BUS-ON-SHOULDERS SERVICE EVALUATION

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EXECUTIVE SUMMARY

1. In 2004 and 2005, the Miami-Dade County Metropolitan Planning Organization (MPO) studied various ways to enhance bus service in Miami-Dade County. One of the concepts was to operate buses on the shoulders of expressways to create a faster and more attractive bus service. Other cities, notably Minneapolis, have employed this strategy with success.

2. An Interlocal Agreement was executed between the Miami Dade County Transit (MDT) and the Florida Department of Transportation (FDOT) Tallahassee Office for establishing a Pilot Project for Bus-on-Shoulders in January 2006.

3. MDT entered into agreements with FDOT and the Miami-Dade Expressway Authority (MDX) to allow transit buses along the shoulders of the expressways under their jurisdictions in March 2006.

4. The Pilot Project was created along SR-874 (Don Shula Expressway) and SR-878 (Snapper Creek Expressway) based on three existing MDT Kendall Area Transit (KAT) routes as the base for the Pilot Project. The three Kendall Area Transit (KAT) routes operate on Sunset (Route 272), Kendall (Route 288) and Killian Drive (Route 204) respectively. Service started in March 2007.

5. Results from the evaluation can safely conclude the following:

   a) There were no traffic accidents involving Bus-on-Shoulders vehicles according to the Florida Highway Patrol, MDT and MDX operations staff.

   b) Field surveys show no adverse wear on the highway shoulders, drainage culverts, or other roadway features due to the demonstration project.

ES-1 BUS-ON-SHOULDER IN OPERATION ON SR-878

   c) The service did gain new riders over 2006. However, cuts in MDT service in 2007 adversely impacted bus ridership. Ridership changed in-line with MDT bus service changes.

   d) Riders are very pleased with the service and judge the project favorably. Riders estimate a greater time savings than they actually receive, but this observation has been made in other cities as well. Many riders made comments that all drivers should use the shoulder and that the Bus-on-Shoulder service was very good.

   e) Because drivers have the option to choose whether or not to operate on the highway shoulder, not all drivers do this voluntarily. Yet, enough change has occurred in route operations to substantially increase on-time performance from MDT, compared to service prior to the experiment.

   f) Nearly 50% of MDT drivers say they almost always use the shoulder when conditions warrant, about 30% use the shoulder sometimes, and about 20% of drivers never use the shoulder. Overwhelmingly, drivers think this Bus-on-Shoulder operation is a good idea.

g) Driver complaints mostly relate to a few issues, such as: (1)- The shoulder is not wide enough for good operation; (2)- The travel-lane/shoulder pavement edge transition creates a less than ideal ride; and, (3)- Other motorists are a problem as buses merge to and from the shoulder.

h) The three routes operate on MDX roadways and there have been no adverse reports from MDX on expressway operations.

i) Costs to implement the project were low – about $15,000 for the creation and installation of the needed special traffic signs. MDT had costs related to in-house driver training for the drivers – which most drivers found to be very satisfactory. This outlay and the increased travel time for many runs yield a favorable cost-benefit, primarily in saving rider travel time.

RECOMMENDATIONS

1. The existing three KAT routes could be strengthened by:

   a) Development of park-and-ride facilities near the western terminus of the three routes. There are several shopping centers at the western end of the three routes that might be willing to participate in a park-and-ride agreement. Extra parking for the KAT routes could take some of the strain off the Dadeland North and Dadeland South Metrorail parking garages which are at 90-100% occupied.

   b) There is frequent peak-hour service on the three routes. Running express or limited bus service by converting some KAT local runs to faster service could attract more riders while not increasing Metrobus operating costs. From the riders survey only one-third of riders are just local trips, but two-thirds are connecting to Metrorail. A faster service could be beneficial to some of those Metrorail connecting riders, especially if there were also park-and-ride lots, by reducing the overall travel time.

2. Bus-on-Shoulders Expansion:

   a) From studies elsewhere, Bus-on-Shoulders or express bus service can attract riders and improve overall bus transit service in a region. Other than the existing I-95 express buses there are no major express bus routes on the regions expressways – the Florida Turnpike, the 826 or 836 expressways. There are a few MAX routes that provide faster "limited" type service compared to regular MDT services. Examination of ways to provide more express runs, possibly with the use of the Bus-on-Shoulder component, could attract new transit users in major corridors to help reduce congestion. These innovative projects would be eligible for FDOT service development funds. Park-and ride facilities are a requirement to make these services successful.

   ES-2 KAT BUS IN OPERATION ON LOCAL ROUTE

   b) *Park-and-Ride Facilities*. Many communities do not build all their park-and ride lots, but enter into lease or development agreements with private property owners. Weekdays, shopping centers usually have unused parking areas. In Southern California agreements with churches or other religious institutions that have unused weekday parking areas has been very successful.

3. Shoulder Facilities:

a) ***Shoulder Width - Design Standards.*** As reported in Chapter 2, only two cities reported shoulder width standards. These two vary from 12-feet in Cincinnati to 10-feet in Minneapolis, except along Jersey walls or other barriers where the standard is 11.5 feet. The standard for the SR-874 and 878 is 10-feet. Many drivers reported that they would like wider shoulders and the estimate to achieve this is over $500,000. It would seem that MDT, the MPO, Florida DOT and MDX should identify potential routes for Bus-on-Shoulders and try to obtain wider shoulder widths when designing new facilities or upgrading existing striping. While costs for the current Bus-on-Shoulder are relatively low, this might not be the case in more complex expressway sections. The standard used by Minneapolis for 11.5 foot wide shoulders where buses operate in tight quarters next to barrier walls should be a minimum in case this operations scenario is contemplated in the future by MDT.

b) ***Pavement Milling – Rumble Strips***. A common complaint from drivers was the pavement slope between the roadway and the shoulder transition felt to be uncomfortable. Drivers of small buses stated that the transition edge was a problem for there vehicles. FDOT, MDX and MDT might want to explore a change in the height and slope of the pavement transition area that might improve driver reaction to the instability caused when vehicles shift from the paved lane to the shoulder. There are no shoulder rumble strips along the roadway section now in use and this might be a policy for other shoulders where buses could operate.

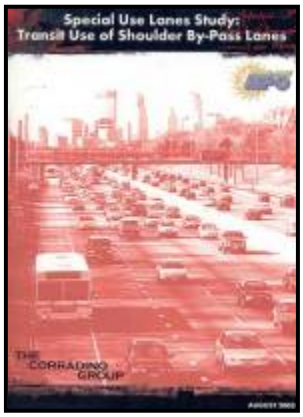
CHAPTER 1.0 OVERVIEW

In October 2004, the Miami-Dade County Metropolitan Planning Organization (MPO) commissioned a Phase I - Special Use Lane Study of ways to enhance bus service on major arterials throughout Miami-Dade County. As a result of this study, two concepts were strongly recommended for further consideration and analysis:

1. Express bus services along I-95, SR-826 (Palmetto Expressway) and SR-836 (Dolphin Expressway). This recommendation considered the development of a Bus-on-Shoulders concept already implemented in Minneapolis, MN.

2. Bus Rapid Transit (BRT) services along Flagler Street, Biscayne Boulevard and Kendall Drive.

The Bus-on-Shoulder proposed project was easier to implement than the BRT services. Therefore, actions were taken to proceed with the implementation of the project. The MPO in conjunction with Miami-Dade Transit (MDT) coordinated meetings with Florida Department of Transportation (FDOT) District 6, Miami-Dade Expressway Authority (MDX) and the Florida's Turnpike Enterprise (FTE). All the entities agreed to proceed with the implementation of the project. However, MDT didn't have jurisdiction over the proposed roadway facilities and approval was required for using the shoulders along the expressways. Meetings were held with FDOT Central Office in Tallahassee and a Letter of Agreement was signed between FDOT and MDT to allow the transit buses to use the shoulders along the expressways in Miami-Dade County as a Pilot Project for three years. As part of this agreement, the MPO would conduct an evaluation of the project, once the project started.



Based on this letter and the recommendations made in the first study, a Phase II was conducted to address specifically the use of the shoulders along the expressways as a by-pass lane for transit buses. After detailed analysis and evaluations the study recommended action plans for the implementation of the Bus-on-Shoulders concept along the following corridors:

1. Florida Turnpike Homestead Extension/SR-836 (Dolphin Expressway)
2. SR-826 (Palmetto Expressway)
3. SW Broward to Palmetto Metrorail Extension using I-75 and SR-826
4. I-95
5. SR-874 (Don Shula Expressway)/SR-878 (Snapper Creek Expressway)

These plans were discussed with MDT, FDOT, MDX and FTE. Due to the fact that several of these facilities had construction projects that could impede traffic flow, the committee recommended the implementation of the bus on shoulder concept along the SR-874/SR-878 corridor.

Under MPO Resolution 10-06 (Appendix A), the MPO was authorized to enter into Interlocal Agreements with MDT for the implementation of the Bus-on-Shoulders project. Separate Interlocal Agreements were signed with FDOT (Appendix B) and MDX for such purposes.

1.1 OBJECTIVE AND SERVICE STANDARDS

The main objective of this project was to reduce bus and bus rider travel time by using the shoulders along the expressway as a bypass lane during congested traffic periods. No specific goal was stated for this Pilot Project other than measure the effectiveness of this concept by comparing factors before and after the implementation of the project. However, by implementing this pilot project, bus service would be more attractive and consequently, there was a potential to attract new transit users with enhanced transit services.

The following standards were established for this project:

1. Buses will use shoulders only when travel speed for regular traffic goes below 25 miles per hour (mph);
2. Buses cannot exceed 35 mph while on shoulders;
3. Buses will maneuver across ramps, vehicles, and shoulder debris as conditions warrant, however exit and entrance ramps on the Bus-on-Shoulder sections can not be too closely spaced and one-half mile minimum was suggested based on the Minneapolis experience; and
4. The project will be "flexible" so that the concept can work with variable conditions, including expressway construction.

1.2 PROJECT INITIATION

Extensive coordination was conducted among the MPO, MDT and MDX for implementing this project. MDT developed a training program for bus drivers participating in the program. Additionally, MDX installed the traffic signs to identify the start and end of the segments were the buses can access the shoulders. Finally, in March 2007 the project started.

The selected project consisted of allowing three (3) existing bus routes to use the shoulders along the SR-874 and SR-878. The three referenced routes are:

1. Kendall Area Transit (KAT) – Route 204
2. Kendall Area Transit (KAT) – Route 272
3. Kendall Area Transit (KAT) – Route 288

Route Diagrams of the three routes are shown in Exhibits 1-1 through 1-3 below. They differ from others that were previously considered, but based on input from MDT's County's Comprehensive Operational Bus Analysis (COBA), these three existing routes appeared to have the best potential to meet the demonstration plan objectives.

EXHIBIT 1-1
KILLIAN KAT ROUTE 204

Bus driver in training

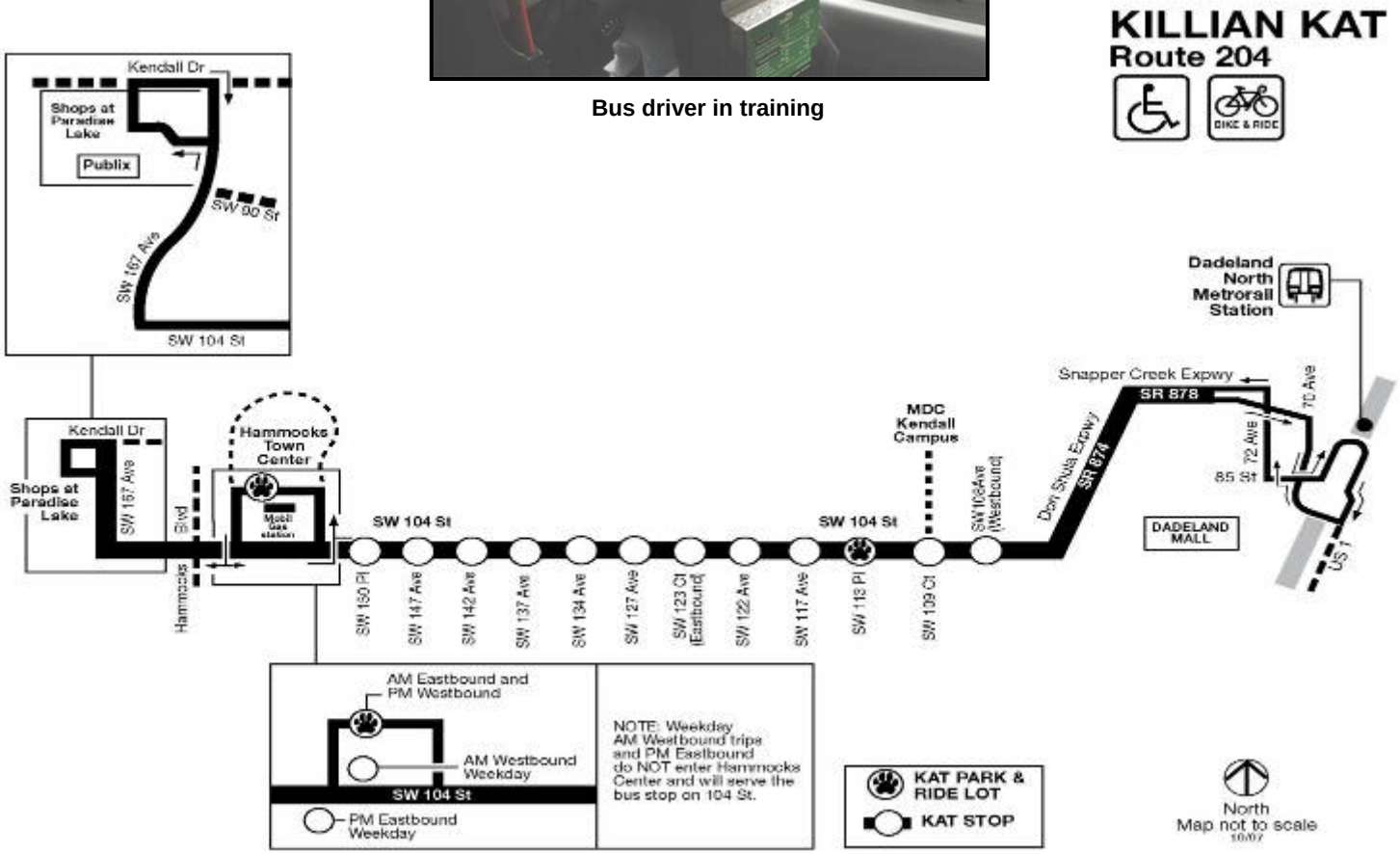
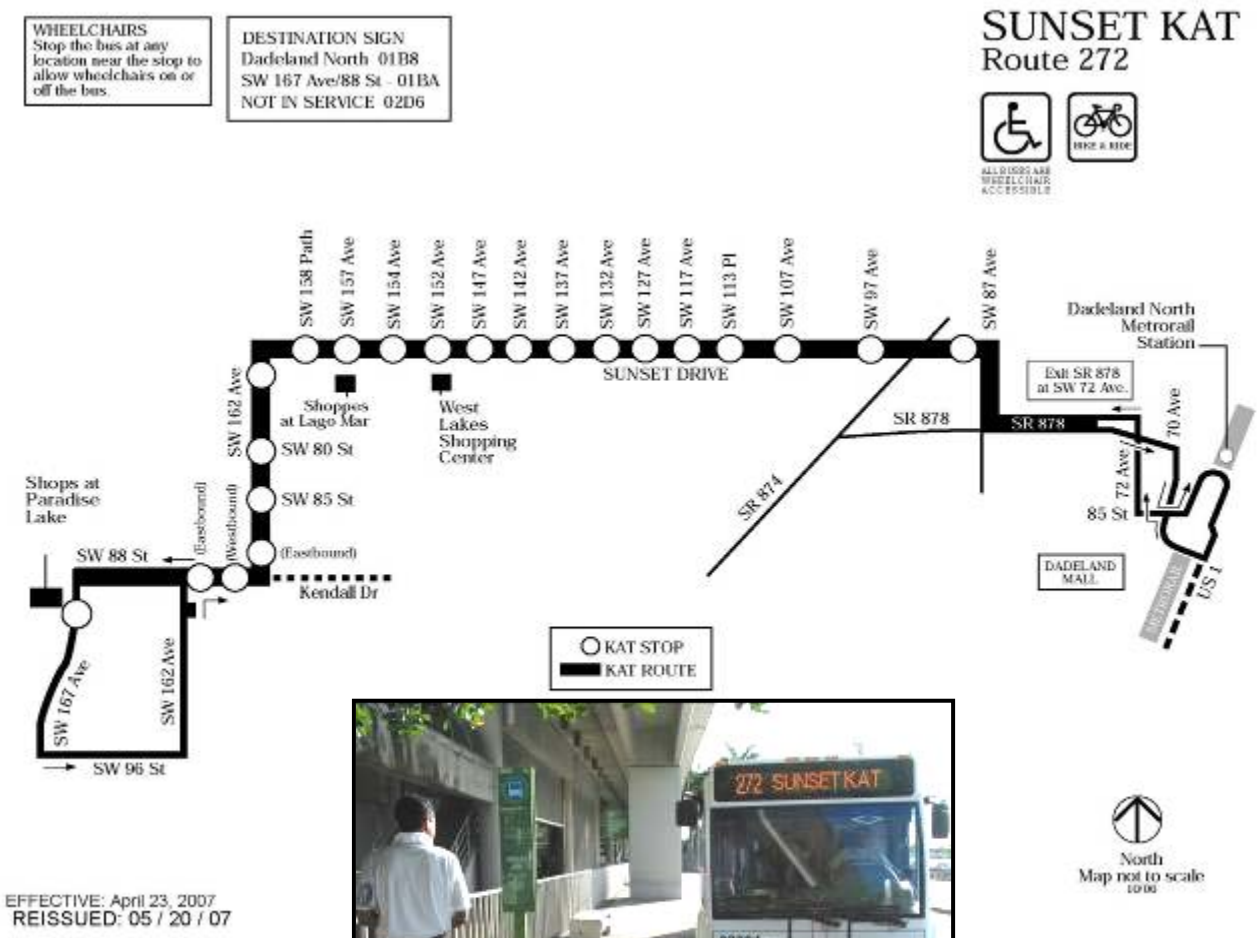


EXHIBIT 1-2
SUNSET KAT ROUTE 272

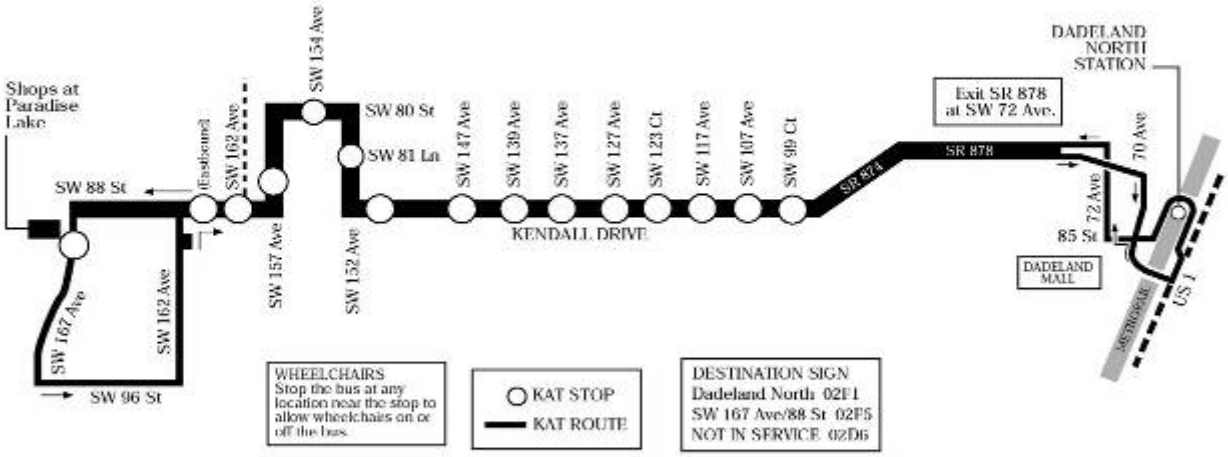


Passenger boarding the Sunset KAT at Metrorail Station

EXHIBIT 1-3
KENDALL KAT ROUTE 288

KAT Bus sign along local route section

KENDALL KAT
Route 288



North
Map not to scale
4/07

EFFECTIVE: April 23, 2007
REISSUED : 05 / 20 / 07

CHAPTER 2.0 REVIEW OF SIMILAR PROJECTS

As noted in Chapter 1.0 Overview, there has been extensive use of shoulder bus operations in Minneapolis and a few other cities. Research for this study shows that other communities, in addition to the Twin Cities, are adopting this concept as a way to improve bus operations in congested corridors. This section describes some of these Bus-on-Shoulders transit operations and how this research was applied to improve and enhance bus operations in Miami-Dade County and new advances in Bus-on-Shoulder operations around the country.

