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NCLOS Program 2010 Update

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16. Abstract

The North Carolina Level of Service (NCLOS) program is a planning-level highway capacity analysis tool developed for NCDOT under a previous project. The program uses the operational methodologies in the 2010 Highway Capacity Manual (HCM), along with specific default parameters from North Carolina data, to determine level-of-service (LOS) threshold "capacities" for freeways, multilane highways, two-lane highways and arterial streets. The program is unique in that it provides a graphical display of the measure of effectiveness (MOE) plotted against AADT for each facility type. Users see best case, default case, and worst case curves, plus a highlighted curve for the LOS selected for the analysis. The focus of this effort was to provide technical support to NCDOT programmers who re-programed NCLOS and analyze NCDOT traffic data for the development of default values and input limitations.

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Executive Summary

The North Carolina Level of Service (NCLOS) program is a planning-level highway capacity analysis tool developed for NCDOT under a previous project completed in 2006. The program uses the operational methodologies in the 2010 Highway Capacity Manual (HCM), along with specific default parameters from North Carolina data, to determine level-of-service (LOS) threshold "capacities" for freeways, multilane highways, two-lane highways and arterial streets. The program is unique in that it provides a graphical display of the measure of effectiveness (MOE) plotted against AADT for each facility type. Users see best case, default case, and worst case curves, plus a highlighted curve for the LOS of the subject facility being analyzed.

The NCLOS program is being used extensively in planning applications within NCDOT. Output capacities are used in travel demand forecasting models and in developing Comprehensive Transportation Plans (CTPs). Output values can also be used in the statewide travel demand model now under development. Currently the tool is also used to provide data for the Performance Metrics Dashboard and is used as a scoring component in the Strategic Prioritization Process and Urban Loop Prioritization Process. In early 2011, the 2010 HCM was available for transportation facility analyses. There are significant and important improvements for many of the methodologies in the new HCM based on the most recent national research in recent years. As with previous editions of the manual, the new 2010 HCM will become the standard for determining capacity of most highway facilities. It was critical for NCLOS to be re-programmed to incorporate these new methodologies and other enhancements to remain current with the state-of-practice. Additionally, there was a need to update default values for key inputs that reflect current traffic data across the state of North Carolina.

The focus of this effort was to provide technical support to NCDOT programmers who re-programed NCLOS and analyze NCDOT traffic data for the development of default values and input limitations.

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1. Introduction

The North Carolina Level of Service (NCLOS) software program is a planning-level highway capacity analysis tool developed for NCDOT under a previous project. The original program uses the operational analysis methodologies and service volume applications in the 2000 Highway Capacity Manual (HCM), along with specific default parameters from North Carolina data, to determine level-of-service (LOS) threshold "capacities" for freeways, multilane highways, two-lane highways, arterial streets and superstreet segments. The program is unique in that it provides a graphical display of the measure of effectiveness (MOE) plotted against annual average daily traffic (AADT) for each facility type. The program outputs best case, default case, and worst case curves for a particular segment category. It also provides a user-defined curve for the particular facility segment being analyzed. The user-defined curve shifts relative to the default case depending on the variations the user makes to input values. The modified curve should remain between the best case and worst case curves, unless the user has documentation to deviate beyond these boundary conditions.

The NCLOS program is being used extensively in planning applications within NCDOT. Output capacities are used in travel demand forecasting models and in developing Comprehensive Transportation Plans (CTPs). Output values can also be used in the statewide travel demand model now under development. Currently the tool is also used to provide data for the Performance Metrics Dashboard and is used as a scoring component in the Strategic Prioritization Process and Urban Loop Prioritization Process.

The Transportation Planning Branch is responsible for working with outside planning agencies in providing engineering and planning assistance for the current, proposed, and potential highway network in North Carolina. This branch is charged with identifying future highway needs through the transportation planning process. This process requires the use of modeling and forecasting techniques to determine potential needs and improvements in the transportation system. Accurate travel demand modeling requires appropriate values for roadway capacities and service volumes at various levels of service (LOS).

Tools such as the Highway Capacity Manual (HCM) are very valuable for performing detailed analyses of facilities and corridors given a series of input data. However, the paucity of information typically available at the planning stages, coupled with the relative complexity of the HCM product, make direct use of the HCM impractical or inefficient for forecasting applications. The HCM is primarily designed for operational analyses; it is not particularly well suited to the reverse process of determining acceptable roadway demands for various maximum service volumes or capacities at LOS thresholds.

In early 2011, the 2010 HCM was available for transportation facility analyses. There are significant and important improvements for many of the methodologies in the new HCM based on the most recent national research. As with previous editions of the manual, the new 2010 HCM will become the standard for determining capacity of most highway facilities. It was critical for NCLOS to be re-programmed to incorporate these new methodologies and other enhancements to remain current with the state-of-practice.

National Cooperative Highway Research Program (NCHRP) Report 599 looked at national default values appropriate for the methodologies in the HCM across all states. These values were reviewed and checked against values appropriate for North Carolina drivers and regional patterns for various highway facilities.

There were two major components to the project. The first one was providing technical support to the programmers on the specific methodologies, or changes to existing methodologies, in the 2010 HCM. The second component involved updating the default values used within NCLOS.

2. Significant HCM 2010 Methodology Changes Affecting NCLOS

The 2010 Highway Capacity Manual (HCM 2010) was officially released in Spring 2011 and includes many adjustments and revisions in analysis procedures for highway facilities. It also includes several new facility types, enhanced capabilities and quality of service measures for various facility types, of which are described in the following sections.

2.1. Basic Freeway Segments (Chapter 11, HCM2010)

In Chapter 11 of the HCM 2010, changes to the speed-flow curves and free-flow speed algorithm affect the analysis of the operational methodology. Exhibit 1 shows the new speed-flow curves. Each of the curves has a unique equation for its shape (Exhibit 2). The shape of each curve includes a straight portion and a curved portion. Exhibit 2 includes the breakpoint flow rate where the curve changes from the straight portion to the curved portion. The footnote also includes the maximum flow rate (i.e., capacity) for each curve. The calculation of flow rate (density times speed) is used to determine the volume at the upper and lower density bounds for each LOS. The density bounds (Exhibit 3) remain unchanged from the 2000 HCM.

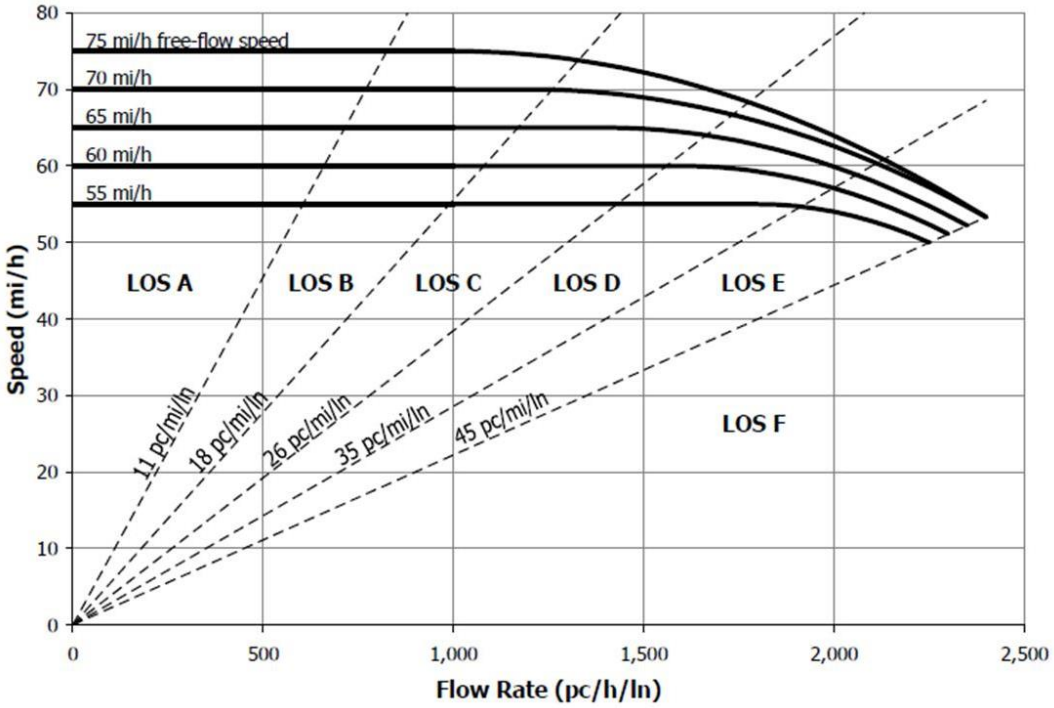


Exhibit 1. Freeway Speed-Flow Curves (Exhibit 11-6 in HCM2010)

FFS (mi/h)	Break-Point (pc/h/ln)	Flow Rate Range: ≥0 ≤ Break-Point	Flow Rate Range: >Break-Point ≤ Capacity
75	1,000	75	$75 - 0.00001107\ (v_p - 1{,}000)^2$
70	1,200	70	$70 - 0.00001160\ (v_p - 1{,}200)^2$
65	1,400	65	$65 - 0.00001418\ (v_p - 1{,}400)^2$
60	1,600	60	$60 - 0.00001816\ (v_p - 1{,}600)^2$
55	1,800	55	$55 - 0.00002469\ (v_p - 1{,}800)^2$

Notes: FFS = free-flow speed, v_p = demand flow rate (pc/h/ln) under equivalent base conditions.
Maximum flow rate for the equations is capacity: 2,400 pc/h/ln for 70- and 75-mph FFS; 2,350 pc/h/ln for 65-mph FFS; 2,300 pc/h/ln for 60-mph FFS; and 2,250 pc/h/ln for 55-mph FFS.

Exhibit 2. Freeway Speed-Flow Curve Equations (Exhibit 11-3 in HCM2010)

Level of Service	Density (pc/mi/ln)
A	≤11
B	>11–18
C	>18–26
D	>26–35
E	>35–45
F	Demand exceeds capacity >45

Exhibit 3. Level of Service Density Boundaries (Exhibit 11-5 in HCM2010)

The procedure now recommends using the closest 5-mph curve to the FFS for analysis of the segment. This eliminates the need for interpolating between any of the pre-defined 5-mph curves. However, the NCLOS program utilizes interpolation to avoid a step function result where one additional vehicle can significantly change the analysis results. The HCM 2010 guidelines are shown below:

≥72.5 mi/h < 77.5 mi/h	Use FFS = 75 mi/h.
≥67.5 mi/h < 72.5 mi/h	Use FFS = 70 mi/h.
≥62.5 mi/h < 67.5 mi/h	Use FFS = 65 mi/h.
≥57.5 mi/h < 62.5 mi/h	Use FFS = 60 mi/h.
≥52.5 mi/h < 57.5 mi/h	Use FFS = 55 mi/h.

In the HCM 2010, there is also a new equation for estimating free flow speed, with revised parameters from the 2000 HCM. The equation and subsequent factors are shown below.

$$FFS = 75.4 - f_{LW} - f_{LC} - 3.22\ TRD^{0.84}$$

where

FFS = free-flow speed of the basic freeway segment (mi/h),

f_{LW} = adjustment for lane width (mi/h),

f_{LC} = adjustment for right-side lateral clearance (mi/h), and

TRD = total ramp density (ramps/mi).

Average Lane Width (ft)	Reduction in FFS, f_{LW} (mi/h)
≥12	0.0
≥11–12	1.9
≥10–11	6.6

Exhibit 4. Adjustment for Lane Width (f_{LW}, HCM2010 Exhibit 11-8):

Right-Side Lateral Clearance (ft)	Lanes in One Direction			
	2	3	4	≥5
≥6	0.0	0.0	0.0	0.0
5	0.6	0.4	0.2	0.1
4	1.2	0.8	0.4	0.2
3	1.8	1.2	0.6	0.3
2	2.4	1.6	0.8	0.4
1	3.0	2.0	1.0	0.5
0	3.6	2.4	1.2	0.6

Exhibit 5. Adjustment for Lateral Clearance (f_{LC}, HCM 2010 Exhibit 11-9):

The adjustment for total ramp density (TRD) is based on the number of on-ramps and off-ramps in one direction that are within 3 miles upstream and 3-miles downstream from the segment being analyzed. The total number of ramps is divided by 6 miles to get an average ramp density, or ramps per mile. The TRD value is then used in the FFS equation shown above.

The overall methodology is shown in the following flow chart:

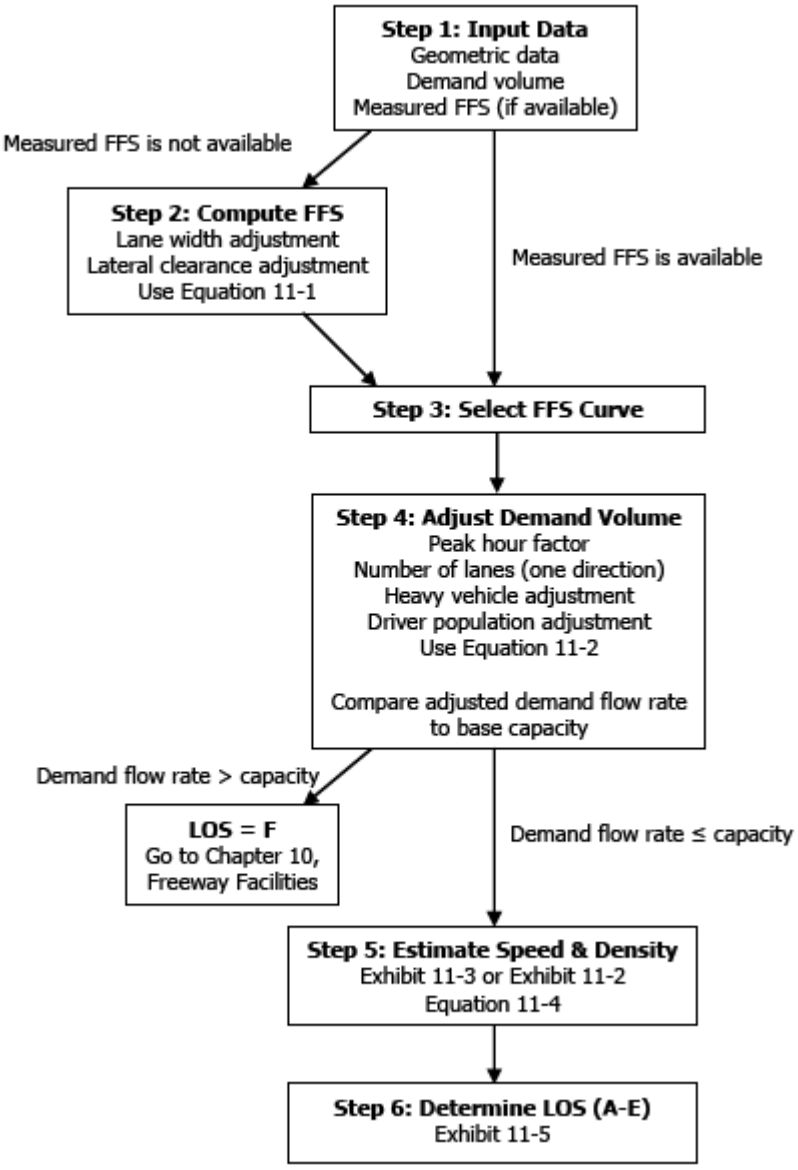


Exhibit 6. Freeway Operational Analysis Flow Chart (Exhibit 11-7 in HCM2010)

Note that in step 4, the following equation is used to adjust demand volume:

$$v_p = \frac{V}{PHF \times N \times f_{HV} \times f_p}$$

where

v_p = demand flow rate under equivalent base conditions (pc/h/ln),

V = demand volume under prevailing conditions (veh/h),

PHF = peak hour factor;

f_{HV} = adjustment factor for the presence of heavy vehicles in the traffic stream, and

f_p = adjustment factor for unfamiliar driver populations.

This equation remains unchanged in the HCM 2010, and all factors and associated adjustments for E_T and E_R that are used in f_{HV} remain unchanged as well.

2.2. Multilane Highways (Chapter 14, HCM2010)

There are two changes in the operational methodology affecting the analysis of multilane highways: new speed-flow curves and rounding to the nearest 5-mph for free-flow speed and using one of the predefined speed-flow curves, instead of interpolating.

Like basic freeway segments, new speed-flow curves were created for multilane highways. They are very close to the previous curves and are shown below (Exhibit 7), along with their equations (Exhibit 8).

