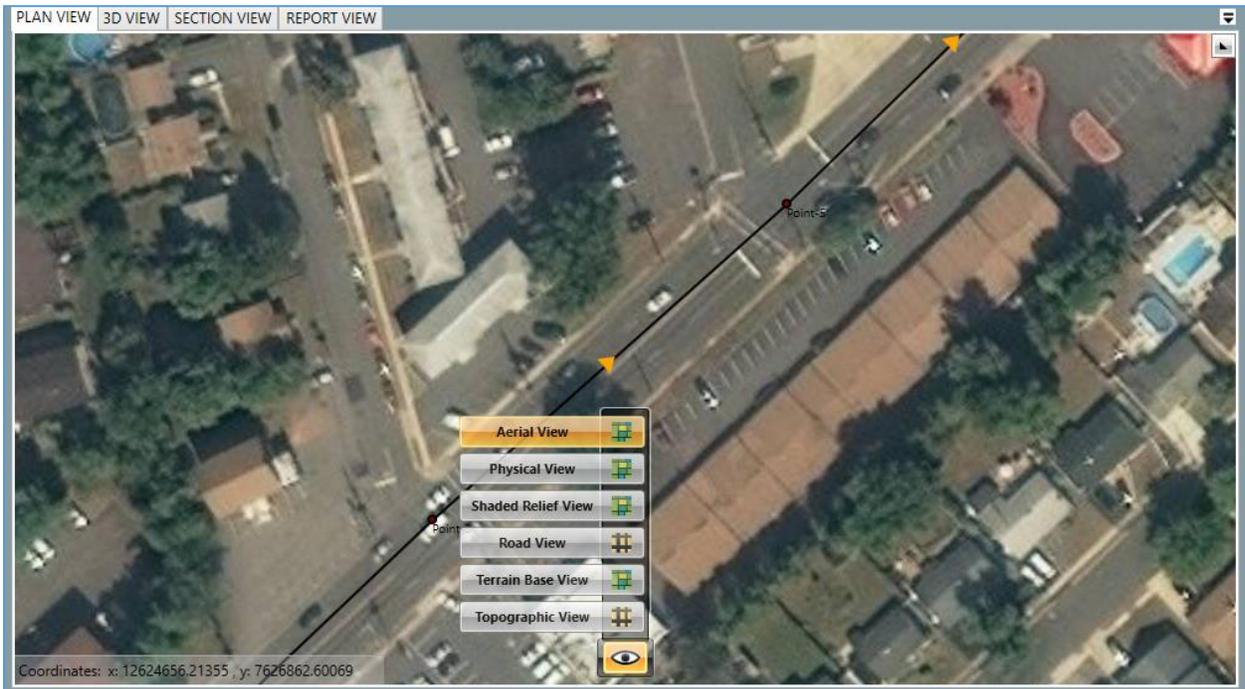


Figure 8 Plan View using the Aerial View option

This aerial view shows that the placement of the road is not quite right. While it is generally more accurate to obtain coordinates for TNM objects from state or municipal plans, this exercise provides an opportunity to see how some of TNM’s editing features work.

Go back to the **Edit/Modify** toolbar and select the **Edit** icon. (See below.) Once this is selected, TNM objects can be edited graphically by selecting points, segments or entire objects. (Edits can also be made in the **Object Details Pane** regardless of whether the **Edit** icon in the toolbar is selected. We will discuss this later.)

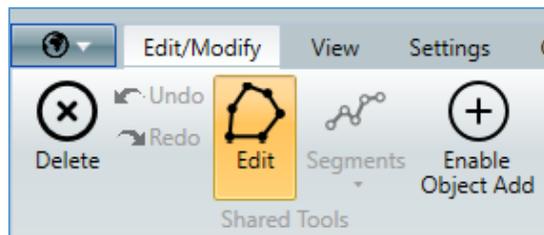


Figure 9 Edit Icon in the Edit/Modify portion of the TNM Toolbar

We want this roadway to be in the center of the two lanes traveling northeast, therefore we need to move each point. Do this by holding the left mouse button down while hovering over a roadway start or

endpoint (when hovering over the point it will change color from dark red to light blue). While holding the left mouse button down, drag the mouse so that the roadway point is moved to the desired location in the **Plan View**. It is easiest to do this by zooming in close to the point, moving it by selecting the point and dragging with the mouse, then panning the map, as discussed previously, to the next point. The next figure shows the roadway, now shifted to align with the center of one lane of traffic. (Note, that a dashed red line is used to show that an object is selected. A dashed blue line shows which segment is selected. To unselect an object, double click on an empty area of the map.)



Figure 10 Selecting the Roadway object in the Aerial View

Now we want to add the other objects in this project, that is, a second roadway, two receivers a building row and one perturbable barrier. Follow the same procedure as adding the first roadway for the second, but this time start clicking on points in the map in the northeast and continue down to the southwest to get the direction of the roadway correct. Once it is roughed in, zoom in to make fine adjustments to the roadway location. Next, in the **Edit** pane, select the **Building Row** icon (see figure below), and then follow a similar sequence of left mouse clicking in the **Plan View** to create a building row in the project.