A. MINNEAPOLIS[1]

Starting in 1992, the Minneapolis transit system initiated the use of transit buses on the outside lane of expressways, under state enabling legislation. Each section used in this way is approved by the State and signed to alert motorists that the shoulders are also used by buses. About 108 bus routes use about 240 miles of expressway shoulders for operations. These routes have over 1700 daily vehicle trips operated by METRO, the Minneapolis region's transit operator. Buses can use the shoulders anytime expressway speeds drop below 35 - mph. Bus drivers use their own judgment regarding use of the shoulders and drivers are not required to use the shoulders even if conditions permit their use.

EXHIBIT 2-1
MINNEAPOLIS METRO BUS-ON-SHOULDERS

A five-mile expressway section in Minneapolis saves an estimated 5-10 minutes of travel time over non-use of the section. However, the study notes schedule reliability is the most evident improvement. Commuters perceive that bus travel time savings are twice as great as actual time saving measurements. Exhibit 2-1 shows a bus in operation on the expressway shoulder.

Shoulders have special warning signs showing the beginning and ending of the shoulder operations section, with other periodic warning signs as needed. In all other ways, the shoulders are marked using usual shoulder signing and stripping. There have been some adjustments to the shoulders, including:

- Chatter and rumble strips have been positioned in the center of the shoulders so buses can operate straddling the strips;
- Some catch basins and run-off culverts need to be modified;
- Shoulders next to Jersey wall barriers need widening (11.5-ft.) from 10-ft. standard;
- Shoulders are used by emergency vehicles, breakdowns, and sometimes debris forcing drivers to navigate onto standard lanes when appropriate;
- Costs have been about $100,000 per mile to ready a shoulder for bus use and system-wide recurring upkeep costs are $5-10,000 per mile in Minneapolis;
- Little damage has been evident to shoulders due to bus operations, except the edges of catch-basins; and

[1] *Miami-Dade MPO, Special Use Transit Lanes Study – November 2005, Page 1-5 to i-6*

- There have been very few traffic violations or accidents. There has never been an injury accident. Most incidents (about 60-90%) involve side mirrors on buses hitting truck side mirrors. A bus has never hit a disabled or stopped vehicle on the shoulder.

B. CINCINNATI[2]

On July 23, 2007, Metro, a non-profit public service of the Southwest Ohio Regional Transit Authority, partnered with Ohio Department of Transportation (ODOT) and the Federal Highway Administration (FHWA) to begin operating buses on I-71's left shoulder to avoid traffic congestion. Metro is the first system nationally to use buses on the left shoulder of an expressway. This on-going pilot project was modeled after the successful programs in Minneapolis, MN, and Columbus, OH. Exhibit 2-2 shows the operation.

EXHIBIT 2-2
CINCINNATI METRO BUS-ON-SHOULDERS
(TWO-VIEWS - INSIDE SHOULDER)

The 11.7-mile Bus-on-Shoulder section saves an estimated 5-20 minutes of travel time over non-use. Two bus routes, Metro's Route 71X-King's Island Express and Route 72-King's Island, use the expressway shoulders for operations. These routes operate about ten daily vehicle trips and provide about 900 riders per week. Buses can use the 12-ft. shoulder anytime expressway speeds drop below 30 mph. Bus drivers use their own judgment regarding use of the shoulders and drivers are not required to use the shoulders even if conditions permit it.

Like Minneapolis, the shoulders have special warning signs showing the beginning and end of the shoulder operations section, with other periodic warning signs posted as needed. In all other ways, the shoulders are marked using usual shoulder signing and stripping. There has not been any need for adjustments to the shoulders. Shoulders are only used by emergency vehicles and Metro buses. Naturally, buses must yield to emergency vehicles and all Metro bus operators who drive the 1-71 routes are trained to safely use the shoulders.

To date, there have only been minor traffic violations and there has never been an accident. Most incidents have been passenger car drivers straddling the shoulder lane, not allowing buses to pass through. A bus has never hit a disabled or stopped vehicle on the shoulder.

[2] *"Metro Using Shoulder to Avoid Congestion", Ohio Transfer, ODOT, Office of Transit, Summer 2007, Page 3*

C. SAN DIEGO[3]

In December 2005, the San Diego Association of Governments (SANDAG), in partnership with the San Diego Metropolitan Transit System (MTS), the California Department of Transportation (Caltrans), and the California Highway Patrol (CHP), implemented a freeway transit lane demonstration project on State Route 52 (SR 52)/Interstate 805 (I-805) between Kearny Mesa and University City using MTS Express Route 960 to evaluate the effectiveness of using the freeway shoulder lanes as a low-speed transit priority measure when the regular freeway lanes are congested, as shown in Exhibit 2-3.

EXHIBIT 2-3
SAN DIEGO TRANSIT
BUS-ON- SHOULDERS OPERATION

This pilot program was initiated as a 24-month project and was divided into two phases:

- An initial 12-month evaluation period that tested the viability of the freeway transit lane concept on transit operations and freeway operations (the focus of this report).
- A second 12-month evaluation period during which more detailed analysis of freeway operations and transit lane performance will be undertaken, along with an assessment of other locations in the region where freeway transit lanes could be implemented.

The conclusion from the first year of the freeway transit lane demonstration project indicates that the freeway transit concept has been successful in meeting a range of objectives, including safety, benefits to transit operations, bus driver and passenger perceptions, freeway level of service/maintenance, and shoulder lane structural issues.

OPERATIONAL GUIDELINES AND REQUIREMENTS

The maximum speed of buses is 35 mph. Buses are allowed to drive on the transit-only lanes only when mainline traffic speeds drop below 35 mph. At the request of the CHP, the speed differential between buses and mainline traffic is limited to 10 mph.

HIGHWAY MODIFICATIONS

Highway signs at the edge of the transit lanes are placed approximately every half-mile throughout the route to inform motorists that the lane is for authorized buses only. Additionally, pavement markings that read "Transit Buses Only" are painted in the lane at intermittent locations.

Performance measures and success criteria for the pilot program are as follows:

- **Safety** – After a 12-month evaluation, there were no transit-related accidents, including no incidents reported by either MTS or the CHP related to the operation of the lane.

[3] *Status Report on Freeway Transit Lane Demonstration Project, San Diego Association of Governments – Transportation Committee, San Diego Association of Governments Agenda Item No.: 8, July 20, 2007, Pages 1-3*

- **Freeway Operations** – Caltrans Traffic Operations and Maintenance have reported no change in freeway level of service, disruption to main lane traffic flow, or any increase in work efforts during the 12-month observation period. In the short-term, the structural pavement section was adequate for the bus volume and low speed.
- **Transit Travel Time Reliability** – All of the trips on Route 960 reported a 99% on-time performance, meaning that nearly all buses operating along the freeway shoulder lane demonstration project got into the northern terminal in University City at or before the time shown on the timetable.
- **Driver/Passenger Perception** – Surveys of passengers and drivers revealed that both see the operation as a good idea that is safe and saves time.
- **Cost vs. Benefit Analysis** – The current project was implemented at minimal cost to Caltrans. The only capital improvements were signage and painted shoulder markings. In terms of travel time savings, SANDAG undertook a test of the travel time savings between buses operating in the shoulder lane versus a car operating in the regular freeway travel lanes. The result of a one-day test showed a five-minute faster travel time for the bus versus the automobile trip. While this result was for only that particular surveyed trip, it does provide a dramatic example of the benefits that a freeway shoulder lane program can offer to transit operations when there is significant traffic congestion in the main travel lanes.

D. COLUMBUS[4]

The Ohio Department of Transportation (ODOT), the Central Ohio Transit Authority (COTA), the Federal Highway Administration (FHWA), and the Mid-Ohio Regional Planning Commission (MORPC), in association with the Ohio State Highway Patrol and the Columbus Police Department (CPD), conducted a one-year pilot project to allow COTA transit buses to use the interstate highway shoulder lanes.

The COTA Bus-on-Shoulders project was implemented on November 20, 2006. The I-70 East corridor between Miller/Kelton and State Route 256 was designated for the pilot project. I-70 East corridor was chosen due to its relatively wide shoulder widths and heavy peak-period congestion levels. Three bus routes were part of the pilot project. The corridor carries 12 express bus trips in the morning peak period and 11 in the evening peak period. COTA, working with ODOT and MORPC, has successfully introduced transit priority measures in the form of transit buses on freeway shoulder lanes under the following operating guidelines:

a) Bus drivers are to exercise best judgment in considering safety of other motorists, as well as bus passengers, while using shoulders;

b) Designated shoulders to be used by buses only when travel speeds drop below 35 mph on mainline;
Only COTA buses are authorized to use freeway shoulders for travel lanes;

c) Shoulder use during 'deadheading' i.e., when the bus carries no passengers, is authorize ;

d) Buses can only travel 15 mph greater than the speed of traffic (maximum speed 35 mph) in adjacent lane;

e) Buses must yield to cars merging to or exiting from the freeway or using shoulder;

[4] *Central Ohio Bus On Freeway Shoulder Evaluation – Central Ohio Pilot Program – December 4, 2007, Page 2 to 5*

f) Buses must use 4-way flashers;

g) Bus drivers must exercise caution during inclement weather; and

h) If shoulder is blocked by any obstruction, bus drivers may re-enter the mainline to avoid it.

Experience gained through the implementation of this project will be used to assess the ability to use freeway shoulder lanes in other corridors where existing express services and future COTA services will operate.

Safety. CPD had reservations with the project initially, but were willing to do everything they could to make it work. However, there have been no accidents to date that have occurred as a result of the demonstration project. ODAOT, OSHP, and CPD have been surveyed to determine if there have been noted, and all the partners in the project have indicated, that there have been no operational issues associated with the shoulder lane operation. There has been no perceived degradation of traffic safety.

Benefits to Transit Operations. The transit service was used 1-2% of the time in the morning during the pilot period while the evening usage increased from 15% in November 2006 to 50% in August 2007. Regarding travel time and reliability, the service was on time only 68% of the time in the evening in August 2006 before the implementation of the project. After the implementation, it improved to being on time 88% of the time in the evening during August 2007. This provides a dramatic example of the advantage in using the shoulder lanes to bypass the congested freeway.

Bus Driver and Passenger Perceptions. Overall, the feedback from drivers and passengers was positive, with emphasis placed on the need for adequate training of the drivers in operating buses on shoulders.

Structural Changes to the Shoulder. Per the ODOT Location and Design Manual, no structural changes were required to the shoulders to make the demonstration project feasible since they were already designed to take the load.

Based on the first year of operations, ODOT, COTA, MORPC, OSHP, and CPD agree that the demonstration project to test the viability of transit vehicles using the shoulder lanes as a low-speed priority measure has been successful. Given the success to date, the next step is to begin looking at other applications for freeway shoulder lanes projects. Toward this end, a variety of issue areas will be examined:

- Advance I-70 East Corridor from pilot status;
- Exploit marketing opportunities with targeted promotions of the service;
- Increase bus driver training by providing more "on shoulder" experience;
- Increase service by adding buses to shoulder routes;
- Develop and evaluate a working list of other corridors that could benefit from this procedure; and
- Undertake a cost benefit analysis for these corridors that would compare the capital costs versus the benefits received.

MORPC will continue the working group with COTA, ODOT, OSHP, and CPD to address these issues over the next year.

CHAPTER 3.0 BEFORE AND AFTER METROBUS AND EXPRESSWAY CONDITIONS

This section reviews the basic operating conditions associated with the three bus routes operated in the demonstration phase of the project:

- Killian KAT (Route 204)
- Sunset KAT (Route 272)
- Kendall KAT (Route 288)

Bus-on-Shoulders operations started in March 2007. The end of the fiscal year for MDT is September 2006 and September 2007 and these dates are used as comparison points. MDT operational data has been taken from the MDT Monthly Technical Reports.

In addition, it is important to study the results to bus service, ridership, safety, and improvements to bus operations and related impacts to the SR-874 (Don Shula Expressway) and SR-878 (Snapper Creek Expressway) expressways where shoulder operation is used by these routes. All three routes connect to the Dadeland North Metrorail station, one of the busiest stations of the Metrorail system. Parking availability is a problem at this station with over 1,800 spaces, reporting 100-percent occupancy on the average weekday. Where suitable, the Metrobus or expressway data will be compared with system-wide information. This will permit changes to the entire Metrobus or expressway sections to be contrasted against those elements engaged in the demonstration project.

EXHIBIT 3-1
DON SHULA EXPRESSWAY (SR-874) AND SNAPPER CREEK EXPRESSWAY (SR-878)

Thus, the study will use available data to review changes to the following as part of the demonstration project:

- Bus ridership
- Bus operations and cost
- Bus safety
- Highway impacts
- Highway safety
- Rider perceptions of service
- Driver and transit operator perceptions of service

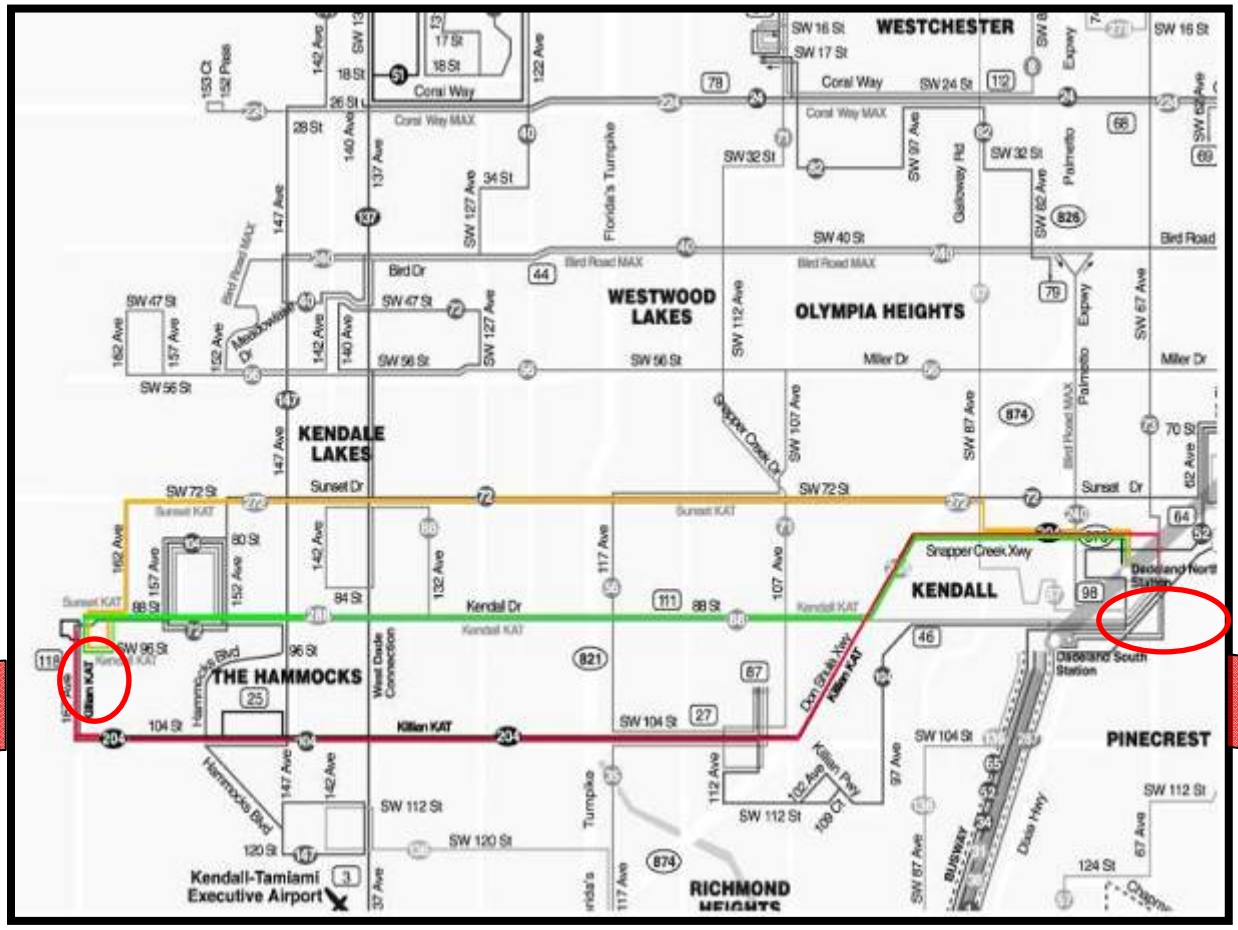
Surveys of bus riders, bus drivers, and meetings or phone calls with Miami-Dade Transit (MDT), Florida Department of Transportation (FDOT), Miami-Dade Expressway (MDX) officials and public safety officials augment empirical data collected from the operating agencies to gain a broad overview of the project's impacts.

MDT METROBUS OPERATIONS

Prior to the project, the three Metrobus routes operated from the Dadeland North Metrorail station along SR-878 and two routes continued onto SR-874. These routes, Route 204 – Killian KAT, Route 272 – Sunset KAT, and Route 288 – Kendall KAT are all engaged in the Bus-on-Shoulders project. Map 3-1 shows these three routes and their operations and stops. All three routes run from

a terminus at the Shops at Paradise Lake near Kendall Drive and SW 167th Avenue to the Dadeland North Metrorail Station.

MAP 3-1
KAT ROUTES



Shops at Paradise Lake

Dadeland North Station

Table 3-1 shows some service characteristics of the three KAT routes before and after the implementation of the Bus-on-Shoulders project.

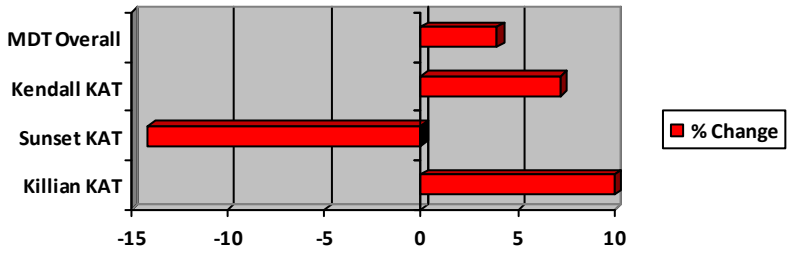
TABLE 3-1
BUS-ON-SHOULDERS SERVICE EVALUATION
PRE/POST SERVICE CONDITIONS

Description	Route 204 Killian KAT	Route 272 Sunset KAT	Route 288 Kendall KAT
Service Period	**Weekdays – Peak hours**	**Weekdays – day long**	**Weekdays – Peak hours**
Prior to Bus-on-Shoulders – September 2006			
Number of Trips	60-round trips	50-round trips	28-round trips
Frequency	6-minute headways	10 to 40-minute headways	12-minute headways
Hours of Operation	5:30 – 9:30 AM 3:00 – 9:00 PM	5:45 AM – 7:30 PM	6:00 – 9:00 AM 4:00 – 7:00 PM
Average Weekday Ridership	2,032	1,549	902
After Bus-on-Shoulders – September 2007			
Number of Trips	54-round trips	38-round trips	24-round trips
Frequency (peak-period)	8-minute headways	10-minute headways	15-minute headways
Hours of Operation	5:30 – 9:30 AM 3:30 – 9:10 PM	5:45 – 9:20 AM 3:25 – 7:00 PM	5:45 – 9:00 AM 4:30 – 7:10 PM
Average Weekday Ridership	2,235	1,330	967
Ridership Change 2006-2007	+10%	-14%	+7%

When comparing both periods, a service reduction was put in effect for 2007. The route mostly affected was the Sunset Kat, where service (trips) was cut by 24%. MDT notes that the reductions were due to mid-day service cuts. Ridership on the 272 for this route reflects a reduction of 14% in daily passenger boardings, as shown in Exhibit 3-2. Individual reductions in services were as follows:

- Killian KAT: 6 roundtrips (10%)
- Sunset KAT: 12 roundtrips (24%)
- Kendall KAT: 4 roundtrips (14%)

EXHIBIT 3-2
RIDERSHIP CHANGE FROM 2006 TO 2007



Overall, the three KAT routes ridership grew by 1% in spite of service cuts. Table 3-1 compares the ridership for the three KAT services and the total ridership for 2006 and 2007. In total, the service for the three KAT routes was reduced by 16%. Considering this situation, it could be concluded that the use of the Bus-on-Shoulders helps to keep a stable ridership in the evaluated routes.

Exhibit 3-2 illustrates the change in percentage. It is important to note that the Sunset KAT was the only one who experienced a reduction in daily ridership. Curiously, this is the route that has the shorter segment along the designated expressways for the demonstration project. System-wide, Metrobus had an average of 3.06% ridership increase from 2006 to 2007.

It is recommended that MDT evaluate in more detail the performance of this route. One possibility is to improve the travel time by limiting the number of stops along Sunset Drive.