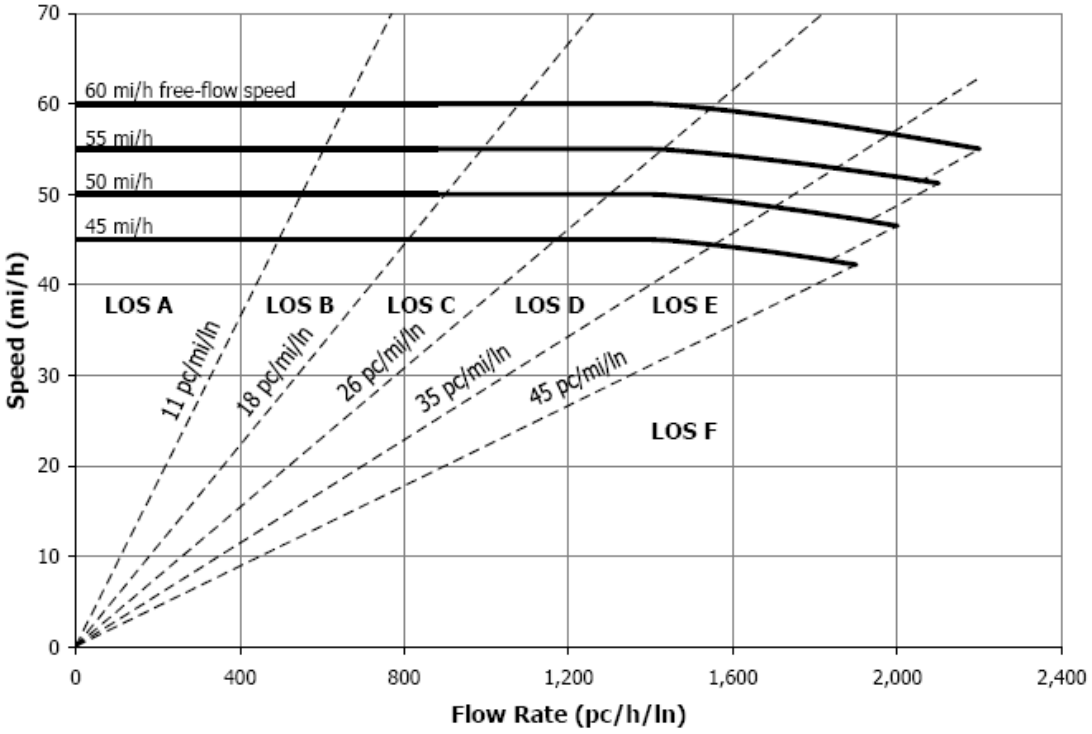


Exhibit 7. Multilane Highway Speed-Flow Curves (Exhibit 14-5 in HCM2010)

FFS (mi/h)	For $v_p \leq 1{,}400$ pc/h/ln S (mi/h)	For $v_p > 1{,}400$ pc/h/ln S (mi/h)
60	60	$60-\left[(5.00)*\left(\frac{v_p-1400}{800}\right)^{1.31}\right]$
55	55	$55-\left[(3.78)*\left(\frac{v_p-1400}{700}\right)^{1.31}\right]$
50	50	$50-\left[(3.49)*\left(\frac{v_p-1400}{600}\right)^{1.31}\right]$
45	45	$45-\left[(2.78)*\left(\frac{v_p-1400}{500}\right)^{1.31}\right]$

Exhibit 8. Multilane Highway Speed-Flow Curve Equations (Exhibit 14-3 in HCM2010)

All curves have a straight portion that extends to1,400 pc/h/ln flow rate and then a curved portion that follows the equation in the above table. The capacities for each FFS curve are:

FFS (mph)	Capacity (pc/h/ln)
60	2,200
55	2,100
50	2,000
45	1,900

Further, density at capacity changes based on the FFS curve, and these densities are:

FFS (mph)	Density (pc/mi/ln)
60	40
55	41
50	43
45	45

The procedure now recommends using the closest 5-mph curve to the FFS for analysis of the segment. This eliminates the need for interpolating between any of the pre-defined 5-mph curves. However, the NCLOS program utilizes interpolation to avoid a step function result where one additional vehicle can significantly change the analysis results. The HCM2010 guidelines are shown below:

42.5 mi/h ≤ FFS < 47.5 mi/h	Use FFS = 45 mi/h
47.5 mi/h ≤ FFS < 52.5 mi/h	Use FFS = 50 mi/h
52.5 mi/h ≤ FFS < 57.5 mi/h	Use FFS = 55 mi/h
57.5 mi/h ≤ FFS < 62.5 mi/h	Use FFS = 60 mi/h

All other aspects of the analysis remain exactly the same as the 2000 HCM. The overall methodology is shown in the following flow chart:

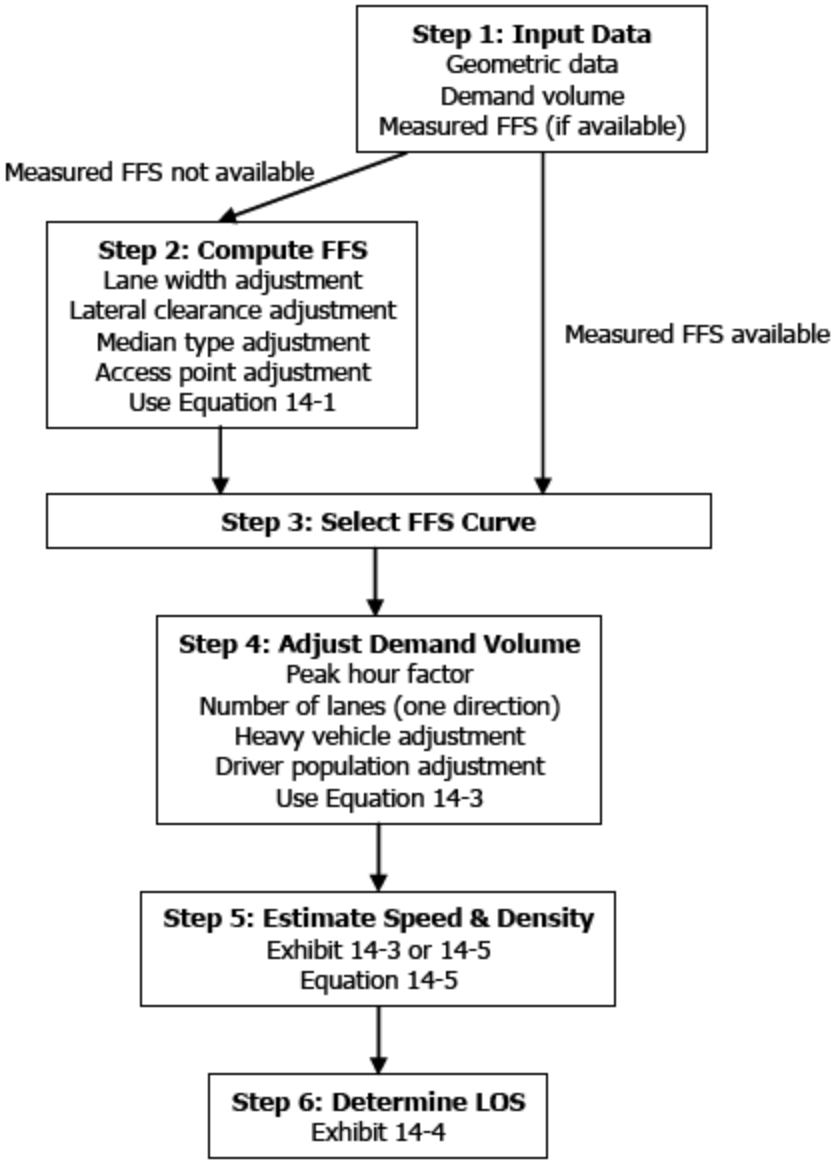


Exhibit 9. Multilane Operational Analysis Flow Chart (Exhibit 14-7 in HCM2010)

2.3. Two-Lane Highways (Chapter 15, HCM2010)

There are several changes to the operational analysis methodology for two-lane highway segments: the two-way analysis procedure was eliminated, some basic characteristic curves and tables were revised and updated, and a third class of two-lane highway was added, based on a procedure developed by the Florida Department of Transportation. Based on these changes, the following flow chart lays out the analysis steps:

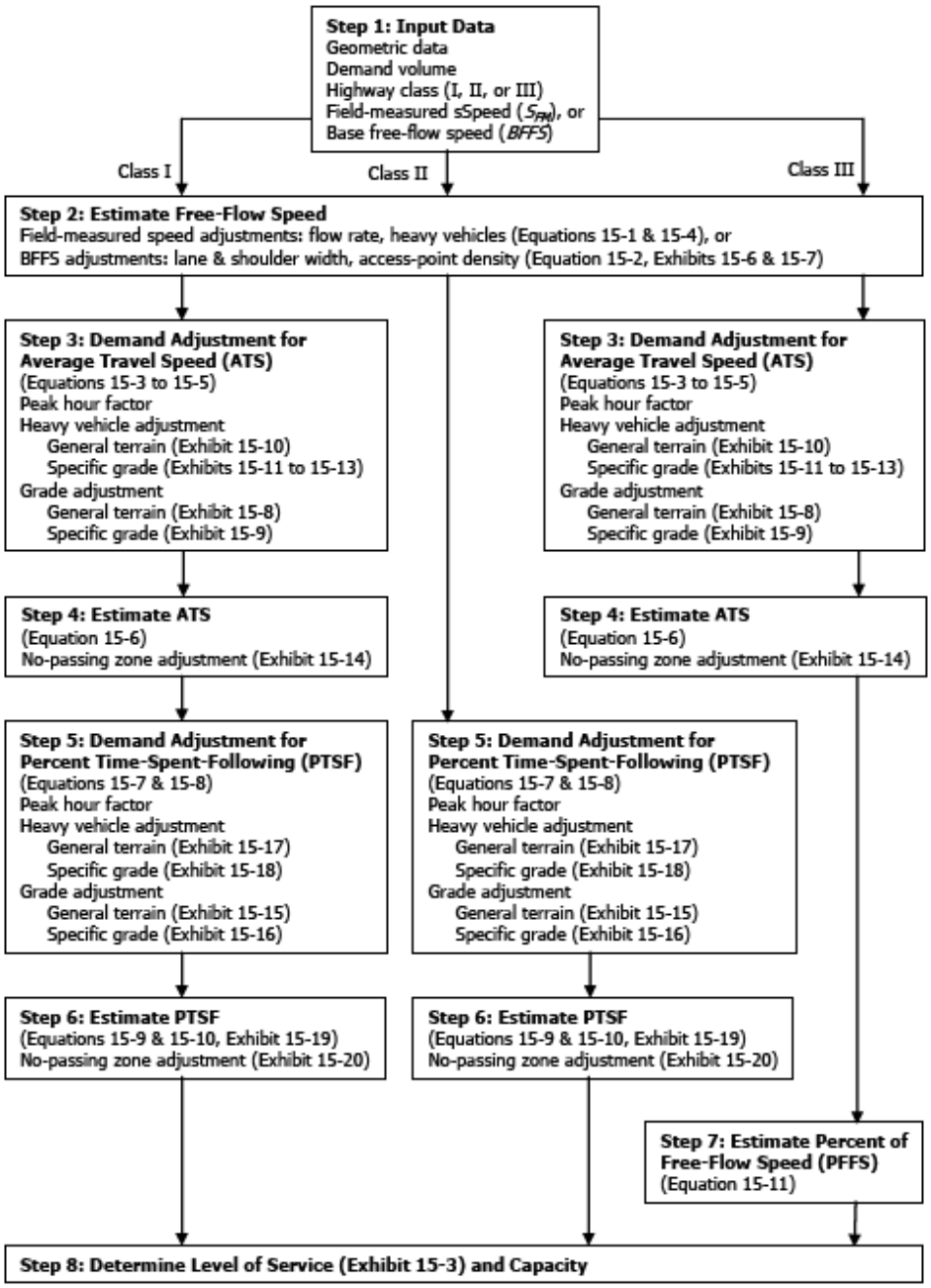


Exhibit 10. Two-Lane Operational Analysis Flow Chart (Exhibit 15-6 in HCM2010)

The 2000 HCM provided procedures for one-way analysis for climbing and passing lanes and two-way analysis for all other segments. The two-way analysis procedure also covered level and rolling terrain analysis, with mountainous terrain analysis covered under the one-way analysis procedure. The inconsistencies between these two procedures led to the elimination of the two-way analysis procedure in the HCM 2010; a single method enabled consistency with directional analysis of other uninterrupted flow facilities.

The one-way capacity of a two-lane highway remains at 1,700 pc/h consistent with the 2000 HCM, while the two-way capacity is limited at a flow of 3,200 pc/h. As shown in the following service volume table, Exhibit 11, AADT capacity values can reach over 30,000 veh/day at LOS E during the peak hour (note assumptions below the table).

K	D	Class I: Level				Class I: Rolling				Class II: Rolling			
Factor	Factor	LOS B	LOS C	LOS D	LOS E	LOS B	LOS C	LOS D	LOS E	LOS B	LOS C	LOS D	LOS E
0.09	50%	5.5	9.3	16.5	31.2	4.2	8.4	15.7	30.3	5.0	9.8	18.2	31.2
	55%	4.9	8.7	14.9	30.2	3.7	7.9	14.0	29.2	4.1	8.7	16.0	30.2
	60%	4.4	8.1	13.9	27.6	3.7	6.2	12.8	26.8	3.7	7.9	14.6	27.6
	65%	4.1	7.9	12.9	25.5	3.4	5.9	11.4	24.7	3.3	5.9	13.2	25.5
0.10	50%	5.0	8.4	14.8	28.0	3.8	7.6	14.2	27.2	4.4	8.8	16.3	28.0
	55%	4.4	7.9	13.4	27.1	3.3	7.1	12.6	26.3	3.7	7.9	14.4	27.1
	60%	4.0	7.3	12.5	24.9	3.3	5.6	11.5	24.1	3.3	7.1	13.1	24.9
	65%	3.7	7.1	11.6	23.0	3.0	5.3	10.3	22.3	3.0	5.3	11.9	23.0
0.12	50%	4.1	7.0	12.4	23.4	3.1	6.3	11.8	22.7	3.7	7.4	13.6	23.4
	55%	3.7	6.5	11.2	22.6	2.8	5.9	10.5	21.9	3.1	6.5	12.0	22.6
	60%	3.3	6.1	10.4	20.7	2.7	4.7	9.6	20.1	2.7	5.9	10.9	20.7
	65%	3.1	5.9	9.6	19.1	2.5	4.4	8.5	18.5	2.4	4.4	9.9	19.1
0.14	50%	3.5	6.0	10.6	20.0	2.7	5.4	10.1	19.4	3.2	6.3	11.7	20.0
	55%	3.1	5.6	9.6	19.4	2.4	5.1	9.0	18.8	2.6	5.6	10.3	19.4
	60%	2.8	5.2	8.9	17.7	2.3	4.0	8.2	17.2	2.3	5.1	9.4	17.7
	65%	2.6	5.1	8.2	16.4	2.1	3.8	7.3	15.9	2.1	3.8	8.5	16.4

Notes: Volumes are thousands of vehicles per day.
Assumed values for all entries: 10% trucks, PHF = 0.88, 12-ft lanes, 6-ft shoulders, 10 access pt/mi.
Assumed values for Class I-Level: BFFS = 65 mi/h, 20% no-passing zones.
Assumed values for Class I-Rolling: BFFS = 60 mi/h, 40% no-passing zones.
Assumed values for Class II-Rolling: BFFS = 50 mi/h, 60% no-passing zones.

Exhibit 11. Two-lane Highway Service Volume Table (Exhibit 15-30 in HCM2010)

However, the HCM 2010 further clarifies these capacity values at LOS E boundary conditions in this way: "Capacity conditions, however, are rarely observed—except in short segments. Because service quality deteriorates at relatively low demand flow rates, most two-lane highways are upgraded before demand approaches capacity (HCM2010 Page 15-5)." Therefore, there is justification not to use LOS E volumes in analysis based on severe deterioration of quality of flow at these volumes. A lower threshold (perhaps LOS D) may provide a better match of volumes when making decisions to upgrade a two-lane highway to a multilane highway.

The flow chart provided in Exhibit 10 shows the analysis steps for directional analysis. Since only the two-way analysis procedure was programmed into NCLOS, the directional analysis procedure is new. However, the overall methodology remains the same between the 2000 HCM and HCM 2010. Those exhibits remaining the same (with the corresponding exhibit number in the 2000 HCM in parentheses) are:

- Exhibit 15-7 (20-5), adjustment for f_{LS} in Eq. 15-2
- Exhibit 15-8 (20-6), adjustment for f_A in Eq. 15-2
- Exhibit 15-15 (20-19), adjustment for $f_{np,ATS}$ in Eq. 15-6

For other exhibits, discontinuities within the analysis procedure in the 2000 HCM were identified by users of the HCM, resulting in modifications of several exhibits in the 2010 HCM. Exhibits that have changed with the HCM 2010 include:

- Exhibit 15-9 (20-7), adjustment for $f_{G,ATS}$ for general terrain in Eq. 15-3
- Exhibit 15-10 (20-13), adjustment for $f_{G,ATS}$ for specific upgrades in Eq. 15-3
- Exhibit 15-11 (20-9), adjustment for E_T and E_R for general terrain and downgrades in Eq. 15-4
- Exhibit 15-12 (20-15), adjustment for E_T for specific upgrades in Eq. 15-4
- Exhibit 15-13 (20-17), adjustment for E_R for specific upgrades in Eq. 15-4
- Exhibit 15-14 (20-18), adjustment for E_{TC} for downgrades at crawl speed in Eq. 15-5
- Exhibit 15-16 (20-8), adjustment for $f_{G,PTSF}$ for general terrain in Eq. 15-7
- Exhibit 15-17 (20-14), adjustment for $f_{G,PTSF}$ for specific upgrades in Eq. 15-7
- Exhibit 15-18 (20-10), adjustment for E_T and E_R for general terrain in Eq. 15-8
- Exhibit 15-19 (20-16), adjustment for E_T and E_R for specific upgrades in Eq. 15-8
- Exhibit 15-20 (20-21), coefficients for BPTSF in Eq. 15-10
- Exhibit 15-21 (20-20), adjustment for $f_{np,PTSF}$ in Eq. 15-9

As a more significant change in HCM2010, a new Class III Two-Lane Highway type was developed and is defined as:

> "*Highways serving moderately developed areas. They may be portions of Class I or Class II highway that pass through small towns or developed recreational areas. On such segments, local traffic often mixes with through traffic, and the density of unsignalized roadside access points is noticeably higher than in a purely rural area. Class III highways may also be longer segments passing through more spread-out recreational areas, also with increased roadside densities. Such segments are often accompanied by reduced speed limits that reflect the higher activity level.*"

The directional methodology is all that is needed to quantify the LOS for Class III highways. The MOE (measure of effectiveness) is based on the percentage of FFS (shown below) that is provided from the ATS analysis. The LOS thresholds for all three classes are provided below in Exhibit 12. The threshold values for Class I and Class II two-lane highways have stayed the same as the 2000 HCM.

$$PFFS = \frac{ATS_d}{FFS}$$

Level of Service	Class I Highways		Class II Highways	Class III Highways
	ATS (mi/h)	PTSF (%)	PTSF (%)	PFFS (%)
A	>55	≤35	≤40	>91.7
B	>50 – 55	>35 – 50	>40 – 55	>83.3 – 91.7
C	>45 – 50	>50 – 65	>55 – 70	>75.0 – 83.3
D	>40 – 45	>65 – 80	>70 – 85	>66.7 – 75.0
E	≤40	>80	>85	≤66.7

Exhibit 12. Level of Service Thresholds (Exhibit 15-3 in HCM2010)

2.4. Urban Streets (Chapter 17, HCM2010)

There have been some major changes with urban streets (also called arterial streets). These changes include the following:

- Elimination of the four classes of arterials (I, II, III, and IV);
- Street segments can make up an urban street *facility,* which is separately analyzed in HCM2010 Chapter 16, and which is not included in the scope of NCLOS (segment-level only, consistent with freeways);
- Individual segments can have a signal, roundabout, or all-way stop-controlled (AWSC) intersection at a segment begin/end point (except no roundabout or AWSC intersection at two or more consecutive begin/end points for segments along a facility);
- Segments can include unsignalized intersection points within the segment;
- The basic signal has an actuated controller, which means effective green time varies per cycle unless all cycles are operating at capacity; and
- A new MOE is included as output. The *stop rate* describes the number of stops per 15-minute analysis period.