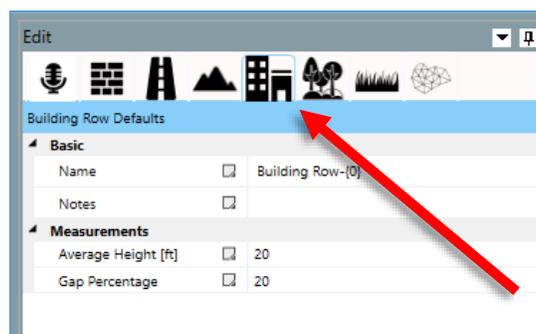


Figure 11 Edit Pane and Building Row button

At this point your Plan View should look something like the figure below.



Figure 12 Aerial view showing the 2 Roadways and the Building Row

Next add two receivers following a similar approach. Place one near the roadway and one on the opposite side of the building row. Finally add a barrier between the near roadway and the receivers. Once finished, your project should look something like the figure below.



Figure 13 Aerial view showing all the project Objects

LEGEND PANE

(The **Legend Pane** displays the layers and/or features that have been added to a project map. When you apply a feature to the map, such as a roadway, it will be listed in the **Legend Pane**. Once a feature is listed in the **Legend Pane**, you can choose whether to have that feature viewable on the map and you can increase or decrease its transparency. **Legend Pane** details can be found in the **Help Menu** under **Legend Pane**.)

At this point, it may be easier to simplify the view so that we can see the objects more clearly. We can change the map type by hovering over the “eye” icon and selecting a different map; however, the cleanest look can be obtained by going to the Legend pane and unchecking the “world” icon. This will hide the map entirely so that the project now looks like the figure below.

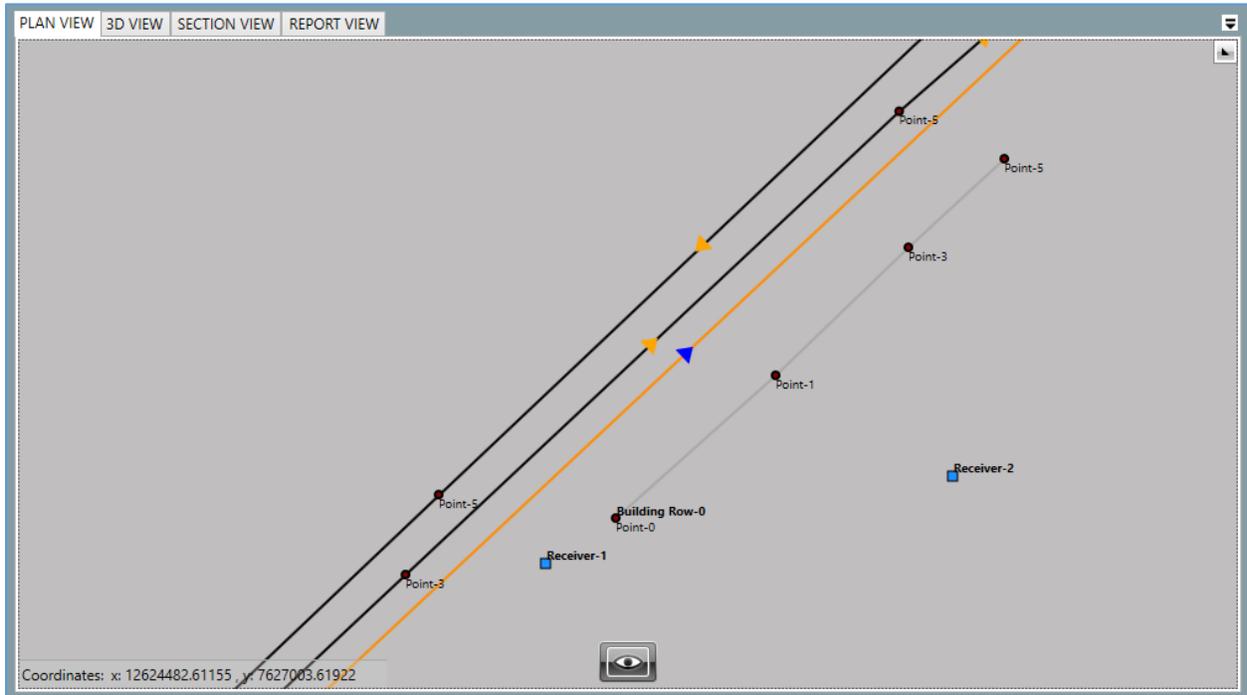


Figure 14 Plan view and project Objects with no background

We have the x- and y-coordinates for the objects that we want in our project, but we do not have z-coordinates or other parameters that important to the run. We can add these by going to the **Objects Detail** pane.

OBJECTS DETAIL PANE

(The **Object Details** Pane list the details for each feature that has been added to the project map.)

To adjust the z-coordinates of points of objects, we go to the **Objects Detail** pane and select the tab on the bottom that relates to the object we want to edit, for example if we want to edit the z-coordinate of one of the roadway objects we would select the **Roadways** tab. For all objects except the receiver objects, we would then select the **Points** tab on the left-hand side. (The other tabs present on the left side will depend on what type of object you have selected in the lower tabs.) For the receiver objects, the z-coordinates are accessible in the **Receivers** tab. If the object has not been selected do so now by selecting it from the dropdown menu. (See figure below.)

