



Glacier

Going to the Sun Road Rehabilitation Mitigation Shuttle Bus Evaluation



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Executive summary

As a mitigation measure during reconstruction of the Going to the Sun Road, Glacier National Park operated a shuttle bus system along three routes during the 2007 season. This report presents a multi-dimensional evaluation of the transportation service during its first season of operation.

Findings in this report are drawn principally from operational data collected by the Park's Transportation Scholar, supplemented by an analysis of driver records and traffic counts, discussions with NPS staff and transportation operators, and an onsite visit by the evaluation team. The scope of the evaluation includes operations and performance (including run times, schedule adherence, and crowding); ridership; effects on traffic, parking, and visitation within the Park; and financial viability and cost-effectiveness. Effects on the visitor experience are considered qualitatively based on a visitor survey conducted by the University of Montana. Safety impacts were not able to be assessed due to a lack of relevant data.

System performance and operations

In large part, the Glacier NP bus system operated effectively, particularly on the St. Mary Valley and Apgar routes. However, the Lake McDonald Valley route, which is the longest and highest-ridership route, suffered from some significant issues including overcrowding/denied boarding, irregular waiting times, and schedule slippage. Some of this may be due to the natural learning curve of the first season of operation, the fact that some of the vehicles did not arrive on time, and the traffic delays associated with road reconstruction during this time period. Nonetheless, there are also some inherent characteristics of the route that contribute to these issues, notably the narrow travel lanes that necessitate smaller vehicles and the lengthy round-trip travel time. There were also operational issues with radio communication and mechanical breakdowns that should be addressed.

Ridership

Ridership on the system totaled about 1790 boardings per day. When adjustment is made for the fact that some visitors make two or more trips in a day, total ridership is estimated at about 830 visitors per day. Ridership appears to have been highest during the earlier part of the season and during mid-day periods. The busiest stops were the Apgar Transportation Center and Logan Pass.

Effects on vehicle traffic and parking

Based on ridership figures and a comparison of traffic counts between 2005 and 2007, it is estimated that the shuttle system was responsible for keeping 210-280 vehicles out of the park on the Lake McDonald Valley route and 120-190 vehicles on the St. Mary route. This is roughly equivalent to a 15-20 percent reduction in vehicle traffic on these routes during the busiest parts of the day. The bus system is also estimated to have reduced the number of cars parked at Logan Pass by 50 to 100 per day.

Visitation and visitor experience

One of the goals of the bus system was to ensure that total seasonal visitation did not decrease by more than 6 percent during the period of road reconstruction. Analysis of both vehicle counts and NPS Public Use data indicate that this goal was met. Survey findings from the University of Montana are recapped in Section 10 of the report. Responses to the shuttle system were generally positive.

Financial viability and cost-effectiveness

The transportation system required upfront capital expenses of about \$4 million for vehicle purchases, plus operational costs (fuel, driver wages, etc.) of \$853,539 for the 2007 season. Operational costs per vehicle-hour were typical for a small transit system.

The average cost per passenger, including annualized capital costs, came out to \$22.71. The productivity of the bus routes is 3.4 to 7.1 passengers per vehicle-hour, which is relatively low for a transit system, but not unexpected given the long routes and the smaller vehicles in use.

When grants received and transportation fee revenues are compared against these costs, the system ran a small surplus of about \$15,000 for the season. Overall, the system is financially sustainable to the extent that external funds can continue to be made available for capital costs.

Purpose

This report presents an evaluation of the shuttle bus system operated in Glacier National Park (NP) as a mitigation measure for reconstruction and rehabilitation of the Going to the Sun Road (GTSR) from July 1 to September 3 (Labor Day), 2007.

The evaluation is intended to determine the impact of the shuttle bus system in terms of major service objectives:

- Ridership/Traffic Impacts—divert a sufficient number of visitors from private vehicles to reduce traffic congestion during road reconstruction.
- Visitation—attract a sufficient number of riders to maintain visitation close to pre-construction levels, despite reduced roadway capacity.
- Financial—provide a financially sustainable, cost-effective solution to construction-related traffic congestion.
- Enhance the visitor experience by providing options to driving and parking under congested conditions.
- Partnership—work in collaboration with Wyoming Department of Transportation and Flathead County – Eagle Transit to provide a cost-effective solution to complementary and shared needs for quality transit service
- Environmental—protect park natural and cultural resources.

Several of these objectives support the goal of satisfying requirements in the Environmental Impact Statement Record of Decision (ROD) for the roadway reconstruction project. Specifically, the shuttle bus service's intended purpose is to help mitigate vehicular traffic during GTSR reconstruction, in accordance with the following conditions of the ROD:

- Cumulative work zone lane closures are not to exceed 30 minutes for end-to-end GTSR travel during the peak hours of 10:00 Am to 4:00 PM.
- Visitation is reduced no more than 6 percent due to construction delays.

Accordingly, a key mitigation commitment is operation of a shuttle bus system to provide alternative transportation access and maintain capacity to accommodate visitation during GTSR reconstruction.

Scope of Evaluation

The anticipated evaluation content was defined in the *Evaluation Plan: Going to the Sun Road Rehabilitation Mitigation Shuttle Bus* and included the following major constituent elements:

- System characteristics - Documentation of the system is needed to clearly establish the basis of the evaluation, i.e., what it is that is being evaluated, and to identify any elements of the system that should be modified to improve future performance. Major characteristics affecting level of service include number and type of vehicles, route configuration, and schedule.

- System Performance – travel times along each segment of the route, operating speeds, schedule adherence, capacity-related problems, vehicle and equipment reliability
- Visitor Use of Shuttle Service – daily ridership volume; composition in terms of visitors and employees, demographics; variation over season, by time of day, and day or week.
- Traffic – traffic volumes on GTSR, frequency and duration of delays.
- Parking – number of spaces used; availability of spaces by location; impacts on traffic of parking shortages.
- Visitation – necessary to determine if project is meeting the objective of maintaining the park’s capacity to accommodate visitors.
- Safety – traffic accidents and incidents—vehicle on vehicle, vehicle/pedestrian, vehicle/bicycle, shuttle-bus related¹.
- Financial Viability – comparison of costs and revenues; cost-effectiveness of expenditures.
- Visitor Experience – not a focus of this evaluation but providing a context for other assessment criteria.

The evaluation has been constrained, however, relative to the original evaluation plan, due to limitations on the data available from Glacier NP. This report will identify the effects of these limitations as they concern individual evaluation topics, as discussed below. A discussion also is included of design and operational issues, based on first-hand on-site observations by Volpe staff and information obtained through interviews with the shuttle operator and others involved in shuttle planning and implementation.

System Characteristics

The shuttle operated daily in 2007 from July 1 through September 3, a total of 65 days. Use of the shuttle was free to all visitors, with operating revenue obtained from a transportation fee incorporated in the park entrance fee (system financial analysis is discussed in Section II of this report). Service attributes are summarized below.

Route Configuration

- Three routes:
 - Apgar Route: Fish Creek Campground to Apgar Transit Center – with stops at Apgar Village and Apgar Campground
 - Lake McDonald Valley Route (West GTSR): Apgar Transportation Center – Logan Pass: 6 stops
 - Apgar Transportation Center
 - Sprague Creek Campground
 - Lake McDonald Lodge
 - Avalanche Creek
 - The Loop
 - Logan Pass

