MONROE COUNTY
TRAFFIC REPORT GUIDELINES MANUAL

FOR TRANSPORTATION SITE IMPACT ANALYSIS

MONROE COUNTY, FLORIDA

MAY 2017

Prepared by

URS

URS Project Number 38620007.00000

URS CORPORATION SOUTHERN
7800 Congress Avenue, Suite 200, Boca Raton, Florida 33487

Table of Contents

The Monroe County Planning Department retained URS Corporation Southern Inc., an AECOM company, to review and modify its present Traffic Report Guidelines Manual to strengthen the County's ability to manage transportation site impact studies. In order to emphasize the County's commitment to a multimodal transportation system, the ***Traffic Report Guidelines Manual*** **now includes the subtitle,** ***for Transportation Site Impact Analysis***. This document, hereafter referred to as the Manual, is intended to provide detailed guidance to developers about the scope, required elements, time-frames, and technical analyses that should be addressed during the development review process. It is also hoped that this Manual will assist the County, their staff members, and others involved in the development process in streamlining and expediting important projects within the County. Please note that the County requires firms to be pre-qualified in order to prepare transportation site impact studies. A list of pre-qualified firms is available from the Monroe County Planning and Environmental Resources Department.

The last update of the Manual was conducted in 1995. The Monroe County Land Development Code, Monroe County Comprehensive Plan, Florida Department of Transportation (FDOT) and national industry standards for the analysis of transportation site impact studies have changed over the last twenty years necessitating the update of the Traffic Report Guidelines Manual. The current update includes relevant procedures, guidelines and requirements from four major sources including: ***Monroe County Comprehensive Plan, Monroe County Land Development Code, FDOT Transportation Site Impact Handbook*** and ***ITE Transportation Impact Analyses for Site Development***.

The Manual explains when a study should be developed, the type and amount of information that is needed for the analysis, the study area, time-frames that should be encompassed in the report, and how the study findings should be properly documented. As always, no written document outlining the requirements of transportation site impact studies within the County will address every issue and situation that may arise out of the site development process. Therefore, the application of professional judgement by the County's staff members and their experience in the development review process will help the County's ongoing efforts to sustain a desirable quality of life for its residents.

The Manual is designed as a general desktop reference. Given the changing nature of laws and professional practice, keeping information within this manual up to date is challenging. Periodic updates and clarifications are expected. References to other resources, which address specific issues in greater detail and reduce the need for updates to the Manual, have been included throughout the document.

2.1 NEED FOR TRANSPORTATION SITE IMPACT STUDIES

The Monroe County Land Development Code (LDC) requires transportation site impact studies for some, but not all, types of development. Monroe County requires developers of projects to prepare a written analysis of how their proposed projects will be designed to meet the physical and operational requirements of the County with respect to site parking, internal circulation, access and impacts to the adjacent multimodal transportation system. The size, location, and intensity of land uses within the development will bring varying levels of impact on the County in general, and within the project area in particular. Well prepared transportation site impact studies should:

- Provide a mechanism for managing transportation impacts of land development within the context of transportation planning, local government comprehensive planning, and concurrency;
- Provide applicants with recommendations for effective site transportation planning;
- Document the methods for analyzing the effects of development on the transportation system;
- Establish a framework for mitigation measures for the impacts created by the development;
- Promote coordination with FDOT when US-1 will be impacted by a proposed development; and
- Promote a multimodal transportation system where appropriate.

US-1 (the Overseas Highway) extends from Key West to the Florida mainland with no major roads intersecting it. Furthermore, no other principal arterial serves the Keys or the Keys' residents and tourist population, which collectively consists of over 150,000 people. Its unique geography, land use patterns and trip making characteristics warrants an alternative Level of Service (LOS) evaluation process to that found in the Highway Capacity Manual.

1991, a uniform method was developed by the US-1 Level of Service Task Force to assess LOS on US-1 to cover both its overall arterial length from Key West to Florida's mainland, and 24 separately delineated roadway segments. The methodology was developed from basic criteria and principles contained in Chapters 7 (Rural Multilane Highway), Chapter 8 (Rural Two-Lane Highways) and Chapter 11 (Urban and Suburban Arterials) of the 1985 Highway Capacity Manual. The methodology established a procedure for using travel speeds as a means of assessing the Level of Service and Reserve Capacity of US-1 in the unique setting of the Florida Keys Overseas Highway. The methodology is attached as **Appendix A.**

Based on the above methodology, Monroe County has been conducting Travel Time & Delay Studies on US-1 since 1991 on an annual basis until 2013, and on a biennial basis thereafter. These studies help establish the travel speeds and reserve capacities on each of the 24 delineated roadway segments on US-1. These reserve capacities serve to monitor the Level of Service on US-1 for concurrency management purposes pursuant to Chapter 163 of the Florida Statues, the Monroe County Comprehensive Plan, and Chapter 114 of the Monroe County Land Development Code. The reserve capacities of the US-1 segments help in the determination of constrained and un-constrained segments on US-1.

2.2 TRANSPORTATION SITE IMPACT STUDY THRESHOLD

The Institute of Transportation Engineers (ITE) reports that communities around the country are addressing the need for traffic studies in a variety of ways. The ITE data show that the following situations, or thresholds, usually trigger the need for a study:

- When development will generate a specific number of peak hour trips
- When the development will generate a specific number of daily trips
- When a specific amount of acreage is proposed for rezoning
- When the development contains a specified number of dwelling units or square footage
- When the development will occur in a sensitive area from a traffic circulation, neighborhood impact or environmental standpoint
- When financial assessments are required and the extent of project impact must be determined
- When a previous transportation site impact study for a development has been deemed out of date

Although there is little consistency in the specific threshold quantities for some of these criteria, ITE recommends that a quantitative threshold be developed by a municipality that relates directly to the cause of traffic needs and impacts, such as trips generated during peak or design hours. These quantitative thresholds should be developed based on local needs, issues, and policies and may vary among agencies due to local conditions and priorities.

It is not the intent of the County to require a traffic study for every new development. The determination of the need for a traffic impact report will depend upon the following two factors:

- Gross Daily Trip Generation for the proposed development using the latest edition of the ***ITE Trip Generation Manual***, and
- The location of the project site relative to certain constrained US-1 segment(s).

Based on the results of the Travel Time and Delay Study conducted biennially on US-1, adequate, marginally adequate, and inadequate capacity segments on US-1 are identified by the County in its biennial assessment of public facilities, and may vary between studies. The developer should obtain this information from the County so as to ascertain the project's impact area. The minimum threshold for developments proposed in certain areas identified by the County as having inadequate, or marginally adequate, roadway capacity is 11 gross trips per day. Any development expected to generate 11 trips per day or more in an area with inadequate or marginally adequate roadway capacity, is required to submit a traffic impact report with the development proposal. However, if any development is expected to generate 250 gross trips per day or more, a traffic impact report will be mandatory regardless of the project's location. **Table 2.1** on page 2-3 presents a summary of traffic study level thresholds.

The "gross" trips are defined as the total trips generated by the entire development, and not merely the net increase or decrease in trips due to the expansion or reduction in the size of an existing development. For example, if an existing development generating 240 trips per day is proposed for an expansion resulting in an increase of 50 trips per day, the gross trips for the development will amount to 290 (240+50) trips per day. These gross trips will dictate the level of transportation site impact study required, if any.