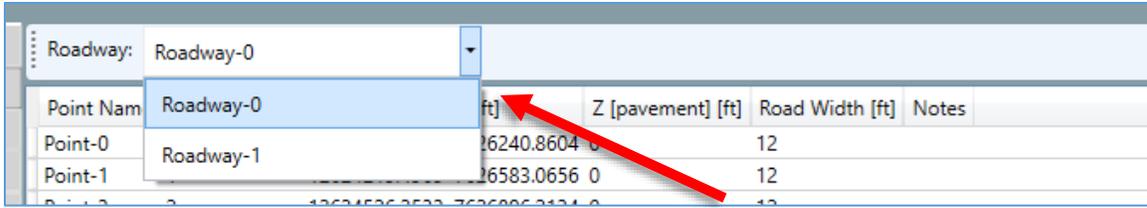


Figure 15 Selecting a Roadway in the Roadway tab of the Objects Detail Pane

Once the specific object has been selected, the grid will be populated with data related to the points for this object. An example is shown for a roadway in the figure below. For the time being, we will assume that the ground around the project all has the same elevation, so we can leave the z-coordinates for all objects at the same relative value, e.g. 0 ft.

Roadways							
Roadways	Roadway: Roadway-0						
Points	Point Name	Point Number	X [ft]	Y [ft]	Z [pavement] [ft]	Road Width [ft]	Notes
Segments	Point-0	0	12623887.1459	7626240.8604	0	12	
Traffic	Point-1	1	12624219.4969	7626583.0656	0	12	
Flow Control	Point-3	2	12624526.2533	7626896.2134	0	12	
	Point-5	3	12624812.9956	7627189.1534	0	12	
	Point-7	4	12624913.2876	7627284.4024	0	12	
	Point-9	5	12625178.3103	7627561.8492	0	12	
	Point-11	6	12625452.9665	7627840.8436	0	12	
	Point-13	7	12625511.2323	7627898.8749	0	12	

Figure 16 Points tab for a Roadway in the Object Details Pane

To add traffic to each roadway, go to the **Roadways** tab at the bottom. On the left side of the pane there will now be five tabs pertinent to roadways. To add traffic to the roadway, select the **Traffic** tab on the left. You will then see a table that has 0 for all traffic volumes and speeds. Each cell can be edited directly. It is often easiest to enter the traffic volumes and speeds for the first row of data and the use the **Copy Down** function at the top of the **Object Details** pane to copy these data. The figure below shows some sample traffic data. Add traffic to both roadways.

Roadways									
Roadways	Roadway: Roadway-0							Grid Settings	<input checked="" type="checkbox"/> Copy Down
Points	Start Point	Start Point Number	Auto Volume	Auto Speed [mph]	Medium Truck Volume	Medium Speed [mph]	Heavy Truck Volume	Heavy Speed [m	
Segments	Point-0	0	1000	55	10	55	0	0	
Traffic	Point-1	1	1000	55	10	55	0	0	
Flow Control	Point-3	2	1000	55	10	55	0	0	
	Point-5	3	1000	55	10	55	0	0	
	Point-7	4	1000	55	10	55	0	0	
	Point-9	5	1000	55	10	55	0	0	
	Point-11	6	1000	55	10	55	0	0	

Figure 17 The Traffic tab for a Roadway in the Object Details Pane

Next, examine the receivers using the **Objects Detail** pane by selecting the **Receivers** tab at the bottom of the pane. Let's assume that the second receiver is on the second floor. We will want to increase the height of the receiver. This can be done in the **Receivers** tab on the left-hand side, i.e. select the **Receivers** tab at the bottom of the **Objects Detail** pane and then select the **Receivers** tab at the left of the **Objects Detail** pane. Note that there are two ways the height of the receiver can be changed. The z-coordinate can be changed (**Z[ground]**) and the height of the receiver above the ground (**Height**) can be changed. If you change **Z[ground]** then the geometry of the model will be changed, effectively adding a slope in the terrain between the receiver and the next object in the propagation path. This is not what we want to do here, rather we want to tell TNM that we are interested in the level a certain height above the ground, thus we need to edit the **Height**. The figure below shows the two receivers, each having a different height above the ground.

Receivers	Active	Receiver Name	Sequence Number	X [ft]	Y [ft]	Z [ground] [ft]	Height [ft]	# Receptors	Notes
Levels/Criteria	<input checked="" type="checkbox"/>	Receiver-1	1	12624610.9235	7626906.698	0	5	1	
Adjustment Factors	<input checked="" type="checkbox"/>	Receiver-2	2	12624855.2724	7626970.4544	0	15	1	

Figure 18 The Receiver tab in the Object Details Pane

Next, we want to set the height of the **Building Row**. Select the **Building Rows** tab at the bottom of the **Object Details** pane and then select the **Building Rows** tab on the left. Make sure that the **Building Row** is selected in the dropdown menu. Just like the receivers, the z-coordinate (found in the **Points** tab) affects the terrain between this object and the nearest objects along the propagation path. We want to affect the actual height, so we adjust the **Average Height** in the **Building Rows** tab on the left. Let's set the **Average Height** to 30 feet. Note, we can also increase the spacing between buildings in the **Building Row** by adjusting the **Gap Percentage**. We will leave the gap percentage at 20%. (Gaps less than 20% should use **Barriers** instead of **Building Rows**.) The settings for this object should look like the figure below.