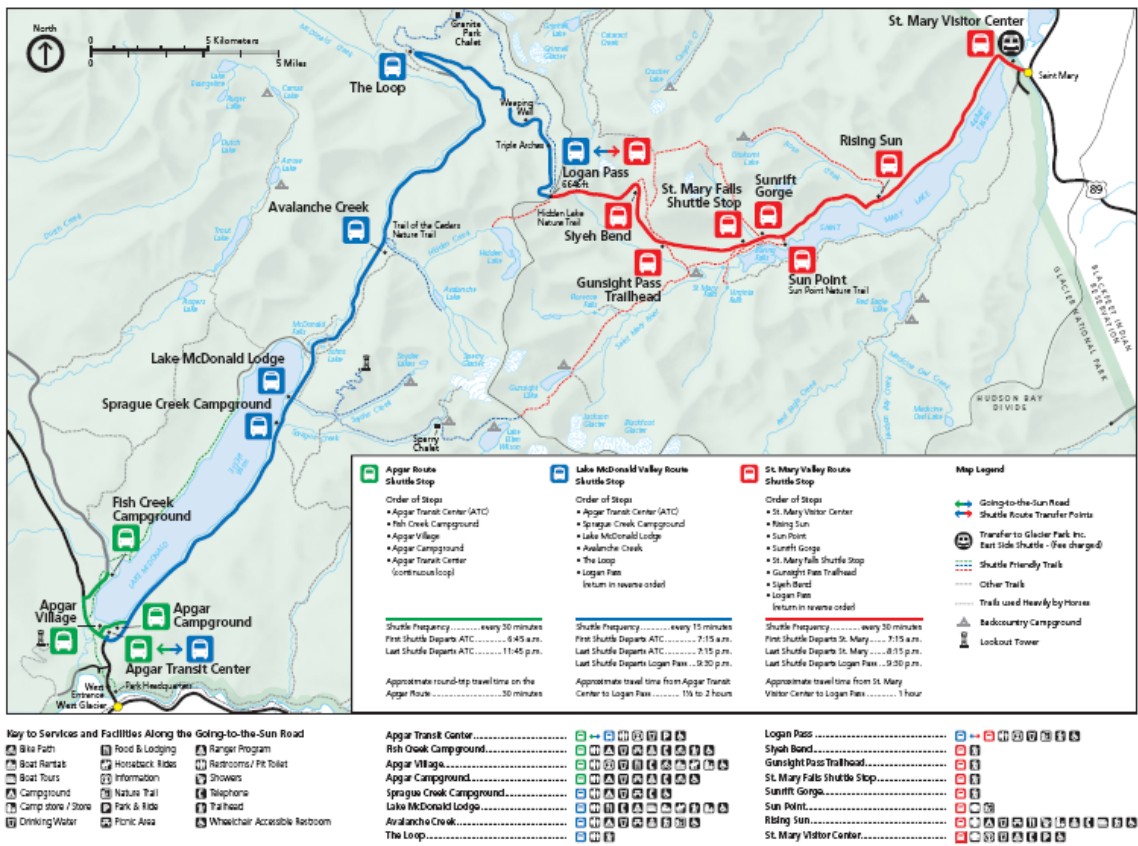
¹ No safety data were provided by Glacier NP for the evaluation.

- St. Mary Valley Route (East GTSR) – St. Mary Visitor Center-Logan Pass: 8 stops
 - St. Mary Visitor Center
 - Rising Sun
 - Sun Point
 - Sunrift Gorge
 - St. Mary Falls
 - Gunsight Pass Trailhead
 - Siyeh Bend
 - Logan Pass

The Lake McDonald Valley Route serves the portion of the GTSR to the west of Logan Pass, with the shuttle traveling back and forth between the Apgar Transit Center and Logan Pass route endpoints. The St. Mary Valley Route serves the portion of the GTSR to the east of Logan Pass, traveling back and forth between the St. Mary Visitor Center and Logan Pass endpoints. Passengers can transfer between the two routes at the Logan Pass Visitor Center. A route map for the shuttle bus service is shown in Figure 1.

Figure 1
Shuttle Bus Route Map

Source: NPS



Most initial boardings on the Lake McDonald Valley Route among visitors entering the park at West Glacier occur at Apgar Transportation Center, although Lake McDonald Lodge is a popular boarding area for tour groups and visitors staying at the hotel. Most visitors entering the park from the east at St. Mary board the shuttle bus at the St. Mary Visitor Center, which is the transportation terminal and information hub for this route.

Route Distances (single direction)

- Apgar Route – approximately 2 ½ miles
- Lake McDonald Valley Route – 30 miles
- St. Mary Valley Route - 17 ¾ miles

Schedule

Hours of Service

- Apgar Route: 6:45 AM – 11:45 PM departing from Apgar Transit Center
- Lake McDonald Valley Route: 7:15 AM – 7:15 PM departing from Apgar Transit Center; last shuttle departs from Logan Pass at 9:15 PM
- St. Mary Valley Route: 7:15 AM – 8:15 PM departing from St. Mary; last shuttle departs from Logan Pass at 9:30 PM

Scheduled Headways (i.e. frequency)

- Apgar Route: 30 minutes
- Lake McDonald Valley Route: 15 minutes; later reduced to 12 minutes, to relieve capacity constraints
- St. Mary Valley Route: 30 minutes

Note that the headway figures cited above are based on the official schedule. In actuality, intervals between bus departures from Apgar Transportation Center (and arrivals at all bus stops) varied widely on the Lake McDonald Valley Route and frequently exceeded officially scheduled times substantially, as will be discussed in the *System Performance* section, below. While delays related to road rehabilitation were a contributing factor to deviations from schedule, variability in traffic conditions and boarding times due to ridership fluctuations, as well as capacity constraints and dispatching irregularities, also appear to have been responsible for wide variations in shuttle arrival and departure times.

Fleet

8 23-seat, 20 standee *Optima* Buses

22 12-seat Dodge Daimler-Chrysler *Sprinters*

Only five of the *Optimas* were delivered and these arrived at the end of the season, too late for deployment in 2007. Thus, during the entire period evaluated, the service was provided with the *Sprinters*, augmented by six loaner “New Yellow Buses” for the St. Mary Valley Route from Yellowstone. Limited data provided to the Volpe Center indicate that on most days, the number of vehicles deployed on each of the routes was as follows: Apgar Route – one vehicle; St. Mary Valley Route (capacity 20 – 25 passengers) – five; Lake McDonald Valley Route – up to 20, depending on availability.

Institutional Responsibilities

The service was provided under contract by Flathead County Eagle Transit, the local public transit operator.

System Performance

System performance relates to the actual experience of operating and using the service, addressing *quality, reliability, and convenience*, as reflected in travel times and schedule adherence. The system performance section of this evaluation is based on three primary sources of information:

- Observations noted by Volpe Center evaluation staff during a field visit on August 15-16;
- Tabulations of passenger boardings, shuttle travel times, number of buses, service hours and related service characteristics for selected days, time periods, and routes compiled by the NPS Glacier NP Transportation Scholar[†];
- A sample of driver records for July 5-8, provided by Flathead County Eagle Transit.

Travel Times and Schedule Reliability

The official posted schedule included in the *Going-to-the-Sun Road Shuttle System Route Map* includes the following estimated travel times:

- Lake McDonald Valley Route: 1 ½ - 2 hours
- St. Mary Valley Route: 1 hour
- Apgar Route: 30 minutes (round trip from Apgar Transit Center[†])

Travel times on the Lake McDonald Valley Route actually were highly variable, due both to reconstruction and baseline conditions (e.g. narrow and winding right of way, steep grades, variable traffic volumes, wildlife and weather-related impacts) inherent to the Alpine section of the roadway.

Analysis of the data provided to the Volpe Center by Glacier NP's Transportation Scholar show the following average travel times and variability for single direction trips:

	Mean	Median	Average Deviation
Lake McDonald Valley Route	78 minutes	78 minutes	13 minutes
St. Mary Valley Route	52 minutes	53 minutes	3 minutes

With single direction route distances of 30 miles for the Lake McDonald Valley Route and 17 ¾ miles for the St. Mary Valley Route, average operating speeds are calculated to be approximately 23 mph on the Lake McDonald Valley Route and 20 mph on the St. Mary Valley Route. An important note is that these speeds include boarding time and therefore do *not* represent actual over the road travel speeds. Considering the difficult operating conditions on the Alpine sections of the GTSR, the travel times are good, although average variability on the Lake McDonald Valley Route are close to the scheduled headway, signaling two major problems concerning system performance: (1) excessive wait times and (2) poor adherence to schedule.

Maintaining 15-minute headways on the Lake McDonald Route should require 11 vehicles based on average (mean/median) travel times, while only four vehicles should be needed to provide 30-minute headways on the St. Mary Valley Route, with some slack incorporated to accommodate a modest level of variability. In fact, the average variability for the St. Mary Valley Route is within the range that allows for meeting scheduled headways most of the time with four vehicles. In the case of the Lake McDonald Route, however, the mean deviation time of 13 minutes is close to the scheduled headway, indicating that more than 11 vehicles frequently would be needed to allow for regular service intervals of 15 minutes at all stops. Generally, 12 vehicles should be sufficient to maintain 15-minute headways, allowing for average rates of deviation.

[†] Lisa Ballard, Glacier National Park Transportation Scholar

[†] The preliminary schedule for the Apgar Route shows travel time for completion of the entire route to be 24 minutes.