The new procedure for operational analysis uses the new signalized intersection methodology in Chapter 18. It is very complex and can only be performed through iterative computer calculations, including a complicated *incremental queue accumulation,* method used to estimate the uniform delay at a signal. The new intersection method was found to be too complex for direct implementation within a planning application like NCLOS, and further would have required very detailed signal timing parameters that are not available in a planning-level application. Consequently, the research team suggested using the Quick Estimation Method for Urban Street Segments found in HCM 2010 Chapter 30, Section 4. This methodology provides a more appropriate level of calculation for planning applications.

The quick estimation method is presented in the flow chart in Exhibit 13. The rounded rectangles represent calculation steps and the parallelograms represent inputs needed. Some inputs can be calculated or estimated, and others left as defaults. Further, some calculations rely on equations presented in Chapter 17 on Urban Street Segments. The flow chart also shows the stop rate being provided as an additional output MOE. This is an important measure when evaluating coordination along a corridor (urban street facility), but is not used in the LOS estimation. The LOS metric for Urban Street is based on a measure known as *percent free flow speed*, which is calculated by the ratio of average travel speed to the free flow speed on the facility.

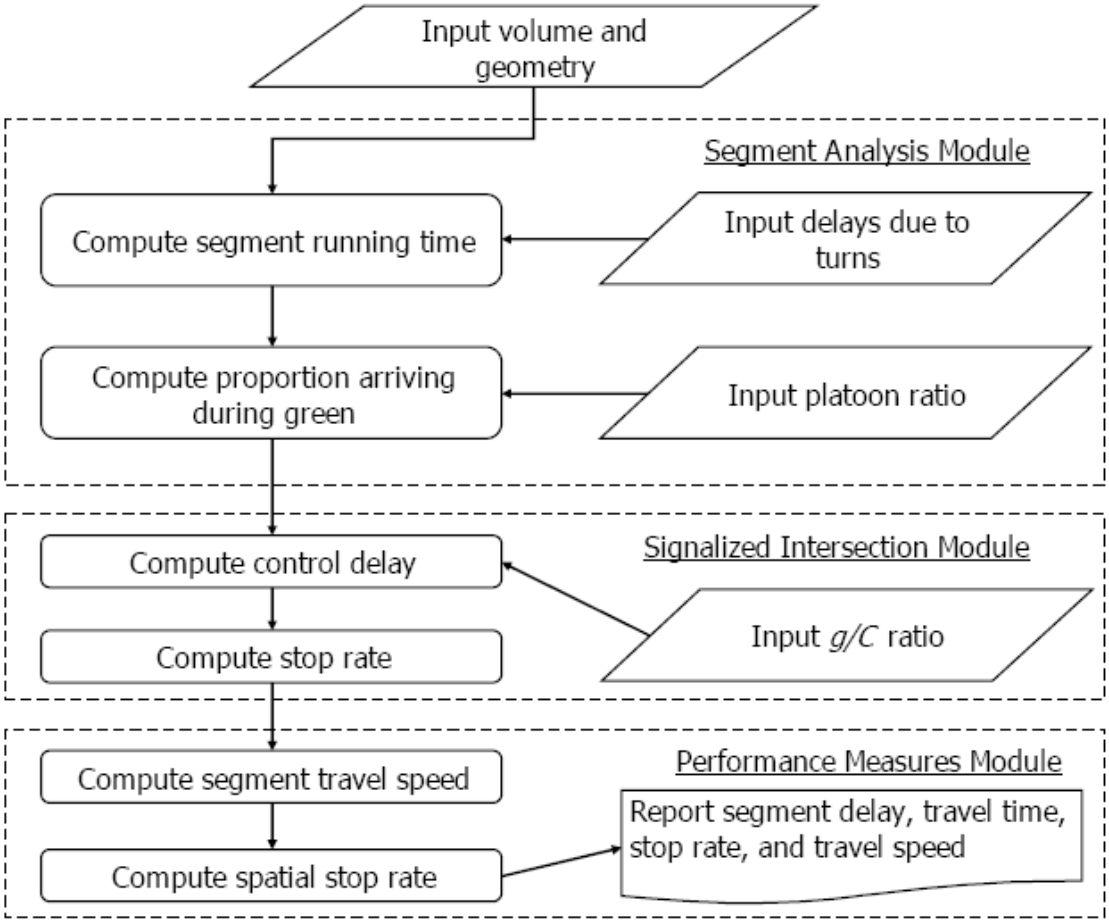


Exhibit 13. Quick Estimation Methodology (Exhibit 30-7 in HCM2010)

A more detailed description of the quick estimation method is available in Chapter 30 of the 2010 HCM. In NCLOS, the method has been adopted and used to estimate the average travel speed on the urban street segment, which then determines LOS. That implementation required the use of several default values, which are discussed in more detail below.

2.5. Superstreets

Superstreets are a type of arterial street treatment that sees increasing use in North Carolina, but which is not included in the Highway Capacity Manual. The format of outputs and inputs was modified consistent with the general software update of NCLOS. Default values were estimated consistent with the new guidance on urban street segments, which are described below.

3. Default Values

The determination of appropriate default values was an important part of this research project. The data used for default value development were based on North Carolina traffic volume data, recommendations from NCHRP Report 599, previous NCLOS default values, and professional judgment if needed.

A significant effort was required to analyze the North Carolina traffic volume data. The data was collected by NCDOT beginning in 1988 and includes information up until 2011. Detailed data from Automated Traffic Recorder (ATR) stations were obtained from the NCDOT Traffic Survey Unit in the form of a large database. The first step of the process was to geocode 7,863 traffic volume data points. Of the 7,863 points, 867 were automatically geocoded and 6,996 required manual geocoding. Another effort required the classification of roadways in terms of their functional classification and area type (urban, suburban, or rural). The following information details the classification system.

Arterials (Selection by Facility Type (#1) and Speed Limit)

Facility is within an MPO or Smoothed Urbanized Area Boundary

- Urban = Roadway has speed limit of 35mph or less
- Suburban = Roadway has speed limit of 36mph or greater
- Rural = No roadways exist in this category

Two-Lane Highways (Selection by Number of Lanes)

Facility is outside an MPO or Smoothed Urbanized Area Boundary

- Urban = No roadways exist in this category (roadway classified as Arterial)
- Suburban = No roadways exist in this category (roadway classified as Arterial)
- Rural = All Two-Lane Highways
    - Class I = Primary Routes (RouteID: RID = prefix of 1, 2, and 3)
    - Class II = SR Routes (RouteID: RID = prefix of 4)
    - Class III = No roadways exist in this category (roadway classified as Arterial)

Multilane Highways (Selection by Facility Type (#3 and #4) and Area Type)

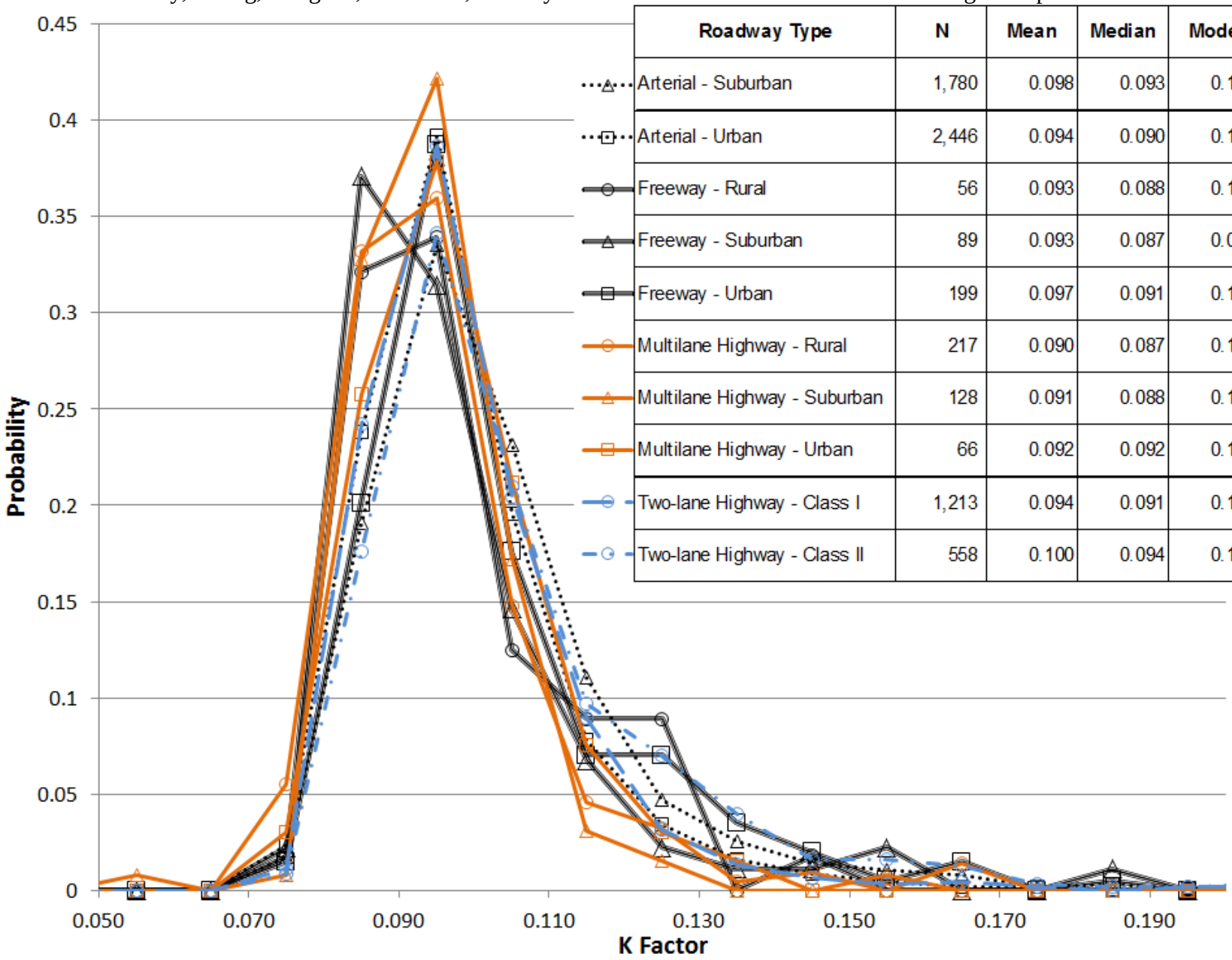
- Urban = Roadway is within a MPO and a Smoothed Urbanized Area Boundary
- Suburban = Roadway is within a MPO, but outside Smoothed Urbanized Area Boundary or roadway is within a Smoothed Urbanized Area Boundary, but outside a MPO
- Rural = Roadway is outside a MPO and outside a Smoothed Urbanized Area Boundary

Freeways (Selection by Facility Type (#3 and #4) and Area Type)

- Urban = Roadway is within a MPO and a Smoothed Urbanized Area Boundary
- Suburban = Roadway is within a MPO, but outside Smoothed Urbanized Area Boundary or roadway is within a Smoothed Urbanized Area Boundary, but outside a MPO
- Rural = Roadway is outside a MPO and outside a Smoothed Urbanized Area Boundary

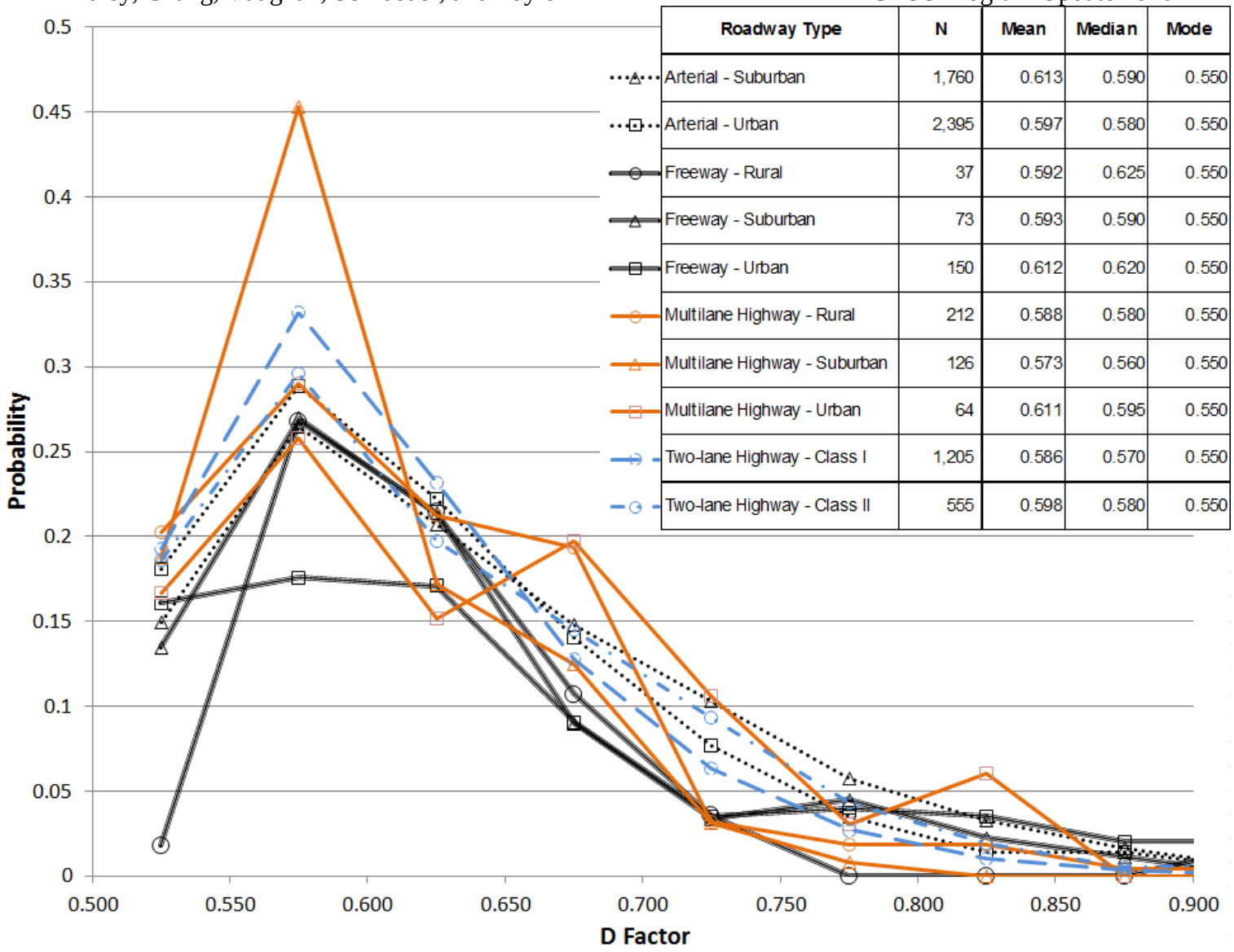
Following the geocoding and categorization process, the available traffic characteristics of hourly K factor (Exhibit 14), directional D factor (Exhibit 15), peak hour factor (PHF, Exhibit 16), and truck percentage (Exhibit 17) were graphed and analyzed as shown in their respective exhibits. The corresponding tables in each exhibit tabulate statistical values of sample size (N), mean, median, and mode for each roadway type. N represents the number of traffic volume data points available for each roadway classification. Mean is the statistical average, median is the numerical value separating the higher and lower halves of the data, and mode is the value occurring most often. The median values were selected as the default value for each parameter and rounded appropriately, as shown in Exhibit 18. Overall, the values show little variability amongst the roadway type dimensions considered in this evaluation.

In addition to the default values determined for inputs, the maximum capacity outputs calculated from default values have been tabulated. The outputs represent the maximum annual average daily traffic volumes calculated by NCLOS rounded to the nearest hundred. The tables are organized by highway facility, area type, and total number of lanes in both directions.
Exhibit **19** summarizes capacity outputs driven by LOS D performance measures, while Exhibit **20** summarized LOS E calculations.



