New Parkway At-Grade Intersection (PAGI)

ITE Western District Annual Meeting
July 2013
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Tucson Metro Area
Population 990,000.

Map source: Google Maps
Existing Land Use and Parcel Boundaries
24-hour two-way traffic volumes, collected Wednesday, March 26, 2008.

2011 Turning Movement Volumes
AM (PM)

Valencia Road

EB Approach
894 (1,383)

647 (990)
227 (382)
20 (11)

655 (373)
501 (180)
26 (41)

NB Approach
646 (710)

WB Approach
1,182 (594)

Kolb Road

29 (16)
597 (560)
20 (134)

Total Vehicles
AM = 4,838
PM = 4,461

Source: Pima County Department of Transportation, May 5, 2011.

Numbers shown in red font represent critical movements at the intersection.
PM Photos

Eastbound

Southbound

Northbound
LEVEL OF SERVICE BY MOVEMENT

AM Performance Statistics
Total Delay (hr): 56.0
Delay/Vehicle (s/veh): 41.8
Total Stops: 3,305
Stops/Vehicle: 0.68
Total Vehicles: 4,821

PM Performance Statistics
Total Delay (hr): 93.0
Delay/Vehicle (s/veh): 75.7
Total Stops: 4,624
Stops/Vehicle: 1.05
Total Vehicles: 4,439

Existing Condition
2011 Volumes

Intersection LOS
AM = D
PM = (E)

Red Font = Critical LOS

120 sec. Cycle Length

Note: Level of Service (LOS) Shown AM (PM)
Project Background

- 2005 – 2008 Pima County contracts to study alternatives.
- June 2008 Traffic Study: By-pass option (new southern alignment) 6-lane arterial with grade separation needed for long-term improvement ($40M - $45M).
Project Background

• 2010 - County searches for additional funding for the project.
• Nov. 2010 PC advertises for DCR and Design Services – consultants must propose alternative that balances performance and cost using design traffic volumes provided.
• Feb. 2011 EPS awarded contract based on innovative design concept.
  – Several additional alternatives evaluated on southern alignment.
  – PAGI on existing (northern alignment) recommended.
  – $16M PAGI concept “works better, costs less” and provides long term improvement.
• 2012 PAG RTA takes over contract – asks for development of interim intersection improvement to reduce initial project cost.
PAGI Concept Development Started Here

MCDOT Parkway-Parkway Grade Separated Interchange (PGSI)
Source: Arizona Parkway Intersection/Interchange Operational Analysis and Design Concepts Study, August 2009, MCDOT.
Maximum Daily Entering Volume Threshold by Interchange Type
Including the PGSI

Design Year Traffic Volumes

**Design Volumes AM (PM)**

- **Valencia Road**
  - Design Volumes:
    - AM: 640 (750)
    - PM: 870 (880)
  - Total Volumes:
    - AM: 1,060 (1,010)
    - PM: 2,720 (1,580)

- **Kolb Road**
  - Design Volumes:
    - AM: 690 (1,010)
    - PM: 280 (860)
  - Total Volumes:
    - AM: 710 (930)
    - PM: 1,300 (2,930)

- **EB Approach**
  - 2,060 (3,900)
  - 1,300 (2,930)
  - 50 (40)

- **SB Approach**
  - 640 (750)
  - 870 (880)
  - 690 (1,010)

- **WB Approach**
  - 2,200 (2,640)
  - 1,150 (1,770)

**Total Vehicles**

- **Design Year**
  - AM: 9,870
  - PM: 11,340

- **2011**
  - AM: 4,838
  - PM: 4,461
PAGI Defining Characteristics

• Indirect left-turns
• 2-Phase traffic signals.
• Quadrant roadways (ramps) for high volume left-turn movements.
• On-ramp merge areas.
• No left-turn out for adjacent land development.
AM Performance Statistics
Total Delay (hr): 98.1
Delay/Vehicle (s/veh): 36.0
Total Stops: 8,048
Stops/Vehicle: 0.8
Total Vehicles: 9,813

