

Maryland Roundabout Safety Experience

As of September 2001, Maryland has more than 25 modern roundabouts in operation at State maintained intersections. The tables below show before and after accident data for Maryland's eight roundabouts that have been in operation long enough to obtain good after period accident data (for those built between April 1993 and December 1998). Accident data used is from the Maryland Automated Accident Reporting System (MAARS) database.

Maryland's first eight roundabouts were all small to moderate size (inscribed circle diameter of 150' or less), with one circular lane and single-lane entry. Each roundabout replaced stop signs or intersection control beacons previously controlling the intersections.

Since conversion to roundabouts, the average annual accidents for the eight intersections fell from an average of 4.98 accidents/year in the before period, to an average of 1.8 accidents/year in the after period, a 64% reduction. Accident severity also decreased, as injury accidents have shown a reduction from an annual average of 3.0 injury accidents in the before period to an annual average of 0.5 injury accidents in the after period, a reduction of 83%. Each intersection shows a reduction in both total reported accidents and injury accidents. These results are shown in the tables below:

***MD 94 @ MD 144-A Lisbon Roundabout
Howard County***

<u>1/1/90 to 4/11/93</u>		<u>4/12/93 to 12/31/00</u>	
Average Annual Accidents (Before)	7.3	Average Annual Accidents (After)	1.9
Annual Average Injury Accidents (Before)	4.3	Annual Average Injury Accidents (After)	0.4
Accident Rate / MVE (Before)	2.1	Accident Rate / MVE (After)	0.5
Injury Accident Rate / MVE (Before)	1.2	Injury Accident Rate / MVE (After)	0.11
Million Vehicle Entering = 11,180,590		Million Vehicles Entering = 28,211,226	

***MD 58 @ MD 63 - Cearfoss
Washington County***

<u>1/1/93 to 12/15/95</u>		<u>12/16/95 to 12/31/00</u>	
Average Annual Accidents (Before)	2.6	Average Annual Accidents (After)	0.8
Annual Average Injury Accidents (Before)	0.67	Annual Average Injury Accidents (After)	0.2
Accident Rate / MVE (Before)	0.84	Accident Rate / MVE (After)	0.3
Injury Accident Rate / MVE (Before)	0.2	Injury Accident Rate / MVE (After)	0.07
Million Vehicle Entering = 9,552,415		Million Vehicles Entering = 14797100	

MD 213 @ Leeds Rd. / Elk Mill Rd
Cecil County

<u>1/1/93 to 8/1/95</u>		<u>8/2/95 to 12/31/00</u>	
Average Annual Accidents (Before)	3.9	Average Annual Accidents (After)	2.03
Annual Average Injury Accidents (Before)	3.1	Annual Average Injury Accidents (After)	0.18
Accident Rate / MVE (Before)	2.9	Accident Rate / MVE (After)	1.2
Injury Accident Rate / MVE (Before)	2.3	Injury Accident Rate / MVE (After)	0.1
Million Vehicles Entering = 3,477,048		Million Vehicles Entering = 9,429,352	

MD 2 @ MD 408 / MD 422 - Lothian
Anne Arundel County

<u>1/1/93 to 10/24/95</u>		<u>10/25/95 to 12/31/00</u>	
Average Annual Accidents (Before)	8.2	Average Annual Accidents (After)	4.8
Annual Average Injury Accidents (Before)	5.3	Annual Average Injury Accidents (After)	1.5
Accident Rate / MVE (Before)	1.05	Accident Rate / MVE (After)	0.74
Injury Accident Rate / MVE (Before)	0.69	Injury Accident Rate / MVE (After)	0.23
Million Vehicles Entering = 21,778,050		Million Vehicles Entering = 33,971,320	

MD 140 @ MD 832 - Taneytown
Carroll County

<u>1/1/93 to 8/18/96</u>		<u>8/18/96 to 12/31/00</u>	
Average Annual Accidents (Before)	4.9	Average Annual Accidents (After)	1.4
Annual Average Injury Accidents (Before)	2.7	Annual Average Injury Accidents (After)	0.7
Accident Rate / MVE (Before)	0.98	Accident Rate / MVE (After)	0.25
Injury Accident Rate / MVE (Before)	0.54	Injury Accident Rate / MVE (After)	0.13
Million Vehicles Entering = 18,353,200		Million Vehicles Entering = 23,659,760	