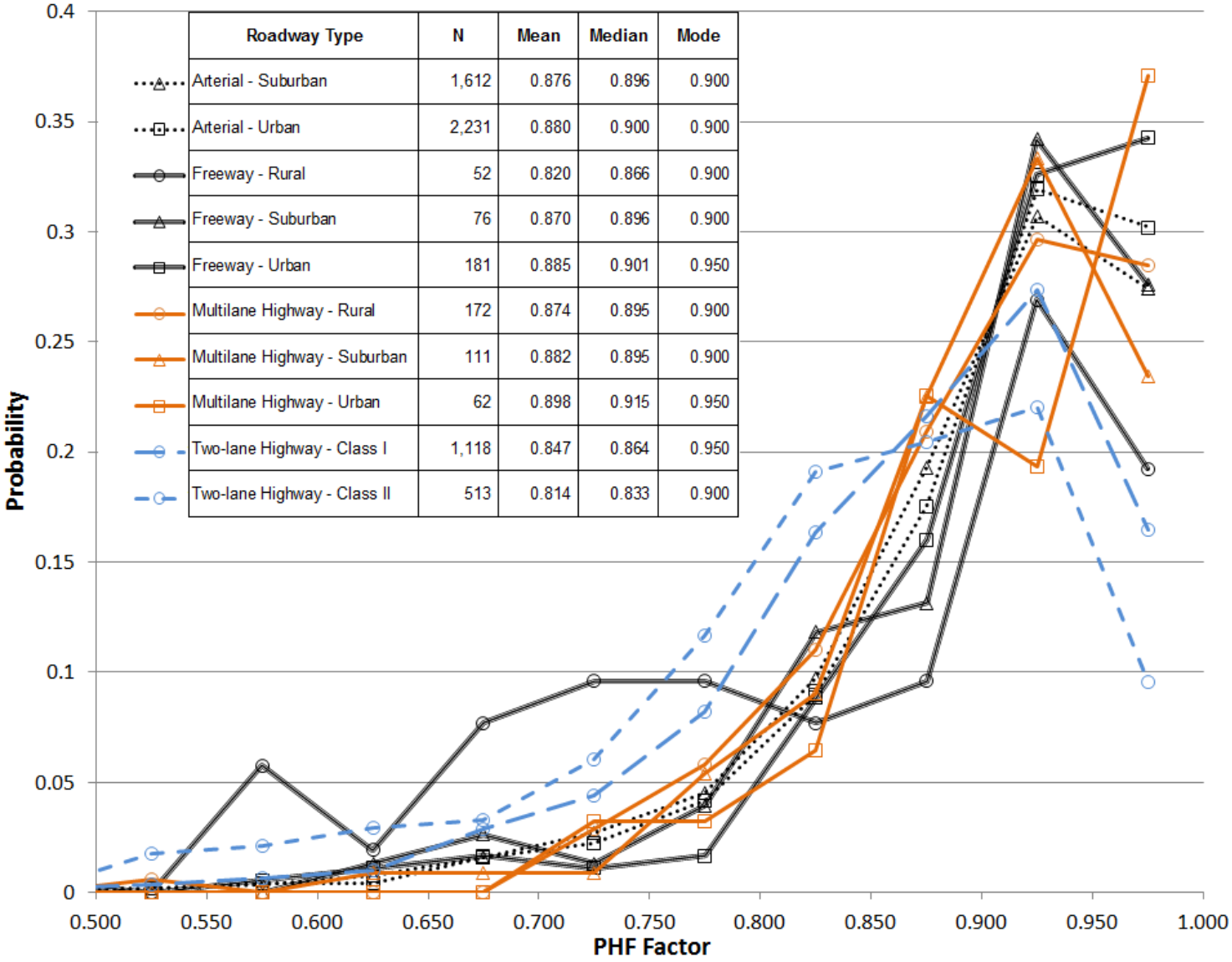
Roadway Type	N	Mean	Median	Mode
Arterial - Suburban	1,780	0.098	0.093	0.100
Arterial - Urban	2,446	0.094	0.090	0.100
Freeway - Rural	56	0.093	0.088	0.100
Freeway - Suburban	89	0.093	0.087	0.090
Freeway - Urban	199	0.097	0.091	0.100
Multilane Highway - Rural	217	0.090	0.087	0.100
Multilane Highway - Suburban	128	0.091	0.088	0.100
Multilane Highway - Urban	66	0.092	0.092	0.100
Two-lane Highway - Class I	1,213	0.094	0.091	0.100
Two-lane Highway - Class II	558	0.100	0.094	0.100

Exhibit 14. North Carolina K Factor Data



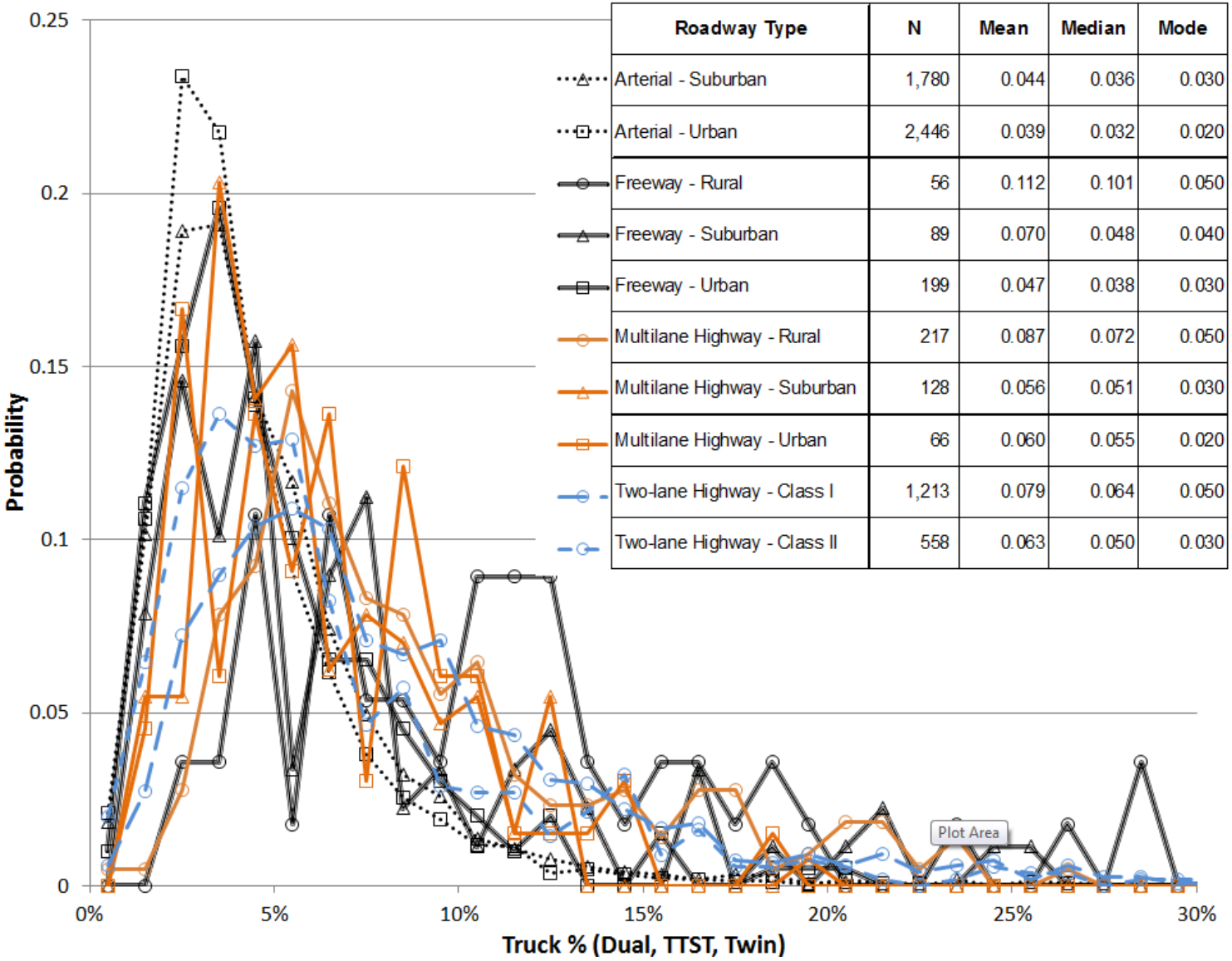
Roadway Type	N	Mean	Median	Mode
Arterial - Suburban	1,760	0.613	0.590	0.550
Arterial - Urban	2,395	0.597	0.580	0.550
Freeway - Rural	37	0.592	0.625	0.550
Freeway - Suburban	73	0.593	0.590	0.550
Freeway - Urban	150	0.612	0.620	0.550
Multilane Highway - Rural	212	0.588	0.580	0.550
Multilane Highway - Suburban	126	0.573	0.560	0.550
Multilane Highway - Urban	64	0.611	0.595	0.550
Two-lane Highway - Class I	1,205	0.586	0.570	0.550
Two-lane Highway - Class II	555	0.598	0.580	0.550

Exhibit 15. North Carolina D Factor Data



Roadway Type	N	Mean	Median	Mode
Arterial - Suburban	1,612	0.876	0.896	0.900
Arterial - Urban	2,231	0.880	0.900	0.900
Freeway - Rural	52	0.820	0.866	0.900
Freeway - Suburban	76	0.870	0.896	0.900
Freeway - Urban	181	0.885	0.901	0.950
Multilane Highway - Rural	172	0.874	0.895	0.900
Multilane Highway - Suburban	111	0.882	0.895	0.900
Multilane Highway - Urban	62	0.898	0.915	0.950
Two-lane Highway - Class I	1,118	0.847	0.864	0.950
Two-lane Highway - Class II	513	0.814	0.833	0.900

Exhibit 16. North Carolina PHF Factor Data



Roadway Type	N	Mean	Median	Mode
Arterial - Suburban	1,780	0.044	0.036	0.030
Arterial - Urban	2,446	0.039	0.032	0.020
Freeway - Rural	56	0.112	0.101	0.050
Freeway - Suburban	89	0.070	0.048	0.040
Freeway - Urban	199	0.047	0.038	0.030
Multilane Highway - Rural	217	0.087	0.072	0.050
Multilane Highway - Suburban	128	0.056	0.051	0.030
Multilane Highway - Urban	66	0.060	0.055	0.020
Two-lane Highway - Class I	1,213	0.079	0.064	0.050
Two-lane Highway - Class II	558	0.063	0.050	0.030

Exhibit 17. North Carolina Truck Percentage Data

Facility Type		Input	Program Limits: Restrict Input Within Boundary Conditions: Minimum	Program Limits: Restrict Input Within Boundary Conditions: Maximum	Practical Limits: Alert Users of Uncommon Input: Worst	Practical Limits: Alert Users of Uncommon Input: Best	NCLOS Default Value: Urban	NCLOS Default Value: Suburban	NCLOS Default Value: Rural	Source
Freeway	Traffic Factors	D	0.50	1.00	0.80	0.50	0.60	0.60	0.65	1
		Driver Population Factor	0.85	1	0.85	1.00	1.00	1.00	1.00	2,3
		K	0.04	1.00	0.13	0.08	0.09	0.09	0.09	1
		PHF	0.25	1	0.75	1.00	0.90	0.90	0.85	1
		Percent RVs	0	100	10	0	0	0	0	3
		Percent Trucks/Buses	0	100	40	0	5	5	10	1
	Roadway Factors	Terrain Type	N/A	N/A	N/A	N/A	Level	Level	Level	2
		Lane Width	8	14	10	12	12	12	12	2,3
		Length of Grade (miles)	0	10	5	0	0	0	0	4
		Number of Lanes (per direction)	2	10	2	5	2	2	2	3
		Percent Grade	-100	100	12	0	0	0	0	4
		Right-Side Lateral Clearance	0	12	6	0	10	10	10	2
		Total Ramp Density	0	12	6	0	1	1	0.5	3
Multi-lane Highway	Traffic Factors	D	0.50	1.00	0.75	0.50	0.60	0.55	0.60	1
		Driver Population Factor	0.85	1.00	0.85	1.00	1.00	1.00	1.00	2,3
		K	0.04	1.00	0.13	0.08	0.09	0.09	0.09	1
		PHF	0.25	1	0.75	1.00	0.9	0.9	0.9	1
		Percent RVs	0	100	10	0	0	0	0	3
		Percent Trucks/Buses	0	100	40	0	5	5	5	1
	Roadway Factors	Access Points Per Mile	0	100	40	0	25	16	8	2
		BFFS	30	80	45	65	60	60	60	2
		Terrain Type	N/A	N/A	N/A	N/A	Level	Level	Level	2
		Lane Width	8	14	10	12	12	12	12	2
		Lateral Clearance	0	12	0	12	8	10	12	3
		Length of Grade	0	10	5	0	0	0	0	4
		Median Type	N/A	N/A	Undivided	Divided	Divided	Divided	Divided	4
		Percent Grade	-100	100	12	0	0	0	0	4
		Total Number of Lanes	4	10	4	6	2	2	2	3
Superstreets	Traffic Factors	D	0.50	1.00	0.75	0.50	0.6	0.6	0.6	1
		K	0.04	1.00	0.13	0.08	0.09	0.09	0.09	1
		PHF	0.25	1	0.75	1.00	0.9	0.9	0.9	1
		Percent RVs	0	100	10	0	0	0	0	4
		Percent Trucks/Buses	0	100	40	0	5	5	5	1
		Saturated Flow Rate	1,000	2,100	1,500	1,800	1,800	1,800	1,800	4
	Roadway Factors	Cycle Length	60	300	80	200	120	120	120	4
		G/C Ratio	0	1	0.6	0.8	0.7	0.7	0.7	4
		Terrain Type	N/A	N/A	N/A	N/A	Level	Level	Level	4
		Lateral Clearance	0	12	0	6	6	6	6	4
		Number of Lanes (per direction)	1	8	2	4	3	2	2	4

Exhibit 18. North Carolina Recommended Default Data

Facility Type		Input	Program Limits		Practical Limits		NCLOS Default Value			
			Restrict Input Within Boundary Conditions		Alert Users of Uncommon Input		Urban	Suburban	Rural	Source
			Minimum	Maximum	Worst	Best				
Two-Lane Highway	Traffic Factors	D	0.50	1.00	0.90	0.50			0.6	1
		FFS	30	80	45	65			60	4
		K	0.04	1.00	0.13	0.08			0.09	1
		PHF	0.25	1	0.75	1.00			0.85	1
		Percent RVs	0	100	10	0			4	2
		Percent Trucks/Buses	0	100	40	0			5	1
	Roadway Factors	Access Points Per Mile	0	100	40	0			8	2
		BFFS	30	80	45	65			60	3
		Terrain Type	N/A	N/A	N/A	N/A			Level	2
		Lane Width	8	14	9	12			12	2,3
		Lateral Clearance	0	12	0	6			6	2,3
		Length of Grade (miles)	0	10	5	0			0	4
		Percent Grade	-100	100	12	0			0	4
		Percent No Passing Zones	0	100	100	0			20	3,A
		Two Lane Class	I	I	I	I			I	4
Arterials	Traffic Factors	BFFS (mph)	30	70	30	60	45	45		4
		K	0.04	1.00	0.13	0.08	0.09	0.09		1
		Midsegment Volume (veh/hr)	0	10,000	0	5,000	User	User		4
		Other Delays (sec)	0	100	0	50	10	10		4
		PHF	0.25	1	0.75	1.00	0.9	0.9		1
		Platoon Ratio	0	1	0.2	0.8	0.6	0.6		4
		Saturated Flow Rate (per lane)	1,300	1,900	1,500	1,900	1,800	1,800		4
		Startup Time Lost (sec)	1	4	1	2.5	1.5	1.5		4
		Total Delay Due To Turns (sec)	0	100	0	50	10	10		4
		Upstream Volume Capacity Ratio	0.2	2.5	1.5	0.5	0.9	0.8		4
	Roadway Factors	Access Points Per Mile	0	60	60	0	25	16		4
		Cycle Length (sec)	60	300	80	200	120	120		4
		G/C Ratio	0	1	0.1	0.6	0.35	0.35		4
		Intersection Width (feet)	24	120	36	84	60	60		4
		Length (feet)	0	100,000	0	20,000	10,000	10,000		4
		Length with Restrictive Median (feet)	0	100,000	0	20,000	2,000	2,000		4
		Number of Lanes (per direction)	1	8	1	4	2	2		4
		Proportion With Curb	0	100	50	100	100	0		4
		Speed Limit	15	60	25	60	45	45		4

Source Information: 1 = NC Traffic Volume Data, 2 = NCHRP Report 599, 3 = Previous NCLOS Default Value, 4 =Professional Judgment
Notes: A = Use 80% in mountainous terrain for limited sight distance

Exhibit 18. North Carolina Recommended Default Data (Continued)

Highway Facility	Maximum Capacity for LOS D under Default Conditions by Highway Facility, Area Type, and Number of Lanes					
	Area Type	Total Number of Lanes				
		2	4	6	8	10
Freeways	Urban	67,600	135,300	202,900	270,600	338,200
	Rural	67,600	135,300	202,900	270,600	338,200
	Suburban	67,600	135,300	202,900	270,600	338,200
Multi-lane Highways	Urban	25,200	50,400	75,600	100,800	126,000
	Rural	30,100	60,200	90,200	120,300	150,400
	Suburban	30,100	60,200	90,200	120,300	150,400
Superstreets	Urban	52,800	105,600	158,400	211,200	263,900
	Rural	52,800	105,600	158,400	211,200	263,900
	Suburban	52,800	105,600	158,400	211,200	263,900
Two-lane Highways	Urban	14,000				
	Rural	14,000				
	Suburban	14,000				
Arterials	Urban	45,700	91,000	203,300	447,800	695,500
	Rural	45,700	91,000	203,300	447,800	695,500
	Suburban	45,700	91,000	203,300	447,800	695,500

Exhibit 19. NCLOS Capacity Outputs for LOS D

Highway Facility	Maximum Capacity for LOS E under Default Conditions by Highway Facility, Area Type, and Number of Lanes					
	Area Type	Total Number of Lanes				
		2	4	6	8	10
Freeways	Urban	78,000	156,100	234,100	312,200	390,200
	Rural	78,000	156,100	234,100	312,200	390,200
	Suburban	78,000	156,100	234,100	312,200	390,200
Multi-lane Highways	Urban	30,900	61,800	92,700	123,600	154,500
	Rural	34,100	68,300	102,400	136,600	170,700
	Suburban	34,100	68,300	102,400	136,600	170,700
Superstreets	Urban	54,600	109,200	163,800	218,300	272,900
	Rural	54,600	109,200	163,800	218,300	272,900
	Suburban	54,600	109,200	163,800	218,300	272,900
Two-lane Highways	Urban	17,000				
	Rural	17,000				
	Suburban	17,000				
Arterials	Urban	46,500	91,600	246,300	584,300	919,000
	Rural	46,500	91,600	246,300	584,300	919,000
	Suburban	46,500	91,600	246,300	584,300	919,000

Exhibit 20. NCLOS Capacity Outputs for LOS E

4. Software Program

The North Carolina Level of Service (NCLOS) program is an implementation of the 2010 Highway Capacity Manual. The development of the software program took the form of a visual display of AADT plotted against the MOE for each facility type in addition to best case, worst case, and default case scenarios.

The best case input values are the required value for each factor that produces the maximum positive affect on the output. The worst case input values are the required value for each factor that produces the maximum negative affect on the output. For the default case input values, NCDOT desired to have values for each factor representative of the average facility for urban, suburban, and rural planning. Exhibit 21 shows the introductory screen of NCLOS which prompts the user to define and create a project. A full description of the program, in the form of the user manual, is included in Appendix A.