PM Performance Statistics
Total Delay (hr): 141.5
Delay/Vehicle (s/veh): 45.2
Total Stops: 11,158
Stops/Vehicle: 1.0
Total Vehicles: 11,271

Note: Level of Service (LOS) Shown AM (PM)
Turning Movement Paths

- Existing and future land development
- Ramp placement
- Ramp geometry and acceleration lane length (design speed)
- Local access potential
- Existing access/access control impacts and turn restrictions
- Right-of-way impacts
- Pedestrian/bicycle accommodations

Note that right-turns will be allowed at the main intersection on all approaches for local access.

PAGI W/3-Ramps:
Recommended Ramp Locations Shown in Blue.
Potential Development Access Locations

Potentially relocate McCulloch Dr.

Restricted access through ramp taper.
Contract Amendment

• Compare the northern and southern alignment alternatives
  – Traffic Analysis and Cost Estimation
    • Northern Parkway At-Grade Intersection (PAGI)
    • Southern Conventional
    • Southern Continuous Flow Intersection (CFI)
    • Southern PAGI
    • Southern Grade Separated Diamond Traffic Interchange (DI)
  – Environmental Impact Analysis
AM Performance Statistics
Total Delay (hrs): 159.7
Delay/Vehicle (s/veh): 57.8
Total Stops: 10,821
Stops/Vehicle: 1.1
Total Vehicles: 9,943

PM Performance Statistics
Total Delay (hrs): 224.3
Delay/Vehicle (s/veh): 71.6
Total Stops: 14,212
Stops/Vehicle: 1.3
Total Vehicles: 11,278

Note: Level of Service (LOS)
Shown AM (PM)
** Minimal volume assumed for this movement in this alternative
Delay Per Vehicle Comparison By Alternative 2025 Design Volumes

Delay Per Vehicle (Sec/Veh)

AM

PM

LOS D

LOS E

LOS F

PAGI North

CFI South

PAGI South

DI South

Conventional South
Total Delay & Cost Comparison of Alternatives

Total Delay Comparison (AM + PM) By Alternative - 2025 Design Volumes

Incremental B/C < 0

Delay Ratio

- PAGI North
- CFI South
- PAGI South
- DI South
- Conventional South

$16.0M $23.7M $21.6M $32.4M $22.4M
PAG RTA Interim Improvement Traffic Analysis

• Goals and Objectives
  – Identify interim improvement based on existing traffic distribution:
    • Minimize cost.
    • Maximize use of existing roadway and right-of-way.
    • Provide improved traffic operations with residual capacity for traffic growth.
    • Improve traffic safety by reducing conflicts and crash potential.
    • Minimize “throw away” elements to upgrade to ultimate improvement.
  – Estimate traffic operations life span of interim improvement.
  – Address access needs for adjacent development while providing access management for improved safety and efficiency.

• Constraints
  – Valencia Road and Kolb Road will remain 4-lane divided roadways except for the improvements needed for the interim improvement.
Alternatives Analysis

1. Configuration of Alternatives Considered
   - 3-Ramp PAGI considered as base condition.
   - 2-Ramp PAGI w/dual southbound right-turn lanes (elimination of NW ramp).
   - 3-Ramp PAGI w/dual westbound right-turn lanes.

2. Traffic Volume Alternatives Considered
   - Existing traffic volumes (2011).
   - Existing traffic volumes + 50% growth (estimate of service life).

