



**RESEARCH & DEVELOPMENT**

# **Peak Spreading Tool Development**

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<p>Abstract</p> <p>NCDOT's Transportation Planning Division (TPD) seeks to utilize a tool to estimate the impact of peak spreading based on capacity constraints that is found in the latest national guidance for traffic forecasting in NCHRP 765. A previous research project (NCDOT 2017-24) synthesized information about how development density and peak travel are related and examined how peak hour traffic has changed throughout the state relative to land use, facility characteristics, and socioeconomic factors.</p> <p>This project takes the results of the previous study and implements them in a computational tool to create a customized model that provides NCDOT with the ability to more realistically forecast traffic based on conditions specific to North Carolina. This research delivers a final tool and implementation strategy that helps traffic forecasters understand how traffic spreads and enable them to provide more realistic traffic forecasts. Previous project efforts are appropriately implemented in a user-friendly tool rather than requiring the forecaster to spend excessive time referencing models, equations, and tables from a final report.</p>			
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## INTRODUCTION AND BACKGROUND

NCDOT's Transportation Planning Division (TPD) seeks to utilize a tool to estimate the impact of peak spreading based on capacity constraints that is found in the latest national guidance for traffic forecasting in NCHRP 765. A previous research project (NCDOT 2017-24) synthesized information about how development density and peak travel are related and examined how peak hour traffic has changed throughout the state relative to land use, facility characteristics, and socioeconomic factors.

This project takes the results of the previous study and implements them in a computational tool to create a customized model that provides NCDOT with the ability to more realistically forecast traffic based on conditions specific to North Carolina. This research delivers a final tool and implementation strategy that helps traffic forecasters understand how traffic spreads and enable them to provide more realistic traffic forecasts. Previous project efforts are appropriately implemented in a user-friendly tool rather than requiring the forecaster to spend excessive time referencing models, equations, and tables from a final report.

The objective of this project was to apply guidance generated from NCDOT 2017-24 to create an easy-to-use software tool with the ability to realistically forecast traffic based on conditions specific to North Carolina. The research team investigated three options for the tool platform in detail and provide an assessment of each option. The three platform options investigated were 1) a macro-based platform, 2) a standalone software platform, and 3) a web-based platform. A web-based platform was chosen to implement the tool.

This report summarizes the development of the Peak Spreading Tool. This report provides documentation for the final tool architecture, tool platform evaluation, and a user's guide for the tool. Tool steps, inputs, and outputs/reporting features, as well as the tool procedural decision-making logic were defined and documented in this report.

## TOOL OVERVIEW

The main purpose of the Peak Spreading Tool is to provide insight into whether an existing facility should be enhanced ("build" or "no build") based on forecasted traffic conditions that incorporate a reasonable estimate of peak spreading. The need for such a tool is driven by three major factors:

### **1) Increased urbanization within North Carolina**

- Many roads that are currently two lanes in the periphery of urbanized areas are approaching capacity and have a certain K-factor
- Current forecasting strategy is to use engineering judgement about future K-factors with limited ability to quantify change and qualifying the likelihood for change

### **2) Limited existing tools for determining how peak hour traffic may change over time**

- Current practice is to assume that peak hour traffic is going to grow commensurate with demand based on travel demand models that determine growth on a daily basis

### **3) Limited budgets for modifying existing facilities**

- Better identifying an appropriate solution relative to forecasted traffic conditions helps inform more efficient use of limited funding

A key output from the Peak Spreading Tool is guidance on how much peak spreading is likely based on prescribed conditions. The tool should allow forecasters, engineers, or other users the ability to explore different scenarios based on expected K-factor change or no change that are constrained to feasible and

reasonable outcomes. The output from the tool provides a guide to decision-making, but professional judgement is necessary for making the final choice between “build” and “no build” based on available data. For example, a 2-lane facility is recommended to be widened. If the K-factor stays the same, then upgrading to a 4-lane facility is an option. However, if the peak moderately spreads, a 3-lane facility may be the better option.

The Peak Spreading Tool is based on an iterative method adapted from NCHRP 765 that splits peak hour traffic to estimate peak spreading effects on forecasted daily traffic distributions. In the NCHRP 765 method, an analyst determines diurnal distribution factors from historic count data and identifies the hourly capacity for the facility for which forecasts are being developed. The analyst then determines which hours of forecast volumes surpass capacity – application of peak spreading to the traffic forecast ends if all hours of traffic are at or below capacity. For the heaviest volume hour(s) that exceed capacity by the greatest amount, the analyst takes the excess volume over capacity, divides it in half, and applies one half of the excess volume onto each shoulder hour to reduce the forecast volumes below capacity.

The NCHRP method only concerns constrained peak spreading. The Peak Spreading Tool allows an analyst to test varying scenarios to examine the effect of constrained peak spreading to determine reasonable and unreasonable outcomes. Required inputs include current volumes, an estimated growth rate, and various capacities/design scenarios. The Peak Spreading Tool uses the predefined data inputs to generate a preliminary alternatives analysis to examine what peak spreading looks like under varying volumes/growth rates/design scenarios.

Analysis from the tool provides information to explore the following questions:

- **Is peak spreading occurring now in the base year?**
- **If peak spreading were to occur in the future year, how much?**
- **What does peak spreading look like under varying volumes/growth rates/design scenarios?**
  - How many hours of traffic at capacity would you have under the scenarios?
    - 3-lane facility = (x) hours of at capacity traffic vs. 4-lane facility = (x) hours of traffic at capacity
    - Key decision – smaller facility comes with trade-off of (n) hours of traffic at capacity
    - Information generated from tool can be used to help aid more local control of a roadway project
- **Is the peak spreading in the base year, in the future year, or not occurring at all?**
  - Peak spreading is occurring because of traffic in the base –
    - Maximum capacity has been reached
    - Facility change needed
  - Peak spreading is occurring because of traffic in the future year –
    - Maximum capacity has been reached
    - Facility change needed
  - Peak spreading is not occurring –
    - Maximum capacity has not been reached
    - Facility change not needed

## EVALUATION OF PLATFORM OPTIONS

Different platforms for tool development were evaluated prior to selecting a web-based platform for the final Peak Spreading Tool. Three main platforms are used in the modern software development industry (ranging from research grade to commercial grade tools): a macro-based platform, a standalone software platform, and a web-based platform.