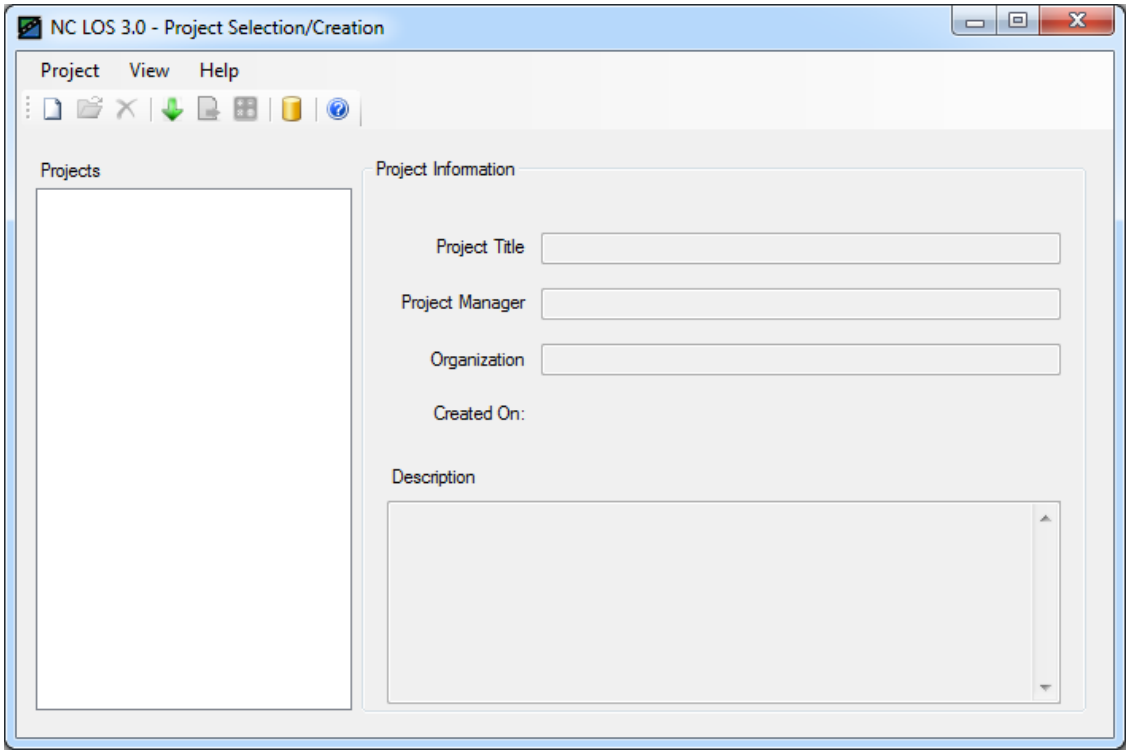


Exhibit 21. NCLOS Program Project Selection/Creation Screen

5. Conclusions and Recommendations

The project team recommends that the NCLOS program be utilized to determine capacities and service volumes for various highway types throughout the state. The updated program will allow for these values to be determined in a consistent, user-friendly manner, geared specifically at conditions prevalent to the highway systems of North Carolina. The visual aspect of the program, provided by the best and worst cases on each graph, allow for an intuitive assessment of the output, and interpreting the subject segment performance relative to the range of expected conditions in North Carolina. The user can attempt various scenarios by altering the input values to represent possible design considerations for each particular highway.

Although the main result of the program is this graphical interface, the program also enables the user to produce a numerical report detailing the results of the analysis as well as the ability to export the calculated capacity to the TransCAD® system model.

With the updates performed under this project, NCLOS has been enhanced to reflect the state-of-the-art operational methodologies in the 2010 Highway Capacity Manual, assuring that NCDOT analysis practices are consistent with national best practice. Through updated input values, the procedures have been calibrated to reflect specific observed conditions within the state of North Carolina. However, it is emphasized that default values should always be scrutinized for any new facility, and local adjustments should be made for facilities that fall outside the range of defaults. The analysis of default values generally showed few trends across facility types and geographic region, although various outlier locations were observed for any of the data points. So while the defaults appear to provide a good general representation if expected conditions in North Carolina, user judgment should always be applied to unusual sites.

6. Implementation and Technology Transfer Plan

The primary result of this project is the redevelopment of a program for calculating capacities for highways, in the form of a web-based program updated to 2010 HCM procedures. This new NCLOS tool is geared specifically to North Carolina by populating geometric and traffic defaults with values representing average conditions throughout the state. Using the 2010 HCM as the backbone for the calculations, a graphical interface was developed that allows rapid, visual feedback on various planning options and their effect on the LOS and capacity for a particular highway segment. Output capacities will be used in travel demand forecasting models, and in developing Comprehensive Transportation Plans (CTPs) based on the 2010 HCM procedures. Output values will be used in the statewide travel demand model now under development. NCLOS will provide data for the Performance Metrics Dashboard and data used as a scoring component in the Strategic Prioritization Process and Urban Loop Prioritization Process.

Secondary products related to the project include the development of default data for various regions, highways types, environments, and system characteristics present throughout the state. These defaults were based on both data provided by the Department and the collective expertise and experience of the Transportation Planning Branch staff and the research team.

The research team anticipates that the new NCLOS program will be used in similar applications to the current version and that a minimal amount of training will be needed. Training in the program was provided during interim meetings and the research team will be available for future training, if needed. It is expected that some training on the new application will be provided by NCDOT, with support from the research team. Training workshops would last about 2 to 4 hours depending on how many examples are used.

7. References

Fain, S.J., C.M. Cunningham, R.S. Foyle, and N.M. Rouphail. "NCDOT Level of Service Software Program for Highway Capacity Manual Planning Applications." North Carolina Department of Transportation Report FHWA/NC/2006-06. August 2006.

Transportation Research Board (TRB), National Research Council. *"2000 Highway Capacity Manual."* Washington D.C., 2000.

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Zegeer, J.D., M. Vandehey, M. Blogg, K. Nguyen, and M. Ereti. (2008). *Default Values for Highway Capacity and Level of Service Analyses*. NCHRP Report 599. Transportation Research Board (TRB), National Research Council.

Appendix A: NCLOS User Guide

NC Department of Transportation

Highways

Level of Service User Guide

Table of Contents

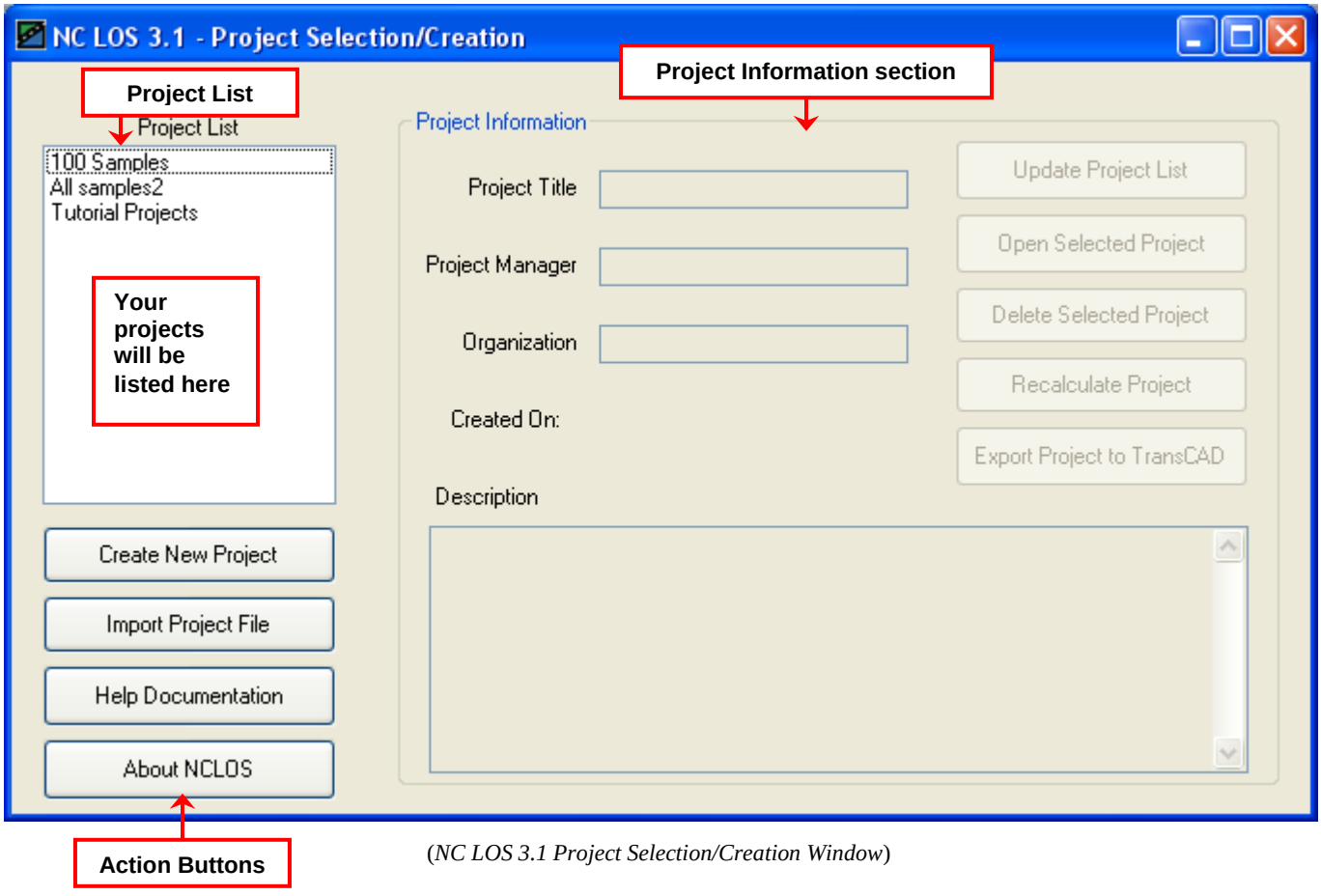
Chapter 1 Application Access

The Project Selection/Creation Window

When the PCS Manager application is launched, you will see the **Project Selection/Creation** window. This window will serve as the application dashboard.

The **Project Selection/Creation** window is made up of 3 parts:

1. The Project List
2. Action Buttons
3. Project Information section



(*NC LOS 3.1 Project Selection/Creation Window*)

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The Project Selection/Creation Window

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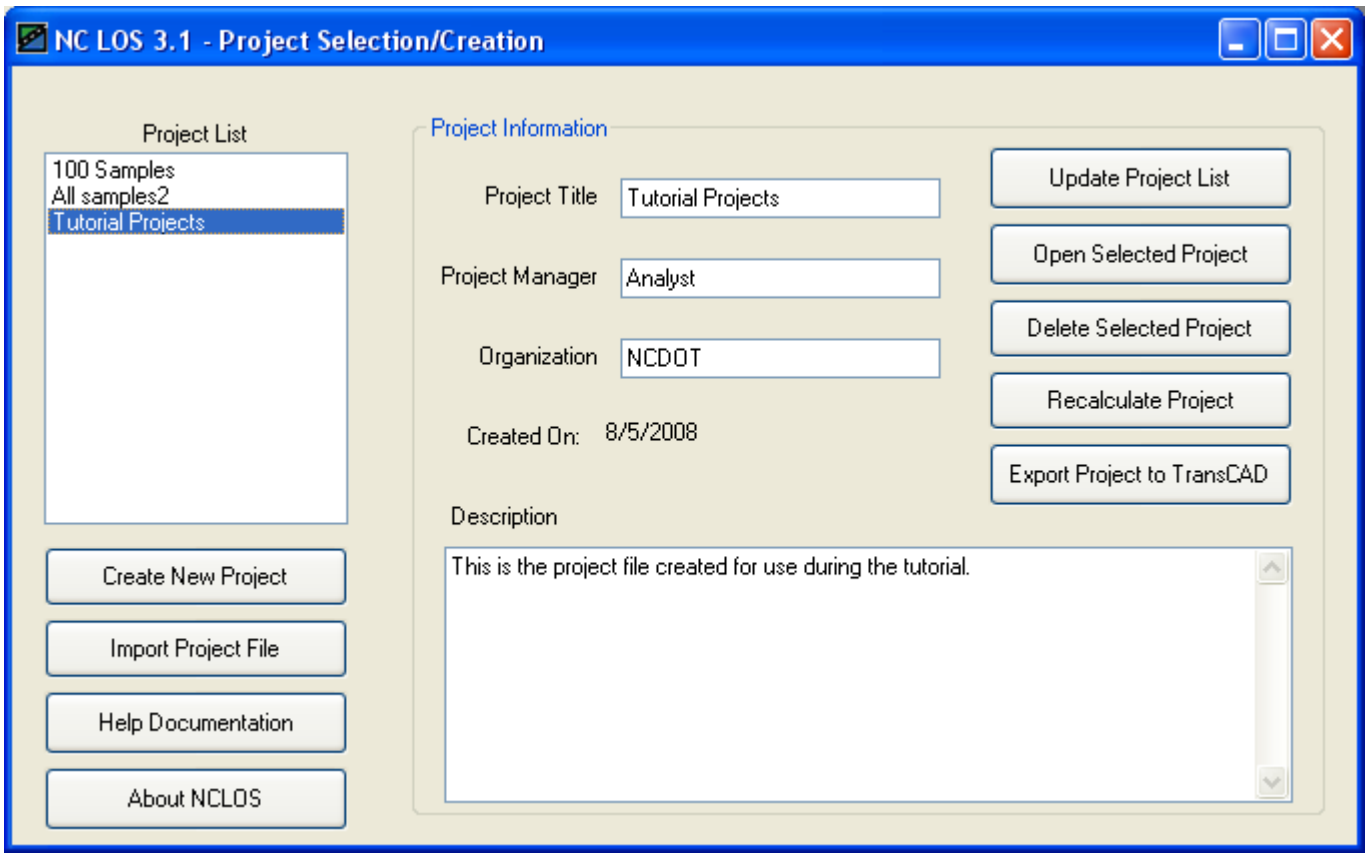


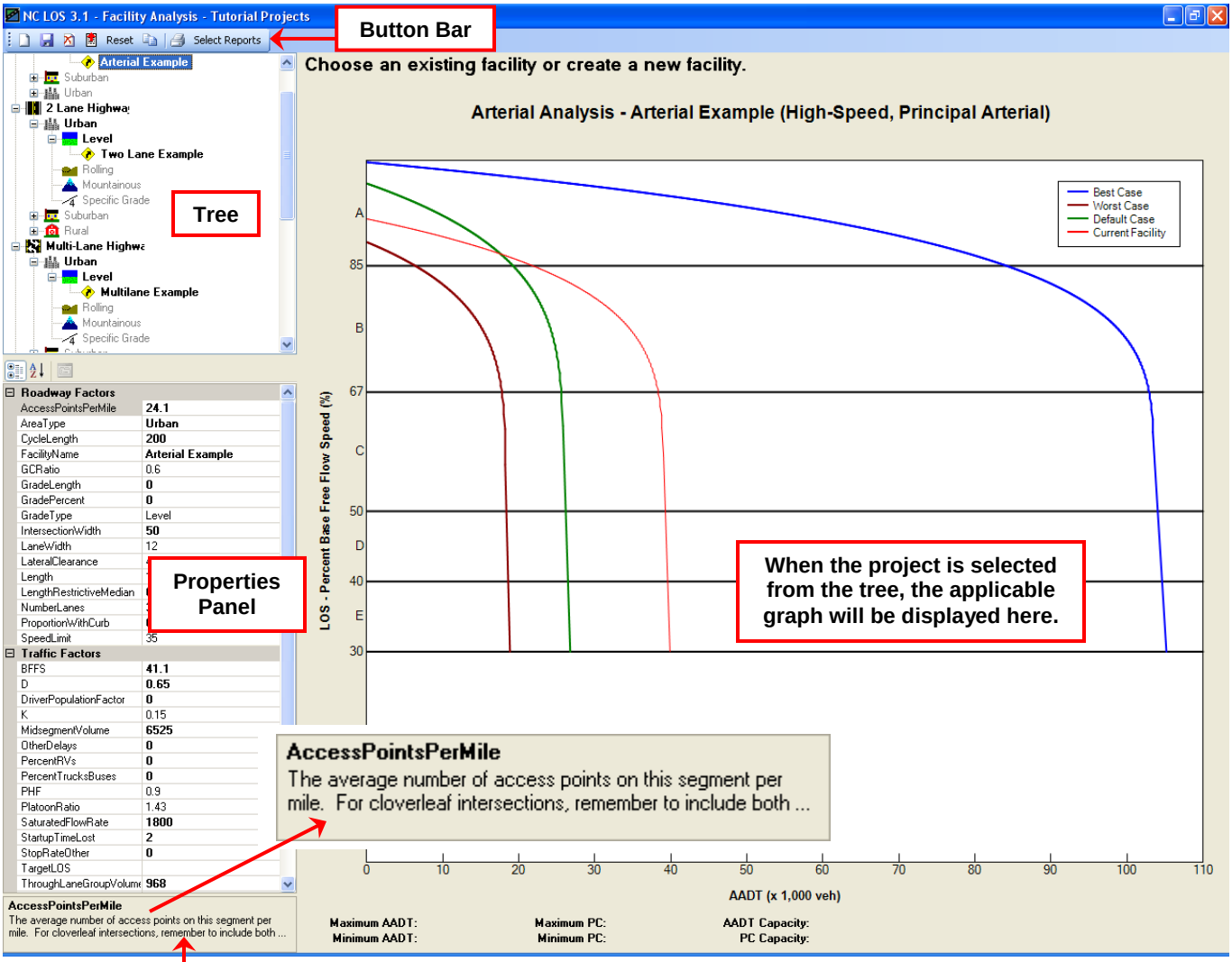
(*NC LOS 3.1 Project Selection/Creation Window*)

When you select a project from the **PROJECT LIST**, information about the project will be displayed in the **PROJECT INFORMATION** section.

The buttons on the right will provide access to features needed to edit, recalculate or delete the selected project.

The Facility Analysis Window

When you open a project, the **Facility Analysis** window will appear. This window will provide detailed information about the project.