Table 3-2 shows the on-time performance for all three routes, increased significantly for the Kendall and Sunset routes. The three routes all perform at better levels than the overall bus system.

TABLE 3-2
BUS-ON-SHOULDERS SERVICE EVALUATION
KAT AND MDT ON-TIME BUS PERFORMANCE COMPARISON

Weekday Operations Bus-on-Shoulders Routes			
Route Number	**On-time Status**	**Sep-06**	**Sep-07**
Killian KAT (Route 204)	Late	13.5%	7.8%
	Early	8.1%	13.1%
	On-time	78.4%	79.1%
Sunset KAT (Route 272)	Late	20.6%	18.1%
	Early	9.9%	5.2%
	On-time	69.5%	76.7%
Kendall KAT (Route 288)	Late	33.3%	14.1%
	Early	8.3%	8.8%
	On-time	58.3%	77.1%
Overall MDT Bus System	Late	19.7%	18.3%
	Early	13.8%	8.6%
	On-time	66.5%	69.7%

Source: MDT On-Time Schedule Reports 2006 and 2007

On-time performance is one of the major benefits obtained by implementing the Bus-on-Shoulders concept. The overall improvement for Metrobus from 2006 to 2007 was 3% while the combined average for the KAT routes were 9%.

Exhibit 3-3 compares on-time performance changes by route and in the overall service. As indicated before, this is one of the most relevant service improvements measured by implementing this project.

Table 3-3 shows a comparison between running time and scheduled time. In these particular routes, there is no end terminal. Therefore, the bus driver starts service as scheduled. Eastbound service is the one more positively affected by this project. It is at the last segments of the routes that they take the SR-874 and SR-878 to finish in the Dadeland North Metrorail Station. By using the shoulders there is an average of 5-minute travel time saved over the entire route schedule, as estimated by Parsons and travel-speed monitoring.

EXHIBIT 3-3

ON-TIME PERFORMANCE CHANGE FROM 2006 TO 2007

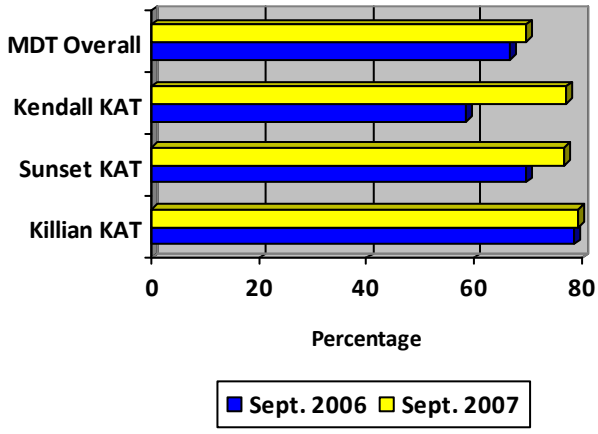


TABLE 3-3
BUS-ON-SHOULDERS SERVICE EVALUATION
RUNTIME AND SCHEDULE TIME

Bus-on-Shoulders Routes	AM Peak Inbound (7:30 AM)	Schedule Time	
Route Number		**Sep-06**	**Sep-07**
Killian KAT (Route 204)	SW 167th Ave to Dadeland North Station	NA	39 minutes
Sunset KAT (Route 272)	SW 167th Ave to Dadeland North Station	NA	37 minutes
Kendall KAT (Route 288)	SW 167th Ave to Dadeland North Station	NA	42 minutes
Bus-on-Shoulders Routes	**PM Peak Outbound (5:30 PM)**	**Schedule Time**	
Route Number		**Sep-06**	**Sep-07**
Killian KAT (Route 204)	Dadeland North Station - SW 167th Ave	NA	40 minutes
Sunset KAT (Route 272)	Dadeland North Station - SW 167th Ave	NA	42 minutes
Kendall KAT (Route 288)	Dadeland North Station - SW 167th Ave	NA	41 minutes

Source: MDT On-Time Schedule Reports 2006 and 2007

Table 3-4 shows overall changes in bus operations, operating costs, and productivity measures. All three routes improved in varying degrees. As mentioned before, the Sunset KAT route had a drop in ridership but also had a drop in service. This service reduction is about 20% or more in service hours, miles, and revenue hours by comparing 2006 to 2007 periods. Thus, a ridership decline is to be expected. However, the ridership decline was less severe than the service decline, so the route's productivity and cost-effectiveness increased. The Killian KAT and the Sunset KAT increased boardings per hour by about 10%, while the Kendall KAT stayed about the same.

Table 3-4 also shows how service has changed on the three routes over the 2006 to 2007 period. Overall service hours were cut about 7% but ridership declined about 1%. Increases in operating costs and declines in farebox recovery were observed on the three routes, but were observed across the MDT bus structure as a whole during the same period as cuts were applied to many other Metrobus routes. Consequently, changes in route ridership on all three KAT routes are also part of a larger transit service profile change and cannot be directly connected to the Bus-on-Shoulders project.

TABLE 3-4
BUS-ON-SHOULDERS SERVICE EVALUATION
SERVICE CHARACTERISTICS

Monthly Operations Data								
Route Number	**Route 204 Killian KAT**		**Route 272 Sunset KAT**		**Route 288 Kendall KAT**		**All KAT Services**	
Bus-on-Shoulders Routes	**Sep-06**	**Sep-07**	**Sep-06**	**Sep-07**	**Sep-06**	**Sep-07**	**Sep-06**	**Sep-07**
Revenue Miles	1,595.4	1,592.6	1,298.3	1,035.8	697.1	733.6	3,590.8	3,362.0
Total Miles	2,155.6	2,152.8	1,754.5	1,501.4	964.9	1,038.9	4,875.0	4,693.1
Vehicle Revenue Hours	93.0	93.0	83.1	63.0	39.4	42.1	215.5	198.1
Total Vehicle Hours	118.2	118.2	103.8	84.0	51.3	55.0	273.3	257.2
Direct Operating Cost	$7,669	$9,323	$6,586	$6,547	$3,331	$4,387	$17,586	$20,257
Avg. Farebox Revenue	$1,703	$2,053	$1,200	$1,149	$791	$920	$3,694	$4,122
Direct Operations\Rev Ratio	22.2%	22.1%	18.2%	17.6%	23.8%	21.0%	21.0%	20.3%
Net Cost\Boarding	$2.94	$3.24	$3.48	$4.06	$2.81	$3.59	$3.10	$3.56
Boardings\Rev Hour	21.8	23.9	18.6	21.1	22.9	23.0	20.8	22.9

Source: MDT Monthly Budget & Performance Reporting
September 2006 and 2007

As shown in Table 3-5, the route length operating on the expressway has remained constant and is relatively a short part of the route-length for the three bus routes which are about 14-16 miles long total. Killian KAT route travels about 4-miles each way on the expressway; the Sunset KAT and Kendall KAT each travel a little over 2 miles each-way on the expressways. In addition, the distances between interchanges where weaves on shoulder conditions might change is over a mile between the two expressways and no less than 0.6-miles at any point. This spacing is consistent with standards set forth for the service established in the planning phase.

TABLE 3-5
BUS-ON-SHOULDERS SERVICE EVALUATION
INTERCHANGE SPACING & METROBUS OPERATIONS

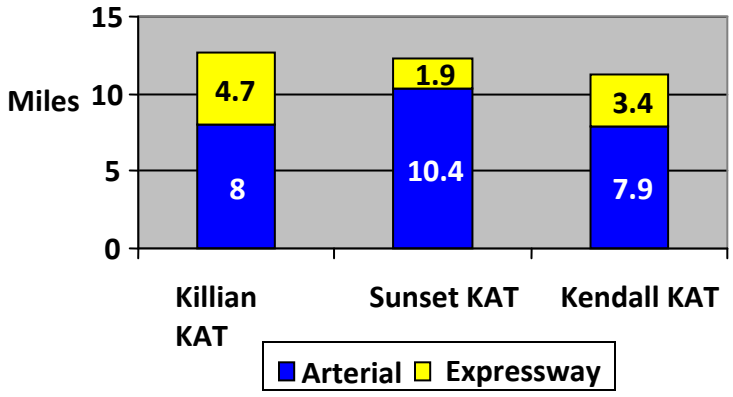
Expressway Section	Mile Post	Distance Between Interchanges
SR-874 (Don Shula Expressway)		
SR-874 @ SR-990 (Killian Parkway)	2.2	2.2
SR-874 @ SR-94 (Kendall Drive)	3.62	1.45
SR-874 @ SR-878	4.2	.6
SR-874 @ SR-826	6.9	2.7
Avg. Interchange Distance = 1.7 miles		
SR-878 (Snapper Creek Expressway)		
SR-878 @ SR-874	0	NA
SR-878 @ SR-973 (SW 87th Avenue)	0.7	0.7
SR-878 @ SW 72nd Avenue	2.2	1.5
Avg. Interchange Distance = .9 miles		

Source: Miami-Dade MPO, Special Use Lanes Study, November 2005 page 6-1

Exhibit 3-4 shows the use of the shoulders by each route. The Killian and Kendall KAT routes have experienced increases in ridership and are the ones with the greater use of the shoulders along the SR-874 and SR-878. Following are the roundtrip mileage for each KAT route:

- Killian – 25.4 miles
- Sunset – 24.6 miles
- Kendall – 22.5 miles

EXHIBIT 3-4
SHOULDER DISTANCE VS TOTAL ROUTE LENGTH



As shown in Table 3-6, accident data also predates the demonstration project and can only be used in future follow-up studies. FDOT accident data is only available through 2006 and is summarized in Chapter 7. The data shown here briefly summarizes total incidents on the two expressways prior to any Bus-on-Shoulders operations. The more congested Don Shula Expressway (SR-874) shows considerably more accidents, injuries, and ramp accidents than the Snapper Creek Expressway (SR-878). However, traffic volume on the Snapper Creek (SR-878) is growing faster. Overall, accident data for 2003 is higher than for previous years, showing an increasing trend in all types of incidents on both expressways. But none of these trends is connected to Bus-on-Shoulder operations.

TABLE 3-6
BUS-ON-SHOULDERS SERVICE EVALUATION
PRE-PROJECT START-UP
ACCIDENT HISTORY

Year	Number of Crashes	Number of Fatalities	Number of Injuries	Number of Ramp Crashes	Percent Change
SR-874 (Don Shula Expressway)					
2001	626	5	290	61	10%
2002	574	4	246	5	9%
2003	712	1	338	68	10%
AVERAGE	**637**	**3**	**291**	**60**	**9%**
SR-878 (Snapper Creek Expressway)					
2001	75	2	31	9	12%
2002	63	1	36	8	13%
2003	85	0	41	14	17%
AVERAGE	**74**	**1**	**36**	**10**	**14%**

Source: Miami-Dade MPO, Special Use Lanes Study, November 2005 page 6-1

EXPRESSWAY CONFIGURATION AND VIABILITY

As mentioned, the Bus-on-Shoulders project has been implemented along two expressways under the jurisdiction of the Miami-Dade Expressway Authority (MDX). This jurisdiction is shown along these facilities with appropriate signs. Figures 3.1 and 3.2 are aerial sections of the SR-874 and SR-878 expressway used by the three Metrobus routes in this demonstration program. The 2005 Bus-on-Shoulders Study cited the following:[5]

- On SR-874 the 10-foot shoulders are entirely useable between the ramps for Killian Parkway and the Florida Turnpike, except around the toll plaza. As shown in Figure 3-1 and 3-2 the majority of the shoulders in both directions between Killian Parkway and SW 87th Avenue are not suitable as a congestion by-pass lane. However, the shoulders from SW 87th Avenue to SR-826 are adequate to support shoulder bypass operations."[6] Figures 3-1 and 3-2 show aerial overviews of the two expressways and notations of shoulder widths.
- According to the Special Use Lanes Study: "The eastbound majority of the shoulders on SR-878 are too narrow for use as a congestion bypass lane. However, almost the entire length of the westbound shoulder is useable from the Palmetto Expressway overcrossing to the interchange with SR-874." Figures 3-1 and 3-2 illustrate the availability of shoulder use along SR-878 and SR-874.[7]

The report recommended the following: ***"…****That the westbound shoulder of SR-878 be signed for bus use only. MDT should coordinate with MDX to start using the shoulders as appropriate for those existing route serving the corridor.****"*[8] *The final determination did sign both the eastbound and westbound shoulders for use in the demonstration project.*

[5] *Source: Miami-Dade MPO, Special Use Lanes Study, November 2005: page 6-7*
[6] *Source: Miami-Dade MPO, Special Use Lanes Study, November 2005: page 6-7*
[7] *Ibid*
[8] *Ibid, page 6-8*

FIGURE 3-1
AERIAL OVERVIEW
SR-874 – DON SHULA EXPRESSWAY

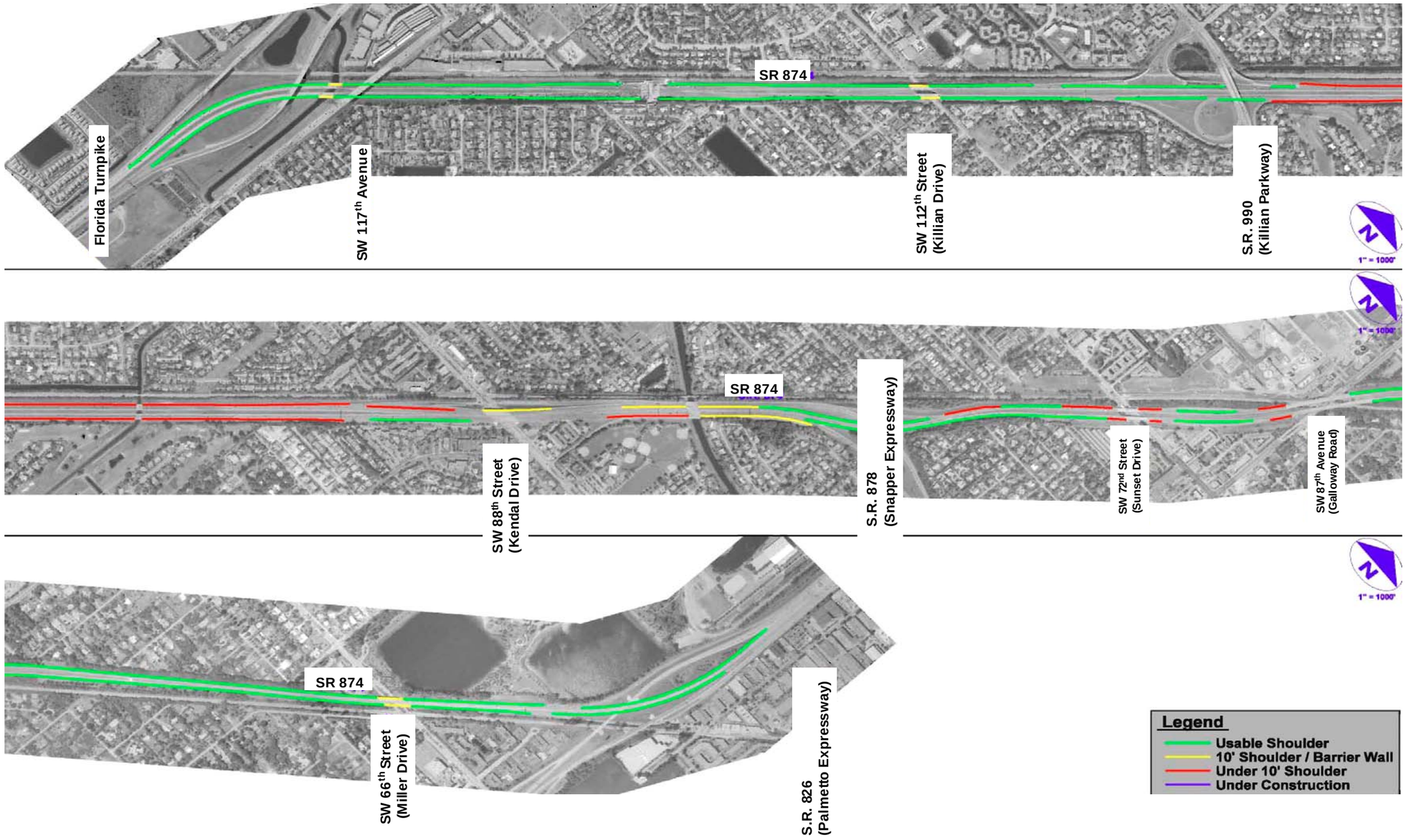


FIGURE 3-2
AERIAL OVERVIEW
SR-878 – SNAPPER CREEK EXPRESSWAY

CHAPTER 4.0 ROADWAY AND TRAFFIC CONDITIONS

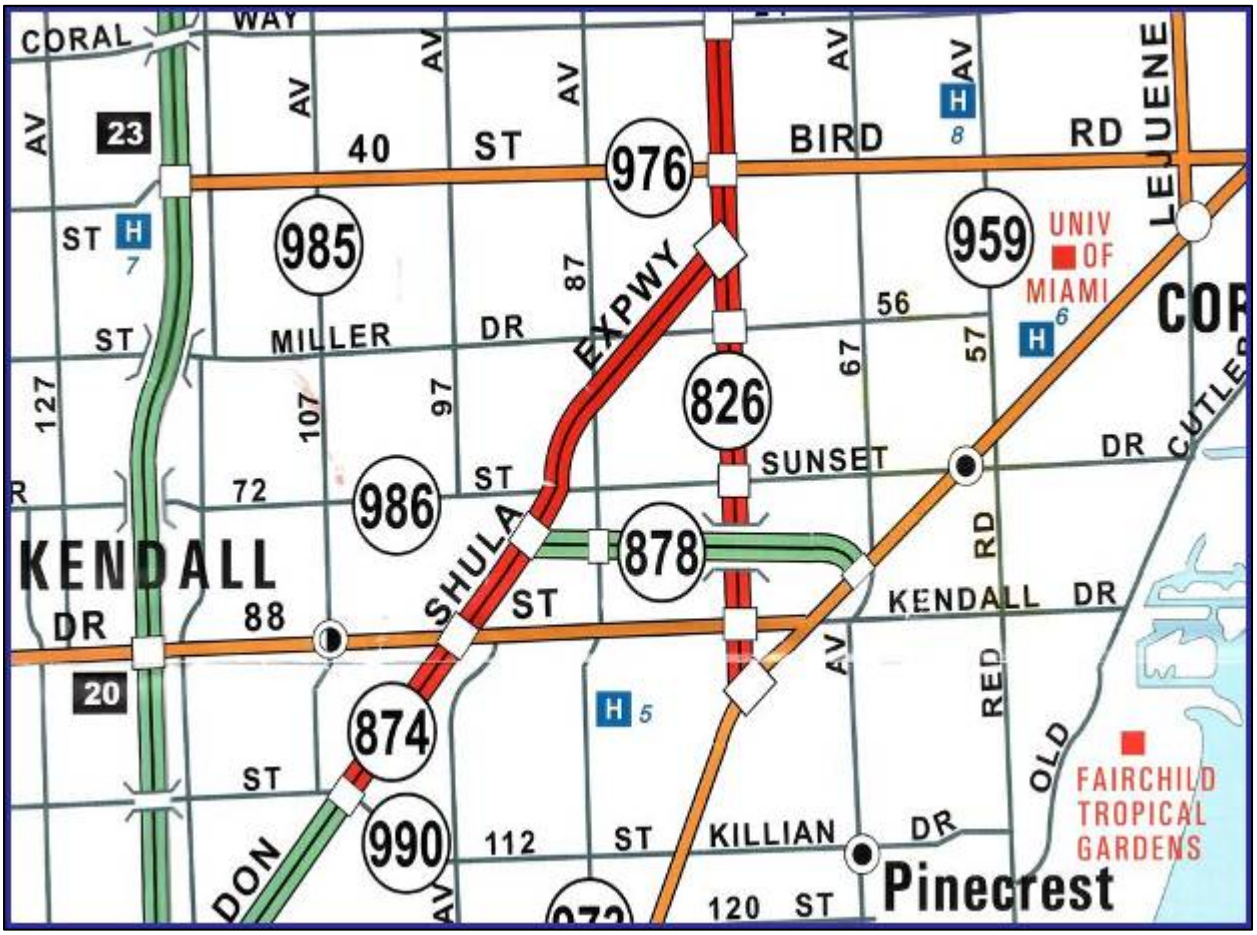
This section describes existing roadway and traffic conditions for the demonstration project.

A. ROUTES ALONG THE MDX SYSTEM

The Don Shula Expressway (SR-874) runs from the Florida Turnpike (HEFT) and the Palmetto Expressway (SR-826). Diverging from SR-874 is the Snapper Creek Expressway (SR-878) that ends at South Dixie Highway (US-1). Both SR-874 and SR-878 are part of the MDX system, which provides service to the Dadeland and Kendall areas. Map 4-1 shows the general service area.

