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CALIFORNIA PATH PROGRAM
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**Final Report: Mobile Surveillance and
Wireless Communication Systems Field
Operational Test
Volume 3: Appendices A-J Containing
Evaluation Data Gathered During the Anaheim
Special Event and I-5 Tests
Lawrence A. Klein**

**California PATH Research Report
UCB-ITS-PRR-99-8**

This work was performed as part of the California PATH Program of the University of California, in cooperation with the State of California Business, Transportation, and Housing Agency, Department of Transportation; and the United States Department of Transportation, Federal Highway Administration.

The contents of this report reflect the views of the authors who are responsible for the facts and the accuracy of the data presented herein. The contents do not necessarily reflect the official views or policies of the State of California. This report does not constitute a standard, specification, or regulation.

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**Final Report: Mobile Surveillance and Wireless
Communication Systems Field Operational Test**

**Volume 3: Appendices A – J Containing Evaluation
Data Gathered During the Anaheim
Special Event and I-5 Tests**

**Prepared by:
Lawrence A. Klein, Ph.D.**

**Prepared for:
University of California at Irvine**

January 1999

Preface

The Mobile Surveillance and Wireless Communication Systems Field Operational Test (FOT) contained two evaluation tests, the Anaheim Special Event Test and the Interstate-5 (I-5) Test. The Anaheim Special Event Test assessed the ability of the surveillance trailers to transmit video imagery to a traffic management center in support of arterial traffic signal control. This test occurred during the Spring of 1997 in conjunction with heavy traffic experienced during hockey playoff games at the Arrowhead Pond in Anaheim, CA. The I-5 Test evaluated the ability of the mobile surveillance and ramp meter trailers to transmit video imagery and data in support of freeway ramp metering. It occurred a year later in Spring 1998 along I-5 in Orange County, CA. The results of these tests and other conclusions from the FOT are presented in three volumes. The first volume serves as the Executive Summary of the FOT. It describes the project objectives, results, conclusions, and recommendations in condensed fashion. The second volume discusses the overall goals and objectives of the FOT and the design of the mobile surveillance and wireless communication system in more detail. Technical and institutional issues that surfaced before either of the two FOT tests was conducted are described. The specific objectives of the Anaheim Special Event and the I-5 Tests, lessons learned, test results, and recommendations are expanded upon in this volume. Photographs and drawings are used liberally to illustrate the types of equipment and test configurations that were tested. Volume 2 also incorporates revisions to the evaluation plans that were originally prepared by Pacific Polytechnic Institute (PPI). The evaluation plans and preliminary results from the planning and design phases of the FOT and the Anaheim Special Event Test were originally published by California Partners for Advanced Transit and Highways (PATH) under Report 97-C34. The third volume consists of ten appendices that contain data and other information gathered during the tests.

The test planning and execution were a cooperative effort among the partner agencies and companies. These were the Federal Highway Administration, California Department of Transportation divisions in Sacramento and Orange County, California Partners for Advanced Transit and Highways, University of California at Irvine Institute of Transportation Studies, California Highway Patrol, City of Anaheim Department of Public Works, Hughes Aircraft Company (now Raytheon Systems Company), Pacific Polytechnic Institute, and Lawrence A. Klein, Consultant.

This report was prepared in cooperation with the State of California, Business Transportation and Housing Agency, Department of Transportation. The material is based on work supported by the Federal Highway Administration, the State of California, Department of Transportation under prime contract number RTA-65A0012, and the Regents of the University of California.

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Appendix A:
Written Statements from Members of Project Management Team

Appendix B:
Trailer Setup and Maintenance Procedures

Post Emplacement Checklist

A. Surveillance Trailer

1. Set all DC and AC circuit breakers in the trailer distribution units (gray boxes located on opposite ends of front inside of trailer) to ON except for the following:
At DC circuit breaker box:
 - Levelers OFF
 - Light OFFAt AC circuit breaker box:
 - Air Conditioner OFF
 - Outside Outlets OFF
 - Light OFF
2. Set all circuit breakers at DC and AC distribution panels on electronic cabinet 1 to ON.
3. Set Pullizi Intelligent Power Controller in electronic cabinet 1 to ON.
4. Set power strips at both electronic cabinets to ON.
5. Set Local/Remote switch at side of cabinet 2 in REMOTE position.
6. Set Auto Generator Start/Stop panel AUTO/MANUAL switch to AUTO.
7. Set Aries Processor (located behind Generator Start/Stop panel) to ON.
8. Unplug RS-232 connector (J3) of each camera control receiver/driver, except for surveillance camera (to prevent accidental movement of antenna and VIP cameras).
9. Set security system cell telephone module to ON (red push button located inside right security system box). Push-button light should be ON.
10. Open floor and roof fan vents (close and secure main roof hatch). Lock all trailer doors and set security system. If a Ramp Trailer is part of emplacement, set security system after completing Ramp Trailer check list below.

B. Ramp Trailer

1. Set all circuit breakers located in electronic cabinet to ON, with exception of the ALARM circuit breaker located on the Power Distribution Box.
Note: The ALARM circuit breaker no longer activates the trailer security system. The Ramp Trailer security is activated by having all other DC circuit breakers set to ON.
2. Set Auto Generator Start/Stop panel AUTO/MANUAL switch to AUTO.
3. Set Aries Processor (located behind Generator Start/Stop panel) to ON.
4. Set cabled Signal Head ON/OFF switch to ON and METER ON indicator switches to ON and AUTO TRAK.
5. If a remote signal head is used, then set its ON/OFF switch to ON and its radio to ON.

Surveillance Trailer Power Up Quick Reference

1. Ensure all circuit breakers and switches on the 120 VAC and +12 VDC panels located at electronic cabinet 1 are set to the OFF (down) position.
2. Ensure the AUTO/MANUAL switch on the Generator Auto Start/Stop Panel located at electronic cabinet 2 is set to MANUAL and the ARIES processor (located behind the panel) ON/OFF switch is set to OFF (down).
3. At trailer +12 VDC distribution box (gray box at side opposite to entry door), set the following circuit breakers to the ON (towards label) position in the order listed:

MAIN 12V, VENT FAN, ELECTRONIC DIST, LIGHTING, AUTO MAST

At the same +12 VDC distribution box, ensure the following are set to the OFF position:

STAB CONT
4. At trailer 120 VAC distribution box (gray box just to right of entry door), set the following circuit breakers to the ON (towards label) position in the order listed:

MAIN, GENERATOR, BAT CHARGER, AIR COMPRESSOR, 2 GFI DUPLEX (inside outlets), ELECTRONICS DIST, LIGHTING

At the same 120 VAC distribution box, ensure the following are set to the OFF position:

COMMERCIAL, AIR CONDITIONER, GFI RECEPTICAL (outside outlets)
5. Turn ON all circuit breakers and switches at both the +12 VDC and 120 VAC distribution panels located at electronic cabinet 1. Wait for the Wide Area Communications Controller (WACC) to boot up (approximately one minute). The single edge-mounted status indicator on each WACC circuit card will flash with a duty of cycle of approximately one second or less.
6. Ensure each power strip ON/OFF switch is set to the ON (up) position.
7. Set the Generator Auto Start/Stop Panel Aries Processor (located behind charge panel) ON/OFF switch to the 12 VDC ON (up) position. When the processor completes its boot up (less than five seconds), it will activate the generator off relay (relay closest to the processor) for 15 seconds. Observe light in relay when activated.
8. When the generator off relay is deactivated, set the Generator Auto Start/Stop Panel AUTO/MANUAL switch to the AUTO position.

Local Camera And Main Antenna Control Procedure

This procedure starts with the assumption that the surveillance trailer power up sequence is complete, the Generator Automatic Start/Stop Panel AUTO/MAN switch is set to AUTO, and the computer keyboard is connected to its wide area communications controller node.

1. At electronic cabinet 2, ensure that the REMOTE/LOCAL switch (located on the side of the cabinet and behind telephone jack) is set to the REMOTE position.
2. At the computer keyboard, set caps lock and type 8:A0 followed by return. This powers up the camera video and control systems and antenna movement control.
3. At the +12 VDC Distribution Panel located at electronic cabinet 1, set the RELAY BOARD switch to the OFF (down) position (allows local switching of cameras).
4. At electronic cabinet 2, set the REMOTE/LOCAL switch to the LOCAL position.
5. At electronic cabinet 2, ensure that the RS-232 cables are plugged into their respective camera control receiver/drivers.

At this point, the three mast mounted cameras and antenna can be controlled from the camera control keyboard.

6. Toggle the MON keyswitch until a 1 is displayed.
7. Select the unit to be controlled by entering its ID as shown in the table below. Then press the CAM keyswitch.

| Unit ID | Description |
|---------|---|
| xx | Surveillance Camera |
| 1xx | VIP camera 1 |
| 2xx | VIP camera 2 |
| 3xx | Security Camera (This camera is fixed in position and, therefore, does not have a receiver/driver.) |
| 4xx | Antenna |

xx is the last two digits of the surveillance trailer license number.

8. To view a particular camera's video on the NTSC monitor, ensure the monitor is ON and select the video via switches 1 (surveillance), 2 (VIP 1), and 3 (VIP 2) on the video switcher located in electronic cabinet 2 (on the right). Switch 4 selects the security camera.
9. When finished, set REMOTE/LOCAL switch to REMOTE, RELAY BOARD switch at electronic cabinet 1 to ON, disconnect RS-232 cables from the antenna and VIP camera receiver/drivers (to prevent inadvertent remote movement), and type 8:K followed by return at the computer keyboard.

Surveillance Trailer Camera Selection Procedure

Each of the surveillance trailers has four cameras that can be selected via the single camera control keyboards located at the City of Anaheim TMC and the Caltrans District 12 TMC. The control keyboard at Caltrans is in the room that contains the Front End Processor (FEP). The cameras that can be controlled are: one color surveillance camera containing a zoom lens on a pan and tilt mechanism, two black and white cameras with fixed field of view (without a zoom lens) on pan and tilt heads, one black and white security camera with a fixed field of view directed towards the trailer access door (not on a pan and tilt mechanism). The single NTSC output of the video decoder installed at the Anaheim TMC is interfaced to Channel 22 of the video matrix switch. Only one video can be viewed at any one time at the Anaheim TMC.

To select a video image from a camera, perform the following at the camera control keyboard:

1. Ensure that a 1 is displayed on the LED display. If not displayed, depress and release the MON keyswitch until a 1 is displayed.
2. Select a camera at a particular trailer by entering the camera identification number (ID) followed by pressing the CAM keyswitch. The ID for each color surveillance camera is the last two digits of the license plate of the trailer on which the camera is located. Thus, the surveillance camera ID numbers are 09, 10, 11, 13, 14, and 15. IDs for the remaining cameras consist of the trailer ID preceded by a 1 (for VIP camera 1), 2 (for VIP camera 2), or 3 (for security camera). The number 4 allows control of the antenna. The table below lists the camera IDs for trailers 09 and 11 as examples.

| Camera ID | Controlled Camera |
|-----------|--------------------------------------|
| 09 | Trailer 09 color surveillance camera |
| 109 | Trailer 09 VIP camera 1 |
| 209 | Trailer 09 VIP camera 2 |
| 309 | Trailer 09 security camera |
| 11 | Trailer 11 color surveillance camera |
| 111 | Trailer 11 VIP camera 1 |
| 211 | Trailer 11 VIP camera 2 |
| 311 | Trailer 11 security camera |

As an example of actual keyswitch procedure, Trailer 11's black and white VIP camera 1 is selected by pressing the 1 keyswitch three times, and then pressing the CAM keyswitch. It may take several seconds for the video to appear on the monitor at the TMC due to the trailer powerup sequence and the time required for acquisition of the video data by the video decoder.

3. **IMPORTANT:** When finished viewing the desired surveillance trailer CCTV, turn off the trailer by entering surveillance camera ID (09, 10, 11, 13, 14, or 15). Then press OFF on the keyboard. When trailer operations are completed for the day, perform this OFF procedure for all six surveillance trailers to ensure that no trailers are accidentally left on due to a remote command. This will prevent waist of trailer generator fuel.

Maintenance Check List

1. GENERATOR

Place the trailer in manual mode when performing the following procedures on the generator. The keys for the security system cabinet are located in the long shelf above work bench.

- Check generator oil level every 150 hours of generator run time. Place AUTO/MANUAL switch located at charge panel to MANUAL before working on generator.
- Check generator air filter bimonthly and after strong wind conditions.
- Change oil and oil filter per Onan Owner's Manual instructions.
- Change fuel filter per Onan Owner's Manual instructions.

2. COMPRESSOR

- Compressor is self lubricated. No lubrication maintenance required.
- Check and clean air filter pad.

3. BATTERIES

- Check main battery fluid level at least twice a month.
- Check secondary battery fluid level at least twice a month.
- Check specific gravity of all batteries at least twice a month.
- Check and clean battery terminals and battery compartment as required.

4. MAST

Clean and oil mast whenever retracted. Clean with alcohol applied with cloth. Lubricate with TMD Mast Lubricant, Will Burt P/N 600. A can was supplied for each mast.

5. MISCELLANEOUS

- Check LPG tank fuel level.
- Ensure tires have adequate pressure (especially just prior to trailer movement).
- Ensure axles are adequately lubed (especially prior to trailer movement).
- Clean inside of trailer after heavy winds.

Appendix C:
Trailer Transport Data Sheets for Anaheim Special Event Test

Appendix D:
Camera Operability Data Sheets for Anaheim Special Event Test

Appendix E:
Trailer Transport Data Sheets for I-5 Test

Appendix F:

Camera Operability Data Sheets for I-5 Test

Data sheets are ordered by: (1) north to south sequence of evaluation sites as Main Place, Grand Avenue, First Street, Tustin Ranch Road, Jamboree Road, Culver Drive and by (2) date data were acquired.

Appendix G:

VIP Believability Data Sheets for I-5 Test

Data sheets are ordered by: (1) north to south sequence of evaluation sites as Main Place, Grand Avenue, First Street, Tustin Ranch Road, Jamboree Road, Culver Drive and by (2) date data were acquired.

Appendix H:

Ramp Meter Operability Data Sheets for I-5 Test

Data sheets are ordered by: (1) north to south sequence of evaluation sites as Grand Avenue, Tustin Ranch Road, and Jamboree Road and by (2) date data were acquired.

Appendix I:

Surveillance Trailer Logs

Surveillance trailer logs are ordered by north to south sequence of evaluation sites as Main Place, Grand Avenue, First Street, Tustin Ranch Road, Jamboree Road, and Culver Drive.

Main Place Surveillance Trailer Logs

Grand Avenue Surveillance Trailer Logs

First Street Surveillance Trailer Logs

Tustin Ranch Road Surveillance Trailer Logs

Jamboree Road Surveillance Trailer Logs

Culver Drive Surveillance Trailer Logs

Appendix J:
**Quantitative Data Used to Evaluate Surveillance and Ramp Meter Trailer
Performance on the I-5 Freeway**

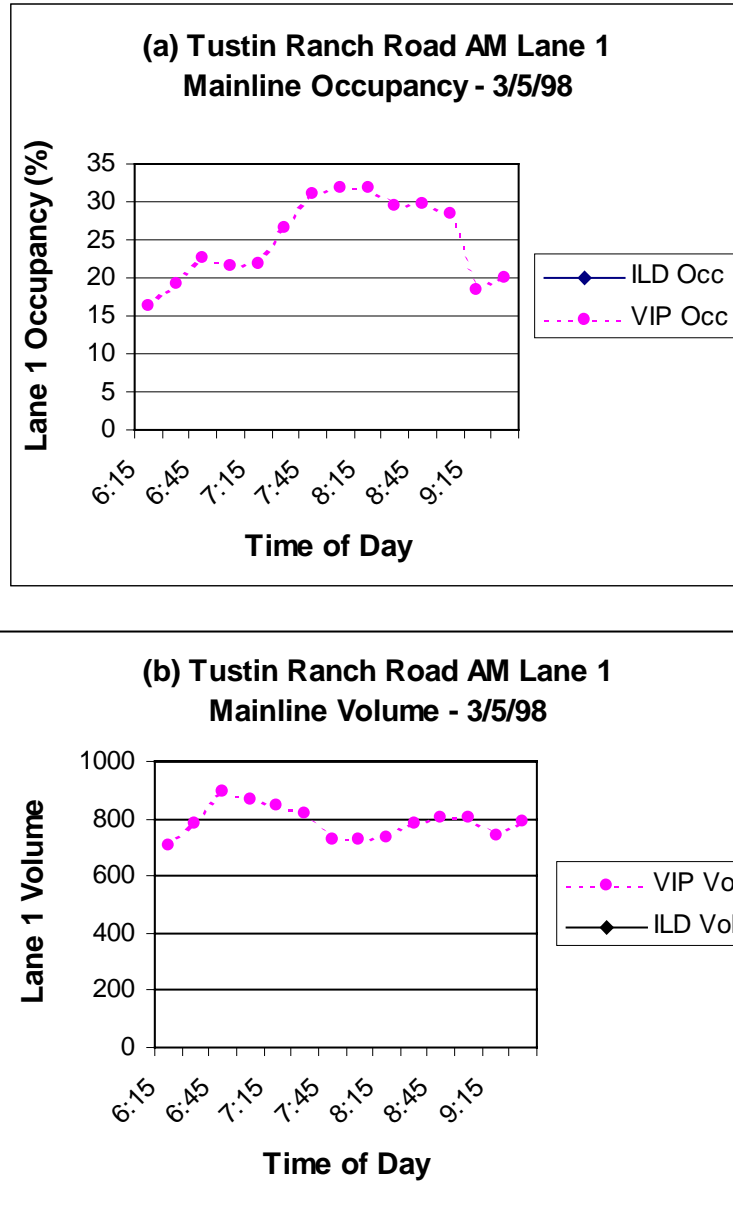


Figure J-1. Lane 1 (a) occupancy and (b) volume at the Tustin Ranch Road evaluation site during the morning rush-hour interval on 3/5/98

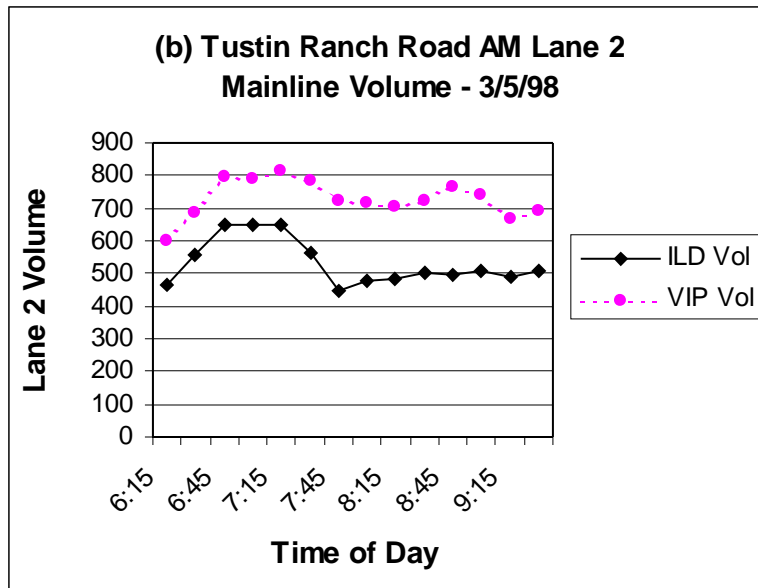
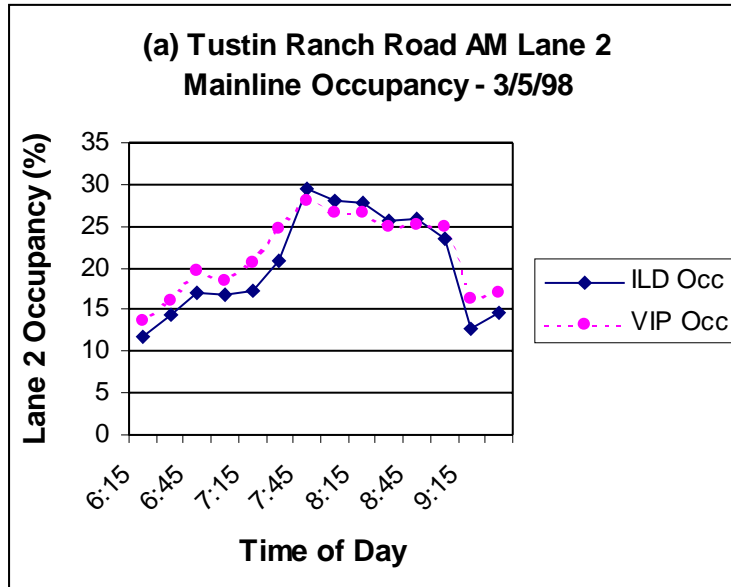


Figure J-2. Lane 2 (a) occupancy and (b) volume at the Tustin Ranch Road evaluation site during the morning rush-hour interval on 3/5/98

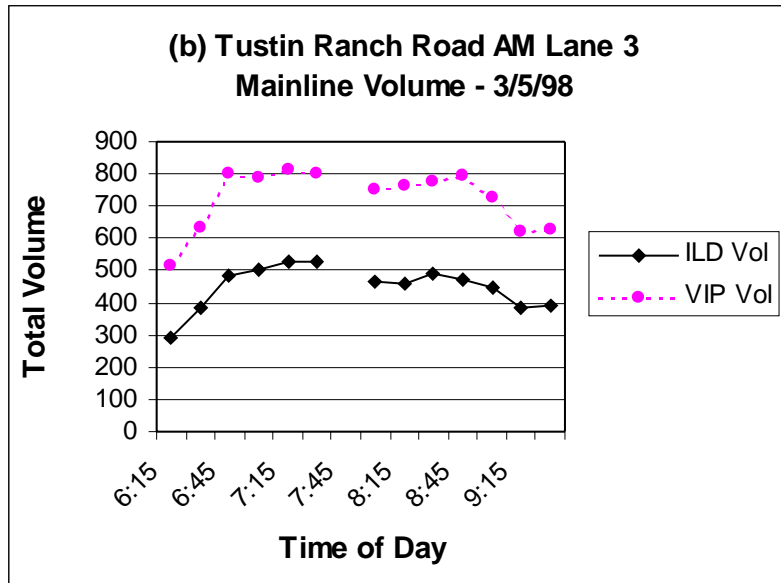
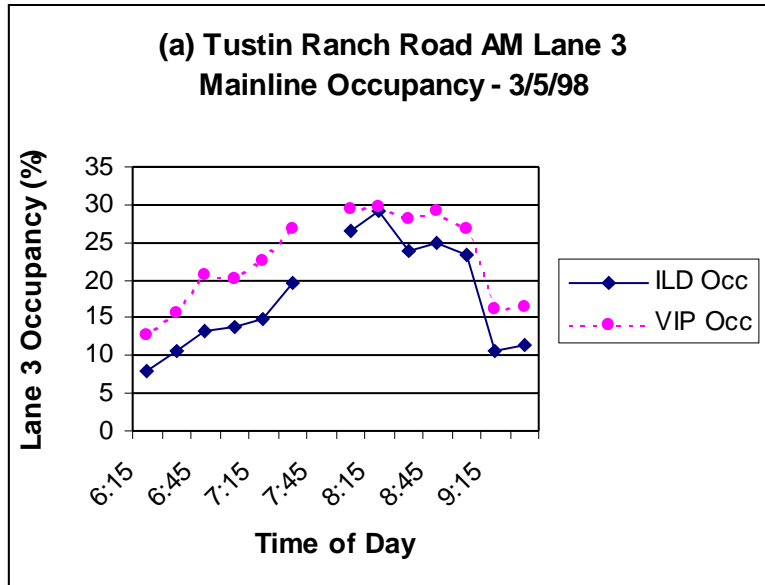


Figure J-3. Lane 3 (a) occupancy and (b) volume at the Tustin Ranch Road evaluation site during the morning rush-hour interval on 3/5/98

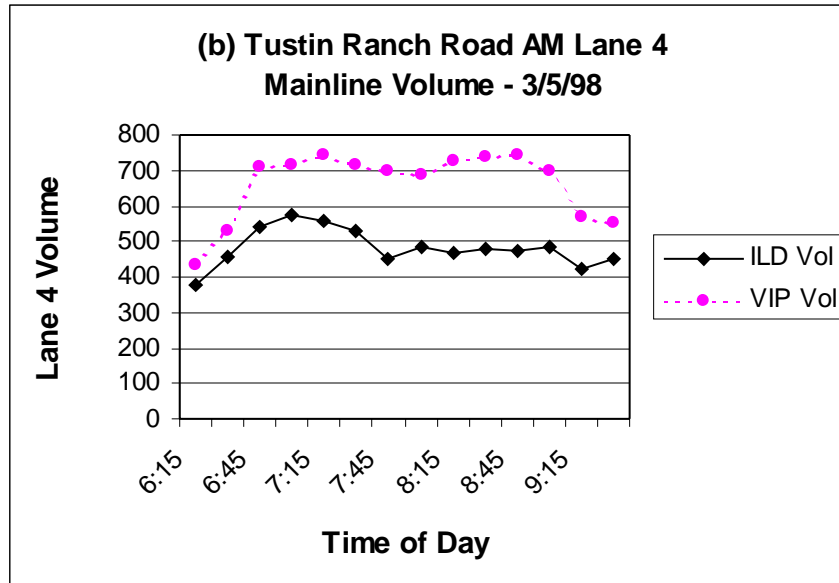
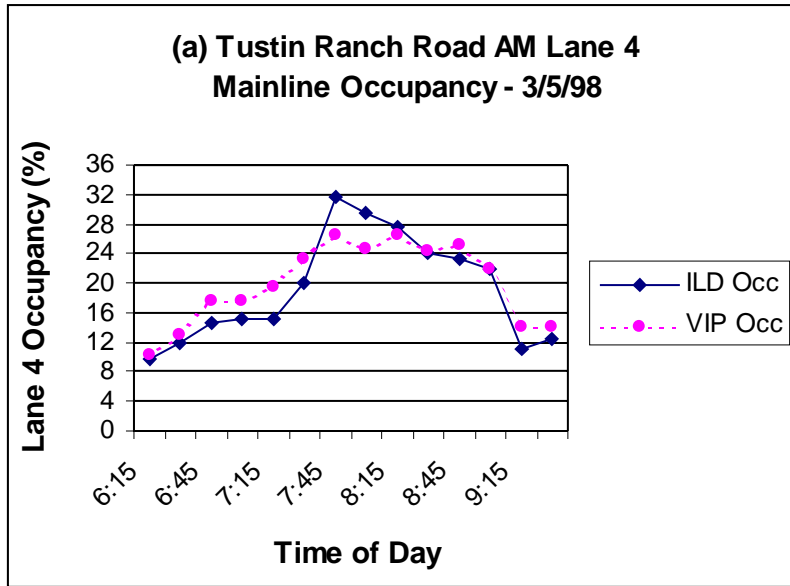


Figure J-4. Lane 4 (a) occupancy and (b) volume at the Tustin Ranch Road evaluation site during the morning rush-hour interval on 3/5/98

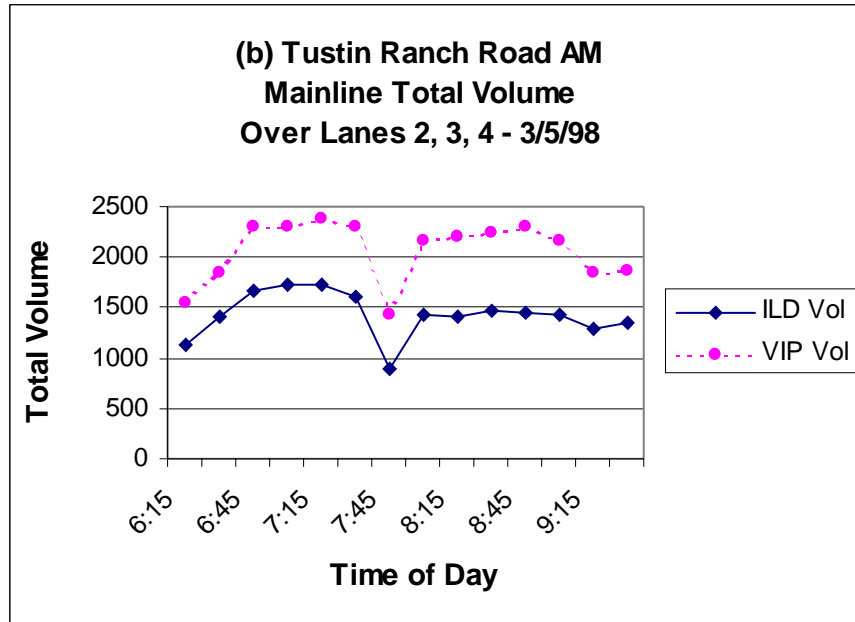
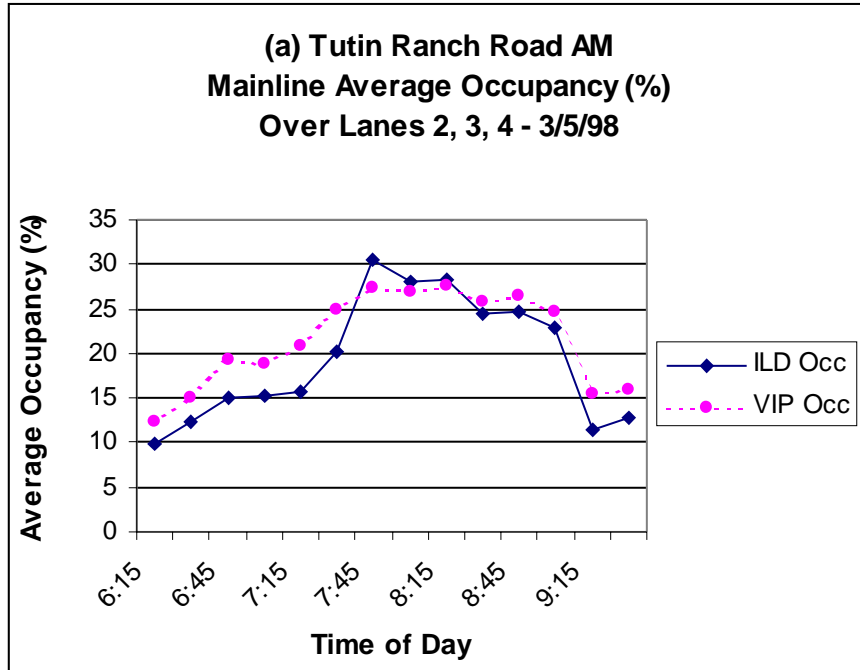


Figure J-5. Average lane (a) occupancy and total (b) volume measured by the ILDs and VIP over lanes 2, 3, and 4 at the Tustin Ranch Road evaluation site during the morning rush-hour interval on 3/5/98

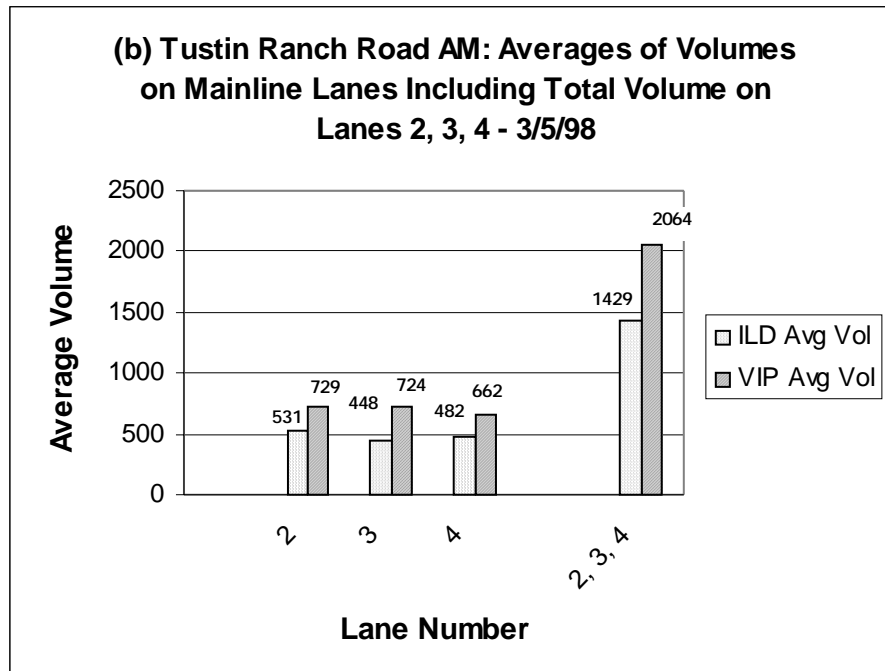
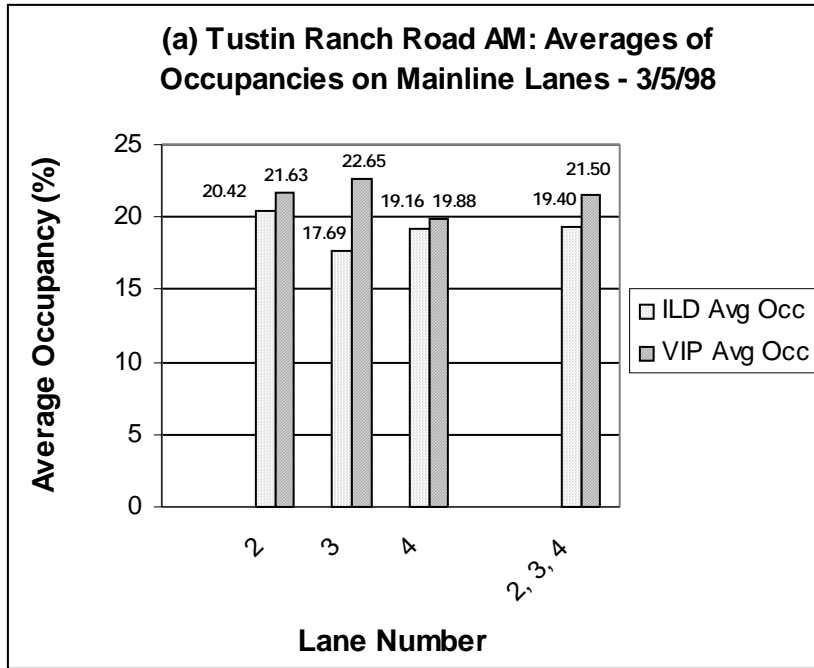


Figure J-6. Comparison of ILD and VIP lane-by-lane averages of (a) lane occupancy and (b) total volume at the Tustin Ranch Road evaluation site during the morning rush-hour interval on 3/5/98

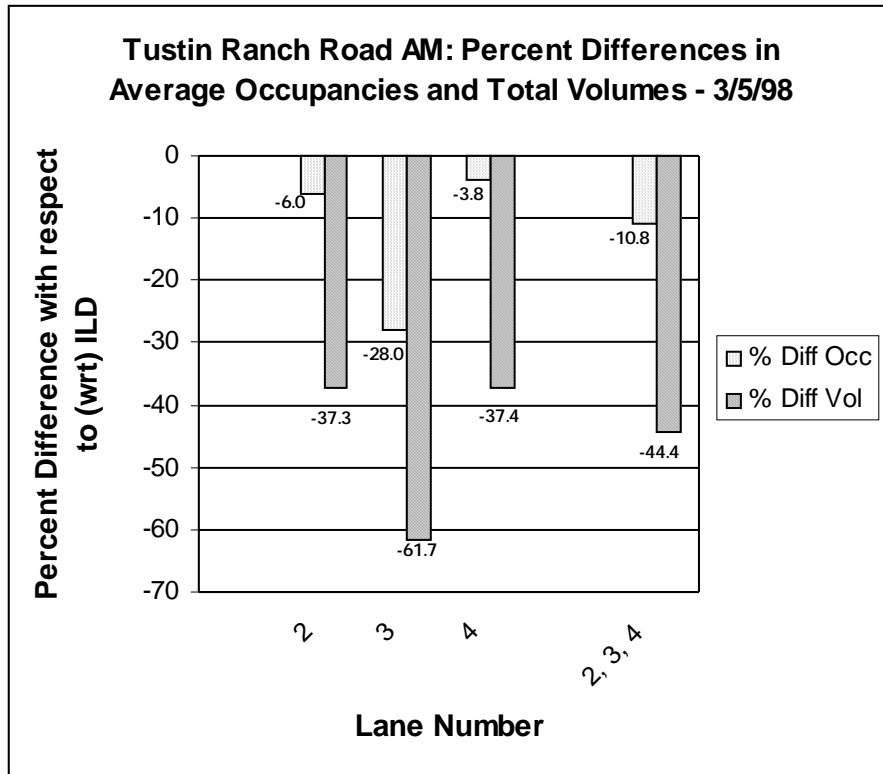


Figure J-7. Percent difference between the ILD and VIP averages of the average occupancy and total volume by lane at the Tustin Ranch Road evaluation site during the morning rush-hour interval on 3/5/98

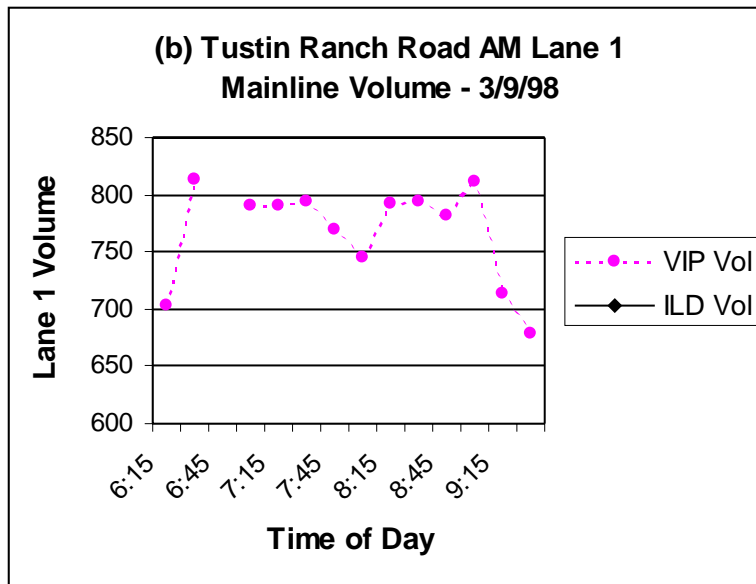
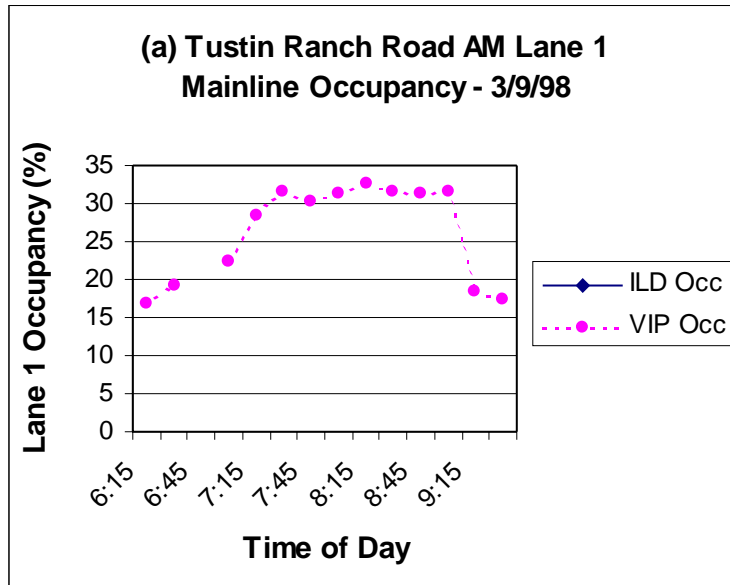


Figure J-8. Lane 1 (a) occupancy and (b) volume at the Tustin Ranch Road evaluation site during the morning rush-hour interval on 3/9/98

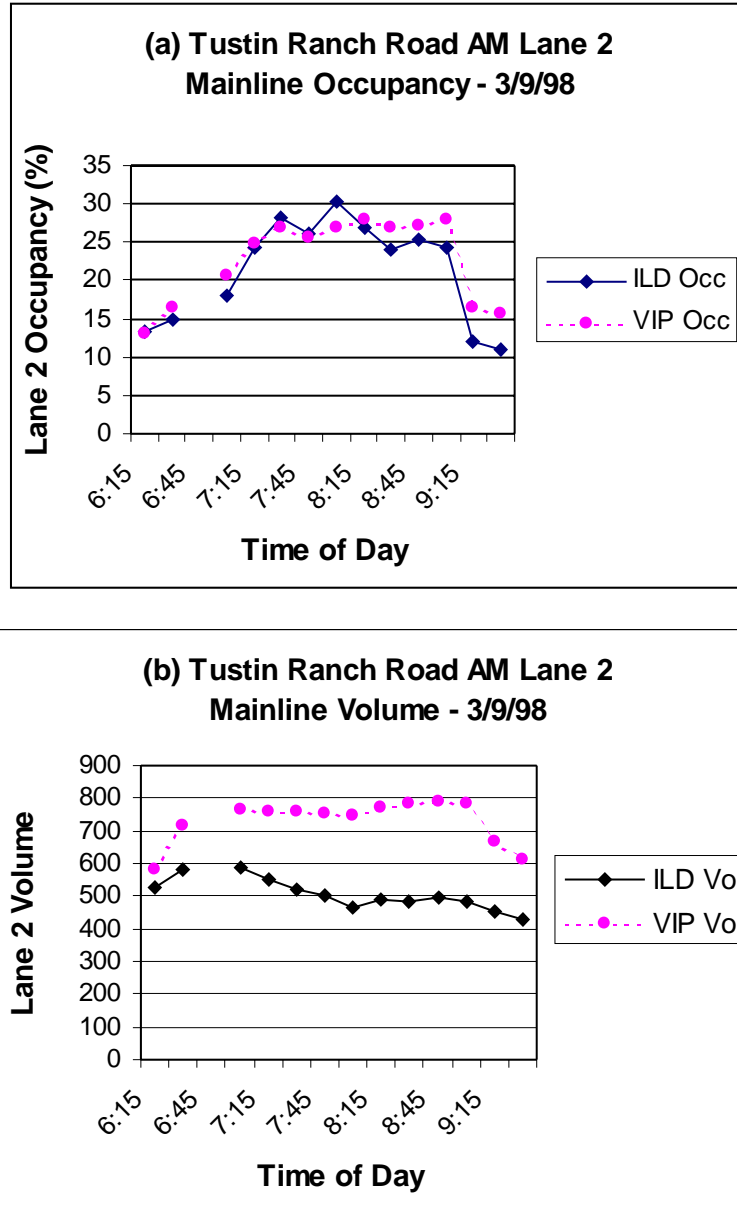


Figure J-9. Lane 2 (a) occupancy and (b) volume at the Tustin Ranch Road evaluation site during the morning rush-hour interval on 3/9/98

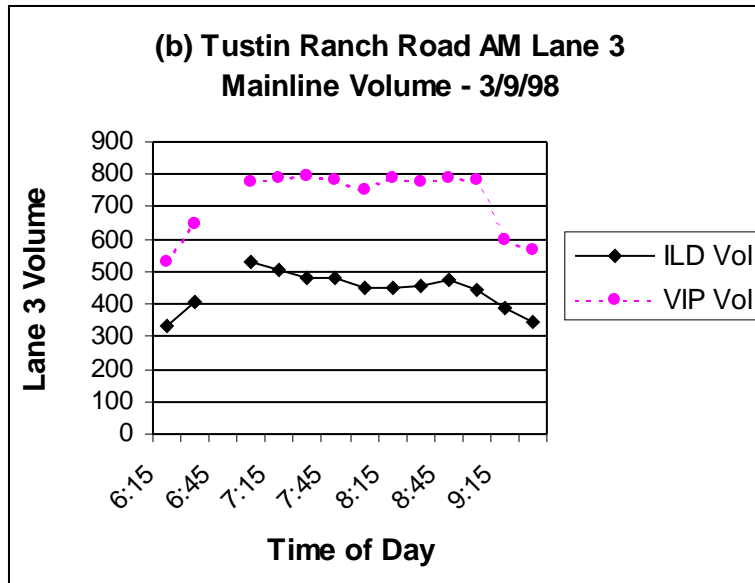
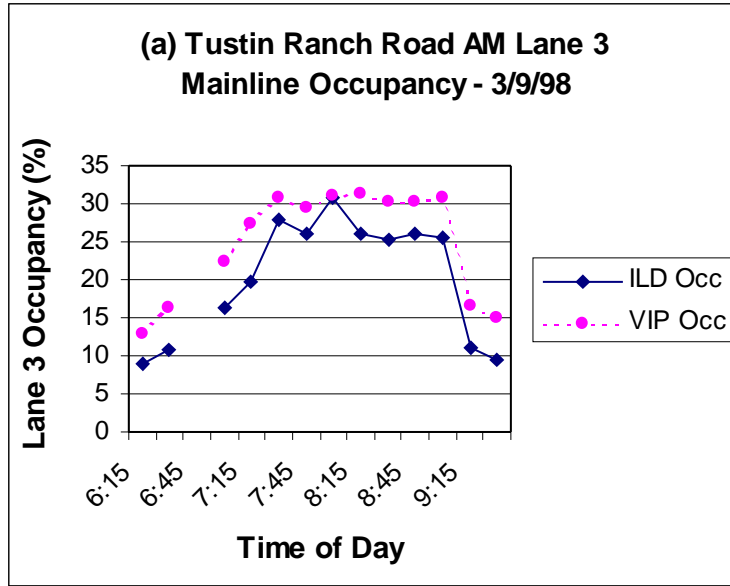


Figure J-10. Lane 10 (a) occupancy and (b) volume at the Tustin Ranch Road evaluation site during the morning rush-hour interval on 3/9/98