A macro-based platform consists of a software program such as Microsoft Excel or Access that uses written macros to automate user input, computational steps, and outputs. This platform requires less coding effort relative to other options, but offers low quality, customization and limited ability to file share. Of the three platform options, a macro-based platform requires the most user management of files and data compared to a standalone software platform or a web-based tool. Typically, macro-based platforms are good for quick tool development and rapid production. These approaches make the Peak Spreading Tool dependent on the platform (which would be Excel or Access). Any future updates may cause breaks within the tool and appropriate maintenance may be required in these circumstances.

A standalone software platform consists of a compiled executable file that runs from a local machine. This platform is commonly programmed in a modern object-oriented programming languages such as Java or C#, its graphic and user interface is customizable to meet users' needs, and it is widely used to develop commercial software tools. However, a challenge with this approach is file sharing since files are stored locally, similarly to the macro-based platform. Moreover, the nicer graphical user interface design comes at the cost of high programming effort that is required. Similar to the macro-based platform, version control needs to be followed by users of the tool to assure use of the latest version.

Web-based tools use web documents written in a standard format such as HTML and JavaScript, which are supported by a variety of web browsers (e.g. Internet Explorer, Chrome, and Firefox). Web based tools can be considered as a specific variant of client-server software, where the client software is downloaded to the client machine when visiting the relevant web page, using standard procedures such as HTTP. Client web software updates may happen each time the web page is visited. During the session, the web browser interprets and displays the pages, and acts as the universal client for any web application. This approach involves developing a web-based interface and computational platform that can be accessed by multiple users via the web, but can also be configured to be stored locally on a single machine. Unlike the macro-based or standalone software platforms, a web-based tool has the added challenge of web security which requires additional development effort.

A web-based platform was selected to implement the Peak Spreading Tool. The key advantages of a web-based solution include the option for continuous updates, bug fixes, and user support without the need for users to download the latest version, and the ability for multiple analysts to log into the same project and complete tasks in a collaborative fashion. Version control and flexibility are key benefits of a web-based platform. In addition, this platform allows for a standard output to be created. The final Peak Spreading Tool is a modular tool that can be easily revised over time and produces a standard, one-page output that can go directly into NCDOT reports. This one-page output includes a standard disclaimer with the assumptions used to generate the final analysis from the tool.

A summary of the platform evaluation considerations is provided in Table 1.



**Table 1 – Tool Development Platform Evaluation Summary**

Development Platform	Advantages	Disadvantages
<b>Macro-Based</b>	<ul style="list-style-type: none"> <li>- Rapid development</li> <li>- Does not require access to the internet</li> </ul>	<ul style="list-style-type: none"> <li>- Version control needs to be done by users.</li> <li>- Depends on the platform (e.g. Excel) and future updates of Excel may result in tool malfunction</li> <li>- The quality of the I/O will remain at the computational engine level. Sharing files and collaborating on the projects will be difficult and time consuming.</li> </ul>
<b>Stand-alone Executable</b>	<ul style="list-style-type: none"> <li>- Does not depend on a secondary platform.</li> <li>- The quality of the I/O will be similar to commercial grade tools.</li> <li>- Does not requires access to the internet</li> </ul>	<ul style="list-style-type: none"> <li>- Takes considerable amount of effort to develop the tool</li> <li>- Version control needs to be done by users.</li> <li>- Sharing files and collaborating on the projects will be difficult and time consuming.</li> </ul>
<b>Web-based</b>	<ul style="list-style-type: none"> <li>- Does not depend on a secondary platform.</li> <li>- The quality of the I/O will be similar to commercial grade tools.</li> <li>- Development Effort will not be as large as standalone option</li> <li>- File Sharing and collaboration will be easy to handle and manage</li> <li>- Version control will not be a problem</li> </ul>	<ul style="list-style-type: none"> <li>- Requires access to the internet.</li> <li>- Users need to have login credential to access files/data in this platform.</li> </ul>

## TOOL ARCHITECTURE

### TOOL INPUTS AND OUTPUTS

The Peak Spreading Tool is a web-based application that allows an analyst to evaluate the effects of peak spreading on base year and future year traffic relative to various “no build” and “build” scenarios. Upon completing a session using the tool, the analyst is provided with information to help answer the following questions:

1. Is there peak spreading in the base year?
2. Is peak spreading possible in the future year under “no build” or “build” scenarios?
3. How many hours are at capacity in the base year?
4. How many hours are at capacity in the future year under “no build”?
5. How many hours are at capacity in the future year under various “build” scenarios?

In its architecture, the tool makes use of data input fields, comment fields, and drop-down menus to guide the analyst through each tool step. For each step, the tool prompts the analyst for specific inputs to necessary to produce calculations, tables, and data visualizations. The tool utilizes default data that is applied in various steps. This data is summarized in Table 2.