The three routes that are involved in the Bus-on-Shoulders project are Route 204 (Killian KAT), Route 272 (Sunset KAT) and Route 288 (Kendall KAT). Two of the routes operate on portions of SR-874 and all three routes operate on SR-878. In Chapter 1, Exhibits 1-1, 1-2 and 1-3 show the three routes, their operations, and stops.

MAP 4-1
SR-874 & SR-878 LOCATION MAP



B. TYPICAL SECTIONS

Figure 4-1 and Figure 4-2 are typical cross-sections of the two corridors. Figure 4-1 is for SR-874, which is a four-lane highway each way divided by a median barrier. The inside shoulder width is mostly 10 ft. Each of the four travel lanes are mainly 12 ft. wide. The outside shoulder, the bus lane, is for the most part 10 ft. wide paved along the length of SR-874.

FIGURE 4-1
TYPICAL SECTION – SR-874 (DON SHULA EXPRESSWAY)

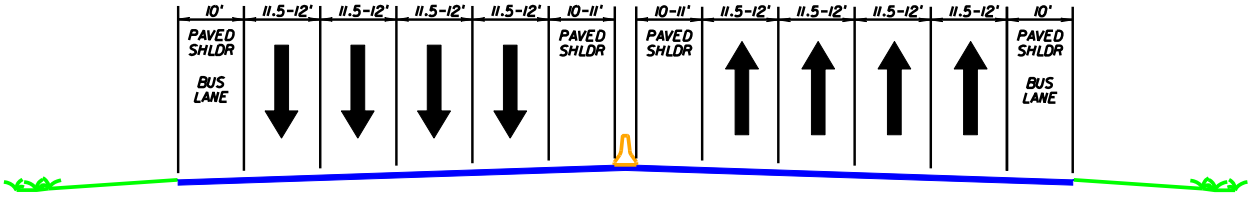
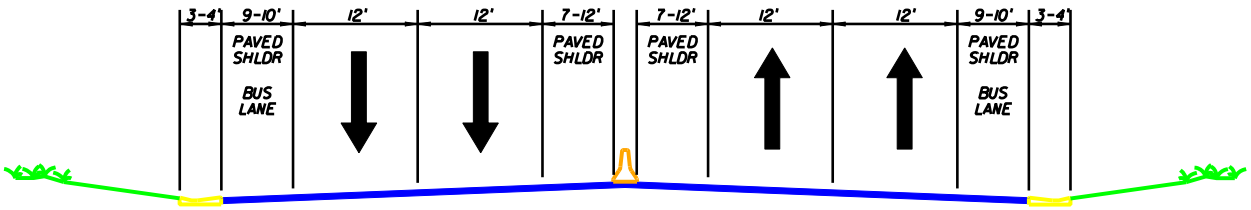


Figure 4-2 is for SR-878, which is a two-lane highway each way with a median barrier dividing east-bound and west-bound traffic. The inside shoulder begins at 7 ft. and widens to 12 ft. for the most part. The two travel lanes are 12 ft. wide. The outside paved shoulder varies from 9 ft. to 10 ft. throughout the SR-878 corridor.

FIGURE 4-2
TYPICAL SECTION – SR-878 (SNAPPER CREEK EXPRESSWAY)



C. EXISTING SHOULDER CONDITIONS

A field review was conducted where the Killian KAT (Route 204), Sunset KAT (Route 272), and Kendall KAT (Route 288) currently operate using the shoulder areas on SR-874 (Don Shula Expressway) and SR-878 (Snapper Creek Expressway). Aside from the obvious construction alongside of SR-874 northbound, there seems to be a problem if the buses choose to use the shoulder in a small area of the corridor. This problem occurs only in the northbound direction of SR-874 where it connects to SR-878 eastbound.

Within the corridor the outside shoulder lanes along SR-874 is at least 10 ft. wide in most locations along its 2-mile length. Adjacent to them on the left are swale areas for drainage, and within these swale areas, light poles and signage can be found. Exhibit 4-1 illustrates the shoulder area along SR-874. The shoulder is signed for bus use just north of Killian Parkway ramps to the SR-878 connection in both the northbound and southbound directions. No rumble strip was seen in the shoulder.

The Bus-on-Shoulders project segment of SR-878 is about 2.6 miles long. The shoulder is signed for bus use in both the eastbound and westbound directions. The outside shoulder lane is at least 10 ft.

wide. Adjacent to the shoulder, there is a shoulder gutter with gutter inlets in some areas. In others, there is a guardrail or barrier wall with the signs located behind. Rumble strips were not observed within the shoulder as illustrated in Exhibit 4-2. But the pavement ridge transition between the operating lane and the shoulder is visible.

The pavement's friction course along SR-874 and SR-878 extends from edge of the travel lane into the shoulder at least 4 to 6 in., reducing the shoulder lane width to less than 10 ft. On SR-878, the shoulder also has gutter inlets on the outside edge taking 2 to 2.5 in. from the shoulder lane, as shown in Exhibit 4-3.

EXHIBIT 4-1
SR-874 SHOULDER AREAS

EXHIBIT 4-2
SHOULDER PAVEMENT

EXHIBIT 4-3 GUTTER INLET

Signs identifying the use of shoulders as bus lanes were found along both SR-874 (Don Shula Expressway) and SR-878 (Snapper Creek Expressway) during the field review. Exhibits 4-4 and 4-5 show two different types of signs used for the Bus-on-Shoulders demonstration project.

EXHIBIT 4-4
BUS-ON-SHOULDER SIGN

EXHIBIT 4-5
SR-878 BUS-ON-SHOULDER SIGN

D. TRAFFIC AND ROADWAY CONDITIONS

Table 4-1 shows the traffic volumes along the expressways. It is important to mention that during the time the service has been evaluated there has been construction activity along SR-874 which can impact traffic volumes and traffic flow. Overall traffic volume has been consistent along the SR-878 (Snapper Creek Expressway). However, traffic volumes have increased on SR-874 (Don Shula Expressway).

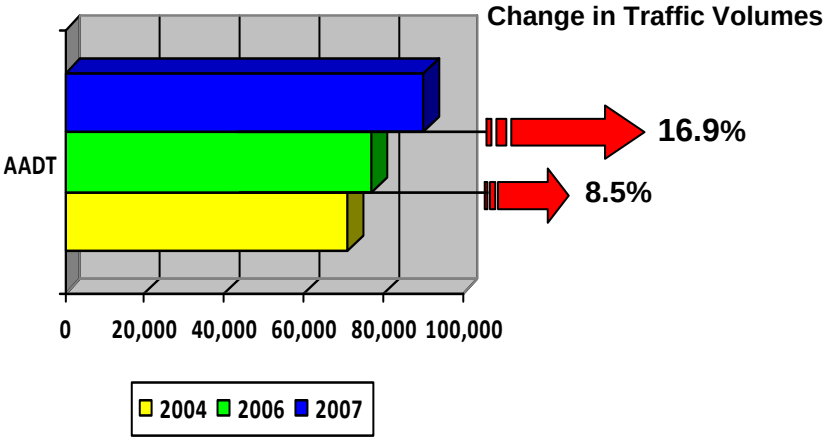
TABLE 4-1
BUS-ON-SHOULDERS SERVICE EVALUATION
2004, 2006 AND 2007 AADT VOLUME

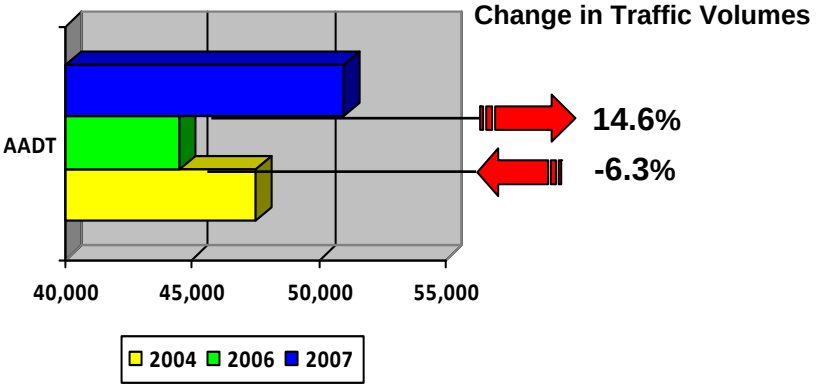
Expressway Section	FDOT Station #	2004 AADT	2006 AADT	2007 AADT
SR-874 (Don Shula Expressway)				
SR-821 HEFT to Killian	872274 – 500' N of toll	71,000	77,000	90,000
Killian Parkway to SR-878	872276 – 300' N of Killian Parkway	111,000	102,500	119,500
North of SR-878 to SR-826	872278 – 300' NE of SW 87th Avenue	48,000	48,000	70,500
SR-878 (Snapper Creek Expressway)				
SR-826 to US 1	872002 – 500' W of US 1	31,000	30,500	31,000
SR-874 to SW 87th Avenue	872522 – 200' E of SW 87th Avenue	47,500	44,500	51,000

Source: FDOT Historical AADT Report

Data shown on Table 4-1 is illustrated in the exhibits below.

EXHIBIT 4-6
SR-874 DON SHULA EXPRESSWAY TRAFFIC VOLUME





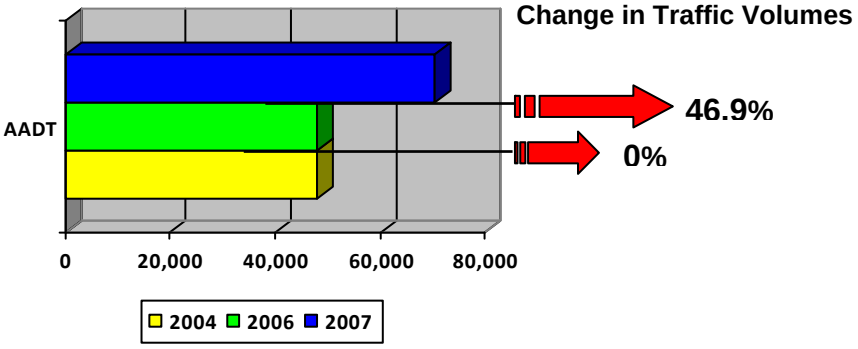
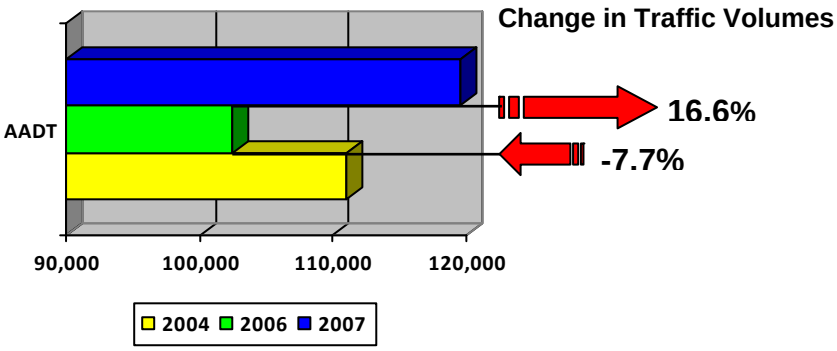
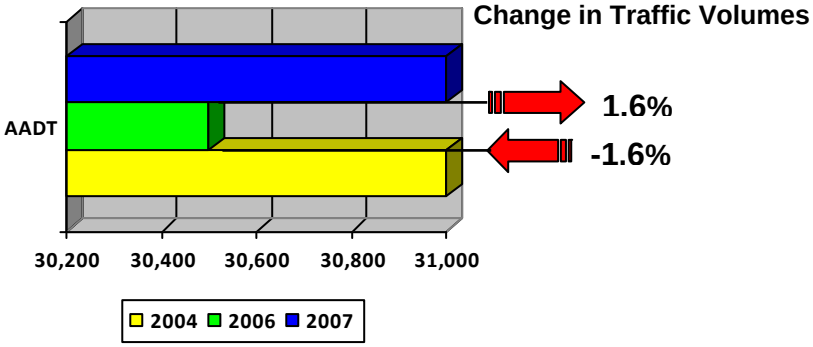


EXHIBIT 4-7
SR-878 SNAPPER CREEK EXPRESSWAY TRAFFIC VOLUME





As shown in the above illustrations, from 2006 to 2007 the Annual Average Daily Traffic (AADT) on SR-874 has had a major increase in traffic volumes in comparison with SR-878. The Killian KAT is the route that receives the most benefit from the implementation of the Bus-on-Shoulders project. This route uses over 4.5 miles of available shoulder along both expressways, and passes by the more congested location of the five (5) FDOT stations. From 2006 to 2007 traffic volumes along SR-874 north of Killian Parkway has increased from 102,500 vehicles to 119,500 vehicles. This represents over 16.5% increase in traffic in one year.

Traffic volume along the SR-878 has been consistent, except at the intersection of SW 87th Avenue, where traffic volume had a 14% growth. All three KAT routes use this facility where almost 2 miles of expressway is available for the Bus-on-Shoulders project.

E. PROPOSED EXPRESSWAY AND ROADWAY IMPROVEMENTS

Table 4.2 shows a list of the roadway projects impacting the study area that are included in the 2009 Transportation Improvement Program (TIP). Some of them include the construction of a new ramp from Kendall Drive to SR-874 that will alleviate traffic congestion at Kendall Drive and provide an alternative to reach the Palmetto Expressway. This is projected to be completed by December 2008, and could affect the northbound shoulder use of SR-874 for the Killian KAT and Kendall KAT. Appendix G shows the details for each TIP project. None of these future improvements impacted KAT service during this evaluation, but could impact future operations. Appendix G lists all future road improvements in the Kendall area.

F. MERGING

Along SR-874, between Killian and Snapper Creek Parkway, there are four thorough lanes in each direction of travel. SR-878 is two lanes in the direction of travel. All the travel lanes are 12 ft. wide, except at a few canal crossings where the lanes are constricted. Auxiliary lanes merging into travel lanes can be of some concern for buses using the shoulder lane.

Buses operating on SR-874 have to deal with this merging issue three times in the AM peak, and anywhere from one to four times in the PM peak. On SR-878, the merging can be an issue at least once in the AM peak and twice in the PM peak. Table 4-3 shows the on and off ramps along the expressway segments involved in the Bus-on-Shoulders project.

TABLE 4-2
BUS-ON-SHOULDERS SERVICE EVALUATION
FUTURE PROGRAMMED IMPROVEMENTS FOR THE EVALUATED ROUTES
2009 TIP - 5-YEAR PLAN

Miami-Dade Expressway Authority (MDX)	
1	SR-878 Communications and Incident Management Program from SR-874 to US 1
2	SR-878 Toll System Conversion from US-1 to SR-874
3	SR-874 Toll System Conversion from SR-826 to HEFT
4	SR-836 Southwest Extension to SW 136th Street
5	SR-874 Killian Parkway Interchange
6	SR-874 On-Ramp from Kendall Drive to SW 72nd Avenue
7	SR-874 Mainline Reconstruction from Kendall Drive to SR-826
8	SR-874 Ramp Connector at SW 136th Street
9	SR-874 / SR-826 Interchange Improvements
Miami-Dade County Public Works Department	
1	SW 157th Avenue from SW 72nd Street to SW 70th Street (new 4-lanes)
2	Killian Parkway – Widening to 6 lanes from Hammocks Blvd. to SW 147th Avenue
3	SW 137th Avenue – Roadway improvements from SW 88th Street to SW 84th Street
4	Killian Parkway and Kendall Blvd. – intersection realignment
5	Kendall Drive and SW 112th Avenue – new right turn lane
6	Killian Parkway and SW 109th Court – new left turn lane
7	SW 97th Avenue from SW 72nd Street to SW 56th Street widening from 2 to 3 lanes
8	SW 127th Avenue from SW 88th Street to SW 120th Street widen to 4 lanes
Florida Department of Transportation	
1	SW 87th Avenue from SW 96th Street to SW 41st Street – resurfacing
2	Kendall Drive west of SW 99th Street – modify intersection
Private Sector	
1	SW 72nd Street from SW 163rd Avenue to SW 164th Avenue new two lane road

Source: Miami-Dade MPO, Special Use Lanes Study, November 2005: page 6-4

TABLE 4-3
BUS-ON-SHOULDERS SERVICE EVALUATION
SR-874 AND SR-878 MERGE SEGMENTS

Merge Segments	
SR-874 (Don Shula Expressway)	
North Bound	**South Bound**
Killian Pkwy On/Off Ramp	Killian Pkwy Off Ramp
	SW 107th Ave Off Ramp
Kendall Dr On/Off Ramp	
SR-878	
SR-878 (Snapper Creek Expressway)	
East Bound	**West Bound**
SW 87th Ave On/Off Ramp	
SW 72nd Ave Off Ramp	SW 72nd Ave On Ramp
US 1 On/Off Ramp	

G. ACCIDENT DATA

Safety was one of the main concerns of all participating agencies while implementing this project. Therefore, this is one of the most important elements to be evaluated in this study. Tables 4-4 and 4-5 show a summary of accidents along SR-874 and SR-878 from 2002 to 2006. Exhibit 4-8 illustrates the record of accidents along these two expressways. There are more accidents along SR-874 than on SR-878. However, there are some consistencies for both corridors regarding the number of accidents:

- From 2002 to 2005 accidents increased each year. But from 2005 to 2006, in both facilities the number of accidents decreased by almost the same percentage: 29% on SR-874 and 25% on SR-878.
- For both facilities, 2005 was the worst year in the number of accidents.
- When comparing the number of accidents on SR-878 vs. SR-874, for the 5-year period, the number of accidents on SR-878 is consistently about 35% of the number of accidents along SR-878. It seems that there is a proportion in the number of accidents that correlates between these facilities.

EXHIBIT 4-8

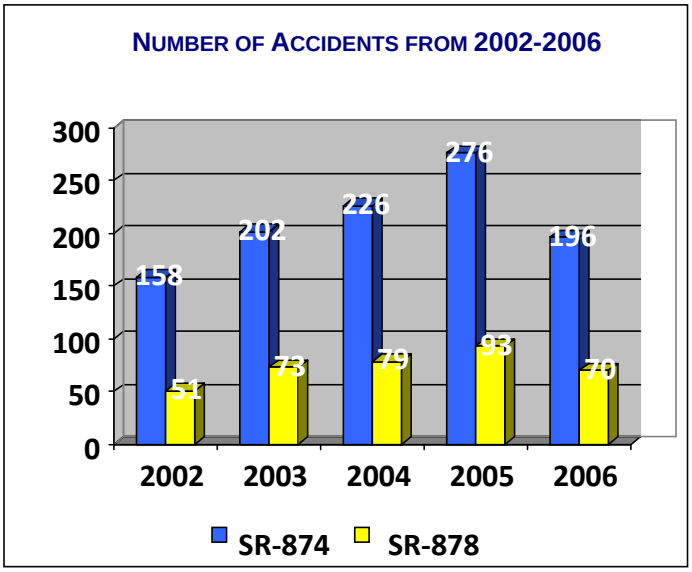


TABLE 4-4
BUS-ON-SHOULDERS SERVICE EVALUATION
SR-874 ACCIDENT SUMMARIES 2002 - 2006

Milepost No.	2002	2003	2004	2005	2006	Total
0.0	1	0	12	1	7	21
0.0 – 0.1	1	0	1	2	1	5
0.1 – 2.0	N/A	N/A	N/A	N/A	N/A	N/A
2.0 – 2.1	8	12	11	6	3	40
2.1 – 2.2	8	11	1	8	1	29
2.2 – 2.3	12	10	8	10	7	47
2.3 – 2.4	17	26	21	32	23	119
2.4 – 2.5	13	15	12	10	3	53
2.5 – 2.6	13	15	12	15	11	66
2.6 – 2.7	2	0	4	6	3	15
2.7 – 2.8	5	9	11	21	8	54
2.8 – 2.9	0	0	0	1	1	2
2.9 – 3.0	0	0	0	2	2	4
3.0 – 3.1	1	3	0	2	2	8
3.1 – 3.2	3	3	6	12	4	28
3.2 – 3.3	0	7	6	5	6	24
3.3 – 3.4	7	7	4	8	9	35
3.4 – 3.5	1	3	1	6	2	13
3.5 – 3.6	12	10	14	18	14	68
3.6 – 3.7	9	9	11	13	9	51
3.7 – 3.8	8	13	26	21	23	91
3.8 – 3.9	2	2	4	3	3	14
3.9 – 4.0	8	23	19	15	13	78
4.0 – 4.1	2	2	5	7	1	17
4.1 – 4.2	8	8	14	22	8	60
4.2 – 4.3	7	2	5	8	9	31
4.3 – 4.4	2	4	5	2	6	19
4.5 – 4.6	2	2	3	2	2	11
4.6 – 4.7	0	0	0	1	0	1
4.7 – 4.8	3	3	5	12	11	34
Totals	**158**	**202**	**226**	**276**	**196**	**1,058**

TABLE 4-5
BUS-ON-SHOULDERS SERVICE EVALUATION
SR-878 ACCIDENT SUMMARIES 2002 - 2006

Milepost No.	2002	2003	2004	2005	2006	Total
0.0	1	0	0	3	3	7
0.0 – 0.1	3	3	3	1	5	15
0.1 – 0.2	0	2	1	3	4	10
0.2 – 0.3	0	1	0	3	0	4
0.3 – 0.4	1	0	0	0	2	3
0.4 – 0.5	1	2	2	4	2	11
0.5 – 0.6	1	3	6	7	2	19
0.6 – 0.7	2	1	5	1	1	10
0.7 – 0.8	2	6	2	2	5	17
0.8 – 0.9	2	3	0	1	1	7
0.9 – 1.0	0	0	0	1	1	2
1.0 – 1.1	0	0	2	0	0	2
1.1 – 1.2	0	0	0	0	0	0
1.2 – 1.3	0	1	4	2	4	11
1.3 – 1.4	11	3	8	16	10	48
1.4 – 1.5	0	1	0	0	0	1
1.5 – 1.6	0	0	0	1	0	1
1.6 – 1.7	0	4	3	0	1	8
1.7 – 1.8	2	0	1	2	0	5
1.8 – 1.9	0	0	0	1	0	1
1.9 – 2.0	1	2	1	2	1	7
2.0 – 2.1	4	6	0	1	2	13
2.1 – 2.2	6	3	10	4	5	28
2.2 – 2.3	0	0	0	0	0	0
2.3 – 2.4	0	0	0	0	0	0
2.4 – 2.5	1	2	2	1	1	7
2.5 – 2.6	2	1	2	4	6	15
2.6 – 2.7	2	1	1	6	2	12
2.7 – 3.8	N/A	N/A	N/A	N/A	N/A	N/A
3.8 – 3.9	1	2	0	2	3	8
3.9 – 4.0	6	21	16	14	8	65
4.0 – 4.1	1	2	3	1	0	7
4.1 – 4.2	0	3	7	10	1	21
Totals	**51**	**73**	**79**	**93**	**70**	**365**

The crash data was obtained from FDOT, District 6. The most recent year for accident data is 2006, and data for 2007 will not be available until 2009. Since the information available is prior to the commencement of the Bus-on-Shoulders Pilot Study in 2007, the data summarized shows the number of accidents per year for every tenth of a mile along both facilities. It is useful to note that even though traffic volumes increased as shown in Table 4-6 the accident history for both roads shows a decline in accidents (SR-874) or a relatively steady number of accidents (SR-878).