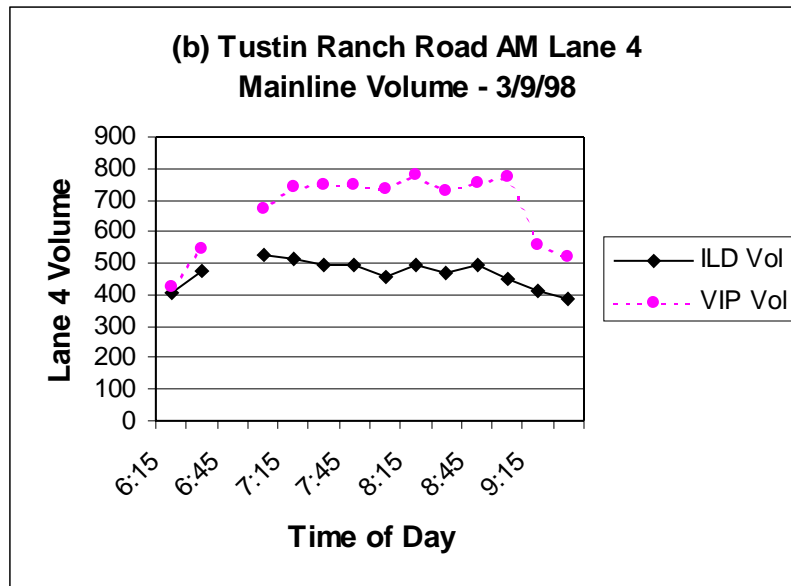
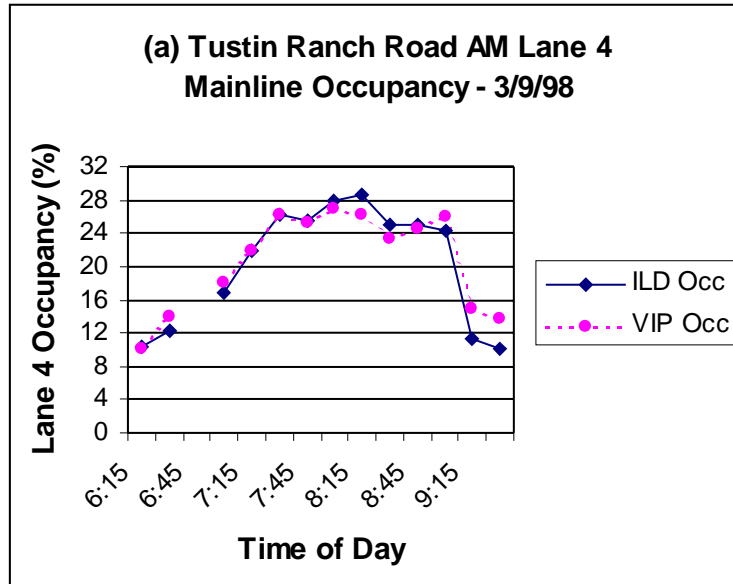


Figure J-11. Lane 4 (a) occupancy and (b) volume at the Tustin Ranch Road evaluation site during the morning rush-hour interval on 3/9/98

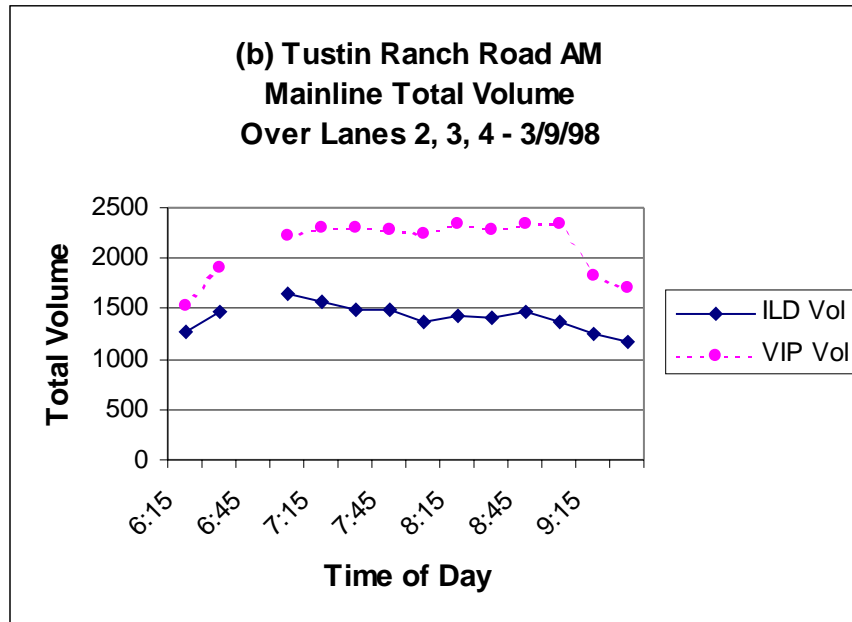
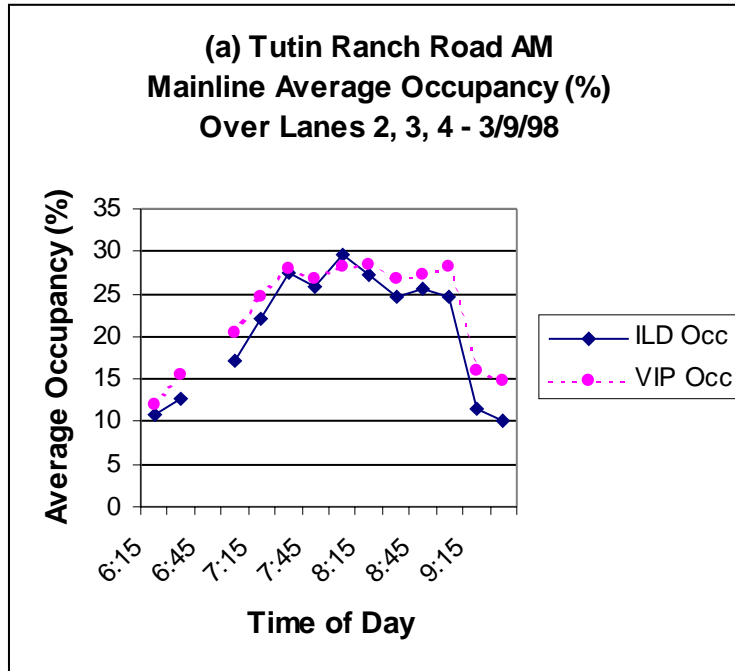


Figure J-12. Average lane (a) occupancy and total (b) volume measured by the ILDs and VIP over lanes 2, 3, and 4 at the Tustin Ranch Road evaluation site during the morning rush-hour interval on 3/9/98

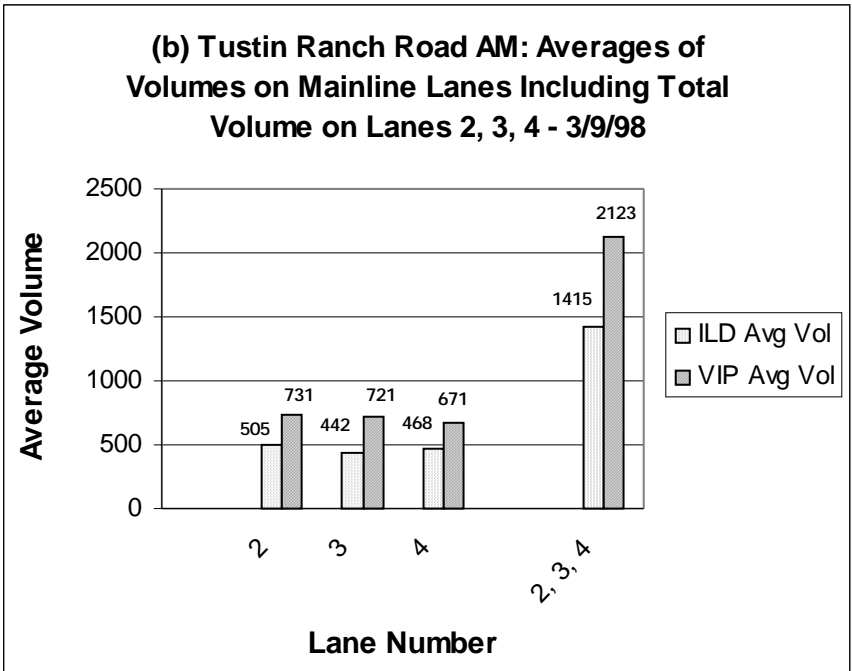
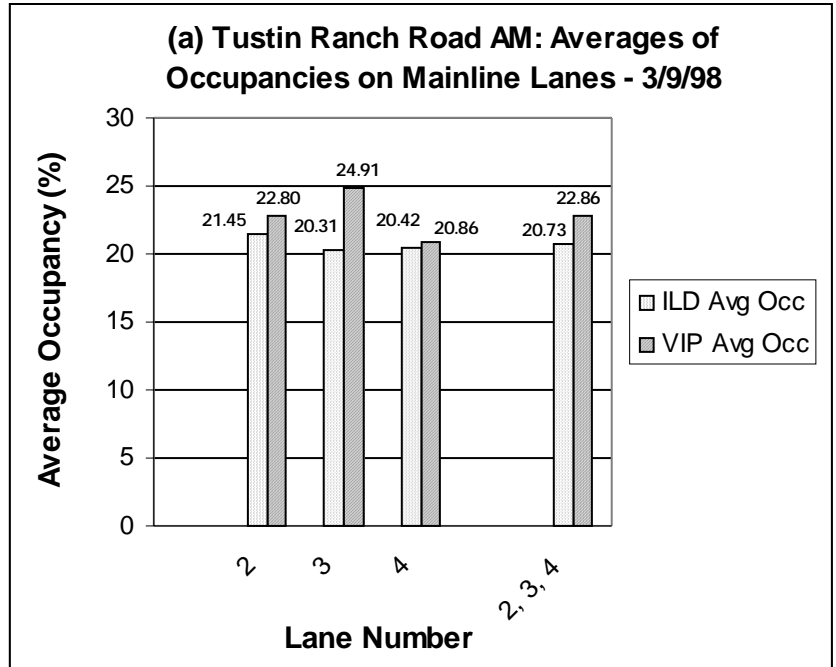


Figure J-13. Comparison of ILD and VIP lane-by-lane averages of (a) lane occupancy and (b) total volume at the Tustin Ranch Road evaluation site during the morning rush-hour interval on 3/9/98

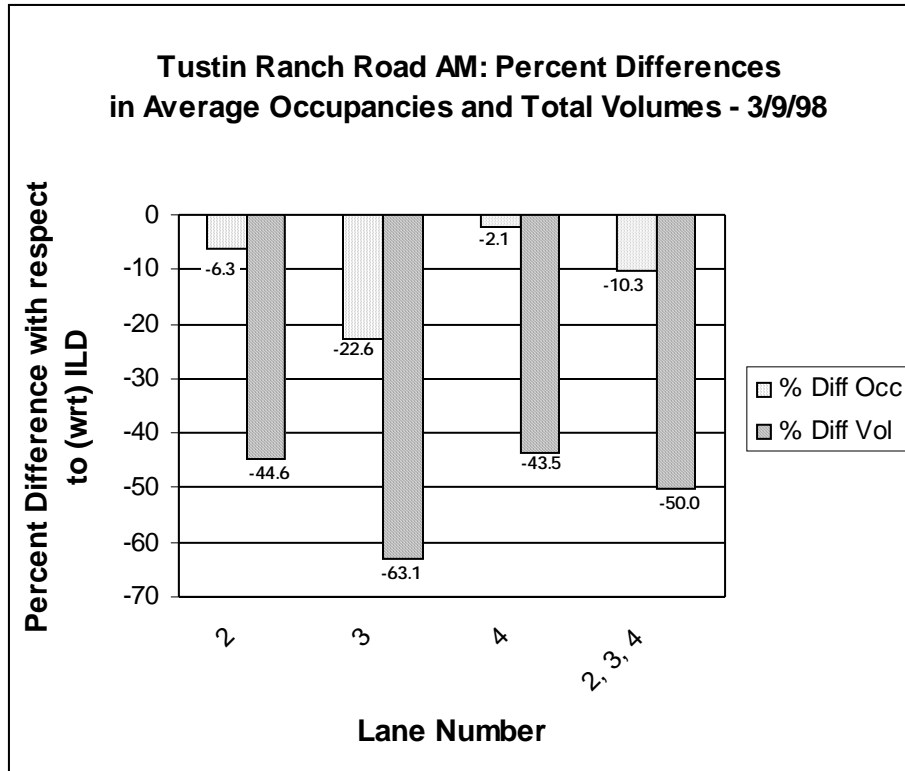


Figure J-14. Percent difference between the ILD and VIP averages of the average occupancy and total volume by lane at the Tustin Ranch Road evaluation site during the morning rush-hour interval on 3/9/98

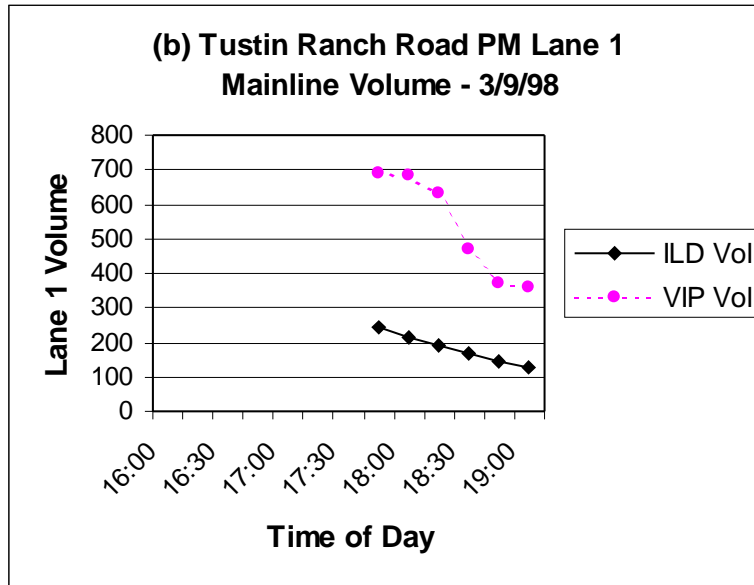
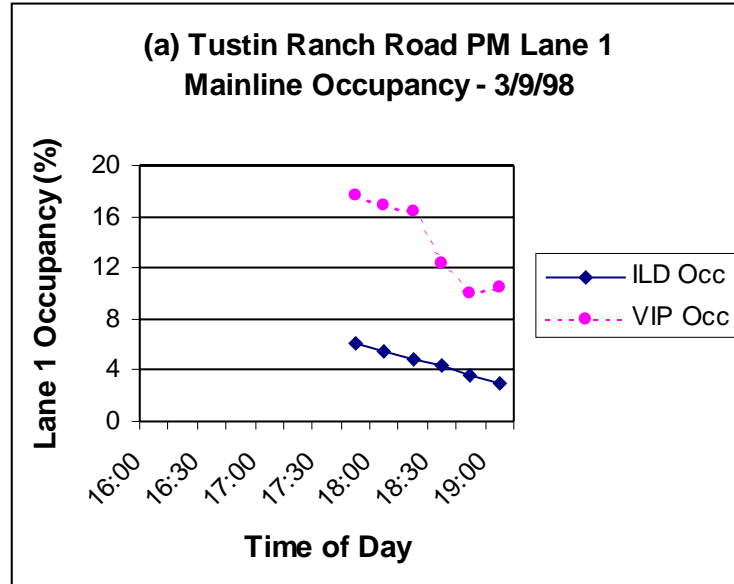


Figure J-15. Lane 1 (a) occupancy and (b) volume at the Tustin Ranch Road evaluation site during the afternoon rush-hour interval on 3/9/98

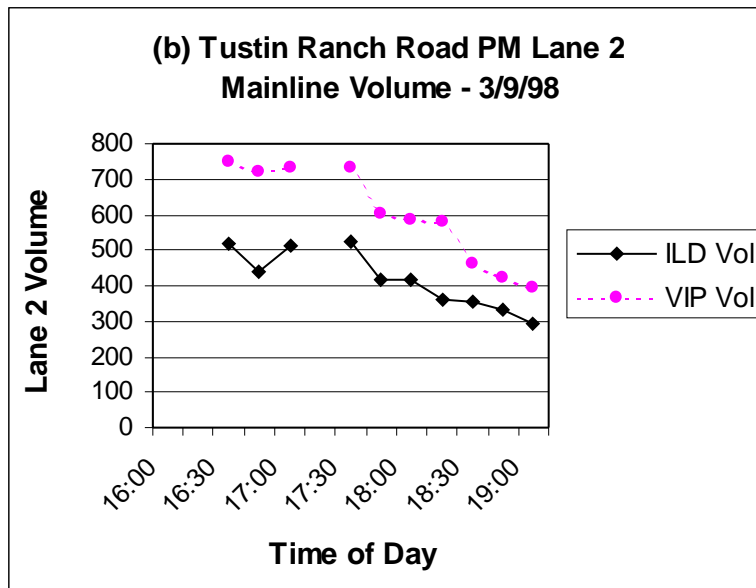
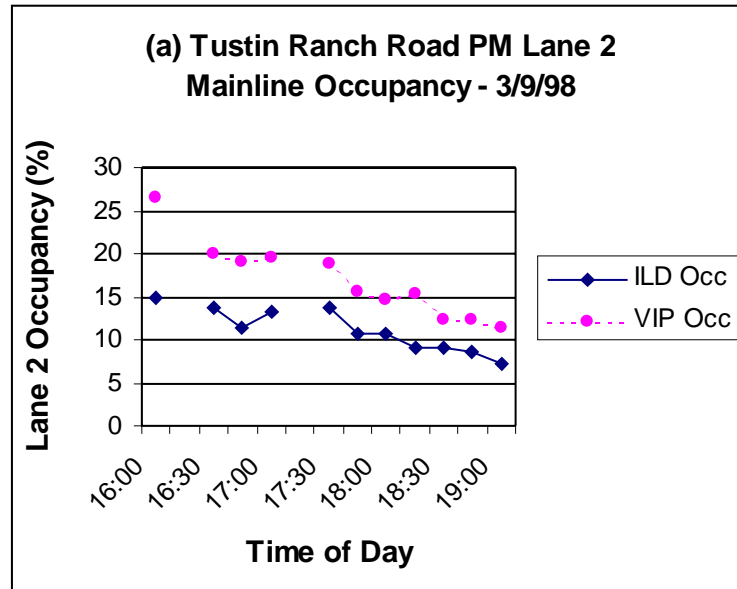


Figure J-16. Lane 2 (a) occupancy and (b) volume at the Tustin Ranch Road evaluation site during the afternoon rush-hour interval on 3/9/98

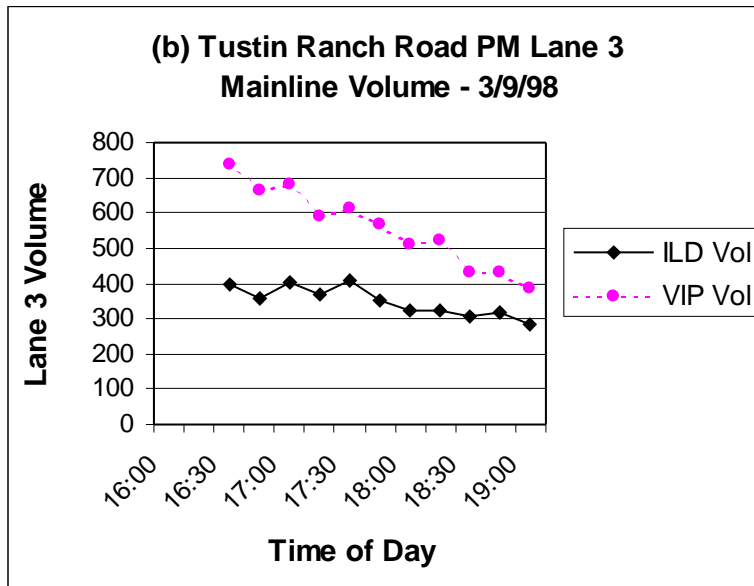
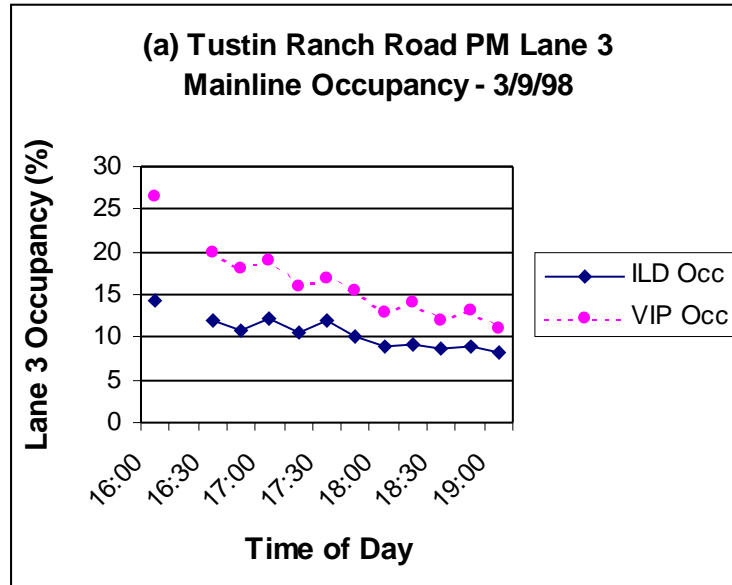


Figure J-17. Lane 3 (a) occupancy and (b) volume at the Tustin Ranch Road evaluation site during the afternoon rush-hour interval on 3/9/98

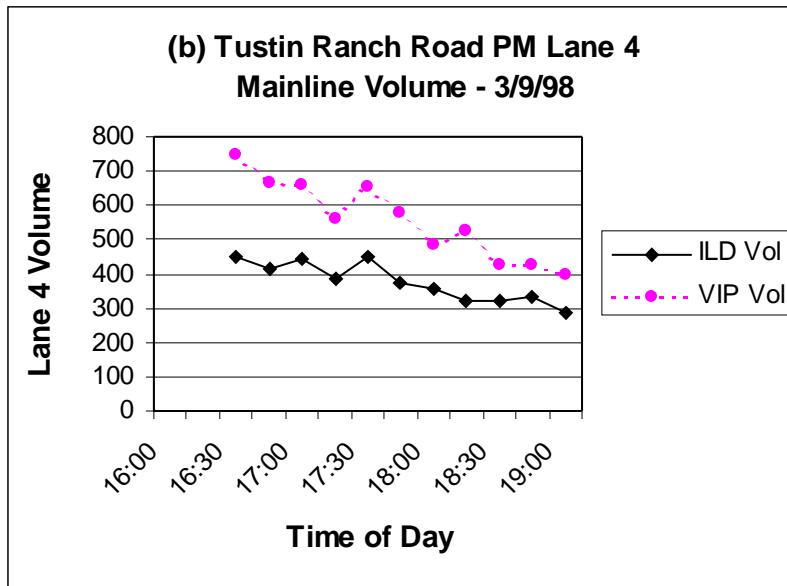
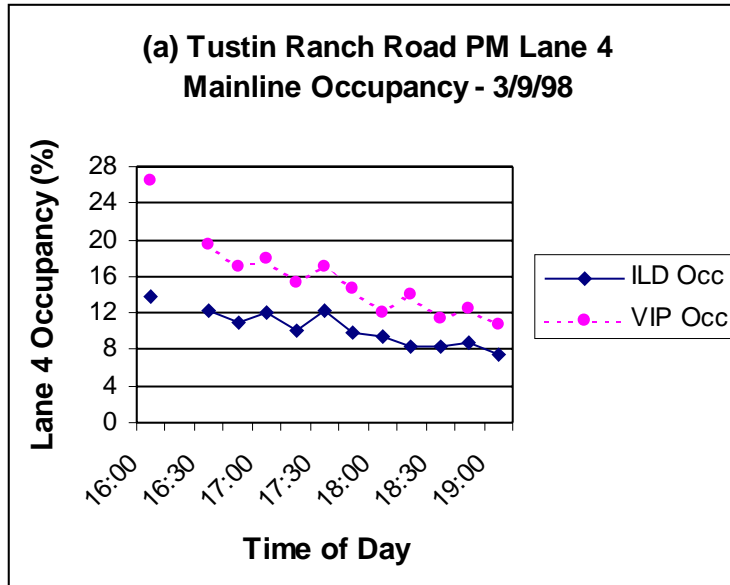


Figure J-18. Lane 4 (a) occupancy and (b) volume at the Tustin Ranch Road evaluation site during the afternoon rush-hour interval on 3/9/98

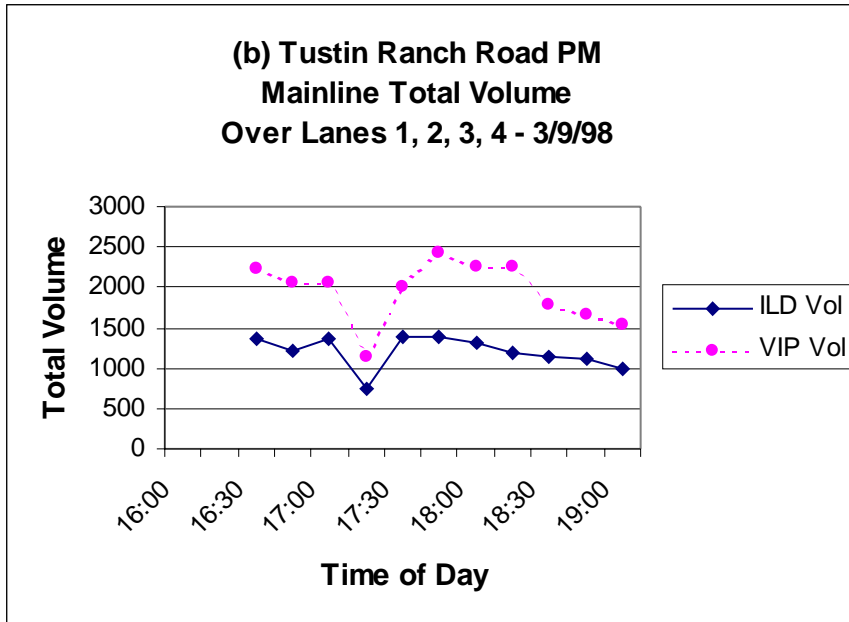
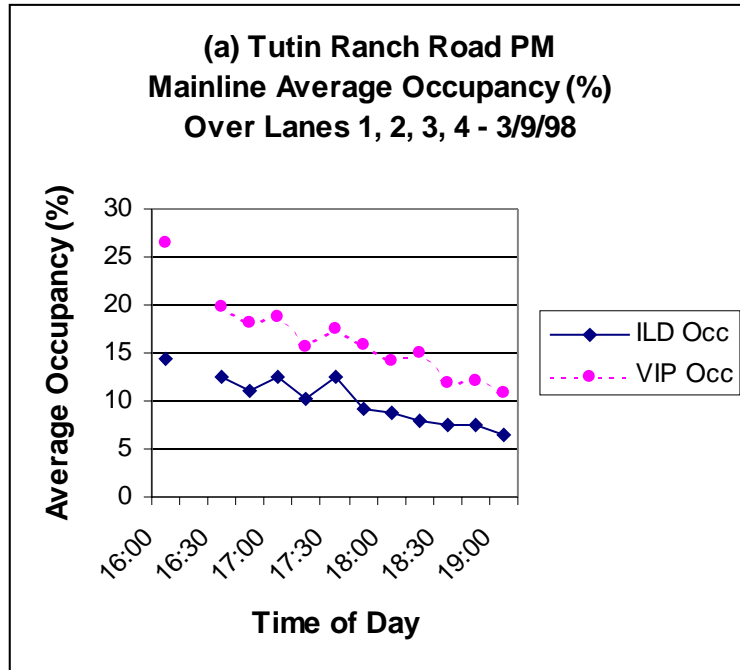


Figure J-19. Average (a) lane occupancy and (b) total volume measured by the ILDs and VIP over all lanes at the Tustin Ranch Road evaluation site during the afternoon rush-hour interval on 3/9/98

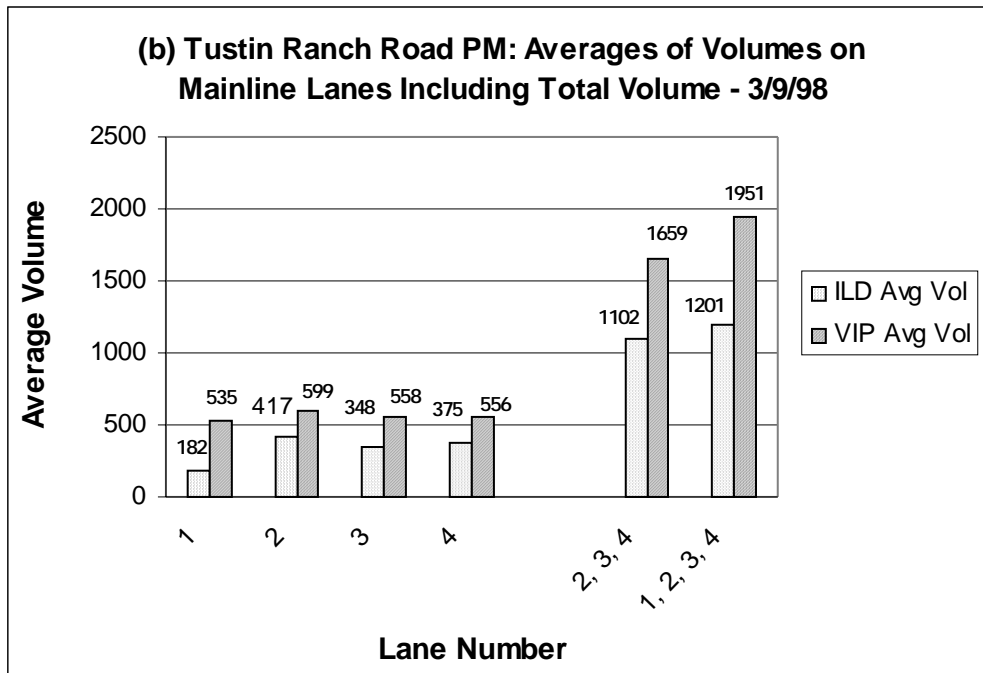
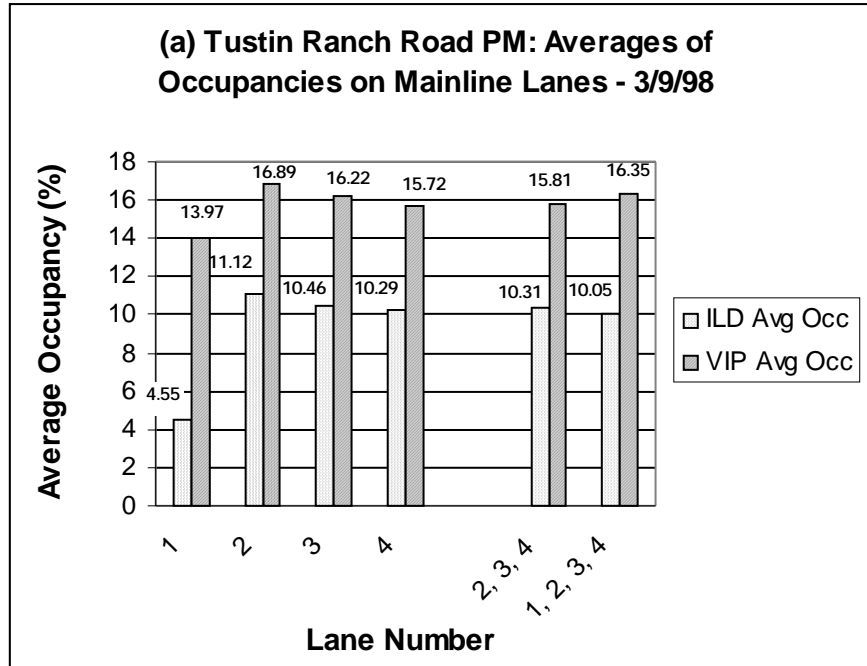


Figure J-20. Comparison of ILD and VIP lane-by-lane averages of (a) lane occupancy and (b) total volume at the Tustin Ranch Road evaluation site during the afternoon rush-hour interval on 3/9/98

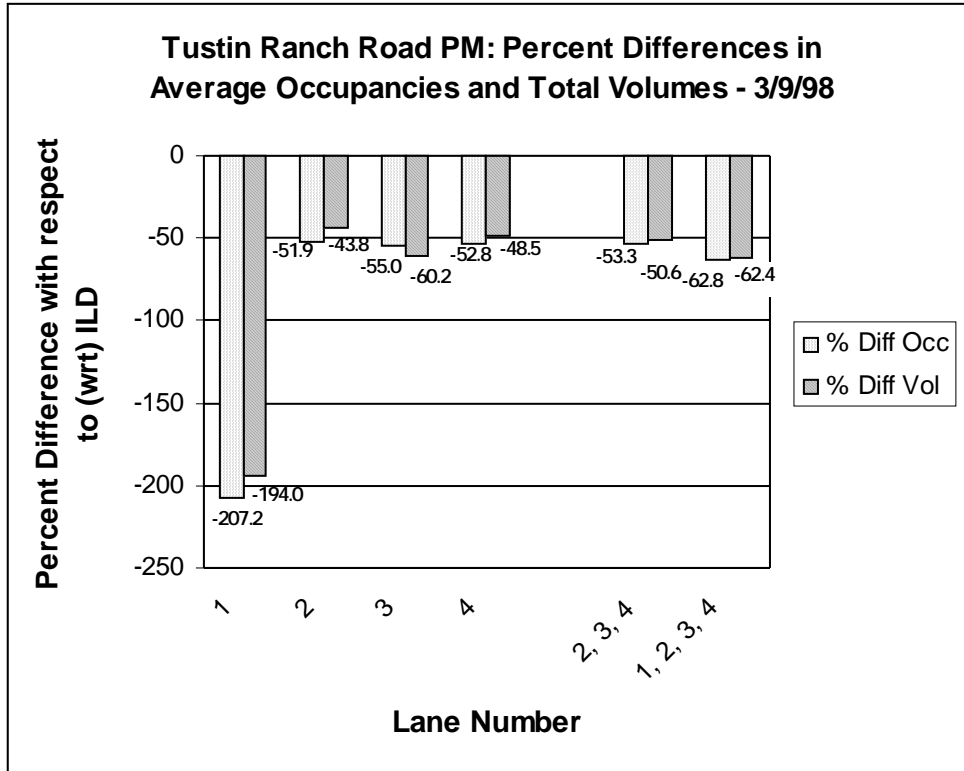


Figure J-21. Percent difference between the ILD and VIP averages of the average occupancy and total volume by lane at the Tustin Ranch Road evaluation site during the afternoon rush-hour interval on 3/9/98

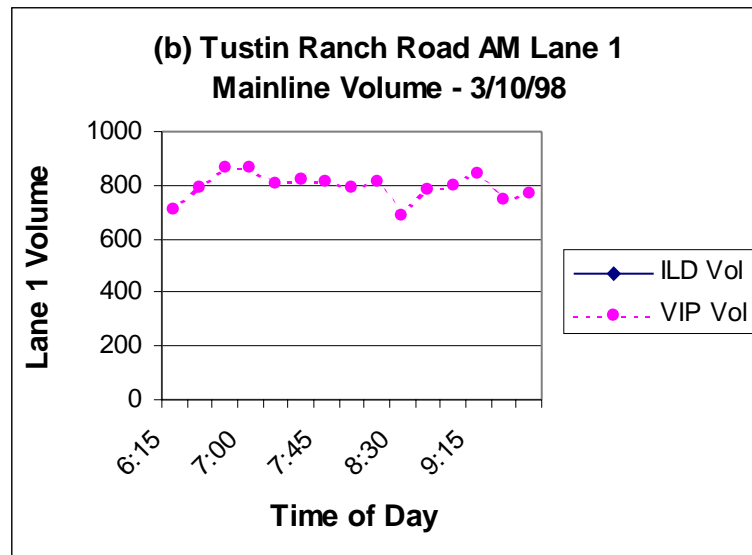
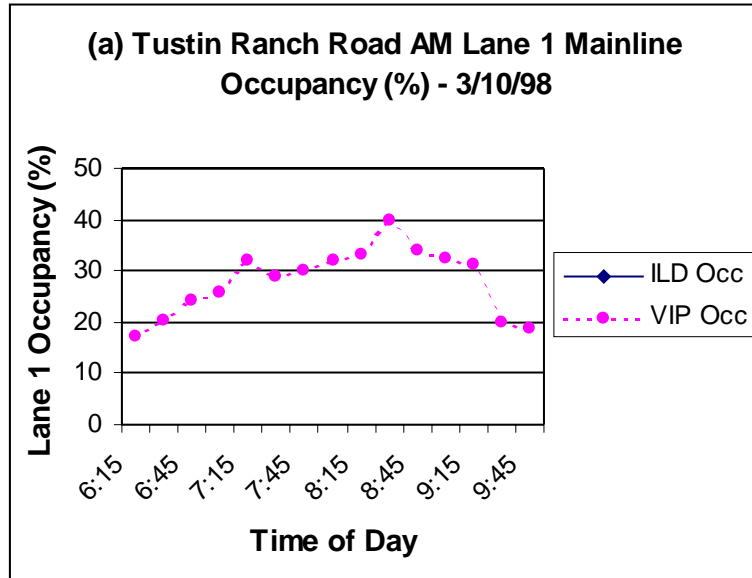


Figure J-22. Lane 1 (a) occupancy and (b) volume at the Tustin Ranch Road evaluation site during the morning rush-hour interval on 3/10/98

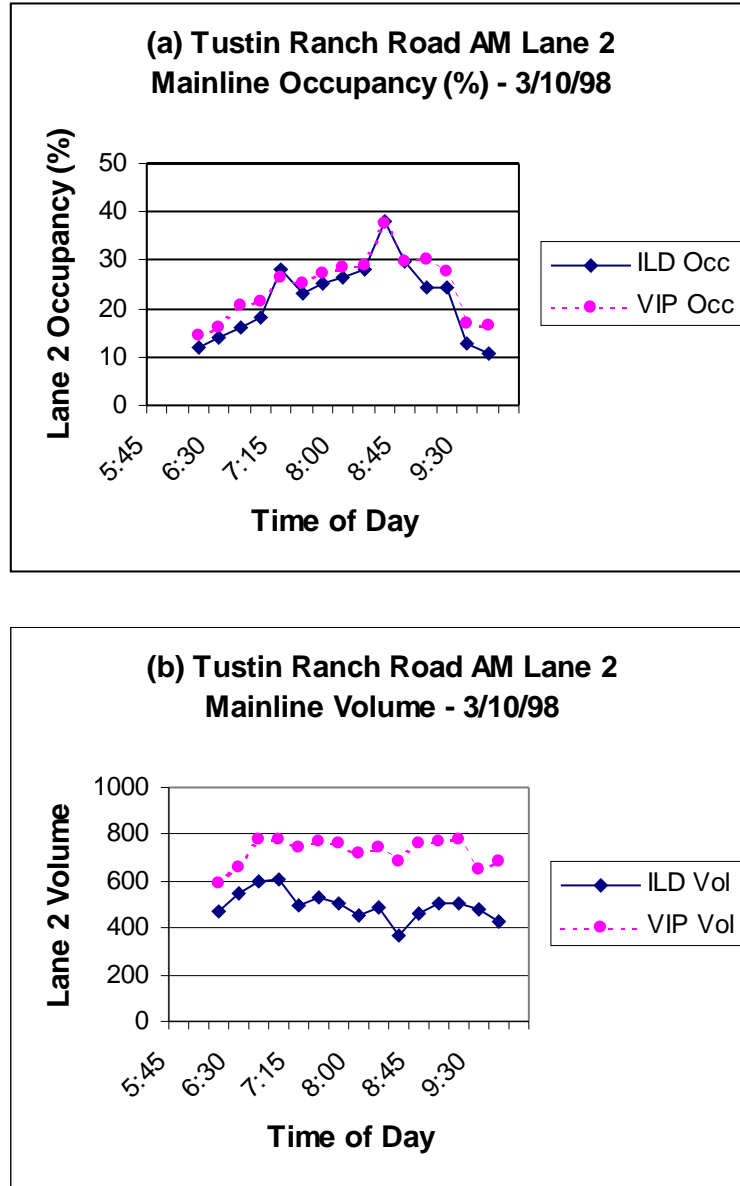


Figure J-23. Lane 2 (a) occupancy and (b) volume at the Tustin Ranch Road evaluation site during the morning rush-hour interval on 3/10/98

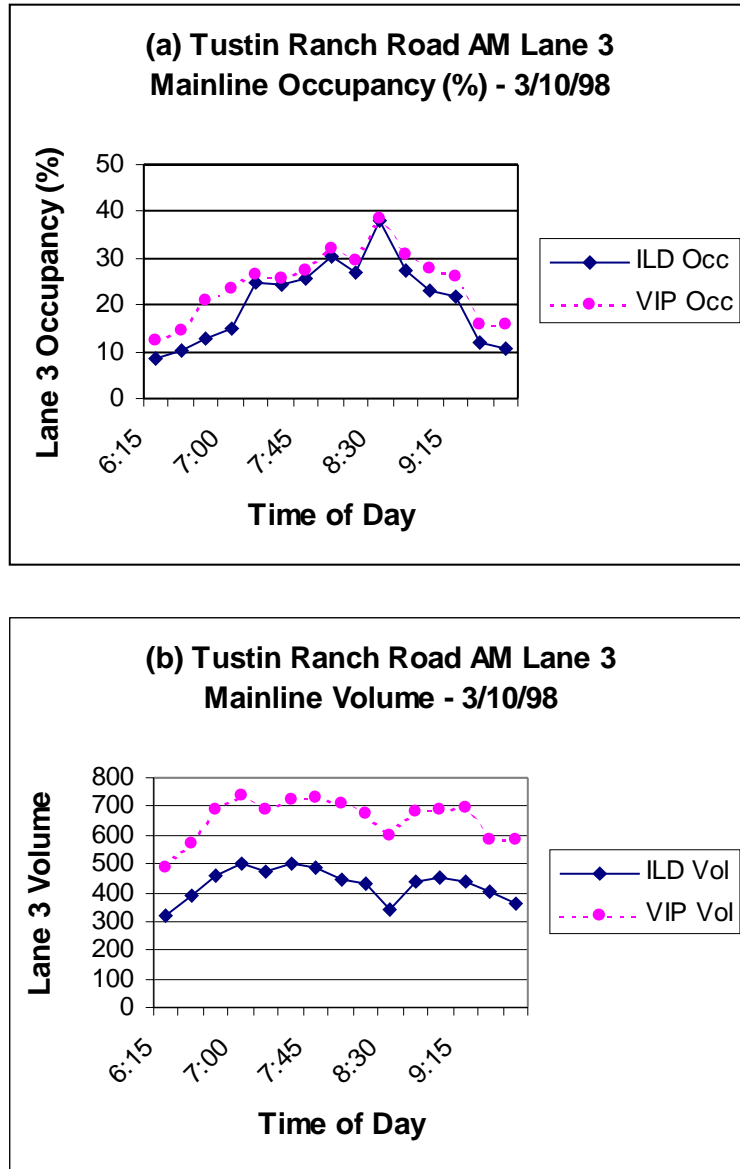


Figure J-24. Lane 3 (a) occupancy and (b) volume at the Tustin Ranch Road evaluation site during the morning rush-hour interval on 3/10/98

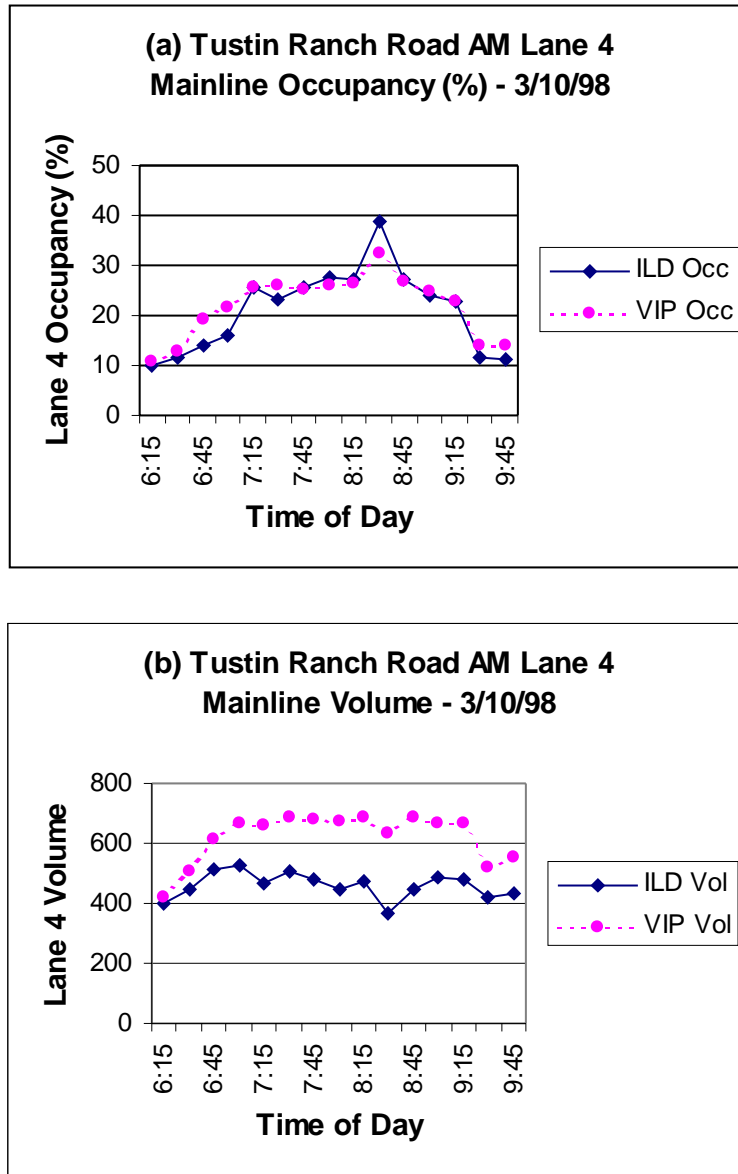


Figure J-25. Lane 4 (a) occupancy and (b) volume at the Tustin Ranch Road evaluation site during the morning rush-hour interval on 3/10/98