The operations data provided to the Volpe Center, however, show that headways on the Lake McDonald Route rarely conformed to the schedule. From 8:00 AM onwards, headways typically varied from just a few minutes to nearly a half hour. This schedule irregularity is not completely explained by travel time variability (i.e. the cycle time for vehicles traveling the route): the first trips of the day by individual buses frequently were off-schedule, before travel conditions could play any role in creating schedule deviation. Moreover, travel time variability was rarely of sufficient magnitude to cause schedule disruptions of the magnitude often experienced. In some cases, additional buses were added just a few minutes after another bus departed from Apgar Transportation Center, to accommodate overflow demand.

Capacity

Lake McDonald Valley Route

The original 15-minute scheduled headway on the Lake McDonald Valley Route would accommodate a steady flow of 48 individual passengers per hour. As the analysis of hourly boardings (Section 6) indicates, this level of capacity would be barely sufficient to accommodate one-half the *maximum* hourly demand of about 94 passengers (i.e. 46 percent of 200 boardings). Even during a more typical hour, when 50 – 100 passengers might be riding the shuttle for some period of time, capacity of approximately 50 passengers hourly would be inadequate, particularly given that schedule irregularities exacerbate the problems caused by even small capacity shortfalls. After scheduled headways were reduced to 12 minutes, the hourly capacity would have increased to 60 passengers hourly, which would have eased capacity constraints significantly, particularly during hours outside peak periods.

The effects of capacity constraints on the Lake McDonald Valley Route were experienced frequently, in terms of visitors being unable to board full buses and needing to wait at shuttle stops for significant periods of time, sometimes as long as over an hour. While schedule deviation contributed significantly to the problem, in that headways of half an hour or longer were experienced on a regular basis, two underlying factors intrinsic to operating conditions on the Alpine section of the Lake McDonald Valley Route are largely responsible for both scheduling and capacity problems:

Severely limited roadway width on Alpine sections of the road dictate the use of relatively small-capacity vehicles (i.e. 12-passenger vans);

The long distance (30 miles) and slow operating speeds cause cycle times for individual vehicles to be lengthy; round-trip travel times average over 2 ½ hours.

The net result of the above factors is that a relatively large fleet of vehicles is needed in relation to total demand, resulting not only in increased costs (addressed in Section below), but added operational complexity and greater likelihood that a variety of logistical problems related to labor, vehicle conditions, dispatching, and traffic will converge to create schedule disruptions.

St. Mary Valley Route

Ridership on the route was only 60 percent of that on the Lake McDonald Valley Route, while the capacity of the vehicles operated was 2/3 to 100 percent higher (although headways were twice as long, at one-half hour). As a result, the incidence of demand exceeding capacity was much lower. Schedule disruptions also were far less frequent on the St. Mary Valley Route.

Design and Operational Issues

Design

Design issues concern the physical layout of the shuttle bus system, including route configuration and the location and characteristics of facilities and bus stops. A related set of issues concerns operational policies and strategies that are influenced by the physical design of the system. Some design characteristics are fundamental to the system and permanent, such as the basic route alignment along the GTSR and the location of large scale terminal facilities, i.e. the Apgar Transit Center and St. Mary Visitor Center. In other cases, there is potential to modify system characteristics, such as the location of intermediate stops and layout of boarding areas, based on the lessons learned from the system's inaugural season in 2007. Even in the case of major permanent features, there may be improvements that can be implemented, such as signage or addition of amenities, to address deficiencies that have become evident on the basis of this past season's experience.

The primary sources of the discussion presented in this section are field observations by Volpe staff and a member of the FHWA staff who has been involved in planning the shuttle bus service[†]. As compared to the data-based analysis included in most of the report, these issues are inherently more subjective in nature and are presented for review and possible consideration in planning next year's shuttle bus service.

Location and Visibility of Apgar Transportation Center

Apgar Transportation Center, which is the stop where most riders initially board the Lake McDonald Valley Route, is located at the intersection of the GTSR and Camas Road, about ½ mile from Apgar Village. The shuttle bus terminal and Village are connected by the Apgar Route shuttle bus and also a pedestrian walkway through a wooded area. The path begins on the Apgar Village end at the edge of a parking area. While the walkway is reasonably well-signed on the Apgar Transportation Center grounds, the way-finding sign at the Village end has limited visibility.

Since many visitors are likely to arrive first at the Village after entering the park at West Glacier, the visibility of the pedestrian walkway is more critical at the Village end, from the standpoint of attracting ridership. Moreover, Volpe Center staff did not see any signs or information about the shuttle bus service in the Apgar Visitor Center. Another related concern is that the existing road sign identifying the location of the "Apgar Transit Center" on GTSR may not adequately communicate that a shuttle bus system serving major destinations within the park is available to visitors. Overall, as a result of these design and signage issues, many visitors to Glacier NP may not become aware of the shuttle service, even though there are attractive and readily comprehensible route maps posted at the Apgar Transit Center and other stops.

While the location of the Apgar Transit Center is—as a practical matter—unalterable, signage and the distribution of other informational materials are features that are subject to improvement and that can help to compensate for the separation between the transit terminal and Apgar Village, most critically the Apgar Visitor Center.

Transportation Center Operations and Amenities[†]

The Apgar Transportation Center is a large, attractive facility. Several operational improvements, however, would enhance the quality of service and overall experience for shuttle bus riders boarding and waiting at this location:

[†] Observations by Susan Law of FHWA are noted. Other observations are by the Volpe Center.

[†] Primary source of observations: Susan Law, FHWA.

- A queuing/loading plan designating boarding and waiting areas, for orderly “first come/first served” boarding; this is critical, because passengers often have to wait for extended periods of time and lack of clarity about boarding procedures makes this experience more onerous.
- At Logan Pass, signs could be relocated to better identify boarding areas; benches and shelters also could be provided.
- Vending machines providing water and snacks would be a desirable amenity at all three shuttle terminals—Apgar Transit Center, Logan Pass, and St. Mary Visitor Center (under construction as of the end of 2007 season). Lack of access to transportable (e.g. bottled) water over the entire length of the shuttle bus routes is a safety concern because round trip travel times are so long.
- Reconfigured placement of kiosks and possible enhancement of informational resources within the Center; stationing a volunteer within the structure might help to increase its use and benefits to visitors. The volunteers play a critical role in providing information to riders, particularly when they must wait for long periods of time.

Configuration of intermediate stops⁴

In the case of three intermediate stops on the Lake McDonald Valley Route—Sprague Creek Campground, Avalanche Creek, and the Loop—there is only a single stop serving the route in both directions, so the bus needs to cross traffic on the GTSR to access the stop. While Sprague Creek Campground is not a busy stop, boarding activity at Avalanche Creek is sufficiently high that the addition of a boarding area in the eastbound direction would be beneficial in terms of safety, traffic flow, shuttle bus travel time and schedule reliability. A westbound pullout is planned at the Loop.

The boarding area at the Loop in the eastbound direction also serves as the area for handicapped parking. The handicapped spaces could be moved, eliminating this conflict. The shared use of space for private vehicle parking and shuttle bus loading/unloading also is an issue at Siyeh Bend and the Sunrift Gorge stops. In addition, at the St. Mary Falls shuttle stop, the sign designating the shuttle bus stop is too small and riders confuse the Virginia Falls trailhead with the shuttle stop.

Operational Issues

The geometry of the GTSR imposes a number of operational constraints, as addressed in the discussion of “Capacity” in Section 4 (*System Performance*). Adding to the inherent problems associated with extremely tight right of way, steep grades, and long route distance were persistent problems with the reliability of the Daimler Chrysler *Sprinters* during this first operating season. To relieve the build-up of passengers waiting at some bus stops as a cumulative result of all these factors, the operator tried a number of remedial strategies, such as the deployment of “rover buses” to respond to problems as they occurred. Given the linear nature of the GTSR, however, coupled with capacity constraints, the value of these actions is unclear and no data were collected to measure results. Adding to the difficulty of implementing dynamic dispatching under these circumstances was the lack of a dedicated radio frequency for the shuttle bus service; drivers used a two-way radio with a low-priority channel to communicate with one another and the dispatcher and on most days no radio communication was possible by drivers enroute.

⁴ Primary source of observations: Susan Law, FHWA.