TABLE 2.1 – TRANSPORTATION SITE IMPACT STUDY THRESHOLD

Gross Daily Trip Generation(1)	**Project Location**	**Type of Report Required**
11 – 249	Segments of US-1 designated as Inadequate Capacity or Marginally Adequate Capacity according to the biennial assessment of public facilities capacity report (LDC Sec. 114-2)	Level 1
250 – 500	All Areas	Level 2
> 500	All Areas	Level 3

(1) The "gross" trips are defined as the total trips generated by the entire development, and not merely the net increase or decrease in trips due to the expansion or reduction in the size of an existing development.

For developments that do not require a transportation site impact study, a Transportation Statement should be submitted to document compliance with the established thresholds. The transportation statement should include the following information for proper review: Brief site description (address/location, land use and density), daily trip generation, and site plan. For developments that require a transportation site impact study, **a Traffic Analysis Methodology Memorandum is recommended in advance of the study report**.

If a new development or modifications to an existing development results in a gross trip generation which meets or exceeds the minimum threshold stated under Section 2.2 or when a previous transportation site impact study for the development has been deemed out of date, a transportation site impact study will be required. The impact of a given development will depend upon the land-use type, size, and location of the development. Depending on the potential extent of impact, the Monroe County Land Development Code specifies three levels of transportation site impact studies. The requirements specified for each level should be regarded as guidance. The requirements for individual studies will vary based on the specific conditions of the subject application site.

Level 1 is the least extensive and Level 3 the most extensive traffic study. However, in deciding how extensive each of these three levels of studies should be, the County will focus on the issues and needs of the specific situation. In thinking about these issues, the developer should contact the County to determine if any special traffic-related issues should be addressed in the study in addition to the standard study elements described in the following Sections. Achieving early consensus on the study assumptions and expected study products will save everyone's time and resources. Traffic studies shall not be required for applications for a single-family residence.

Level 1 traffic studies shall include the following:

a. Provide a detailed assessment of the number of additional daily trips generated by the development as calculated by the most current edition of the ITE Trip Generation Manual;

b. Analysis shall be based on the project's expected trip generation broken into primary, pass-by, and internal trips, as well as the directional split and trip lengths to estimate the number of additional primary trips on US-1;

c. The report shall provide recommendations for mitigating any project trips in excess of the LOS C standard; and

d. The applicant shall be responsible for construction of the improvements recommended in the study

Based on the specific conditions of the subject application site, a Level 1 traffic study may need to include the following additional items:

e. Ensure adequate access to the street system. All access driveways into the development shall be analyzed and evaluated for traffic operations, safety and visibility

f. The data shall include background traffic (existing traffic plus traffic from approved projects) and proposed project traffic;

g. The study shall also include traffic diagrams detailing the existing peak hour traffic count (if applicable) and projected future turning movements at access driveways;

h. The applicant shall be responsible construction of the improvements recommended in the study; and

i. Any recommendation for a traffic signal will require an alternatives analysis.

Level 2 traffic studies shall include all elements of a Level 1 study, plus the following:

a. Ensure adequate access to the street system;

b. The study shall also include traffic diagrams detailing the peak hour and AADT traffic counts at intersections and turning movements;

c. The data shall include background traffic (existing traffic plus traffic from approved projects) and proposed project traffic;

d. Any recommendation for a traffic signal will required an alternatives analysis;

e. All roadways and intersections along the access routes shall be evaluated for traffic safety and visibility; and

f. The study shall recommend improvements necessary to meet the accepted traffic standards for Monroe County.

Based on the specific conditions of the subject application site, a Level 2 traffic study may need to include the following additional items:

g. All signalized and major un-signalized intersections within one mile of the development shall be analyzed; and

Level 3 traffic studies shall include all elements of both Level 1 and Level 2 studies, plus the following:

a. Ensure all intersections serving the development will operate at or above the County's LOS standards;

b. All signalized and unsignalized intersections within one mile of the development shall be analyzed; and

c. The study shall recommend mitigation measures for deterioration of LOS at signalized and/or unsignalized intersections.

Based on the specific conditions of the subject application site, a Level 3 traffic study may need to include the following additional items:

d. Other studies may be required based on site and surrounding conditions

All required traffic studies shall indicate that U.S. 1 has sufficient available capacity to operate at or within five percent (5%) of a level of service of C as measured on an overall (countywide) and each impacted segment basis as measured by the U.S. 1 Level of Service Task Force Methodology. If the proposed development will reduce the level service below a level of service C, the traffic study shall indicate mitigation measures required to maintain the adopted level of service.

All Level 3 traffic studies shall indicate that every paved County road within one (1) mile of the parcel proposed for development and all bridges on U.S.1 within six (6) miles of the parcel proposed for development shall have sufficient available capacity to operate at minimum peak hour at or within five percent (5%) of a level of service D as measured by the methodology identified in the most recent edition of the Highway Capacity Manual. If the proposed development will reduce the level service below a level of service D, the traffic study shall indicate mitigation measures required to maintain the adopted level of service

It is strongly recommended that prior to beginning work on the study, the preparer of the study should request a meeting with all agencies affected by traffic issues in the project area to identify the pertinent issues, discuss the level of detail required, and agree on the study methodology and assumptions. This will reduce the likelihood of differing expectations by the reviewing agencies. The questions in **Table 3.1** below can be used to stimulate the discussion on what the study should include and the extent to which traffic issues need to be analyzed.

TABLE 3.1 – Study Parameters

1. What elements of the report should be included in the body and in the appendix of the report?
2. What land-use should be used for the proposed development? What variables (seats, employees, gross floor area, acreage) should be used for trip generation? How detailed an analysis is needed for the trip generation forecast? Use ITE Trip Generation rates or conduct a special study?
3. How large an area should the study include? What is the area of influence of the project?
4. Are traffic counts needed? Which days and hours should be counted? What peak hour should be used for analysis? How should the peak hour be determined for analysis purposes? Will traffic counts more than one year old be acceptable to the County?
5. How should adjacent developments be considered in the study? How should areawide growth estimates and future traffic assignments be utilized?
6. How should approved but not yet built developments be accounted for? To what extent does the developer need to address this issue?
7. Should the various stages of multi-phased development be analyzed individually? What study years should be used and how should existing, background, and project trips be presented?
8. Which traffic distribution and assignment methods should be used? How detailed should it be?
9. How should average trip length, directional split, trip dissipation, pass-by trips, internal capture, etc. be determined? What documentation should be provided for any assumptions?
10. Which capacity analysis technique should be used when analyzing unsignalized intersections on a divided highway?
11. What traffic control changes, including traffic signal phasing, and timing are needed?
12. How should US-1 reserve capacity be interpreted and used in determining the impact on US-1 segments? How should the project trips in excess of the reserve capacity of US-1 segments be mitigated? When is the developer responsible for mitigating project trips on US-1 segments in addition to the segment being directly impacted by the project?
13. Are other analyses needed, such as signal warrant analysis, crash/safety analyses, and sight distance analyses?
14. What information should be shown on the site plan?
15. Under what circumstances should a field trip be undertaken jointly by the County and the developer?