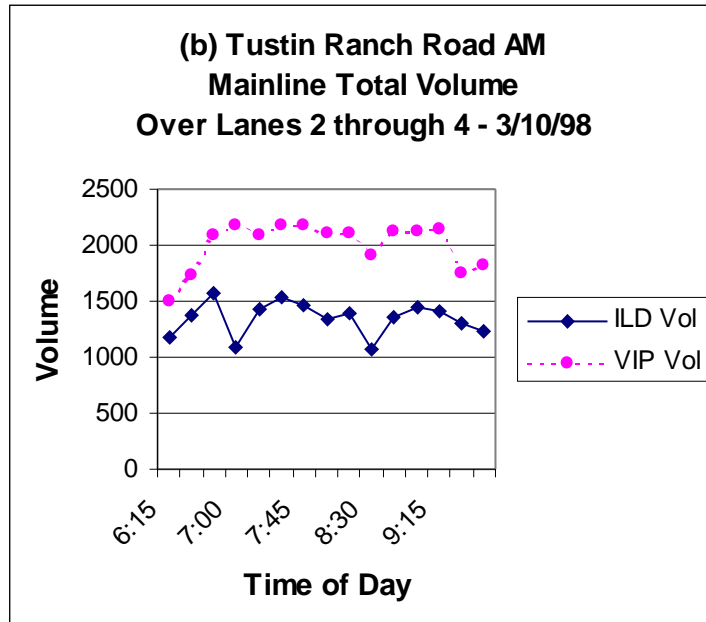
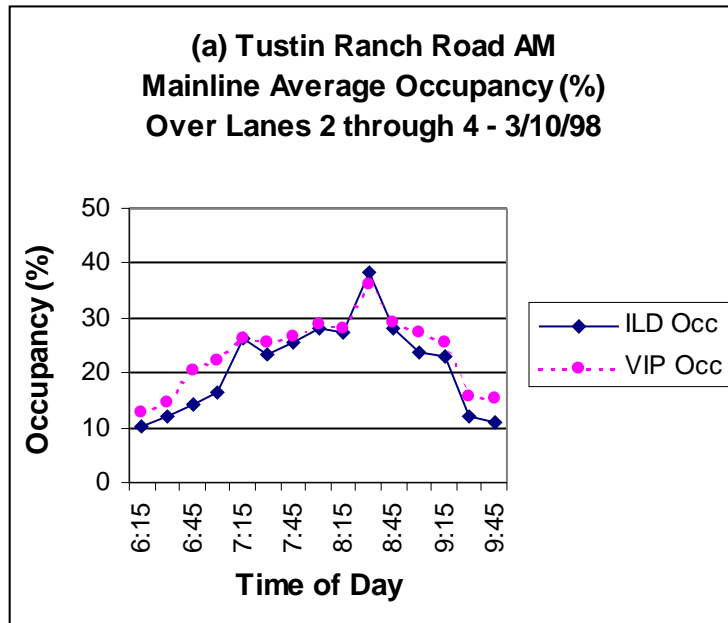


Figure J-26. Average (a) lane occupancy and (b) total volume measured by the ILDs and VIP over lanes 1, 3, and 4 at the Tustin Ranch Road evaluation site during the morning rush-hour interval on 3/10/98

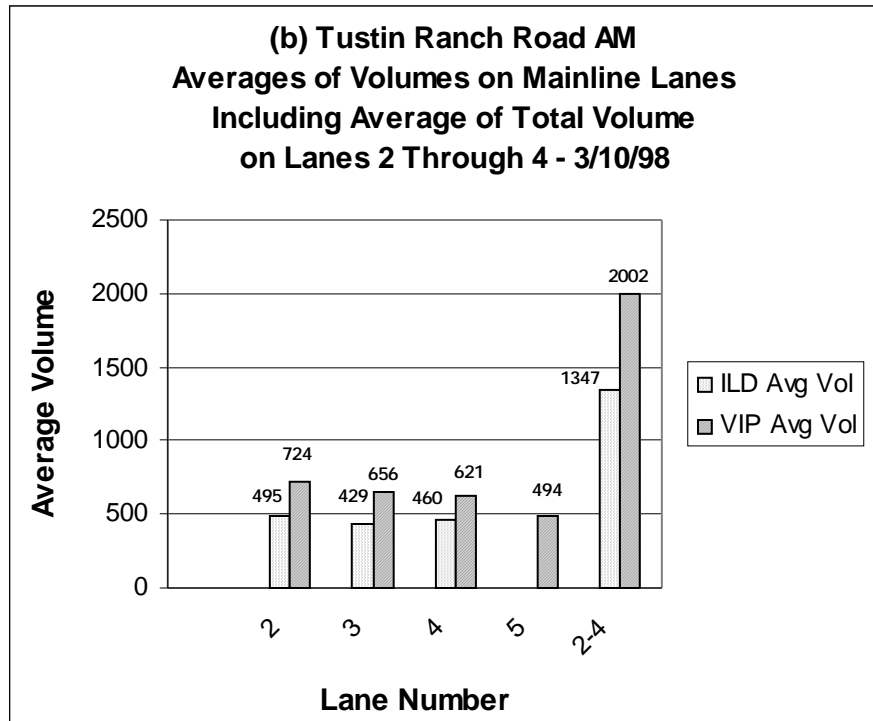
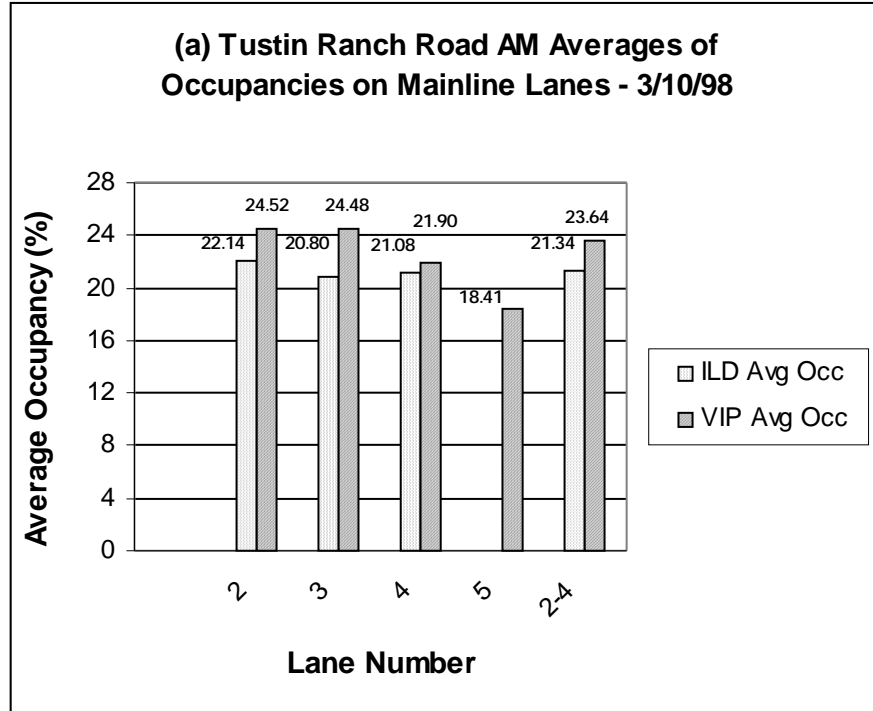


Figure J-27. Comparison of ILD and VIP lane-by-lane averages of (a) lane occupancy and (b) total volume at the Tustin Ranch Road evaluation site during the morning rush-hour interval on 3/10/98

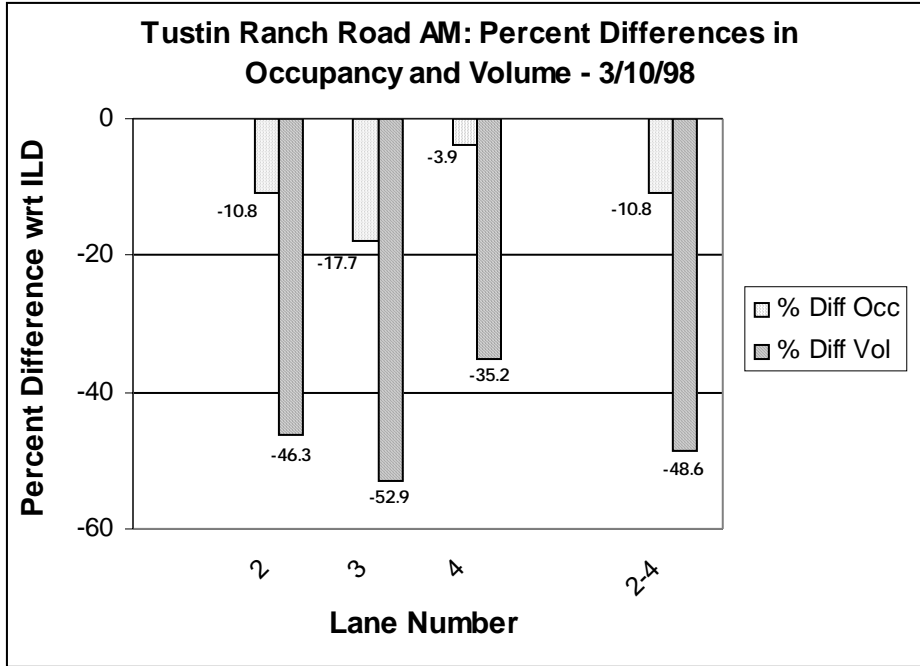


Figure J-28. Percent difference between the ILD and VIP averages of the average occupancy and total volume by lane at the Tustin Ranch Road evaluation site during the morning rush-hour interval on 3/10/98

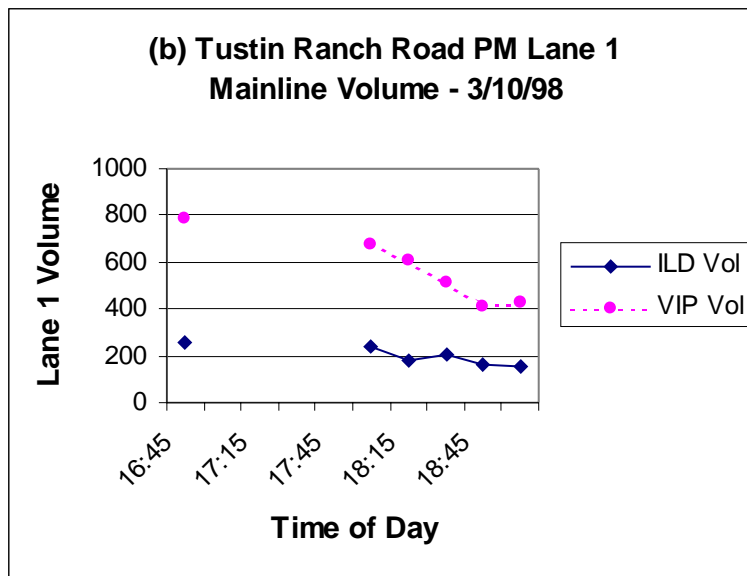
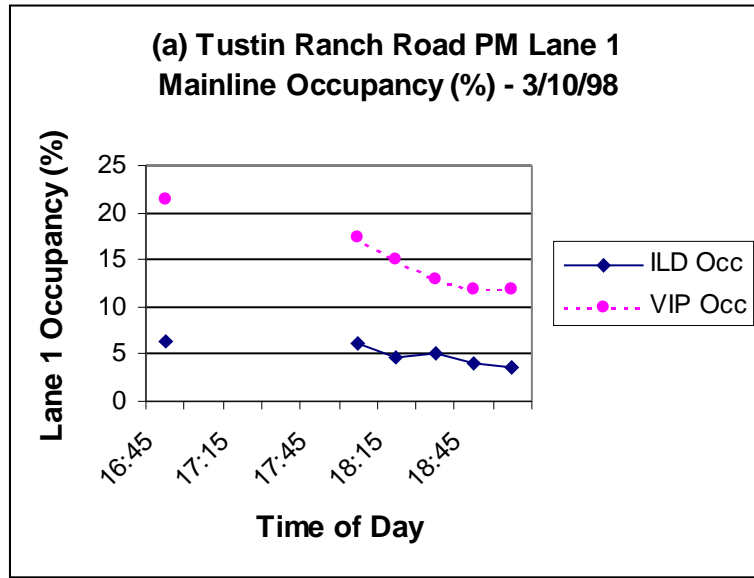


Figure J-29. Lane 1 (a) occupancy and (b) volume at the Tustin Ranch Road evaluation site during the afternoon rush-hour interval on 3/10/98

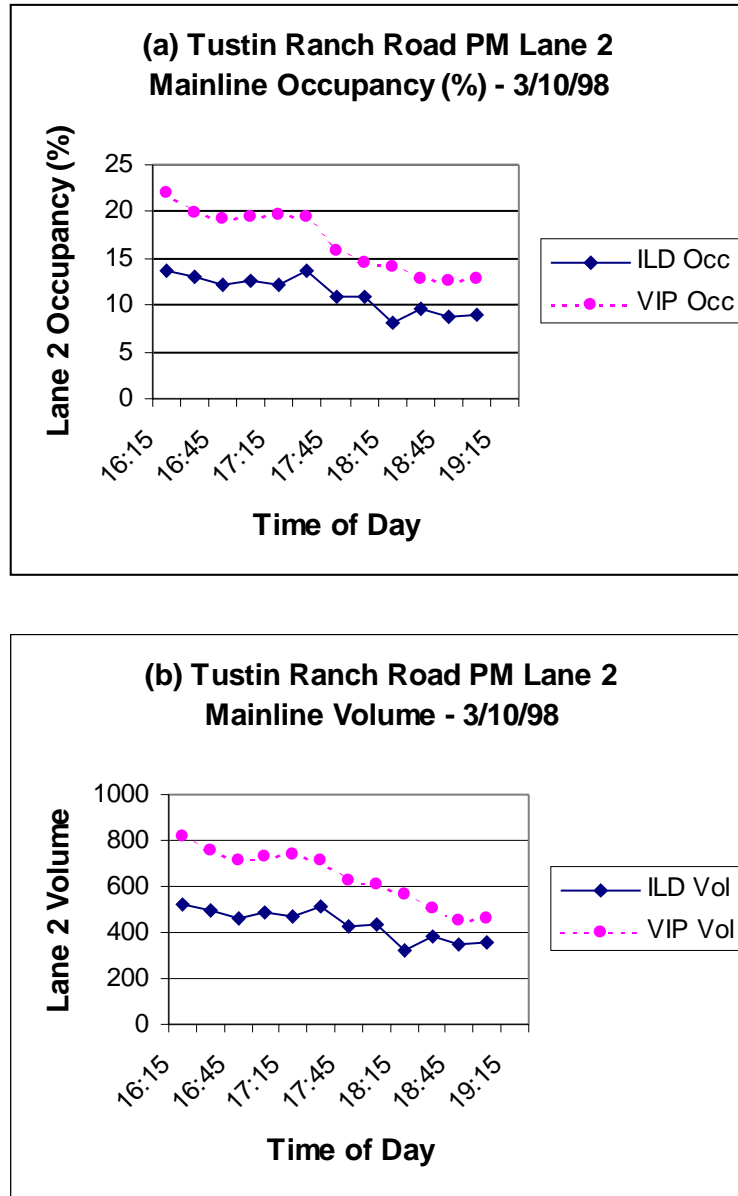


Figure J-30. Lane 2 (a) occupancy and (b) volume at the Tustin Ranch Road evaluation site during the afternoon rush-hour interval on 3/10/98

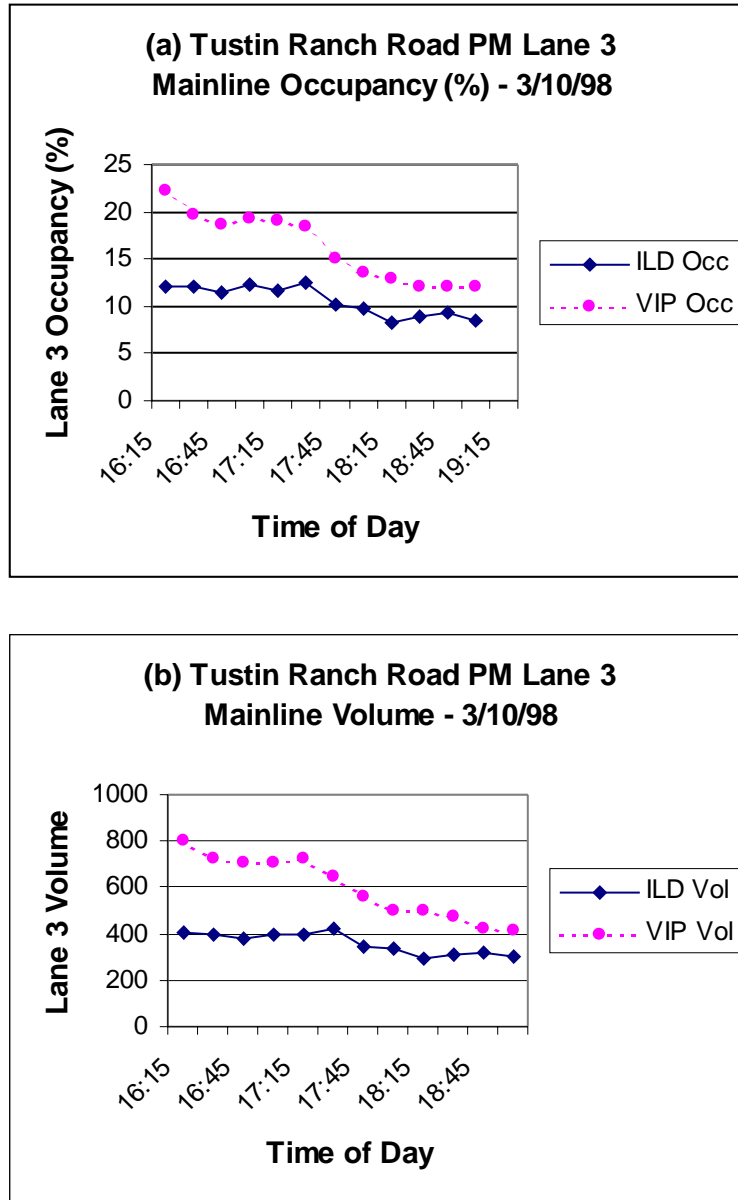


Figure J-31. Lane 3 (a) occupancy and (b) volume at the Tustin Ranch Road evaluation site during the afternoon rush-hour interval on 3/10/98

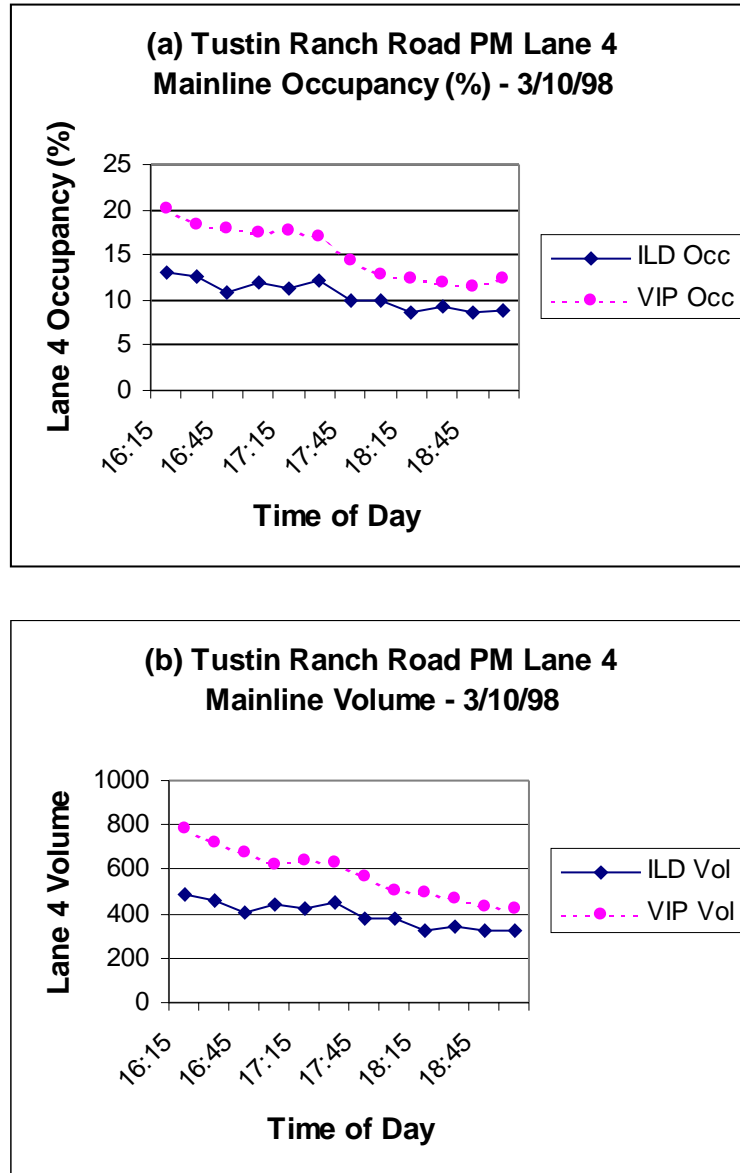


Figure J-32. Lane 4 (a) occupancy and (b) volume at the Tustin Ranch Road evaluation site during the afternoon rush-hour interval on 3/10/98

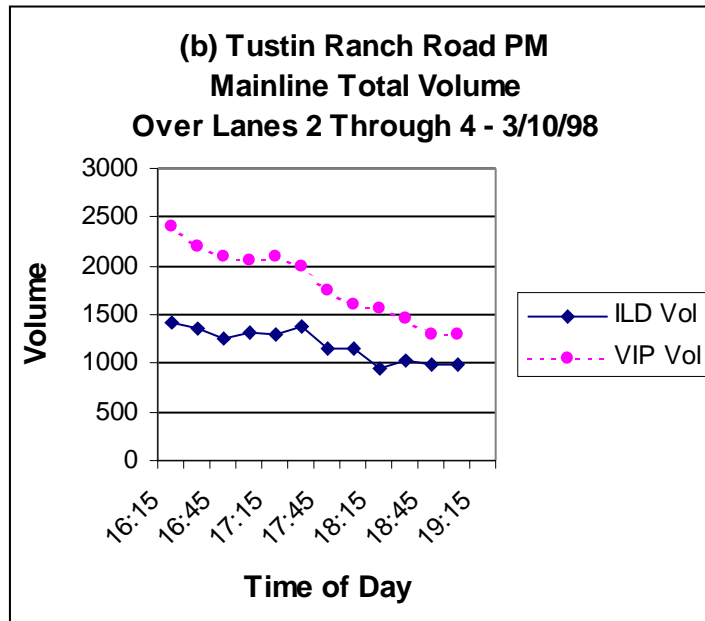
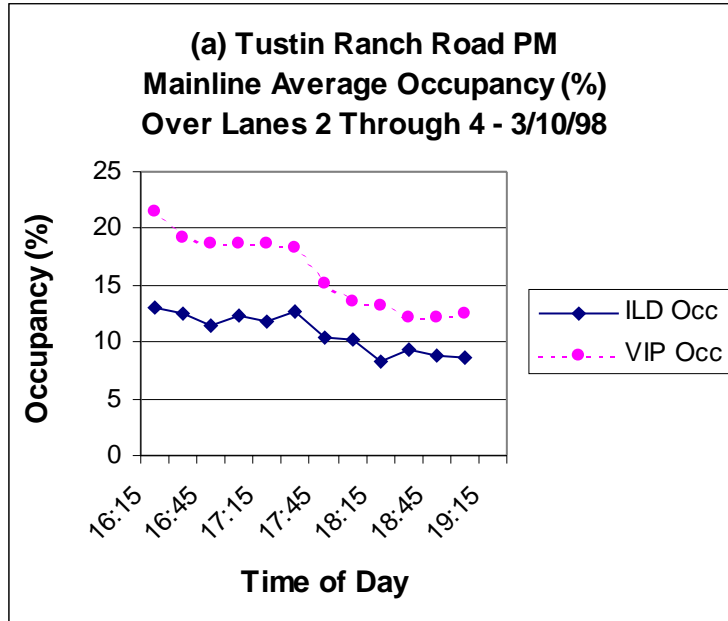


Figure J-33. Average (a) lane occupancy and (b) total volume measured by the ILDs and VIP over all lanes at the Tustin Ranch Road evaluation site during the afternoon rush-hour interval on 3/10/98

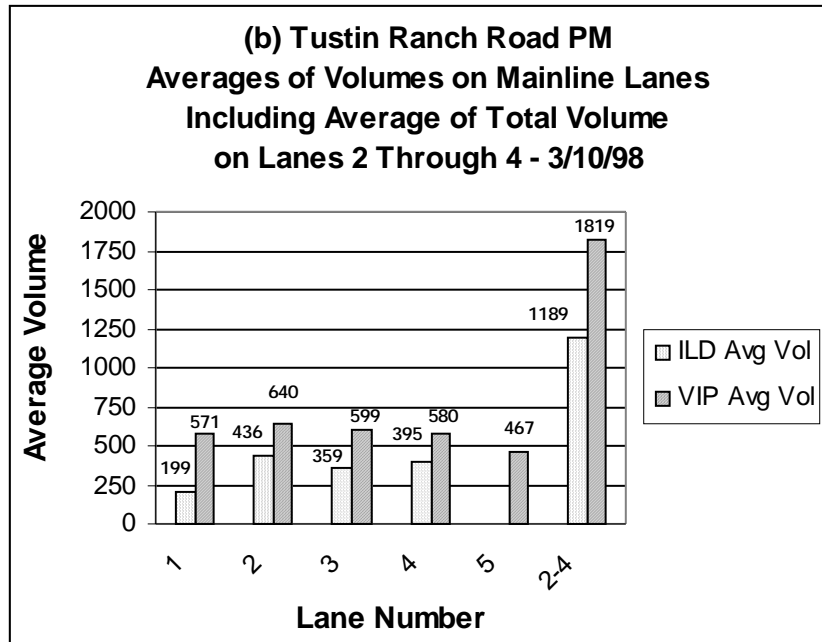
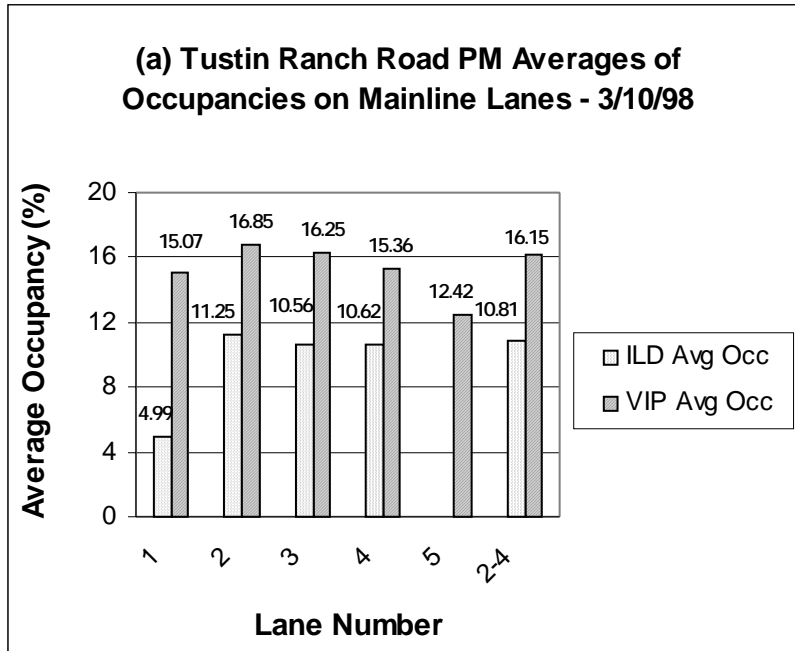


Figure J-34. Comparison of ILD and VIP lane-by-lane averages of (a) lane occupancy and (b) total volume at the Tustin Ranch Road evaluation site during the afternoon rush-hour interval on 3/10/98

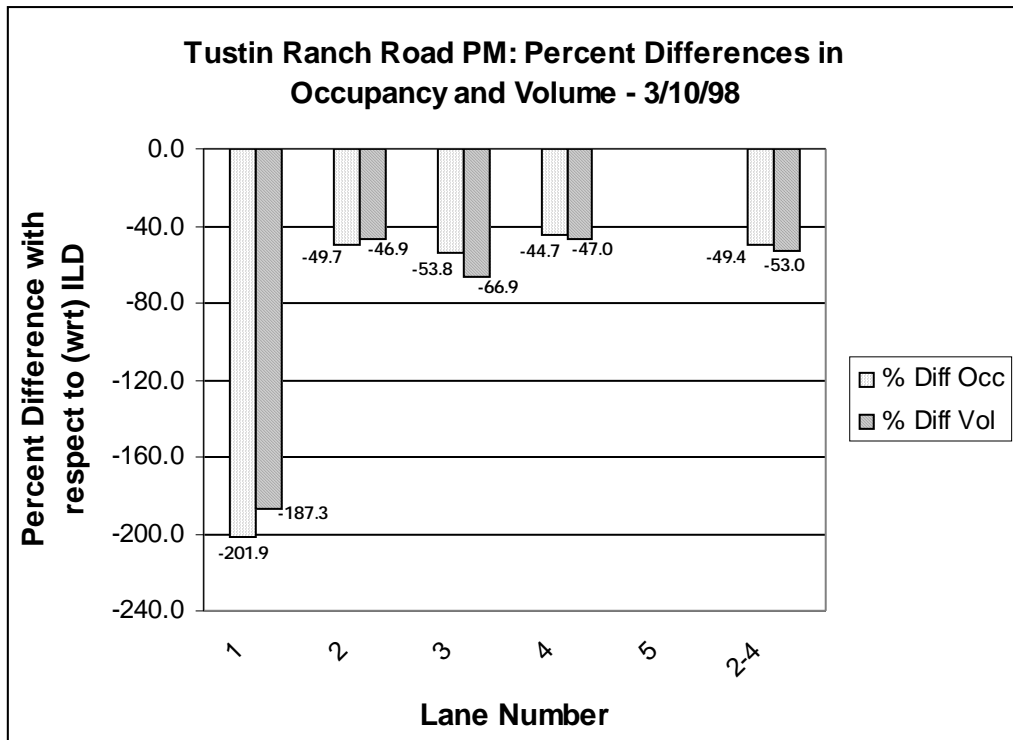


Figure J-35. Percent difference between the ILD and VIP averages of the average occupancy and total volume by lane at the Tustin Ranch Road evaluation site during the afternoon rush-hour interval on 3/10/98

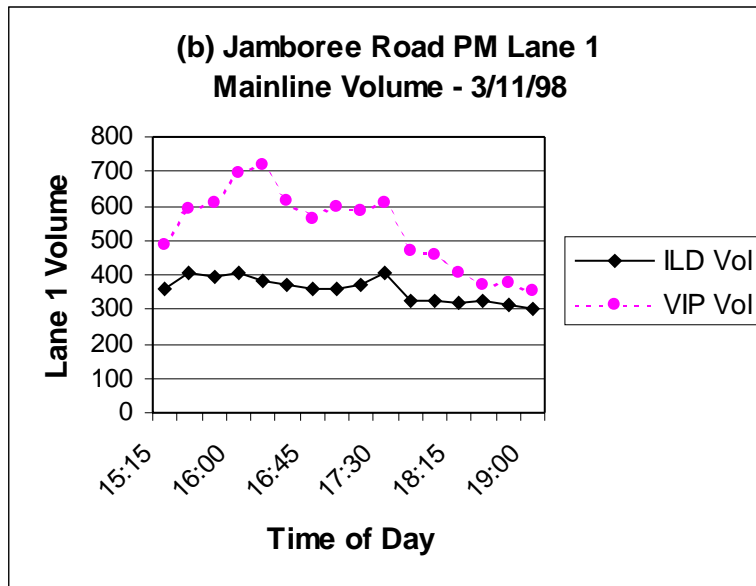
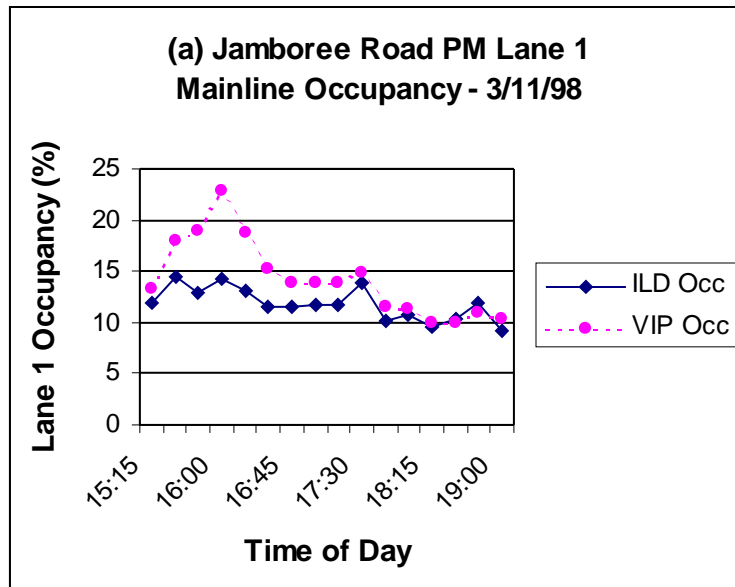


Figure J-36. Lane 1 (a) occupancy and (b) volume at the Jamboree Road evaluation site during the afternoon rush-hour interval on 3/11/98

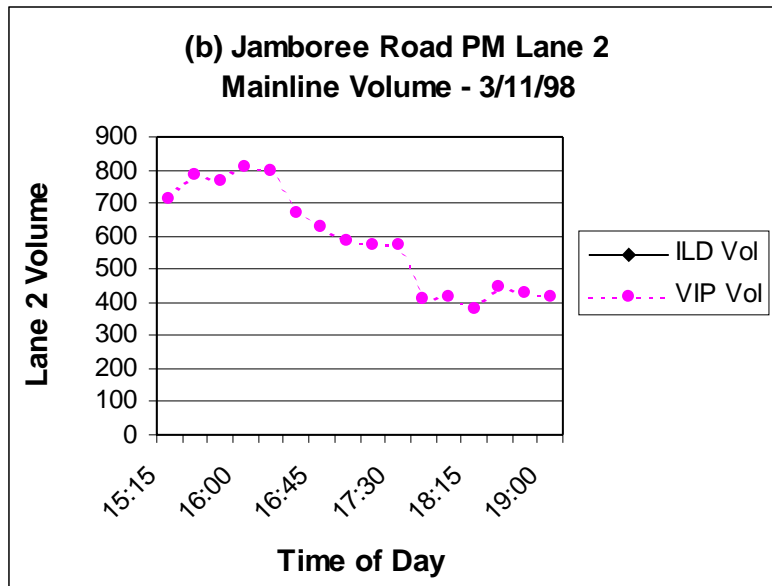
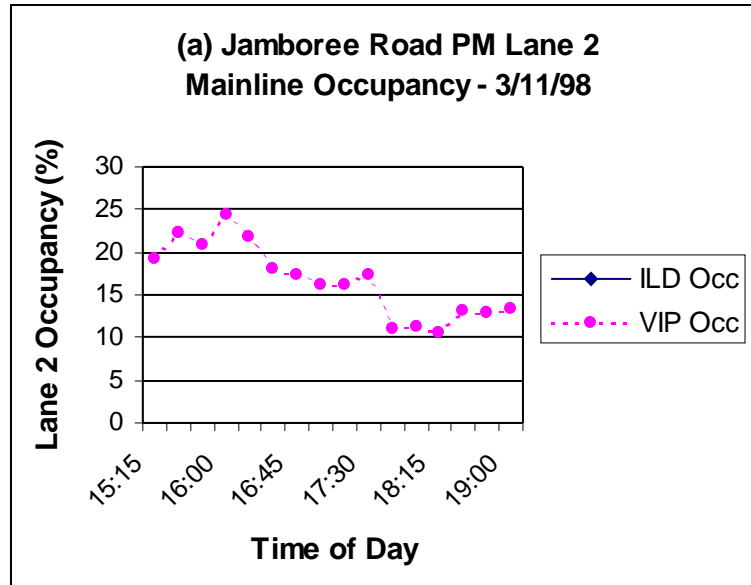


Figure J-37. Lane 2 (a) occupancy and (b) volume at the Jamboree Road evaluation site during the afternoon rush-hour interval on 3/11/98

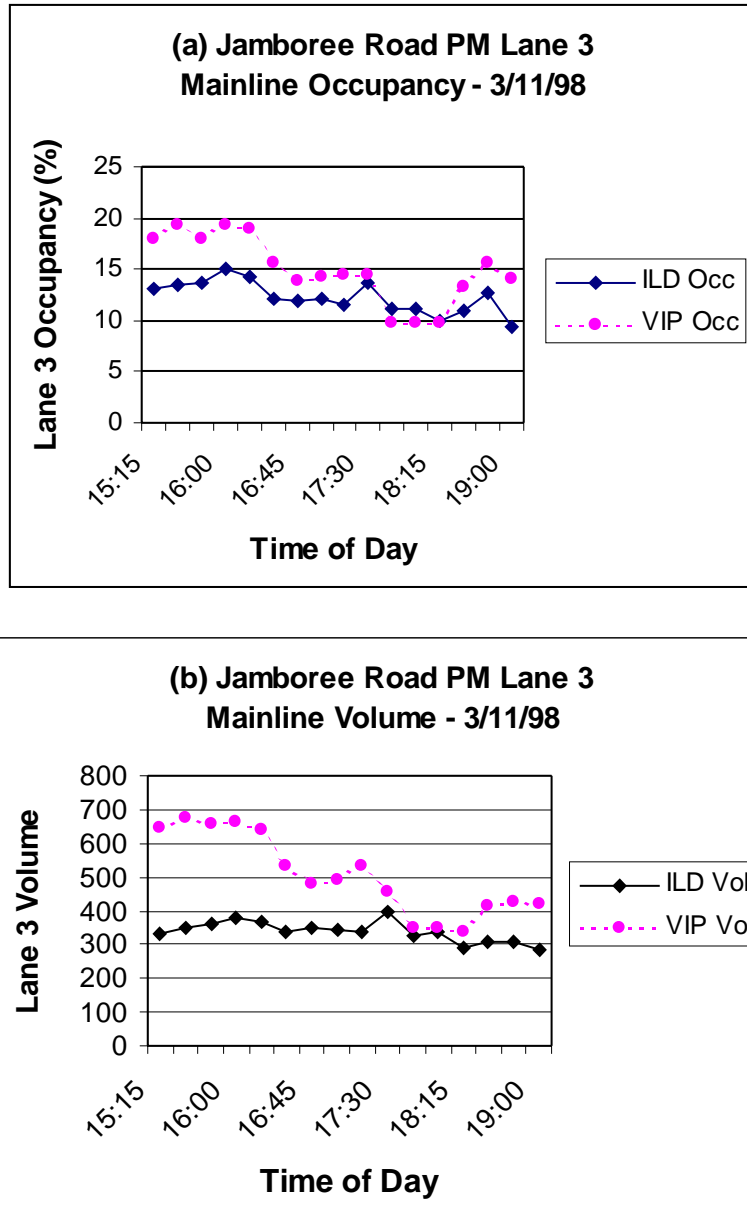


Figure J-38. Lane 3 (a) occupancy and (b) volume at the Jamboree Road evaluation site during the afternoon rush-hour interval on 3/11/98

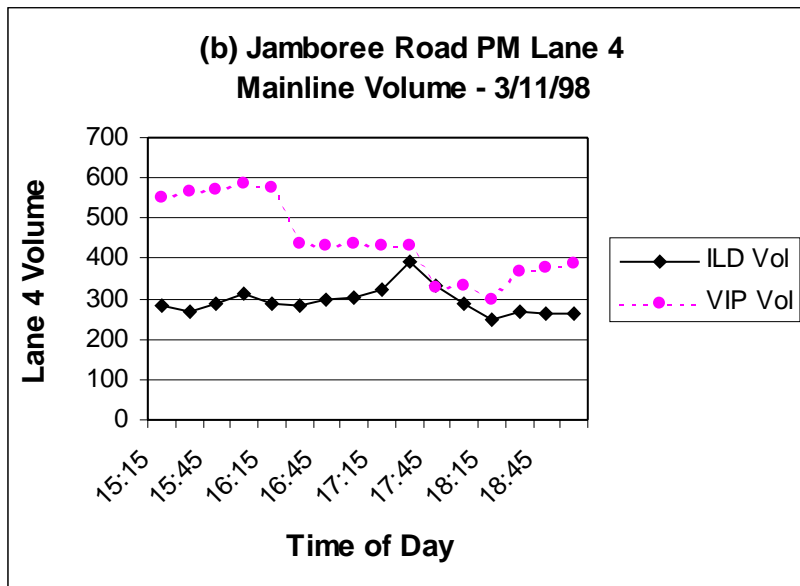
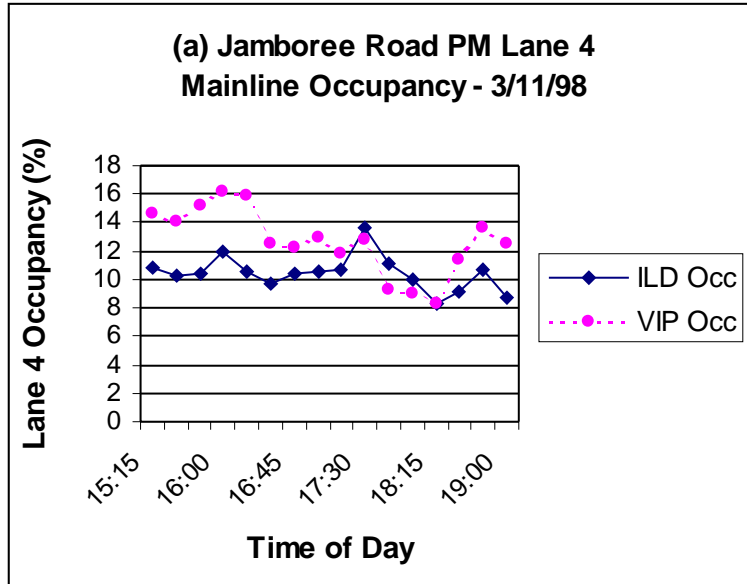


Figure J-39. Lane 4 (a) occupancy and (b) volume at the Jamboree Road evaluation site during the afternoon rush-hour interval on 3/11/98

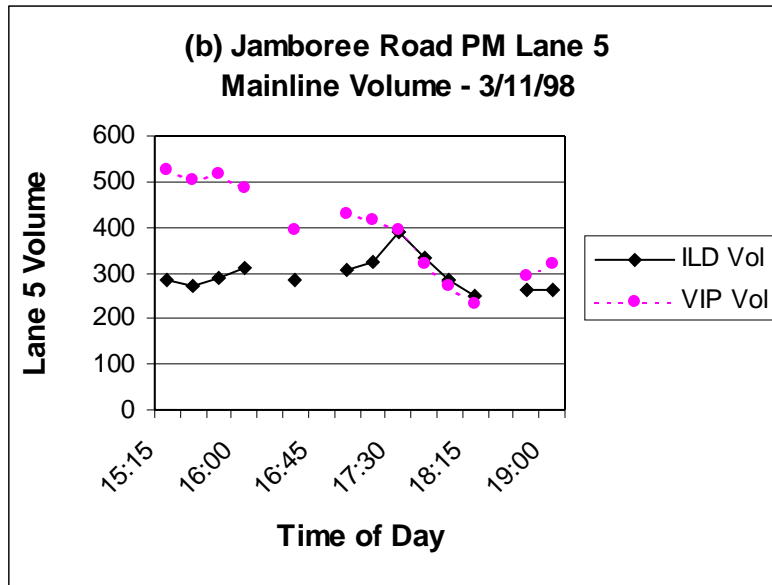
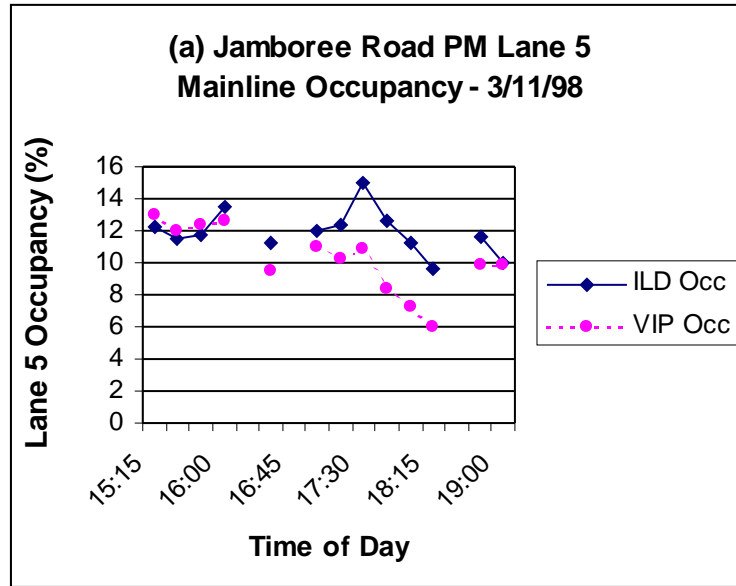


Figure J-40. Lane 5 (a) occupancy and (b) volume at the Jamboree Road evaluation site during the afternoon rush-hour interval on 3/11/98