(*Facility Analysis Window*)

Continued on Following Page

The Facility Analysis Window

continued

The Button Bar

A button bar will appear at the top of the **Facility Analysis Window**. These buttons will contain the following functions:

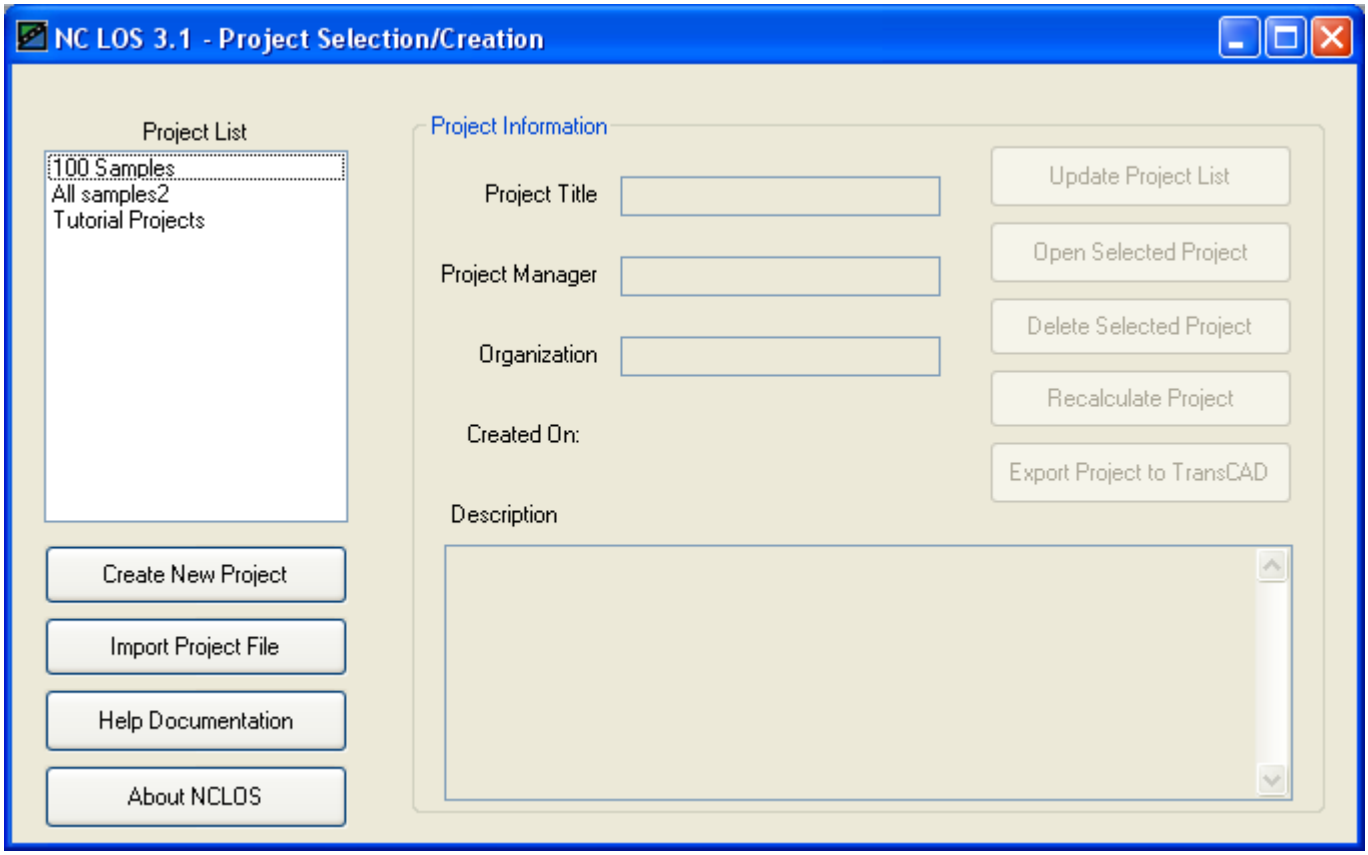
	**Create New Facility:** Click this button to launch the ***Create New Facility*** dialog.
	**Save Facility Information:** If you have made changes to the information in this window, click this button to save them.
	**Delete Facility:** Click this button to delete the selected facility.
	**Reset:** Click this button to reset the facility information to the application defaults.
	**Copy Facility:** Click this button to copy the information from the currently selected facility to a new facility.
	**Preview Reports:** Click this button to launch the currently selected facility report in a print preview window.
	**Select Reports:** Click this button to launch a dialog that will allow you to select the reports you wish to print.

Chapter 2 Procedures

Creating a New Project

Once you have created a new project, you will be able to view/edit data by following the **Viewing / Editing Project Data** procedure on page **2-8**.

From the **Project Selection/Creation** window:



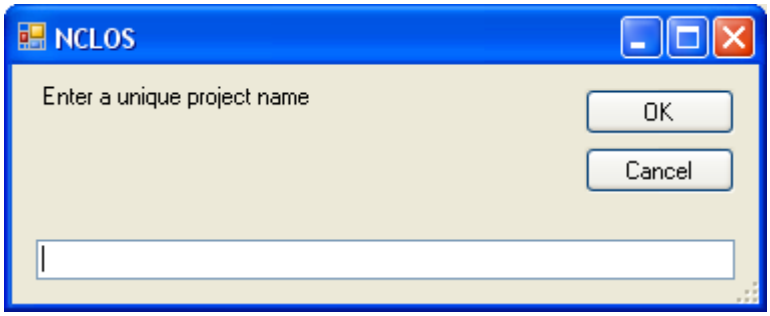
(*NC LOS 3.1 – Project Selection/Creation Window*)

Step	Action	Result
1	Click the Create New Project button.	The **Create New Project** dialog will appear.

Continued on Following Page

Creating a New Project

(continued)



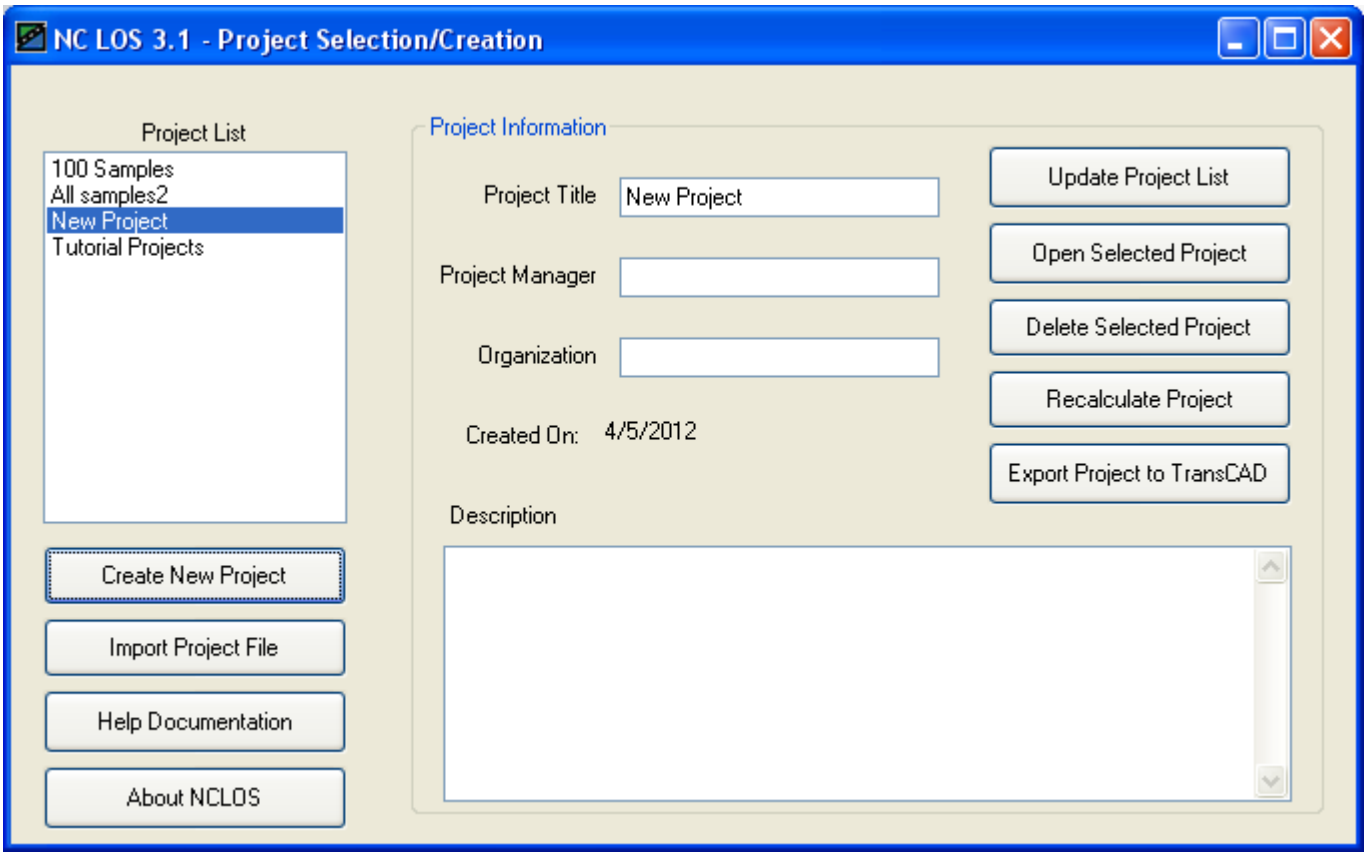
(*Create New Project Dialog*)

2	Type the **name of the new project** in the **ENTER A UNIQUE PROJECT NAME** field.	N/A
3	Click the **OK** button.	The new project will appear in the **Project List**.

Continued on Following Page

Creating a New Project

(continued)



(*NC LOS 3.1 – Project Selection/Creation Window (New Project)*)

In the **Project Information** section:

NOTE: The **PROJECT TITLE** field will be populated with the project name. You will be able to edit this information if needed.

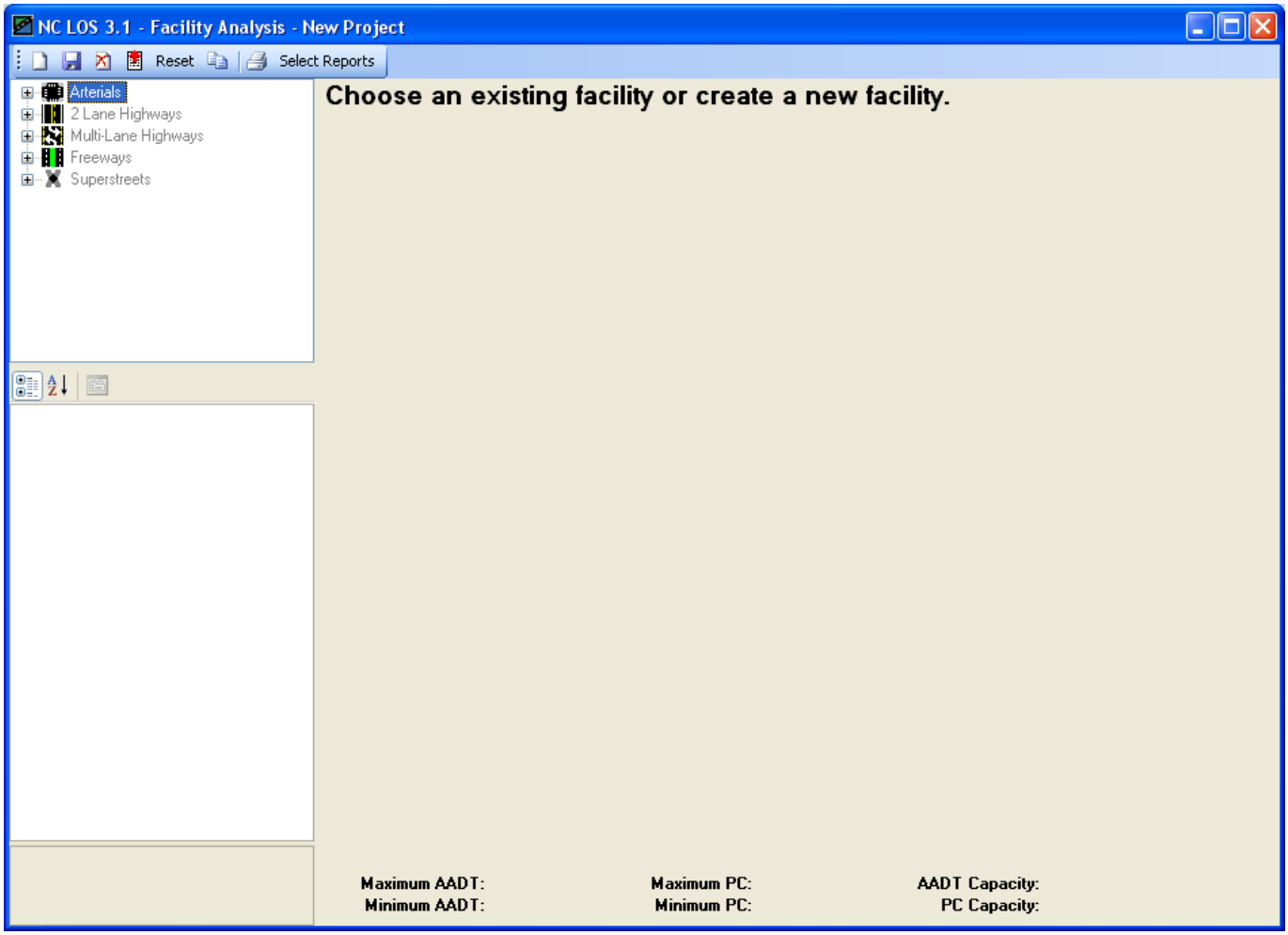
4	Type the **name of the project manager** in the **PROJECT MANAGER** field.	N/A
5	Type the **name of the organization** in the **ORGANIZATION** field.	N/A
6	Type a **description of the project** in the **DESCRIPTION** field.	N/A

Continued on Following Page

Creating a New Project

(continued)

7	Click the Open Selected Project button.	The **Facility Analysis** window will appear.



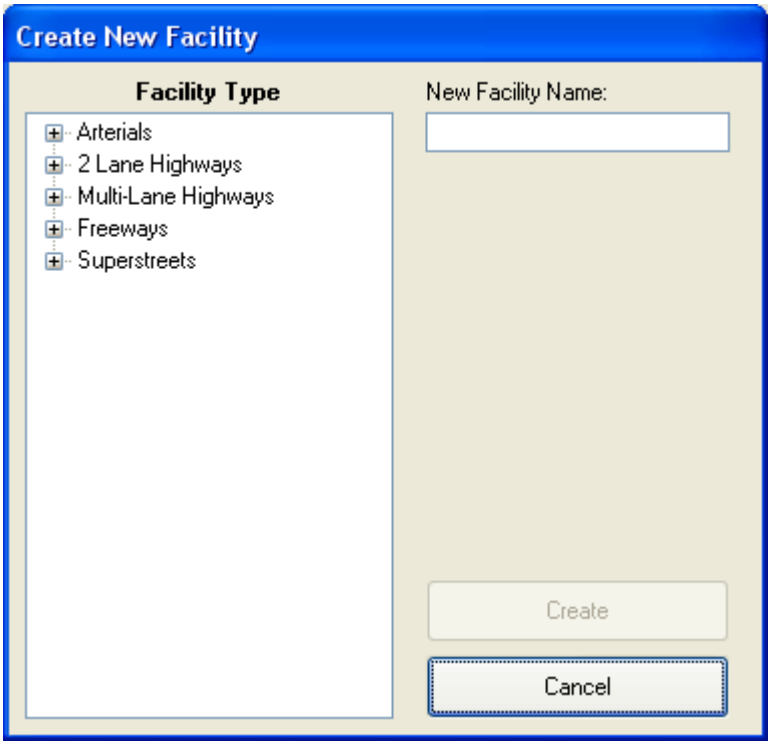
(*Facility Analysis Window*)

8	Click the button.	The **Create New Facility** dialog will appear.

Continued on Following Page

Creating a New Project

(continued)



(*Create New Facility Dialog*)

9	Type the **name of the new facility** in the **NEW FACILITY NAME** field.	N/A
10	In the **FACILITY TYPE** section, expand the tree for the applicable category and select the correct attribute. The categories are: • Arterials • 2 Lane Highways • Multi-Lane Highways • Freeways • Superstreets	N/A

Continued on Following Page

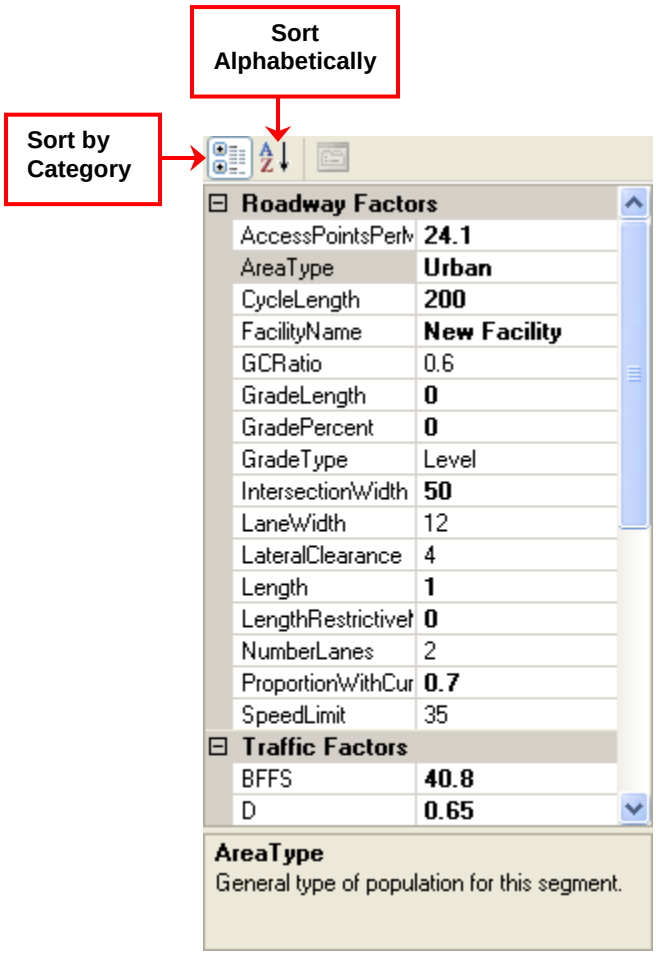
Creating a New Project

(continued)

11	Click the **CREATE** button.	The information for the new facility will be displayed in the **Facility Analysis** window.

Repeat steps **9 - 11** to add additional facilities.

Each facility will have its own set of properties.