3.1 REPORT INFORMATION

In addition to identifying site-specific issues that need to be addressed in the transportation site impact analysis, the developer or the developer's traffic engineer should include the following information in the transportation site impact report:

- Certain basic elements, such as existing and future traffic volumes with lane configuration, summary of the trip generation, summary of signalized and unsignalized intersection analysis results, should be included in the body of the report.
- Existing and/or future Land Use Codes for trip generation should be clearly defined in the body of the report, both in terms of type (e.g., Shopping Center, Residential-Single Family Homes, Fast-Food Restaurant) and density (e.g., gross floor area, number of units, number of seats, number of employees) along with the rates or equations used for calculating trip generation. The basis for using number of seats/employees or gross floor area, etc. for trip generation should be explained in the report.
- Existing, background, and project traffic data should be included in the body of the report.
- All traffic data used in the analyses should be included in the appendix of the report.
- All assumptions (average trip length, directional split, trips dissipation, etc.) along with the basis for the assumptions made should be clearly stated in the report. All supporting documents should be included in the appendix and mentioned in the report.
- For traffic analyses, a worst case scenario should be determined and analyzed.
- A site plan (8.5"X11" or 11"X17") should be included in the appendix of the report. This site plan should include the sight triangles, turning radii, internal circulation, access location, and any other access within 700 feet of the project site.
- The report should include a paragraph on sight triangles and any obstructions within the sight triangles should be identified.

It is difficult to specify the required elements for small, medium-sized and large developments, due to the unique nature of the specific projects, the area in which it will be located, and the general condition of the transportation system that will support the development. Hence, it is highly recommended that the developer have a meeting with the County prior to initiating any work on the project in order to determine the requirements associated with the transportation site impact report.

3.2 STUDY AREA

To a large degree, the contents and scope of a transportation site impact study depend on the location and size of the proposed development and the prevailing conditions in the surrounding area. Very large developments that are proposed in already congested or poorly accessible areas will obviously require more sophisticated traffic analyses; whereas, smaller developments that are being planned for areas that are not currently encountering traffic problems will likely not require extensive analysis.

Care should be given in determining the boundaries of the study area to make sure that resources of either the developer or the reviewing agency(ies) are not unnecessarily spent on the study. ITE suggests that any transportation site impact study analysis including off-site access

needs and impacts should include at least all site access points and major intersections (signalized and unsignalized) adjacent to the site.

The developer, in consultation with Monroe County, should determine the extent to which adjacent development should be considered in the study. Generally, adjacent developments sharing access with the proposed project should be included. Also, projects intending to utilize internal trip capture for determining project trips, should include all adjacent developments.

In most cases, Level 1 transportation site impact studies should analyze the point(s) of access being proposed in conjunction with the development in order to assess the operational impact they will have due to site generated traffic. Level 2 transportation site impact studies include all of the components associated with the Level 1 studies; however, the boundaries of the study are expanded to include an analysis to determine the impact that site generated traffic will have on intersections adjacent to the project site. Level 3 transportation site impact studies are the most comprehensive and include all of the components required in performing the Level 1 and 2 studies. The study boundaries are further expanded to allow for an assessment of the impact that site generated traffic will have on the surrounding roadway network, including all signalized and unsignalized intersections located within a one (1) mile radius of the project site. For the Level 3 study, the boundaries of the required analysis may be extended beyond the one mile radius to include roadways and intersections where the additional traffic generated due to the development is equivalent to five (5) percent of the maximum service volume associated with the adopted Level of Service (LOS) standard for the facility (i.e.; LOS C for US-1, and LOS D for all other County maintained roadways). It is further stipulated that based upon the specific conditions related to the applicant's site, each level of the above traffic studies may need to include additional items.

3.3 STUDY TIME-FRAMES

Transportation site impact studies are typically developed to identify the impacts of the proposed project at key points in time, called analysis years. The determination of the analysis year(s) for which the study should be targeted depends on several factors. ITE guidance suggests that if a project is a large multi-phase development in which there are several stages of development activities, several analysis years may be required for the study that correspond to the time-frames when major project development phases are brought "on-line". The initial analysis year should be the year when the first occupancy occurs or when the first major segment of the project opens, and the last analysis year should be selected to coincide with full trip generation. For developments that require significant time to mature and reach their full traffic generation potential, interim analysis years should be identified that reflect when major components of the development will be opened. For small developments or developments that do not phase occupancy, the initial and last analysis years will be the same constituting the opening date of the proposed development. In general, the analysis periods should include:

- The existing year
- The opening date (or date of reaching buildout or full occupancy) of the proposed development
- The interim years for major phases of the proposed development or for other projects in the immediate area

3.4 GROWTH FACTORS, BACKGROUND TRAFFIC, AND COMMITTED ROADWAY IMPROVEMENTS

The areawide traffic growth should be considered to reflect the future year traffic conditions opening and interim years, if any. The areawide vehicle growth rate could be determined by performing a historical trend analysis using the most recent ten years of data, when available. Special care should be used to negate counts that might be obviously out of sync with other years. Negative historical growth rates will not be applicable. In some cases, background traffic from approved but not yet built developments may be added to volumes developed by performing a historical trend analysis. Additional techniques to develop future traffic can be obtained from the ***FDOT Project Traffic Forecasting Handbook***. Average Annual Daily Traffic (AADT) data can be obtained from ***FDOT's Florida Transportation Information database***. The estimation of background traffic and project traffic should be included in the report.

It is recommended that the developer include roadway improvements committed by others in the analysis. Committed roadway improvements may include committed improvements as part of previously approved site developments, improvement projects in the County's Transportation Improvement Program (T.I.P.) and/or **FDOT's 5-year work program**. This information, if utilized by the developer, should be adequately documented in the traffic report.

3.5 DAILY AND PEAK HOUR VOLUME CALCULATION

The project's projected daily vehicular trip generation volumes should be calculated using the current edition of the **ITE Trip Generation Manual**, unless more detailed information is available for the proposed land use. The trip generation analysis shall be based on full occupancy of the project in the peak season. ***The daily trip generation volumes shall be based on a weighted average of the weekday, Saturday, and/or Sunday trip generation rates.***

The primary purpose of transportation site impact studies is to examine the effects of a proposed project on the overall transportation system. The most critical traffic time period(s) for which an understanding of traffic impacts is needed is associated with both the peaking of project-related traffic and the overall transportation system.

The peaking characteristics of the adjacent roadway network can be determined through analyses of traffic count data. In some cases, the data is available from secondary sources; in other cases, such data needs to be collected. The peak periods in the Keys vary from one Key to another due to the uniqueness of the area's geography, land use patterns and trip making characteristics. Hence, it is important that the peak hour traffic for the adjacent street and highway systems be independently determined. However, care should be taken to consider potential changes in peaking characteristics over time, particularly in growing areas in order to maintain an acceptable LOS.

Peaking characteristics of the project result from the trip-making characteristics projected for the various discrete uses within the project. The peak site activity period may differ from the adjacent street system peak. The time period that provides the highest total traffic demands (site and adjacent street traffic) should be used to assess the impact of site traffic on the adjacent

street system and to define the roadway configurations and traffic control measure changes needed in the study area.

Some uses, such as churches, special events, and recreational facilities, generate their peak traffic on evenings or weekends, when other land uses are relatively inactive during the normal weekday. Therefore, it is recommended that weekend and other typically off-peak conditions be reviewed to determine if a more detailed analysis is required. In any case, the peak hour analysis should consider the worst case scenario.