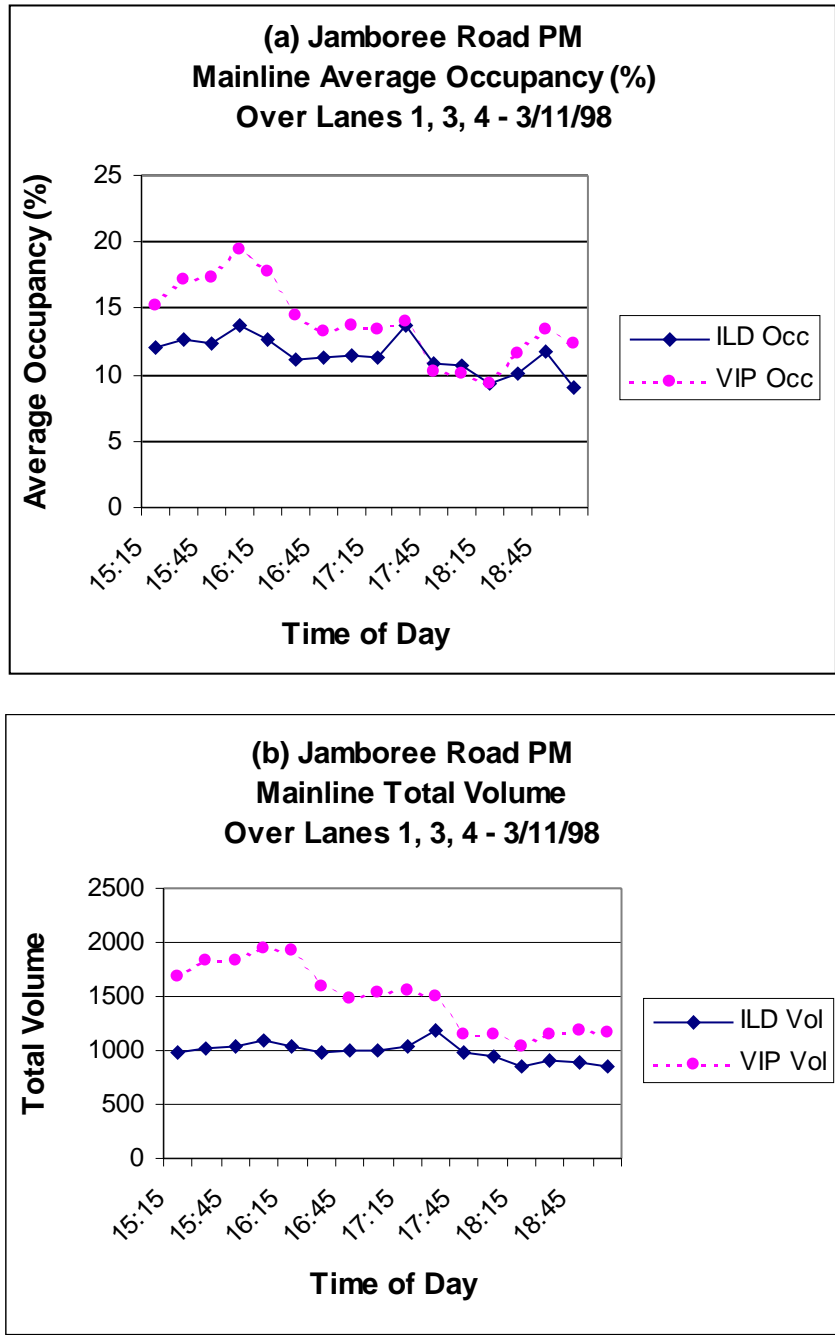


Figure J-41. Average (a) lane occupancy and (b) total volume measured by the ILDs and VIP over all lanes at the Jamboree Road evaluation site during the afternoon rush-hour interval on 3/11/98

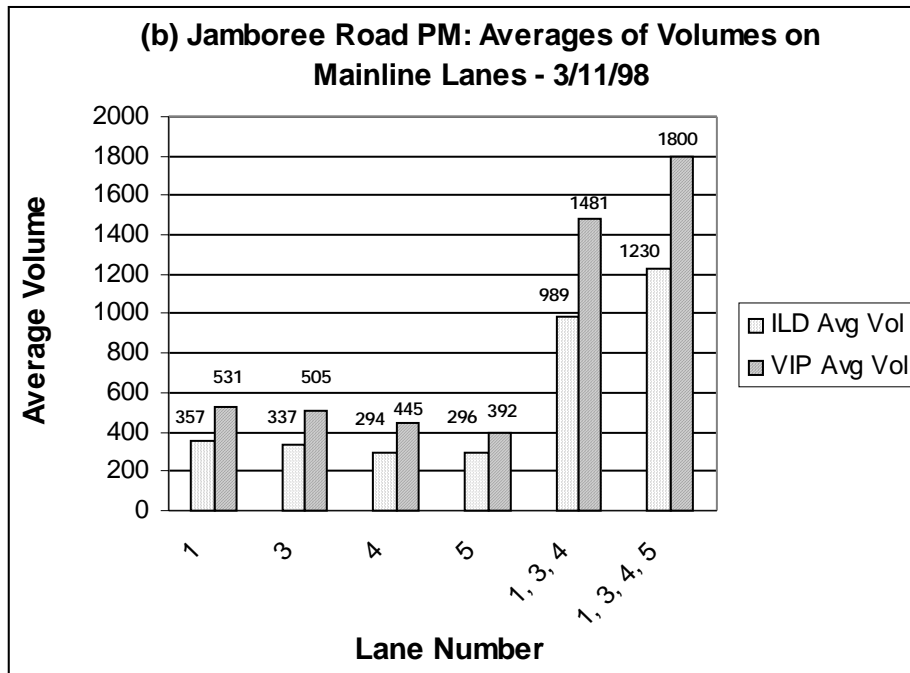
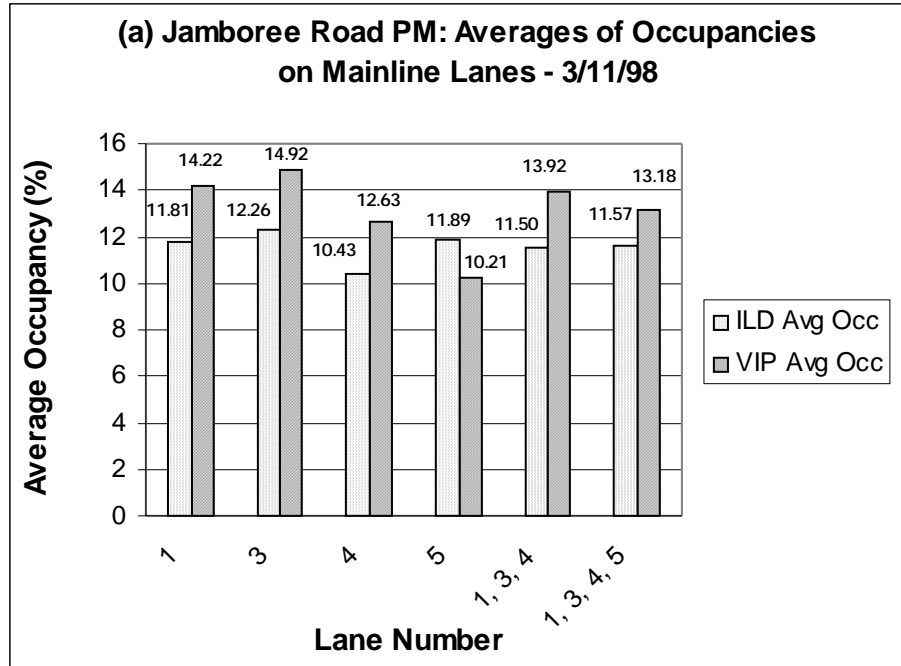


Figure J-42. Comparison of ILD and VIP lane-by-lane averages of (a) lane occupancy and (b) total volume at the Jamboree Road evaluation site during the afternoon rush-hour interval on 3/11/98

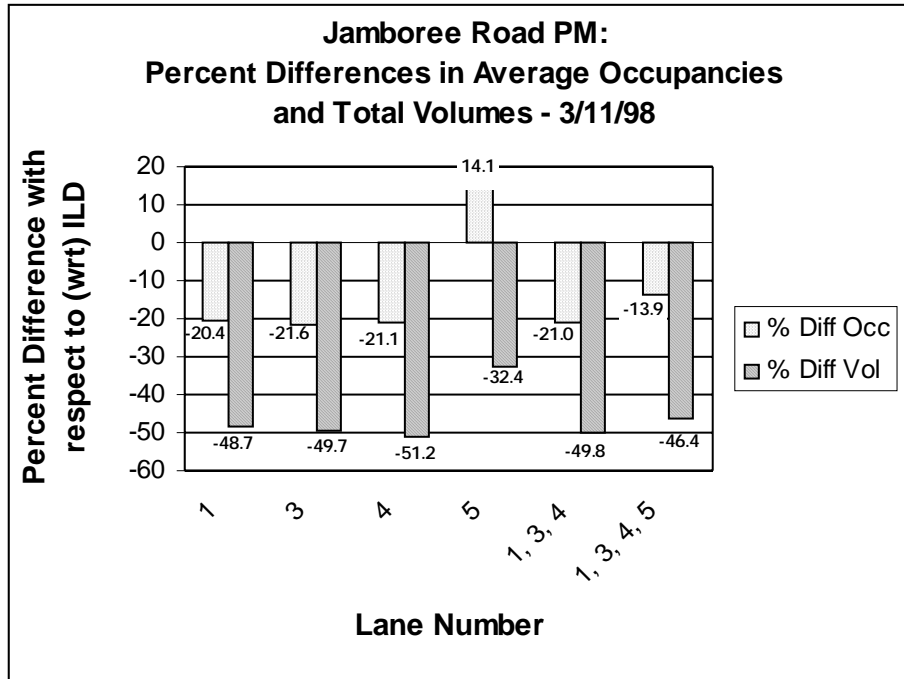


Figure J-43. Percent difference between the ILD and VIP averages of the average occupancy and total volume by lane at the Jamboree Road evaluation site during the afternoon rush-hour interval on 3/11/98

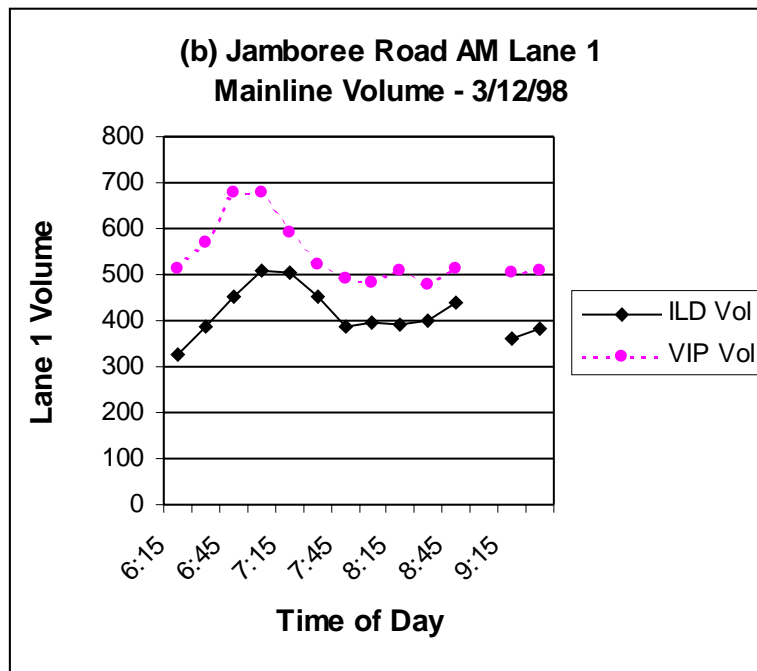
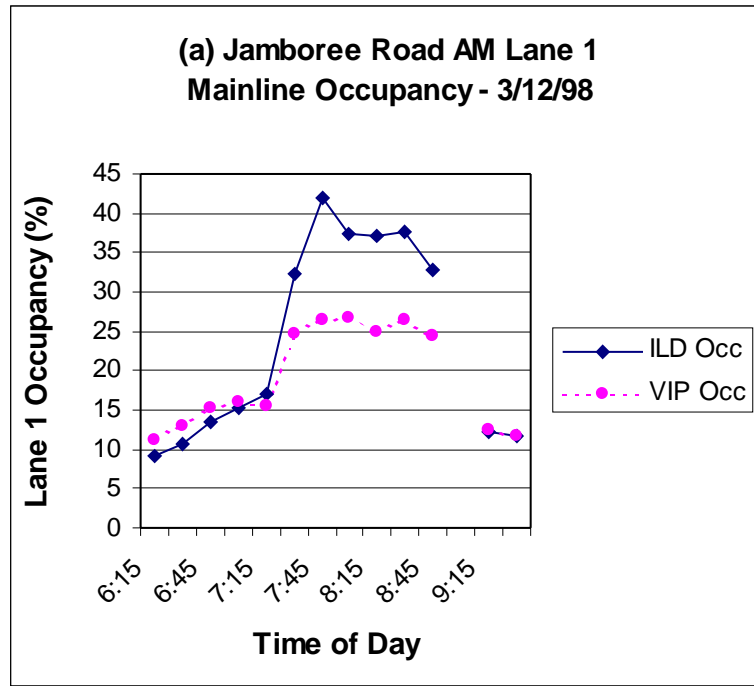


Figure J-44. Lane 1 (a) occupancy and (b) volume at the Jamboree Road evaluation site during the morning rush-hour interval on 3/12/98

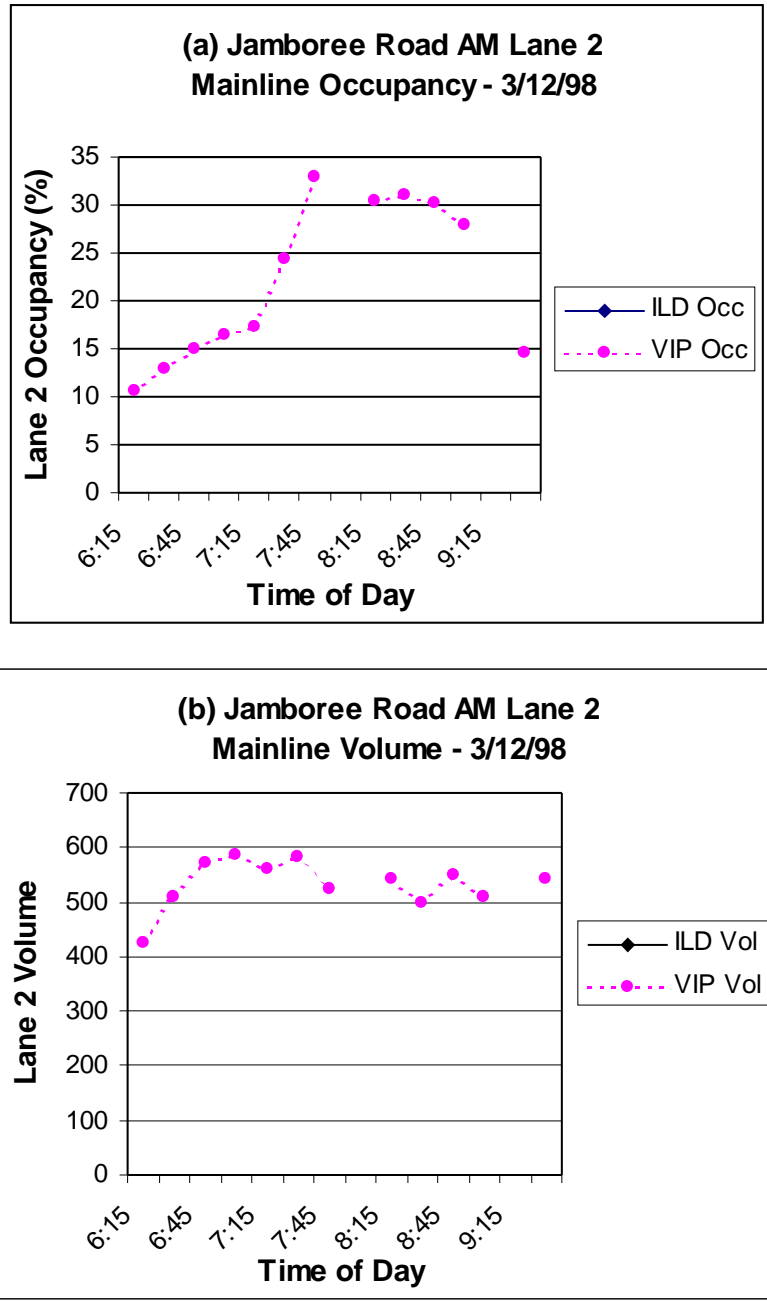


Figure J-45. Lane 2 (a) occupancy and (b) volume at the Jamboree Road evaluation site during the morning rush-hour interval on 3/12/98

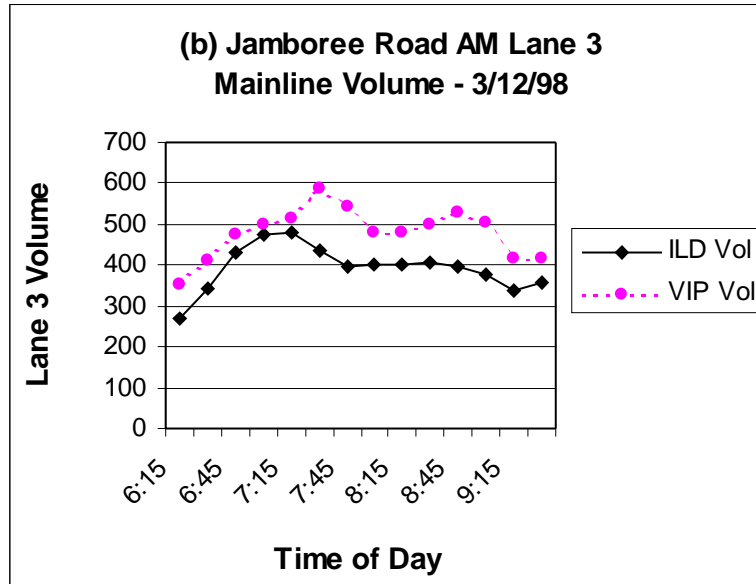
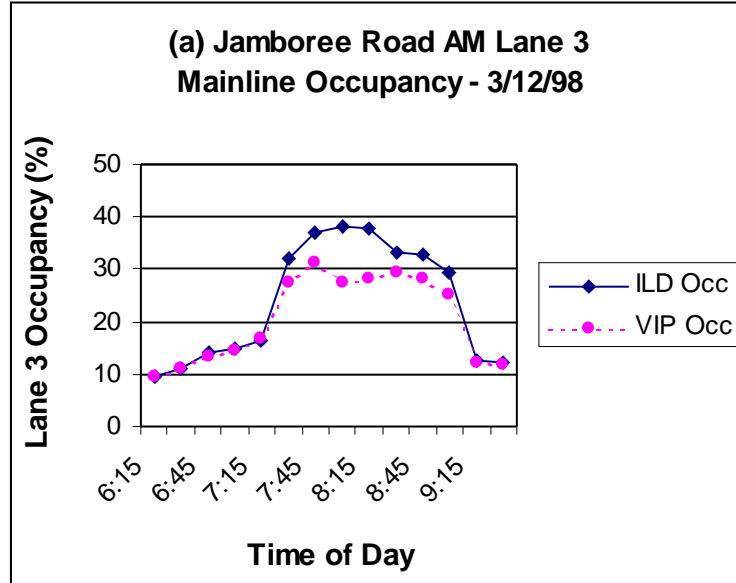


Figure J-46. Lane 3 (a) occupancy and (b) volume at the Jamboree Road evaluation site during the morning rush-hour interval on 3/12/98

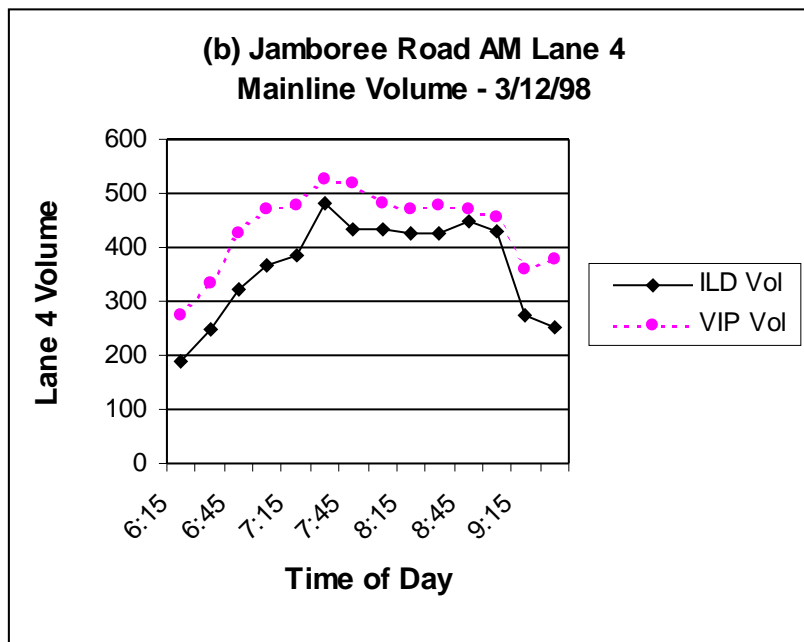
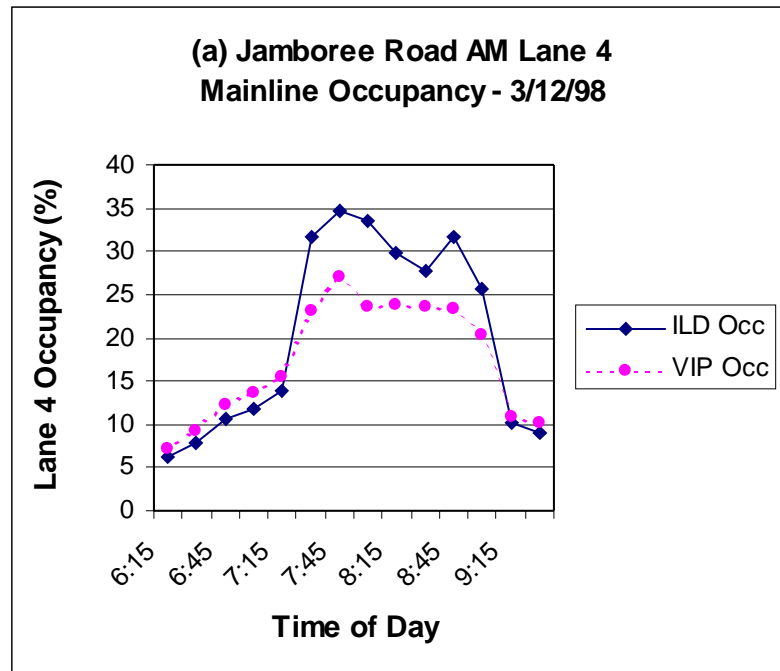


Figure J-47. Lane 4 (a) occupancy and (b) volume at the Jamboree Road evaluation site during the morning rush-hour interval on 3/12/98

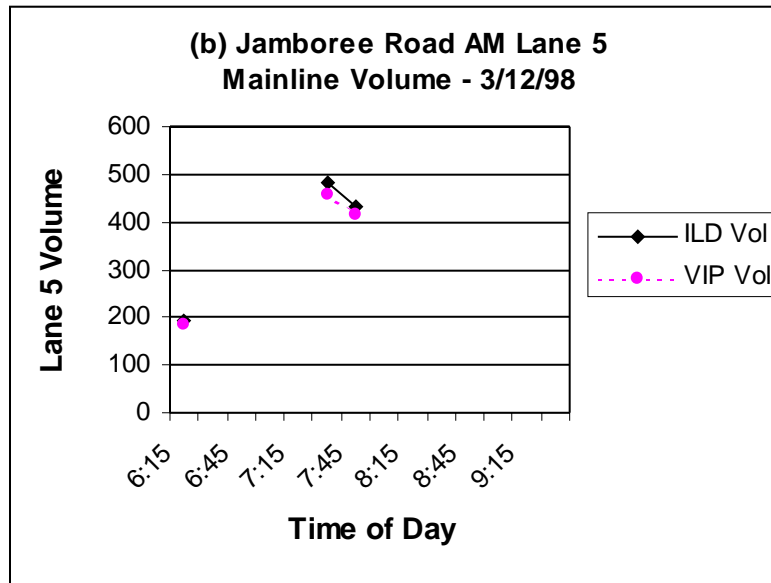
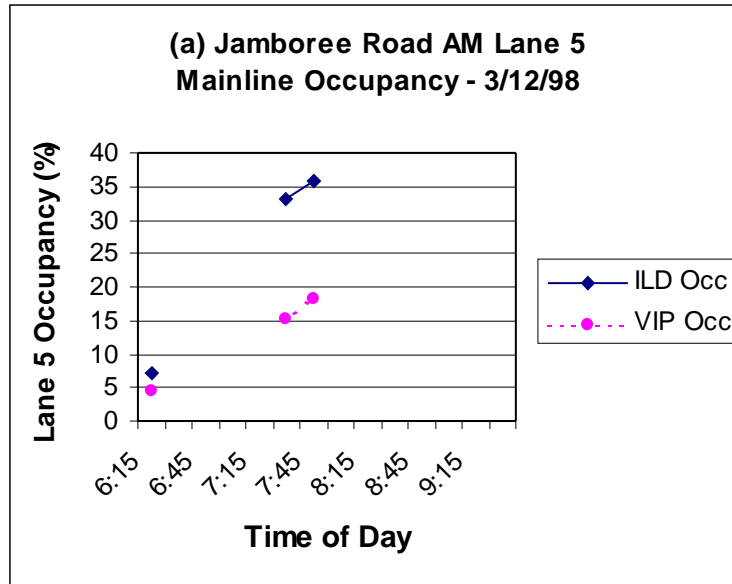


Figure J-48. Lane 5 (a) occupancy and (b) volume at the Jamboree Road evaluation site during the morning rush-hour interval on 3/12/98

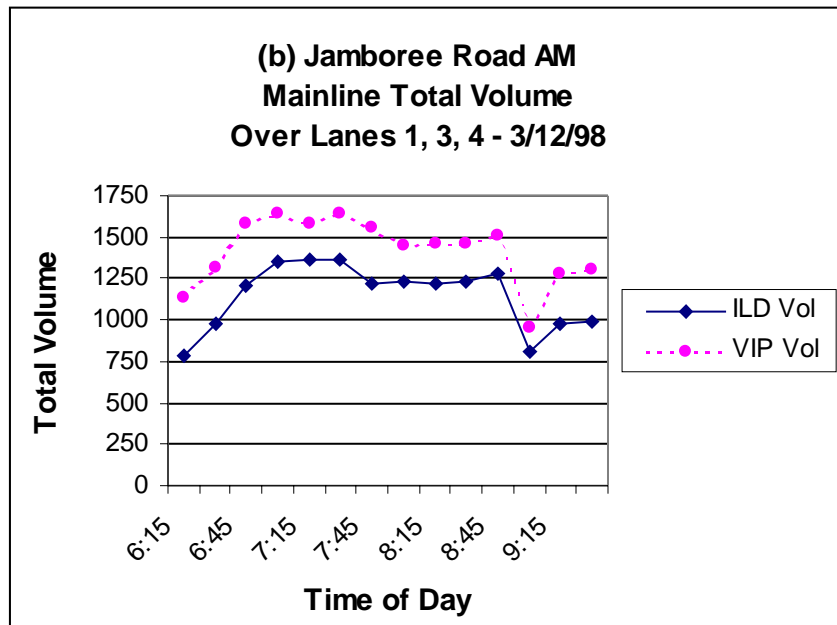
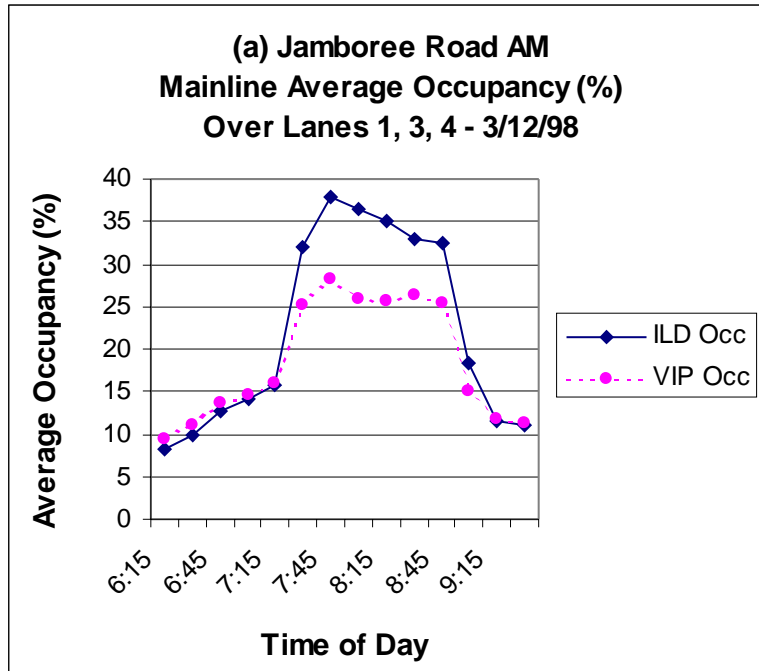


Figure J-49. Average (a) lane occupancy and (b) total volume measured by the ILDs and VIP over lanes 1, 3, and 4 at the Jamboree Road evaluation site during the morning rush-hour interval on 3/12/98

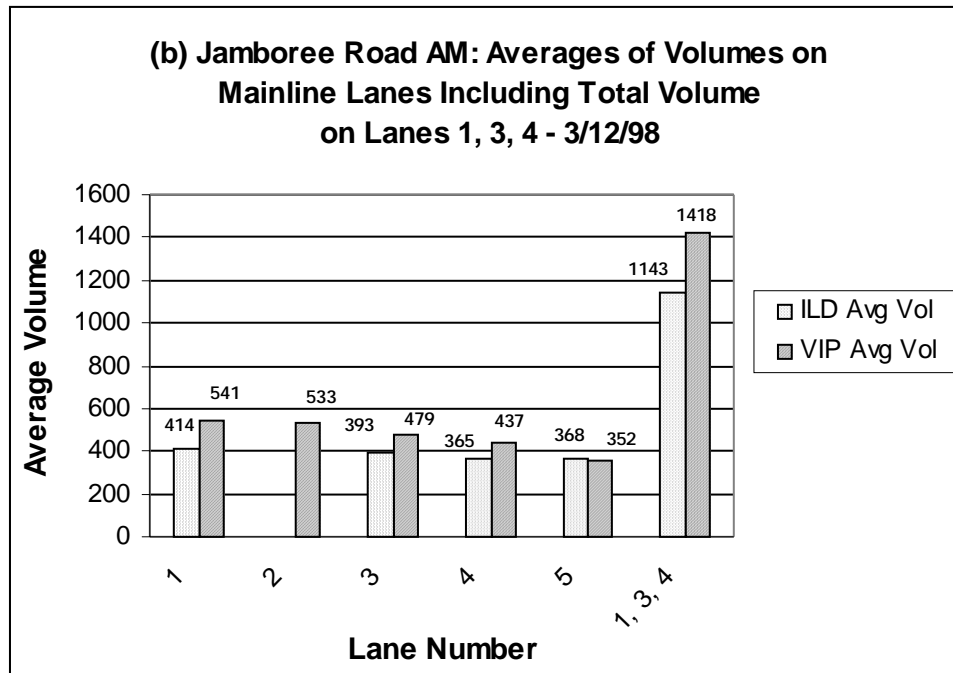
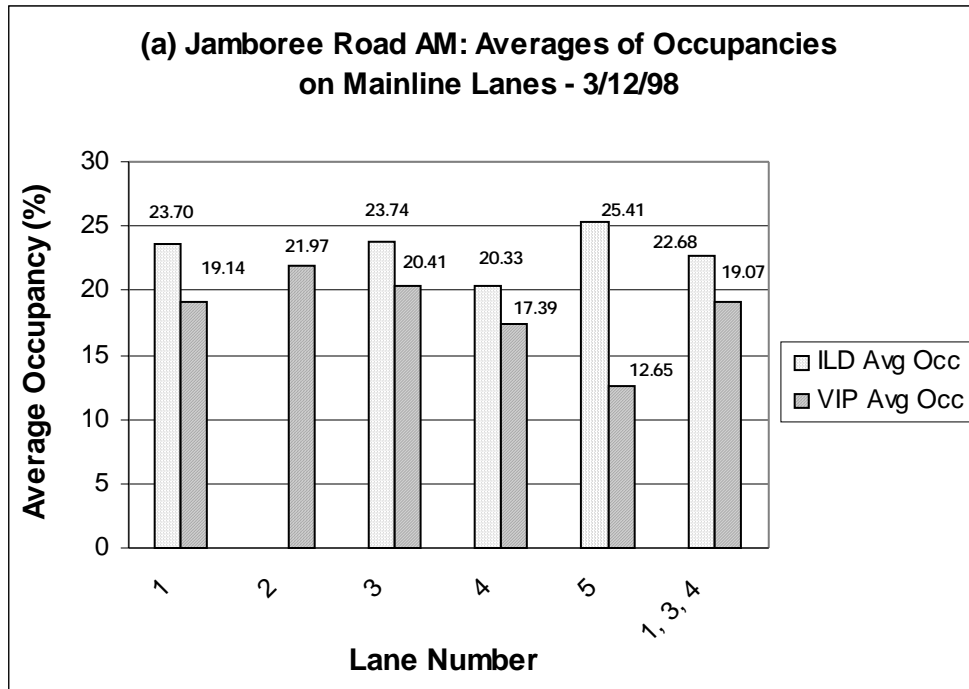


Figure J-50. Comparison of ILD and VIP lane-by-lane averages of (a) lane occupancy and (b) total volume at the Jamboree Road evaluation site during the morning rush-hour interval on 3/12/98

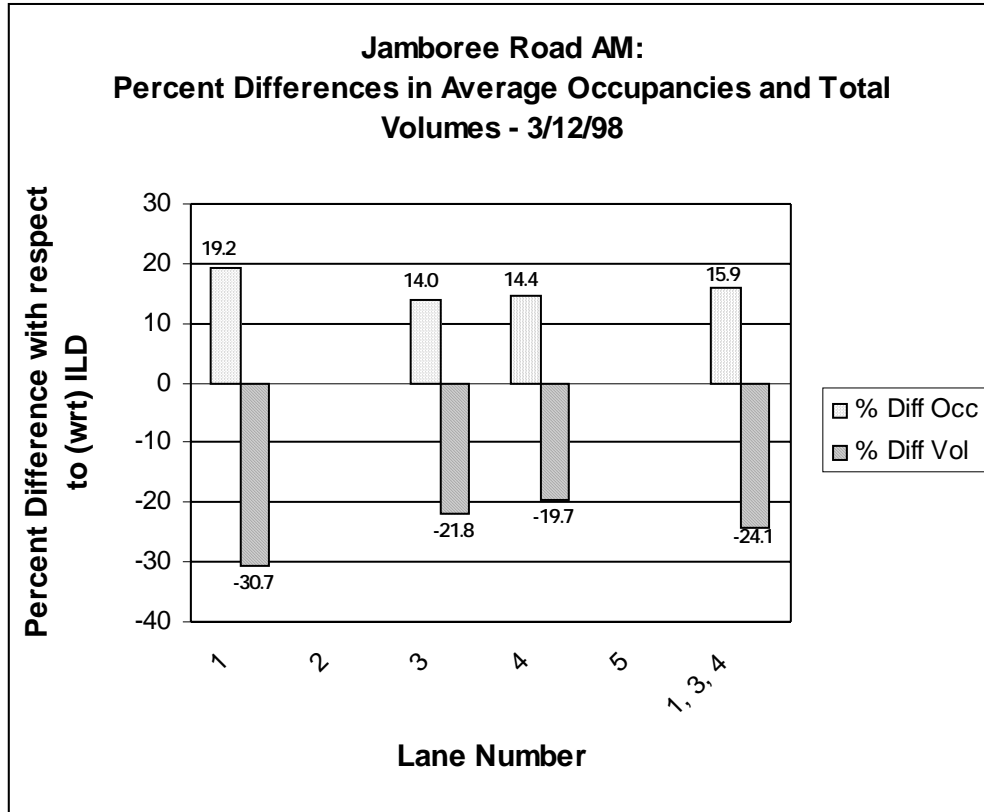


Figure J-51. Percent difference between the ILD and VIP averages of the average occupancy and total volume by lane at the Jamboree Road evaluation site during the morning rush-hour interval on 3/12/98

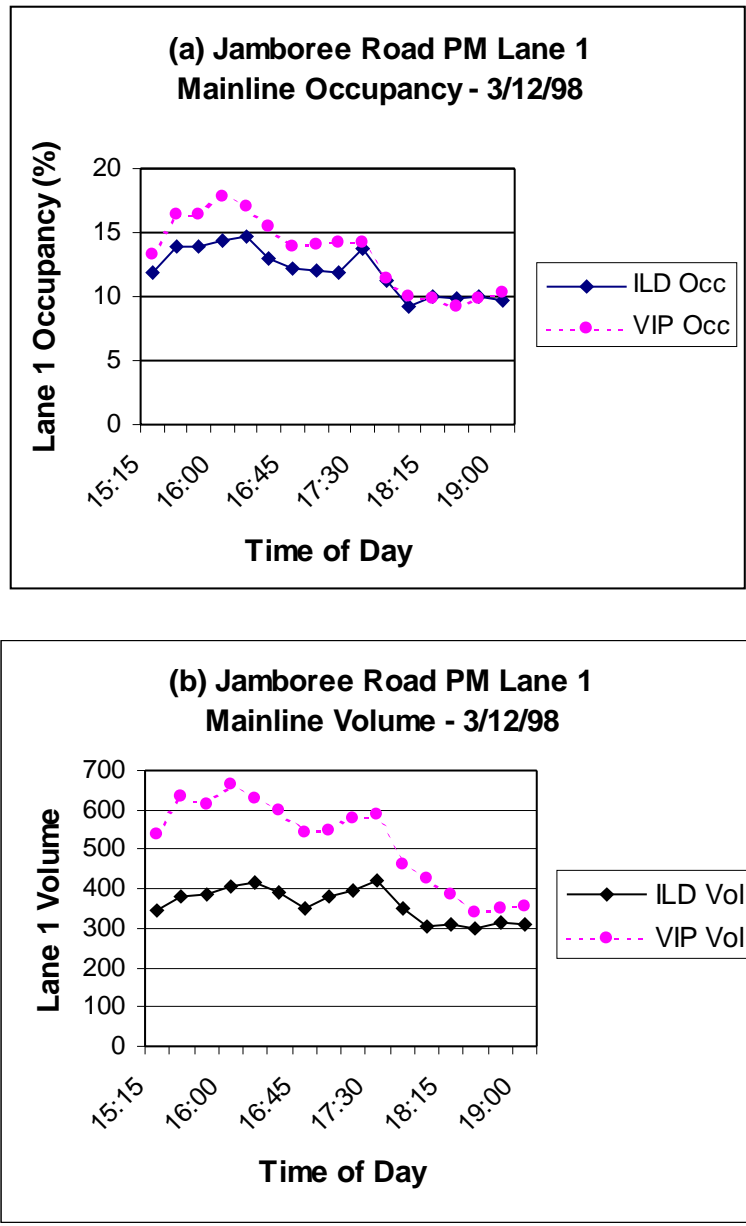


Figure J-52. Lane 1 (a) occupancy and (b) volume at the Jamboree Road evaluation site during the afternoon rush-hour interval on 3/12/98

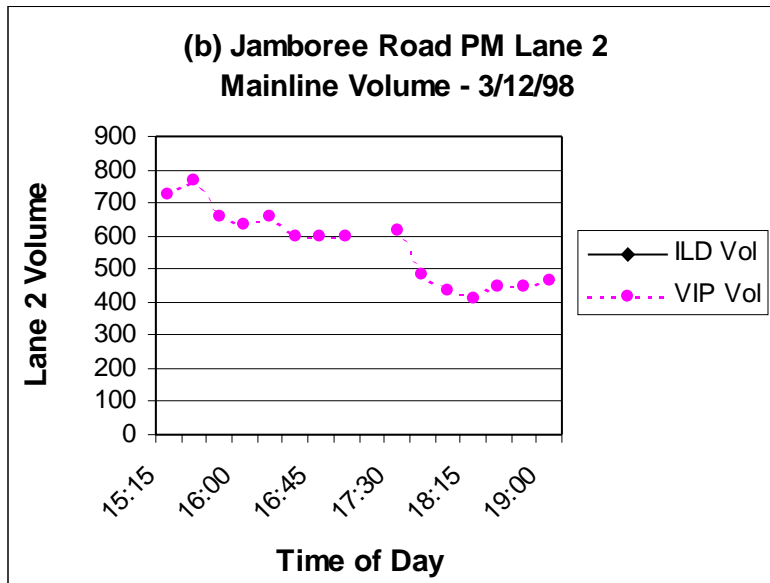
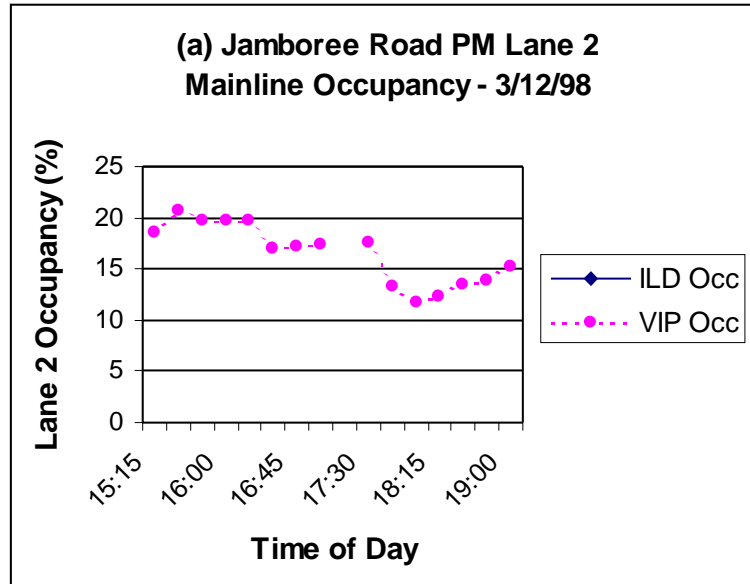


Figure J-53. Lane 2 (a) occupancy and (b) volume at the Jamboree Road evaluation site during the afternoon rush-hour interval on 3/12/98

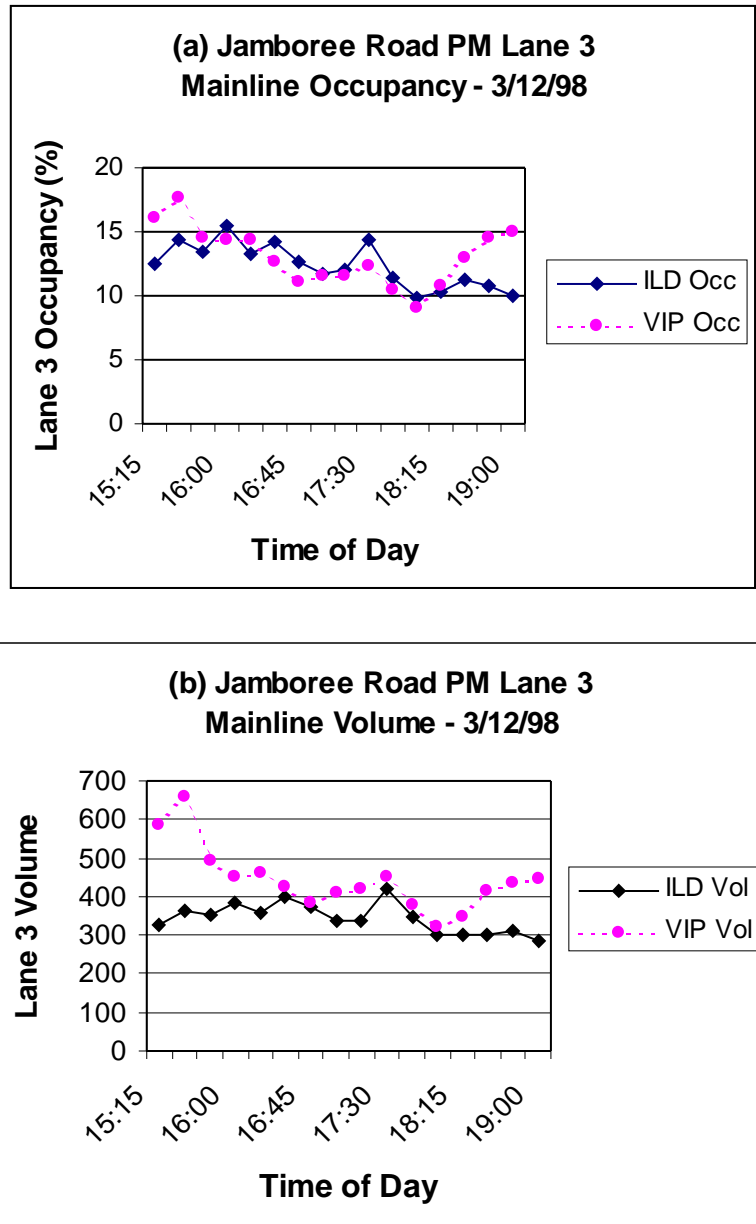


Figure J-54. Lane 3 (a) occupancy and (b) volume at the Jamboree Road evaluation site during the afternoon rush-hour interval on 3/12/98

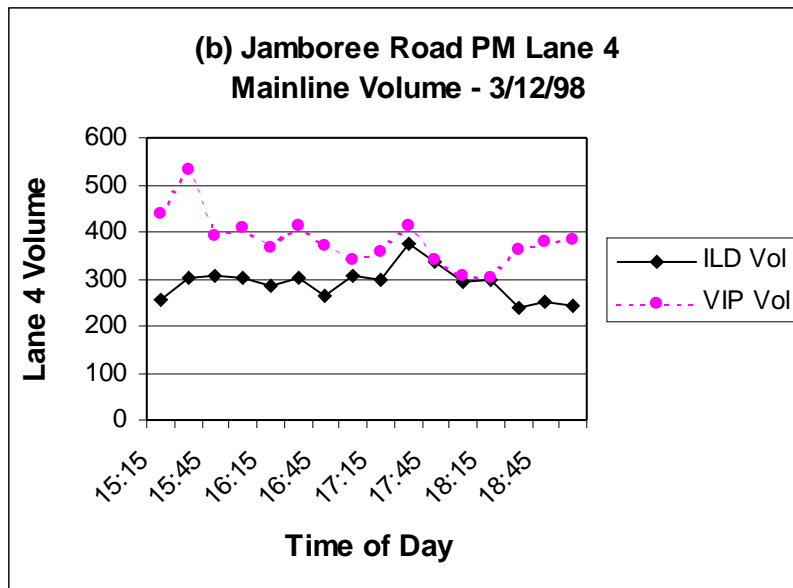
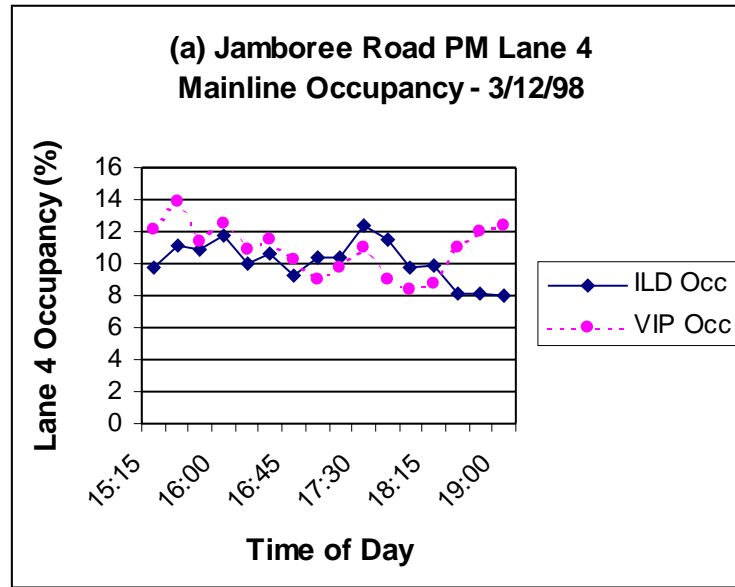