Ridership

Average Daily Ridership

Glacier NP collected only some of the data specified in the *Evaluation Plan* and the ridership data processed and provided to the Volpe Center covered only a fraction of the days on which the service was operated in 2007. Boarding data that could serve as a basis for determining ridership were provided for the following number of days and percent of the total 65 service days in the season:

- Apgar Route: 23 days (35 %)
- St. Mary: 25 days (38%)
- Lake McDonald Valley: 27 days (42%)

On several of the days for which data were provided, there were gaps during some time periods. In addition, inbound and outbound boardings did not balance, nor did the counts of passengers getting on and off the buses. These imbalances indicate variability in data collection, most likely in the logs maintained by the drivers, which served as the source of boarding/ridership data. The error rate is not unusual, however, and does not appear to be of sufficient magnitude to seriously compromise the reliability of the analysis. Overall, enough data were provided—and the data appear to be sufficiently consistent—to provide a reasonably reliable estimate of average ridership levels and the pattern of variation throughout the season.

Average daily boardings or ridership, as reported by Glacier NP's National Park Scholar, are as follows :

- Apgar Route: 56.3
- Lake McDonald Valley Route: 1061.7
- St. Mary Valley Route: 672.2

The total average daily ridership for all routes,[†] therefore, would be 1745.2. The figures also show that the Lake McDonald Valley Route accounts for 60 percent of total shuttle ridership—58 percent more trips than the St. Mary Valley Route—and the Apgar Route accounts for only 3 percent of total ridership.

These ridership figures may be subject to misinterpretation, however, in terms of impacts on the number of vehicles removed from the GTSR, and the consequent performance of the shuttle in reducing traffic congestion and meeting initial ridership expectations. The average ridership figure of 1745.2 represents total *boardings*—not individual *riders*—and therefore does not translate directly into the number of visitors diverted from automobiles and other private vehicles to the shuttle.

For example, if a visitor boarded at the Apgar Transit Center and disembarked and later re-boarded at Avalanche Creek, 2 trips would be recorded. Then if the same person disembarked and later re-boarded at Logan Pass, another trip would be recorded and if that same person then disembarked on the return trip at The Loop, re-boarding at Avalanche Creek, another trip would be recorded, yielding *a total of 5 trips for this single passenger* on the Lake McDonald Valley Route. If that person transferred at Logan Pass to the St. Mary Valley Route, disembarked at Rising Sun and reboarded at the St. Mary Falls Shuttle Stop on the return trip to Logan Pass, 3 trips also would be recorded on the St. Mary Valley Route. This example is not typical of most users but it is not highly unusual, either.

[†] Daily Summary of Ridership and Hours by Route, Lisa Ballard.

[†] The average daily ridership figure is not weighted to reflect variations in the number of days included for each of the three routes.

Data provided to Volpe indicate that over 30 percent of Lake McDonald Valley Route riders may have boarded several times between the route endpoints of Apgar Transit Center (or Lake McDonald Lodge or Sprague Creek Campground, where some visitors first board the shuttle) and Logan Pass on the Lake McDonald Valley Route. Multiple boardings between the St. Mary Visitor Center and Logan Pass endpoints may account for nearly 50 percent of total riders on the St. Mary Valley Route. Moreover, virtually all riders make round trips to and from Logan Pass on both of these routes and these trips are recorded as two boardings. While the Apgar Route accounts for only a small share of total trips, most of these also are round trips that are counted twice.

Thus, the numbers require adjustment to assess traffic-related impacts and ridership relative to initial pre-implementation expectations or forecasts. The data are lacking to determine the precise percentages of riders boarding at intermediate stops who actually first boarded the shuttle at the Apgar Transit Center on the Lake McDonald Valley Route or the St. Mary Visitor Center on the St. Mary Valley Route. While it can reasonably be assumed that many passengers boarding at some intermediate stops, stops such as Sprague Creek Campground and Lake McDonald Lodge, boarded the shuttle for the first time, in other cases, such as the Avalanche Creek and The Loop stops, many of those boarding had boarded previously at Apgar Transit Center and already had been included in ridership counts.

Planning studies for the shuttle, including the May 2005 *Draft Transit System Plan Alternatives Value Analysis/Choosing by Advantages*, include the following estimates of “Daily Rides,” representing 2 – 7.5% of automobile person-trips at the entrances indicated:

- West Entrance (served by Apgar Transit Center) 330 – 1,238
- East Entrance (served by St. Mary Visitor Center) 148 – 553

An adjustment of the actual shuttle boarding counts is needed to establish a basis for comparing the counts with the pre-implementation ridership estimates. The ridership estimates below incorporate a conservative adjustment to reduce multiple counting of individual riders, with a substantial margin of error to avoid over-adjustment. The adjustment consists of the following:

- Total boardings outbound at Apgar Transportation Center and St. Mary Visitor Center have been added to inbound boardings at Logan Pass (for the Lake McDonald Valley and St. Mary Valley Routes, respectively) and reduced by 50 percent to avoid double-counting for return trips
- In addition, boardings at all *intermediate* stops on the Lake McDonald Valley and St. Mary Valley Routes (i.e. stops other than Apgar Transit Center, Logan Pass, and St. Mary Visitor Center), except for Sprague Creek Campground and Lake McDonald Lodge, have been reduced by 50 percent.
- Apgar Route boardings have been reduced by approximately 50 percent.

The resulting daily average ridership figures are as follows:

- Lake McDonald Valley Route: 500
- St. Mary Valley Route: 300
- Apgar Route: 30

Thus, the total adjusted average daily ridership on all three routes is estimated to be approximately 830 passengers, in terms of the number of visitors diverted from automobiles and other private vehicles to the shuttle. These figures are at the lower end of the range forecast during pre-implementation planning for the Lake McDonald Valley Route, i.e. 330 – 1,238 and the middle of the 148-553 range forecast for the St. Mary Valley Route. Most critically in terms of traffic management

¹ David Evans and Associates, Inc., DRAFT Transit System Plan Transit Concepts Report, Glacier National Park, Table 3: Range of Ridership for Going-to-the-Sun based on July 2002 Peak Traffic Volumes, p.4.

objectives, the associated reduction in vehicular traffic is estimated to be about 210 on the Lake McDonald Valley Route and 125 on the St. Mary Valley Route,[†] for a total of 335 on both routes combined. In the peak hour of shuttle use (see discussion below) the estimated reduction in vehicle traffic is estimated to be approximately 40 vehicles in each direction on the GTSR between Apgar Transit Center and Logan Pass, and 22 vehicles per direction between St. Mary Visitor Center and Logan Pass.

Distribution of Ridership by Stop

Table 1 below shows the number and percentage of boardings by stop for the Lake McDonald Valley and St. Mary Valley routes[†]. The largest number of boardings was at the Apgar Transportation Center inbound on the Lake McDonald Valley Route, followed closely by Logan Pass outbound on the same route. These stops account for 62 percent and 69 percent of total single direction boardings, respectively, and since they represent the initial boarding points for inbound and outbound trips on the Lake McDonald Valley Route, the close match in boarding numbers is to be expected. Lake McDonald Lodge, Avalanche Creek, and the Loop account for 13.9 percent, 9.5 percent, and 12 percent of outbound boardings, respectively, while only two percent of boardings occur at Sprague Creek Campground. In the inbound (i.e. return trip) direction, Avalanche Creek and Lake McDonald Lodge account for 12 percent and 11 percent of total boardings, respectively, The Loop contributes 6 percent, and Sprague Creek accounts for under 1 percent of the total of 13,300 boardings on the route. The relatively high number of boardings at several intermediate stops suggests that multiple boardings by individual riders account for a high percentage of total ridership, as previously discussed.

Lake McDonald Valley Route	On		Off	
		%		%
<i>Outbound:</i>				
Apgar Transportation Center	9,443	61.6	163	11.1
Sprague Creek Campground	311	2.0	76	0.1
Lake McDonald Lodge	2,135	13.9	882	6.0
Avalanche Creek	1,449	9.5	1,654	11.3
The Loop	1,833	12.0	435	3.0
Logan Pass	160	10.4	11,378	78.0
<i>Total Outbound</i>	<i>15,331</i>	<i>100</i>	<i>14,588</i>	<i>100</i>
<i>Inbound:</i>				
Logan Pass	9,212	69.3	261	2.0
The Loop	786	5.9	389	2.9
Avalanche Creek	1,546	11.6	1,563	11.8
Lake McDonald Lodge	1,443	10.9	2,529	19.2
Sprague Creek Campground	86	0.6	418	31.7
Apgar Transportation Center	225	1.7	8,041	60.9
<i>Total Inbound</i>	<i>13,298</i>	<i>100</i>	<i>13,201</i>	<i>100</i>

[†] Average private vehicle occupancy of 2.4 passengers.