Building Rows	Name	Average Height [ft]	Gap Percentage	Notes
Points	Building Row-0	30	20	
Segments				

Figure 19 The Building Rows tab in the Object Details Pane

Now let's finalize the barrier. Select the **Barriers** tab at the bottom of the **Object Details** pane. The **Barriers** tab on the left allows you to select whether the barrier is a **Wall** or a **Berm**. If it is a berm, then more of the parameters in this grid are applicable. (If you switch back and forth between berm and wall, TNM will remember the settings that you entered while the object was set as a berm even though they are not displayed when set as a wall.) For this walkthrough, we will work with a **Wall** type barrier. In this case, we can set the **Wall Area Unit Cost** and **Wall (Additional) Lineal Unit Cost**. Set these to 100 \$/ft² and 10 \$/ft respectively. The grid should look similar to the figure below.

Barriers	Name	Barrier Type	Notes	Min Height [ft]	Max Height [ft]	Wall Area Unit Cost [\$/ft²]	Wall (Additional) Lineal Unit Cost [\$/ft]	Berm Top Width [ft]
Barrier-0	Barrier-0	Wall		0	300	100	10	-

Figure 20 The Barriers tab in the Object Details Pane

Next, we want to tell TNM to start compute the effect of the barrier for more than one height. We do this by going to the **Segments** tab on the left and setting the input heights in **Segment Height** to a desired height. Let’s start the computations with a large value for the **Segment Height**, e.g. 30 ft. We will then tell TNM to compute the effect of the barrier for different combinations of heights for each segment. To do this set the **Increment** to 2 ft, leave the number of **Up Increments** at 0 and set the number of **Down Increments** to 10. For this example, when TNM computes levels for the receivers, it will start with all segments of the barrier at 30 feet and store these values. It will then reduce one segment by 2 feet and re-compute the levels and store these values, it will continue perturbing the segments until all combinations have been evaluated, e.g. 30, 30, 30 ft; 28, 30, 30 ft; 26, 30, 30 ft; ... 10, 30, 30 ft; 30, 28, 30 ft; ... 30, 10, 30 ft; 28, 28, 30 ft, ... 10, 10, 10 ft. Adding perturbations greatly increases the number of computations. To keep runtimes reasonable, choose perturbations carefully. The **Segments** grid for or example is shown in the figure below.

Start Point Name	Start Point Number	Segment Height [ft]	For Noise Abatement	Increment [ft]	Up Increments	Down Increments	Wall Area Unit Cost [\$/ft²]	Wall (Additional) Lineal Unit Cost [\$/ft]
Point-0	0	30	<input checked="" type="checkbox"/>	2	0	10	100	10
Point-1	1	30	<input checked="" type="checkbox"/>	2	0	10	100	10
Point-3	2	30	<input checked="" type="checkbox"/>	2	0	10	100	10

Figure 21 The Segments tab for a Barrier in the Object Details Pane

CALCULATING AND REVIEWING RESULTS

TNM TOOLBAR - CALCULATE TAB

At this point our project is ready to be run. Go to the **Calculate** tab in the **TNM Toolbar** and select **All Receivers**. As the calculations are done, TNM will switch the bottom panel to show the Calculation Results, as shown in the next figure. Here the top bar shows the progress for the current receiver and the lower bar shows the progress for the receiver list.

Receiver Name	Calculated	Noise Reduction Difference	Noise Reduction	With Barrier Level	No Barrier Level	Meet Noise Reduction Goal	Parallel Increase
Receiver-1	True	13.5	21.5	48.2	69.6	True	0.0
Receiver-2	True	1.4	9.4	50.3	59.7	True	0.0

Figure 22 Calculation Results panel, calculations in progress

The next figure shows the completed calculations. The table below the progress bar will be updated to show the results for each receiver. Note, it will take a few seconds for this to update after the calculations are completed.

Road Segment Progress:		Calculation Completed					
Receiver Progress:		Calculation Completed					
Current Status: Successfully calculated 'DemonstrationProject' for All receivers. Calculation time: 0d 0h 0m 07.02s							
Receiver Name	Calculated	Noise Reduction Difference	Noise Reduction	With Barrier Level	No Barrier Level	Meet Noise Reduction Goal	Parallel Increase
Receiver-1	True	13.5	21.5	48.2	69.6	True	0.0
Receiver-2	True	1.4	9.4	50.3	59.7	True	0.0

Figure 23 Calculation Results panel, calculations completed

TNM TOOLBAR - REPORTS TAB AND THE VIEW PANE - REPORTS VIEW

There are a number of reports that the user can view once TNM has finished its calculations. These reports can be opened by selecting the desired report from the Reports menu (shown below).