Figure J-55. Lane 4 (a) occupancy and (b) volume at the Jamboree Road evaluation site during the afternoon rush-hour interval on 3/12/98

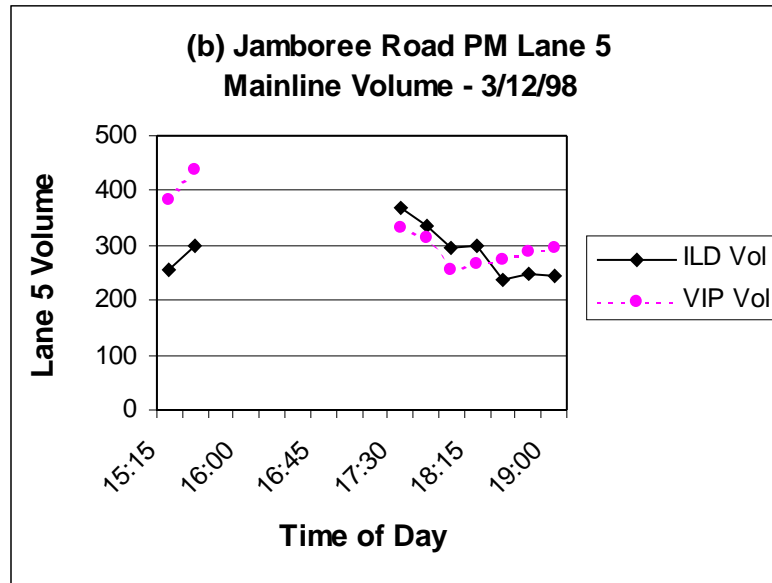
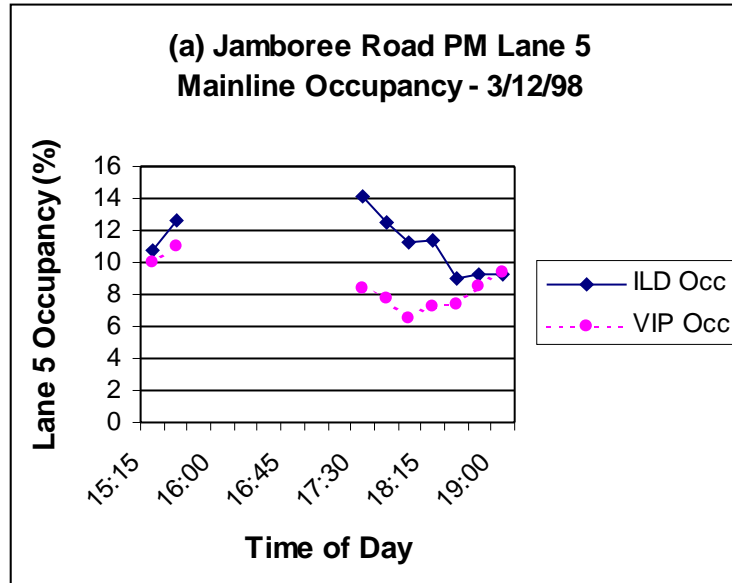


Figure J-56. Lane 5 (a) occupancy and (b) volume at the Jamboree Road evaluation site during the afternoon rush-hour interval on 3/12/98

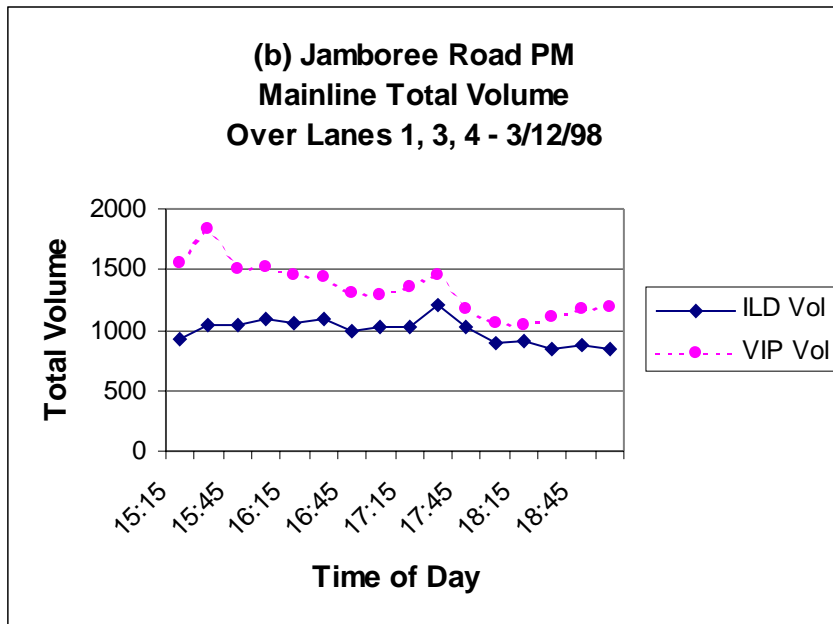
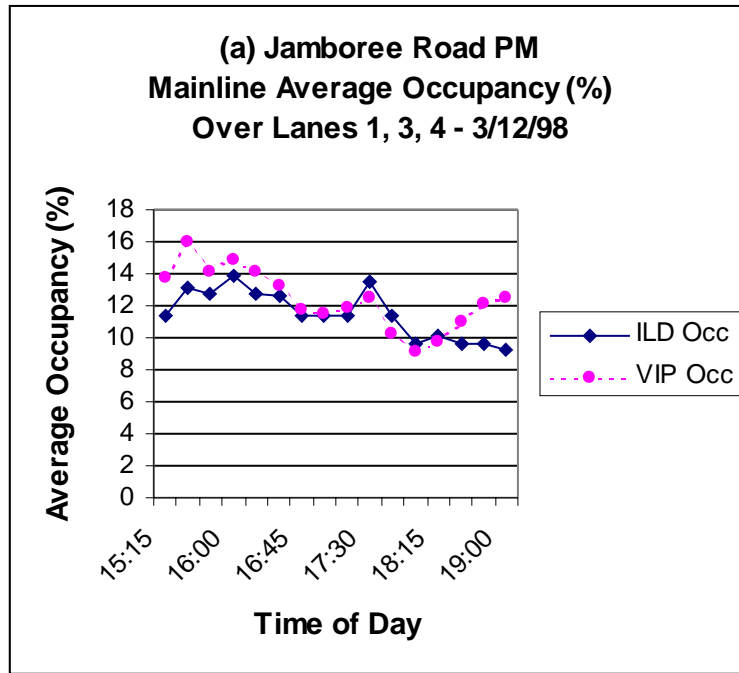


Figure J-57. Average (a) lane occupancy and (b) total volume measured by the ILDs and VIP over all lanes at the Jamboree Road evaluation site during the afternoon rush-hour interval on 3/12/98

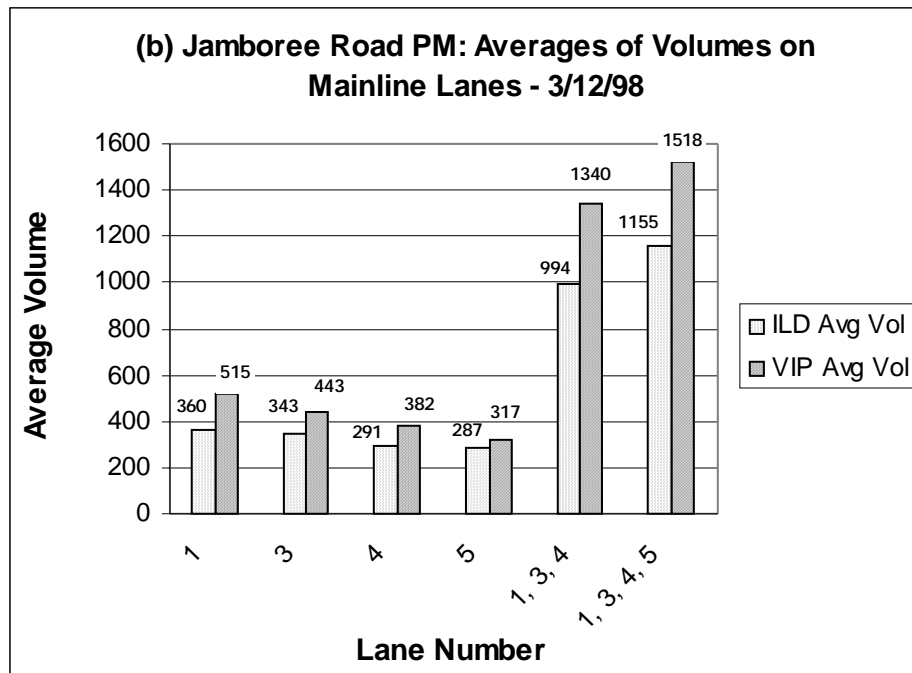
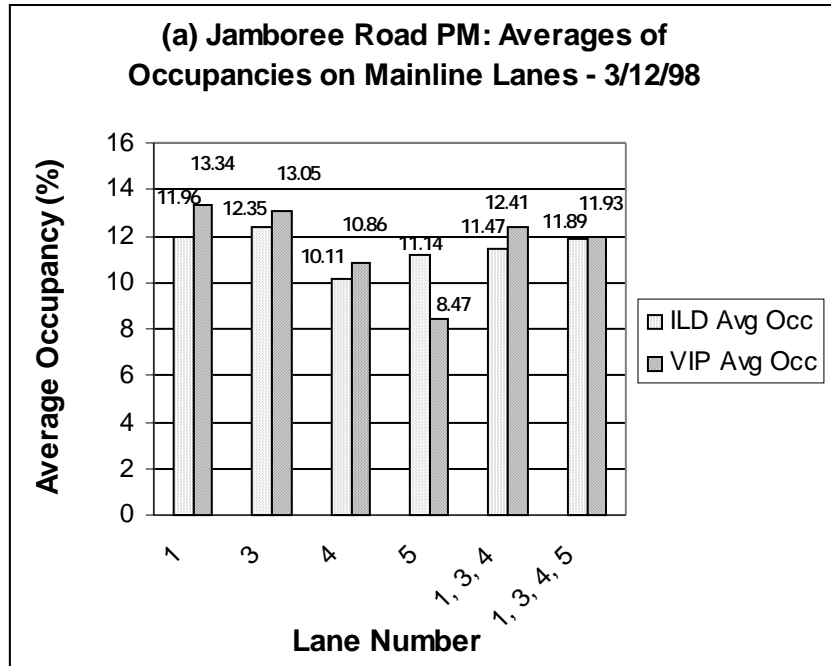


Figure J-58. Comparison of ILD and VIP lane-by-lane averages of (a) lane occupancy and (b) total volume at the Jamboree Road evaluation site during the afternoon rush-hour interval on 3/12/98

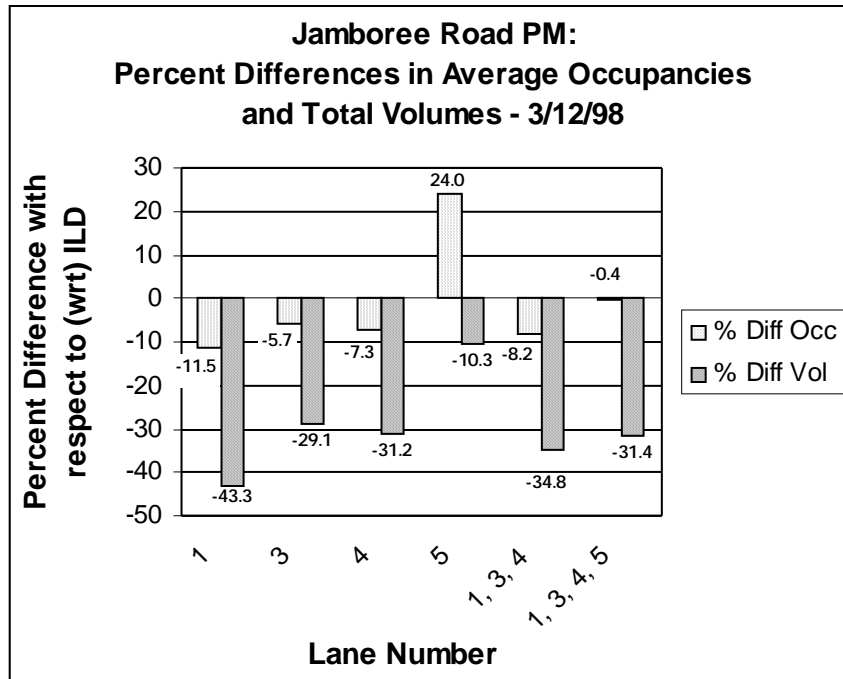


Figure J-59. Percent difference between the ILD and VIP averages of the average occupancy and total volume by lane at the Jamboree Road evaluation site during the afternoon rush-hour interval on 3/12/98

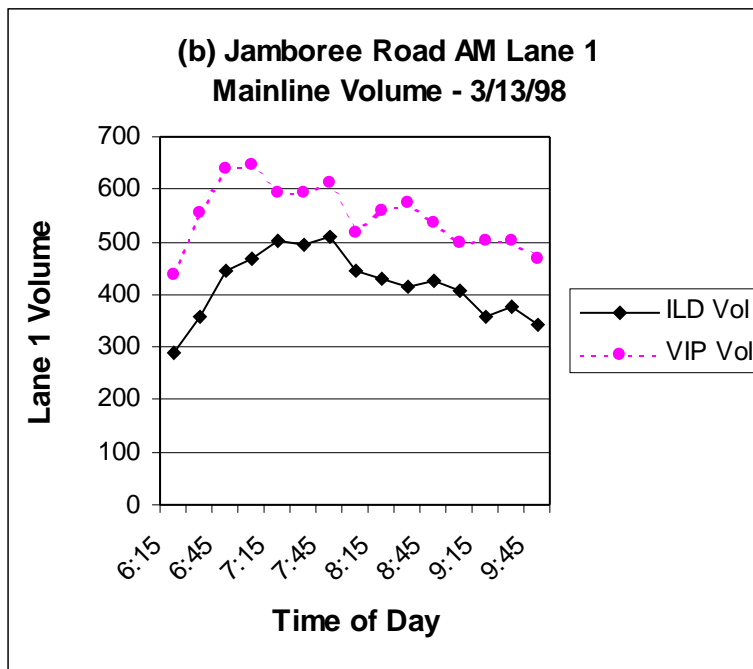
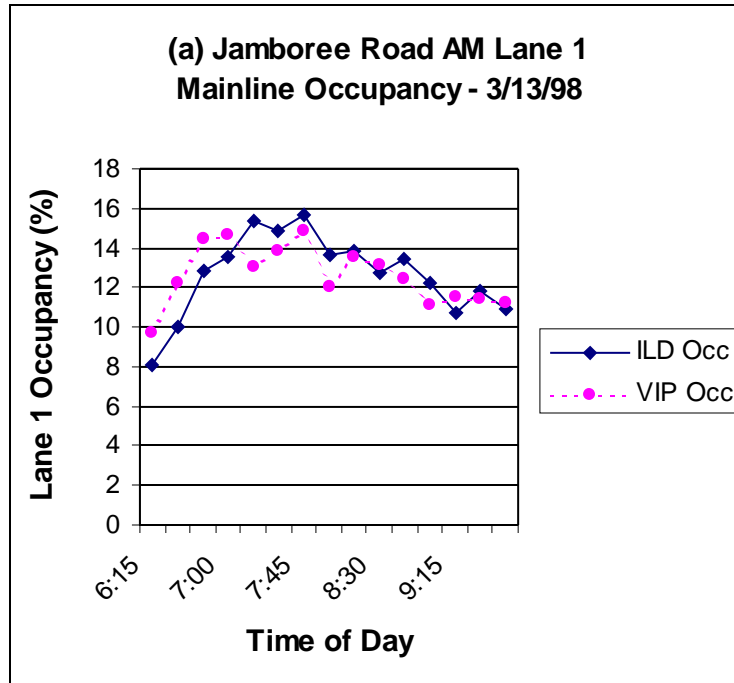


Figure J-60. Lane 1 (a) occupancy and (b) volume at the Jamboree Road evaluation site during the morning rush-hour interval on 3/13/98

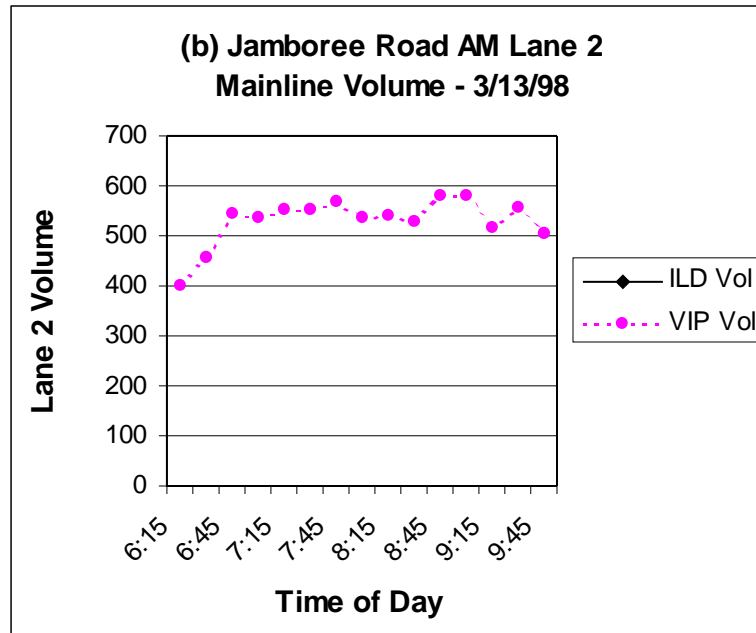
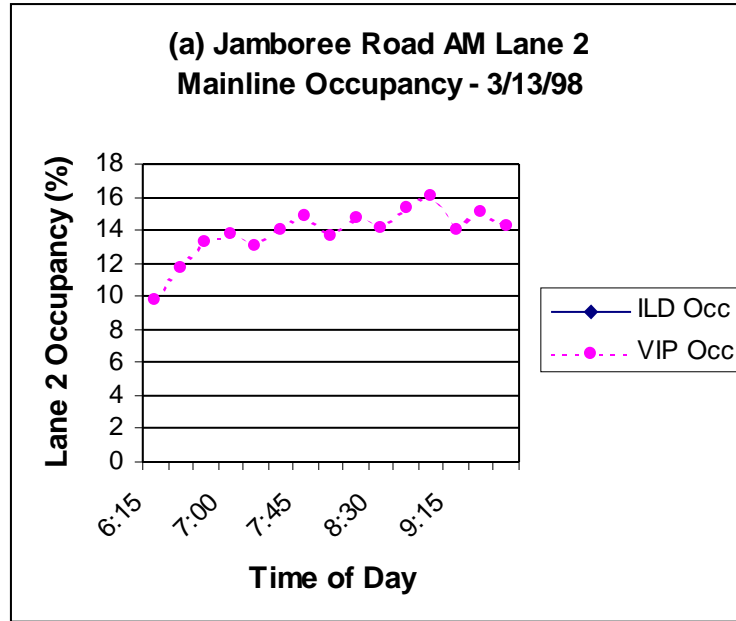


Figure J-61. Lane 2 (a) occupancy and (b) volume at the Jamboree Road evaluation site during the morning rush-hour interval on 3/13/98

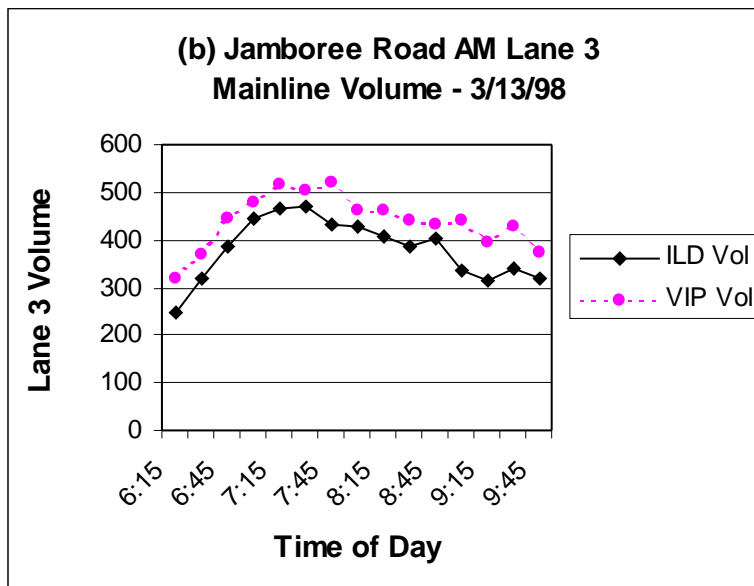
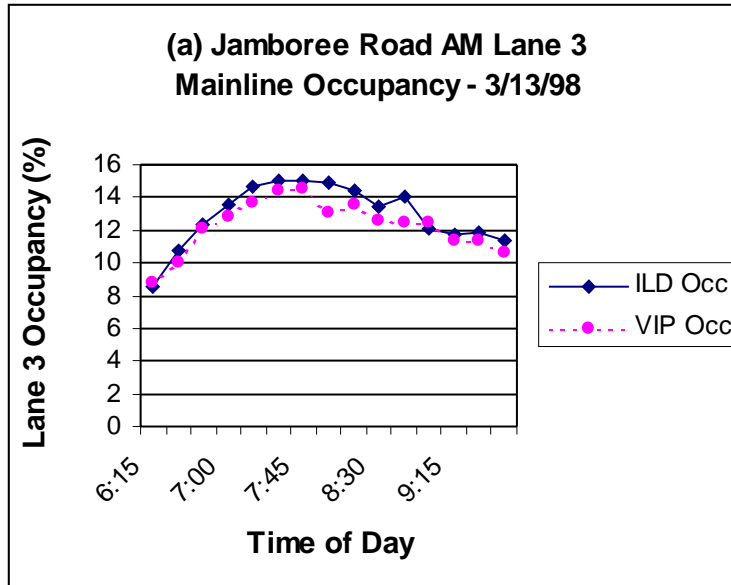


Figure J-62. Lane 3 (a) occupancy and (b) volume at the Jamboree Road evaluation site during the morning rush-hour interval on 3/13/98

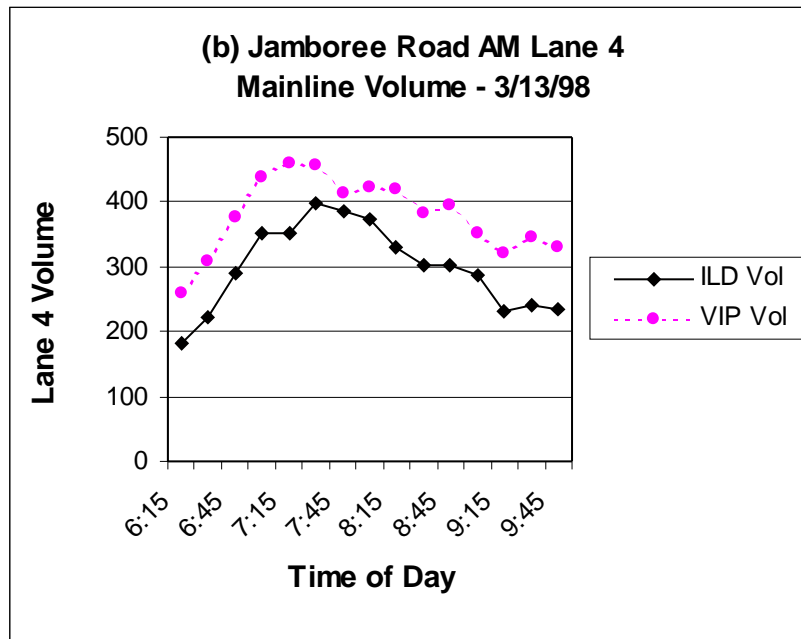
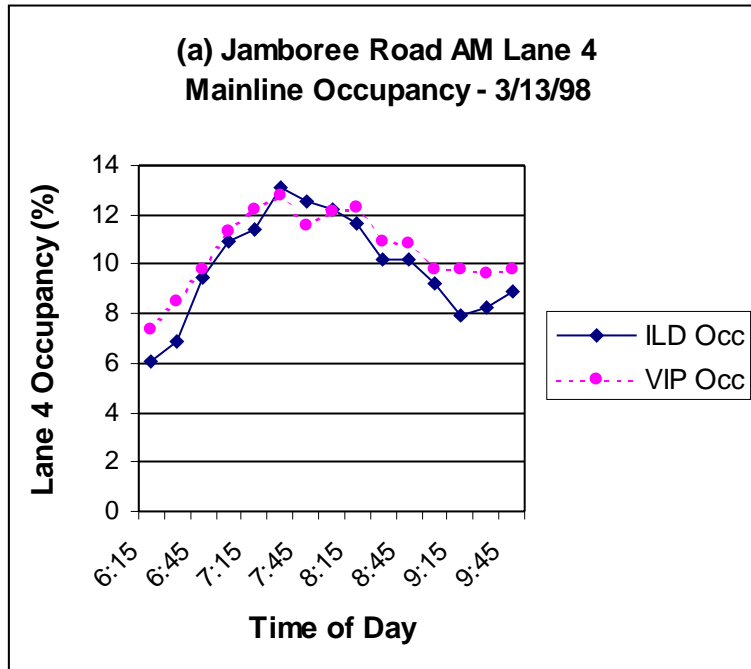


Figure J-63. Lane 4 (a) occupancy and (b) volume at the Jamboree Road evaluation site during the morning rush-hour interval on 3/13/98

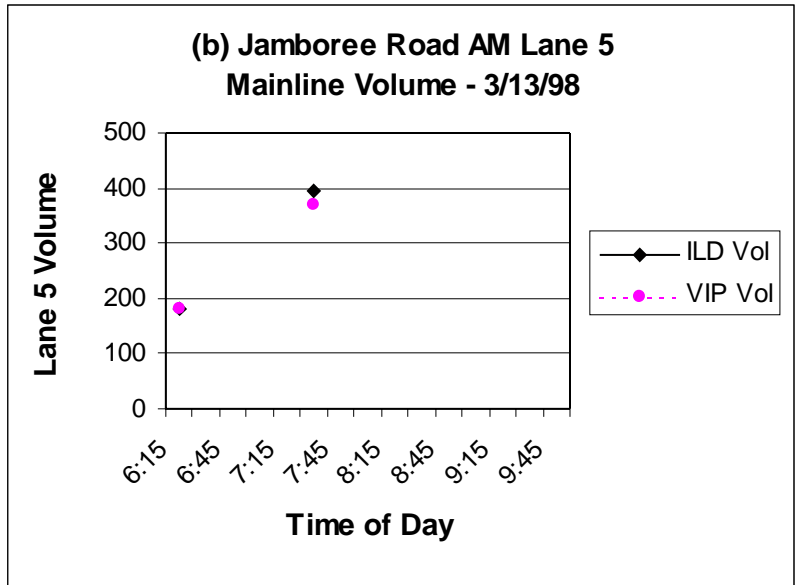
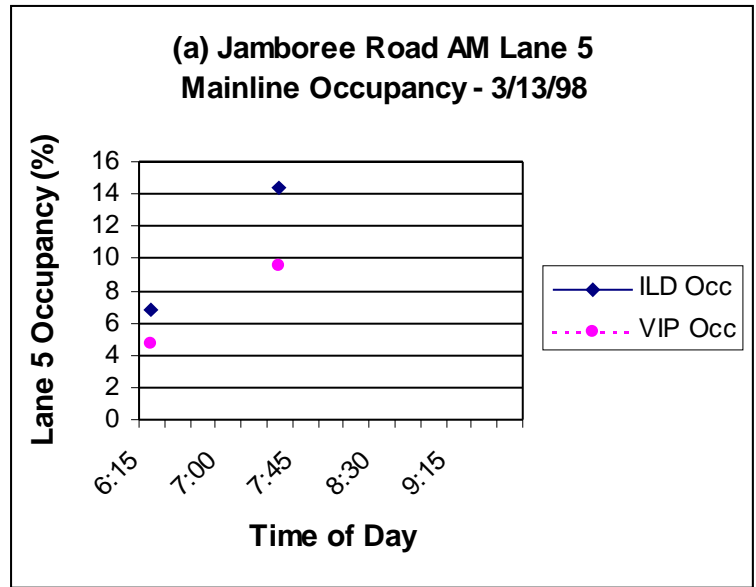


Figure J-64. Lane 5 (a) occupancy and (b) volume at the Jamboree Road evaluation site during the morning rush-hour interval on 3/13/98

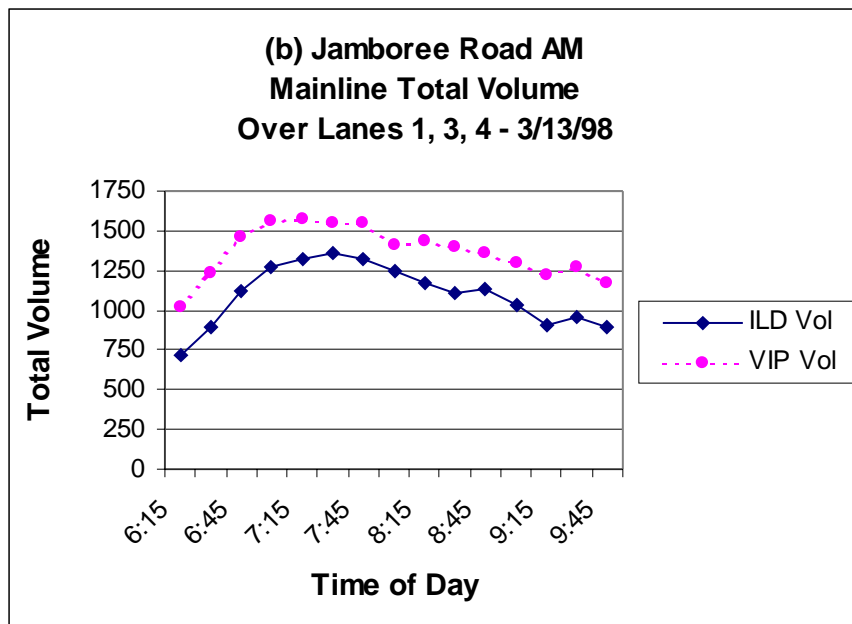
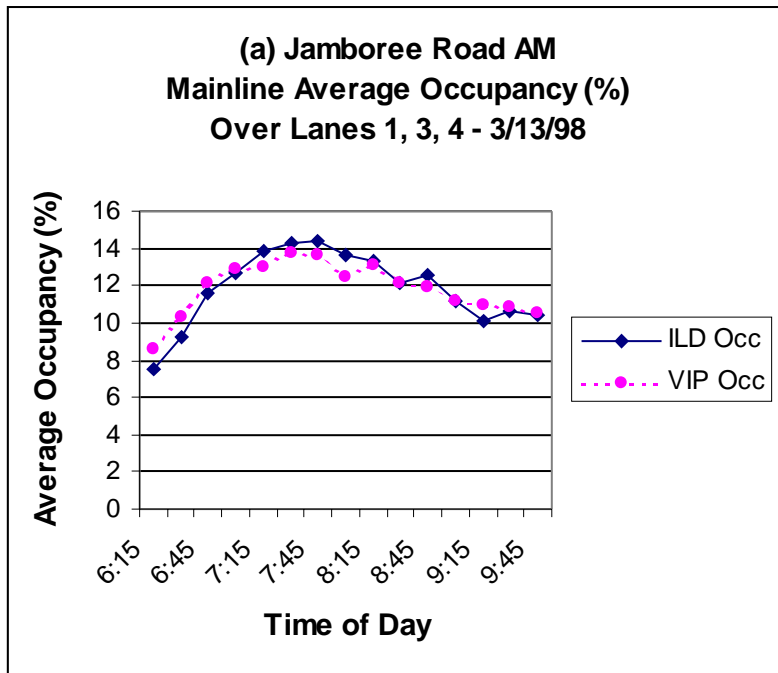


Figure J-65. Average (a) lane occupancy and (b) total volume measured by the ILDs and VIP over lanes 1, 3, and 4 at the Jamboree Road evaluation site during the morning rush-hour interval on 3/13/98

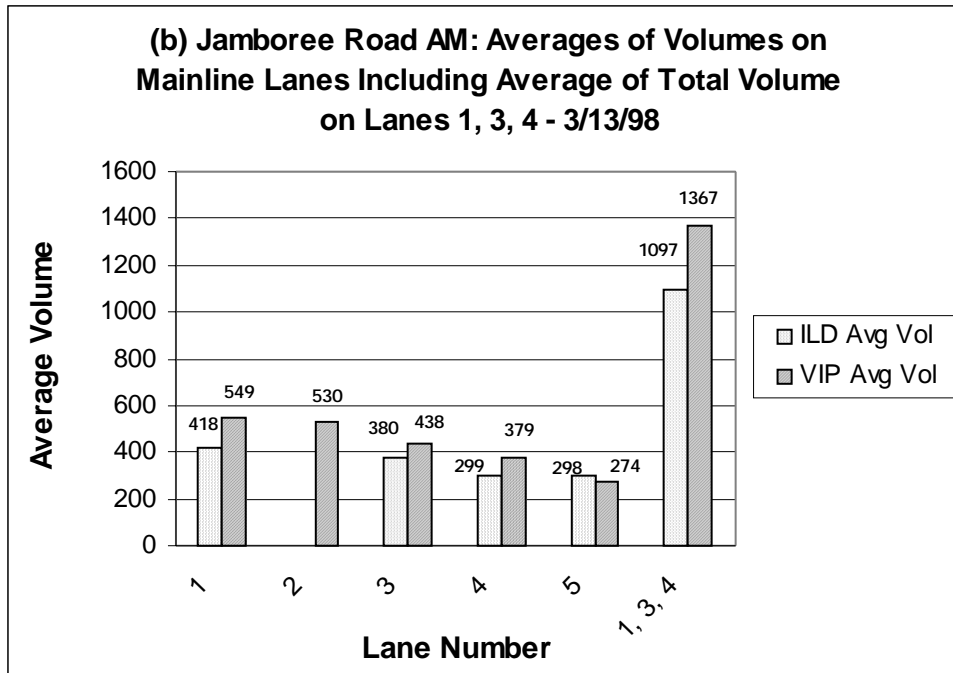
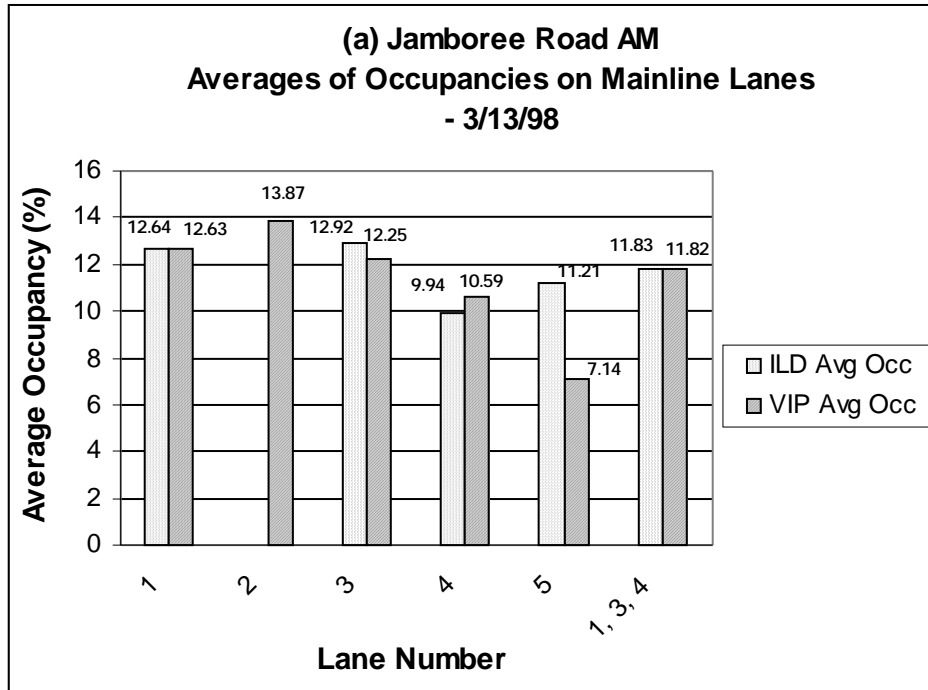


Figure J-66. Comparison of ILD and VIP lane-by-lane averages of (a) lane occupancy and (b) total volume at the Jamboree Road evaluation site during the morning rush-hour interval on 3/13/98

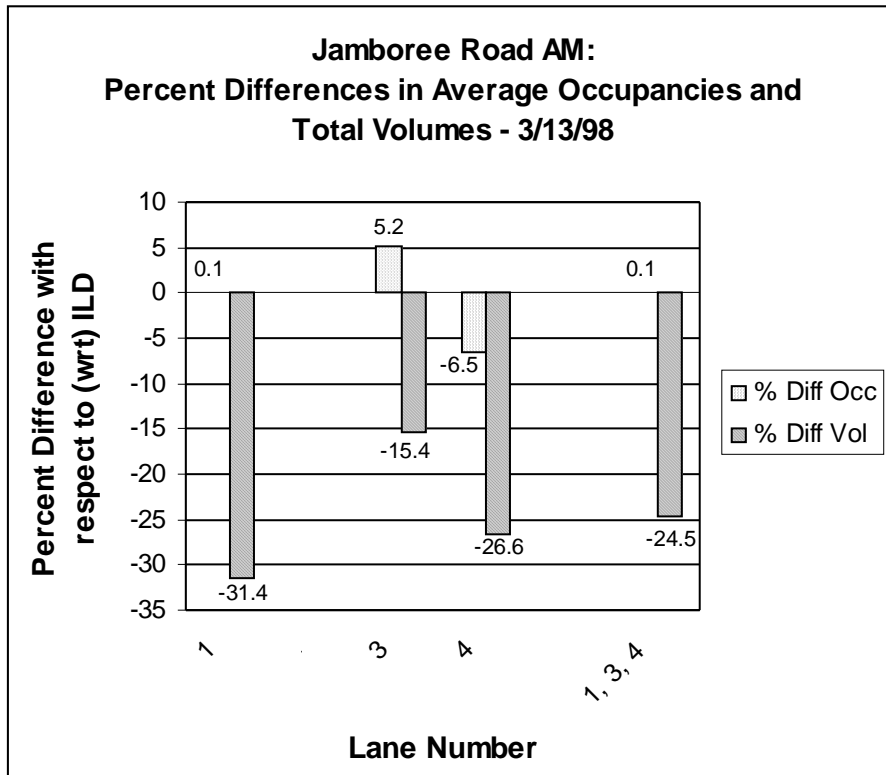


Figure J-67. Percent difference between the ILD and VIP averages of the average occupancy and total volume by lane at the Jamboree Road evaluation site during the morning rush-hour interval on 3/13/98

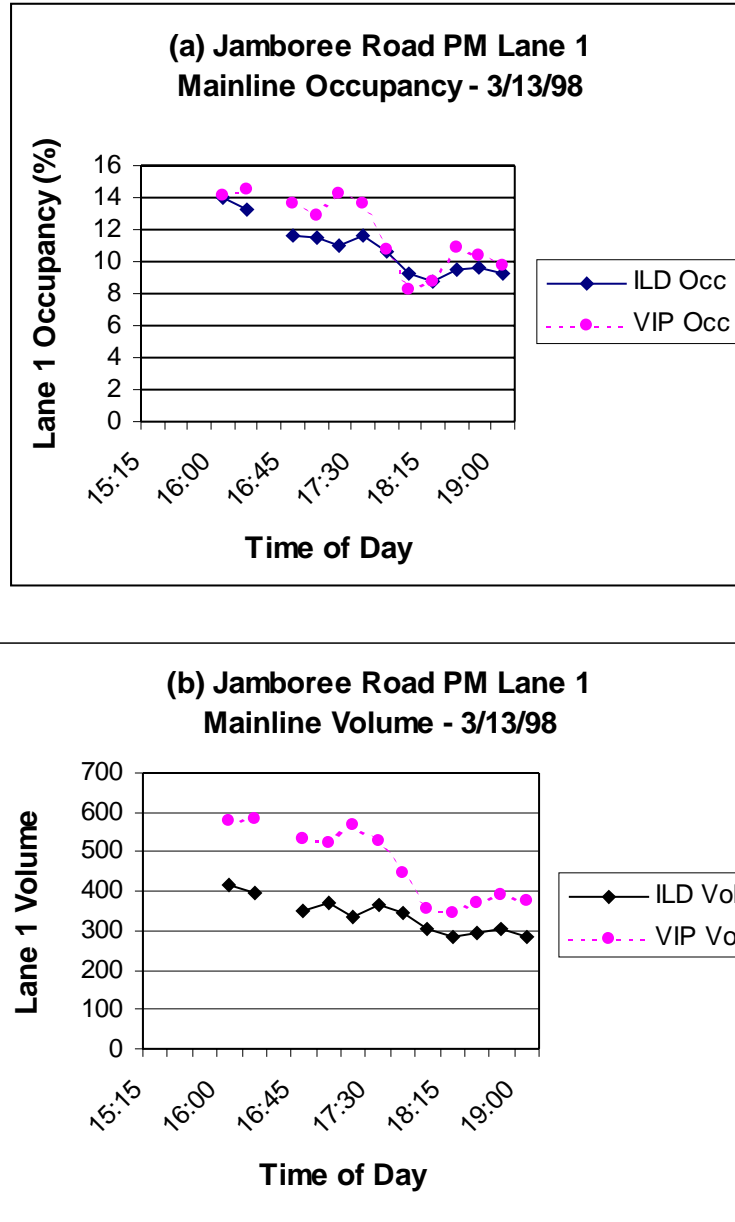


Figure J-68. Lane 1 (a) occupancy and (b) volume at the Jamboree Road evaluation site during the afternoon rush-hour interval on 3/13/98

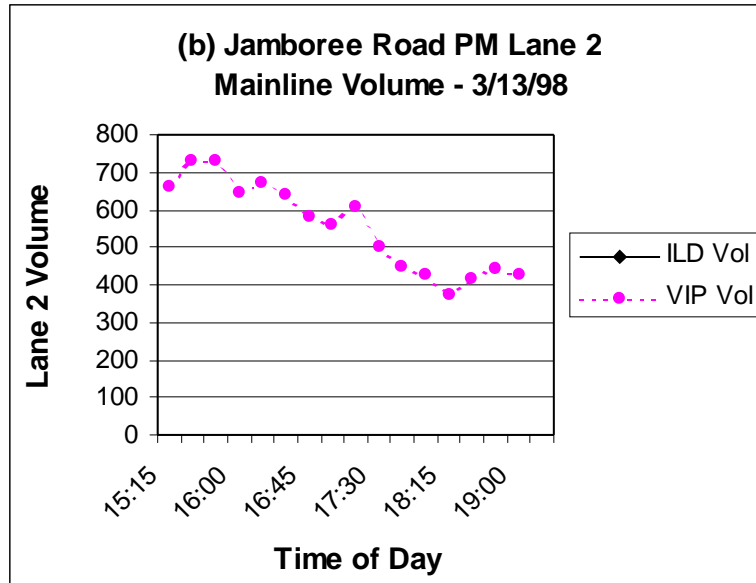
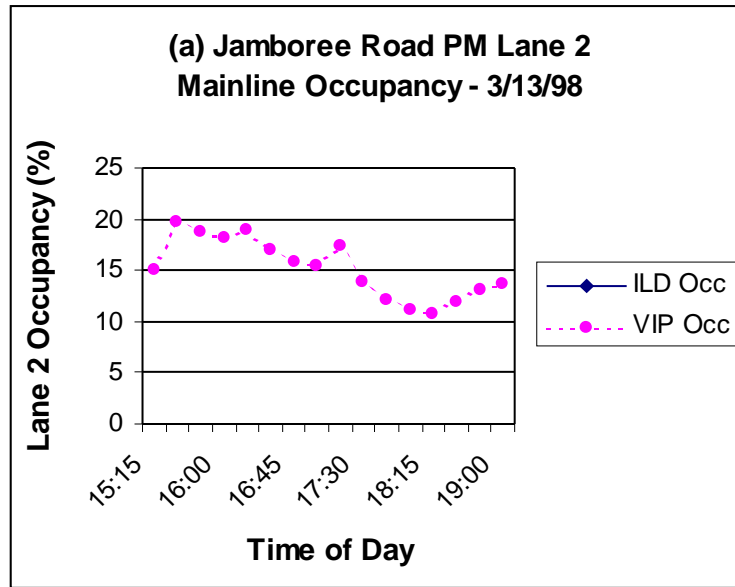


Figure J-69. Lane 2 (a) occupancy and (b) volume at the Jamboree Road evaluation site during the afternoon rush-hour interval on 3/13/98