MD 307 @ MD 313 / MD 318 - Federalsburg
Caroline County

<u>1/1/96 to 12/31/98</u>		<u>1/1/99 to 12/31/00</u>	
Average Annual Accidents (Before)	4	Average Annual Accidents (After)	1
Annual Average Injury Accidents (Before)	2.7	Annual Average Injury Accidents (After)	0.5
Accident Rate / MVE (Before)	1.17	Accident Rate / MVE (After)	0.27
Injury Accident Rate / MVE (Before)	0.78	Injury Accident Rate / MVE (After)	0.13
Million Vehicles Entering = 10,265,625		Million Vehicles Entering = 7,260,534	

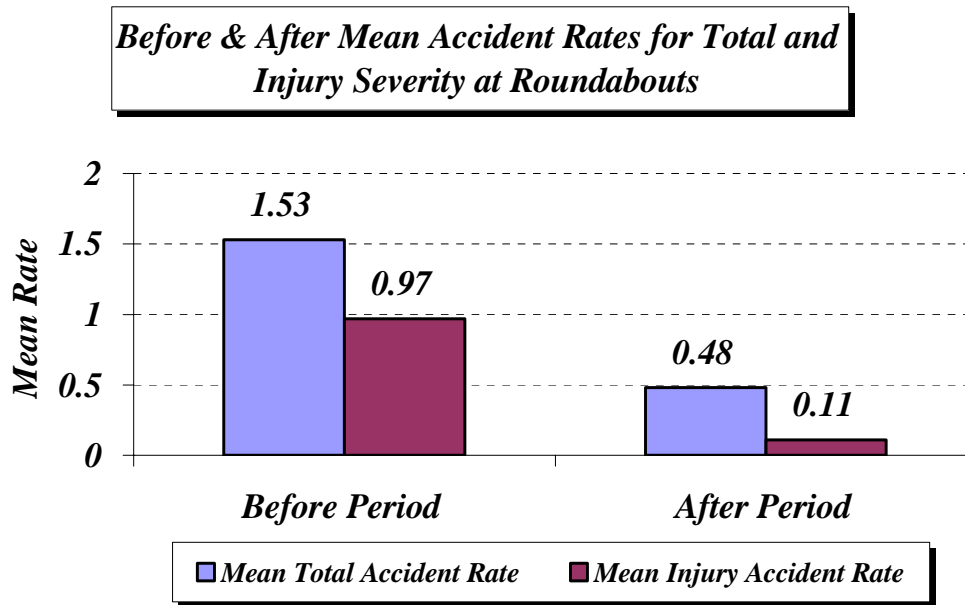
MD 94 @ Old Frederick Road
Howard County

<u>1/1/96 to 12/31/98</u>		<u>1/1/99 to 12/31/00</u>	
Average Annual Accidents (Before)	5.33	Average Annual Accidents (After)	1
Annual Average Injury Accidents (Before)	4	Annual Average Injury Accidents (After)	0
Accident Rate / MVE (Before)	2.32	Accident Rate / MVE (After)	0.30
Injury Accident Rate / MVE (Before)	1.74	Injury Accident Rate / MVE (After)	0
Million Vehicles Entering = 6,890,552		Million Vehicles Entering = 6,620,370	

**MD 372 @ Hilltop Road - UMBC
Baltimore County**

1/1/96 to 12/31/98		1/1/99 to 12/31/00	
Average Annual Accidents (Before)	3.6	Average Annual Accidents (After)	1.5
Annual Average Injury Accidents (Before)	1.3	Annual Average Injury Accidents (After)	0.5
Accident Rate / MVE (Before)	0.84	Accident Rate / MVE (After)	0.3
Injury Accident Rate / MVE (Before)	0.30	Injury Accident Rate / MVE (After)	0.1
Million Vehicles Entering = 13,140,000		Million Vehicles Entering = 9,572,490	

Using Donald A. Morin application of statistical concepts to accident data (Morin Lower Control Limit Test) indicate that both total and injury accident reductions are significant reductions at a 95% confidence interval. Total and injury accident rates in the following graph and table are per million vehicles entering (MVE). The mean **total** accident rate for the roundabouts in the **before** period was 1.53 reported accidents/MVE. The mean **total** accident rate in the **after** period was 0.48 accidents/MVE. The mean **injury** rate in the **before** period was 0.97 accidents/MVE. The **after** period mean **injury** rate was 0.11 accidents/MVE.



Total Mean Rate		Injury Mean Rate	
Before Period	1.53 acc/MVE	Before Period	0.97 acc/MVE
After Period	0.48 acc/MVE	After Period	0.11 acc/MVE

In addition to the eight (8) roundabouts mentioned above, nine (9) other single lane roundabouts were opened to traffic in late 1998 and 1999. Although not enough time has elapsed in order to derive any statistically

significant accident data for the after period of these roundabouts, below is their before/after accident history.