3. Enhanced Access alternatives
   - Location of SE ramp.
   - Access to NE quadrant w/egress option from NW development.
Comparison of Alternatives w/o/Access Alternative

Delay Per Vehicle Comparison

- **AM**
  - Existing Condition (2011 Vols)
  - 3-Ramp PAGI Base Condition (2011 Vols)
  - 2-Ramp PAGI w/2 SB RT Lanes (2011 Vols)
  - 3-Ramp PAGI Base Condition (2011 +50% Vols)
  - 3-Ramp PAGI w/2 WB RT Lanes (2011 +50% Vols)
  - 2-Ramp PAGI w/2 SB RT Lanes (2011 +50% Vols)

- **PM**
  - Existing Condition (2011 Vols)
  - 3-Ramp PAGI Base Condition (2011 Vols)
  - 2-Ramp PAGI w/2 SB RT Lanes (2011 Vols)
  - 3-Ramp PAGI Base Condition (2011 +50% Vols)
  - 3-Ramp PAGI w/2 WB RT Lanes (2011 +50% Vols)
  - 2-Ramp PAGI w/2 SB RT Lanes (2011 +50% Vols)
2-Ramp PAGI, Dual SB RT W/Access Alternatives
2011 Volumes +50% Growth

Intersection LOS
AM = D
PM = (D)
100 sec. Cycle Length

AM Performance Statistics
Total Delay (hr): 91.1
Delay/Veh (s/veh): 45.8
Total Stops: 6,509
Stops/Vehicle: 0.9
Total Vehicles: 7,153

PM Performance Statistics
Total Delay (hr): 92.6
Delay/Veh (s/veh): 50.2
Total Stops: 6,870
Stops/Vehicle: 1.0
Total Vehicles: 6,647

Note: Level of Service (LOS) Shown AM (PM)
* Indicates Site Traffic Included in Metric Estimates.
Delay Per Vehicle Comparison

- 2-Ramp PAGI w/2 SB RT Lanes (50% Growth)
- 2-Ramp PAGI, Dual SB RT Lanes W/Access Alt (50% Growth)
- 2-Ramp PAGI, Dual SB RT Lanes W/Access Alt (50% Growth+Site)
Conclusions

• The PAGI provides a low cost, high capacity alternative.
• The PAGI provides a flexible design alternative in conjunction with the use of indirect left-turns and 2-phase traffic signals.
  – Ramp placement/design can be tailored:
    ➢ Turn volume demand (ramps placed only where needed).
    ➢ Existing and proposed land development.
• Quadrant ramps can be designed for two-way traffic and access to adjacent development.
• 2-Phase signals provide greater flexibility in setting timing/phasing/offsets and coordination to address traffic demand needs.
• Consideration of ramp placement can allow conversion of main intersection to a grade-separation if needed, without relocation of ramp intersections.
Example of a Quadrant Intersection
Amherst Ave/Old Keene Mill Rd Springfield, VA
Contact Information

James Witkowski
EPS Group, Inc.
8710 N. Thornydale Rd., Suite 140
Tucson, AZ 85742
520-408-1400
James.Witkowski@epsgroupinc.com

Darrell Truitt
EPS Group, Inc.
2045 South Vineyard Ave, Suite 101
Mesa, AZ 85210
480-503-2250
Darrell.Truitt@epsgroupinc.com
Bike and Ped Treatment w/Right-lane Merge

Right-lane merge – bike lane and sidewalk configuration (urban design – not for use on limited access freeways). Image source: FHWA Course on Bicycle and Pedestrian Transportation – Lesson 19 Bicycle Lanes.
LEVEL OF SERVICE BY MOVEMENT

2-Ramp PAGI, Dual SB RT
W/Access Alternatives
2011 Volumes +50% Growth

Intersection LOS
AM = D
PM = (D)
100 sec. Cycle Length

**AM Performance Statistics**
- Total Delay (hr): 91.1 (93.5*)
- Delay/Veh (s/veh): 45.8 (46.6*)
- Total Stops: 6,509 (6,617*)
- Stops/Vehicle: 0.9 (0.9*)
- Total Vehicles: 7,153 (7,230*)

**PM Performance Statistics**
- Total Delay (hr): 92.6 (95.9*)
- Delay/Veh (s/veh): 50.2 (50.5*)
- Total Stops: 6,870 (7,173*)
- Stops/Vehicle: 1.0 (1.1*)
- Total Vehicles: 6,647 (6,830*)

Note: Level of Service (LOS) Shown AM (PM)
* Indicates Site Traffic Included in Metric Estimates.