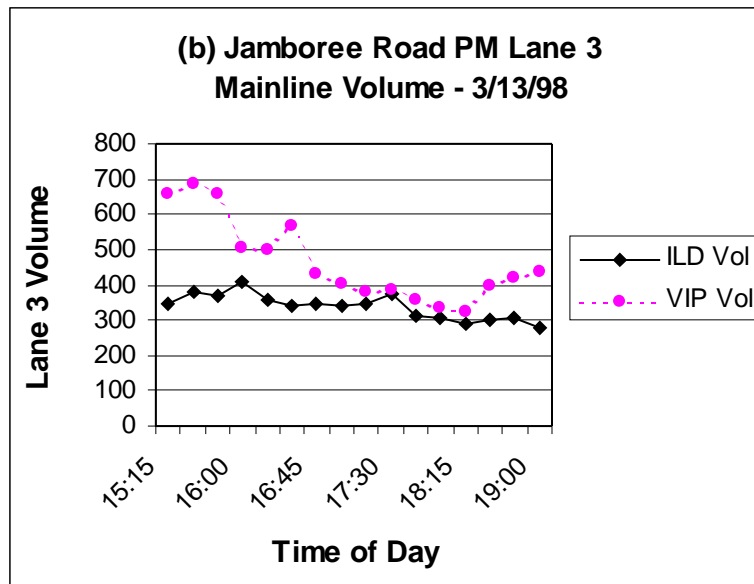
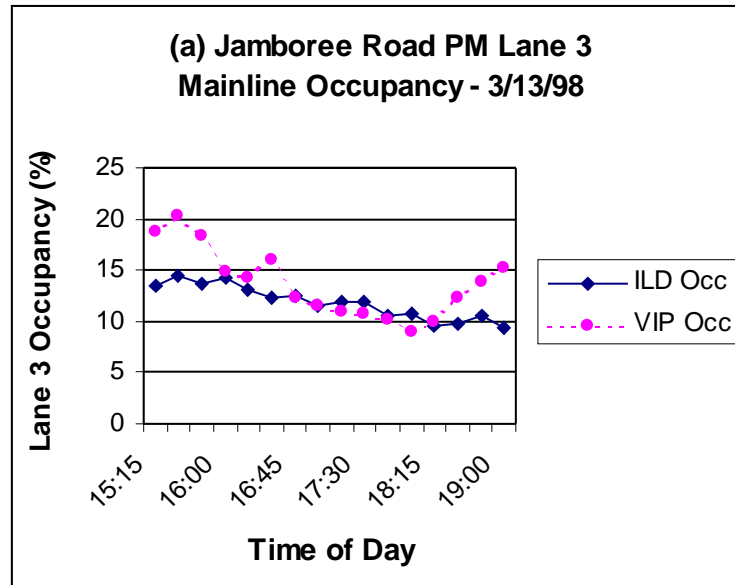


Figure J-70. Lane 3 (a) occupancy and (b) volume at the Jamboree Road evaluation site during the afternoon rush-hour interval on 3/13/98

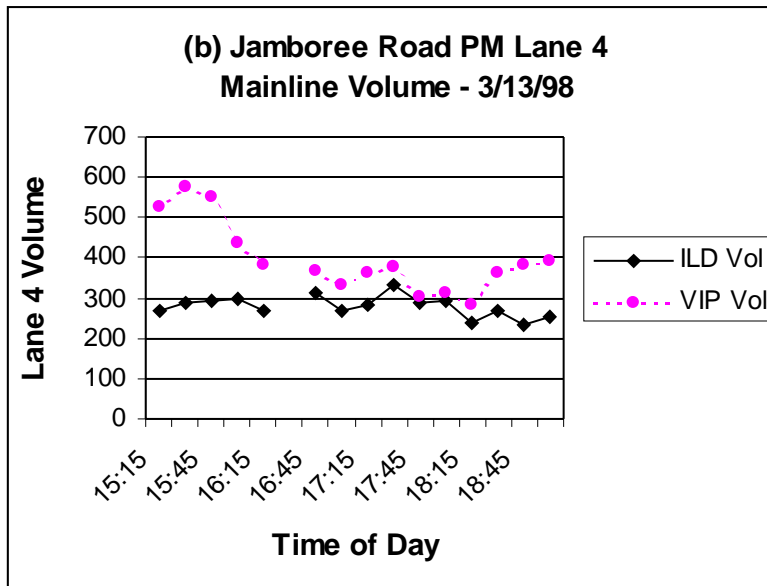
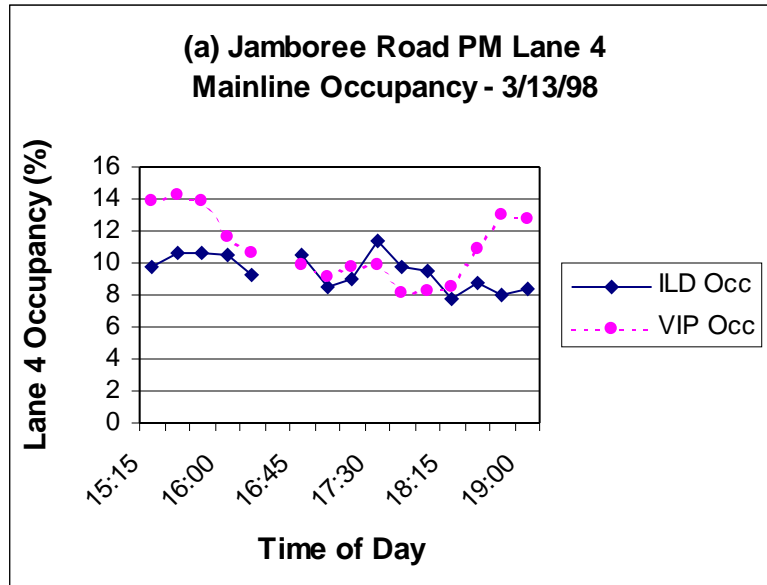


Figure J-71. Lane 4 (a) occupancy and (b) volume at the Jamboree Road evaluation site during the afternoon rush-hour interval on 3/13/98

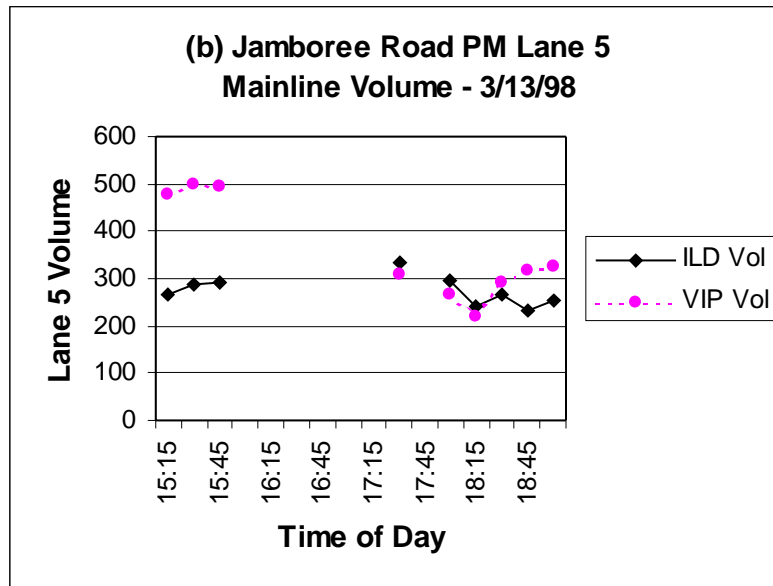
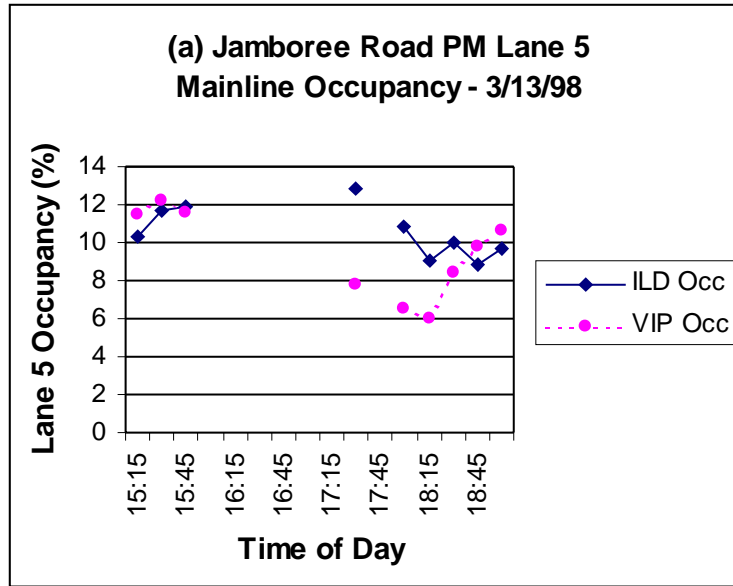


Figure J-72. Lane 5 (a) occupancy and (b) volume at the Jamboree Road evaluation site during the afternoon rush-hour interval on 3/13/98

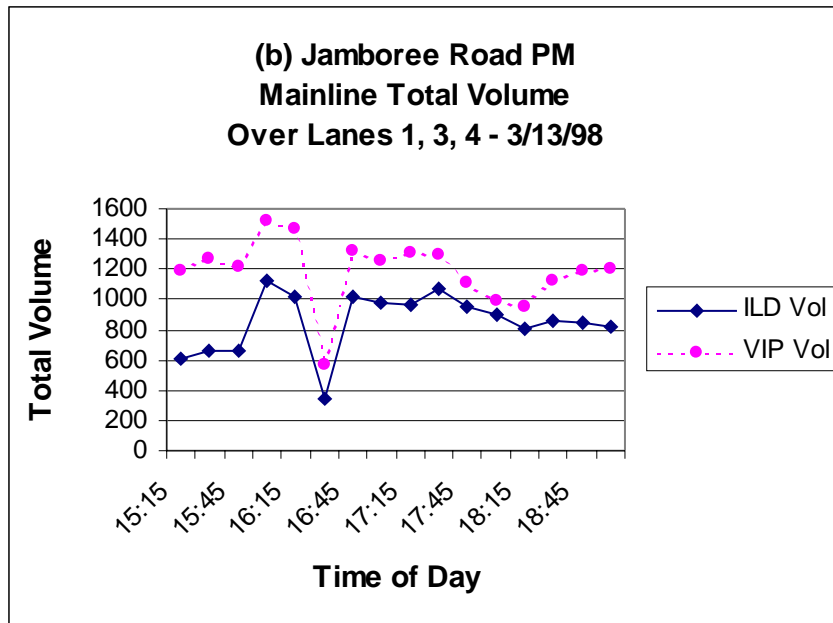
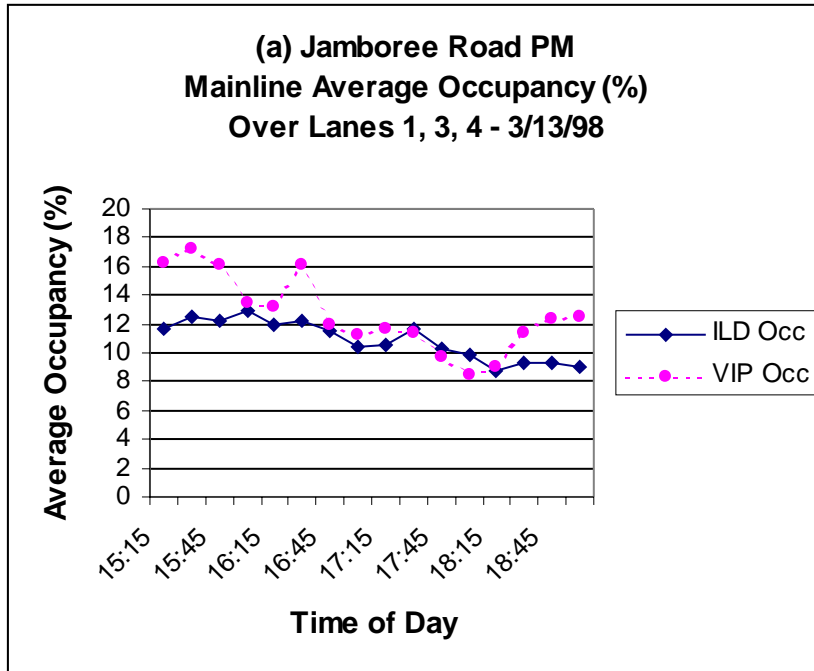


Figure J-73. Average (a) lane occupancy and (b) total volume measured by the ILDs and VIP over all lanes at the Jamboree Road evaluation site during the afternoon rush-hour interval on 3/13/98

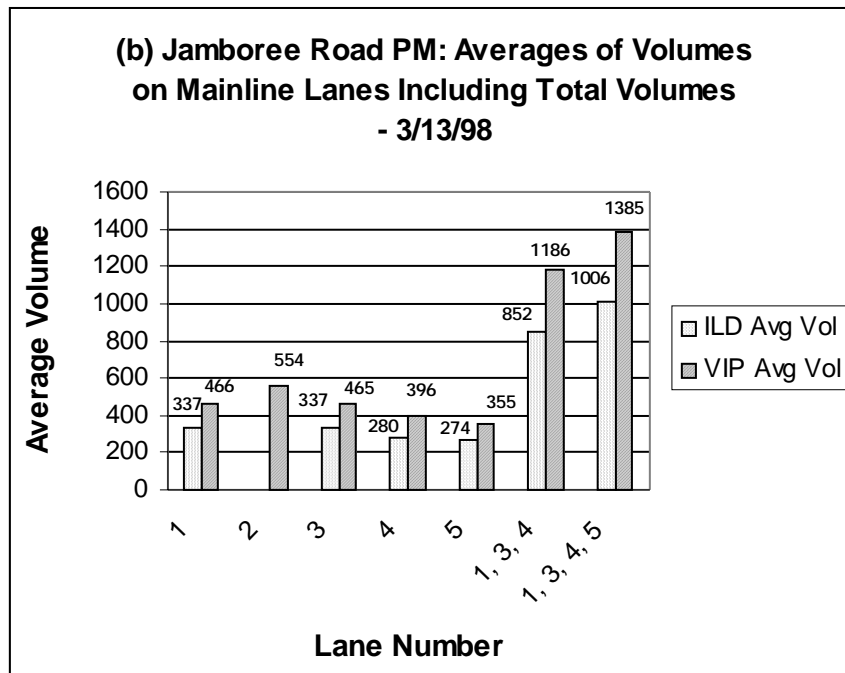
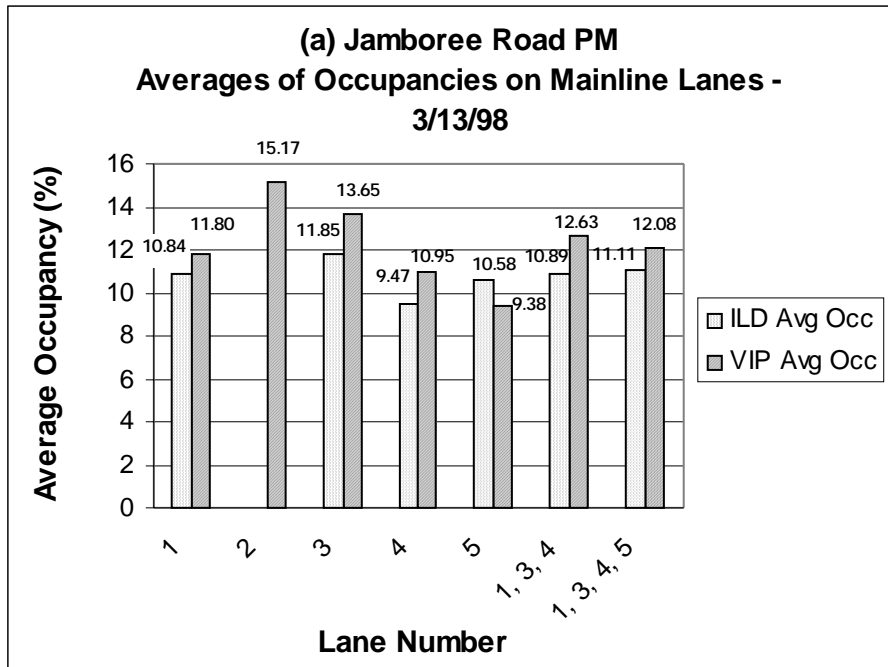


Figure J-74. Comparison of ILD and VIP lane-by-lane averages of (a) lane occupancy and (b) total volume at the Jamboree Road evaluation site during the afternoon rush-hour interval on 3/13/98

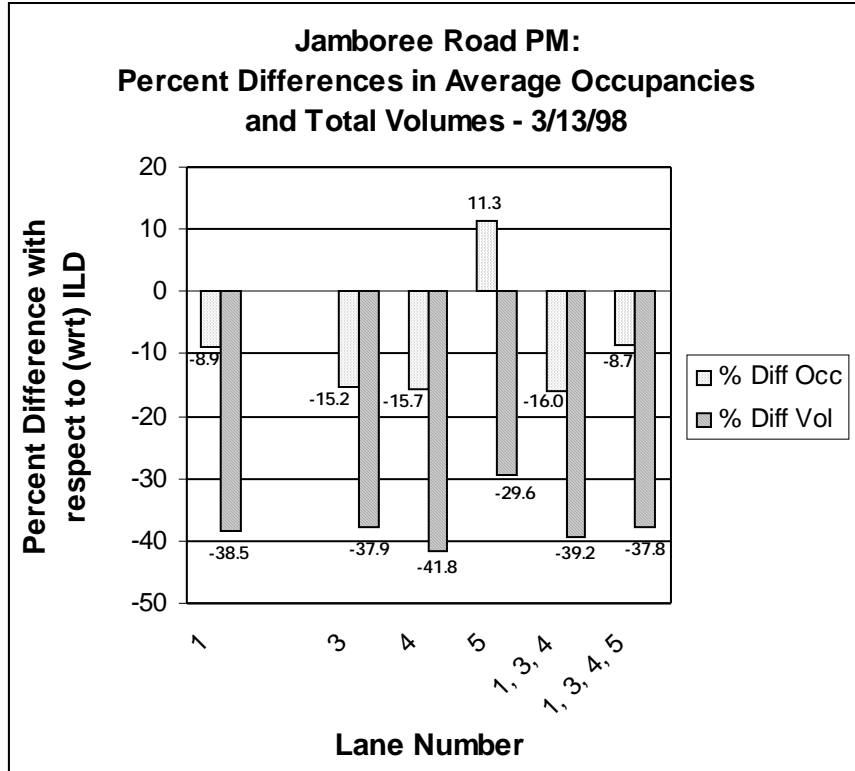


Figure J-75. Percent difference between the ILD and VIP averages of the average occupancy and total volume by lane at the Jamboree Road evaluation site during the afternoon rush-hour interval on 3/13/98

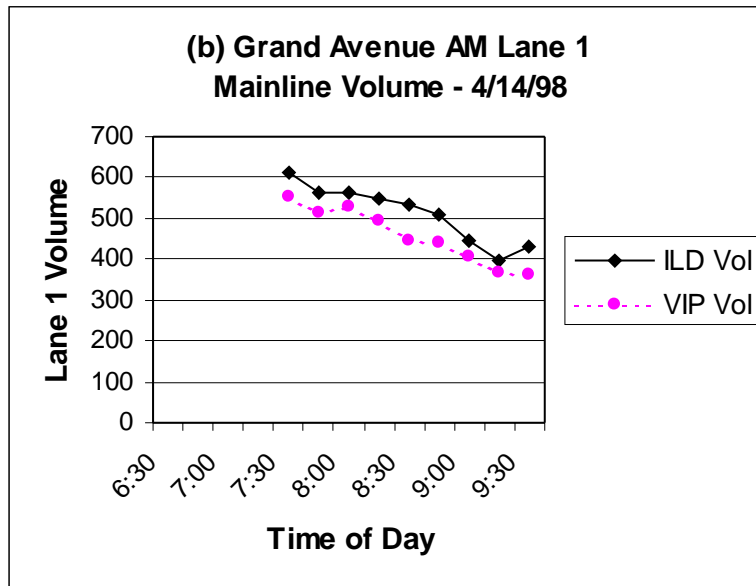
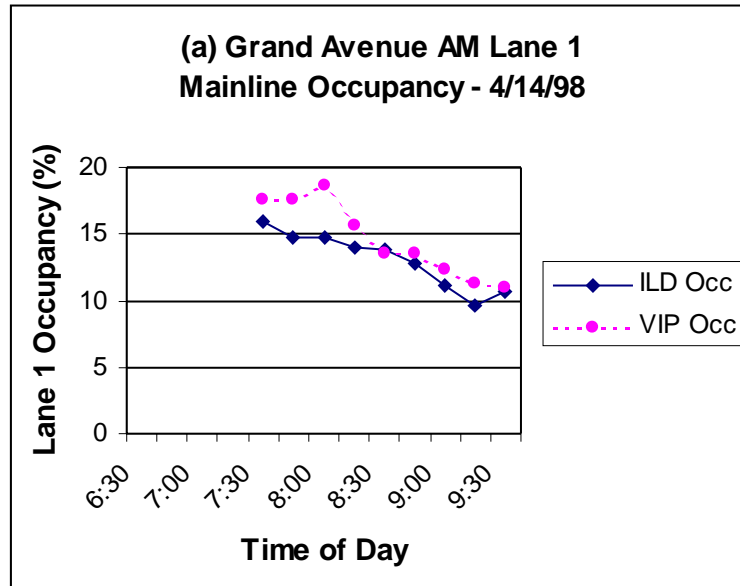


Figure J-76. Lane 1 (a) occupancy and (b) volume at the Grand Avenue evaluation site during the morning rush-hour interval on 4/14/98

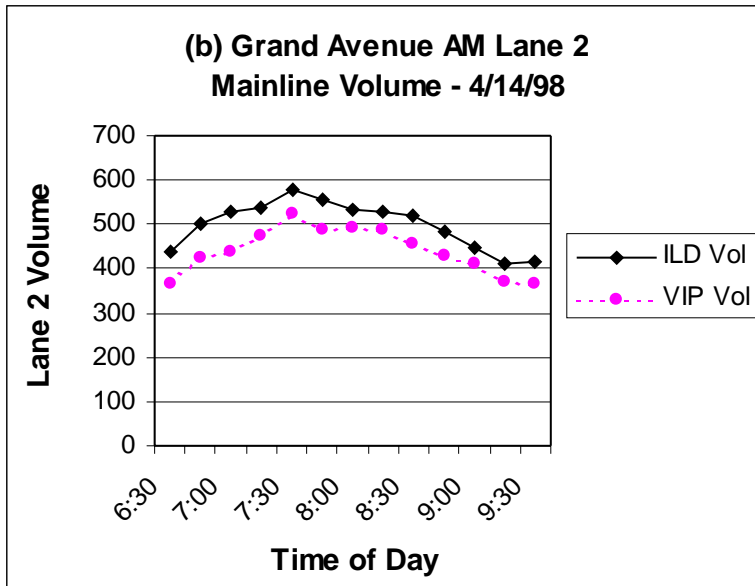
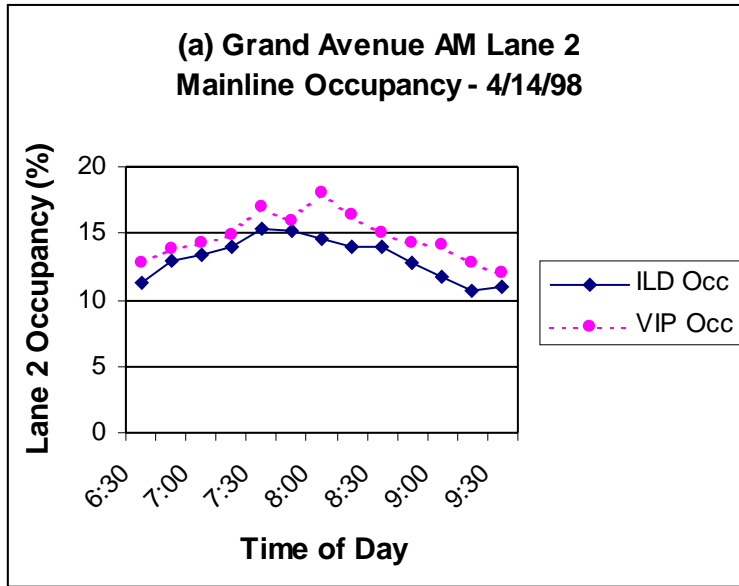


Figure J-77. Lane 2 (a) occupancy and (b) volume at the Grand Avenue evaluation site during the morning rush-hour interval on 4/14/98

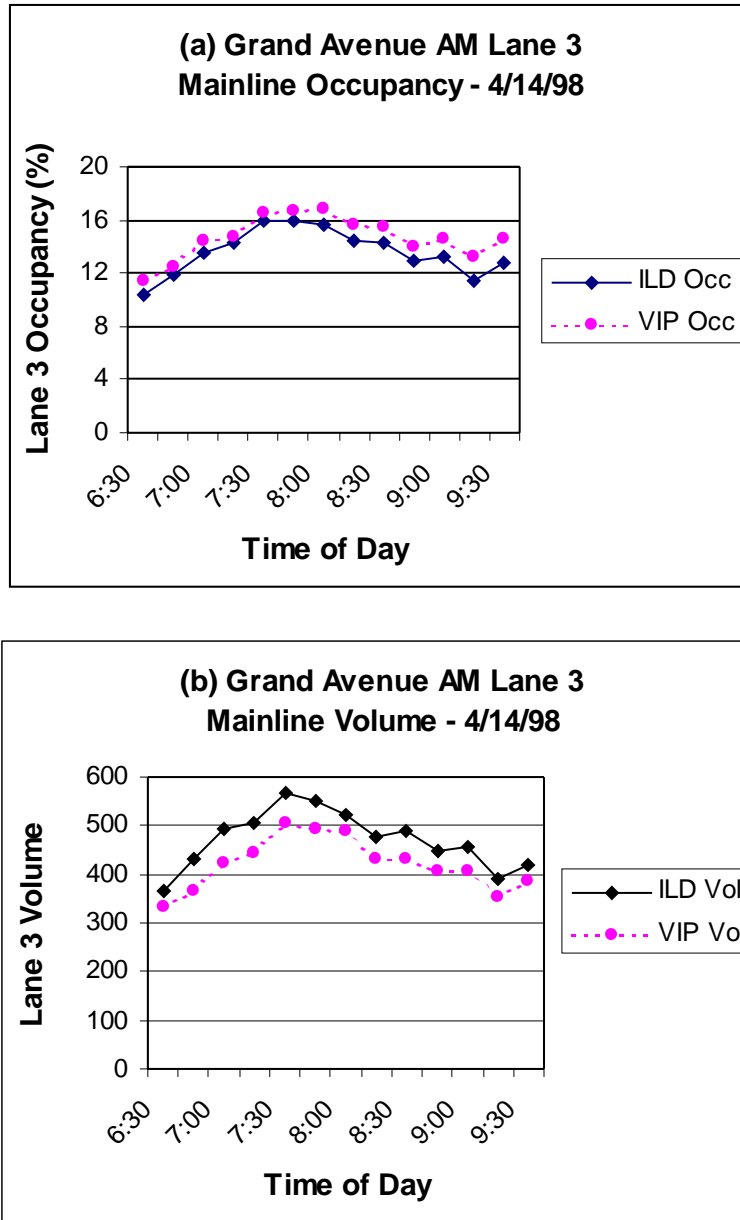


Figure J-78. Lane 3 (a) occupancy and (b) volume at the Grand Avenue evaluation site during the morning rush-hour interval on 4/14/98

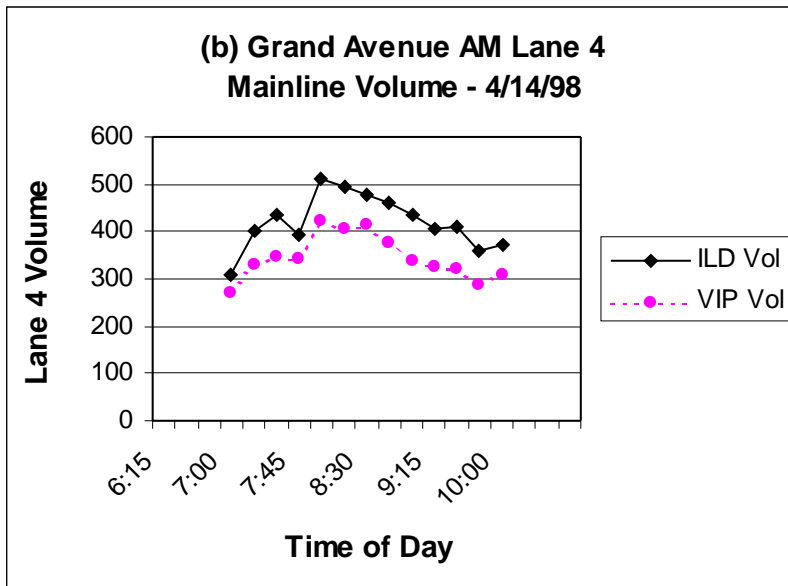
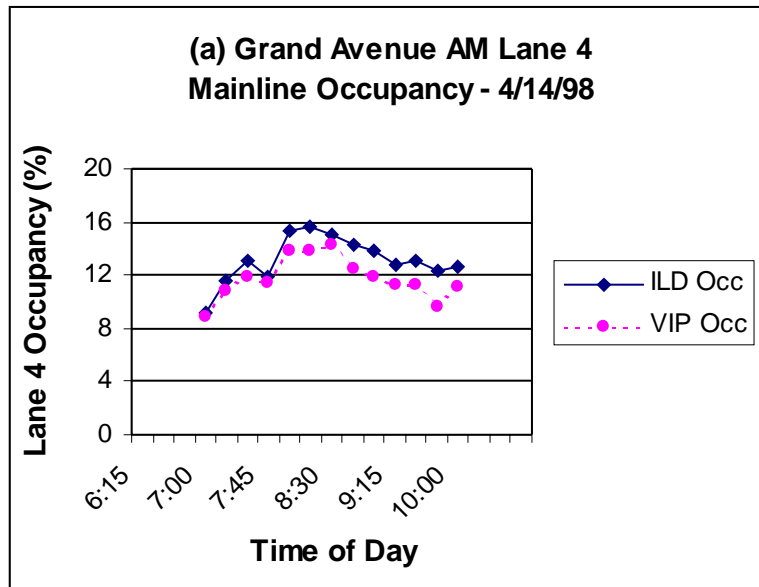


Figure J-79. Lane 4 (a) occupancy and (b) volume at the Grand Avenue evaluation site during the morning rush-hour interval on 4/14/98

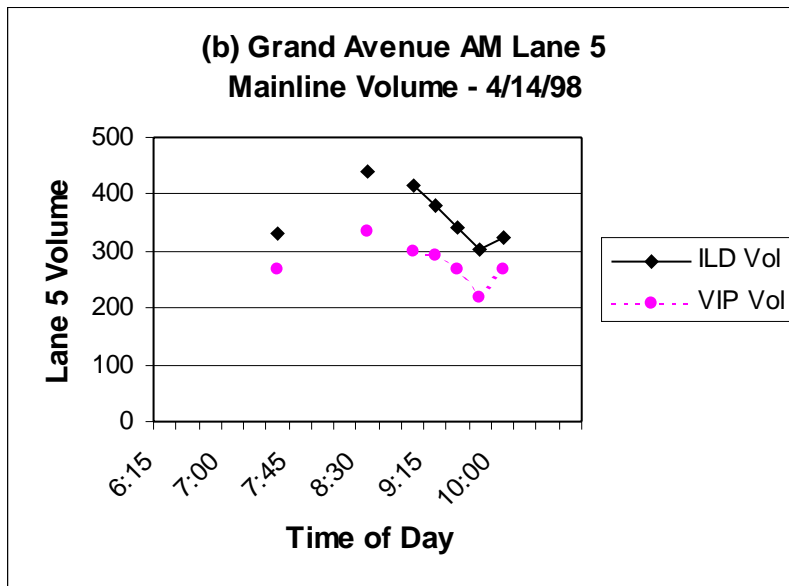
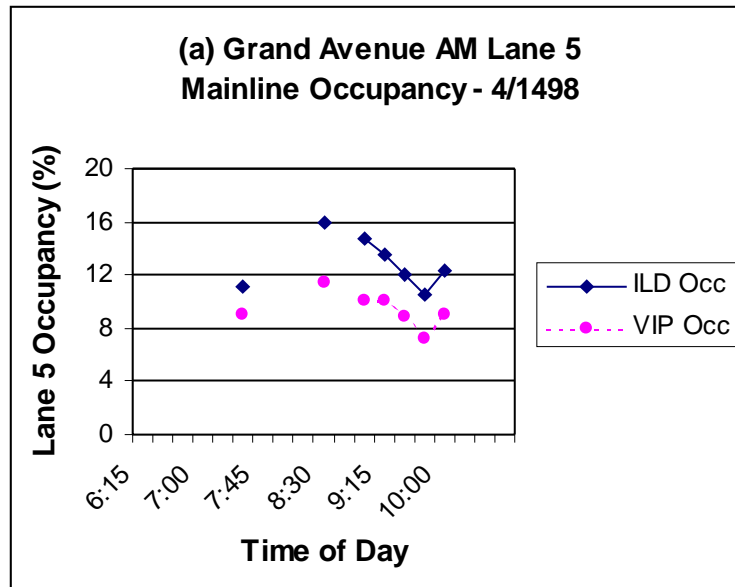


Figure J-80. Lane 5 (a) occupancy and (b) volume at the Grand Avenue evaluation site during the morning rush-hour interval on 4/14/98

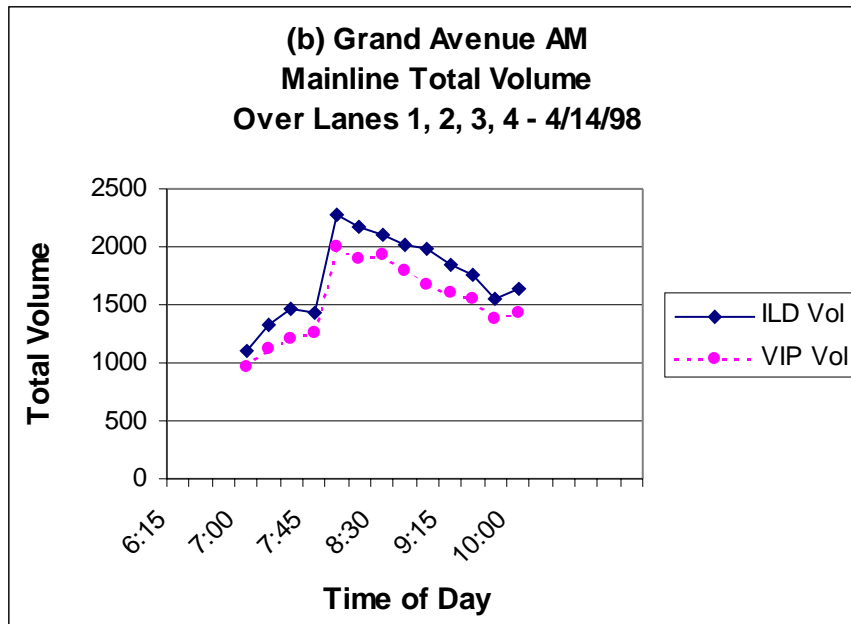
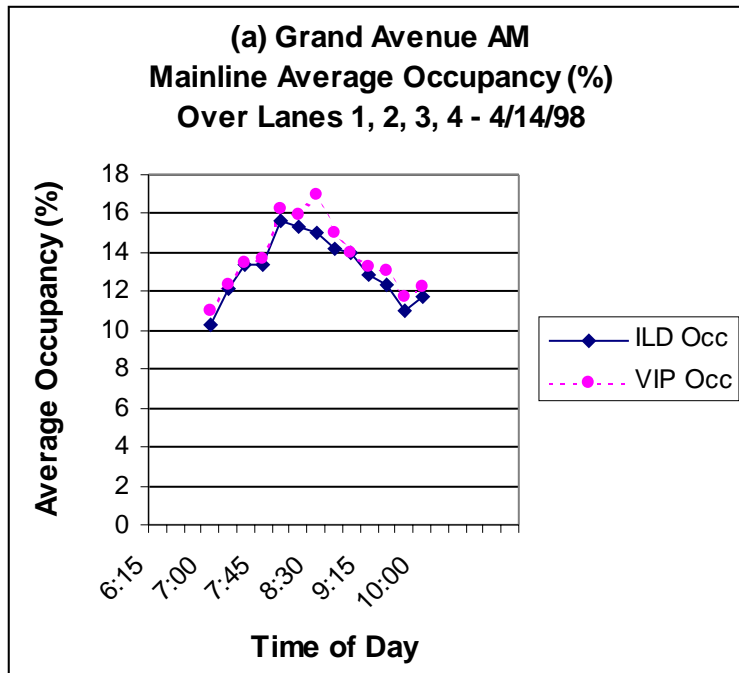


Figure J-81. Average (a) lane occupancy and (b) total volume measured by the ILDs and VIP over lanes 1 through 4 at the Grand Avenue evaluation site during the morning rush-hour interval on 4/14/98

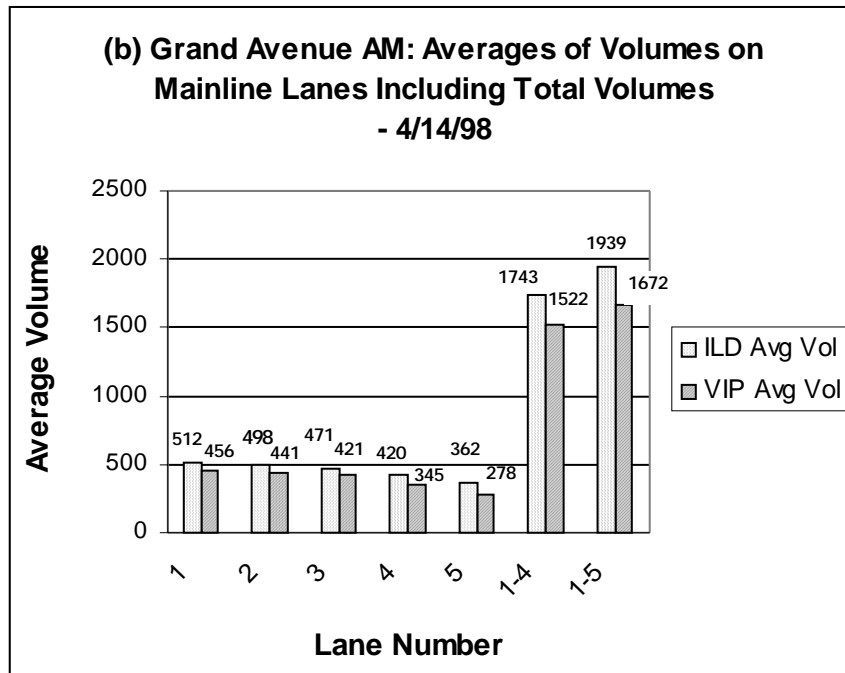
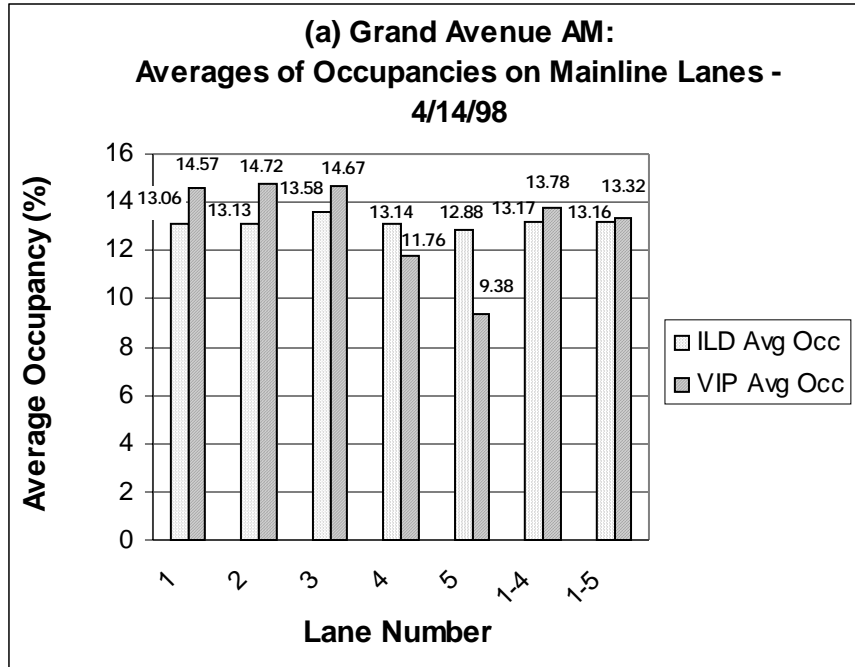


Figure J-82. Comparison of ILD and VIP lane-by-lane averages of (a) lane occupancy and (b) total volume at the Grand Avenue evaluation site during the morning rush-hour interval on 4/14/98

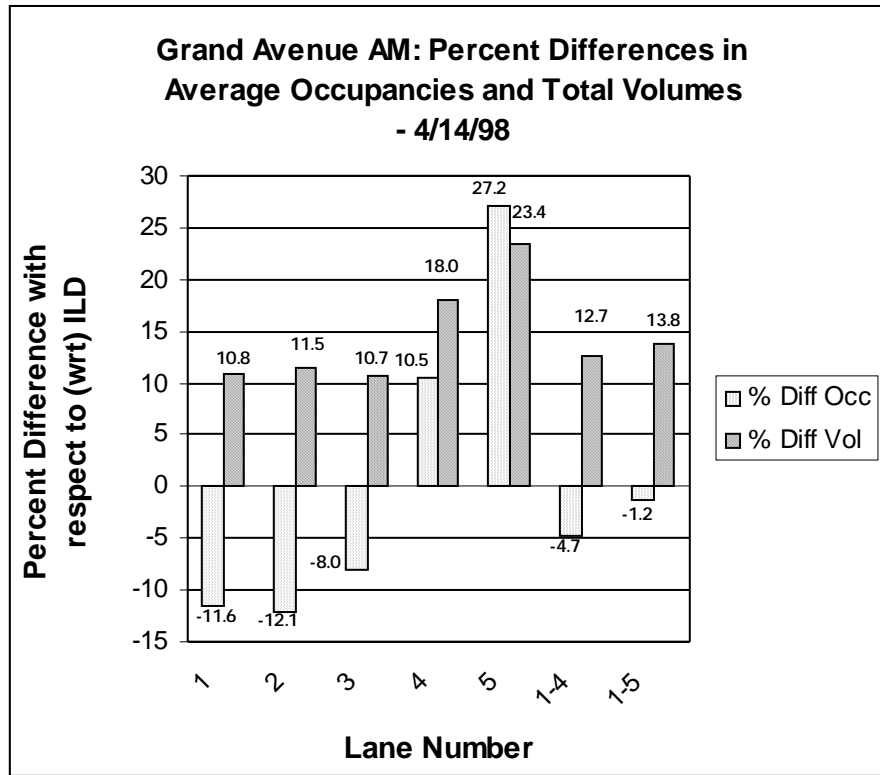


Figure J-83. Percent difference between the ILD and VIP averages of the average occupancy and total volume by lane at the Grand Avenue evaluation site during the morning rush-hour interval on 4/14/98

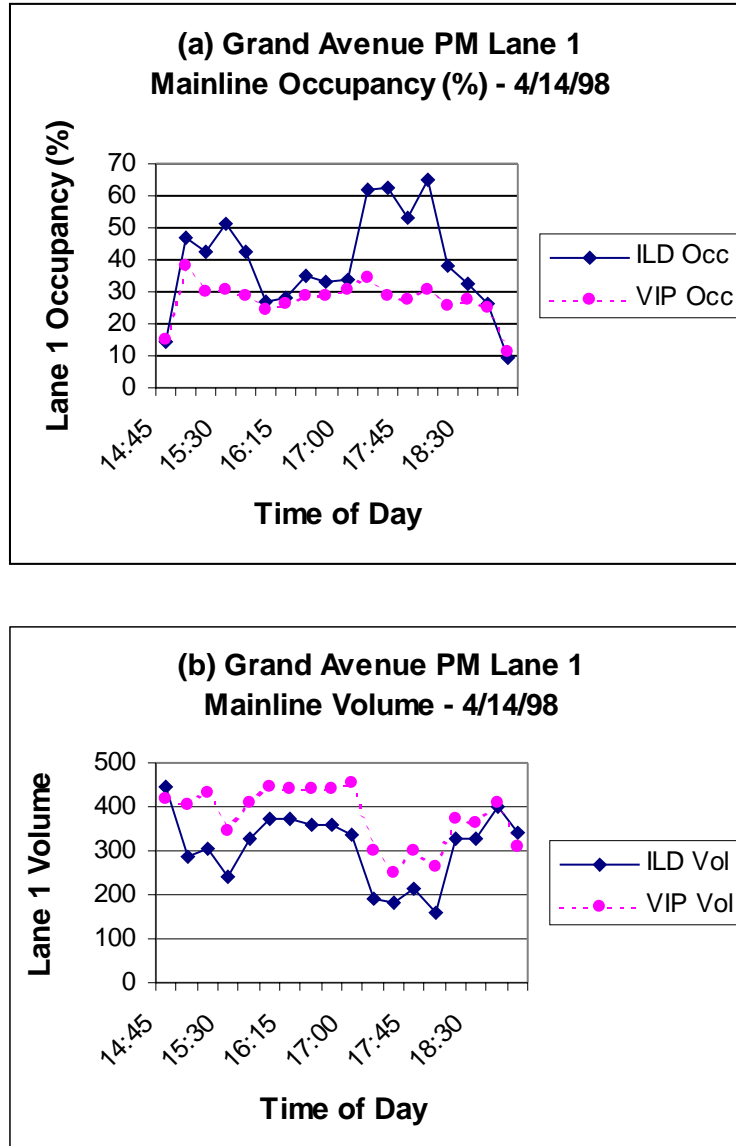


Figure J-84. Lane 1 (a) occupancy and (b) volume at the Grand Avenue evaluation site during the afternoon rush-hour interval on 4/14/98