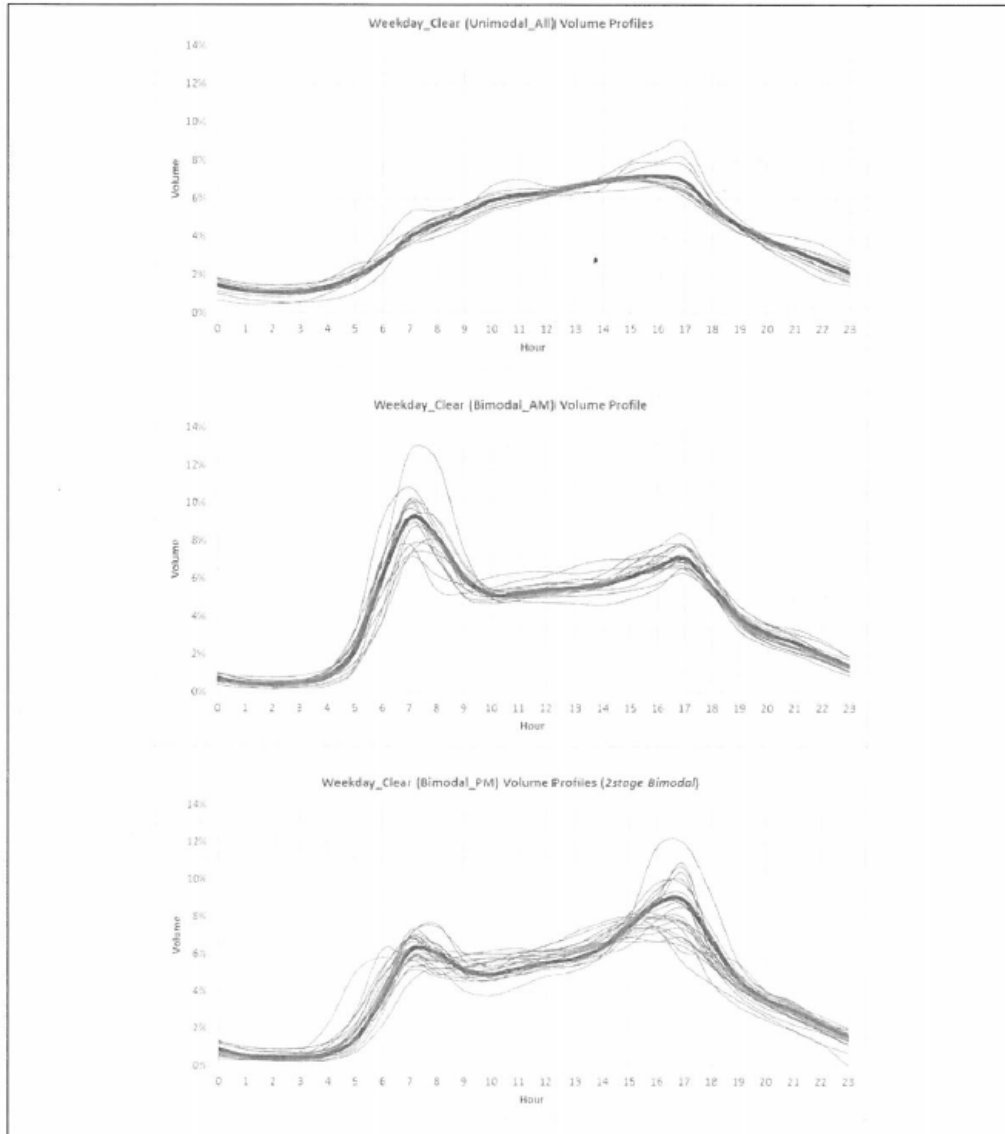
**Table 2 - Default Data Types Used in the Peak Spreading Tool**

#	Item	Description	Future use in the following tool steps
1	Default Hourly Traffic Distributions	Standard Hourly Traffic Distributions by Functional Classification	2.1 Calculate Base Year Volumes; 2.2 Pattern Fit Base Year Volumes to Standard Traffic Distribution Curve; 3.1 Expand Base Year Volumes to Future Year Volumes; 5.1 User-Specified Report Elements
2	Hourly Capacity	Hourly Capacities from HCM 6 <sup>th</sup> Edition by Facility Type, Region Type, Area Type, No. of Lanes on the Direction of Travel, and LOS E/LOS F Threshold	2.2 Pattern Fit Base Year Volumes to Standard Traffic Distribution Curve; 3.1 Compare Target Year Demand to Base Year Demand and Capacity; 3.2 Compare Future Year Volumes with Future Year Hourly Capacity; 4.2 Scenario Evaluation Results Summary; 4.3 Scenario Evaluation Results Details; 5.1 User-Specified Report Elements

One default data type used in the tool is default hourly traffic distributions. The methodology for NCDOT 2015-09 was adopted to determine the default distributions by time of day:

- **Step 1: Define AM peak, PM peak, and between peak times**
  - AM peak: volume data collected between 6 AM and 8 AM
  - PM peak: volume data collected between 4 PM and 6 PM
  - Between peak: volume data collected between 9 AM and 3 PM
- **Step 2: Estimate volume percentage of the peaks identified in Step 1**
  - AM peak: the highest percentage (A %)
  - PM peak: the highest percentage (P %)
  - Between peak: the lowest percentage (B %)
- **Step 3: Define unimodal and bimodal volume profiles**
  - If  $B \% > A \% + 0.3\%$  and  $P \% > A \%$  then unimodal
  - Otherwise, bimodal
- **Step 4: Define bimodal volume profiles separately**
  - If  $A \% > P \%$ , then bimodal-AM peak
  - If  $P \% > A \%$ , then bimodal-PM peak

Automatic traffic recorder (ATR) data available from permanent count stations across the state were used to develop the default distributions. The Kolmogorov-Smirnov test (K-S test) was used to compare individual distributions to the average distributions to identify outliers. Additionally, cluster analysis was performed to identify if any other clusters of distributions were unique from the three identified. Although individual outliers were identified through the K-S test, no unique group was found in the cluster analysis. Figure 1 provides visualizations of the defined default distributions that were generated from the input ATR data.



**Figure 1 – Default Distributions from ATR Data Inputs**

## TOOL STEPS

The tool has five steps in total. The specific steps, inputs, and outputs are provided in the following.

*Step 1 – Obtain and enter user-provided project data.*

In the first step (Table 3), the analyst gathers data about the project to be included in the analysis, including the project name, location, and description; traffic counts collected at the project location (e.g. 13, 16, or 48 hour counts); and the future year growth rate associated with the project location.