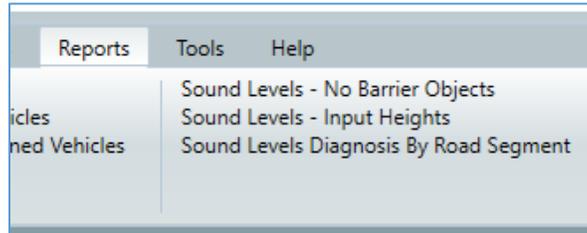


Figure 24 Reports tab in the TNM Toolbar

For example, selecting the report, Sound Levels – input Heights, will generate a report in the **View Pane** in the **Report View** as shown in the next figure. Note that these reports can be printed directly from the Report View or they can be exported to many common formats. To print or export the report use the options in the ribbon just below the **Report View** tab.

PLAN VIEW 3D VIEW SECTION VIEW REPORT VIEW												
REPORT: Results - Sound Levels - Input Heights												
TNM VERSION: 3.0.0.27811				REPORT DATE: 30 January 2019								
CALCULATED WITH: 3.0.0.27811				CALCULATION DATE: 12/11/2018 8:55:23 AM								
CASE: Demonstration_Project				ORGANIZATION: DOT								
ANALYSIS BY: J. Smith				PROJECT/CONTRACT: Demonstration								
DEFAULT GROUND TYPE: HardSoil				Average pavement type shall be used unless a state highway agency substantiates the use of a different type with approval of FHWA.								
ATMOSPHERICS: 68°F, 50%												
PAVEMENT TYPE(S) USED: Average												
Results for:		DUs	Noise Reduction			Barrier Cost						
			Min	Avg	Max	Area /Volume	Lineal	Total	Total/DUs			
			dB	dB	dB	\$	\$	\$	\$			
Receivers in the Barrier Design:		All	9.4	15.4	21.5	4,471,434	14,905	4,486,338	∞			
		All Impacted	0	---	---	4,471,434	14,905	4,486,338	---			
Meeting Noise Reduction Goal:		All	0	---	---	4,471,434	14,905	4,486,338	---			
		All Impacted	0	---	---	4,471,434	14,905	4,486,338	---			
Receiver		Modeled Traffic Noise Levels										
		All Abatement Barriers at Zero Height					With Abatement Barriers					
		Existing LAeq		Increase over Existing		Type of Impact	Noise Reduction			Calc. Minus Goal		
		Calc.	Absolute Criterion	Calc.	Relative Criterion		Calc. LAeq	Calc.	Goal			
Name	No.	DUs	dBA	dBA	dBA	dBA	dBA	dBA	dBA	dBA		
Receiver-1	0	0	---	69.6	0.0	---	---	Sound Level	48.2	21.5	8.0	13.5
Receiver-2	0	0	---	59.7	0.0	---	---	Sound Level	50.3	9.4	8.0	1.4

Figure 25 Report View in the View Pane

TNM TOOLBAR - BARRIER ANALYSIS TAB

The Barrier Analysis tool allows the user to precompute receiver levels for all combinations of barrier heights for each segment, as was discussed in the **Objects Detail Pane** section. Once TNM has computed all of the possible combinations, the user can then start a new **Barrier Analysis**. To do so, select the **Barrier Analysis** tab and click on the **Start Analysis** icon.

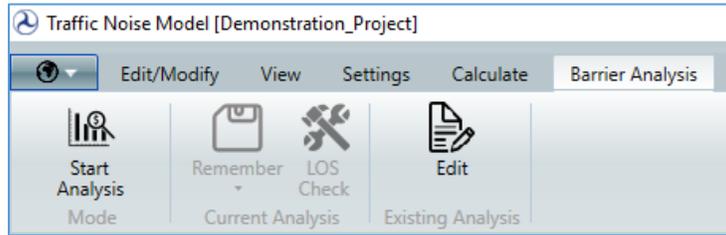


Figure 26 Barrier Analysis tab in the TNM Toolbar

Pressing the **Start Analysis** icon will change the layout of TNM to the form shown in the next figure. This layout is designed to be able to perturb selected barriers through their precomputed perturbations while at the same time seeing how these changes affect the receiver levels and the geometry. The **Plan View** is still enabled and this can facilitate selecting a particular receiver. The **3D View** can be used to see what the current design would look like. You can manipulate the orientation of the **3D View** by holding down the scroll wheel while in the **3D View** and moving the mouse around to get a good perspective of the barrier that you are interested in. The lower panels show the results for each receiver for the barrier design and cost for the design. The **Barrier Analysis Tool** panel, in the upper right, is where most of the user interaction will take place.