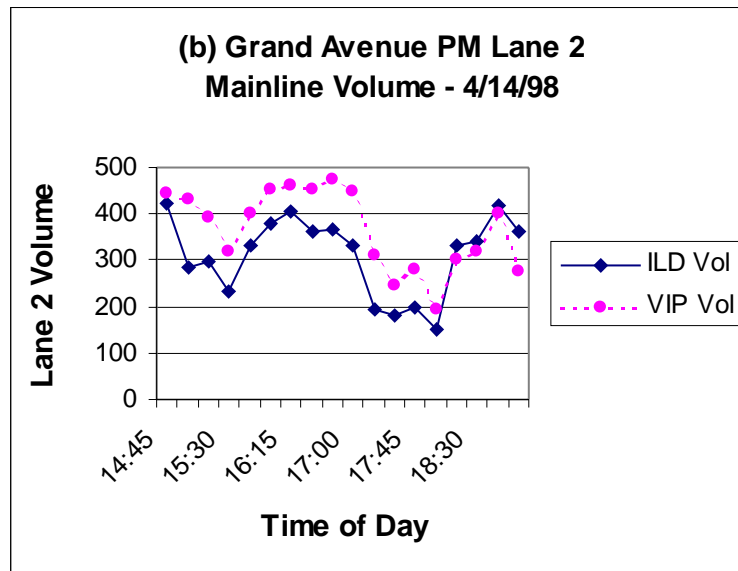
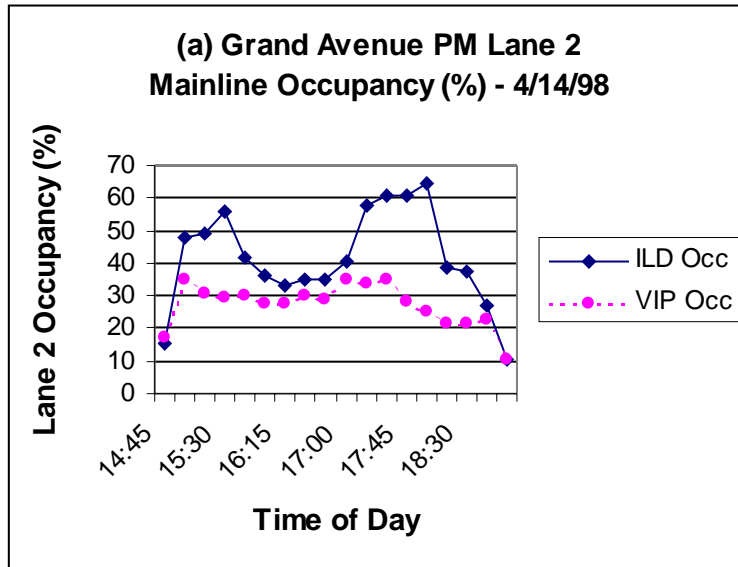


Figure J-85. Lane 2 (a) occupancy and (b) volume at the Grand Avenue evaluation site during the afternoon rush-hour interval on 4/14/98

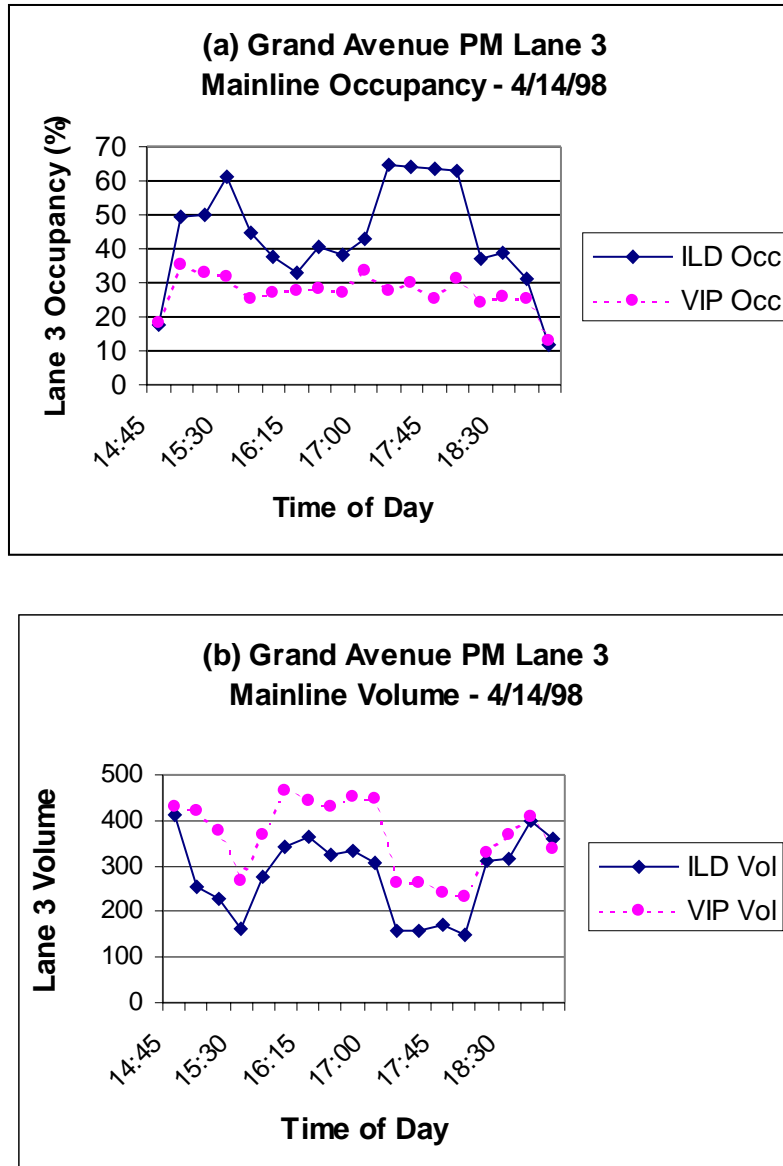


Figure J-86. Lane 3 (a) occupancy and (b) volume at the Grand Avenue evaluation site during the afternoon rush-hour interval on 4/14/98

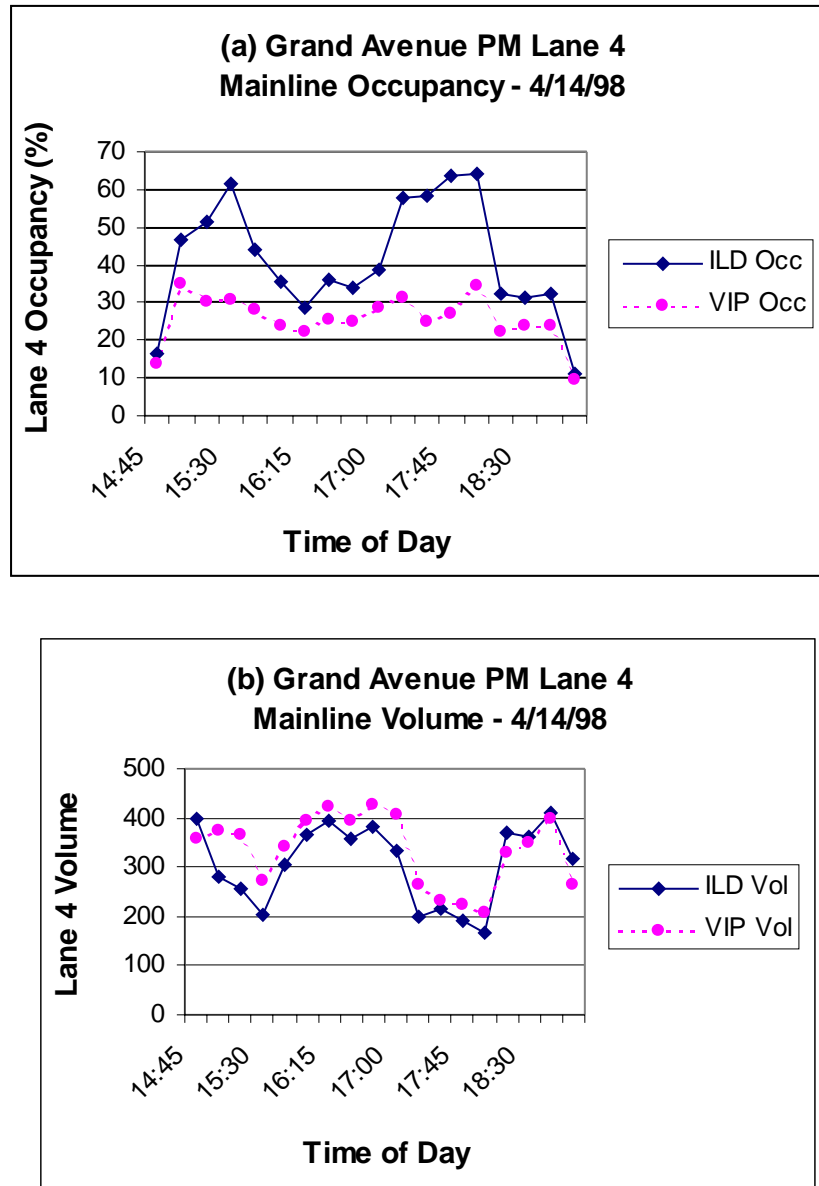


Figure J-87. Lane 4 (a) occupancy and (b) volume at the Grand Avenue evaluation site during the afternoon rush-hour interval on 4/14/98

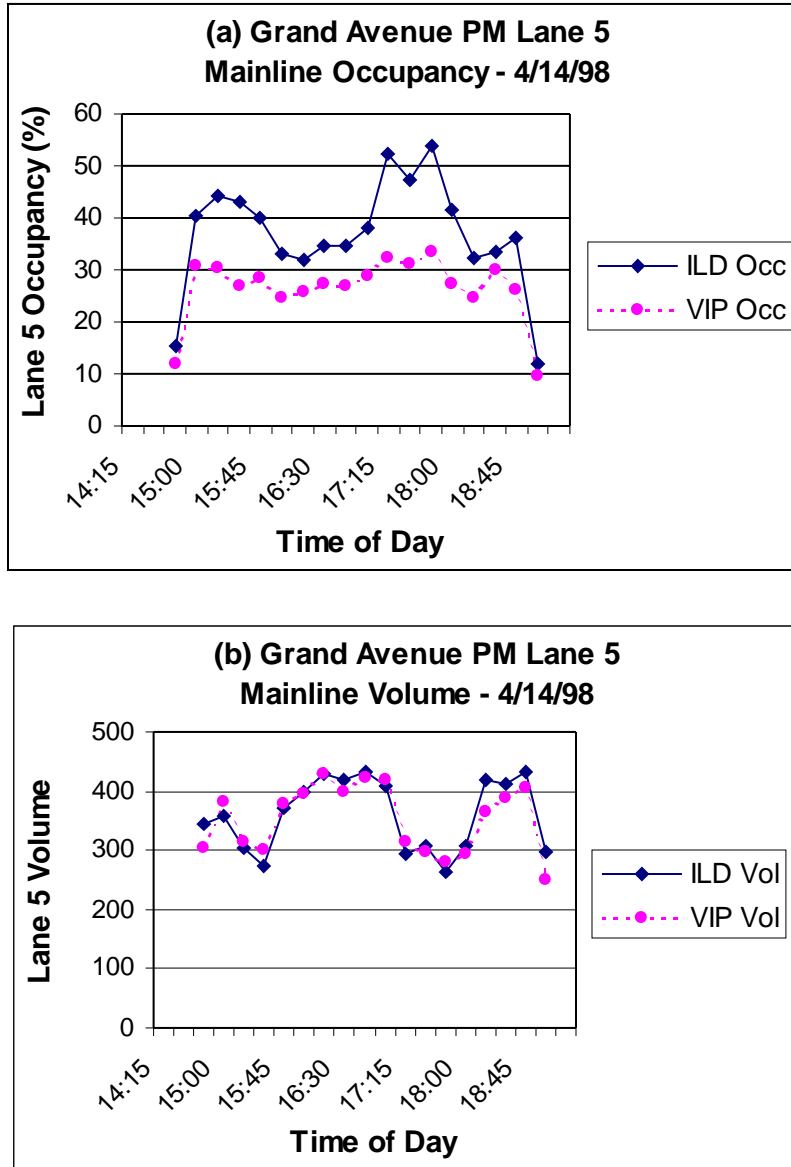


Figure J-88. Lane 5 (a) occupancy and (b) volume at the Grand Avenue evaluation site during the afternoon rush-hour interval on 4/14/98

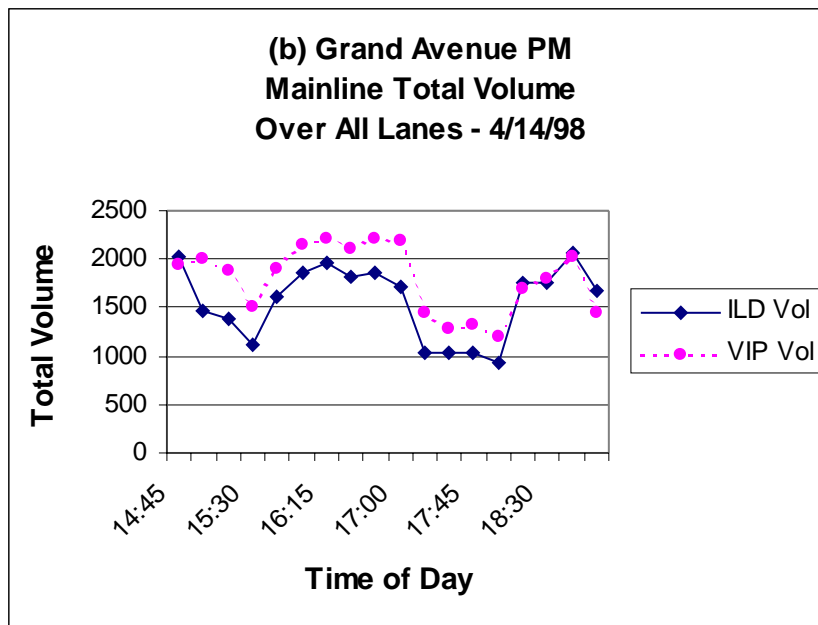
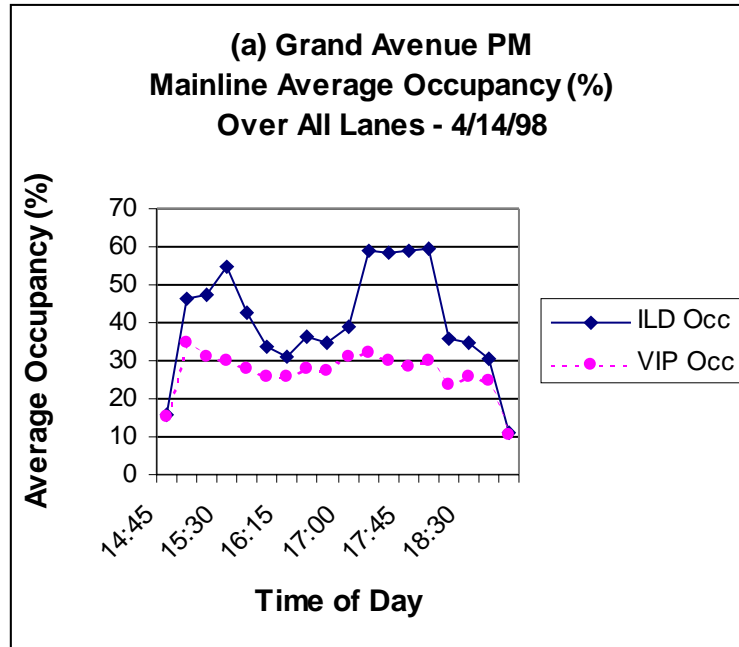


Figure J-89. Average (a) lane occupancy and (b) total volume measured by the ILDs and VIP over all lanes at the Grand Avenue evaluation site during the afternoon rush-hour interval on 4/14/98

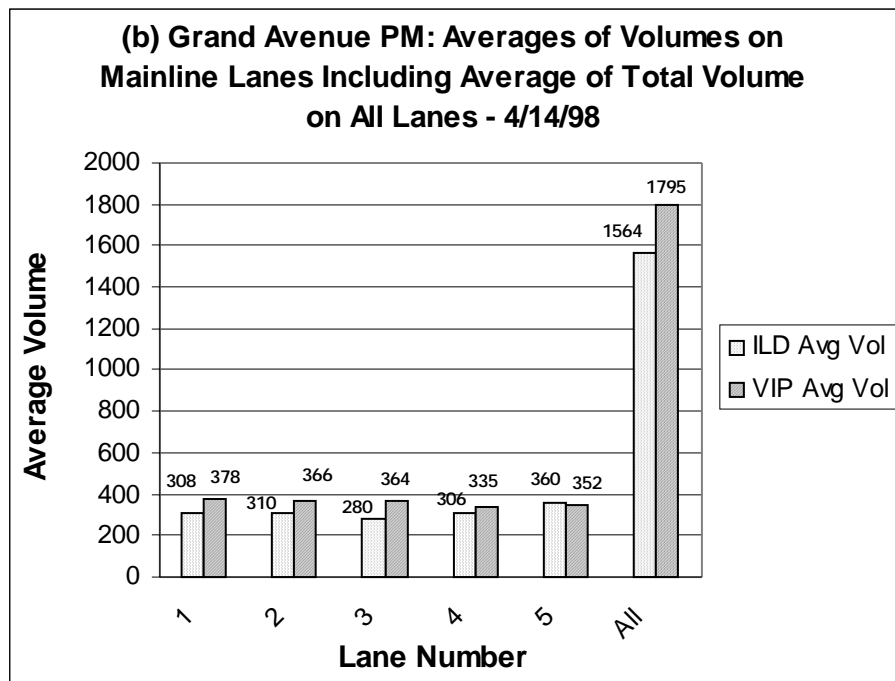
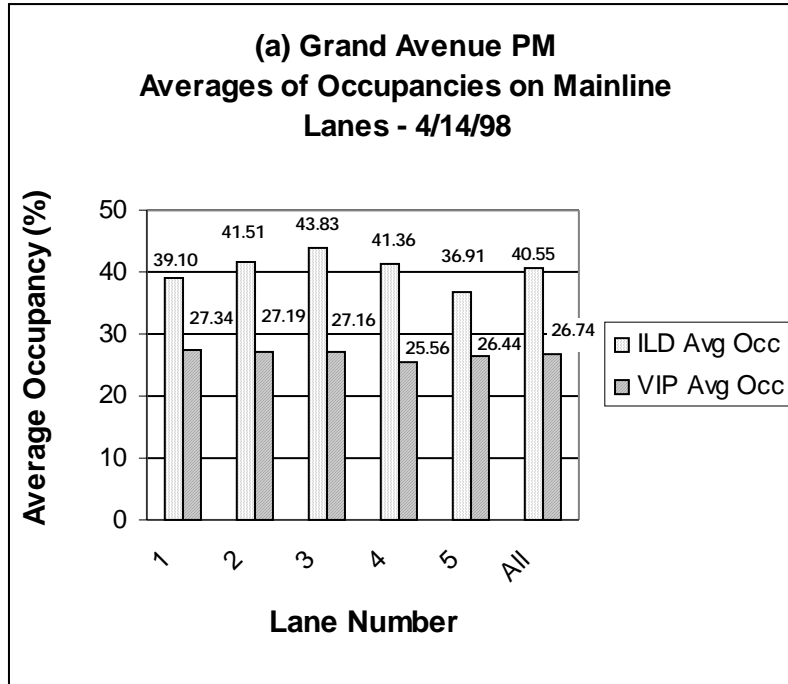


Figure J-90. Comparison of ILD and VIP lane-by-lane averages of (a) lane occupancy and (b) total volume at the Grand Avenue evaluation site during the afternoon rush-hour interval on 4/14/98

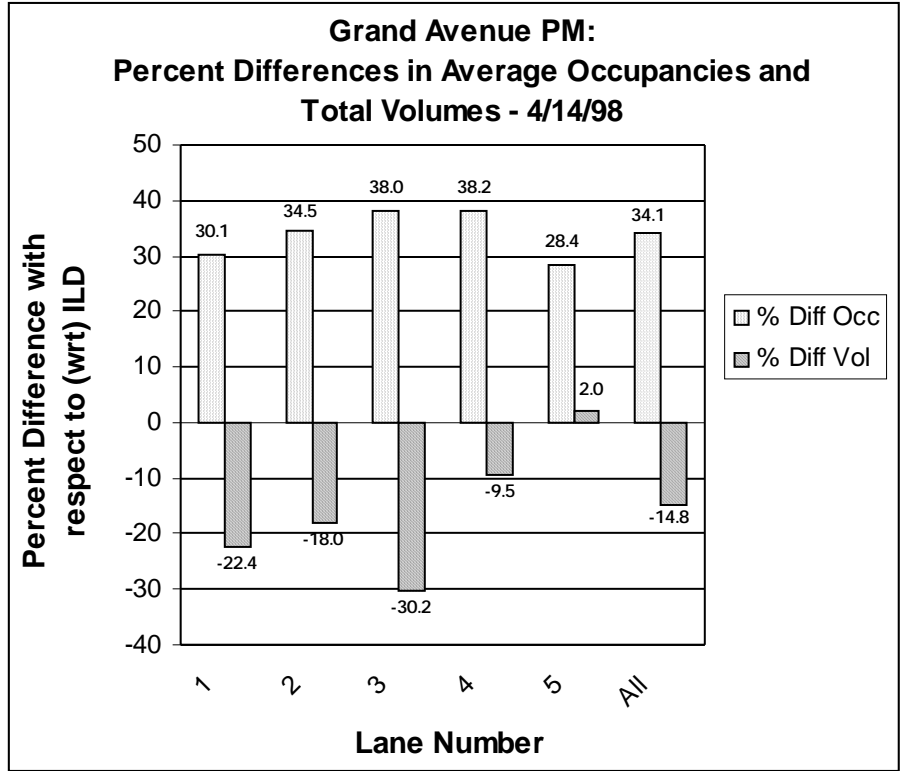


Figure J-91. Percent difference between the ILD and VIP averages of the average occupancy and total volume by lane at the Grand Avenue evaluation site during the afternoon rush-hour interval on 4/14/98

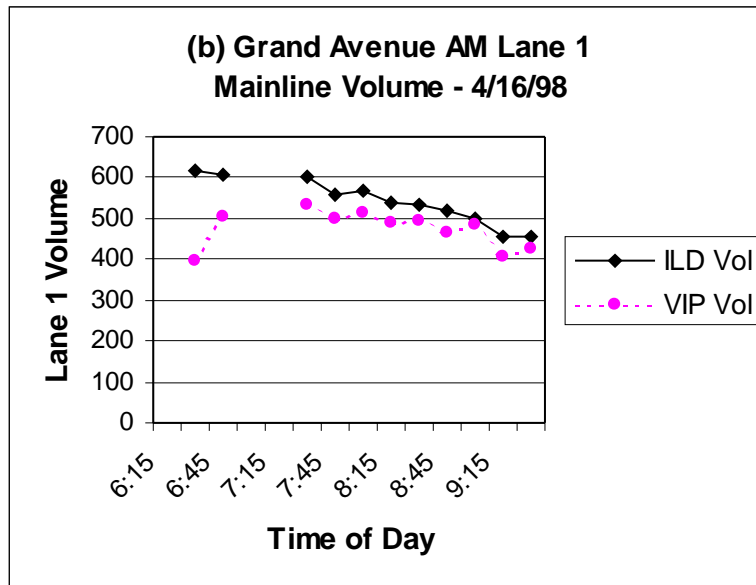
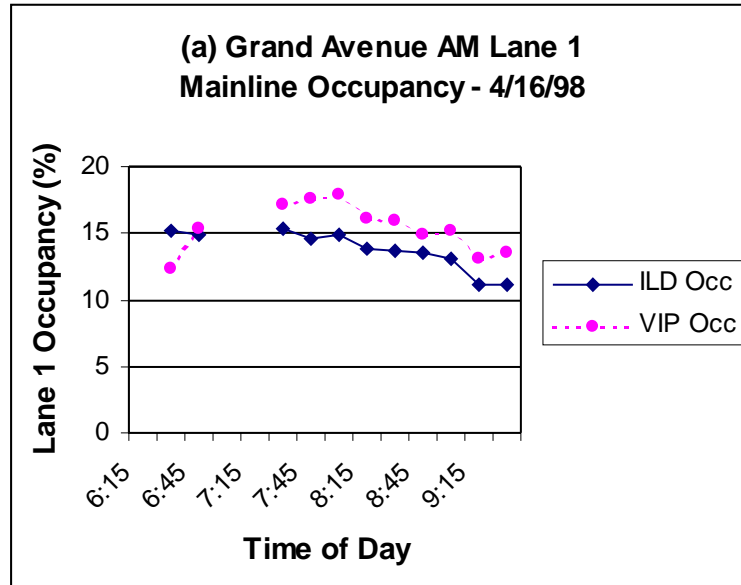


Figure J-92. Lane 1 (a) occupancy and (b) volume at the Grand Avenue evaluation site during the morning rush-hour interval on 4/16/98

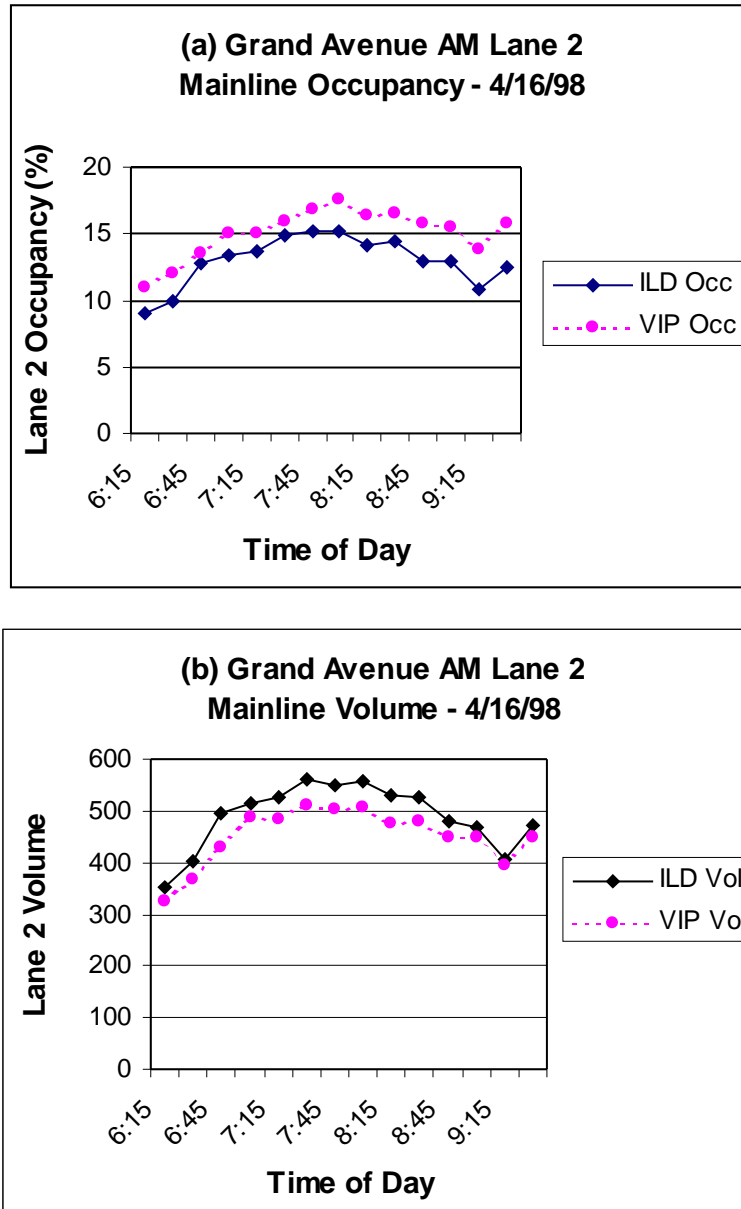


Figure J-93. Lane 2 (a) occupancy and (b) volume at the Grand Avenue evaluation site during the morning rush-hour interval on 4/16/98

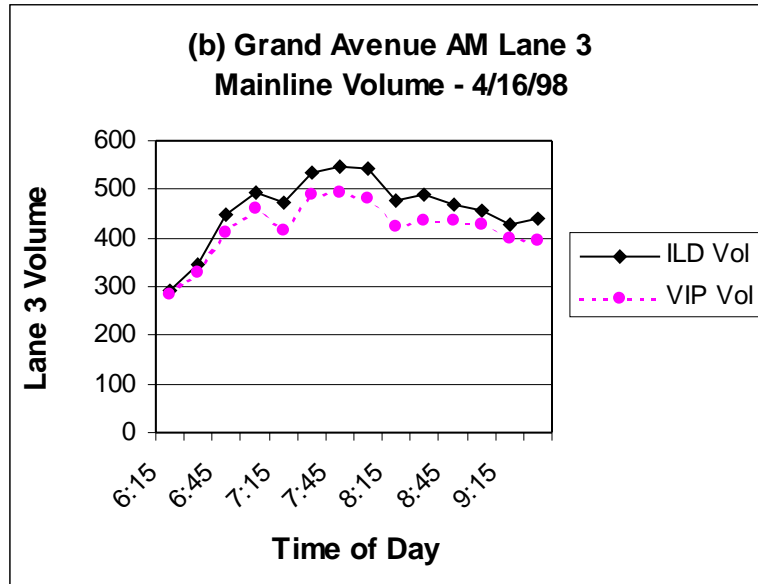
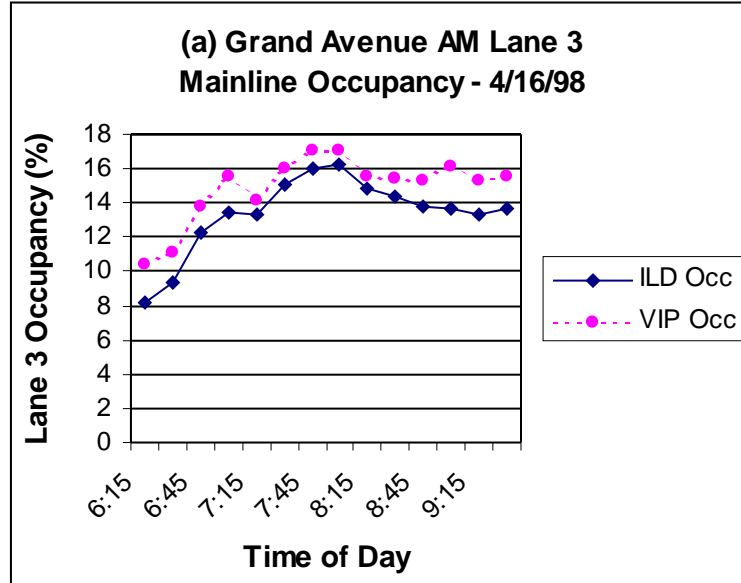


Figure J-94. Lane 3 (a) occupancy and (b) volume at the Grand Avenue evaluation site during the morning rush-hour interval on 4/16/98

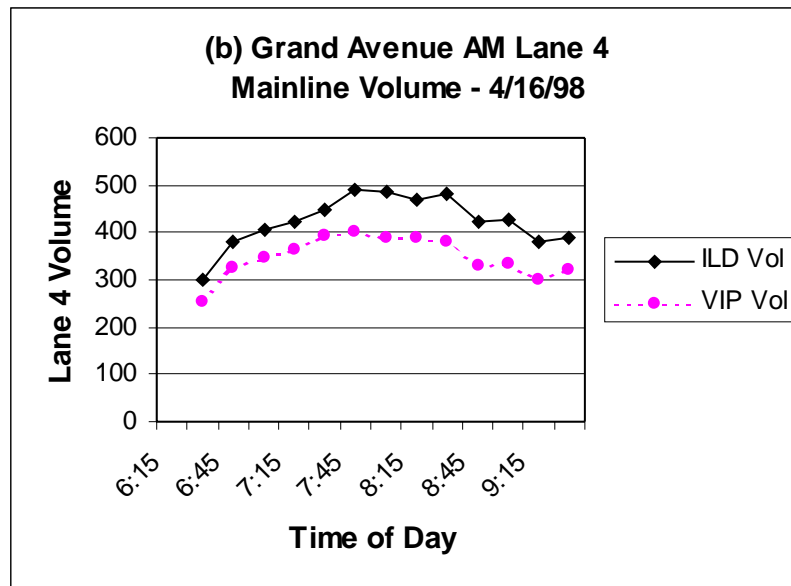
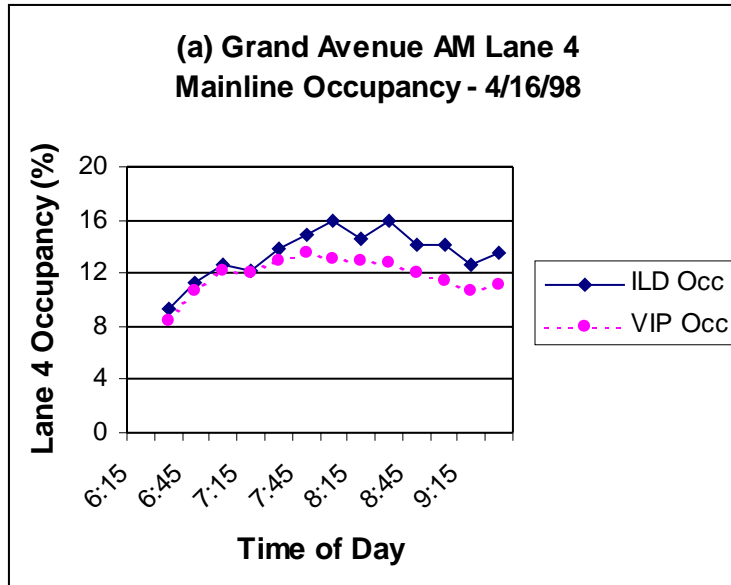


Figure J-95. Lane 4 (a) occupancy and (b) volume at the Grand Avenue evaluation site during the morning rush-hour interval on 4/16/98

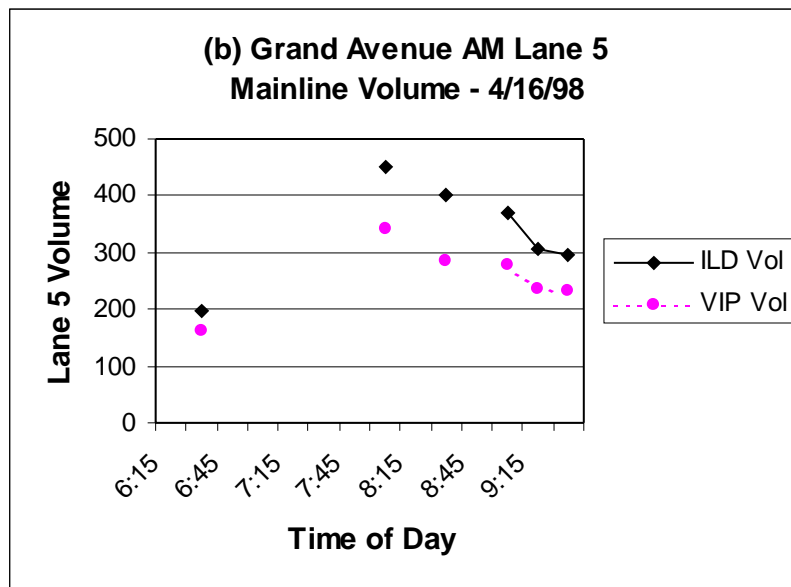
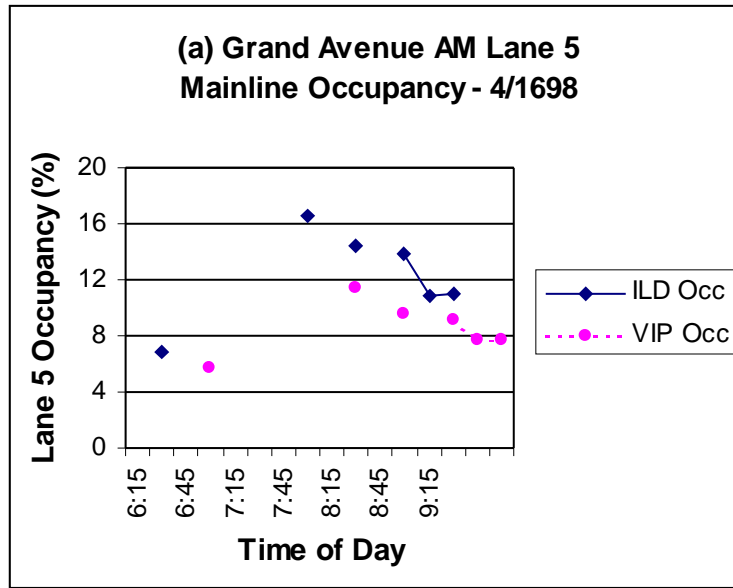


Figure J-96. Lane 5 (a) occupancy and (b) volume at the Grand Avenue evaluation site during the morning rush-hour interval on 4/16/98

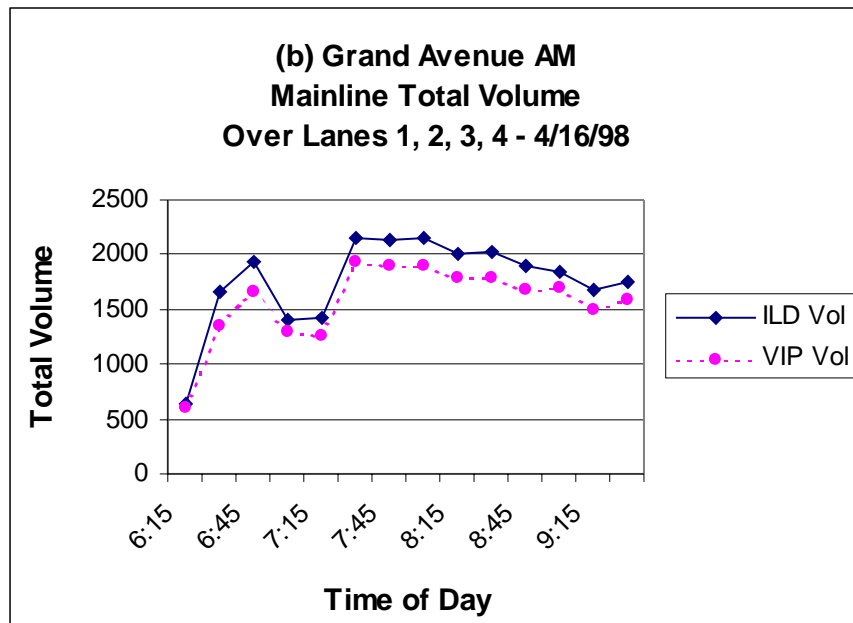
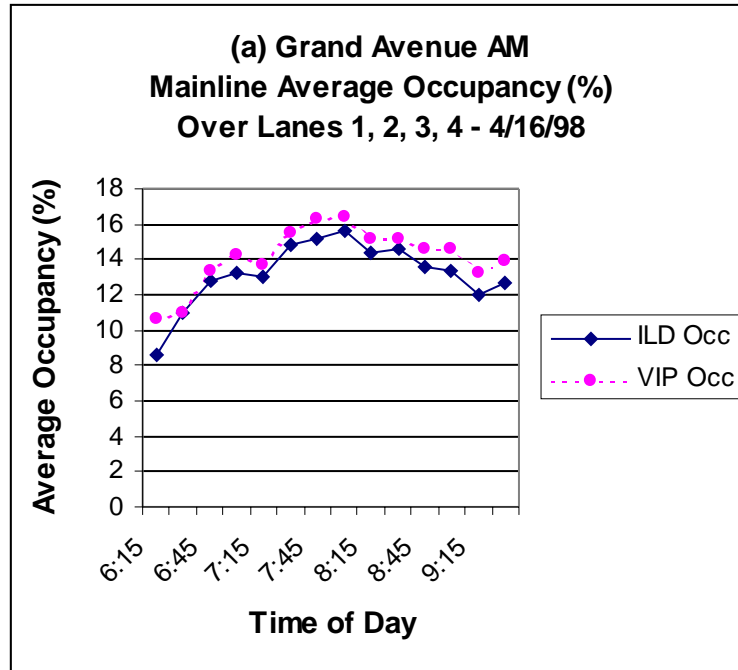


Figure J-97. Average (a) lane occupancy and (b) total volume measured by the ILDs and VIP over lanes 1 through 4 at the Grand Avenue evaluation site during the morning rush-hour interval on 4/16/98

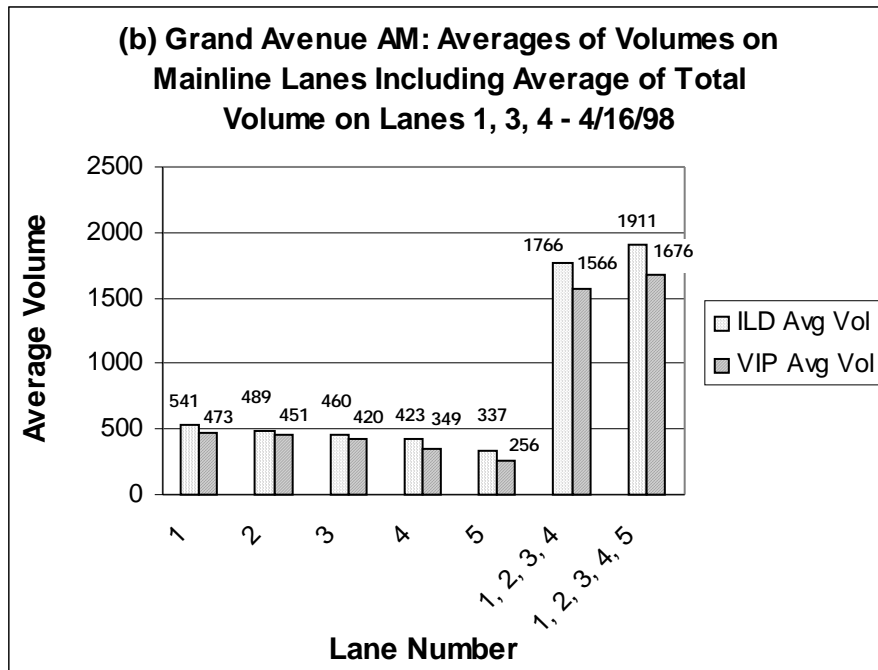
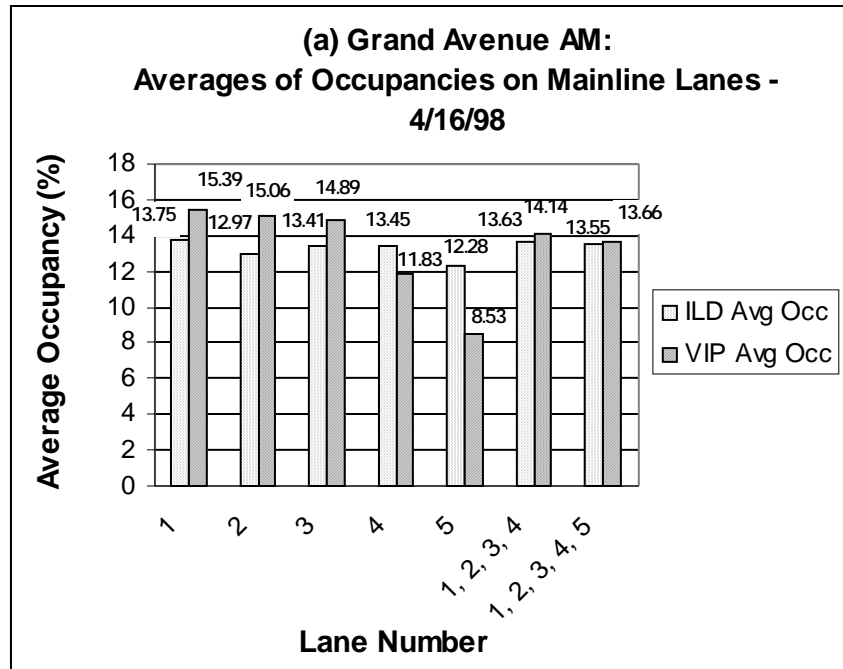


Figure J-98. Comparison of ILD and VIP lane-by-lane averages of (a) lane occupancy and (b) total volume at the Grand Avenue evaluation site during the morning rush-hour interval on 4/16/98

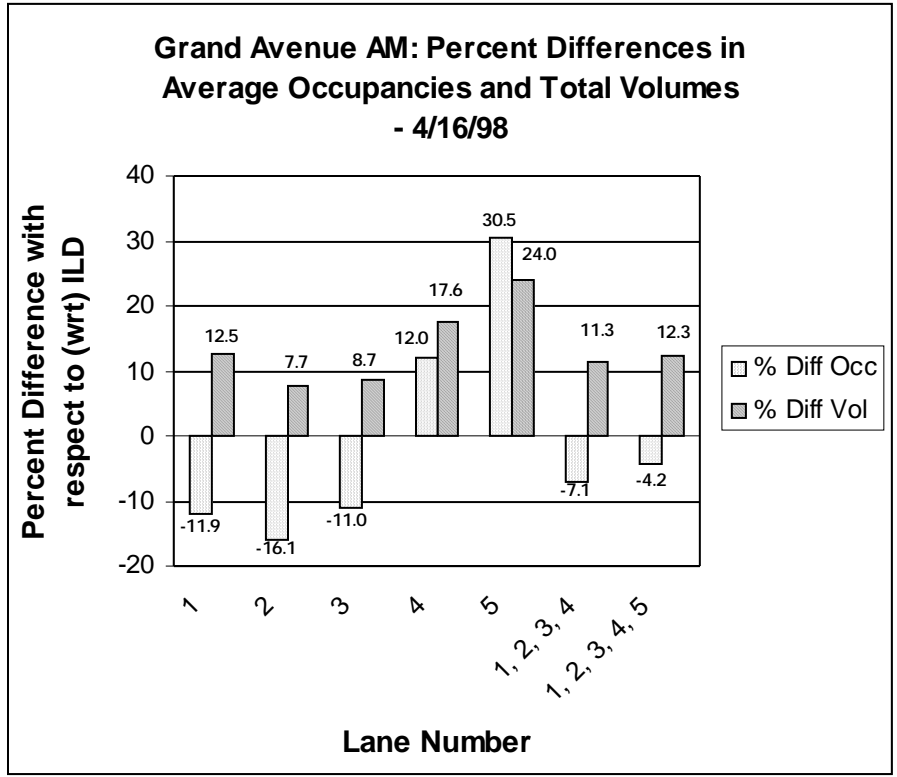


Figure J-99. Percent difference between the ILD and VIP averages of the average occupancy and total volume by lane at the Grand Avenue evaluation site during the morning rush-hour interval on 4/16/98