The following two methods of determining the peak hour used for analysis may be appropriate:

- Conduct turning movement counts (including through movements on US-1) during 7:00 a.m. - 9:00 a.m., 11:00 a.m. - 1:00 p.m. and/or 4:00 p.m. - 6:00 p.m. during a weekday (Tuesday, Wednesday or Thursday) and/or weekend (for some land uses). Determine the peak hour from these peak period counts.
- Conduct machine counts on US-1 and determine the peak hour on US-1. Conduct turning movement counts during the peak hour for the development. Combine the peak hour of the development with the peak hour of US-1. This will result in a more conservative analysis.

3.6 METHODOLOGY TO EVALUATE IMPACTS TO US-1 SEGMENTS AND OTHER ROADWAYS

Monroe County conducts Travel Time and Delay Studies of US-1 on a biennial basis to determine the Level of Service and the reserve capacity for each of the US-1 segments (see **Appendix B** for identification of US-1 segments). All transportation site impact studies should include a summary of the project development impact on US-1 segments in terms of number of additional trips. The additional trips on each of the US-1 segments should be compared against their reserve capacities. In the event that the reserve capacity is zero for a particular segment, a five percent allocation below LOS C for that segment should be considered for comparison. The reserve capacities and five percent allocation below LOS C for US-1 segments with zero reserve capacities are included in the Travel Time and Delay Study conducted biennially by the County, which is available from the Planning and Environmental Resources Department. Any trips in excess of reserve capacity or five percent allocation below LOS C, whichever applicable, on the US-1 impacted segments should be mitigated. Excess project trips on all impacted US-1 segments can be mitigated through reduced development or off-site improvements.

The number of additional project trips on US-1 segments will depend upon the assumed average trip length, percentage of primary trips, and directional split. The trip assignment procedure on US-1 segments should attenuate from a maximum at the project segment to zero trips on the segment corresponding to the maximum trip length with Miami-Dade County Line to the north and Key West City Limits to the south, whichever comes first. For example, if the maximum trip length is 20 miles and the Key West City limit is only 10 miles from the project site, the trip assignment should be considered as zero for the segment corresponding to the Key West City Limits.

The segment of US-1 to which the development site's access driveway is connected is referred to as the "site segment". The trips assigned to the site segment should be based on the dominant flow of the directional split. For example, if the trips generated by the development have a directional split of 55% from/to the north and 45% from/to the south of the development site,

the trip assignment for the site segment should be based on the "dominant flow", which in this case would be 55% of the total trips generated by the site.

The site's average trip length should be determined based on market studies, population distribution, development patterns, traffic data, or any other reasonable information or logical conclusions, as deemed appropriate.

Assuming an average trip length of 5 miles and linear trip dissipation, the maximum trip length will be 10 miles. Therefore, the impact on US-I segments would extend up to 10 miles from the project site. If a project is located at US-1 mile-marker (MM) 31 within segment number 10, the percent impact on segment #9 (assuming a linear trip dissipation) which begins at MM 27.5 and ends at MM 29.5 should be estimated as follows:

$$1 - [\{31 - ((27.5 + 29.5)12) \}/10] = 75\%$$

The percent impact on other segments based on linear trip dissipation should be estimated as shown above. Trip dissipation may not necessarily be linear. Any other assumptions for trip dissipation such as population density, land use, etc. should be clearly stated in the report. Table 3.2 provides a sample US-1 Trip Assignment Summary. It shows that for US-1 segment # 10, the reserve capacity is zero. The County permits five percent more trips than the Level of Service C threshold on US-1 segments with Level of Service below the acceptable standard of LOS C. Hence, for segments with zero reserve capacity, five percent allocation below LOS C should be considered. However, in this case the five percent allocation was also found to be zero and hence, all 157 primary trips generated by the project for this segment will have to be mitigated.

Monroe County's level of service standards for US-1 is based on average travel speed under largely uninterrupted flow conditions. The US-1 Level of Service Task Force has recommended that segments of US-1 outside of Marathon and Stock Island remain as uninterrupted flow facilities to preserve travel speeds. This means that traffic signals can be placed no closer than two miles apart.

It should be noted that the Levels of Service for US-1 segments are determined through the Travel Time and Delay Study, and that the minimum threshold for an acceptable Level of Service is LOS C. The impact on US-1 segments is determined based upon the reserve capacities corresponding to Level of Service C standards. However, the minimum threshold for Level of Service on other County roads is LOS D. The traffic impact analysis for other County roads such as CR-905 should be conducted based on the procedures specified in the latest edition of the ***Highway Capacity Manual (HCM).***

TABLE 3.2 – SAMPLE US-1 TRIP ASSIGNMENT SUMMARY

Project:			The Scuttlebutt Café							
Location:			Big Pine Key							
Type of Development:			Café/Diner							
Project Size:			1000 sq. ft. (Varies with Project					832 (High Turnover Sit Down Restaurant)		
Average Tip Length:			5 miles (Varies with Project					209 trips per 1000 sq. ft. (7-Day Average)		
Total Delay Trips	Percent Pass-by Trips	Percent Primary Trips	Primary Trips	(1) US-1 Segment Number	(2) US-1 Segment Limits		(3) Percent Directional Split	(4) % Impact Based on Trip Length	Project Generated Daily Trips	1995 Reserve Capacity
					Begin MM	End MM				
209	25%	75%	157	#5	16.5	20.5	75%	0%	(157x0.75x0.00)= 0	926
				#6	20.5	23.0	75%	8%	(157x0.75x0.08)= 9	1663
				#7	23.0	25.0	75%	30%	(157x0.75x0.30)= 35	848
				#8	25.0	27.5	75%	53%	(157x0.75x0.53)= 62	1508
				#9	27.5	29.5	75%	75%	(157x0.75x0.75)= 88	1195
Project Segment (MM 31)			→	#10	29.5	33.0	(75%)/(25%)	100%	(157x0.75x1)/(157x.25x1)= 118/39	0*
				#11	33.0	40.0	25%	45%	(157x0.75x0.00)= 0	3847
				#12	40.0	47.0	25%	0%	(157x0.75x0.00)= 0	4130

* Five percent sample allocation below LOS C for this segment is also zero and hence all 157 trips will have to be mitigated.

(1) Please refer to Appendix G for US-1 roadway segments number and segment limits.

(2) With average trip length of 5 miles and linear trip dissipation, the US-1 impacted segments is shown to extend 10 miles from the project site.

(3) Assumed directional split. Directional split of the trips generated by the proposed project should be determined for each individual project.

(4) % impact on US segment based on linear trip dissipation. For example impact on segment number 9 would be = 1 - [{31 - ((27.5 + 29.5)/2}/10] = 75%

3.7 OFF-SITE INTERSECTION ANALYSIS

For the intersections included in the report as part of defining the study area, analytical (deterministic) tools should be use based on **HCM** procedures unless specific complexities in the analysis justify the use of microscopic traffic simulations. The Developer's traffic engineer is free to use any capacity analysis software such as Highway Capacity Software (HCS), Synchro, SIDRA or other software after receiving concurrence from Monroe County through the approval of the Traffic Analysis Methodology Memorandum.