Locations where no Before period exists

MD 100 @ MD 103 Interchange
(2 Separate Single Lane Roundabouts)
Howard County

This is a new interchange along MD 100 at MD 103 that opened to traffic in late November 1998. Since these intersections are new there is no before period accident data to report. The inscribed circle diameter of both of these roundabouts is 120'. **Since opening there has been one police reported accident at Meadow Ridge Road (north roundabout) and none at the south roundabout from January 1, 1999 to December 31, 2000.**

MD 100 @ Snowden River Parkway
(1 Single Lane Roundabout)
Howard County

This is a new interchange along MD 100 at Snowden River Parkway that opened to traffic in late November 1998. Since this intersection is new, there is no before period accident data to report. Below are the police reported accidents that have occurred since the opening of the roundabout. The inscribed circle diameter of this roundabout is 100'.

<u>Collision Type</u>	<u>1-1-99 to 12-31-00</u>
Rear End	2
Injury	0
Property Damage	2

MD 7 @ Holly Oaks Drive
(1 Single Lane Roundabout)
Harford County

This is a new roundabout opened to traffic in September 1999. Since this is a new location there is no before period accident data to report. Since September of 1999, there have been 4 accidents at this location. The inscribed circle diameter of this roundabout is 120'.

<u>Collision Type</u>	<u>7-99 to 12-31-00</u>
Rear End	1
Fixed Object	1
Other	2
Injury	2
Property Damage	2

Locations having less than 2-year After Data

MD 291 @ US 301 Interchange

(2 Separate Single Lane Roundabouts)

Kent County

These are new roundabouts that opened to traffic in August 1999 as part of a new interchange project. Since the improvement is actually an interchange with roundabouts providing access to and from the ramps, the accident frequencies may be somewhat misleading. The inscribed circle diameter for both roundabouts is 110'. **Since September 1, 1999, there have been no reported accidents.**

<u>Collision Type</u>	1-1-95 to 12-31-98	9-1-99 to 12-31-00
	Before	After
Angle	24	0
Rear end	1	0
Opposite Direction	1	0
Fixed Object	1	0
Overturn	1	0
Injury	16	0
Property Damage	12	0

MD 139 @ Bellona Avenue

(1 Single Lane Roundabout)

Baltimore County

This roundabout opened to traffic in May of 1999. The inscribed circle diameter of the roundabout is 85' with the central island being fully mountable. Since July 1, 1999, there have been no reported accidents.

<u>Collision Type</u>	1-1-96 to 12-31-98	7-1-99 to 12-31-00
	Before	After
Angle	1	0
Rear End	4	0
Injury	2	0
Property Damage	3	0

MD 17 @ B Street / A Street / Maryland Avenue

(1 single lane roundabout)

Frederick County

This roundabout opened to traffic in January of 2000. The inscribed circle diameter is 150'. Currently, there is only 1-year after data.

Collision Type	1-1-96 to 12-31-98	1-1-00 to 12-31-00
	Before	After
Angle	1	0
Injury	1	0
Property Damage	0	0

MD 18A @ MD 18H (Castle Marina Road)

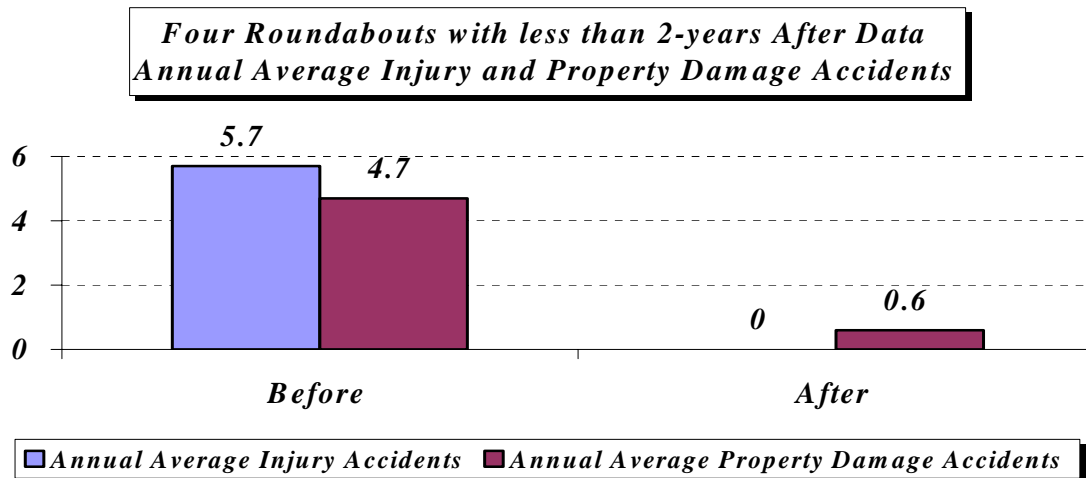
(1 single lane roundabout)