FDOT accident data is only available through 2006 and is summarized in Chapter 7. The data shown here briefly summarizes total incidents on the two expressways prior to any Bus-on-Shoulders operations. The more congested Don Shula Expressway (SR-874) shows considerably more accidents, injuries, and ramp accidents than the Snapper Creek Expressway (SR-878). However, traffic volume on the Snapper Creek (SR-878) is growing faster. Overall, accident data for 2003 is higher than for previous years, showing an increasing trend in all types of incidents on both expressways. But none of these trends is connected to Bus-on-Shoulder operations.

TABLE 4-6
BUS-ON-SHOULDERS SERVICE EVALUATION
PRE-PROJECT START-UP
ACCIDENT HISTORY

Year	Number of Crashes	Number of Fatalities	Number of Injuries	Number of Ramp Crashes	Percent Change
SR-874 (Don Shula Expressway)					
2001	626	5	290	61	10%
2002	574	4	246	5	9%
2003	712	1	338	68	10%
AVERAGE	**637**	**3**	**291**	**60**	**9%**
SR-878 (Snapper Creek Expressway)					
2001	75	2	31	9	12%
2002	63	1	36	8	13%
2003	85	0	41	14	17%
AVERAGE	**74**	**1**	**36**	**10**	**14%**

Source: Miami-Dade MPO, Special Use Lanes Study, November 2005 page 6-1

H. IMPLEMENTATION COSTS

As previously mentioned, one of the reasons for selecting these corridors for the implementation of the Bus-on-Shoulders concept was the low cost involved in the development and implementation of this project. Based on the agreement between the parties involved, MDX would proceed with the cleaning of the shoulders and the installations of the designed signs, while MDT would reimburse these costs, as appropriate. Basically, the costs incurred by MDX in order to implement the Bus-on-Shoulders Pilot Project, was $14,220 for the installation of the traffic signs along the existing corridors of SR-874 and SR-878. There were a total of 18 signs installed for identifying the outside shoulders for bus use.

CHAPTER 5.0 PASSENGER SURVEY

A. SURVEY AND RESPONSE TABULATIONS

In March and April 2008 surveys were conducted of the three bus routes (204, 272 and 288) assigned to the Bus-on-Shoulders project. The purpose of these surveys was to obtain riders and bus drivers' information regarding the services rendered using the bus on shoulder concept. The rider survey instrument was developed in conjunction with a national study of Bus-on-Shoulders operations sponsored by the Transportation Research Board (TRB) through the Transit Cooperative Research Program (TCRP), as recommended by the MPO. By using the same questionnaire, there was a consistency for further comparison with the study conducted by TCRP. Sample survey is shown on Appendix C in both English and Spanish. However, this questionnaire was slightly modified to fit the MDT operations and local conditions. The survey was conducted in both English and Spanish by surveyors of MDT who were on-board the vehicles.

Approximately, one-quarter to one-third of runs on each of the three routes were surveyed based on reported MDT ridership data from January 2008. The sample size was designed to give a 95% confidence level. A slightly higher percentage of riders on routes 288 (Kendall KAT) and 272 (Sunset KAT) were targeted for surveys because there were fewer total riders resulting in a greater ratio of riders for the sample. These two routes had about 33% run samples versus route 204 (Killian KAT), which had a 25% sample due to its greater ridership. Surveyors counted boardings and nearly one-third of passengers boarded and left the bus route before it reached the expressway segment of the run where it runs on shoulders. Of those on-board, about 50% returned surveys. This survey confidence level is about 90% and nearly one-in-ten total boardings returned a useful survey.

Surveyors distributed the questionnaires both inbound toward Dadeland North station and outbound away from the station. All service is during peak weekday hours. Inbound riders received a survey as the bus reached the expressway where the Bus-on-Shoulders operations began; while outbound riders received the survey form when they boarded the bus at Dadeland North station. Forms were collected by surveyors as riders left inbound buses at Dadeland North station, or when the outbound buses left the expressway. About one-third of riders were only on-board the bus for the local service portion of the bus run. About one-half of the remaining passengers returned a completed survey form. In some cases, surveyors assisted the riders if they did not understand the form or needed help filling out the form.

The actual results for these routes yielded about 350 completed surveys as shown in Appendix D For the most part, survey findings were fairly conclusive as will be described in this chapter. Detailed data summaries are included in the Appendix D of this report. An analysis of the survey questionnaires found the following responses:

1. How often do you ride the bus?

a. How many days a week do you ride a bus (write in the number of days) _____

b. Less than one day a week

The combined response showed that over 80% of riders rode more than five days a week. Based on the way the question was worded, the ride was not necessarily on one of the three routes under study, and some respondents listed many bus routes used. But, clearly transit users overwhelmingly were regular bus riders, riding five days a week. Exhibit 5-1 clearly shows that the persons responding to the questionnaire are frequent riders of the KAT routes.

Additionally, Exhibit 5-2 illustrates the percentage distribution by route, where an average of 82% use the buses more than 5 days a week.

2. What is the bus route number?

a. Killian Kat (Route 204)
b. Sunset Kat (Route 272)
c. Kendall Kat (Route 288)

About 42% of responding riders used the Killian KAT; about 33% used the Sunset KAT and the balance, or 25%, used the Kendall KAT as shown on Exhibit 5-3. Again, these proportions match the ridership distribution according to MDT data.

EXHIBIT 5-1
TRIPS PER WEEK

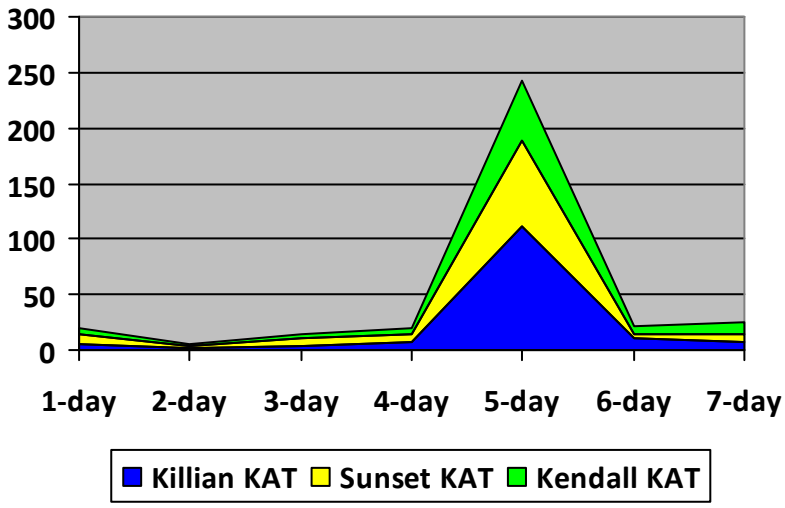


EXHIBIT 5-2
ROUTE COMPARISON BY PERCENTAGE

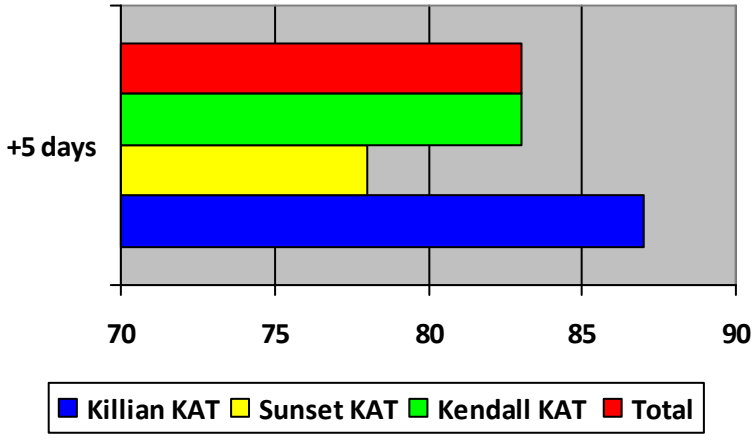
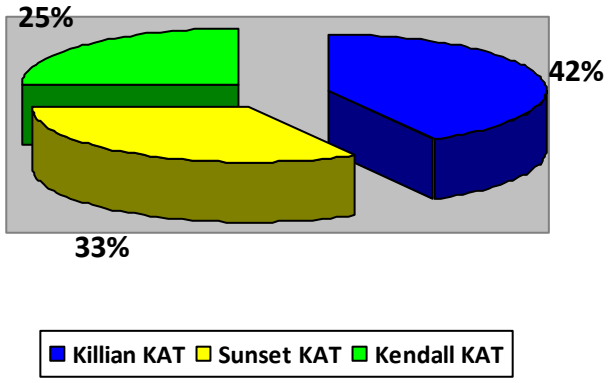


EXHIBIT 5-3
TOTAL RESPONSES BY ROUTE (%)



3. What time did you board the bus?

_____ Approximate time that you boarded?

This question yielded "approximate" times since boardings and schedule times did not always coincide due to buses running off schedule or riders filling in the response in approximate times. Roughly AM and PM boardings matched and there was no noticeable difference in responses based on time of day the rider was on the bus. The three routes only operate during the AM or PM peaks, and bus runs are allocated that way. Responses to this question show that there is no difference between rider perceptions or responses based on time of day the rider used the bus.

4. Was it inbound towards downtown or outbound?

a. Inbound direction
b. Outbound direction

This question, even though described, appeared to confuse some respondents. Surveyors indicated the direction of the bus run as inbound (towards Dadeland North) or outbound (away from Dadeland North) on master copies, but a number of rider responses did not agree with the surveyors' notes. This appears to be due to confusion in the way the question was worded, since MDT riders are not familiar with these terms. The confusion appeared in both, the English and Spanish versions. In retrospect, instead of inbound or outbound, the question would have been better phrased as "Was it inbound towards Dadeland North Station, or outbound away from Dadeland North Station?"

More importantly, as in question 3, in spite of this minor problem, there appeared to be no difference in responses to service questions between service directions (inbound vs. outbound). The service runs two-ways inbound and outbound during both the AM and PM peak, so both periods have service operating in two directions at all times, and this could be part of the respondent confusion. Again, there appears to be no difference in responses to other questions based on time-of-day or service direction.

5. What is the purpose of this trip?

a. Travel between home and work
b. Travel between home and school
c. Travel between home and shopping/errands
d. Other (please specify) _____

There were slight variations in responses to this question, with riders on the Killian and Sunset KAT routes using the service more than the Kendall KAT. Ninety one percent (91%) of the Killian KAT and eighty eight percent (88%) of the Sunset KAT riders who responded were using the route for work trips. On the Kendall KAT, the percentage was sixty four percent (64%). However, on Kendall KAT 32% of the riders were using the service for school purposes. While on the other two routes the percentages were only 6 and 3 percent, respectively.

Comparative trip purpose is shown on Exhibit 5-4. On all three routes, going to or coming from work, was overwhelmingly (83%) the main reason for taking the bus. This travel purpose is typical for most express bus and Metrorail riders. There were very few respondents who entered "other." A few entered "for multiple purposes," which may be true for the trip being made. The higher ratio of school use on the Kendall route could reflect the presence of many schools along the route. Exhibit 5-5 shows aggregated travel purpose for all routes.

EXHIBIT 5-4
RIDER TRIP PURPOSE BY KAT ROUTE

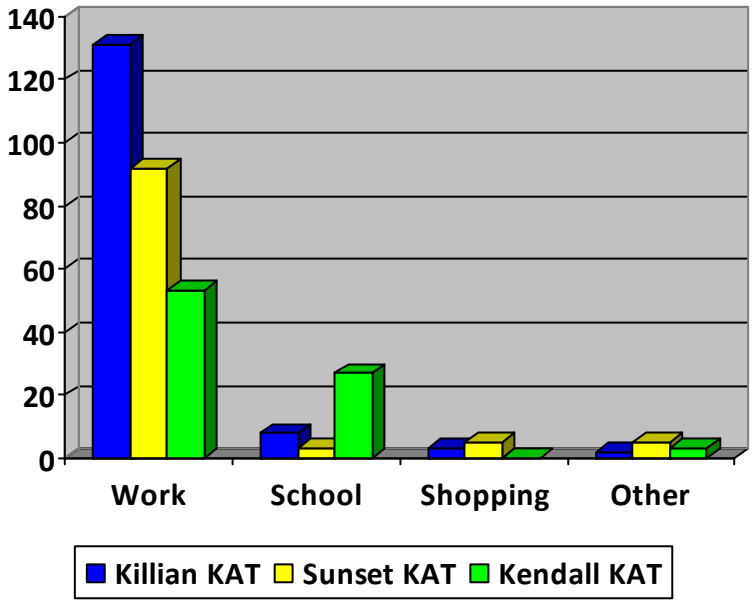
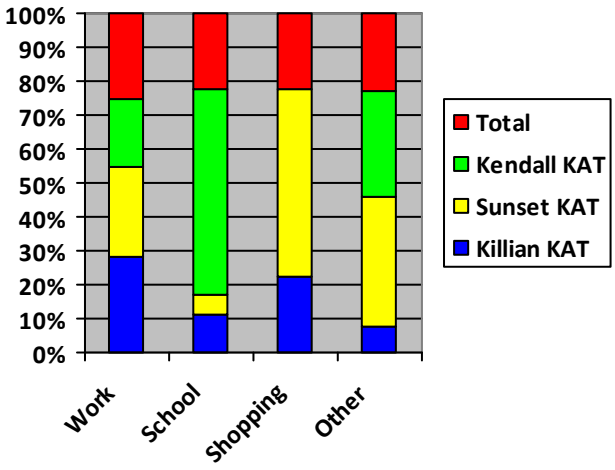


EXHIBIT 5-5
TOTAL PERCENTAGE OF TRIP PURPOSES



6. By your estimate, how much time do you save when the bus uses the shoulder to go around congestion?

a. On a typical day ____ minutes
b. On a bad traffic day ____ minutes

The three routes showed fairly tight clustered estimates of time saved by the Bus-on-Shoulders operation, as shown in the Table 5-1.

These estimates are fairly close together for both conditions. The estimated travel time difference between the routes on a "typical" day is within 15% from highest to lowest. The difference in time saved on a "bad" day is within 5% from highest to lowest. Thus, the overall impression is fairly uniform and no major differences in perceived time savings exist among the three routes.

TABLE 5-1
BUS-ON-SHOULDERS SERVICE EVALUATION
USER ESTIMATED TRAVEL TIME BENEFIT (AVERAGE)

Route and Number	On a typical day	On a bad day
Killian Kat (Rt 204)	15.1 minutes	20.6 minutes
Sunset KAT (Rt 272)	12.6 minutes	19.4 minutes
Kendall KAT (Rt 288)	13.5 minutes	19.4 minutes

In comparison with auto travel time over the SR-874 (Don Shula Expressway) and SR-878 (Snapper Creek Expressway), these time savings appear high when compared to actual auto travel times, as shown in Table 3-3, where total bus travel time for each route is about 40-minutes. The travel time runs of the expressway section show a variance of five minutes between free flow conditions versus bus schedule time. This figure is the difference between free-flow traffic and congested traffic flow between Killian Drive and Dadeland North Metrorail based on test drives by the consulting team on weekday peak periods. Needless to say, every run and every day will be unique and this is an average. The perceived time savings of almost triple the actual travel time is consistent with findings around the country, according to the national study of Bus-on-Shoulders operations conducted for the Transportation Research Board (TRB), suggesting that passengers perceive a much higher benefit in time savings than actually exists. Killian KAT riders spend more time on the expressway due to their route configuration and they have a slightly higher estimate of travel time benefit than the other two routes.

7. How strongly do you agree with the following statements? circle one - Strongly agree (1) – Somewhat agree (2) – No opinion (3) – Somewhat disagree (4) – Strongly disagree (5)

The specific statements asked were:

A. This bus route generally runs on time
B. Traffic congestion is a daily problem for this highway
C. Ride comfort is good on the shoulders
D. Use of shoulders by the bus is safe
E. I enjoy passing cars stopped in traffic
F. Allowing buses to use shoulders is a good idea

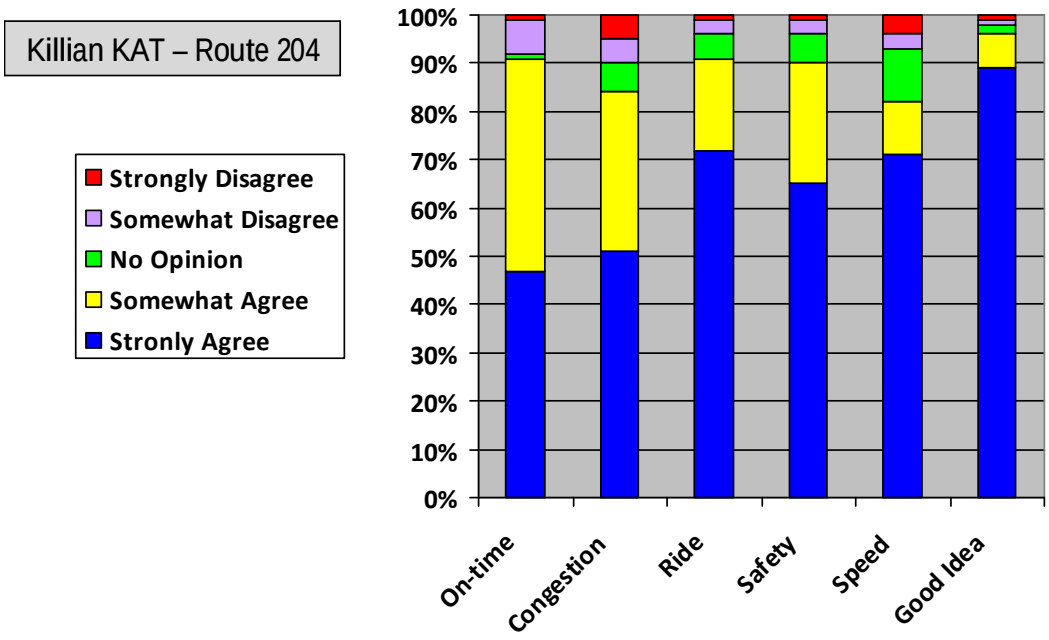
A summary of the responses received for this question is presented in Table 5-2. These numbers represent the average obtained by each question. In general terms, most of the riders are comfortable using the shoulders along the expressways. A rating of 1.0 would be a strong agreement with the statement, and 5.0 would be a strong disagreement.