[†] Total boardings for sample provided to Volpe Center.

St. Mary Valley Route				
St. Mary Visitor Center	4,836	53.2	0	0
Rising Sun	1,862	20.5	449	5.3
Sun Rift Gorge	375	4.1	312	3.7
Sun Rift Gorge	698	7.7	287	3.4
St. Mary Falls	703	7.7	467	5.5
Gunsight	304	3.3	307	3.6
Siyeh Bend	157	1.7	664	7.8
Logan Pass	157	1.7	6042	70.80
Total Outbound	9,092	1	8,528	1
Logan Pass	5,975	77.5	146	17.6
Siyeh Bend	212	2.7	230	2.8
Gunsight	139	1.8	370	4.5
St. Mary Falls	538	7.0	489	5.9
Sun Rift Gorge	277	3.6	303	3.7
Sun Point	198	2.6	377	4.6
Rising Sun	369	4.8	1,797	21.7
St. Mary Visitor Center	4	0.0	4,564	55.1
Total Inbound	7,712	100	8,276	100

St. Mary Valley boardings are just under 60 percent of boardings on the Lake McDonald Valley Route. Approximately 53 percent of outbound boardings occurred at the St. Mary Visitor Center and 20 percent occurred at Rising Sun. Sun Rift Gorge and St. Mary Falls each accounted for eight percent of outbound boardings, while Gunsight contributed three percent. In the inbound direction, Logan Pass accounted for 78 percent of boardings and all the other stops each accounted for seven percent or less.

Daily and Seasonal Distribution of Ridership

The data provided to the Volpe Center show significant variation from day to day in terms of the distribution of shuttle boardings by time of day. A sample of three days' data for the Lake McDonald Valley Route and two days' data for the St. Mary Valley Route are graphed in Figures 2 and 3 below. Unsurprisingly, the busiest time period generally was the middle of the day, broadly defined as extending from 11:00 AM through 5:00 PM, although there was a significant mid-day dip in ridership on the Lake McDonald Valley Route, which occurred from 1:00 to 2:00 PM on two of the three days for which data are presented. Maximum hourly boardings ranged from 150 to about 200 on the Lake McDonald Route and 90 to 120 on the St. Mary Valley Route.

Figure 2

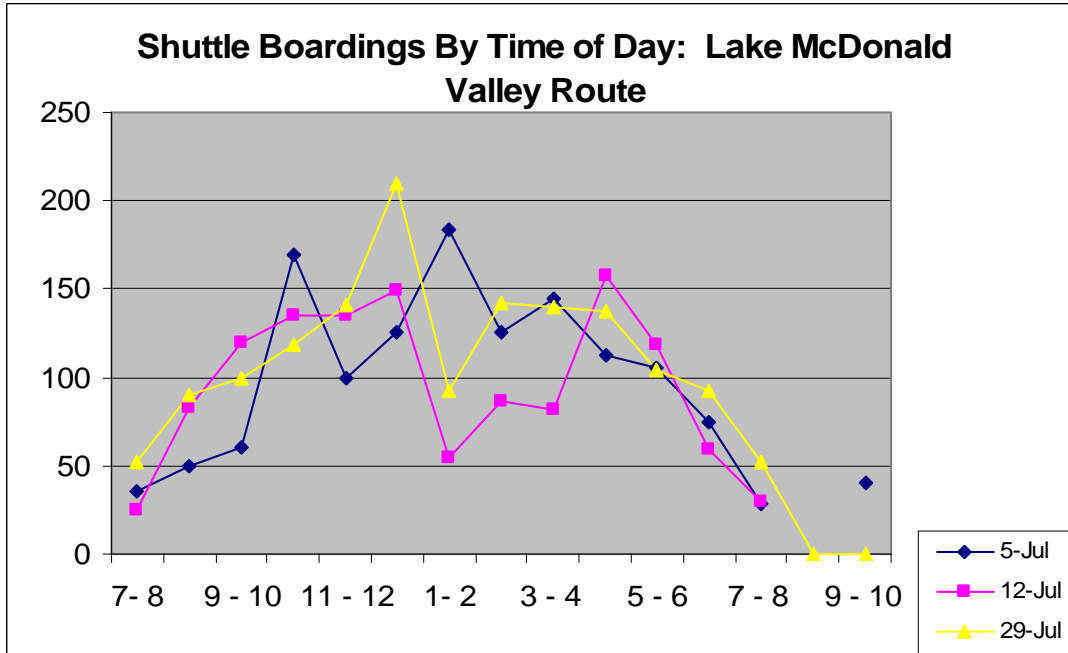
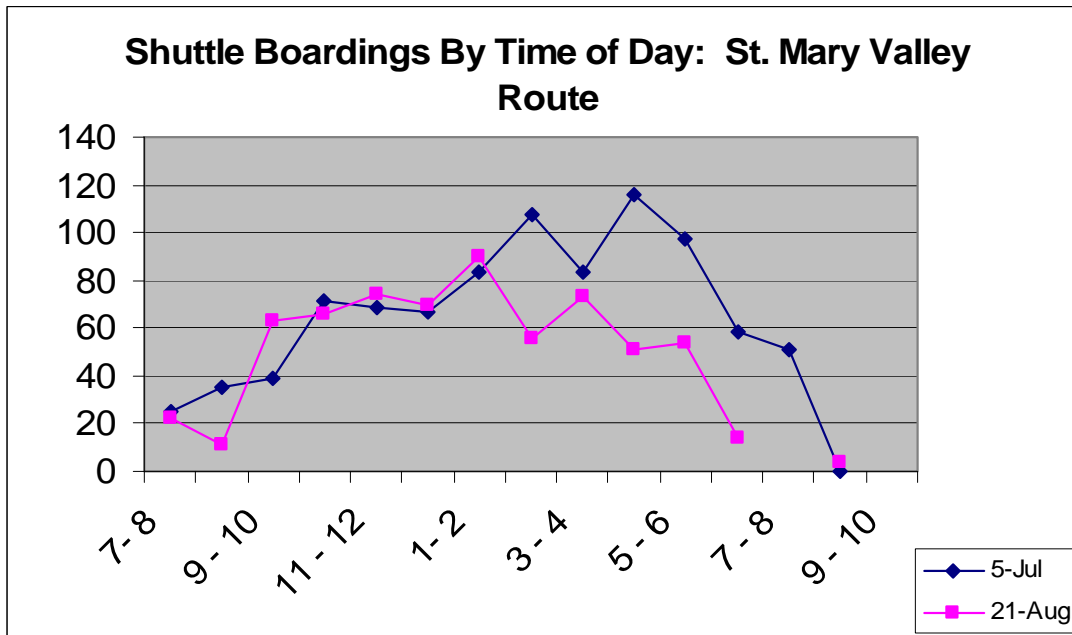
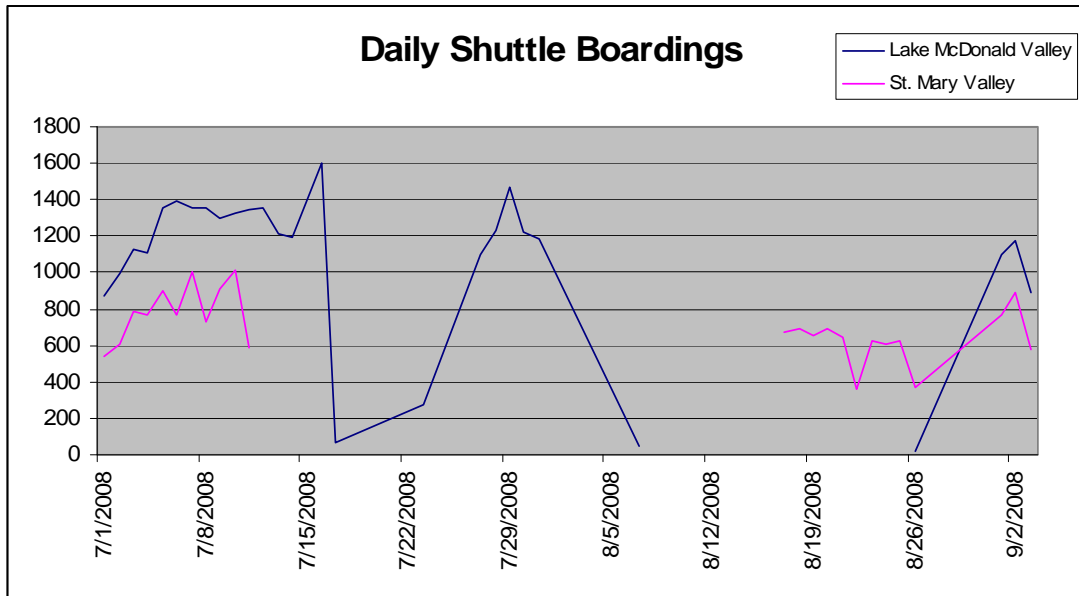


Figure 3



The pattern of daily boardings over the 2007 season for both the Lake McDonald Valley and St. Mary Valley Routes (Figure 4) shows that ridership generally was higher earlier in the season, when combined boardings (including multiple rides by individual visitors) were about 2,300 daily. While only limited reliable data are available for both routes after July 11, it appears that typical combined boardings on both route were about 1,700 daily for the remainder of the season.