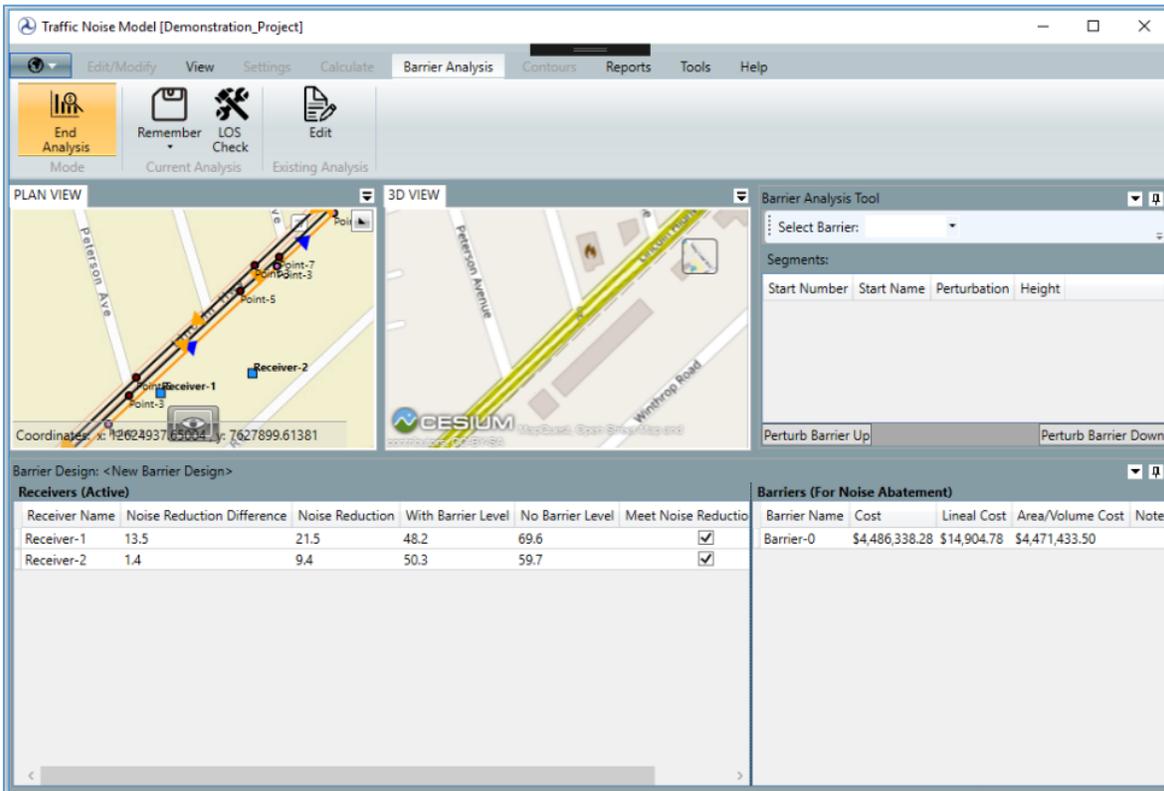


Figure 27 Barrier Analysis tab with End Analysis button and the View Pane with Plan View and 3D View windows

The user can select a barrier to perturb in the **Barrier Analysis Tool** as shown in the next figure. When the barrier is selected the segments that can be perturbed will be listed. There will be buttons for perturbing each segment up or down and a column that indicates the height for the current design. Note that the entire barrier can be perturbed up or down inside the tool by utilizing the buttons on the lower left and lower right. When a barrier segment has reached the end of its perturbed heights (either the upper limit or lower limit) it will remain at this height for any further perturbations in this direction.

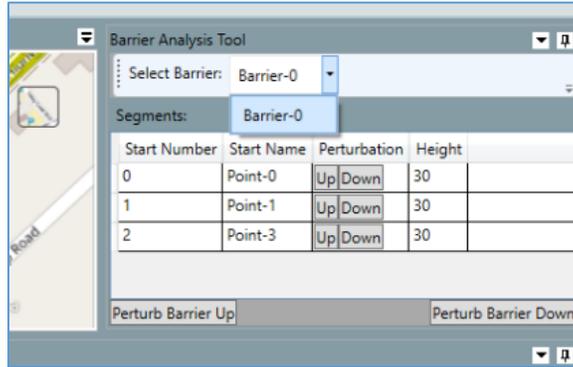


Figure 28 Edit Pane with Barrier Analysis Tool and perturbable barriers

The next figure shows the **Barrier Design Tool** as initialized with all barrier segments at input heights. Note, the levels in the lower panel for each receiver and the geometry of the design in the **3D View**.