TABLE 5-2
BUS-ON-SHOULDERS SERVICE EVALUATION
PASSENGER SURVEY
REPONSES TO QUESTION 7

Letter	Comment	Killian KAT	Sunset KAT	Kendall KAT
A	This bus route generally runs on time	1.702	1.926	2.195
B	Traffic congestion is a daily problem for this highway	1.803	1.923	1.844
C	Ride comfort is good on the shoulders	1.417	1.563	1.533
D	Use of shoulders by the bus is safe	1.525	1.592	1.769
E	I enjoy passing cars stopped in traffic	1.587	1.782	1.821
F	Allowing buses to use shoulders is a good idea	1.162	1.279	1.320

The following Exhibits, 5-6, 5-7, 5-8 and 5-9 are presentations of user satisfaction results by each surveyed route and the entire KAT system.

EXHIBIT 5-6
ROUTE 204 USER SATISFACTION



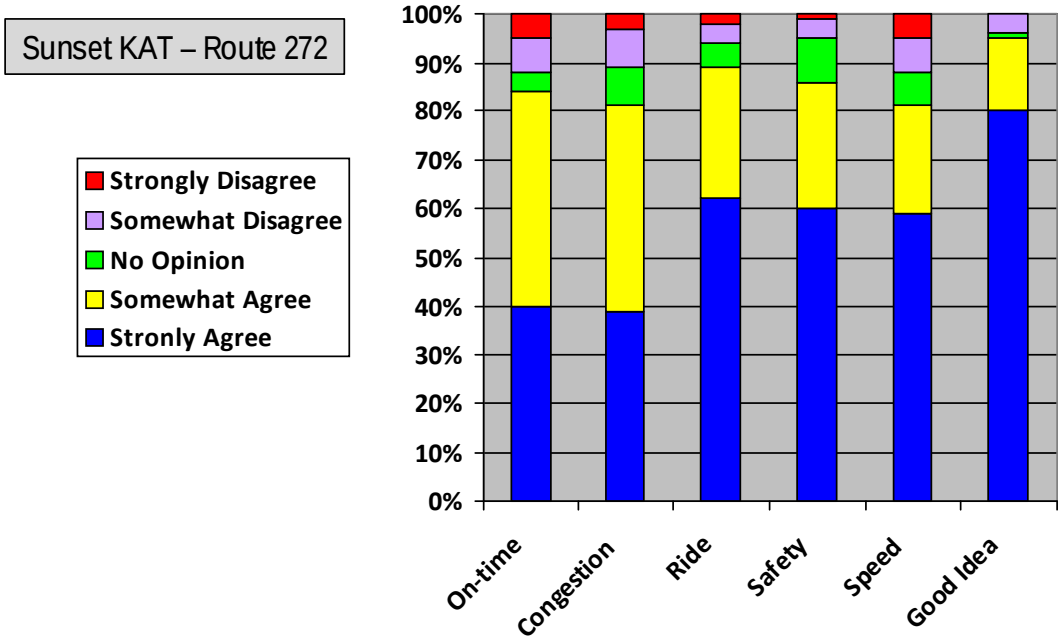
Highlights:

- It is important to notice that 96% of the passengers in this route, which is the longer one using the Bus-on-Shoulders, consider that the implementation of this concept is a good idea.
- One of the major concerns during the planning phase of this project was the safety of the passengers and the ride comfort when using the shoulders. From Exhibit 5-6, 90% of the

passengers consider that the ride is good and they don't have any problem in terms of safety when the buses are using the shoulders. No incidents or accidents have been reported in this route.

- Most of the riders (91%) consider that this route is on time.
- There was no clear rider opinion regarding question "E". In question "E", regarding buses passing cars, responses were divided among the 5 options. Probably, for future surveys this question should be rephrased. 15 percent of the riders that didn't have any opinion on this matter.
- Congestion does not seem to be a problem. Only 10% consider that traffic congestion is a daily problem in this route.

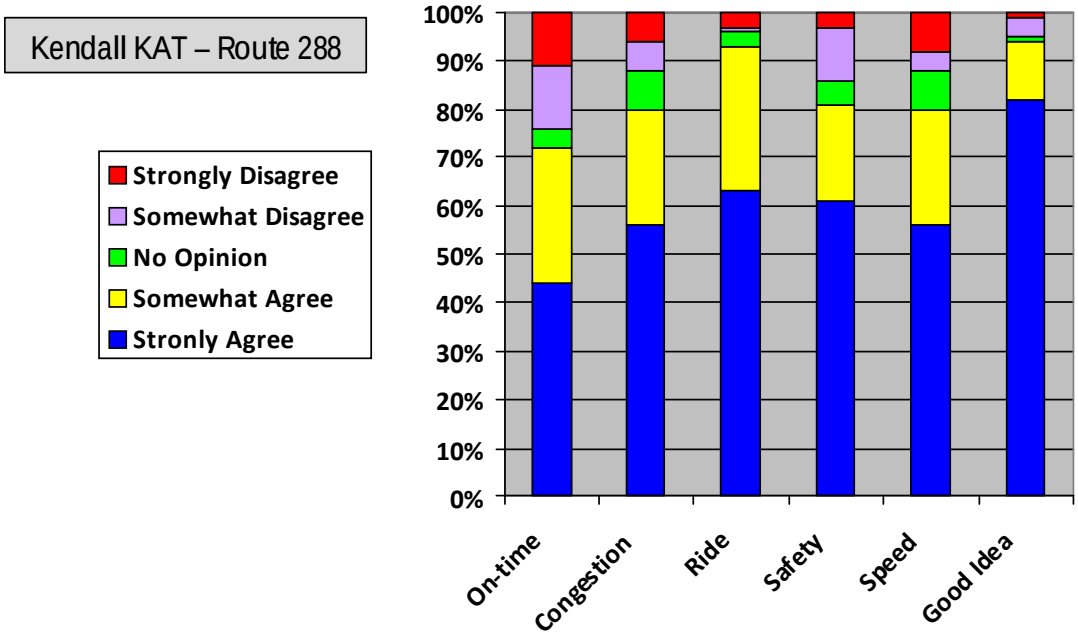
EXHIBIT 5-7
ROUTE 272 USER SATISFACTION



Highlights:

- Similar to the Killian KAT, 95% of the passengers in this route consider that the implementation of the bus on shoulder project has been a good idea.
- No other questions reached 90% or more of the passengers' acceptance.
- The comfort of riding on the shoulders and the safety issue got also very good acceptance. Over 85% of the passengers consider that there is no problem using the shoulders.
- Over 12% consider that traffic congestion is a daily problem along this route and that the buses are not running on time as it should be. Looking on the positive side, about 82% of the passengers consider that these issues are not a concern in their daily trip.
- Curiously, this is the route that uses the shorter length of the shoulders along the Snapper Creek Expressway. It could be possible that the passengers may reference to the level of congestion before the route access the expressway. If so, traffic congestion could be an issue along Sunset drive.

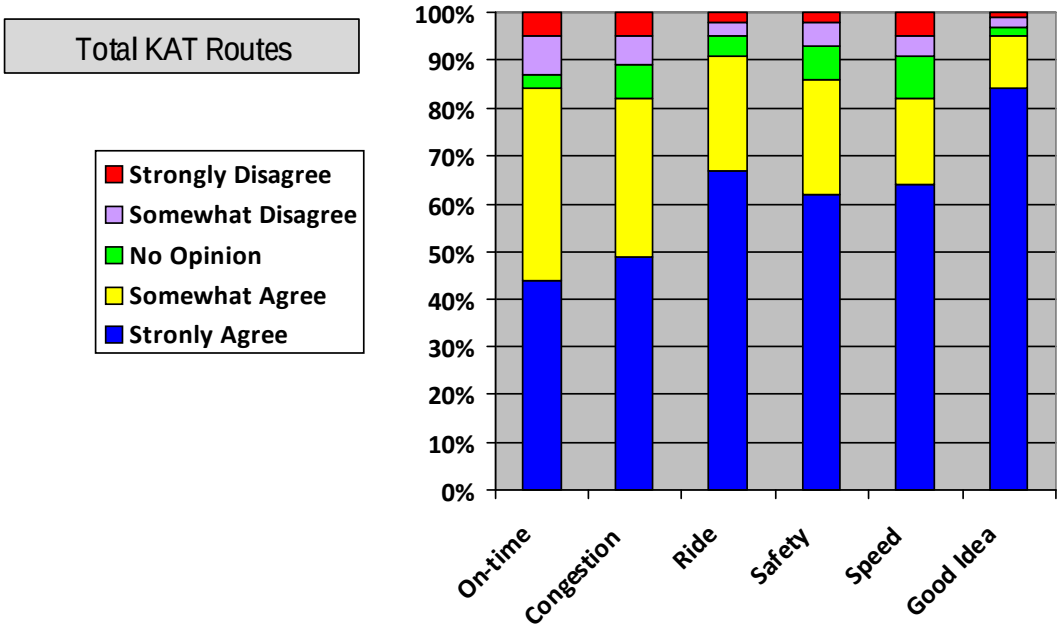
EXHIBIT 5-8
ROUTE 288 USER SATISFACTION



Highlights

- Following the pattern of the other routes, 94% of the passengers in this route consider that the implementation of this project was a good idea.
- On time performance is not well perceived by the passengers on Kendall KAT. Only 72% of the passengers considered the buses to be on time, in comparison to 91% and 84% of Route 204 and Route 272. This could open the door for MDT to consider further evaluation of this route.
- Additionally, the response of riders is totally different from passengers evaluating riding on the shoulders and safety. On this route, 93% of the passengers consider that it is comfortable riding on the shoulder. However, 81% of them agreed on the safe ride on the shoulder compare to over 85% in the other routes.
- The other factors evaluated by the passengers are similar to responses from the other routes.

EXHIBIT 5-9
ALL KAT ROUTES USER SATISFACTION



After analyzing the responses of riders of the individual routes, we may conclude that in general:

This bus generally runs on time.
Most respondents agreed with this statement, 88% of all passengers. The riders of the Kendall KAT were slightly more negative in their views than the riders in the other two routes.

Traffic congestion is a daily problem for this highway.
Comments were fairly consistent on this question, with riders somewhat strongly agreeing with the statement. The responses were very close together among the three routes. By a narrow margin, the Sunset KAT users were slightly more negative than in the other two routes.

Ride comfort is good on the shoulders.
Comments were fairly consistent on this question, with riders somewhat strongly agreeing with the statement (91%). The response was very close together among the three routes. It could be concluded that the existing concern before implementing the project that the weight of the buses will impact the surface of the shoulders is no longer a valid issue.

Use of shoulders by the bus is safe.
In total, 84% of the passengers consider that there is no issue regarding running the buses on the shoulders. About 7% of passengers had no opinion. The riders on Kendall KAT were slightly more negative in their views than the riders on the other two routes.

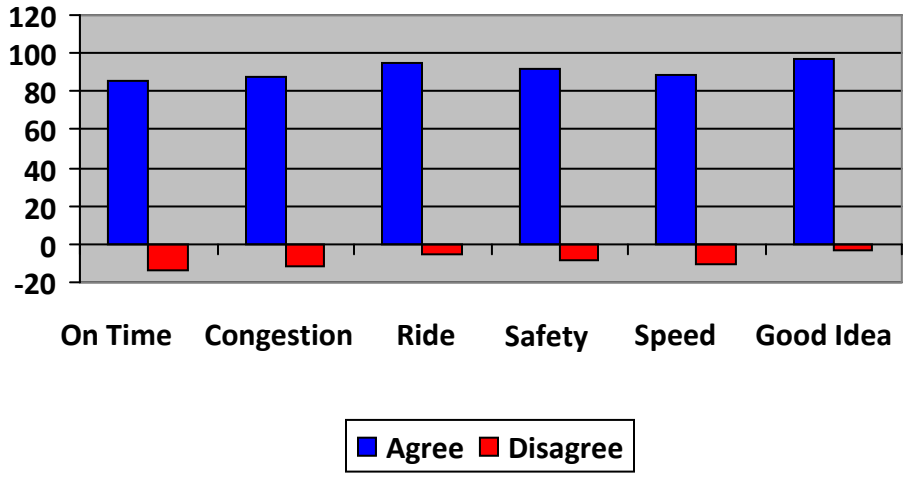
I enjoy passing cars stopped in traffic.
Even though comments were fairly consistent on this question, riders on the Killian KAT were more positive in responding to this question. However, this question has the highest number of persons not responding to the question and having no opinion. For future surveys, this question should be revised to reflect a better understanding or replaced by other question to allow riders to evaluate other aspects of the service.

Allowing buses to use shoulders is a good idea.
The responses were very close together among the three routes. Significantly, this question had the most positive responses (strongly agree) of any question. There is no doubt that most riders think operating the Bus-on-Shoulders is a very positive idea. Based on what these passengers consider, it would be appropriate to continue the expansion of the Bus-on-Shoulders project to other expressways facilities.

Summary of Attitudes
Overall, affirmative impressions were vey uniform among the three routes and riders felt positive towards all the statements. By a slight margin, riders on the Killian KAT were more satisfied than riders on the other two routes – but all riders on all three routes had positive impressions of the Bus-on-Shoulders project.

This consistency could be better observed when no opinion and no responses are eliminated from the tabulated responses. If so, Exhibit 5-10 shows the aggregated responses:

EXHIBIT 5-10
ATTITUDE SUMMARY
PROS AND CONS RESPONSES IN PERCENT



8. Please write any additional comments you have.

In the final portion of the survey, passengers were able to offer unstructured opinions of the Bus-on-Shoulders project. After tabulating the responses, nearly 37% of the passengers surveyed offered comments. Some comments were specifically oriented towards the Bus-on-Shoulders project, while others referred to route problems or more general public transit issues.

Several comments were made very often, and although some were phrased slightly differently, they generally fell into the same category, such as:

1. Happy with the bus service, continue the route.
2. More bus drivers should use shoulders; it saves time, encourages transit use, and provides for better service.
3. Buses are not dependable, they come early or late.
4. Transit service needs to improve. The routes need more buses to run more frequently - earlier, later, weekends and holidays.

Exhibit 5-11 illustrates the percentage of comments by route. Nearly 50% of riders made comments about the service. Table 5-3 shows the type of comments made by the respondents.

Comments related to bus service have been submitted to Miami-Dade Transit for further consideration. Additionally, comments related to the operation of the Bus-on-Shoulders project are discussed further in this report.

EXHIBIT 5-11
RESPONDENT COMMENT RATE

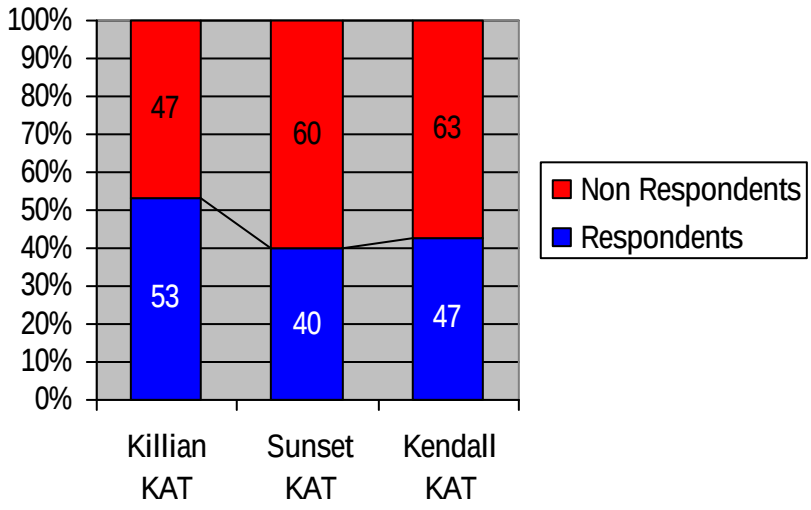


TABLE 5-3
BUS-ON-SHOULDERS SERVICE EVALUATION
RIDERS RESPONSES SUMMARY

Comments:	Number of Responses			
	Killian KAT	Sunset KAT	Kendall KAT	Total
AC Problem on Bus	1	3		4
Bus schedule not coordinated with Metrorail schedule	2		1	3
Don't waste taxpayers money and put surveys to good use	2			2
Drivers are courteous	1	1		2
Drivers are not courteous	2	2	1	5
Drivers don't accept return transfers	1			1
Equipment not in good condition	1		1	2
Feel safe on the bus	1			1
Improve shoulder surface for better ride	1		1	2
Keep doing these surveys	1			1
Lighting is bad at 80th St. & 154th Ave – 2 ladies were robbed		1		1
Metropass too expensive			1	1
Morning buses run well, problems in the afternoon	2	1	1	4
Need bus stop near 161st Ave. & 97th St.	1			1
Need bus stop near 132nd Ave in Calusa area	1			1
Need bus stop near 104th & 157th (and pave the area)	1			1
Need bus stop at 133 Ave.& 142nd Ave			2	2
Need bus route from Metrorail to Tamiami Airport area			1	1
Make room for buses only during road construction	1			1
Need more signs so that cars don't drive on shoulders	1			1
No one at MDT is helpful	1	1		2
Provide shelters at bus stops to provide sun and rain protection			2	2
Route 288 is the worst. No one supervises drivers.			2	2
Safety is more important than using shoulder	4	1		5
Shoulders should be wider	2			2
Shoulders should be used only during heavy traffic	1			1
Shoulders should be used as long as they don't interfere with emergency vehicles	1			1
Combined Answers:				
Happy with the bus service, continue the route	10	8	4	22
Need better public transit information – educate public & drivers about Bus-on-Shoulders or make lanes for buses only	4			4
More bus drivers should use shoulders; it saves time, encourages transit use, and provides for better service.	17	3	5	25
Buses are not dependable, they come early or late.	13	14	7	34
Transit service needs to improve. The routes need more buses to run more frequently - earlier, later, weekends and holidays.	7	11	13	31
TOTAL COMMENTS BY ROUTE	**80**	**46**	**42**	**168**

CHAPTER 6.0 DRIVER SURVEY

A. SURVEY AND RESPONSE TABULATIONS

In March 2008, Miami Dade Transit (MDT) conducted a survey of bus drivers that operated routes (204, 272 and 288) assigned to the Bus-on-Shoulders project. All operators are assigned to the Coral Way Bus Operations Facility. As with the Passenger Survey, this survey instrument was developed in conjunction with a national study of Bus-on-Shoulders operations sponsored by the Transportation Research Board through the Transit Cooperative Research Program (TCRP) as recommended to the MPO and Parsons by Peter Martin, Wilbur Smith and Associates. A sample survey is shown in Appendix E. It was modified slightly by Parsons from the sample sent to the MPO to fit the MDT operations and local conditions. The survey was conducted solely in English by MDT supervisors and trainers and was totally anonymous.

For the most part, survey findings were fairly conclusive as will be described in this chapter. Detailed response summaries are included in Appendix F. An analysis of the 12-question survey is presented below.

1. *How long have you been a bus driver?*

The typical driver had about seven years driving experience. There were a few very senior drivers with over 25 years driving experience and many with three years or less. The most senior drivers did have regularly assigned routes, unlike the less experienced drivers, due to MDT and TWU labor agreements which give more senior operators the right to pick their work assignments. However, the responses of drivers with more experience versus those with less experience did not appear to vary.

2. *What bus routes do you regularly drive?*

About 40 of the 73 respondents said they had a regular route. The balance of drivers either worked several routes, including mixed route patterns (a route in the Bus-on-Shoulders pattern plus driving another route not in the experiment, or driving two or three of the routes in the experiment); or more typically from the Coral Way "extra board" where driver assignments vary daily. Again, responses and response rates to the survey did not appear to vary, based on bus route assignment.

3. *Are the shoulder use segments of the Don Shula and Snapper Creek Parkways regularly congested? Pick one of three answers:*

a. Yes, during most of the commute period
b. Yes, but only for 30-minutes or less during the commute peak
c. No, only during bad weather or when an accident occurs
d. No response

Overwhelmingly, drivers picked answer "a." The percentages of the responses to the questions are shown below:

a.	51%	c.	18%
b.	27%	d.	3% - no answer

Just over 50% of drivers report congestion almost all the time, about 25% some of the time, and about 18% ever feel there is much congestion.

4. ***Do you use the shoulders on most trips?***

a. Yes, almost all peak trips
b. Yes, but on less than half of commute trips
c. No, hardly ever

About half the drivers said they use the shoulder on most trips, but almost the same number does not. About 30% use it sometimes, about 20% hardly ever, and there were four no-responses. In total, about 80% of drivers do use the shoulders frequently or sometimes. The percentages are as follows:

a.	51%	c.	16%
b.	29%	d.	4% – no answer

5. What is the biggest challenge to operating a Bus-on-Shoulders? (Free response)

There were two places on the survey where drivers could post free comments. Question 5 was the first and question 12 asked for other comments. Overwhelmingly, drivers responded to question 5 rather than question 12. Some 59 of the 73 drivers surveyed posted written comments – an 80% response rate. Many of the comments were subtly different and for ease of interpretation the answers were categorized into a few general responses. These responses are tabulated on Table 6.1.