(*Properties Panel*)

Continued on Following Page

Creating a New Project

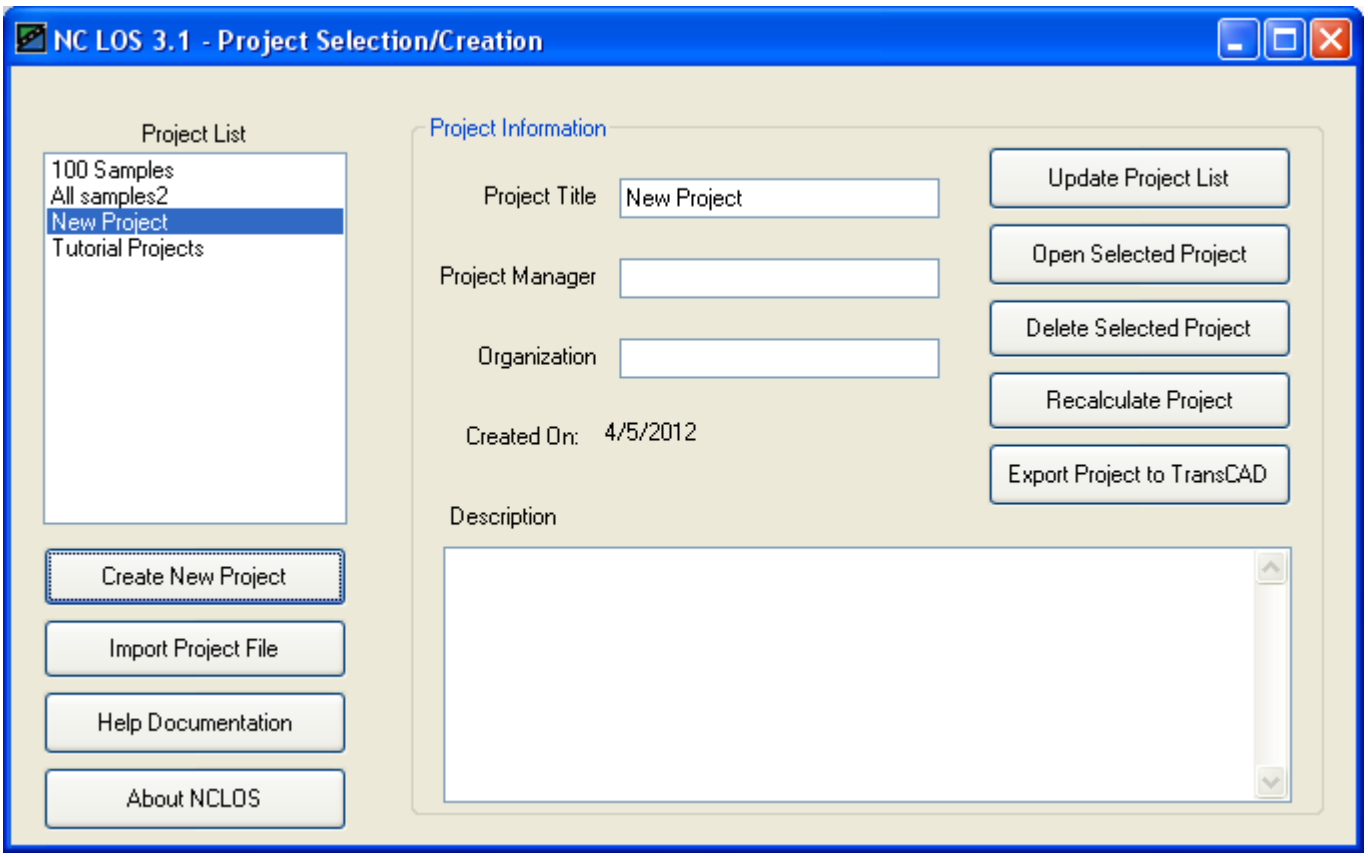
(continued)

12	In the tree, click on the facility name to reveal the list of properties. (Roadway and Traffic Factors)	The list of properties for the selected facility will appear in the **Properties** panel.
13	Type the value of each property in the associated field. 🗁**NOTE:** Some values will default. You will be able to edit them if needed.	N/A
14	Click the  button.	The new project (and facilities) will be saved.

Viewing / Editing Project Data

If you need to view/edit project data, you can do so by following this procedure.

From the **Project Selection/Creation** window:



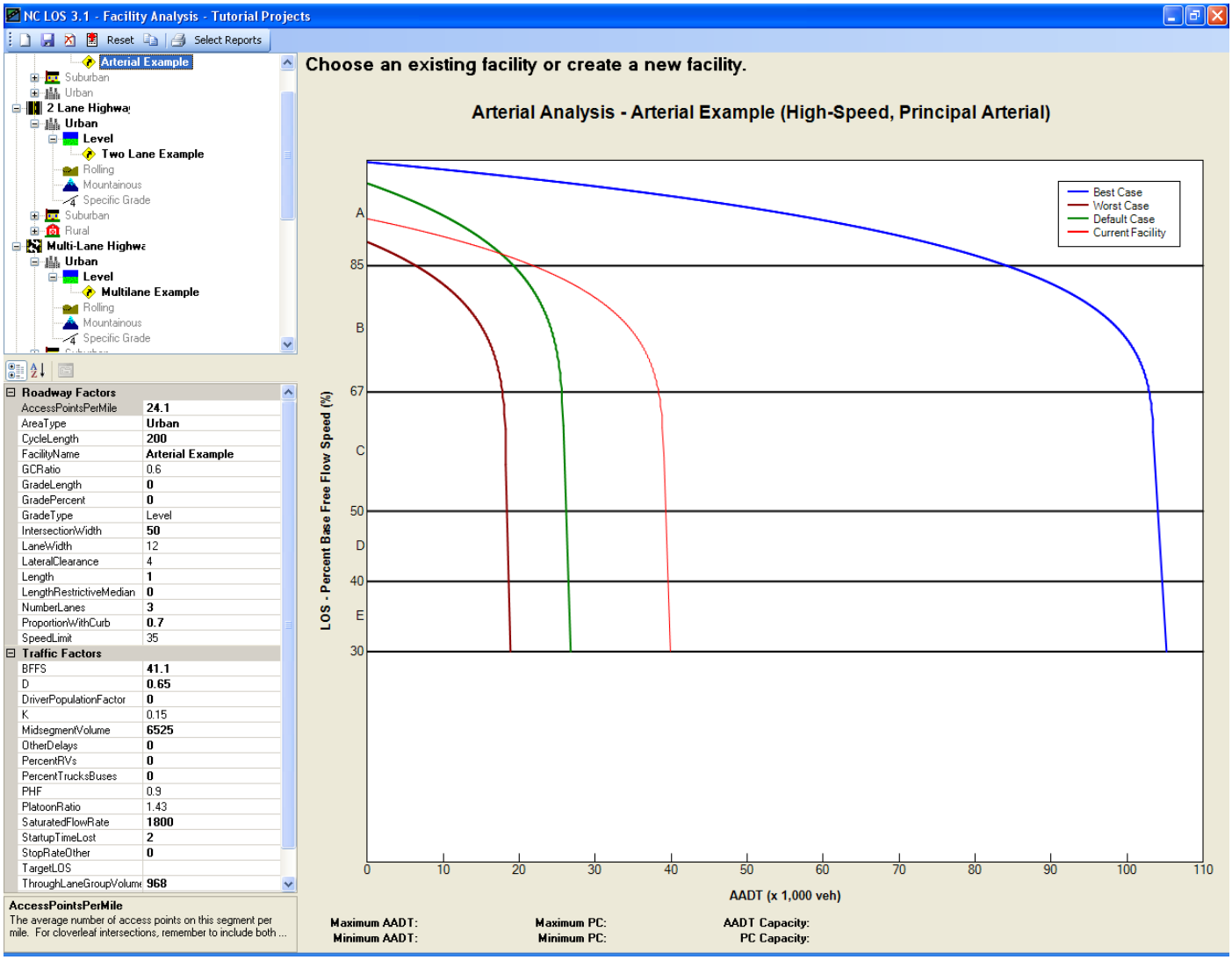
(*NC LOS 3.1 – Project Selection/Creation Window*)

Step	Action	Result
1	Select the **project** from the **Project List**.	The **Project Information** fields will populate with project data.
2	Click the Open Selected Project button.	The **Facility Analysis** window will appear.

Continued on Following Page

Viewing / Editing Project Data

(continued)



(*Facility Analysis Window*)

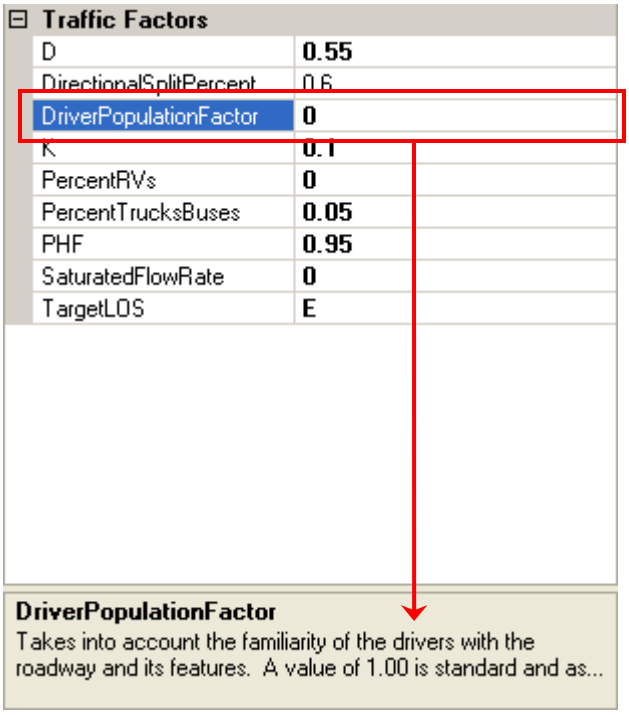
3	Select the **facility you wish to edit** from the tree.	The applicable data fields will appear in the Properties panel.
4	You will be able to edit any information in the data fields.	N/A

Continued on Following Page

Viewing / Editing Project Data

(continued)

🗁**NOTE:** For field-sensitive help, click on the applicable field. Help will appear below.

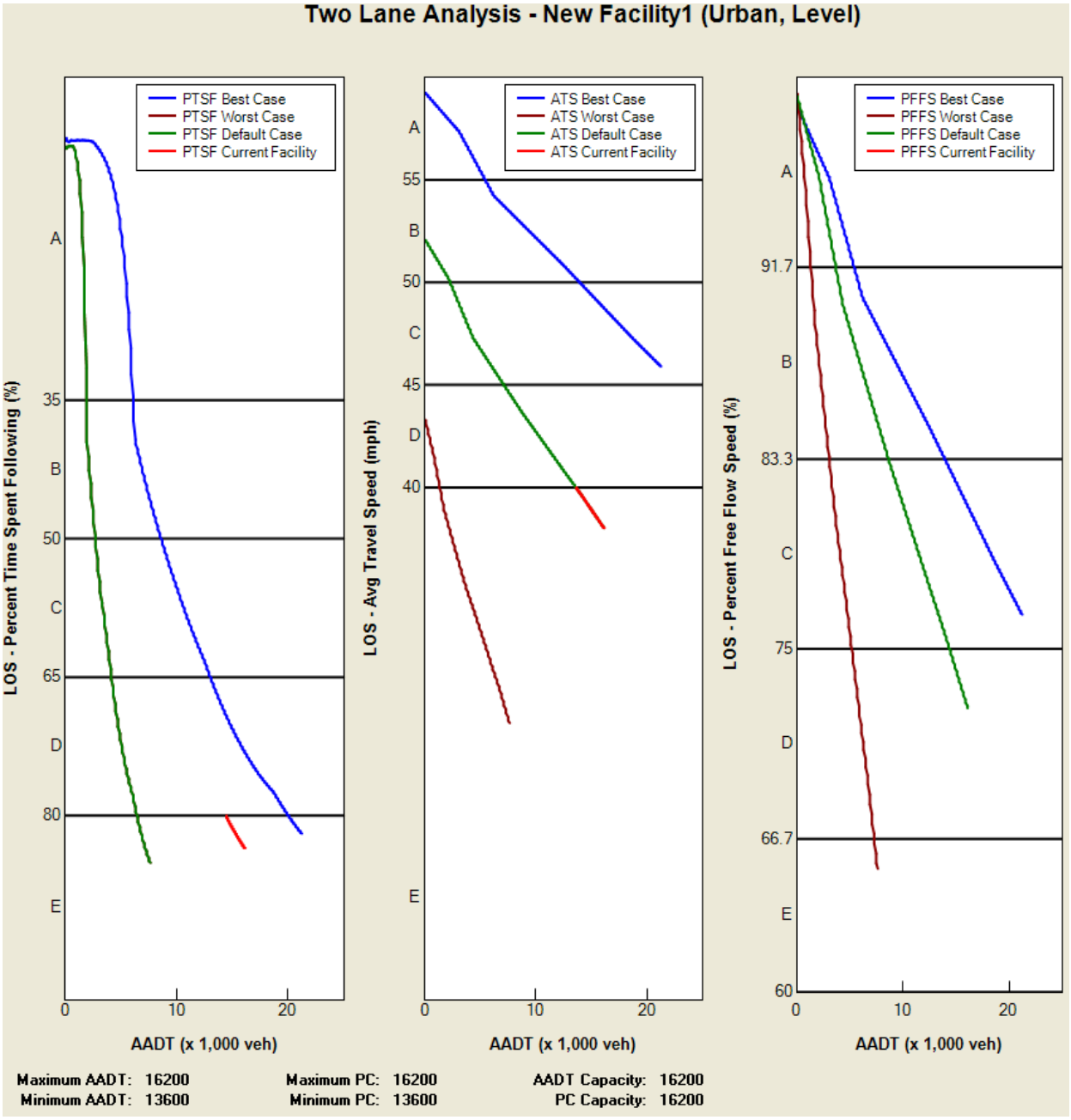


5	Once you have selected a facility from the tree, the applicable analysis graph will appear in the right panel.	N/A

Continued on Following Page

Viewing / Editing Project Data

(continued)



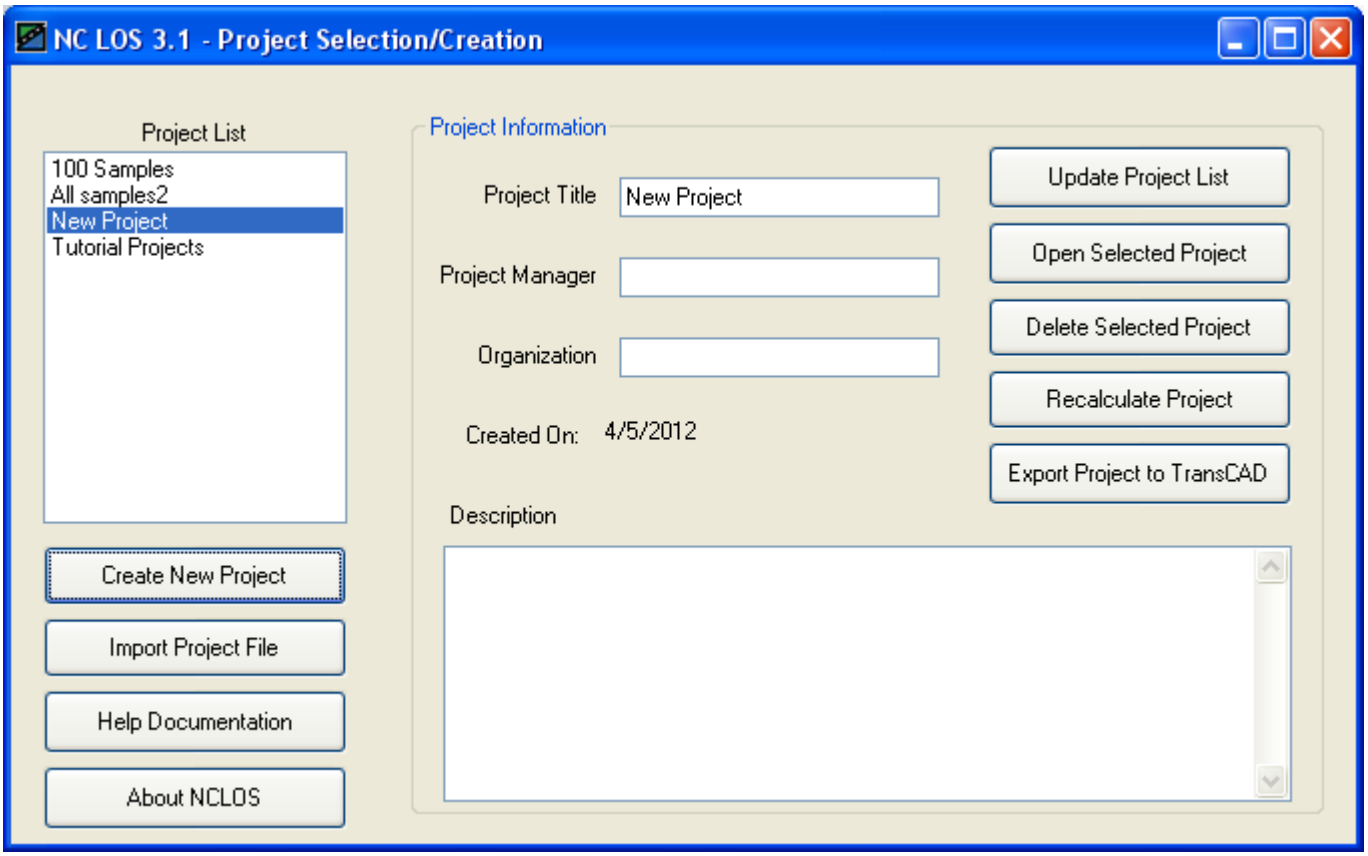
(*Facility Analysis Graph*)

6	Click the  button.	Your edits will be saved.

Deleting a Facility

If you wish to delete a facility from a project, you can do so by following this procedure.