The Traffic Analysis Methodology Memorandum should also include the methodology to be used in calculating traffic parameters for the analysis, such as peak hour factor (PHF) and heavy vehicle factor. When feasible, the factors should be calculated based on field data collected for the study or obtained from applicable FDOT count stations within or near the study area. All modifications to the default values in the capacity analysis software should be justified and

properly documented in the transportation site impact report to allow the reviewer to reproduce the analysis.

Signalized Intersections: Signal timing plans including offsets, cycle lengths splits, interconnection, and phasing plan should be obtained from FDOT's District Traffic Operations office or local agencies responsible for maintaining the signals. Signal timing information needs to be field verified, and a field verification statement needs to be included in the transportation site impact report. For future analyses that require signal retiming, timing data should be calculated based on the ***Manual on Uniform Traffic Control Devices' (MUTCD)*** requirements and the guidelines published in the ***FDOT Traffic Engineering Manual (TEM*)**. Proposed modifications to the existing signal timing and phasing plans must be approved by the maintaining agency.

3.8 SITE ACCESS ANALYSIS

Site access shall be reviewed for compliance with the County's Land Development Code [currently Sec. 114-195 through Sec. 114-199 and Sec. 114-201]. As stated in Sec. 114-201, Clear Sight Triangles at drives along US-1 and street intersections with US-1 shall adhere to the clear sight triangle requirements of the LDC< , FDOT standards, or national American Association of State Highway and Transportation Officials (AASHTO) standards, whichever is most restrictive. The ***FDOT Design Standard Index*** presents a concise summary of FDOT requirements. ASSHTO requirements are presented in ***"The Green Book", A Policy on Geometric Design of Highways and Streets*** publication.

In accordance with ITE, "*site access objectives are to serve abutting properties, preserve roadway capacity, maintain efficient traffic flow, and maintain safety."* For most developments along US-1, these objectives could be met by assessing site access for compliance with FDOT Access Management and Driveway Design Guidelines (including sight distance requirements). For larger developments, additional safety analyses including identification of high crash locations and patterns, potential contributing hazardous conditions and feasible countermeasures based on the most recent 3-years of crash data may be required. The application of site access and access management principles are presented in greater detail in FDOT publications such as the ***Driveway Information Guide***, ***Median Handbook*** and other resources on the **FDOT System Planning Access Management website.**

If a traffic signal is proposed for US-1, the report shall acknowledge the County's compelling desire to maintain the existing travel speeds and predominantly uninterrupted flow conditions on US-1. The report shall include a figure or map showing the location of the proposed signal with respect to the existing traffic signals. Furthermore, the report shall explore alternatives to signalization before recommending a traffic signal along US-1 in compliance with MUTCD and FDOT guidelines.

Site access analysis should also assess site connectivity to transit, bicycle and pedestrian facilities nearby. Sec. 114-16 of the County's Land Development Code states that *Development occurring on or adjacent to the location of a planned bicycle or pedestrian facility as identified by the County shall provide for the construction of that portion of the facility occurring within or adjacent to the development. If the facility already has been built, or if it will be constructed by an external agency, the development shall be connected to the facility in a safe and convenient manner to ensure that it is part of the development's overall transportation system. For State owned bicycle or pedestrian facilities, a connection permit shall be required.*

3.9 SITE CIRCULATION ANALYSIS

The transportation site impact study needs to assess the development for the following applicable on-site planning principals and summarize the findings and recommendations in the report:

Vehicular Queue Storage: Queuing analysis needs to be conducted for all drive-in/through facilities. The site plan provided with the transportation site impact report needs to clearly depict the available vehicular storage for these facilities. Depending on the development's size and trip generation characteristics, queuing analysis may also be required at its various driveways and other internal intersections.

Internal Vehicular Circulation: An important consideration for proper internal vehicular circulation is to provide adequate driveway length to transition entering vehicles without disturbing traffic movements on-site or on the main roadways.

Traffic Calming/Speed Control: The site layout should discourage cut-through traffic and speeding.

Service and Delivery Vehicles: Vehicle maneuverability details (also referred to as AutoTURN plots) need to be presented on the site plan provided with the transportation site impact report. Specific areas of concern include: access to loading areas, access to trash collection (dumpster) areas, and emergency vehicle access.

Building Service Drives are roadways immediately adjacent to a building to provide emergency vehicle access, pedestrian pick-up/drop-off points, internal circulation and/or recirculation in parking areas. Building service drives should provide sufficient width, pavement markings and signage to allow for safe and efficient operation.

Signs and Pavement Markings need to be reviewed for compliance with the most current edition of the *Manual on Uniform Traffic Control Devices (MUTCD)* per Sec. 114-11, Traffic-Control Signs and Devices of the County's Land Development Code.

Parking and Loading facilities should be provided to meet site-generated demand and to be consistent with Monroe County policies. The ***ITE Parking Generation*** publication provides generalized parking demand data. Site parking and loading facilities need to be reviewed for compliance with Sec. 114-66 through Sec. 114-71 of the County's **Land Development Code**. Specific requirements for bicycle parking are presented in Sec. 114-71.

Transit, Bicycle, Pedestrian and Accessible Facilities: Pedestrian connections between these facilities and the site's buildings should be integrated into the overall design of the project. Access for people with disabilities should also be provided in accordance with appropriate Federal, State, and County requirements.

As previously stated, Monroe County conducts Travel Time and Delay Studies along US-1 on a biennial basis to determine the Level of Service and the reserve capacity for each segment. However, land development is a dynamic process which affects the reserve capacity of the US-1 segments, and it is not cost feasible to conduct a Travel Time and Delay Study every time a development takes place to determine the reserve capacity of the various US-1 segments. At the same time, it is important to monitor and regulate the development process in order to avoid adversely impacting the level of service on US-1. This is possible only through maintaining a record of the approved but unbuilt developments (developed and undeveloped projects) and their impact on the reserve capacity of the various US-1 segments. This record will help to determine the reduction in reserve capacity of the US-1 segments as a result of new land development occurring between successive Travel Time and Delay Studies. It will also help to monitor the development process until a new Travel Time and Delay Study could be performed. The County will maintain this record of approved projects and their impact on reserve capacity of the US-1 segments. It is the developer's responsibility to obtain this information from the County and accordingly address the impact on the US-1 segments based upon the data contained in this record.

The County maintains the list of firms which are pre-qualified to prepare transportation site impact studies. Firms who wish to be pre-qualified and included in the list should contact the Monroe County Planning Department.

In accordance with section 61G15-23.001 (Signature, Date and Seal Shall Be Affixed) of the Florida Administrative Code, "(1) A professional engineer shall sign, date and seal: (a) All final plans, prints, specifications, **reports** [*emphasis added*], or other documents prepared or issued by the licensee and being filed for public record." Furthermore, "(3) A professional engineer may only sign, date and seal engineering plans, prints, specifications, reports or other documents if that professional engineer was in responsible charge, as that term is defined in subsection 61G15-18.011(1), F.A.C., of the preparation and production of the engineering document **and the professional engineer has the expertise in the engineering discipline used in producing the engineering document(s) in question** [*emphasis added*]."