Figure 4



Traffic

Only a limited sample of count data is available as a basis for determining the possible impact of the shuttle on traffic conditions. The Glacier NP Transportation Scholar compiled traffic counts taken on July 27 through August 10, 2007 for several locations on the GTSR and compared them to count data for the same or similar locations for the period from July 21 through August 1, 2005. While recorded 2007 daily traffic volumes were 23 percent higher at West Glacier eastbound (inbound) and four percent higher at West Glacier westbound (outbound) on the Lake McDonald Valley Route, and 11 percent higher at St. Mary westbound (inbound) on the St. Mary Valley Route, the number of vehicles was lower at the other locations sampled: Logan West in both directions on the Lake McDonald Valley Route, Siyeh Bend in both directions on the St. Mary Valley Route, and St. Mary eastbound on the St. Mary Valley Route. Table 2 shows the comparison of 2005 and 2007 traffic counts.

The reported increase in vehicular traffic at the West Glacier and St. Mary park entrances is greater than the growth in visitation between 2005 and 2007 of 12 percent at West Glacier and 7 percent at St. Mary, as reported in *Public Use Statistics*. The reliability of the vehicle counts data is questionable, however, due to a several factors:

- Low number of days for which data were collected;
- Even lower number of days that are the same for both 2005 and 2007—only six days (7/27 through 8/1);
- Lack of data for 2006;
- Questionable reliability of automatic vehicle counters (pneumatic tubes) used for data collection;
- Inbound and outbound traffic flows are significantly out of balance, with many more vehicles entering than leaving the park. This is particularly true of the West Glacier entrance. It is unlikely that diversions to other exit points explain this degree of imbalance.

Due to these deficiencies in the count data, particularly the last of the above factors, the NPS *Public Use* statistics, which show that visitation increased five percent between 2005 and 2007, may provide a more accurate measure of changes in the number of vehicles entering the park over the

shuttle bus season. A five percent increase in the number of vehicles entering the park at West Glacier and St. Mary between 2005 and 2007 would raise traffic volumes at those locations to 3,952 and 1,865 respectively, corresponding to an incremental increase of 188 and 89 vehicles. The net reduction in traffic at the intermediate locations where traffic counts were taken, due to diversion of visitors to the shuttle bus, would then be 220 to 280 vehicles on the Lake McDonald Valley Route and 120 to 190 on the St. Mary Valley Route.

The ridership analysis discussed earlier in Section 6 can serve as a check on the count and *Public Use* data. The estimated reduction in daily traffic based on reported shuttle ridership data is 210 vehicles on the Lake McDonald Valley Route and 125 vehicles on the St. Mary Route. Both of these figures are close to or within the ranges estimated above and therefore provide greater confidence in both sets of estimates.

Assuming that the distribution of vehicles over the course of the day is similar to the shuttle bus ridership boarding pattern, with most traffic spread over the period from 11:00 AM to 5:00 PM, peak hourly traffic would be about 15 percent of the daily total, or 225 vehicles in each direction on the Alpine section of the Lake McDonald Valley Route and over 100 vehicles in each direction at Siyeh Bend on the St. Mary Valley Route. The reduction in peak hour vehicles would be about 40 vehicles in each direction on the Lake McDonald Valley Route and 15-20 vehicles in each direction at Siyeh Bend.

In a situation where traffic capacity is highly constrained, as with the closing of the only available lane in one direction for periods of times in construction work zones with traffic flow alternating by direction in the single remaining open lane, there are likely to be noticeable positive benefits of this level of traffic reduction. While Glacier NP did not systematically record traffic delays or travel times, delays of about 10 minutes at individual locations, with cumulative delays up to about 20 minutes, appeared to be common during the Volpe Center site visit. Better traffic counts and travel time/delay measurements, as specified in the *Evaluation Plan* prepared by the Volpe Center, would be needed to quantify the impact of the shuttle bus service on traffic conditions.

Table 2. Traffic Counts at Selected Locations on GTSR

	West Glacier		Logan West		Logan East		Siyeh Bend		Rising Sun		St. Mary	
	West	East	West	East	West	East	West	East	West	East	West	East
2005 (7/21 - 8/1)	3763	2928	1590	1628	-	-	1479*	1385*	-	-	1776	1090
2007 (7/27 - 8/10)	4643	3045	1498	1598	1402	1318	1389	1357	1590	1504	1678	1212
2005 - 2007	880	117	-92	-30	-	-	-90	-28	-	-	-98	122
Change	23%	4%	-6%	-2%	-	-	-6%	-2%	-	-	-6%	11%

*2005 count taken at Lunch Creek

Parking

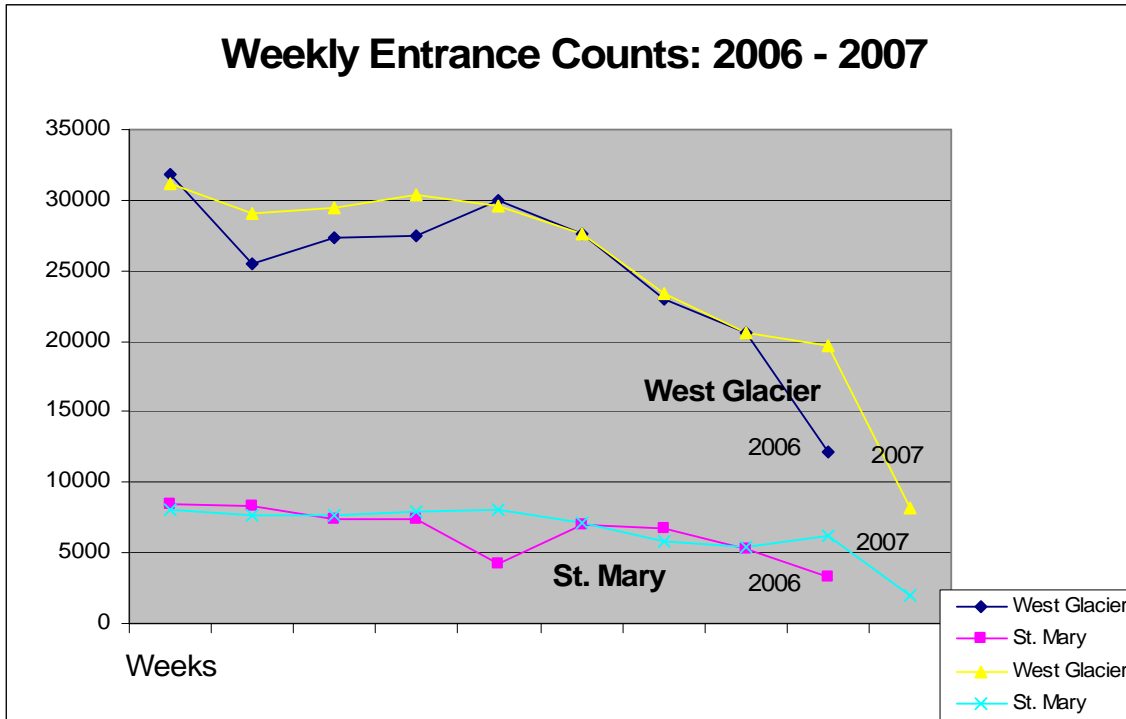
While Glacier NP did not collect parking data that could be used in this evaluation, the ridership and related traffic analysis provides some insights into the impact of the shuttle on parking. Traffic volume reductions have been estimated to be 220-280 vehicles per day on the Lake McDonald Valley Route and 120-190 on the St. Mary Valley Route, in each direction. These vehicles were parked at the Apgar Transportation Center and St. Mary Visitor Center, respectively, and most otherwise would have been parked at Logan Pass for one to several hours. In the peak hour, the reduction in parking at Logan Pass is likely to have been upwards of 50 vehicles, or slightly less than 15 percent of the daily total of vehicles removed from the GTSR. Since some of the vehicles which otherwise would have arrived at Logan Pass earlier in the day would have been parked for several hours, the reduction in vehicles parked at Logan Pass could have ranged up to 100 vehicles during the period of peak parking accumulation.