The total response is higher than the number of drivers responding to the survey, since several offered multiple comments or suggestions. Two comments were made overwhelmingly, followed closely by a third. These were:

1. The shoulder is not wide-enough;
2. Merging onto the shoulder or back into traffic is a problem; and
3. The shoulder pavement is a problem, or the transition seam between the outer travel lane and the shoulder is rough or uneven.

TABLE 6-1
BUS-ON-SHOULDERS SERVICE EVALUATION
DRIVERS RESPONSE SUMMARY-RESPONSES TO QUESTION 5 OR 12

Biggest Challenge (some made more than one comment)	
Don't like to use shoulder	1
Shoulder not wide enough	19
Poor Pavement or edges – shoulder	10
Other motorist problems	6
Other vehicles	1
Drivers on cell phones	1
Cars on shoulder	1
Merge back into or from traffic a problem / cars block access or egress	19
Improve schedule time	2
Need to be safe all the time	1
Distance between cars & guard rail	1
Other motorists don't accept bus use of shoulder	1
Cars close to shoulder	1
Debris in road or shoulder	2
Good ideas - passengers are happy	1
Cars don't respect ROW	1
Good bus	1
Blue Bird bus not good on shoulder	2
A good tool to have	1
Total	**72**

A fourth problem commonly referred to was *poor driving by other motorists*, but often was not more explicit. Other comments about poor driver behavior were also cited. Other issues were cited, but by very few drivers.

6. *How strongly do you agree with the following statements? (Circle one: Strongly agree – Somewhat agree – No opinion – Somewhat disagree – Strongly disagree)*

This question requested that drivers give their opinion regarding ten statements. The statements were as follows:

a. Traffic congestion is a problem on this route
b. Using the shoulder shortens the trip
c. Using the shoulder improves schedule time
d. Using the shoulder is safe
e. The shoulder is wide enough to drive on
f. Signs and pavement markings are adequate
g. Training was adequate
h. Ride comfort is good
i. Other motorists accept buses using shoulders
j. Using shoulders is a good idea

Drivers answered all or most of these questions with 100% to questions D, H, I and J and 71 or 72 answers to the other questions; with 1 being "Strongly Agree," 5 being "Strongly Disagree," and 3 "No Opinion." The overall responses to the questions are shown in Table 6.2.

TABLE 6-2
BUS-ON-SHOULDERS SERVICE EVALUATION
DRIVERS RESPONSE SUMMARY TO QUESTION 6

Letter	Comment	Score
A	Traffic congestion is a problem on this route	1.75
B	Using the shoulder shortens the trip	1.83
C	Using the shoulder improves schedule time	1.94
D	Using the shoulder is safe	3.04
E	The shoulder is wide enough to drive on	3.65
F	Signs and pavement marking are adequate	2.72
G	Training was adequate	1.48
H	Ride comfort is good	2.49
I	Other motorists accept buses using shoulders	3.53
J	Using shoulders is a good idea	2.03

A review of the bus drivers' opinions in Table 6-2, is significant. Drivers strongly agreed with five statements (A. B, C, G and J); somewhat agreed with two (F and H); and had adverse reactions to three statements. Their response is summarized as follows:

Drivers "Strongly Agreed" or "Somewhat Agreed" that:

A. Traffic congestion is a problem on this route
B. Using the shoulder shortens the trip
C. Using the shoulder improves schedule time
G. Training was adequate
J. Using shoulders is good idea

Drivers "Somewhat Agreed" that:

F. Signs and pavement markings are adequate
H. Ride comfort is good

Of the two questions above, drivers were close with their responses. However, drivers had only a somewhat favorable opinion towards Question F - Signs and pavement markings are adequate. By response, the tabulation follows in Table 6.3.

TABLE 6-3
BUS-ON-SHOULDERS SERVICE EVALUATION
DRIVERS RESPONSE SUMMARY RESPONSES TO QUESTION 6.F
SIGNS AND PAVEMENT MARKINGS ARE ADEQUATE

Answer	Number of Responses	Percent Distribution
Strongly Agree	14	19.8%
Somewhat Agree	26	35.7%
No Opinion	8	11.3%
Somewhat Disagree	10	14.1%
Strongly Disagree	13	18.3%

About 55% of drivers agreed with the statement, while 42% did not agree. Where drivers agreed, they selected the "Somewhat Agree" response nearly 2-to-1 over "Strongly Agree." By contrast, drivers with an unfavorable opinion tended to be stronger in their opinions with the largest number selecting the "Strongly Disagree" statement.

Adverse Opinions:

There were three areas where driver opinions were mixed or adverse. These three topics were:

D. Using the shoulder is safe
I. Other motorists accept buses using shoulders
E. The shoulder is wide enough to drive on

For Question D - "Using the shoulder is safe," the respondent ratings ranged from "Strongly Agree" to "Strongly Disagree," with very few drivers having "No Opinion." By response, the tabulation follows in Table 6.4:

TABLE 6-4
BUS-ON-SHOULDERS SERVICE EVALUATION
DRIVERS RESPONSE SUMMARY RESPONSES TO QUESTION 6.D
USING THE SHOULDER IS SAFE

Answer	Number of Responses	Percent Distribution
Strongly Agree	12	16.5%
Somewhat Agree	24	32.9%
No Opinion	5	6.9%
Somewhat Disagree	13	17.8%
Strongly Disagree	19	26.1%

Nearly one-third of drivers chose the "Somewhat Agree" response that using the shoulder was safe. However, the next most common answer was "Strongly Disagree," selected by 26% of drivers. The "Somewhat Disagree" and "Strongly Agree" answers were selected by almost the same number of drivers, 17.8% and 16.9% respectively. Less than 7% had no opinion. This strong divergence of opinion among drivers is noteworthy and worth further investigation since the reason the drivers agreed or disagreed with the statement are unclear. It is notable that 44% of drivers had negative safety opinions contrasted to 49% with favorable safety opinions, but there were stronger adverse rather than positive impressions.

Bus drivers had an adverse response to question 6.I – "Other motorists accept drivers using shoulders." The overall response of 3.53 weighted the average response towards "Somewhat Disagree." The tabulations are divided in Table 6.5:

TABLE 6-5
BUS-ON-SHOULDERS SERVICE EVALUATION
DRIVERS RESPONSE SUMMARY RESPONSES TO QUESTION 6.I
OTHER MOTORISTS ACCEPT DRIVERS USING SHOULDERS

Answer	Number of Responses	Percent Distribution
Strongly Agree	7	9.6%
Somewhat Agree	15	20.6%
No Opinion	5	6.9%
Somewhat Disagree	23	31.5%
Strongly Disagree	23	31.5%

Nearly two-thirds of drivers disagreed with the statement, about 20% somewhat agreed and about 10% strongly agreed with the statement. Overall, drivers were 2:1 against the statement that drivers accepted buses using the shoulder.

Drivers also had adverse responses to Question 6.E. – "The shoulder is wide enough to drive on," which had the most adverse response, with over 75% of drivers disagreeing with the statement. Only 11% strongly agreed with the statement and 20% somewhat agreed. This is a 2:1 adverse opinion regarding shoulder width among the bus drivers, and the strongest adverse opinion among the ten questions is summarized in Table 6.6:

TABLE 6-6
BUS-ON-SHOULDERS SERVICE EVALUATION
DRIVERS RESPONSE SUMMARY RESPONSES TO QUESTION 6.E
THE SHOULDER IS WIDE ENOUGH TO DRIVE ON

Answer	Number of Responses	Percent Distribution
Strongly Agree	8	11.0%
Somewhat Agree	15	20.6%
No Opinion	5	6.9%
Somewhat Disagree	24	32.9%
Strongly Disagree	31	42.5%

This question had the highest proportion of adverse comments from drivers, but is consistent with the open-ended responses received from drivers in questions 5 and 12 of the surveys.

7. *Do you feel it would be safe to operate at higher speeds on the shoulder?*

a. Yes, with current shoulder widths – how fast? ___mph
b. Yes, with standard traffic lanes width (12-ft.) – how fast? _____mph
c. No, current maximum speed is good

Nearly 70% of all drivers selected answer "c." About 11% thought current speeds could be higher, but very few entered a suggested speed. Another 15.1% said operating speed could be increased if the shoulders were widened. Again, few drivers suggested a new operating speed. Only about 2.5%

of drivers did not answer this question, which had one of the highest rates of driver agreement, with 69% of drivers selecting answer "c."

8. ***At what speed for general traffic should buses be allowed to use the shoulder?***

A) __ 25 mph
B) __ 30 mph
C) __ 35 mph
D) __ 40 mph
E) __ 45 mph
F) __ 50 mph

Most of all drivers answered this question. The average response came out to 28.57 mph. Drivers overwhelming selected 25 mph (53.5%) or 30 mph (22.0%). There were 4.1% that didn't answer. The remainder (10.4%) selected one of the other four higher speeds.

9. ***How often do you encounter a motorist in the general traffic lanes trying to block buses using the shoulder (check best answer)?***

a. Daily
b. Several tines a week
c. Less than once a week

Only one driver didn't answer this question. Response "a" - "Daily" was selected by 42.3% of drivers, while 23.3% selected "b" - "Several times a week." About 31% of drivers responded to answer "c - Less than once a week." This response shows a considerable divergence among driver opinion.

10. ***Which is the more challenging weave at interchanges?***

a. Weave with traffic existing at off-ramps?
b. Weave with traffic entering from an on-ramp?

Drivers overwhelmingly selected answer "a - Weave with traffic existing at off-ramps" over "b - Weave with traffic entering from an on-ramp," by 58.3% to 28.3% – almost 2:1. But, nearly 15.1% of drivers checked both answers showing that weaves in either configuration were a challenge. Again, this issue is consistent with open-ended responses from drivers citing that the weave and drivers blocking lanes is a problem.

The final question was number 11.

11. ***How would you best describe passenger attitudes on buses using shoulder?***

a. Passengers love it
b. Passengers seem to like it
c. Passengers do not seem to care much
d. Passengers do not like riding on the shoulder

Overwhelmingly, drivers selected answer "a. Passengers love it," or "b. Passengers seem to like it." Answer "a" was chosen 47.9% and "b" was selected 39.3%. Only 2.7% did not answer, and another 12.3% selected answers "c" or "d."

CHAPTER 7.0 SERVICE EVALUATION - FINDINGS

A. INTRODUCTION

No formal service objectives were set for the Kendall Area Transit Bus-on-Shoulders demonstration prior to its inauguration in 2007. However, the purpose of the project was unquestionably to improve public transportation by using the shoulders of the expressways. By inference, improvements that could be expected would be: increased transit ridership; improved transit performance; public satisfaction with the routes or enhanced public perception of transit service; or cuts in vehicle service hours due to efficiencies or related financial improvements. In addition, these improvements had to have minimal adverse impacts to highway operations with low costs to implement. This evaluation period covers from 2006 (pre-demonstration) to 2007-2008 (demonstration period one-year mark) for the KAT program using available data plus the attitude survey of drivers and passengers.

A similar pilot project in San Diego listed evaluative criteria as follows:[9]

a. Safety
b. Benefits to transit operations
c. Bus driver and passenger perception
d. Expressway level-of-service/maintenance
e. Shoulder lane pavement and materials

San Diego's evaluation covers a three-year period after service implementation. The longer evaluation period permits a greater time span to collect data and evaluate impacts.

Nationally, recent Bus-on-Shoulders experiments have tried to prove that use of the shoulder-lane by buses will permit bus riders to have an improved travel experience compared to the bus sitting in traffic with other vehicles or using an arterial street to make the same journey. Use of the shoulder by buses is seen as a low cost method to improve or enhance the public transit trip and thereby make transit use more attractive or effective than not implementing the program.

Using the data collected during the course of this study and reported in parts 1-6 of this report, an evaluation of the success of meeting the five criteria listed above is covered in this section of the document,

This evaluation is dependent on the thoroughness of the data collected by the MDT, MDX, FDOT, and Florida Highway Patrol since service inauguration in 2007.

[9] *California DOT and the San Diego Association of Governments; Transit Lane Demonstration Pilot – Technical Report Draft, June 15, 2007 page 3*

B. SAFETY

As shown in Chapter 4, the accident data available from FDOT and MDX do not cover the 2007 and 2008 period. Thus, all available data relates to conditions prior to the start of the project in early 2007. The tables in Chapter 4 summarize the accident history for the 2002-2006 periods. Since the period reported is before the start-up of the Bus-on-Shoulders project, no overall incident trend is visible for the "before" period for this project from available data. In discussions with the Florida Highway patrol, the MDX, and MDT, no known incidents were reported since the project went into service that related to the Bus-on-Shoulders operation.

C. BENEFITS TO TRANSIT OPERATIONS

As shown in Table 7.1, route on-time performance has improved since inauguration of the KAT program. All three routes show significant on-time performance improvements. However, the MDT as a whole has also shown better on-time performance from 66.5% to 76.9%. However, the three KAT routes improved even more than the MDT system. As a result, schedule adherence has been measurably improved.

TABLE 7-1
BUS-ON-SHOULDERS SERVICE EVALUATION
ON-TIME ADHERENCE CHANGE - KAT AND MDT ON-TIME PERFORMANCE COMPARISON
weekday operations

Route Number	On-time Status	Sep-06	Sep-07	May- 08
Bus-on-Shoulders Routes				
204 - Killian	Late	13.5%	7.8%	5.1%
	Early	8.1%	13.1%	6.2%
	On-time	78.4%	79.1%	88.6%
272- Sunset	Late	20.6%	18.1%	16.0%
	Early	9.9%	5.2%	1.3%
	On-time	69.5%	76.7%	82.7%
288 - Kendall	Late	33.3%	14.1%	12.5%
	Early	8.3%	8.8%	7.4%
	On-time	58.3%	77.1%	80.1%
Overall MDT Bus System	Late	19.7%	18.3%	18.7%
	Early	13.8%	8.6%	4.4%
	On-time	66.5%	69.7%	76.9%

Source: MDT On-Time Schedule Reports Sept. 2006, Sept. 2007and May 2008

These three routes operate primarily on arterials and only partly on expressways as express runs, as indicated in Table 3.6. On-time performance also has to account for time-points along the arterial highways, as well the Dadeland North Metrorail station end-point.

Table 7-2 show changes in operating vital statistics for the three KAT routes and for all MDT MAX (express bus) services. During the demonstration period, MDT made significant service changes to the three routes. This table builds upon Table 3.5, where 2006 and 2007 data were compared against March 2008 operations data. Service on all three KAT routes was changed at least once, and in some cases, twice during the demonstration period. Overall service miles dropped 20% from 2006 to 2008; overall service hours dropped 23% during the same period; and operating costs per rider increased nearly 40%. Many of these trends were true across all MDT routes, MAX express routes, and the three KAT routes.

TABLE 7-2
BUS-ON-SHOULDERS SERVICE EVALUATION
MONTHLY OPERATIONS DATA

weekday operations

Route Number	Route 204		Route 272		Route 288		All KAT Services		All MAX Services	
Bus-on-Shoulders Routes	**Sep-07**	**Mar-08**	**Sep-07**	**Mar-08**	**Sep-07**	**Mar-08**	**Sep-07**	**Mar-08**	**Sep-07**	**Mar-08**
Revenue Miles	1,592.6	1365.5	1,035.8	937.1	733.6	586.2	3,362.0	2,888.8	12,682.2	11,445.20
Total Miles	2,152.8	1786.5	1,501.4	1326	1,038.9	806.5	4,693.1	3,919.0	16,480.3	14,535.50
Vehicle Revenue Hours	93.0	80.8	63.0	58	42.1	34	198.1	172.8	835.1	755.7
Total Vehicle Hours	118.2	101.6	84.0	76.3	55.0	44.2	257.2	222.1	1,006.6	901.4
Direct Operating Cost	$9,323	$9,579	$6,547	$6,992	$4,387	$4,144	$20,257	$20,715	$79,020	$83,916
Operating Cost per Rev Mile	$5.85	$7.02	$6.32	$7.46	$5.98	$7.07	$6.03	$7.17	$6.23	$7.33
Avg. Farebox Revenue	$2,053	$2,043	$1,149	$1,013	$920	$757	$4,122	$3,813	$18,256	$17,795
Farebox to Operations Rev Ratio	22.1%	21.30%	17.6%	14.50%	21.0%	18.30%	NA	NA	23.1%	21.10%
Est. Boardings	2,235	2,209	1,330	1,112	967	806	4,532.0	4,127.0		
Net Cost\Boarding	$3.24	$3.41	$4.06	$5.38	$3.59	$4.20	$4.47	$5.02	$2.93	$3.43
Boardings\Rev Hour	23.9	27.4	21.1	19.2	23.0	23.7	22.9	23.9	24.8	25.6

Source: MDT Monthly Budget & Performance Reporting
September 9-2007 & 3-2008

As shown below and in Table 7-3, the number of average weekday boardings in May 2008 for the three routes was 4,136 compared to 4,532 in September 2007 and 4,483 in September 2006, an overall drop of 8%. However, when compared to Table 7-2, ridership declined to a far lesser degree than the cuts in service – a good omen regarding service optimization and the ability of the three lines to keep riders despite service cuts. Perhaps more significantly, compared to 2003-2004 when the concept was advanced (see Table 3-1), ridership grew from 2550 per average weekday to over 4100 today, with less bus service in place on the three routes in 2008.[10]

TABLE 7- 3
BUS-ON-SHOULDERS SERVICE EVALUATION
WEEKDAY OPERATIONS – RIDERSHIP CHANGE

	Sep-06	Sep-07	May-08	Percent Change
Route Number				**9-06 to 5-08**
204 - Killian	2,032	2,235	2,176	+7.08%
272- Sunset	1,549	1,330	1,131	-27.00%
288 - Kendall	902	967	829	-8.01%
Total	4,483	4,532	4,136	-7.80%
Avg. Weekday - MDT Bus System	269,534	280,200	273,520	+1.50%
Avg. Weekday - Metrorail System	51,658	68,031	61,821	+19.7%
Avg. Weekday - Dadeland North	5,949	6,878	5,602	-5.90%
Dadeland North - Parking Occupancy*	100%	100%	NA	NA

* 1883 public spaces – Parking Counts not recovered for 2008

Source: MDT Monthly Operations Reports 2006, 2007 and 2008 for month noted

As shown in Table 7-4 other factors are harder to evaluation due to major service changes between 2006 and 2008. There were major service cuts, which make the ridership gains even more noteworthy.

TABLE 7-4
BUS-ON-SHOULDERS EVALUATION STUDY
MONTHLY OPERATIONS DATA – CHANGE PRE-BUS-ON-SHOULDERS TO PROJECT IMPLEMENTATION

Change 9-06 to 3-08

Route Number	204	272	288	All KAT Routes	All MAX Routes
Revenue Miles	-14.41%	-27.82%	-15.91%	-24.30%	-16.85%
Total Miles	-17.12%	-24.42%	-16.42%	-24.39%	-15.89%
Vehicle Revenue Hours	-13.12%	-30.20%	-13.71%	-24.71%	-14.46%
Total Vehicle Hours	-14.04%	-26.49%	-13.84%	-23.05%	-13.50%
Direct Operating Cost	24.91%	6.16%	24.41%	15.10%	21.65%
Operating Cost Per Rev Mile	45.93%	47.09%	47.94%	31.70%	46.30%
Avg. Farebox Revenue	19.96%	-15.58%	-4.30%	3.12%	0.59%
Direct Operations\Rev Ratio	-4.05%	-20.33%	-23.11%	-14.12%	-17.31%
Net Cost\Boarding	15.99%	54.60%	49.47%	NA	NA
Boardings\Rev Hour	25.69%	3.23%	3.49%	NA	NA
Change in Cost Per Rev Mile	45.93%	47.09%	47.94%	46.42%	46.30%

[10] *Miami-Dade MPO, Special Use Lanes Study, 2005 page 6-6*

Source: MDT Monthly Technical Reports

In summary, benefits to transit operations definitely include better service schedule adherence – a common finding throughout the literature for Bus-on-Shoulders demonstration projects. More tangentially, due to numerous service adjustments, the routes seem to be able to keep riders better than adverse service changes would indicate. However, when compared to other express bus routes, the KAT system does show higher unit operating costs. These costs could be due to factors other than the bus- on-shoulders operations, and as noted, there is a dual nature to these three routes as arterial locals and then express buses. Anywhere from 80-85% of the three routes travel distance is along arterial roads, making local stops.

As a result, there are benefits from this operations configuration, but other than much improved schedule adherence, other benefits cannot be isolated. Frequent MDT service changes impose too many variables to be certain of other cause-and-effect relationships, although route ridership is greater than in 2004 and ridership appears to be retained despite service cuts. Future analysis might answer these questions.