**Table 3 – Summary of Step 1 (“Global Data Entry”)**

Step	Inputs	Description	Future use in the following steps
1	<b>Global Information</b>		
	Project Name	Name of the project included in the analysis	5
	Analyst Name	Name of analyst performing the analysis	5
	Organization Name	Name of the analyst’s organization	5
	Facility Location	GPS coordinates or description for facility location	5
	Facility or Analysis Description	Brief description of facility or analysis being performed	5
	<b>Capacity Characteristics</b>		
	Facility Type	Facility type categories are: 1) freeways, 2) multilane highways, 3) superstreets, 4) two lane highways, and 5) arterials	2; 3; 4; 5
	County and Region Type	Region type categories are: 1) coastal, 2) piedmont, and 3) mountains	2; 3; 4; 5
	Area Type	Area type categories are: 1) rural, 2) suburban, and 3) urban	2; 3; 4; 5
	Number of Lanes	Number of lanes at project location on the direction of travel	2; 3; 4; 5
	<b>Analysis Time Horizon</b>		
	Analysis Base Year	Base year for the analysis	2; 3; 4; 5
	Future Year	Future year for the analysis	3; 4; 5
	Annual Percent Growth Factor	Annual percent growth factor associated with the project location	3; 4; 5
	<b>Hourly Demand Data</b>		
	1.2 Enter Hourly Demand Data	Data Collection Date	Date that the counts were collected
	Volume Counts	Traffic counts collected at project location (e.g. 13, 16, or 24 hour counts)	2; 3; 4; 5

*Step 2 – Evaluate base year demand condition.*

In the second step (Table 4), the appropriate default distribution is recommended to the analyst based on model fitting to extrapolate the input counts to a 24-hr distribution. The analyst is also provided the option to examine the other default distribution options. The extrapolated percentages are then plotted relative to the default percentages to check fitting to the default curve and determine if peak spreading is occurring in the base year. The tool advises whether peak spreading is occurring according to the selected default distribution. If peak spreading is occurring in the base year, an option is provided to adjust the input counts from Step 1.

**Table 4 – Summary of Step 2 (“Demand Evaluation”)**

	Step	Description	Future use in the following steps
<b>2</b>	<b>Sub-Step A: Default Distribution Fit</b>		
	2.1 Calculate Base Year Volumes	Appropriate distribution for extrapolation to 24-hr volume is recommended to analyst based on computational matching; option for analyst to select default distribution	3; 4; 5
	2.2 Pattern Fit Base Year Volumes to Default Distribution Curve	Graph extrapolated percentages relative to default percentages	3; 4; 5
	<b>Sub-Step B: Current Year’s Peak Spreading Assessment and Handling Missing Data</b>		
2.3 Adjust Input Counts	Option to adjust input counts if peak spreading is occurring in the base year	3; 4; 5	

*Step 3 – Evaluate future demand condition.*

In the third step (Table 5), the true demand identified in Step 2 is inflated to reflect the target year based on the growth rate provided in Step 1. If true demand exceeds capacity in the target year, two graphs are provided that model the spreading. The first graph shows the target year demand compared to the base year capacity. The current year capacity will be drawn to show how the target year’s demand exceeds the capacity with no treatment. The second graph will show the demand spreading given the current capacity of the facility. By comparing the current capacity to the target year’s demand, excess capacity can be identified prior to evaluating the effects of changes to the facility.

**Table 5 – Summary of Step 3 (“Future Demand Condition”)**

Step		Description	Future use in the following steps
3	3.1 Demand Analysis in the Target Year	Graph demand in the target year compared to the current year relative to the current year capacity	5
	3.2 Demand Spreading Analysis in the Target Year	Graph demand spreading given the current capacity of the facility	5

*Step 4 – Perform alternatives analysis.*

In the fourth step (Table 6), the analyst defines scenarios that alleviate capacity surge and address demand spreading. Up to six scenarios can be defined for the target year generated by selecting facility type and number of lanes. After setting each scenario’s specification, the number of overcapacity hours and the capacity deficiency for each scenario is provided. Graphs that show the future year demand against the future year demand under each scenario relative to the future year capacity are also provided. The information generated in Step 4 helps inform a key planning decision – i.e., a smaller facility comes with a trade-off of  $n$  hours of at capacity traffic.

**Table 6 – Summary of Step 4 (“Alternatives Analysis”)**

Step	Inputs	Description	Future use in the following steps
4	4.1 Define Scenarios for Target Year	Define up to six scenarios for the target year by facility type and number of lanes	5
	4.2 Scenario Evaluation Results Summary	Summary information for each scenario including facility type, number of lanes, number of overcapacity hours, and capacity deficiency	5
	4.3 Scenario Evaluation Results Details	Graph future year demand against the future year demand under each scenario relative to the future year capacity	5

Step 5 – Generate report.

In the fifth and final step (Table 7), the results from prior steps are compiled and summarized in an output report that is generated in a new browser window and can be printed to PDF or a physical copy. All report elements are user-specified.