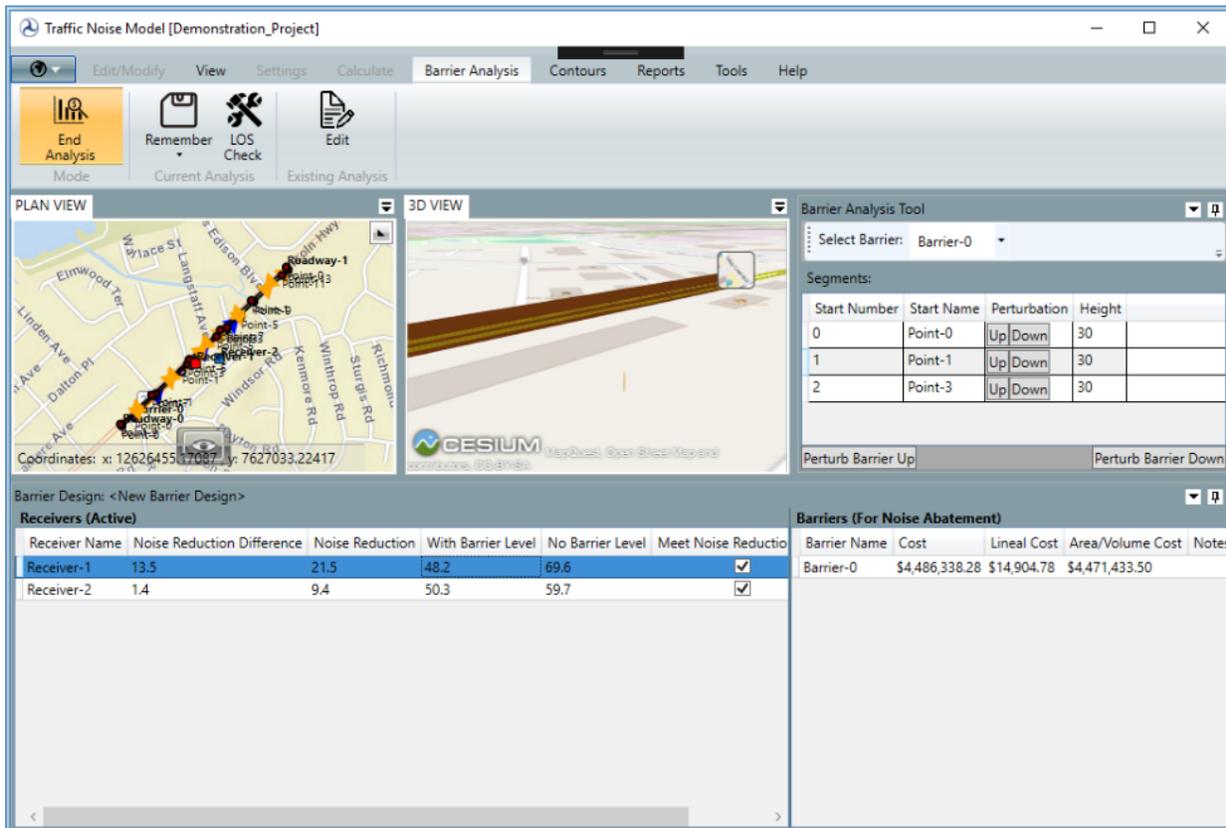


Figure 29 Barrier Analysis tab during barrier perturbation analysis

The next figure shows a barrier design for this barrier where the middle segment has been perturbed down from its input height of 30 ft. to the design height of 16 ft. Notice the difference in receiver levels and in the geometry in the **3D View**.