D. BUS DRIVER AND PASSENGER AND BUS DRIVER PERCEPTIONS

Sections 5.0 and 6.0 of this report respectively explain the results of findings from passenger and driver surveys. This section highlights findings from these surveys.

A. Passenger Perceptions

There was a large degree on homogeneity among rider habits and background. They made overwhelmingly work trips and used the service every weekday. There are no formal park-and-ride facilities with these routes, so all riders were picked-up or dropped-off at bus stops. From data collected by surveyors about one-third of route riders use the routes as a local route along Killian, Kendall, or Sunset Drives. Surveys were made only of the rider segment on-board buses during the expressway portion of the operation. This is about 2700 daily passengers. There were about 350 returned useable surveys – or about a 13-15% sample size.

Riders overwhelmingly found Bus-on-Shoulders to be a positive improvement. Most responses were skewed towards the Highly Agreed response on the questionnaire. Thus, most riders found the Bus-on-Shoulders operation to:

A. Run on time
B. That there is traffic congestion on the route
C. That ride comfort on the shoulder is good.
D. That the service is safe.
E. That they enjoy passing stalled passengers cars
F. That the project is a good idea.

Rider survey responses estimated a time saving of 13-15 minutes daily (each-way) when buses operate on the shoulder. However, Parsons estimates that the maximum run-time saving from Bus-on-Shoulders operation is at most 5-7 minutes on the 204 KAT route using road travel surveys during congested weekday periods. Comparing peak-hour traffic operating speed savings versus possible bus- on-shoulders time savings is imprecise since not all buses use the Bus-on-Shoulders option and there are variations among the three routes for on-expressway travel time. However, from several sets of expressway runtime observations, the 5-7 minutes is a working estimate.

Because MDT does not require drivers to use shoulder operation and because traffic conditions are so variable, the time saving is an estimate. The 3-routes all have schedule run times shown on Table 3.3 of 37-42 minutes depending on the route and time of day. The route operation on the freeways is only 10-20% of actual route length so many factors influence any time saving or less.

What is significant is the passenger time saving estimate. This appears to be 2-3 times the actual benefit. This perception fits trends from national data for Bus-on-Shoulder operations, according to Peter Martin, a researcher of national Bus-on-Shoulders project under contract to the Transportation Research Board.

Nearly 37% of riders gave a response to the open-ended survey question to express their own views of the service. Major responses can be grouped into four areas:

- The service is great
- Routes need more frequent service or longer hours
- Buses are not on time
- Make all drivers operate on the shoulder

The number of positive responses was rather high for a survey of this type. Riders obviously enjoy the service from the Bus-on-Shoulders demonstration.

B. Driver Perceptions

MDT surveyed the operators assigned to the KAT routes as described in Chapter 6. The driver views on the service can be summarized as follows:

- Riders like the service
- Training by MDT to use the route was good
- The shoulder can be narrow in areas and a wider shoulder is desired
- Merging the bus into and out of traffic along the shoulder can be difficult due to auto driver behavior
- The surface between the shoulder and the adjacent travel lane (the rumble strip course) can be a problem
- Using the shoulder is a good idea

Overwhelmingly, the drivers were in favor of the project and felt that passengers really enjoyed the use of the shoulder. About 50% said they used the shoulder frequently; 27% were occasional users; and about 18% said they hardly ever used it. Drivers were a bit more reserved about how safe travel on the shoulder was with a neutral rating. Only the question regarding adequacy of shoulder width showed drivers with a negative attitude towards the project.

These points were reiterated in the open-response portion of the survey.

Drivers cited problems with shoulder width adequacy, traffic merging, and the rumble strip pavement. The drivers also noted that riders really liked the service.

E. EXPRESSWAY LEVEL-OF-SERVICE AND MAINTENANCE

With limited data, there appears to be no change in traffic volume on the two expressways. Changes in the cost of auto operations and other changes in travel behavior due to record gasoline prices will impact any trends in auto operations levels on the expressways in the last 18 months. No adverse impacts were reported by MDX, the owner-operator of the highways.

F. SHOULDER LANE PAVEMENT AND MATERIALS

A visual survey of the shoulders used by the demonstration showed no adverse impact to the roadway, culvert, rumble strip or other shoulder facilities. As noted, the expressway is used by up to 110,000 vehicles daily. Only about 50 bus operations a day each way use the shoulder based on driver responses, perhaps 5-8 buses an hour at the peak service period. The main adverse reaction regarding the width of the shoulder and the transition zone (rumble strip) between the travel lanes and the shoulder came from bus drivers. Almost no riders cited an uncomfortable or unsafe trip on the shoulder.

CHAPTER 8.0 FINDINGS AND RECOMMENDATIONS

A. FINDINGS

Using the information presented in Chapters 1-7 of this report, there are a few findings that are important in determining the success of the KAT Bus-on-Shoulders project. These findings are presented below.

Cost-Benefit Standards:

MDX spent about $14,000 on signs and MDT spent funds on training drivers (no amount reported). Parsons estimates that the cost in staff time and training for about 75 MDT Metrobus drivers is estimated by Parsons to be between $500-$1000 each, primarily in training time. Combined, this is a relatively low financially outlay. Parsons also estimates that buses save about five minutes of travel time when using the shoulders. While this financial saving cannot be realized since the MDT has not cut schedule time on the KAT when use of the shoulder is voluntary, it does represent a real economic value that could be applied to the project's benefit.

There are two ways to estimate the benefits of the project:

1. Bus Travel Operations: The real time savings of perhaps five minutes daily for 50% of bus runs operating on shoulders is about eight hours total. Using current MDT Metrobus operating costs of about $105 per hour, there is an estimated $185,000 in possible travel operations savings if MDT could adjust schedules.

2. User Cost Savings: Faster bus operations create financial benefits to Metrobus riders. A five minute savings in real travel time for 50% of all daily KAT boardings using Bus-on-Shoulders (1500 riders carried on the expressway segments) with an assumed travel time cost of $15.00 per hour would result in a savings benefit of 125 hours of weekday travel time to KAT users – or a savings of 27,500 travel hours yearly. The value of this rider time-savings is slightly over $412,000 yearly.

The two cost savings combined are nearly $600,000 yearly, with two-thirds of the potential benefit going to Metrobus riders with faster bus service. MDT does not have a way to benefit financially from this operation. This value sets the base benefit in estimating the return on any proposed investment in the project.

Potential capital investments needed to improve Bus-on-Shoulders service need to be fairly modest to keep a positive cost benefit ratio.

Transit Operations:

Based upon research cited earlier in this study, areas that need improvement include**:**

- Rider demand for better on-time performance
- Rider demand for more frequent service

Given the MDT's financial situation, added service is not likely in the near future. On-time performance has improved greatly since 2006, but since the three KAT bus routes also travel on congested arterials real-time, schedule adherence improvements can be limited. The MDT has overall on-time performance objectives, and the KAT routes are getting close to 90% on-time performance, a fairly high industry standard. It is not clear that still greater on-time schedule adherence can be achieved first through the use of the Bus-on-Shoulders effort.

Other transit operations aspects appear to be satisfactory, with the exception of Metrobus driver acceptance of buses merging on and off the shoulder. This driver behavior pattern can be difficult or impossible to modify. Better enforcement of existing laws is always a mitigation policy, but vehicle merges on crowded highways will always be difficult. A rule that requires giving buses right-of-way preference might be considered along with the overall Bus-on-Shoulders statutes. Signs could be installed warning buses of merge preference. However, without enforcement, this regulation will not be well observed. This warning, indicating that use of an inside shoulder for Bus-on-Shoulder operations where the bus will need to weave across several lanes of traffic, could be very unpopular with Metrobus drivers and should be avoided.

The Florida High Patrol, MDT and MDX operations staff reported no incidents or accidents due to the Bus-on-Shoulders operation. There have been no accidents reported due to implementation of the Bus-on-Shoulders demonstration based on verbal feedback. Over the next several years, the MPO and other agencies may want to collect data to update safety records, which lag by 2-3 years from current conditions.

Driver and Rider Response:

The project is viewed very favorably by both transit riders and drivers. Few significant problems exist and those have been cited earlier.

The only step that might significantly enhance service is to require drivers to use the shoulders under certain set congestion parameters. Currently, most drivers voluntarily use the shoulder; with about 20% of drivers never using the shoulder. Bus riders now prefer Bus-on-Shoulders operations during congested periods, and have indicated they would like all buses to use the shoulder during congested travel times. A mandatory requirement might please transit riders, but the agreement to operate MDT bus service with the Transit Workers Union (TWU) allows this assignment to be voluntary. Similar driver work rules exist in other communities operating bus-on- shoulders service.

Roadway Recommendations:

Mitigations for the roadway deficiencies cited in Chapter 4 regarding the existing roadway and pavement include:

- Pavement: Upgrade the pavement and reduce the pavement edge slope for a better shoulder/ travel-lane transition. The friction course layer of the pavement can be added to the outside shoulder. This can be incorporated into the next roadway project, which includes milling and resurfacing the existing pavement. By adding a friction course to the shoulder area, the ride is smoother and switching in and out of the shoulder lane easier and safer. It may also add some miles to the life of the buses' tires. It was noticed that these shoulders do not have rumple strips. If they are to be added at a future time, the recommendation would be to place them mid-width of the shoulder area. This would guarantee that bus tires

won't be driving on them and still serve safety purposes. Estimated costs for adding the friction pavement over the existing shoulder lanes for SR-874 would be about $171,000. Estimated costs along SR-878 for adding the friction pavement over the existing shoulder lanes would be about $188,000. Please refer to Tables 8-1 and 8-2 for details.

- Shoulder-widening: Widen the shoulder whenever MDX has a roadway improvement project along SR-874 and SR-878 and incorporate wider shoulders making 11-12-ft. the standard width. Estimated costs for widening the shoulder lane for SR-874 would be about $89,000. Estimated costs for widening the SR-878 shoulder lane would be about $98,000. Please refer to Table 8-2 for details.

If widening would to occur along SR-878, it would involve removal and replacement of most of its existing drainage system and shoulder gutters. This would be very expensive, estimated by Parsons at over $16 million. Since there are no signs of damage or problems with the existing system, widening along SR-878 is not favorable. Therefore, widening is only recommended along SR-874 and in flush shoulder areas along SR-878. Future roadway improvements now programmed are shown in Appendix G. Perhaps some of the shoulder design principles cited above can be incorporated into these projects.

Combining these capital costs with upgrades as part of a larger roadway improvement program will minimize direct Bus-on-Shoulders project related costs. A multimillion dollar capital outlay just for Bus-on-Shoulders is not likely to be cost-effective on its own.

The cost to redo the pavement and widen the shoulder on both roads would cost just over $536,000.

Other Factors

- While all three routes begin at the same location the Shops at Paradise Lake there is no Park-and-Ride facility at this location or along most of the three routes. Virtually all riders are picked up at bus stops along the local service portion of the routes. Given the lack of parking at Dadeland North Metrorail station using these three routes to attract park-and-ride patrons would be a low cost way to expand parking supply and attract more riders to the service.
- All three routes operate as local routes along Killian, Kendall and Sunset with peak hour frequencies in the 5-10 minute range. All routes take from 37-42 minutes to complete a peak-hour trip from end-to-end schedule time. Running a few express or limited buses between the end points might attract time sensitive riders. This could be useful if tied with end line parking facilities.
- The favorable reviews given to the service shows that transit riders welcome fast and reliable bus service, Bus-on-Shoulders and express buses can become a tool to lure choice riders and workers to transit. The overwhelming majority of riders, make work or school trips and uses the service 4-5 days a week. Thus, service expansion with more Bus-on-Shoulder operations, express buses, dependable schedules and parking facilities for park-and-ride users could be one way to attract new transit users, especially with Metrorail garages at capacity.

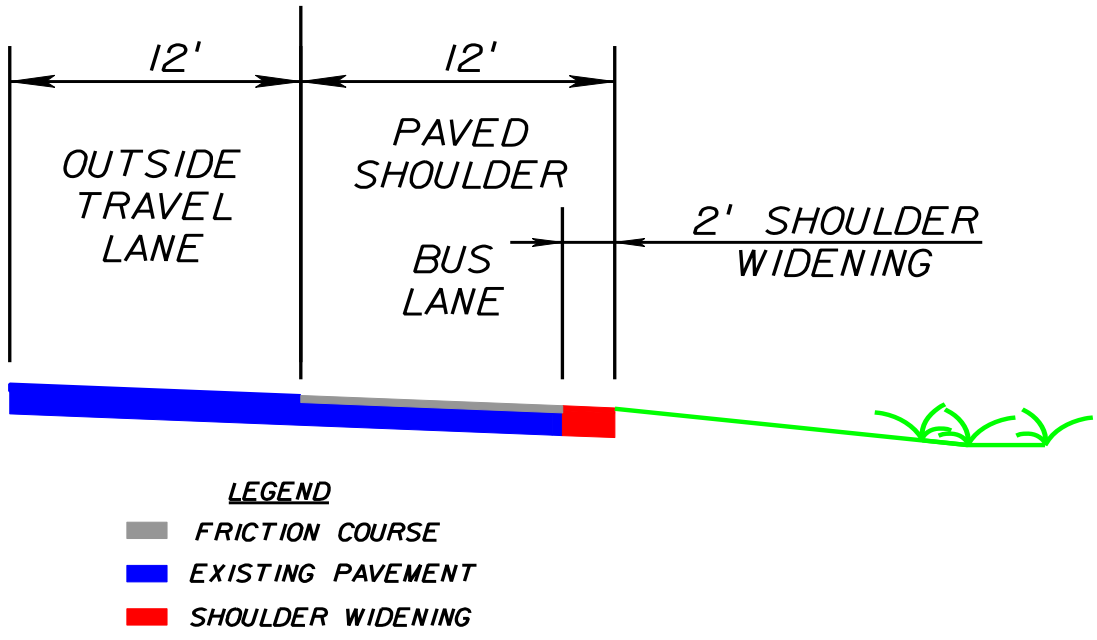
TABLE 8-1
BUS-ON-SHOULDERS EVALUATION STUDY
ADDING FRICTION COURSE TO EXISTING SHOULDER

Area							
Item	**Width**	**Length**	**SF**	**SY**	**Tons**	**Unit Cost**	**Item Cost**
Friction Course (874)	10 ft.	21,120 ft.	211,200	23,467	1,291	$131.91	$ 170,251.84
Friction Course (878)	10 ft.	23,232 ft.	232,320	25,813	1,420	$131.91	$187,277.02

TABLE 8-2
BUS-ON-SHOULDERS EVALUATION STUDY
WIDENING SHOULDER

Area							
Item	**Width**	**Length**	**SF**	**SY**	**Tons**	**Unit Cost**	**Item Cost**
SR-874							
Friction Course	2 ft.	21,120 ft.	42,240	4,693	258	$131.91	$34,050.37
SP Structural Course	2 ft.	21,120 ft.	42,240	4,693	516	$106.21	$54,832.68
						SR-874 Total	$88,883.05
SR-878							
Friction Course	2 ft.	23,232 ft.	46,464	5,163	284	$131.91	$37,455.40
SP Structural Course	2 ft.	23,232 ft.	46,464	5,163	568	$106.21	$60,315.95
						SR-878 Total	$97,771.36

FIGURE 8-1
RECOMMENDED ROADWAY IMPROVEMENTS



CHAPTER 9.0 APPLICABILITY TO OTHER MDT ROUTES

In October 2004, the Miami-Dade County Metropolitan Planning Organization (MPO) Phase 1 - Special Use Lane Study suggested improvements to bus service on major arterials throughout Miami-Dade County. That report recommended the following major projects:[11]

- Homestead Extension - Florida Turnpike/Kendall Drive to SR-836; to the Miami Intermodal Center (MIC); and then onto downtown Miami.
- State Road (SR) 826 from Dadeland to NW 154th Street.
- Pines Boulevard/I-75 to Miami Gardens Drive to SR-826 to the Palmetto Metrorail Station.

A Phase II component suggested how expressway shoulders could be used for congestion by-pass. The expressways studied included the following:

- Interstates 75 and 95.
- SR-826 and SR-836.
- Florida Turnpike (Homestead Extension /Florida Turnpike – HEFT) from South County to Kendall.
- SR-874/SR-878 westbound from Dadeland North Metrorail station.

Bus-on-Shoulders was seen as a fast and inexpensive way to improve bus service and operations on these corridors. Criteria for determining where to recommend Bus-on-Shoulders was needed to satisfy two issues - existing bus routes on or near the highway and that the highway had usable shoulders. To meet minimum standards for Bus-on-Shoulders there needed to be:

- Existing shoulder lanes that are at least 10 ft. wide.
- Buses that will use shoulders only when travel speed goes below 25 miles per hour (mph).
- Buses that cannot exceed 35 mph while on shoulders, or 15 miles over expressway travel speed.
- There should be about 2500-feet between exits.
- Buses that will maneuver across ramps, vehicles, and shoulder debris as conditions warrant.
- Program that will be "flexible" so that the concept can work with variable conditions, including expressway construction.

In looking at other corridors where the Bus-on-Shoulder operation can be applied, the following conditions appear to exist at this time:

1. I-95 – The new HOT lanes now under development by Florida DOT provide a superior facility for use compared to using the shoulders of I-95. The project incorporates new expanded express bus service from Golden Glades to Downtown Miami.

2. Homestead Extension - Florida Turnpike (HEFT) - Existing shoulder lanes that are at least 10 ft. wide were found along SR 821. However, there are no existing bus routes using Florida's Turnpike. There are a number of bus routes using paralleling roadways in the mid and southern portions of the County, but on/off ramps for SR 821 are not readily available

[11] *Miami-Dade MPO, Special Use Transit Lanes Study – November 2005,Executive Summary*

for these routes. Most of these routes are local service, so shifting onto the expressway could adversely impact ridership. In the southerly end of the Metrobus service area - the South Dade Busway - provides dedicated lanes, stops and parking that are superior to operating buses on the Florida Turnpike extension. There are only 3-4 connections onto the HEFT in the northern part of the County and there are no existing bus routes.

3. The Dolphin Expressway (SR-836) has the majority of its existing outside shoulder lanes with 10 ft. usable shoulder west of SR-826. The issue here is that there are no existing bus routes that actually use SR-836. In order to have a Bus-on-Shoulders project along SR-836, one or more new bus routes would need to be created as proposed with park-and-ride lots.[12] The MIC is not scheduled to be completed until 2014 and an east-west rail connection is scheduled to be completed by 2024. Thus, there could be a ten-year period where Bus-on-Shoulders might be beneficial if it was at low cost, but this concept requires new MDT Metrobus service. Comments from MDX consultants note that there are sections where the shoulder is less than 10-feet wide, and that in sections entrances and exits are closer than one-half mile spacing standard set-up for the demonstration project causing excessive weaving by buses as they would enter and exit the shoulder.[13].

   The Palmetto Expressway (SR-826) to Palmetto Metrorail Station - Developing new routes is a possibility, but would involve separate evaluation of where there is a ridership need and what benefit would new routes on SR-826 provide. Using I-75 as a link using the expressway shoulders could be viable, if there were a demand for service. The I-75 to SR-826 connection is highly congested. The elevated merge between the two expressways has no shoulder for buses to use. Connections to the Palmetto Metrorail station just west of SR-826 off the Palmetto are also congested. While, there are parallel MAX routes, the 267 and 282 on NW 67 and NW 87 Avenue a study of how to connect the Metrorail station with the Doral, Hialeah, Virginia Gardens and Medley communities might show areas of underserved needs. Connections from this station to high employment concentrations in the surrounding areas could also be useful and attract reverse commute riders. Connections from this Metrorail station to areas served via the Florida Turnpike Homestead Extension (HEFT) might be viable too,

4. Bird Road MAX (Route 240) uses the Palmetto Expressway between Kendall Drive and Bird Road (see Exhibit 9-1). This would be a possible candidate for the Bus-on-Shoulders project. Most of the shoulder areas in the portion of SR-826 which Route 240 operates are at least 10 ft. wide. The merge areas are the few areas where the shoulders are less than 10 ft. wide.

5. Facility Improvements: A number of drivers were not satisfied with the 10-foot standard lane width for operations. While it's hard to retrofit lanes, if FDOT or MDX could develop a policy of 11-12 foot shoulders for the region, it would be easier to operate future Bus-on-Shoulder routes in the future. The cost to widen the Don Shula and Snapper Creek Expressway to 12-feet is about $600,000. Signage and other notice appear to be adequate from a safety viewpoint.

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[12] *Ibid. Page 1-3*

[13] *HNTB, Memo to Myra Diaz, MDX – MPO Study, Bus-on-Shoulder Service Evaluation (SR-874 and SR-878)- revised draft - September 12,2008)*

EXHIBIT 9-1
BIRD ROAD MAX ROUTE 240