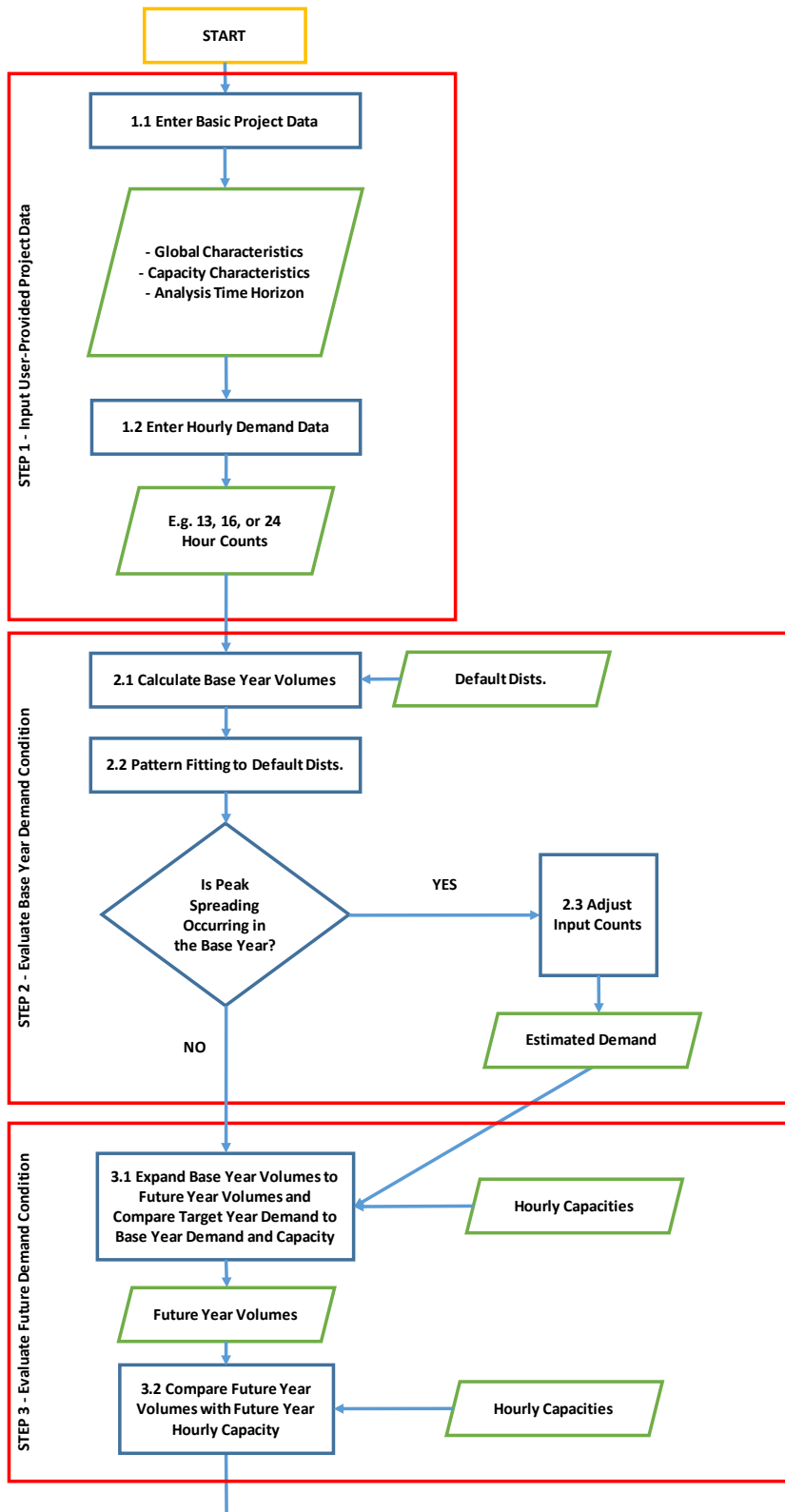
**Table 7 – Summary of Step 5 (“Generate Report”)**

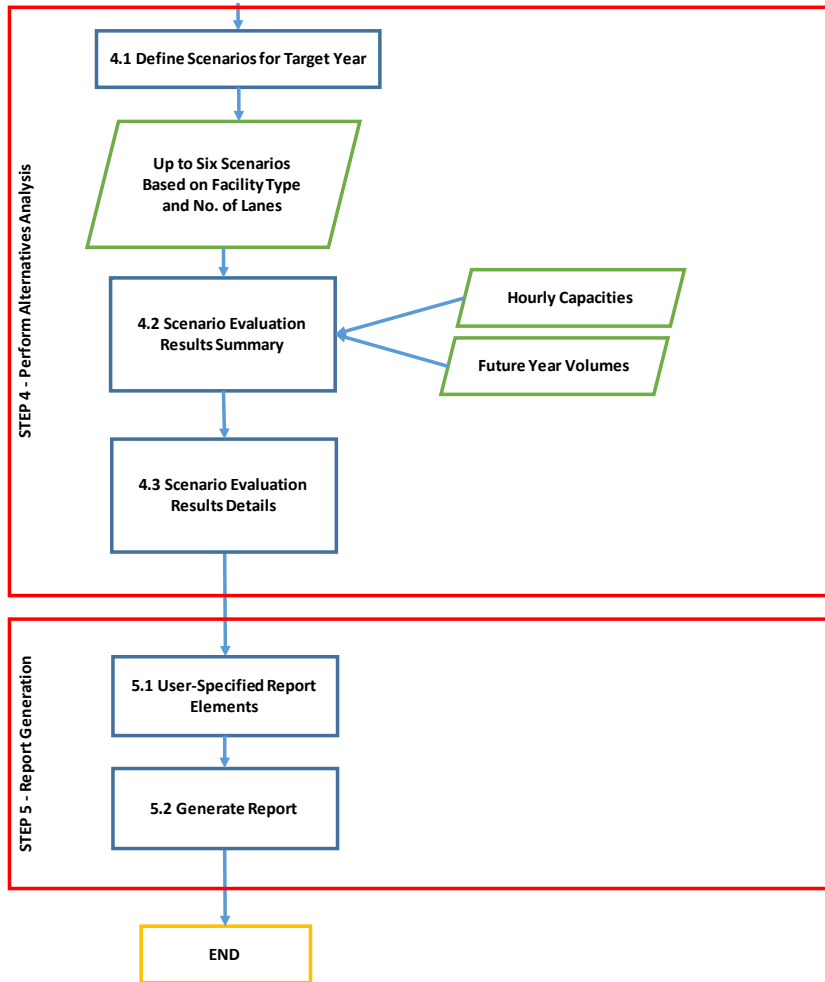
Step	Inputs	Description	
5	5.1 User-Specified Report Elements	<b>General Analysis Information</b>	
		Project Name	Name of the project included in the analysis
		Analyst Name	Name of analyst performing the analysis
		Organization Name	Name of the analyst’s organization
		Facility Location	GPS coordinates or description for facility location
		Description	Brief description of facility or analysis being performed
		<b>Facility Base Year Capacity Characteristics</b>	
		Facility Type	Facility type categories are: 1) freeways, 2) multilane highways, 3) superstreets, 4) two lane highways, and 5) arterials
		County and Region Type	Region type categories are: 1) coastal, 2) piedmont, and 3) mountains
		Area Type	Area type categories are: 1) rural, 2) suburban, and 3) urban
		Number of Lanes	Number of lanes at project location on the direction of travel
		<b>Analysis Time Horizon</b>	
		Analysis Base Year	Base year for the analysis
		Future Year	Future year for the analysis
		Demand Growth Factor	Annual percent growth factor associated with the project location
		<b>Demand Data</b>	
		Base Year Demand Data	User-provided counts extrapolated to a 24-hr distribution based on specified default distribution
		Revised Demand Estimation Due to Current Year’s Peak Spreading	Revised count data due to current year’s peak spreading, if provided
		Future Year Demand Spreading Under Current Condition	Graph of demand in the target year compared to the current year relative to current year capacity; graph of the demand spreading given current capacity of the facility
		<b>Alternatives Analysis</b>	
Characteristics of Alternative Scenarios	Summary information for each scenario including facility type, number of lanes, number of overcapacity hours, and capacity deficiency		
Scenario Evaluation Results	Summary information for each scenario including facility type, number of lanes, number of overcapacity hours, and capacity deficiency; graphs of future year demand against the future year demand under each scenario relative to the future year capacity		
5.2 Generate Report	Generate Report in New Window	Report is generated in a new browser window based on the user-specified report elements	