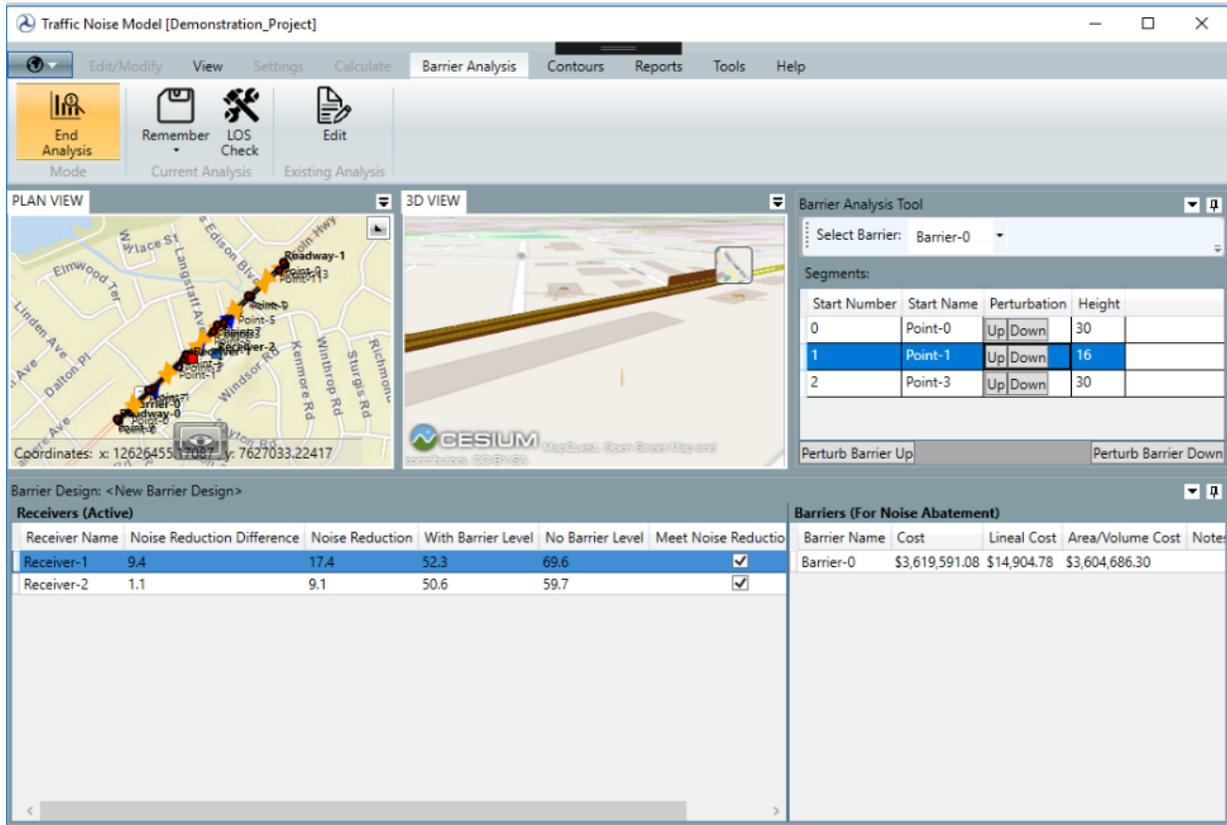


Figure 30 Barrier Analysis tab with a perturbed barrier segment

Once a barrier design of interest has been designed, it should be saved. This is done by clicking on the **Remember** icon in the **Barrier Analysis** tab.

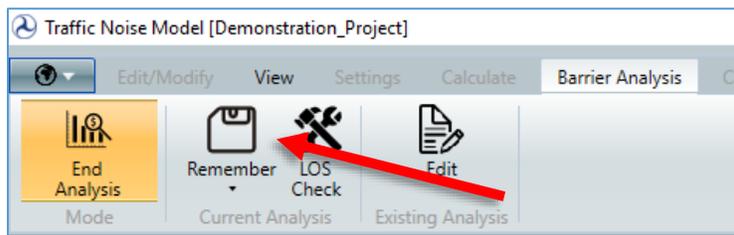


Figure 31 Remember button in the Barrier Analysis tab

This will open a dialog where a name can be entered for the new design. Press **OK** after entering the desired name.

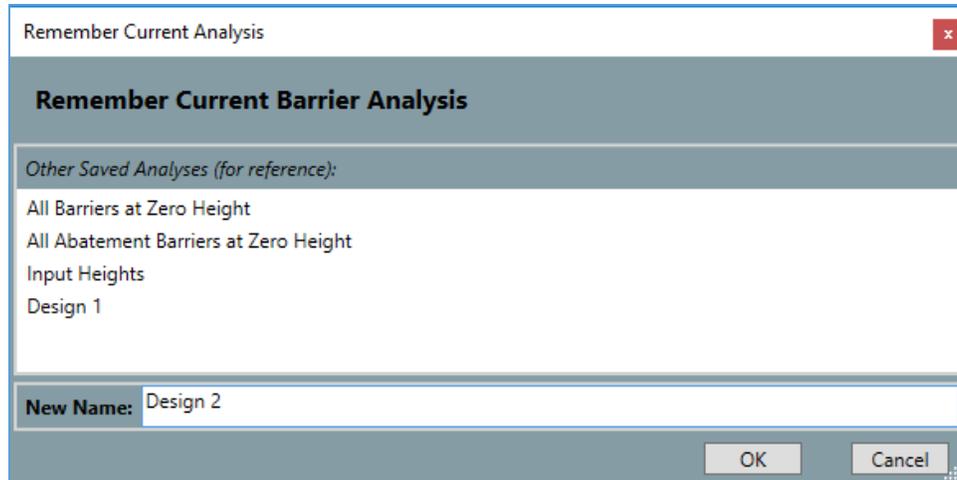


Figure 32 Remember dialog box

Pressing **End Analysis** returns TNM to the normal layout.

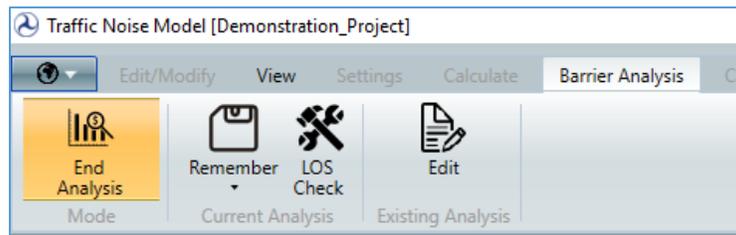


Figure 33 End Analysis button in the Barrier Analysis tab

Finally, remember to save the entire project by clicking on the **World** tab and selecting **Save Project**.

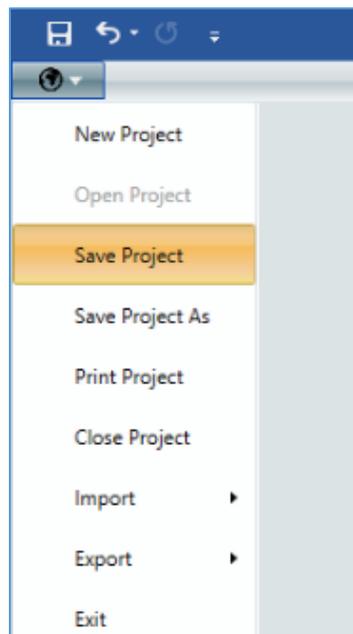


Figure 34 World tab with Save Project

SUMMARY

This concludes the walkthrough. You should now be able to

- Set project defaults
- Create a new project
- Understand the main areas of the interface
- Add the TNM objects to the project
- Compute levels and view reports for input heights
- Use the **Barrier Analysis** tool

Further details and functionality can be explored by using the **User's Guide** in the **Help Menu**.