Firms selected to prepare transportation site impact studies must demonstrate their qualifications to the County, if requested, through submission of previous traffic impact analyses and resumes of staff members who will prepare the report. The County reserves the right to reject transportation site impact reports prepared by persons who fail to present relevant experience in traffic and transportation analyses, including the preparation of transportation site impact analyses to meet the above Florida Board of Professional Engineers (FBPE) requirements.

Although the County requires firms to be pre-qualified to prepare transportation site impact studies, it is the developer's responsibility to ensure that his/her transportation site impact reports are prepared under the supervision of professionals who meet the requirements outlined above. For all transportation impact reports, the onus for the authenticity and veracity of the analyses and the reasonableness of any other assumptions or statements falls upon the Engineer of Record (EOR), who signs and seals the report.

APPENDIX A

Methodology to Assess Level of Service on US-1 in the Florida Keys

APPENDIX

A

URS

A METHODOLOGY TO ASSESS LEVEL-OF-SERVICE

ON US-1 IN THE FLORIDA KEYS

By

Rafael E. De Arazoza
Florida Department of Transportation
District 6
602 South Miami Avenue
Miami, Florida 33130
(305) 377-5910

And

Douglas S. McLeod
Florida Department of Transportation
Mail Station 19
605 Suwannee Street
Tallahassee, Florida 32399-0450
(904) 922-0449

For Presentation at the
Transportation Research Board Annual Meeting
January 1993

R.E. De Arazoza
D.S. MaCleod

ABSTRACT

This paper presents the methodology developed to assess level-of-service (LOS) on US-1 in the Florida Keys. Although predominantly an uninterrupted flow two-lane roadway in the Keys, US-1's uniqueness warrants all alternative LOS evaluation process to that found in the 1985 Highway Capacity Manual.

U.S.-1 extends from the Key West to the Florida mainland with no major roads intersecting it. Furthermore, no other principal arterial serves the Keys or the Keys' resident and tourist population, over 100,000. Its unique geography, land use patterns, trip making characteristics presented a challenge in developing and applying a reasonable and acceptable method to assess its LOS.

A uniform method was developed to assess LOS on U.S.-1 to cover both its overall arterial length from Key West to the Florida mainland, and 24 roadway segments delineated. The methodology employs average travel speed as the main measure of effectiveness. It was developed from basic criteria and principles contained in Chapters 7 (Rural Multilane Highways), 8 (Rural Two-Lane Highways) and 11 (Urban and Suburban Arterials) of the 1985 Highway Capacity Manual.

The results of the study correlate well with perceived operating conditions on US-1 and over a two-year period the methodology appears to have a good level of reliability. The authors recommend that for uninterrupted flow conditions in developed areas, Chapters 7 and 8 of the Highway Capacity Manual incorporates average travel speed as the main measure of effectiveness to determine LOS.

R.E. De Arazoza
D.S. MaCleod

A METHOD TO ASSESS LEVEL-OF-SERVICE ON US-1 IN THE FLORIDA KEYS

INTRODUCTION

The purpose of this paper is to present the methodology developed by the Monroe County US-1 level-of-service (LOS) Task Force to assess LOS on US-1 (the Overseas Highway) in the Florida Keys (1). The authors are members of the referenced task force.

US-1 which is mostly two-lanes, has unique geographic and trip characteristics. It extends through the Florida Keys covering approximately 180 kilometers (112 miles) from the City of Key West to the Florida mainland (Figure 1). There are 48 bridges crossing water for a total length of 35 km (22 mi), with the longest bridge approximately 11 km (7 mi) long. There is no other road, to provide vehicular access to the Florida Keys from the rest of Florida or anywhere else. Few local roads are 5 km (3 mi) in length. Consequently, US-1 serves not only as a regional principal arterial which serves intra as well as interstate travel, but also serves as the local road for most of the trips within the Keys. US-1 Annual average daily traffic (AADT) volumes range from a low of 4700 to a high of 34200. The road serves a large tourist demand and is one of the most scenic in the United States. The linear geography with the narrow land width of most of the Florida Keys are further characteristics.

Most of the surrounding land use is rural developed and suburban in nature; however, some areas are totally rural and others are urban, such as the Key West and its suburbs. With the exception of the few completely rural segments and the bridges, strip commercial stores, motels and restaurants are very common throughout the Keys along US-1. Numerous driveways and intersecting local roads provide access to the surrounding residential areas.

The US-1 LOS study encompassed approximately 174 km (108 mi) of US-1 from Key West/Stock Island to the Monroe/Dade County Line, broken down as follows:

- **129 km (80 mi) (74%) two-lane uninterrupted flow;**
- **32 km (20 mi) (19 %) four-lane uninterrupted flow; and**
- **13 km (8 mi) (7%) four-lane urban/suburban interrupted flow.**

Part of the growth management process in Florida is to assess roadway LOS to determine if roadway facilities meet standards established by state regulations. The Transportation Research Board Special Report 209 Highway Capacity Manual (HCM) (2) is extensively used throughout Florida as the source document to determine highway capacities and LOS.

HCM Chapter 7 (Rural Multilane Highways), 8 (Rural Two-Lane Highways) and 11 (Urban and Suburban Arterials) were consulted to determine applicability to the unique conditions and vehicular traffic operations and characteristics of the Florida Keys. Only the 13 km (8 mi) of urban/suburban interrupted flow and the small percentage of the two-lane truly rural portions correlate directly to the HCM Chapters 11 and 8.

Thus, the challenge was to develop a methodology to assess arterial LOS along US-1 without deviating from the principles of the HCM. Towards that end a task force was created consisting of representatives from State and local agencies and an engineering consulting firm.

THE NEED TO DEVELOP A LOS MEASUREMENT METHOD

From a state transportation perspective, the overall operating condition of US-1 is important, not the condition of any smaller segment. With Key West as a major tourist destination at the southern end of the Keys and no alternative routes, the logical analysis section of highway extends from Key West to the mainland. From local transportation and development approval perspectives, shorter segments for analysis are desirable.

Chapter 8 of the HCM presents a methodology which applies to typical rural two-lane highways with basically long stretches of roads, and few side intersecting streets and driveways directly connecting to the roads. Chapter 8 methodology relies mainly on "percent time delay" to assess LOS. The HCM further states that "Percent time delay...is defined as the average percent of time that all vehicles are delayed while traveling in platoons due to inability to pass. Percent time delay is difficult to measure directly in the field. The percent of vehicles traveling at headways less than 5 seconds can be used as a surrogate measure in field studies."

Chapter 8 of the HCM also uses average travel speed and capacity utilization as additional measures of effectiveness to assess LOS. However, the HCM states clearly that percent time delay is the primary measure of service quality. Further inspection of the average speeds for level terrain depicted by Table 8-1 of the HCM do not correspond well with the typical operating speeds of US-1 in the Florida Keys. For instance, Table 8-1 shows average speeds ranging from 58 mph (93 kmh) (LOS A) to 45 mph (72 kmh) (LOS D).

The overall weighted posted speed limit for US-1 in the Florida Keys is 79.7 kmh (49.5 mph). The overall median operating speeds along US-1 according to the 1991 and 1992 field studies (3, 4) were 76.8 and 75.5 kmh (47.7 and 46.9 mph), respectively. The field studies showed, for the most part, the survey vehicle(s) was traveling close to the posted speed limit.