# TOOL LOGIC

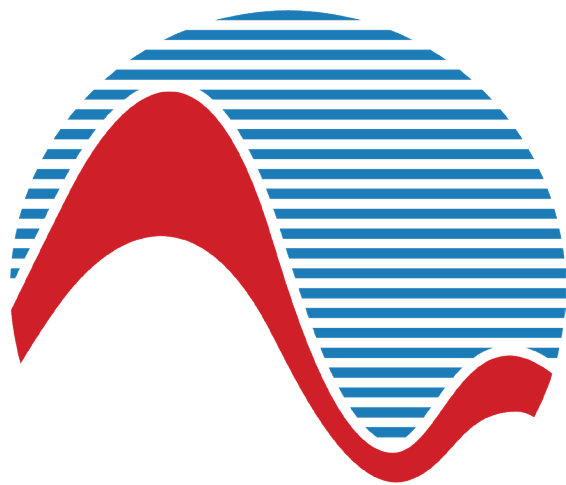
The following provides a summary diagram of the tool logic from Step 1 through Step 5 of the tool.





## USER'S GUIDE

The following provides a User's Guide to navigating the Peak Spreading Tool. Additional resources, including a training video, can be found within the tool under the tutorials page.



**NCDOT**  
**Peak Spreading Tool**

# Instruction Manual

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# Overview

## Purpose

The NCDOT Peak Spreading Tool helps the user determine whether an existing facility should be enhanced (“build” or “no build”) based on forecasted traffic conditions that incorporate a reasonable estimate of peak spreading.

## Theory and Process

The NCDOT Peak Spreading Tool is based on an iterative method adapted from NCHRP 765 that splits peak hour traffic to estimate peak spreading effects on forecasted daily traffic distributions. In the NCHRP 765 method, an analyst determines diurnal distribution factors from historic count data and identifies the hourly capacity for the facility for which forecasts are being developed. The analyst then determines which hours of forecast volumes surpass capacity. Application of peak spreading to the traffic forecast ends if all hours of traffic are at or below capacity. For the heaviest volume hour(s) that exceed capacity by the greatest amount, the analyst takes the excess volume over capacity, divides it in half, and applies one half of the excess volume onto each shoulder hour to reduce the forecast volumes below capacity.

# Tool Description

The NCHRP 765 method only concerns constrained peak spreading. The Peak Spreading Tool allows an analyst to test varying scenarios to examine the effect of constrained peak spreading to determine reasonable and unreasonable outcomes. Required inputs include current volumes, an estimated growth rate, and various capacities/design scenarios. The Peak Spreading Tool uses the predefined data inputs to generate a preliminary alternatives analysis to examine what peak spreading looks like under varying volumes/growth rates/design scenarios.

A key output from the tool is guidance on how much peak spreading is likely based on prescribed conditions. The tool should allow forecasters, engineers, or other users the ability to explore different scenarios based on expected K-factor change or no change that are constrained to feasible and reasonable outcomes. The output from the tool will provide a guide to decision-making, but professional judgement is necessary for making the final choice between “build” and “no build” based on available data. For example, a 2-lane facility is recommended to be widened. If the K-factor stays the same, then upgrading to a 4-lane facility is an option. However, if the peak moderately spreads, a 3-lane facility may be the better option.

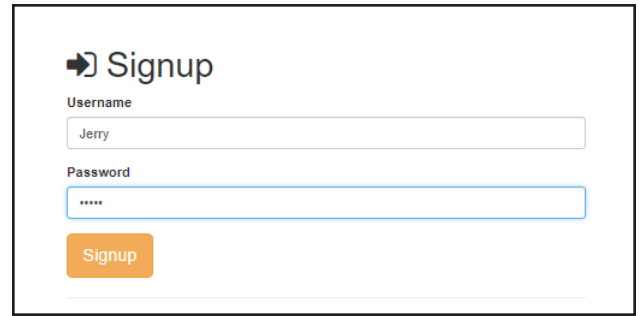
## Example Use Cases

- Determine if peak spreading is occurring now in the base year for a facility
- Determine if peak spreading will occur in the future year for a facility
- Investigate what peak spreading looks like under varying volumes/growth rates/design scenarios
- Investigate whether peak spreading is the result of constraint in the base year, constraint in the future year, or because of natural land use changes that should be designed around

# Create a User Account

1

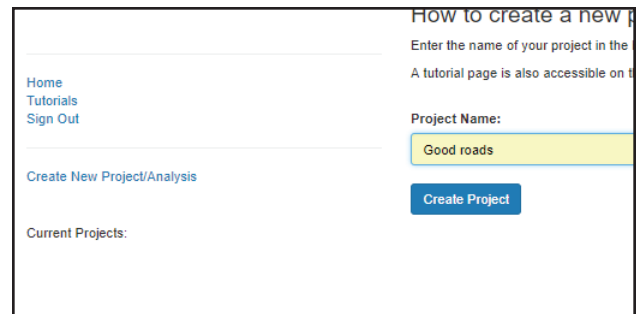
From the landing page, create a user account by clicking “Signup” at the bottom of the page. Once you have created an account, you will be directed to the tool homepage.



The screenshot shows a 'Signup' form with a title 'Signup' and a right-pointing arrow icon. Below the title are two input fields: 'Username' with the text 'Jerry' and 'Password' with masked characters '\*\*\*\*'. An orange 'Signup' button is located below the password field.