Visitation

The number of vehicles entering Glacier NP at the western and eastern entrances leading to the GTSR increased by 11 percent between 2006 and 2007 over the entire shuttle season, according to counts taken at West Glacier and St. Mary (see Figure 5 below). West Glacier entrance counts increased by 10.5 percent and the number of vehicles entering the park at St. Mary increased by 13.1 percent. This compares to the ROD requirement that visitation not be allowed to decline by more than six percent. Thus, this set of data indicate that the requirement was not only met, but exceeded, assuming that the number of visitors per vehicle did not decrease.

According to the *Public Use* statistics on the NPS website, visitation increased by only three percent during July and August between 2006 and 2007. While visitors entering the park at other locations are reflected in the *Public Use* statistics, it is unlikely that these additional visitors would affect the data sufficiently to account for the approximately eight percent difference between the *Public Use* statistics and the vehicle counts. Both sets of data indicate that Glacier NP exceeded the visitation requirement stipulated in the ROD.

Figure 5



Visitor Experience

University of Montana researchers have conducted a visitor survey of attitudes toward the shuttle service in the 2007 season.⁷ The authors have identified the purposes of their research effort as follows:

- “Understand visitor choices regarding shuttle use
- “Understand visitor evaluations of shuttle system
- “Gather feedback on shuttle system from various constituencies.”

Key findings relevant to impacts on the visitor experience are summarized below:

- Information from Internet, Personal Communication, printed material, and other sources generally was rated favorably.
- System performance was rated as good or excellent in terms of “timeliness, frequency, consistency, the condition of vehicles, design of shuttle stops, and demeanor of drivers.”
- Chief among the complaints were “long waits, lack of/inaccurate information, shuttle stop design, limited coverage, and driver behavior.” Thus, some of the complaints conflicted with high ratings for attributes such as timeliness, quality of information, and driver behavior.
- The most frequent suggestions for improvement concerned shelters and benches, the need for clearly designated queuing areas at shuttle stops, more capacity, shorter headways, and expanded service.

⁷ Melissa Baker and Wayne Freimund, Department of Society and Conservation, University of Montana, Going to the Sun Road Shuttle System: First-year Preliminary Assessment.

The researchers concluded that the reactions to the service were positive and that complaints could be resolved. These findings are consistent with the analysis in other sections of this evaluation, particularly in identifying capacity and wait times as problems despite the generally positive impact of the system in providing a desirable option for transportation along the GTSR for many visitors.

Financial Viability

The 22 *Sprinters* and 9 *Optima* buses were purchased in partnership through a cooperative agreement between the NPS, using an Alternative Transportation in the Parks and Public Lands (ATPPL) grant, and the Montana Department of Transportation (MDT). The total cost for the vehicles was \$4.0 million, of which the ATPPL provided \$2.1 million and MDT contributed \$1.9 million.

Operating cost for the service totaled \$835,539 in 2007. Drivers' salaries accounted for \$563,230, or nearly 70 percent of the total operating cost. The next-highest components of costs were \$125,000 for supervisory and maintenance personnel, accounting for 15 percent of total operating cost, followed by approximately \$63,000 for fuel and lubrication. Operating costs were funded from a transportation fee included as part of the visitor entrance fee. Financial data provided by Glacier NP show a small operating surplus of about \$15,000 for the 2007 season. Volpe has prepared a financial proforma for the 2007 season based on this data.

¹ Capital expenses are limited to vehicle costs and do not include Apgar Transit Center and other fixed facilities.

Measures of Productivity and Cost-Effectiveness

The productivity and cost-effectiveness measures presented below provide information that can be used to assess the benefits of the shuttle service objectively, in terms of whether the associated investment represents a sound allocation of park financial resources and a good value for park visitors:

- *Operating and Maintenance (O & M) Cost Per Vehicle Hour: \$64.60*
- *O & M Cost Per Vehicle Mile: \$2.94*
- *Net O & M Cost Per Vehicle Hour: \$63.38*
- *Net O & M Cost Per Vehicle Mile: \$2.88*
- *Total (Annualized) Cost Per Vehicle Hour: \$96.51*
- *Total (Annualized) Cost Per Vehicle Mile: \$4.39*
- *Passengers/Vehicle Hour*
 - *Apgar Route: 4.11*
 - *Lake McDonald Valley Route: 3.43*
 - *St. Mary Valley Route: 7.09*
- *Passengers/Vehicle Mile*
 - *Apgar Route: 3.43*
 - *Lake McDonald Valley Route: 0.15*
 - *St. Mary Valley Route: 0.34*
- *Passenger Trips/Vehicle Hour*
 - *Apgar Route: 7.7*
 - *Lake McDonald Route: 7.3*
 - *St. Mary Valley Route: 15.9*
- *Passenger Trips/Vehicle Mile*
 - *Apgar Route: 6.4*
 - *Lake McDonald Valley Route: 0.3*
 - *St. Mary Valley Route: 0.8*
- *O & M Cost Per Passenger: \$15.20*
- *Net O & M Cost Per Passenger: \$14.91*
- *Total (Annualized) Cost Per Passenger: \$22.71*

The O & M costs per hour are in the range typical for small bus systems. *Net* operating and maintenance costs reflect a reduction in cost equivalent to the small net surplus (\$15,497) in revenues collected relative to total system operating costs for the season (\$820,092). When the annualized capital costs of the vehicles (calculated as 10 percent of total vehicle purchase price) are included, total costs per hour increase to \$96.51. This last calculation is based on the assumption that the vehicles are only used for the Glacier NP shuttle service and are otherwise idle. If the vehicles are used during the off-season by Flathead County Eagle Transit for local or regional passenger service, the capital costs per mile would decrease on a short-term basis, although the service life of the vehicles also would decline.

The long distances traveled, particularly on the Lake McDonald Valley Route, result in relatively low costs per mile, although they also result in relatively low productivity, measured in terms of passengers per hour and per mile. On the Lake McDonald Valley Route, for example, it is estimated there was on average only 3.4 individual passengers per vehicle hour and the estimated number of passengers per mile is only 0.15. These low figures are, to a significant extent, the inevitable consequence of the long distance and travel times for the route and the low capacity of the 12-passenger vehicles. The low productivity translates into high costs per passenger: over all three routes,[†] O & M costs average \$15.20 per passenger and total costs per passenger (including capital

[†] Annualized costs include vehicle capital costs allocated over 10-year vehicle service life.

[†] Data not available to calculate costs for individual routes.

costs) average \$22.71, again assuming that the vehicles are not used in other services during the off-season.

If the number of *passenger trips* or boardings is considered as the measure of service benefit, instead of the number of individual passengers, productivity improves by about 100 percent. The number of passenger trips per hour is estimated to be 7.3 on the Lake McDonald Valley Route, 15.9 on the St. Mary Valley Route, and 7.7 on the Apgar Route. O & M costs per passenger trip for all three routes are estimated to be \$7.05.

Summary and Key Findings

The shuttle bus system operated in the 2007 season as a mitigation measure for reconstruction and rehabilitation of the GTSR was in service on three routes for a total of 65 days, extending from July 1 through September 3. The longest of the routes, which also operated on the most frequent headways and attracted the greatest ridership, was the Lake McDonald Valley Route, extending 30 miles from the Apgar Transit Center near the West Glacier park entrance to Logan Pass. The other principal route served passengers entering the park from the east at St. Mary and traveling to Logan Pass, a distance of 17 ³/₄ miles, and several destinations in-between. A summary of evaluation observations and findings is presented below by topic.

System Performance

Travel Times and Schedule Reliability

Travel times averaged 78 minutes on the Lake McDonald Valley Route, with an average deviation of 13 minutes, and 52 minutes, with an average deviation of only 3 minutes, on the St. Mary Valley Route. Thus, travel times were actually shorter, on average, than the official schedule of 1 ¹/₂ hours for the Lake McDonald Valley Route and 1 hour for the St. Mary Valley Route, although the deviation in travel times was significant on the Lake McDonald Valley Route. In contrast, the St. Mary Valley Route service kept very close to the scheduled travel time of one hour.