It is believed the average motorist in the Florida Keys is mostly concerned with operating at an acceptable average travel speed rather than being concerned about the ability to pass. This is supported by the physical and traffic characteristics of the Keys (e.g., adjacent land development, sight seeing tourists), local knowledge, and discussions with motorists.

From the above statements, it was clear to the task team that HCM Chapter 8 methodology could not be applied to US-1 for analysis of its two-lane sections.

With regards to the four-lane uninterrupted flow portions of US-1, a similar dilemma occurred. HCM Chapter 7 methodology applies to multi-lane highways with operating characteristics generally unlike those of US-1 through the Florida Keys. For instance, average travel speeds depicted by Table 7-1 of the HCM are also higher than those encountered in the Keys. Further, the methodology inherent in equations (7-1), (7-2) and (7-3)are closely related to those of freeways with their higher service flow rates, which again neither simulate nor resemble those of US-1 in the Keys. The Four-lane portion is found mostly in Key Largo (the northeastern end of the Keys) which has a weighted posted speed limit of 72.5 kmh (45 mph). Key largo is developed with strip commercial and residential development. It has numerous driveway connections and side streets directly accessing US-1.

The remaining 7% of the total US-1 mileage is four-lane interrupted flow. These are the portions encompassing Marathon (in the middle of the Keys) and Stock Island (near Key West). The operating characteristics here are truly urban/suburban and interrupted flow in nature resembling those of HCM Chapter 11. Thus, the methodology of Chapter 11 was employed in assessing LOS on these segments.

From the preceding discussion, it was evident that a distinct method to assess LOS on US-1 had to be developed. The task team's efforts concentrated on keeping consistency with the basic philosophy of the HCM, and yet be sensitive to the Keys uniqueness. Thus, the proposed methodology correlates measured travel speeds along US-1 with LOS speed thresholds developed as part of this study. This is in line with the concept behind the HCM of average travel speed being the main parameter to measure arterial LOS.

METHODOLOGY

Considering the types of trips served by US-1, it was decided to conduct travel time and delay runs to cover both the entire length of US-1 from Key West to the Monroe/Dade County Line (mainland) and for each segment of the highway along the way. Twenty-four segments were selected as depicted by Table 1. Each segment is fairly homogeneous in nature having a uniform roadway cross section and traffic flow.

Travel speeds for the overall length (from Key West to the mainland) provide an indication of the LOS for the regional trips. Travel speeds for each segment also provides an opportunity to assess the impact of local trips. Establishing speed criteria for both the overall length and for each roadway segment satisfies the requirements of the Florida growth management process.

The next step in the process was to determine the number of travel time runs and how, when and to/from where. Runs were started at both ends of US-1. For example, one run started on Stock Island (Key West City limits) and proceeded to the mainland (Dade County). After reaching this point, the vehicle turned back and proceeded to end the run where it started, on Stock Island. On another day the reverse was true (i.e., the run started in Dade County instead of Stock Island). It was decided to perform a total of fourteen two-way runs or twenty-eight in each direction covering the 174 km (108 mi) study portion of US-1. Twenty-eight runs provide enough data for statistical significance. Control points were established at each of the 24 segments to record travel time and speed data specific to each one of those segments. Seven runs were started at Stock Island and seven in Dade County. Each began at staggered hours to cover the varied trip purposes and time frames within the Keys. The surveys were conducted during March, reflecting the area's peak traffic season.

For each run the process provided data, such as running speed and travel speed, in each direction of US-1. Vehicular traffic counts were also collected at three locations covering seven days.

The travel time runs yielded a total of 28 one-way travel speed values for the overall length of US-1 and for each of the 24 segments. The value selected for analysis was the median speed which would reflect a "typical peak period during the peak season." In other developed parts of Florida the typical peak hour of the peak season approximates the 100th highest hour of the year (5).

The median value was also selected, instead of the average, to avoid the influence of extremely high or low speed value at either end of the survey population.

The process up to this point provided median travel speeds. The question then became, what LOS do these speeds represent.

The next step was to develop a set of LOS/Speed threshold values for both the overall length of US-1 and the pertinent segments of the highway. Towards this end, the speed ratios between LOS thresholds from Tables 7-1, 8-1 and 11-1 of the HCM were used in the analysis. These ratios were weighted against actual mileage of US-1 in the Florida Keys to represent the prevailing type of flow; two-lane uninterrupted flow, four-lane uninterrupted flow and four-lane interrupted flow. For example, from the level terrain portion of HCM Table 8-1, the ratio between LOS B speed and LOS A speed is 55/58 = 0.948. The ratio between LOS C/LOS A = 52/58 = 0.897; the ratio between LOS D/LOS A = 50/58 = 0.862 and so on. The same process was applied to Tables 7-1 (96.6 kmh) (60 mph) and 11-1. Then each ratio was weighted to take into account the length of the section of US-1 to which that type of traffic flow applied. Once all the ratios were developed, the weight criteria was applied as in the following example:

TYPE OF FLOW	LOS C/LOS A RATIO	WEIGHT
Two-lane uninterrupted	52/58 = 0.897	74
Four-lane uninterrupted	44/50 = 0.880	19
Four-lane interrupted	22/35 = 0.629	07

Therefore, the overall speed ratio between LOS C and LOS A is:

$$[74(0.897)+19(0.880)+7(0.629)]+100=0.875$$

The above process was applied to develop all the required ratios.
Further observations with reference to Tables 8-1, 7-1 and 11-1 yielded the following. From Table 8-1 the difference between LOS A and LOS B speeds is 4.8 kmh (3 mph), or 4.8 kmh (3 mph) above an assumed posted speed limit of 88 kmh (55 mph). From Tables 7-1 and 11-1 the differences are 3.2 kmh and 11.3 kmh (2 mph and 7 mph), respectively, with LOS lower than assumed speed limits. Therefore, from these observations plus local knowledge, it was determined that the overall US-1 posted speed limit is 79.7 kmh (49.5 mph) reasonably fell between the LOS A and B thresholds. This

assumption is not far away from the premise that if a vehicle is able to sustain a travel speed equal to the posted speed limit, then it will correspond typically with the upper ranges of LOS (i.e., LOS A or B).

With the above speed differentials and LOS range premise in mind, the US-1 overall speed thresholds for LOS A and B became 82.1 kmh (51 mph) (2.4 kmh (1.5 mph) above 79.7 kmh (49.5) and 77.3 kmh (48 mph), respectively. Applying the developed ratio between LOS C/LOS A to the LOS A speed resulted in 72.5 kmh (45 mph), rounded off (i.e., 0.875 x 82.1 kmh (51 mph) = 71.8 kmh (44.6 mph)), which then became the threshold for LOS C. After applying all the ratios the overall LOS criteria for US-1 became:

LOS	Speed
A	≥ 82 kmh (51 mph)
B	≥ 77 kmh (48 mph)
C	≥ 72 kmh (45 mph)
D	≥ 68 kmh (42 mph)
E	≥ 58 kmh (36 mph)
F	< 58 kmh (36 mph)

Inspection of the criteria above indicates a close relationship with the speed differentials of both Tables 8-1 and 7-1 of the HCM. Comparing the median speed data for US-1 from the 1991 and 1992 field studies to the above criteria resulted in an overall LOS of C for both years, i.e., 76.8 kmh (47.7 mph) for 1991 and 75.5 kmh (46.9 mph) for 1992. These speeds are 2.9 kmh (1.8 mph) and 4.2 kmh (2.6 mph) below the overall weighted 79.7 kmh (49.5 mph) speed limit, which would correspond to the upper range of LOS C. The authors also believe that LOS C is the appropriate LOS designation for the whole of US-1 from Key West to the mainland.