From the **Project Selection/Creation** window:



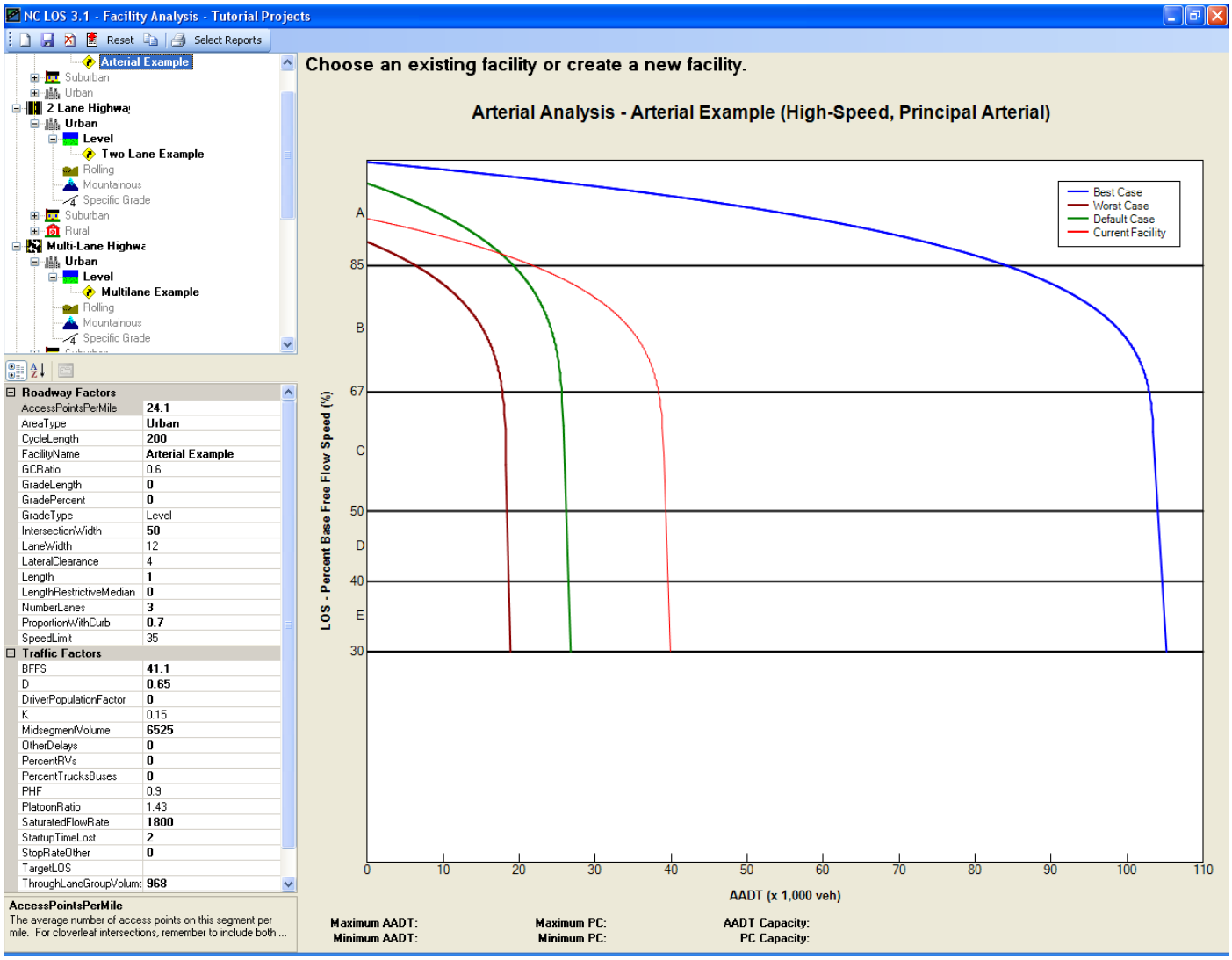
(*NC LOS 3.1 – Project Selection/Creation Window*)

Step	Action	Result
1	Select the **project** from the **Project List**.	The **Project Information** fields will populate with project data.
2	Click the Open Selected Project button.	The **Facility Analysis** window will appear.

Continued on Following Page

Deleting a Facility

(continued)



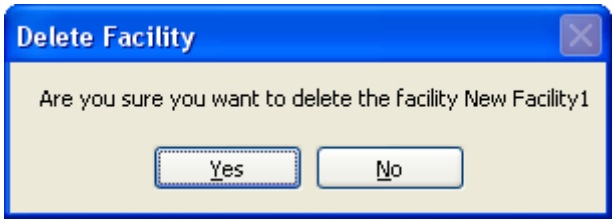
(*Facility Analysis Window*)

3	Select the **facility you wish to delete** from the tree.	The applicable data fields will appear in the Properties panel.
4	Click the  button.	The **Delete Facility** popup will appear.

Continued on Following Page

Deleting a Facility

(continued)



(*Delete Facility Popup*)

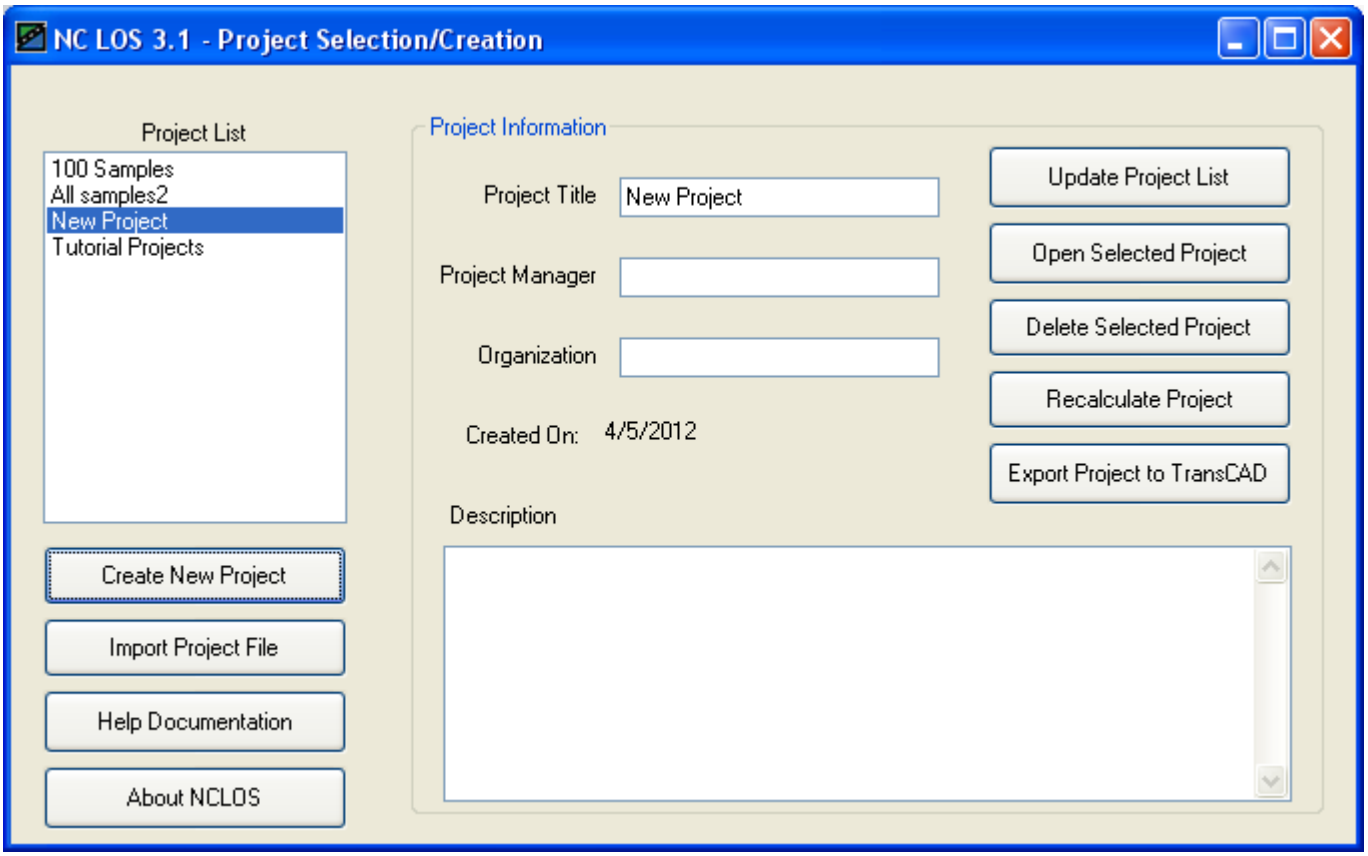
5	Click the **YES** button.	After a few seconds, the facility will disappear from the tree.

Deleting a Project

If you wish to delete a project, you can do so by following this procedure.

🗁**NOTE:** Deleting a project will also delete the facilities attached to it.

From the **Project Selection/Creation** window:



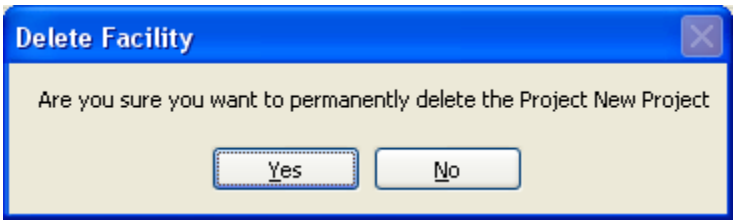
(*NC LOS 3.1 – Project Selection/Creation Window*)

Step	Action	Result
1	Select the **project** from the **Project List**.	The **Project Information** fields will populate with project data.
2	Click the Delete Selected Project button.	The **Delete Project** popup will appear.

Continued on Following Page

Deleting a Project

(continued)



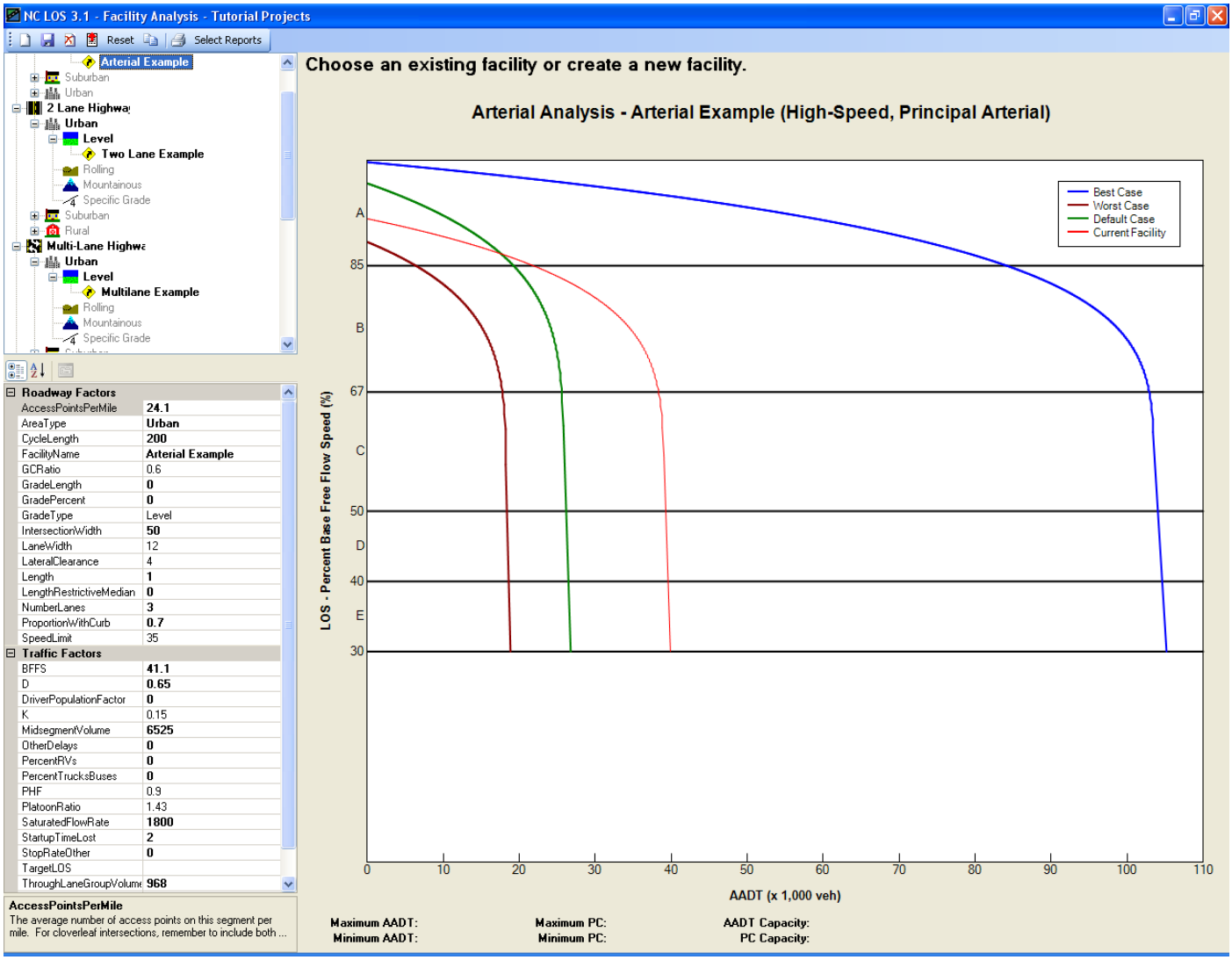
(*Delete Facility Popup*)

3	Click the **YES** button.	The project will disappear from the list.

Chapter 3 Reports

Selecting and Previewing Reports

From the **Facility Analysis** window:



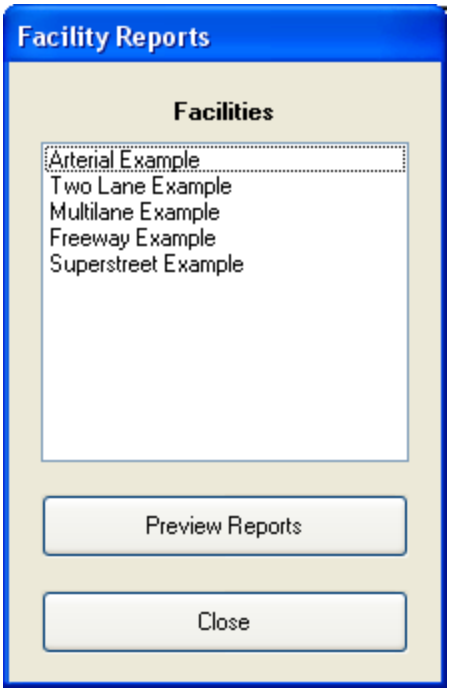
(*Facility Analysis Window*)

Step	Action	Result
1	Click the Select Reports button.	The **Facility Reports** dialog will appear.

Continued on Following Page

Selecting and Previewing Reports

(continued)



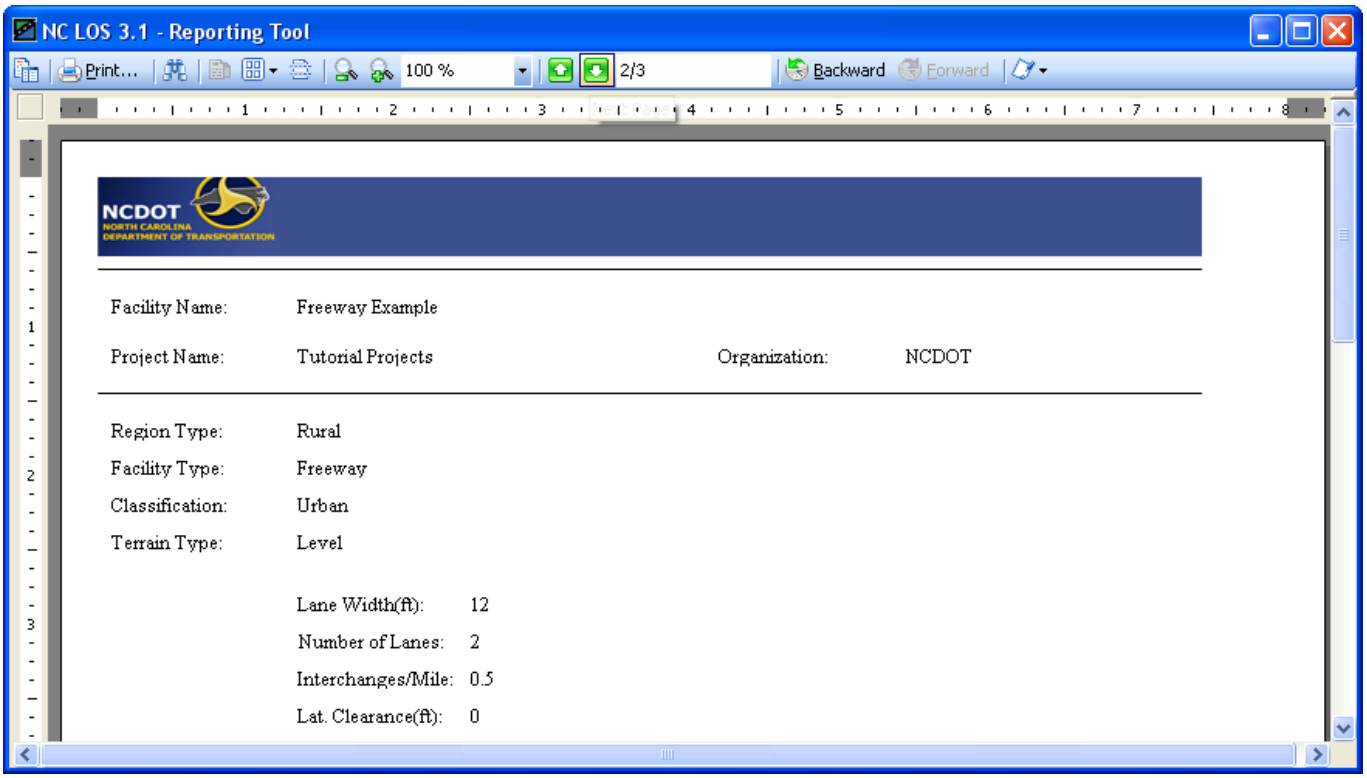
(*Facility Reports Dialog*)

2	Select the report(s) you wish to view. 🗁**NOTE:** To select subsequent reports, hold down your ⇧ key and select the first, then the last in the list. To select individual reports, hold down your Ctrl key and select each report.	N/A
3	Click the **PREVIEW REPORTS** button.	The selected reports will appear.

Continued on Following Page

Selecting and Previewing Reports

(continued)



(*Reporting Tool Window*)

The following toolbar will appear at the top of the window.