Queen Annes County

This single lane roundabout opened to traffic in December 1999. The inscribed circle diameter is 110'. Currently, we have 1 ½ years after data only.

Collision Type	1-1-97 to 10-31-99	7-1-99 to 12-31-00
	Before	After
Angle	2	1
Sideswipe	2	0
Injury	2	0
Property Damage	2	1

The graph below indicates the annual average injury and property damage accidents at the above 4 roundabouts for which we have before data and less than 2-years after data.



Two Lane Roundabouts

Maryland has also constructed three 2-lane roundabouts: MD 45 @ MD 146 /Joppa Road (Towson Roundabout) in Baltimore County, MD 450 @ Taylor Avenue/Spa Road in Anne Arundel County and MD 100 @ MD 104 in Howard County.

MD 45 @ MD 146 / Joppa Road (Towson Roundabout)
 (2 Lane Roundabout)
Baltimore County

The Towson Roundabout was opened to traffic in October of 1998. The configuration of this roundabout is oval in design and has an inscribed circle diameter ranging from 140' to 260'. Prior to the construction of the roundabout, this intersection was controlled by two separate traffic signals. This roundabout is in a very urbanized area having five approach lanes. The average ADT for the 5-year before period of 1993 through 1997 was approximately 44,900 and it was 52,000 for the 2-year after period of 1999 and 2000.

<u>1/1/93 to 12/31/97</u>		<u>1/1/99 to 12/31/00</u>	
Average Annual Accidents (Before)	6.8	Average Annual Accidents (After)	16.5
Annual Average Injury Accidents (Before)	4.2	Annual Average Injury Accidents (After)	1.5
Accident Rate / MVE (Before)	0.41	Accident Rate / MVE (After)	0.87
Injury Accident Rate / MVE (Before)	0.26	Injury Accident Rate / MVE (After)	0.08
Million Vehicle Entering = 81,927,142		Million Vehicles Entering = 37,970,220	

Although the average annual accident rate in the after period resulted in an increase of 112%, injury accidents decreased by 64%. With the installation of the roundabout, the a.m. peak period improved from a Level of Service (LOS) B to LOS A, during the p.m. peak period went from a LOS E to LOS B. Furthermore, the roundabout resulted in a 70% delay reduction in the a.m. peak hour and a 58% delay reduction in the p.m. peak hour.

MD 450 @ Taylor Avenue/Spa Road (Annapolis Gateway)
 (2 Lane Roundabout)
Anne Arundel County

The MD 450 roundabout was opened to traffic in December of 1999. The inscribed circle diameter ranges from 168' to 188'. Currently we have only 1-year after data at this location. Our records indicated that this roundabout was under construction during 1998 and most of 1999.

<u>Collision Type</u>	<u>1-1-96 to 12-31-98</u>	<u>1-1-00 to 12-31-00</u>
	Before	After
Angle	1	0
Rear End	4	0
Left turn	1	0
Sideswipe	4	3
Pedestrian	1	0
Other Collision	1	0
Injury	5	1
Property Damage	7	2

MD 100 @ MD 104

(1 Two Lane Roundabout)

Howard County

This is a new interchange along MD 100 at MD 104 that opened to traffic in late November 1998. Since this location is new there is no before period accident data to report. Below are the police reported accidents that have occurred since the opening of the roundabout. The inscribed circle diameter of this roundabout is 150'.

<u>Collision Type</u>	<u>1-1-99 to 12-31-00</u>
Rear End	3
Sideswipe	1
Injury	1
Property Damage	3

As can be seen from the above accident data, the modern roundabout has in most cases had a great impact on the reduction of overall accidents at intersections where they have been constructed. The overall reduction for the 8 roundabouts, for which there is good after data resulted in a reduction of 63% of the total accidents. More importantly, the roundabouts have had a greater impact on the reduction of injury related accidents at 83% due to the reduction of conflict points and lower vehicle speeds.