2

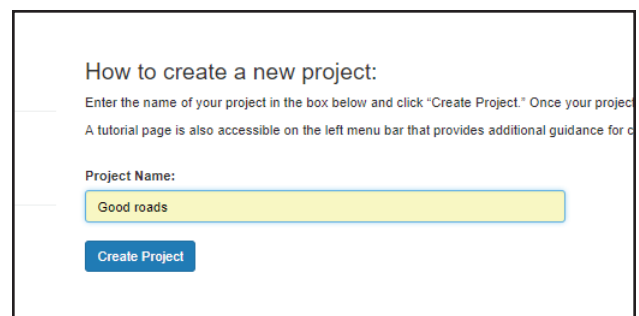
Click “Create New Project/Analysis” on the left menu bar to start a new analysis.



The screenshot shows the tool homepage. On the left is a navigation menu with 'Home', 'Tutorials', 'Sign Out', and 'Create New Project/Analysis'. The main content area has a heading 'How to create a new project', followed by instructions to enter a project name and click 'Create Project'. A text input field contains 'Good roads' and a blue 'Create Project' button is below it.

3

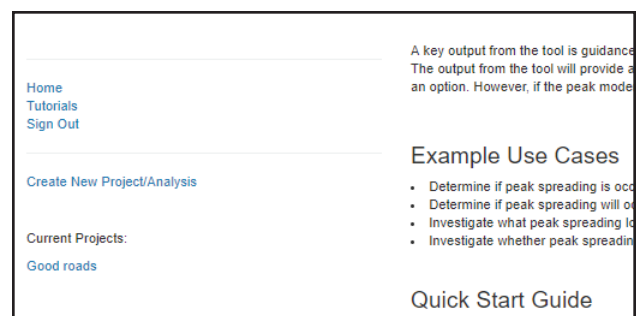
Enter the project name as instructed, then click “Create Project.” You will then return to the landing page.



This is a close-up of the project creation form. It shows the heading 'How to create a new project:', the instruction 'Enter the name of your project in the box below and click “Create Project.”', and the text input field containing 'Good roads' with a blue 'Create Project' button below it.

4

Find your new project under “Current Projects” on the left menu bar. Click the name of your new project to begin the analysis.



The screenshot shows the tool homepage after project creation. The left menu now includes 'Good roads' under the 'Current Projects' section. The main content area shows a heading 'Example Use Cases' with a bulleted list: 'Determine if peak spreading is occ...', 'Determine if peak spreading will o...', 'Investigate what peak spreading l...', and 'Investigate whether peak spreadin...'. A 'Quick Start Guide' link is at the bottom right.

# Step 1

## Global Data Entry

1. Enter project data in the appropriate fields.

Project data includes global information, capacity characteristics, analysis time horizon, and hourly demand data (e.g., 13, 16, or 24 hour counts). If your available counts do not cover 24 hours, enter 0 for hours with no available data. The zeros will be treated as "no data."

2. Click "Save Step 1 Data Entry" at the bottom of the page.
3. Click the "Step 2: Demand Evaluation" tab to proceed to the next step.

Hour of the Day	Volume Counts
Hour 0	122
Hour 1	2
Hour 2	3
Hour 3	4
Hour 4	5
Hour 5	6
Hour 6	1500
Hour 7	2250

All fields with red astrisk should be filled. Be

**Save Step 1 Data Entry**

By pressing the following button, you will de

**Delete This Project Forever!**

## Tip: Copy/Paste from Microsoft Excel

You can copy/paste data from an Excel workbook into the hourly demand data table. For this purpose, arrange your data in the Excel in one column. Then, copy your data from Excel into clipboard. Click on the hour that your data starts, and paste values from clipboard. Each new paste attempt will clear out all the stored data.



# Step 2

## Demand Evaluation

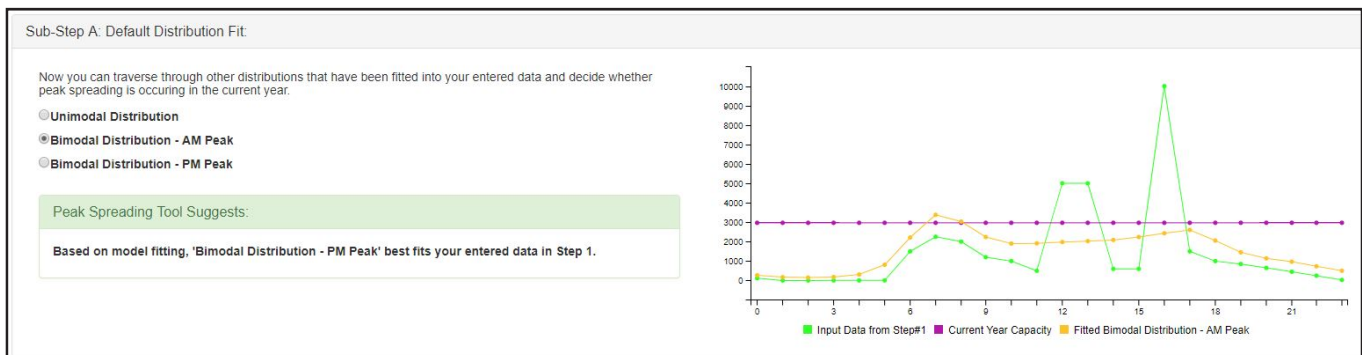
### Sub-Step A

#### 1. Select a default distribution.

The tool recommends one of three default distributions based on model fitting. The default distribution you select determines how the tool extrapolates your inputs from Step 1 to a 24-hour distribution.

#### 2. Examine other default distributions to determine if peak spreading is occurring.

A line graph plots the extrapolated percentages relative to the default percentages. Check the fitting to the default curve to determine if peak spreading is occurring in the base year.



### Sub-Step B

#### 3. The box labeled “Peak Spreading Tool Suggests” advises you whether peak spreading is occurring according to the default distribution currently selected.

If you find that peak spreading is occurring, you can alter your inputs from Step 1, then rerun the analysis.