Travel time variability on the Lake McDonald Valley Route was of sufficient magnitude to contribute to disruptions in schedule, because deviations were typically close to the scheduled headways, initially 15 minutes. (Scheduled headways were reduced to 12 minutes midseason, in an attempt to reduce the number of passengers waiting for long periods of time at shuttle stops). Adherence to scheduled arrival times at the Apgar Transit Center, Logan Pass, and other stops was erratic. Variability in travel times, however, does not fully account for the high incidence of irregular headways.

Capacity

Capacity was markedly constrained in peak travel periods on the Lake McDonald Valley Route, due to the small capacity of the *Sprinter* vans in service and practical limitations on the ability to operate enough vehicles to meet demand on a regular schedule. Specifically, the long route distance and difficult operating conditions resulted in long cycle times for vehicles and a high degree of variability in travel times, noted above, creating the need for a large vehicle fleet and producing irregular headways. In combination with the small capacity of individual vehicles, the net result was significant difficulty in meeting peak hour demand for service, with riders often having to wait for long periods of time at a number of the stops on the route.

These problems are largely inherent to the operating conditions on the Alpine section of the GTSR, chief of which is the limited width—and thus relatively low capacity—of the vehicles that can be deployed on the narrow roadway. In response to the problems caused by capacity constraints, a large number of vehicles were operated on the Lake McDonald Valley Route, resulting in reduced

productivity and cost-effectiveness.

Capacity problems were largely confined, however, to particular hours of operation. Throughout much of the day, there was adequate or excess capacity available on the Lake McDonald Route. Capacity on the St. Mary Valley and Apgar Routes met or exceeded demand most of the time.

Design and Operational Issues

Design

The location of the Apgar Transit Center approximately ½ mile from Apgar Village represents a significant disadvantage from the standpoint of attracting riders, although this concern is offset as a practical matter by system capacity constraints that limit the numbers of riders that can be accommodated below current peak period demand levels. Moreover, the challenge posed by the separation of the Apgar Transit Center and Apgar Village can be addressed to a degree through signage and informational media. The Apgar Visitor Center did not showcase informational materials promoting the shuttle this past season, however, and signage at both Apgar Village and the entrance to the Apgar Transit Center was not highly visible or descriptive. It is recommended that improved signage and information dissemination be considered in planning for the 2008 season.

Operational Issues

Operations in the first season were significantly impaired by persistent breakdowns and other reliability problems affecting the *Sprinter* vehicles. These problems contributed to the difficulty of maintaining regular headways and the consequent frequent occurrence of passengers waiting at shuttle stops for extended periods of time, ranging up to an hour or longer. Another serious problem was the lack of a dedicated radio channel that could be used reliably by drivers and dispatcher to communicate breakdowns, accumulations of waiting passengers, and other problems affecting service. It is recommended that addressing these operational issues be accorded high priority in ht 2008 season.

Ridership

Average daily *boardings*, based on data collected for fewer than half the number of days the shuttle was operated, are estimated as follows for the three shuttle bus routes:

- Apgar Route: 56.3 (23 days)
- Lake McDonald Valley Route: 1061.7 (27 days)
- St. Mary Valley Route: 672.2 (25 days)

The highest boardings on the Lake McDonald Valley Route were at the Apgar Transportation Center inbound (62 percent) and Logan Pass outbound (69 percent). On the St. Mary Valley Route, approximately 53 percent of outbound boardings occurred at the St. Mary Visitor Center, while Logan Pass accounted for 78 percent of inbound boardings. Boarding tabulations reflect the total number of times passengers entered a shuttle bus, without regard to the number of individual passengers represented. Therefore, a single passenger may be recorded multiple times, which was frequently the case and the number of boardings does not translate directly into the number of visitors diverted from cars. Volpe has prepared estimates of individual riders using the shuttle bus service, based on analysis of the likely frequency of multiple boardings, as indicated by boarding counts at intermediate stops. The resulting ridership estimates are as follows:

- Lake McDonald Valley Route: 500
- St. Mary Valley Route: 300
- Apgar Route: 30

Thus, the total adjusted average daily ridership on all routes combined is estimated to be approximately 830 passengers. These figures compare to the following pre-implementation estimates of ridership prepared in planning the shuttle service:

- West Entrance (served by Apgar Transit Center): 330-1,238
- East Entrance (served by St. Mary Visitor Center): 148 -553

These pre-implementation projections represented 2 – 7.5% of automobile person-trips (i.e. individual riders) at the entrances indicated. The estimates of actual 2007 ridership calculated for this evaluation are at the lower end of the 330-1,238 range projected for the Lake McDonald Valley Route and in the middle of the 148-553 range projected for the St. Mary Valley Route. Ridership was highest early in the season and appeared to decrease after the first few weeks, on the basis of limited data available after the first few weeks of July.

Traffic and Parking

The estimated daily reduction in vehicular traffic volumes due to shuttle operation is approximately 225 vehicles in each direction on the Alpine section of the Lake McDonald Valley Route and about 100 vehicles in each direction on the St. Mary Valley Route. The reduction in peak hour traffic volume would be about 40 vehicles in each direction on the Lake McDonald Valley Route and 15-20 vehicles per direction on the St. Mary Valley Route. Due to the severely limited capacity of roadways in construction zones on the GTSR, these reductions in traffic could be expected to have discernible positive benefits on traffic conditions. It is estimated that the shuttle reduced parking requirements at Logan Pass by upwards of 50 spaces during peak visitation hours.

Visitation

According to NPS *Public Use* statistics, July and August visitation at Glacier NP increased by three percent between 2006 and 2007. Vehicle counts taken at the western and eastern entrances leading to the GTSR increased by 11 percent from 2006 to 2007 throughout the shuttle season (approximately July and August). While there is a substantial difference between these two sets of data, both are consistent in indicating sizeable increases in visitation. In comparison, the ROD stipulated that visitation should not be reduced by more than 6 percent. Thus the ROD requirement was exceeded decisively.

Financial Viability

Operating and maintenance costs for the 2007 season were covered by revenues from transportation fees incorporated in the park entrance fees charged to all visitors. This result suggests that the service is financially viable, subject to the condition that sources are available from outside Glacier NP to fund capital costs; looking to the future, this would include re-capitalization costs. A summary of major cost and revenue data follows:

- Operating and maintenance costs for 2007 season: \$820,092
- Capital costs – 22 Daimler-Chrysler *Sprinters*; 20 *Optima* buses: \$4.0 million..
- Operating revenue (from transportation fees): \$835,600
- Capital funding: ATTPL - \$2.1 million; MDOT (FTA Section 5311) - \$1.9 million
- Operating balance: \$15,500 surplus

Productivity and Cost-Effectiveness

Measures of unit costs, particularly operating and maintenance costs per hour, indicate that costs were contained to a moderate level, typical for small bus systems—and lower than a number of other bus systems operated in NPS units—*relative to output, in terms of the amount of service provided*. The long route distances and, in the case of the Lake McDonald Valley Route, the low-

capacity vehicles in service, resulted, however, in relatively low productivity, measured in terms of passengers per hour or mile of service. Consequently, costs per passenger were relatively high, although not necessarily excessive compared to bus services provided at other National Parks. When costs are considered relative to the number of passenger *trips* (i.e. boardings), rather than individual passengers served, productivity doubles. Key estimated productivity statistics are:

- O & M Cost Per Vehicle Hour: \$63.38
- O & M Cost Per Vehicle Mile: \$2.88
- Passengers Per Vehicle Hour
 - Apgar Route: 4.1
 - Lake McDonald Valley Route: 3.4
 - St. Mary Valley Route: 7.1
- O & M Cost Per Passenger: \$15.20
- O & M Cost Per Passenger Trip: \$7.05

These statistics may be of value in determining whether future expenditures on continued shuttle bus operations are justified on a long-term basis, relative to alternative investments. It may be possible to improve productivity to some degree if the *Sprinters'* reliability problems can be solved and headways can be maintained on a more regular basis on the Lake McDonald Valley Route, to accommodate passengers with fewer vehicles in service. On a short-term basis over the next several years, the service appears to be affordable with existing revenues, as reflected in the small operating surplus for 2007. Particularly during GTSR construction, the modest positive impact on traffic conditions discussed above represents a tangible benefit, which could be further quantified in the 2008 operating season with more rigorous data collection focused on traffic operations.