A final step was still needed to complete the task of developing LOS/Speed threshold values for the segments of US-1. No further work was needed to cover the 7% mileage of the interrupted portions of US-1 found on Marathon and Stock Island, adjacent to Key West. As discussed earlier, these segments correlate with Chapter 11 of the HCM. Therefore, direct application of Table 11-1 LOS/speed criteria for a Class I arterial was made.

The remaining segments fell within the two-lane and four lane uninterrupted flow criteria. It was decided to make LOS A speed criterion 2.4 kmh (1.5 mph) above the weighted posted speed limit in order to keep consistency with the overall criteria. LOS C speed was set 9.7 kmh (6 mph) below LOS A speed consistent with Tables 7-1 and 8-1 of the HCM. LOS B and D speed criteria were set to provide equal increments between LOS A and LOS D (i.e., LOS B 4.8 kmh (3 mph) below LOS A speed and LOS D 4.8 kmh (3 mph) below LOS C speed). LOS E was set 9.7 kmh (6 mph) below the LOS D Speed. This makes the segmental speed differential between LOS thresholds consistent with the differentials in the overall criteria, except for one consideration. On any segment, intersection delay would be deducted from the segment's travel time to account for the influence of that signal on the segment (i.e., signal delay = 1.0 x 15 seconds average stopped delay). This corresponds to an LOS C delay due to isolated signals. LOS C delay was chosen because LOS C is the state LOS standard for US-1 in the Florida Keys. The rationale behind deducting signal delay from the segment analysis was to recognize for the impact of signals in reducing travel time. This provides the required sensitivity in the segment which is not only to assess the impact of regional vehicular trips, but also those that are local in nature. The following illustrates the concept plus one example for the US-1 Segmental LOS/speed relationship.

- **The uninterrupted flow segment criteria are:**

LOS	SPEED
A	**≥ 2.4 kmh (1.5 mph) above the posted speed limit**
B	**≥ 4.8 kmh (3.0 mph) below LOS A**
C	**≥ 9.7 kmh (6.0 mph) below LOS A**
D	**≥ 14.5 kmh (9.0 mph) below LOS A**
E	**≥ 24 kmh (15.0 mph) below LOS A**
F	**< 24 kmh (15.0 mph) below LOS A**

- **A segment having a weighted posted speed limit of 72 kmh (45 mph) would then have this criteria:**

LOS	SPEED
A	**≥ 74.9 kmh (46.5 mph)**
B	**≥ 70.0 kmh (43.5 mph)**
C	**≥ 65.2 kmh (40.5 mph)**
D	**≥ 60.4 kmh (37.5 mph)**
E	**≥ 50.7 kmh (31.5 mph)**
F	**< 50.7 kmh (31.5 mph)**

- **The LOS/Speed criteria for interrupted flow segments (marathon and Stock Island) are based directly on a Class I arterial from Table 11-1 of the HCM.**

LOS	SPEED
A	**≥ 56.4 kmh (35 mph)**
B	**≥ 45.1 kmh (28 mph)**
C	**≥ 35.4 kmh (22 mph)**
D	**≥ 27.4 kmh (17 mph)**
E	**≥ 20.9 kmh (13 mph)**
F	**< 20.9 kmh (13 mph)**

Speed data from both the overall length of US-1 and the individual segments were compared against the applicable LOS/speed thresholds. This provided for an assessment of the facility LOS plus an indication of reserve speed, if any.

Under Florida's and Monroe County's growth management process if the overall LOS for US-1 fell below the LOS C standard, then no additional land development would be allowed to proceed in the Florida Keys. Unless the proposed new development traffic impact were mitigated. If the overall LOS for US-1 was C or better, then additional development could take place in those segments where there was reserve speed available (i.e., segment's speed was higher than the standard threshold).

Besides meeting highway LOS standards there are numerous other considerations in Florida's growth management process pertaining to the Florida Keys that are beyond the scope of this paper. As mentioned in the introduction, the purpose of this study was to present the methodology to assess LOS on US-1.

APPENDIX B

US-1 Roadway Segments

APPENDIX B

URS

SEG NO.	APPROXIMATE MILE - MARKER		CONTROL POINTS		KEY(S)
	Begin	End	Beginning	Ending	
1	4.0	5.0	Cow Key Bridge (N)	Key Haven Boulevard	Stock Island, Key Haven
2	5.0	9.0	Key Haven Boulevard	Rockland Drive	Boca Chica, Rockland
3	9.0	10.5	Rockland Drive	Boca Chica Road	Big Coppitt
4	10.5	16.5	Boca Chica Road	Harris Channel Bridge (N)	Shark, Saddlebunch
5	16.5	20.5	Harris Channel Bridge (N)	Bow Channel Bridge (N)	Lower Sugarloaf, Upper Sugarloaf
6	20.5	23.0	Bow Channel Bridge (N)	Spanish Main Drive	Cudjoe
7	23.0	25.0	Spanish Main Drive	East Shore Drive	Summerland
8	25.0	27.5	East Shore Drive	Torch-Ramrod Bridge (S)	Ramrod
9	27.5	29.5	Torch-Ramrod Bridge (S)	N. Pine Channel Bridge (N)	Torch
10	29.5	33.0	N. Pine Channel Bridge (N)	Long Beach Drive	Big Pine
11	33.0	40.0	Long Beach Drive	7- Mile Bridge (S)	W. Summerland, Bahia Honda, Ohio
12	40.0	47.0	7- Mile Bridge (S)	7- Mile Bridge (N)	7-Mile Bridge
13	47.0	54.0	7- Mile Bridge (N)	Cocoa Plum Drive	Marathon, Key Colony Beach
14	54.0	60.5	Cocoa Plum Drive	Toms Harbor Ch Bridge (S)	Fat Deer Crawl, Grassy
15	60.5	63.0	Toms Harbor Ch Bridge (S)	Long Key Bridge (S)	Duck, Conch
16	63.0	73.0	Long Key Bridge (S)	Channel # 2 Bridge (N)	Long, Fiesta, Craig
17	73.0	77.5	Channel #2 Bridge (N)	Lignum Vitae Bridge (S)	Lower Matecumbe
18	77.5	79.5	Lignum Vitae Bridge (S)	Tea Table Relief Bridge (N)	Fill
19	79.5	84.0	Tea Table Relief Bridge (N)	Whale Harbor Bridge (S)	Upper Matecumbe
20	84.0	86.0	Whale Harbor Bridge (S)	Snake Creek Bridge (N)	Windley
21	86.0	91.5	Snake Creek Bridge (N)	Ocean Boulevard	Plantation
22	91.5	99.5	Ocean Boulevard	Atlantic Boulevard	Key Largo
23	99.5	106.0	Atlantic Boulevard	C-905	Key Largo
24	106.0	112.5	C-905	County Line Sign	Key Largo, Cross Key

URS

URS CORPORATION SOUTHERN
7800 Congress Avenue, Suite 200, Boca Raton, Florida 33487