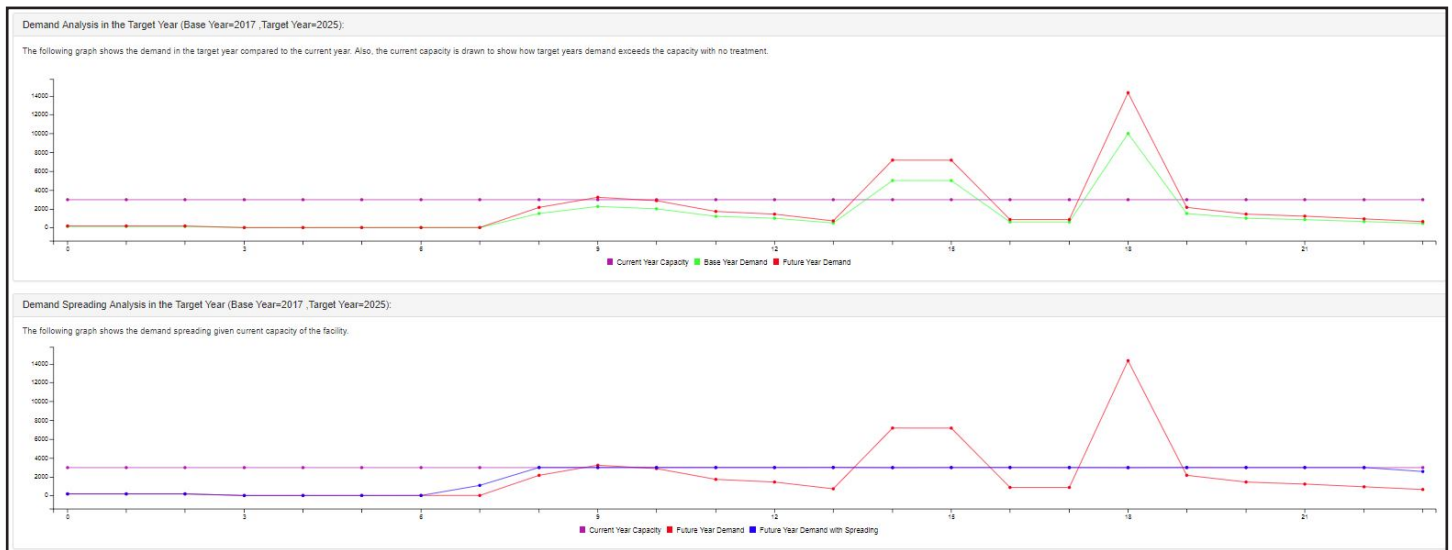
#### 4. Click the “Step 3: Future Demand Condition” tab to proceed to the next step.

# Step 3

## Future Demand Condition

1. The true demand identified in Step 2 will be projected to the target year based on the growth rate provided in Step 1.

If true demand exceeds capacity in the target year, then the graphs in Step 3 will model the spreading. The first graph shows the target year demand compared to the current year capacity. The current year capacity will be modeled to show how the target year's demand exceeds the capacity with no treatment. The second graph will show the demand spreading given the current capacity of the facility.



2. Click the “Step 4: Alternatives Analysis” tab to proceed to the next step.

### Tip: Why evaluate future demand condition?

By comparing the current capacity to the target year's demand, excess capacity can be identified prior to evaluating the effects of changes to the facility.

# Step 4

## Alternatives Analysis

### 1. Define scenarios that relieve capacity surge and address demand spreading.

In the first section of the page, define up to six scenarios for the target year by clicking each check box and filling in each scenario's specification. After setting each scenario's specification, click the button to update the results in the table in the second section of the page. This section summarizes the number of over-capacity hours and the capacity deficiency for each scenario configuration. Plots of the future year demand against the future year demand under each scenario relative to the future year capacity are provided in the third section.

Define Scenarios (Base Year=2017 ,Target Year=2025):

In this section, you can define up to six scenarios for target year. Click on enable scenario in the header column and fill each scenario's specification.

Scenario #	Enabled?	Facility Type	Number of Lanes
1	<input checked="" type="checkbox"/>	Freeway	2
2	<input checked="" type="checkbox"/>	Multilane Highway	3
3	<input checked="" type="checkbox"/>	-- Select --	4
4	<input type="checkbox"/>	-- Select --	-- Select --
5	<input type="checkbox"/>	Freeway	-- Select --
6	<input type="checkbox"/>	-- Select --	-- Select --

[Save Step 4 Data Entry and Update the Results Below](#)

Summary Scenario Evaluation Results (Base Year=2017 ,Target Year=2025):

The following table shows details of each scenario configuration and outcome:

Scenario #	Defined?	Facility Type	# of Lanes	Over-Capacity Hours	Capacity Deficiency
1	Yes	Freeway	2	3	14265
2	Yes	Multilane Highway	3	3	9225
3	Yes	none	4	0	0

### 2. Click the “Step 5: Generate Report” tab to proceed to the final step.

## Tip: Why define scenarios?

This information helps inform a key planning decision - i.e., a smaller facility comes with a trade-off of  $n$  hours of at capacity traffic.

# Step 5

## Generate a Report

1. The results from prior steps are compiled and summarized into a printable report.

All report elements are user-specified and include general analysis information, base year capacity characteristics of the facility, analysis time horizon, demand data for the base year, future year demand analysis, scenario characteristics, and scenario evaluation results.

Select Items to Included in the Report:

<input checked="" type="checkbox"/>	General Analysis Information:
<input checked="" type="checkbox"/>	Facilities Base Year Capacity Characteristics:
<input checked="" type="checkbox"/>	Analysis Time Horizon:
<input checked="" type="checkbox"/>	Base Year's Demand Data:
<input checked="" type="checkbox"/>	Revised Demand Estimation Due to Current Year's Peak Spreading:
<input checked="" type="checkbox"/>	Future Year's Demand Spreading Under Current Condition:
<input checked="" type="checkbox"/>	Alternative Scenarios' Characteristics:
<input checked="" type="checkbox"/>	Scenario(s) Evaluation Results:

[Generate Report in the New Window](#)

2. The report is generated in a new browser window where it can be printed to PDF or a physical copy.