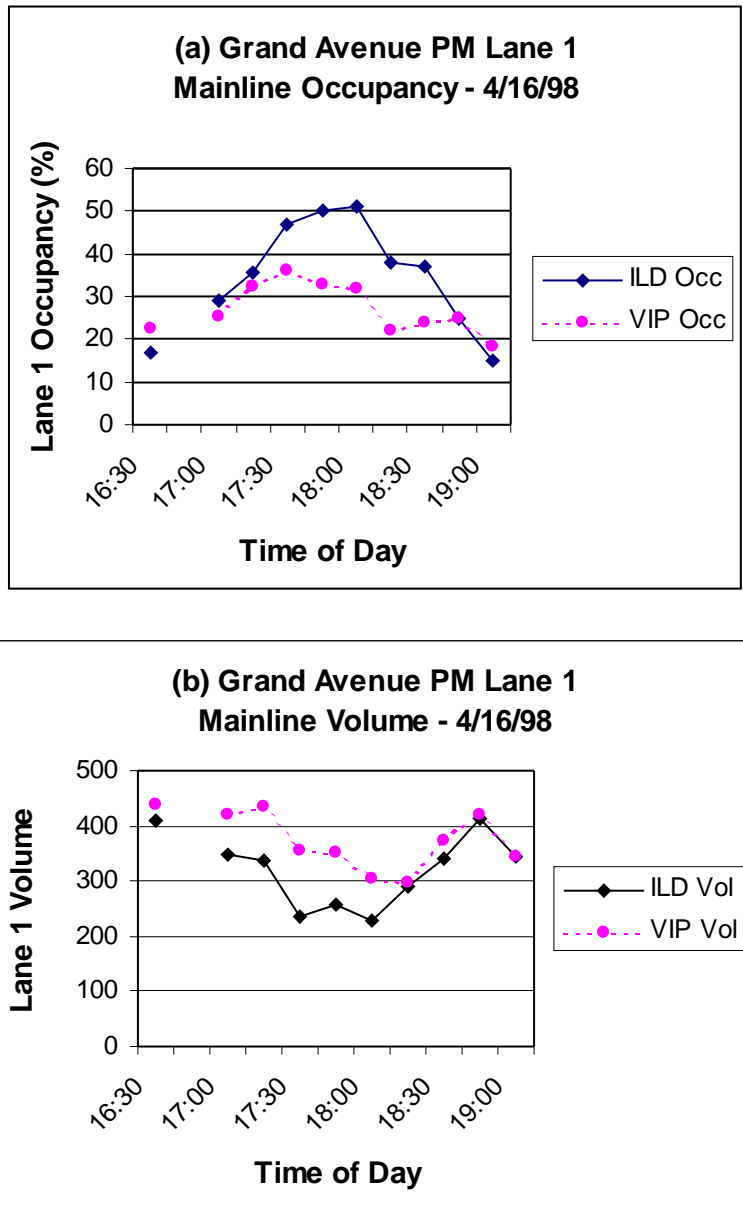


Figure J-100. Lane 1 (a) occupancy and (b) volume at the Grand Avenue evaluation site during the afternoon rush-hour interval on 4/16/98

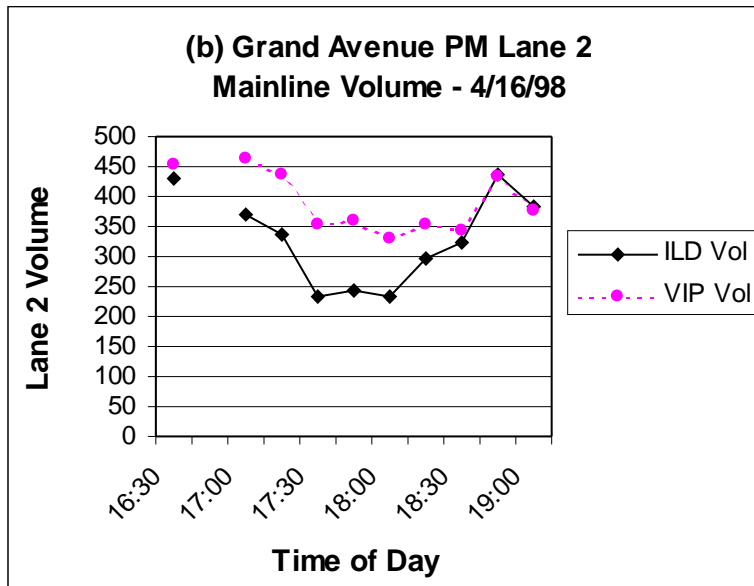
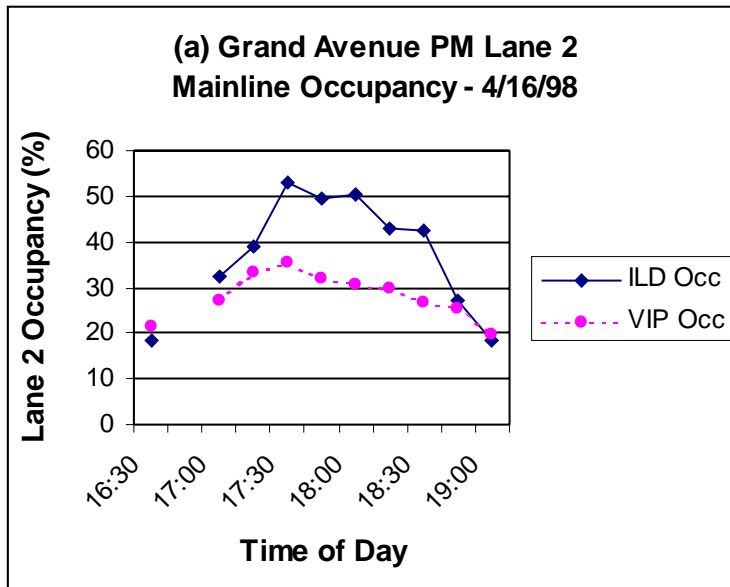


Figure J-101. Lane 2 (a) occupancy and (b) volume at the Grand Avenue evaluation site during the afternoon rush-hour interval on 4/16/98

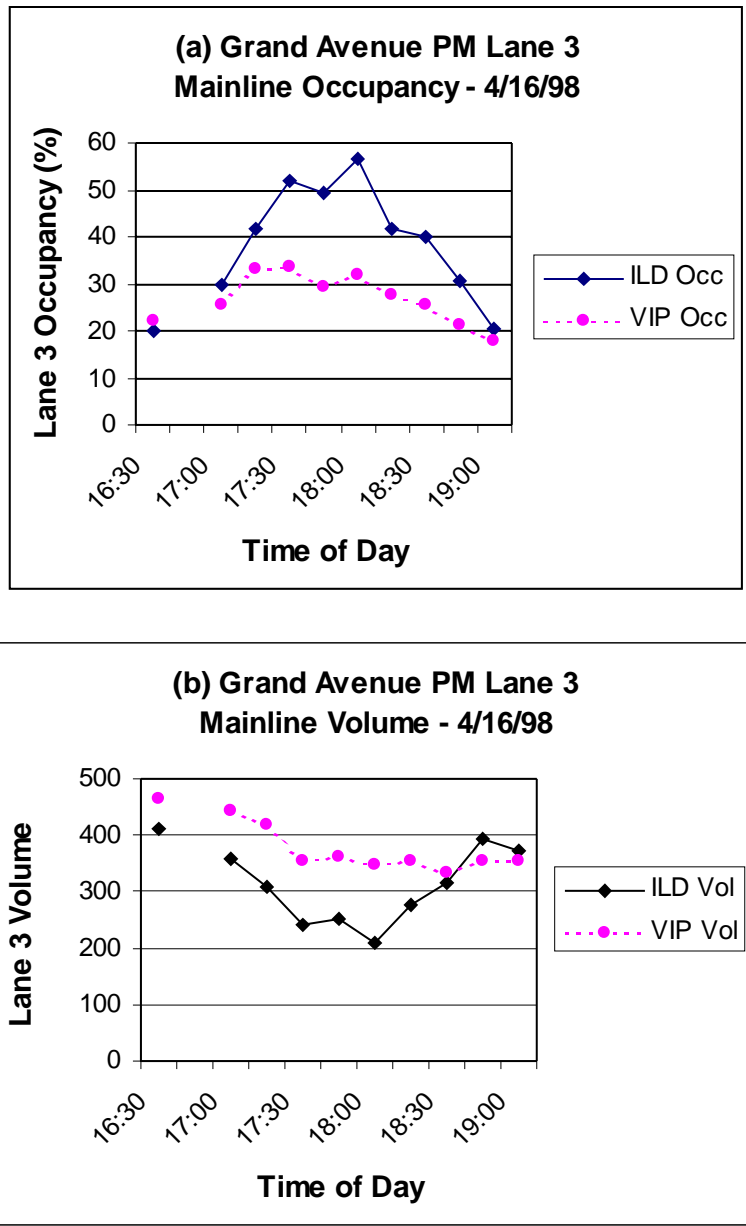


Figure J-102. Lane 3 (a) occupancy and (b) volume at the Grand Avenue evaluation site during the afternoon rush-hour interval on 4/16/98

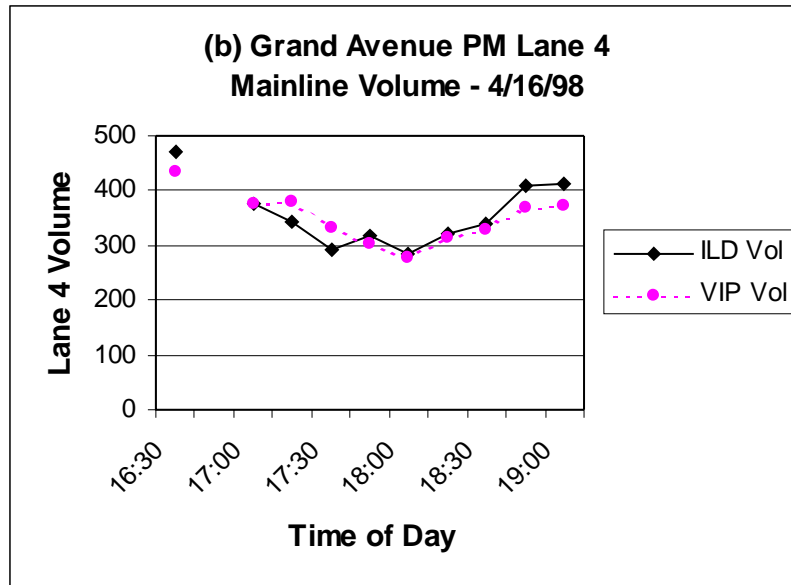
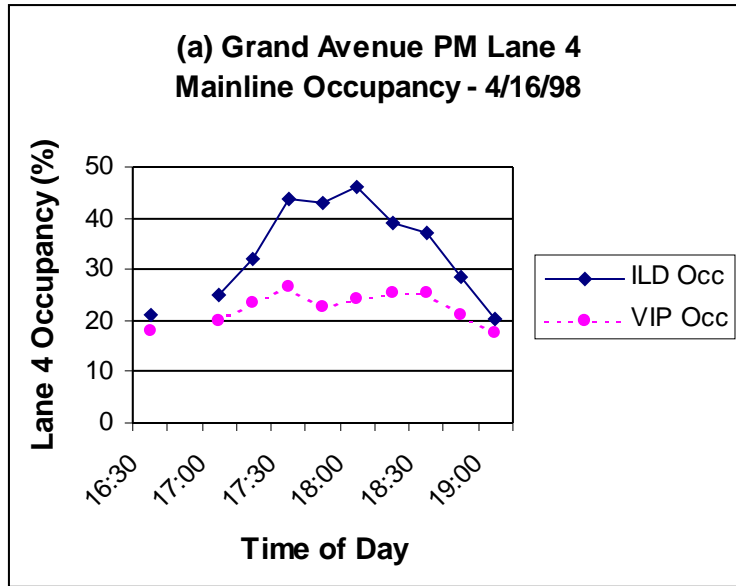


Figure J-103. Lane 4 (a) occupancy and (b) volume at the Grand Avenue evaluation site during the afternoon rush-hour interval on 4/16/98

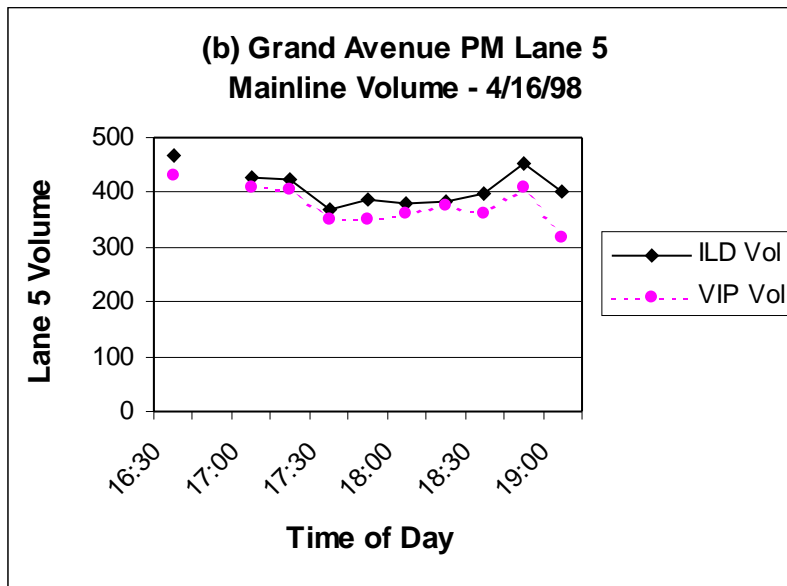
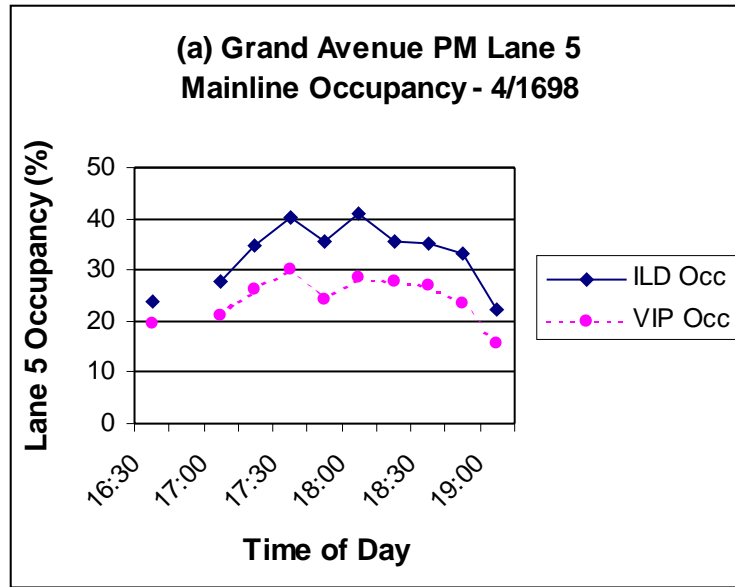


Figure J-104. Lane 5 (a) occupancy and (b) volume at the Grand Avenue evaluation site during the afternoon rush-hour interval on 4/16/98

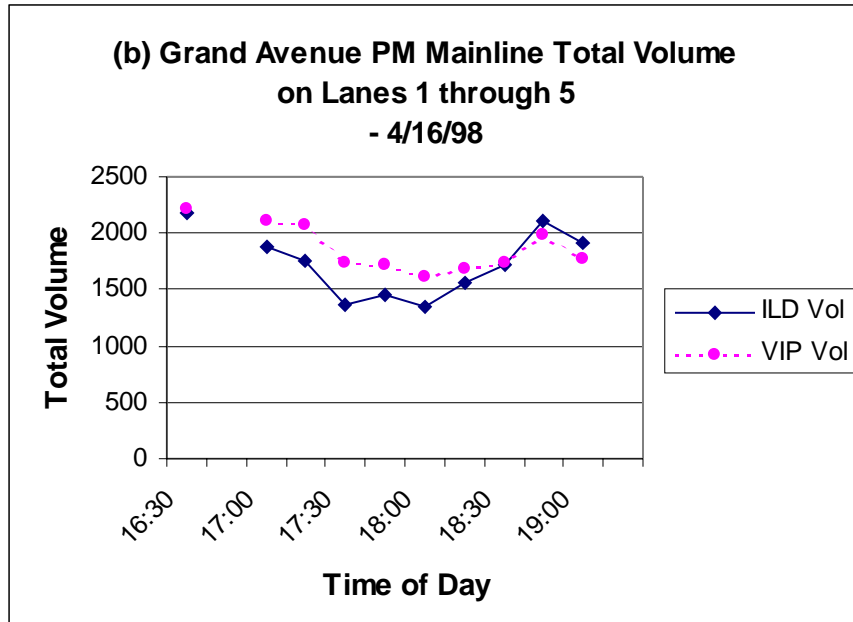
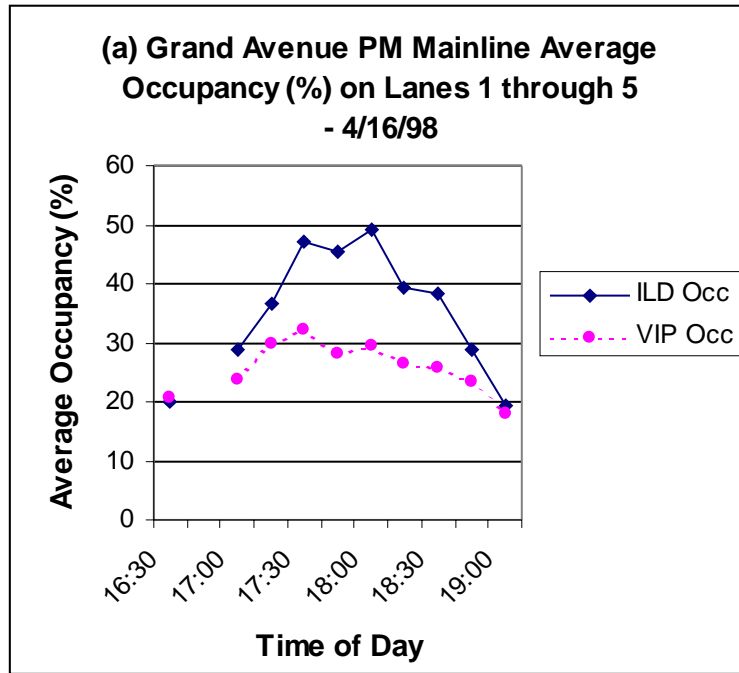


Figure J-105. Average (a) lane occupancy and (b) total volume measured by the ILDs and VIP over all lanes at the Grand Avenue evaluation site during the afternoon rush-hour interval on 4/16/98

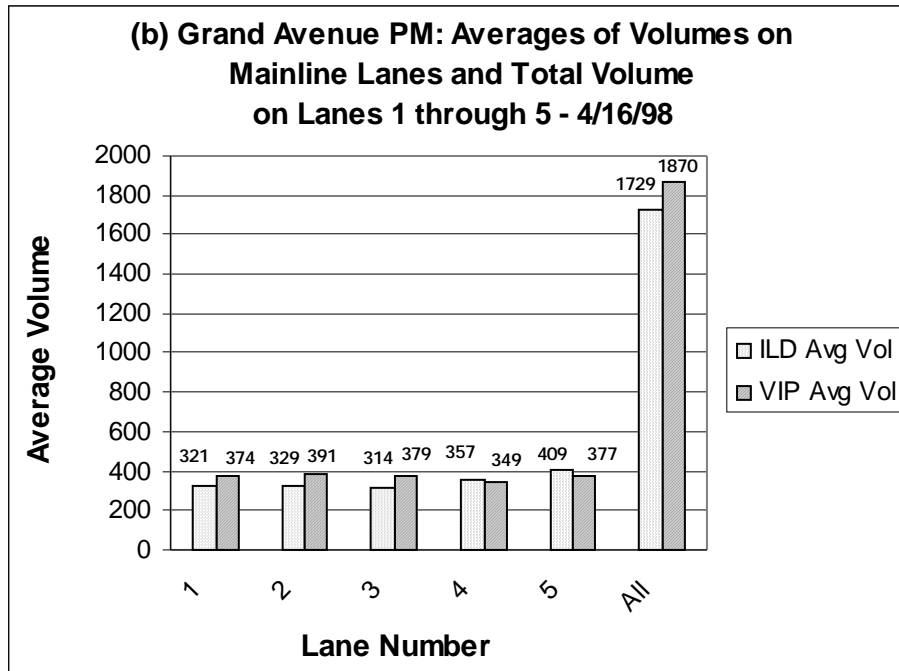
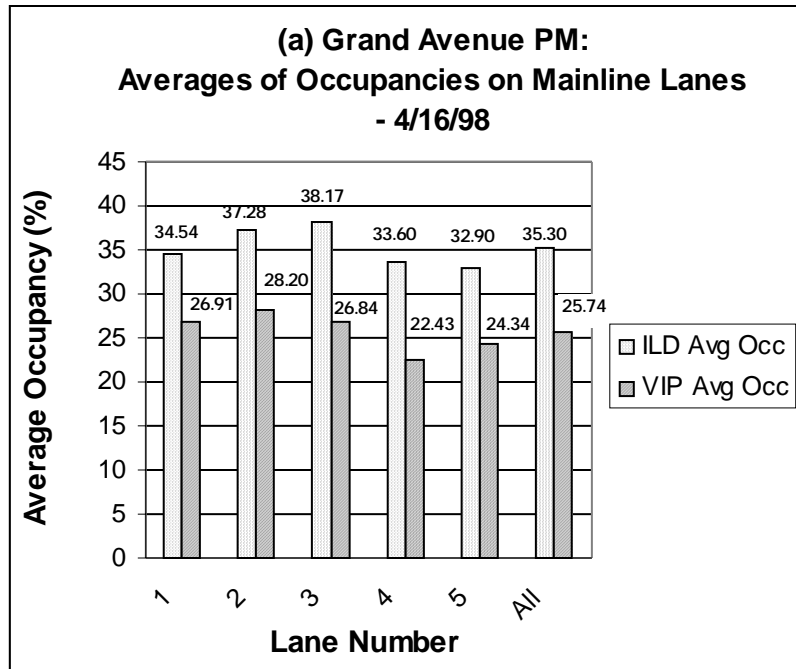


Figure J-106. Comparison of ILD and VIP lane-by-lane averages of (a) lane occupancy and (b) total volume at the Grand Avenue evaluation site during the afternoon rush-hour interval on 4/16/98

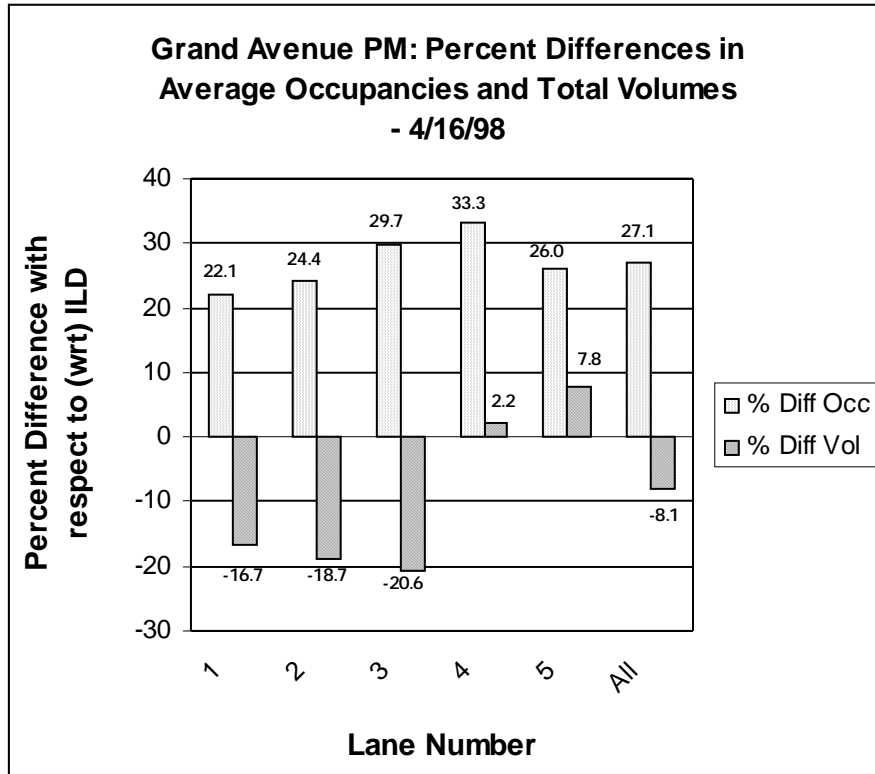


Figure J-107. Percent difference between the ILD and VIP averages of the average occupancy and total volume by lane at the Grand Avenue evaluation site during the afternoon rush-hour interval on 4/16/98

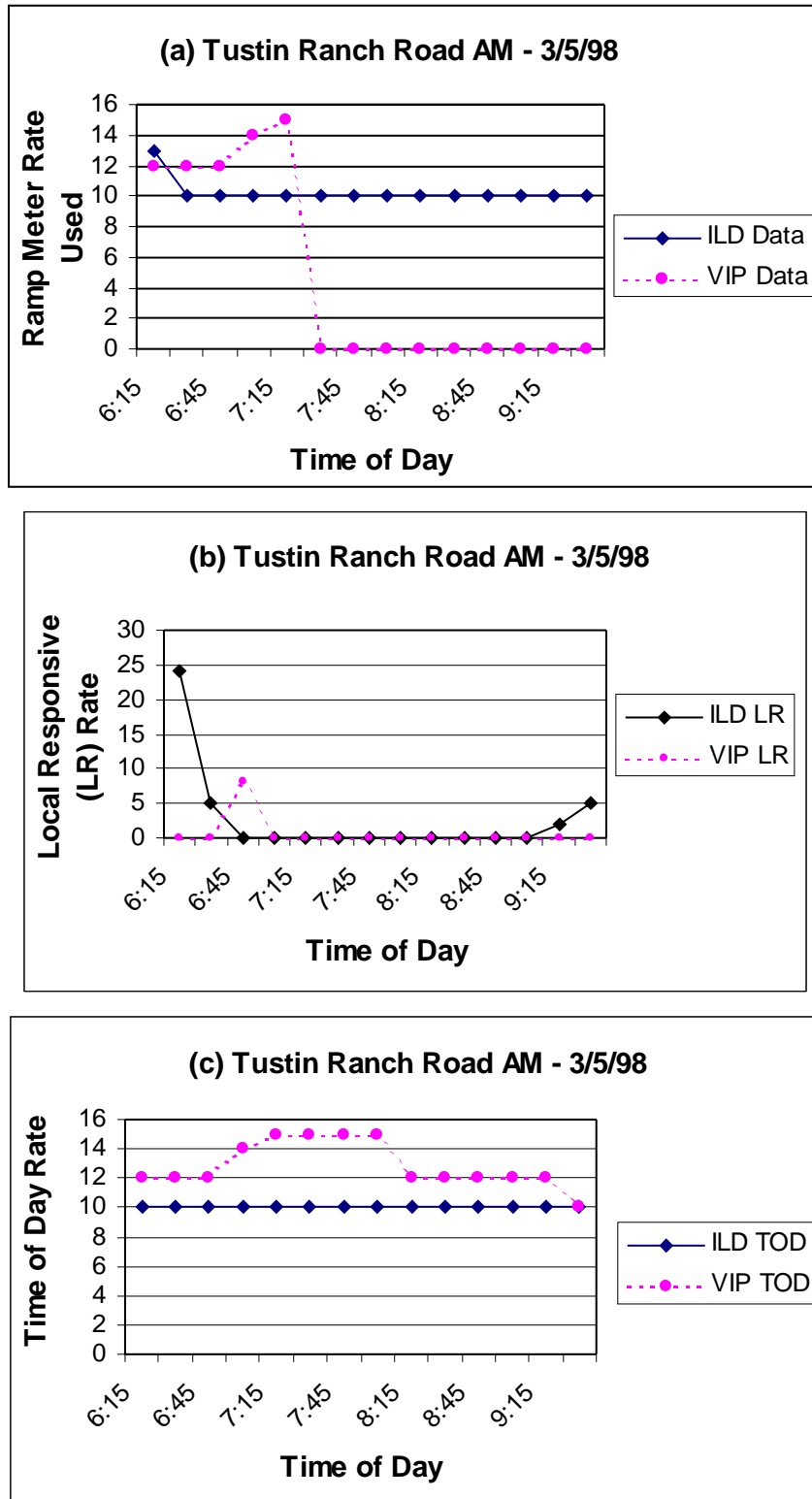


Figure J-108. Ramp meter rates (vehicles/minute) at Tustin Ranch Road for AM rush hours on 3/5/98: (a) Ramp meter rate used, (b) Local responsive rate, (c) Time of day rate

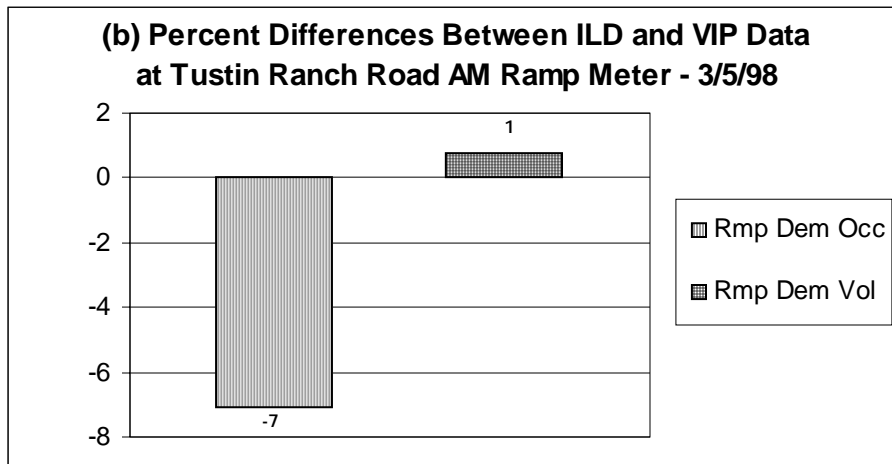
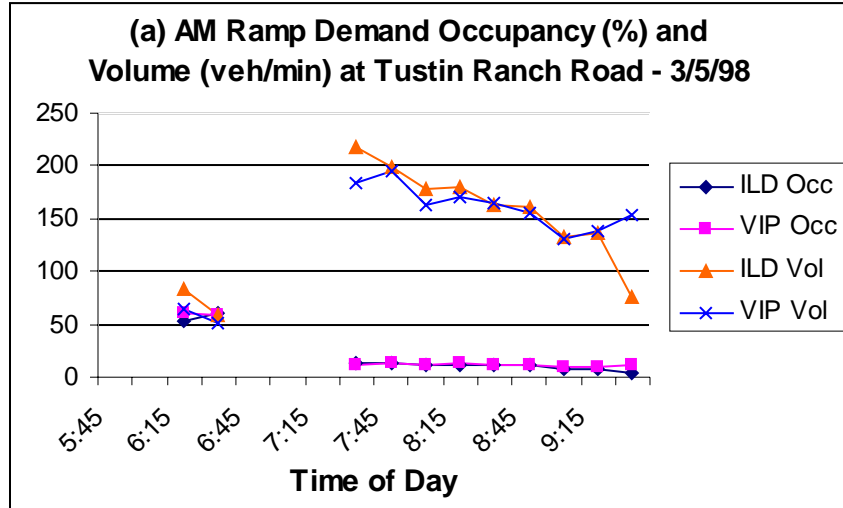


Figure J-109. ILD and VIP ramp and mainline data at Tustin Ranch Road ramp meter for AM rush hours on 3/5/98: (a) Ramp demand occupancy and volume, (b) Percent differences between ILD and VIP data

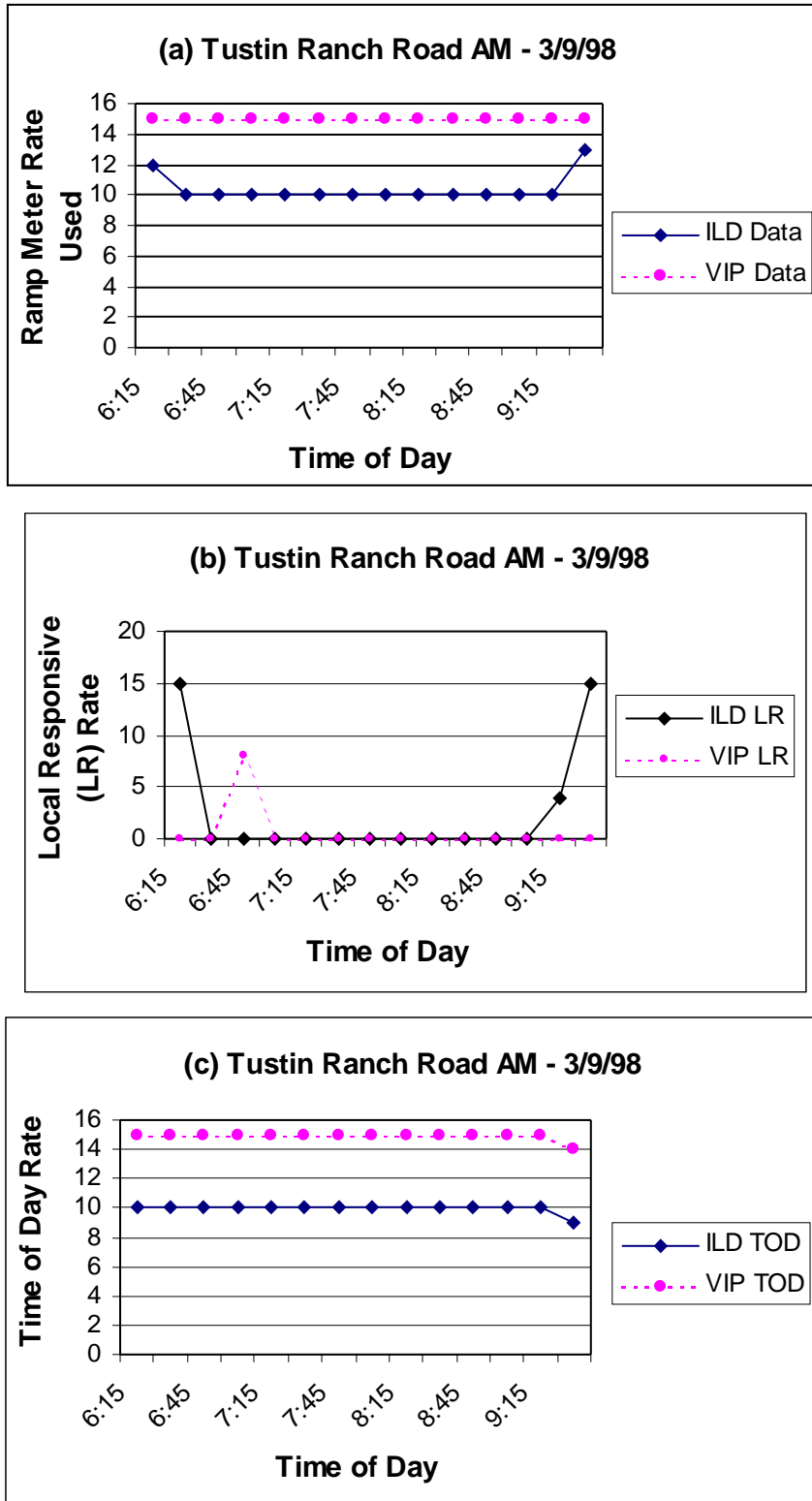


Figure J-110. Ramp meter rates (vehicles/minute) at Tustin Ranch Road for AM rush hours on 3/9/98: (a) Ramp meter rate used, (b) Local responsive rate, (c) Time of day rate

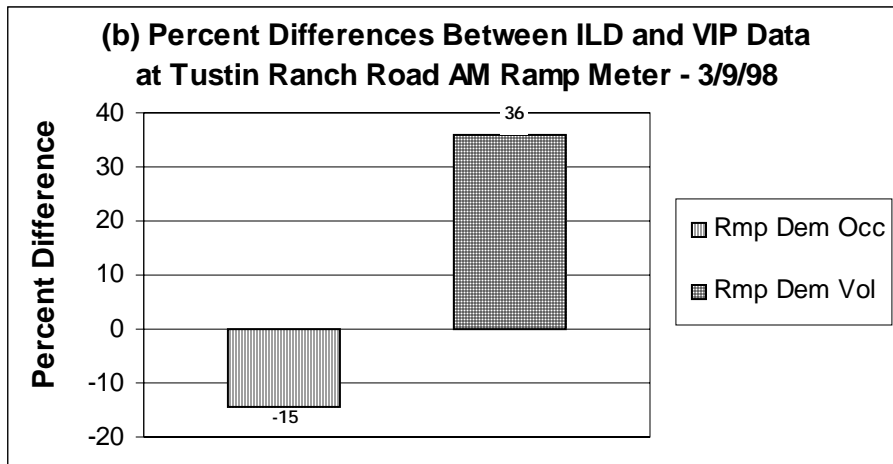
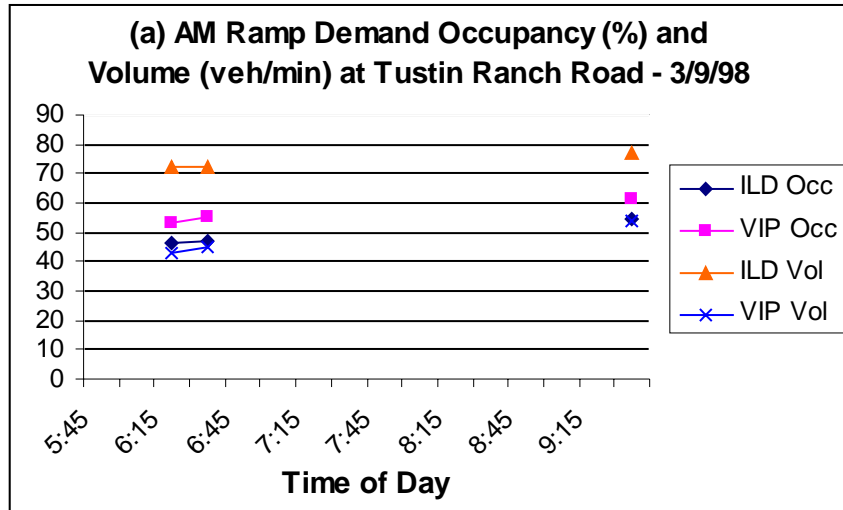


Figure J-111. ILD and VIP ramp and mainline data at Tustin Ranch Road ramp meter for AM rush hours on 3/9/98: (a) Ramp demand occupancy and volume, (b) Percent differences between ILD and VIP data

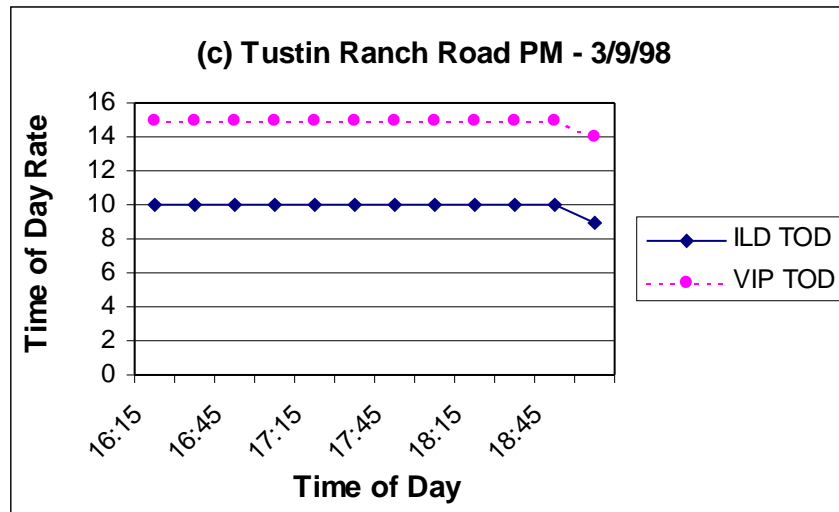
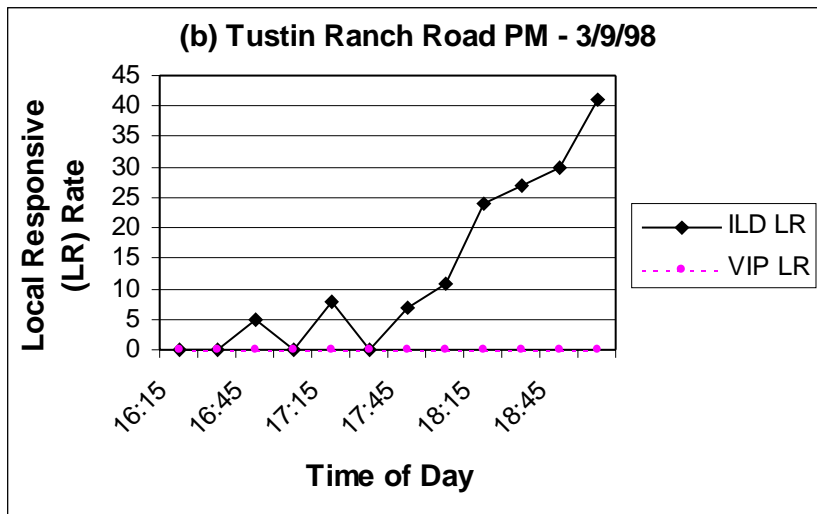
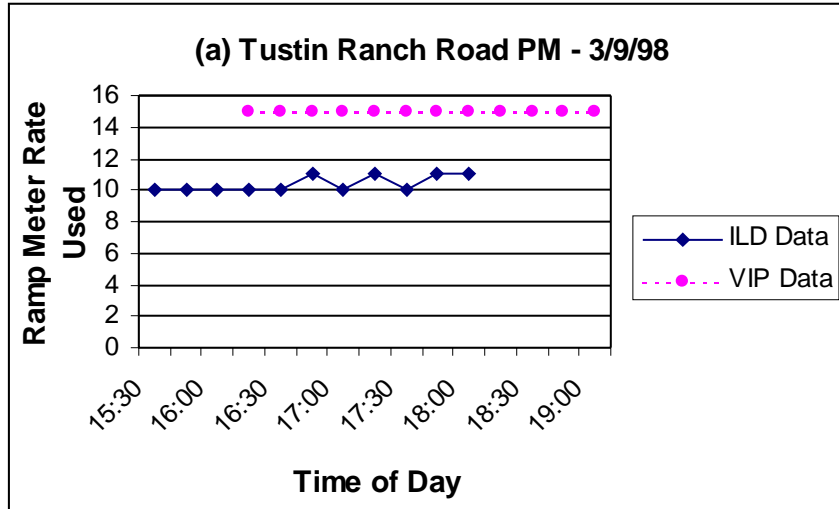


Figure J-112. Ramp meter rates (vehicles/minute) at Tustin Ranch Road for PM rush hours on 3/9/98: (a) Ramp meter rate used, (b) Local responsive rate, (c) Time of day rate

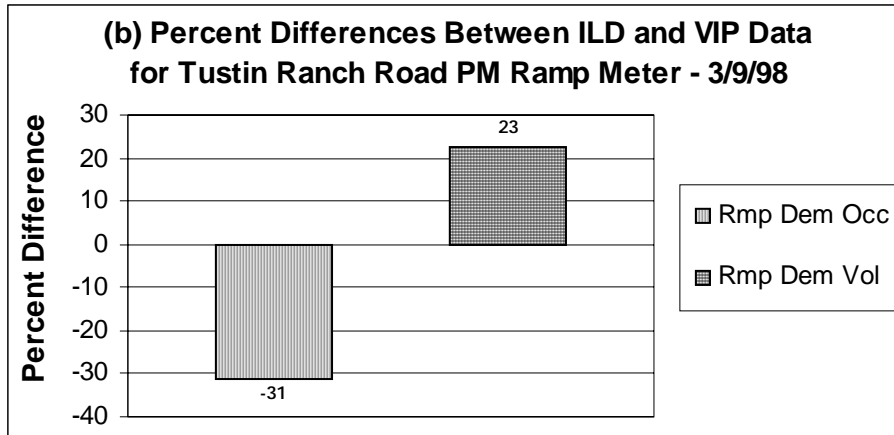
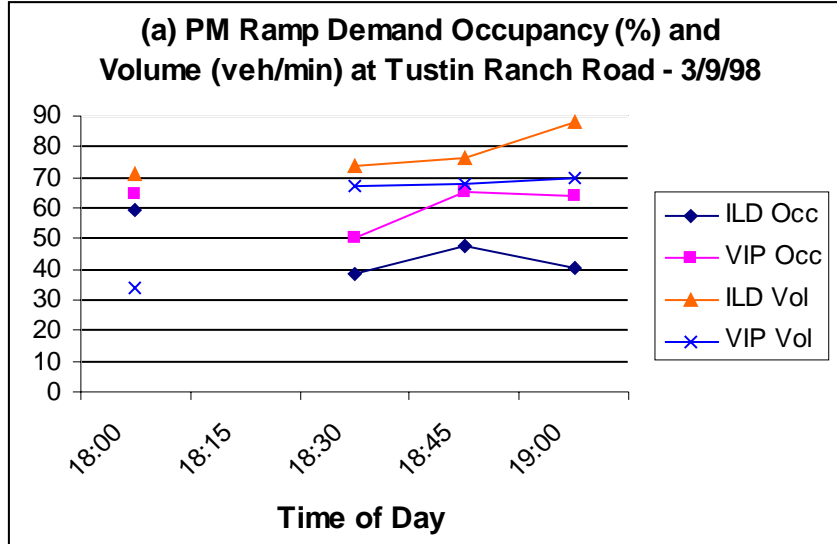


Figure J-113. ILD and VIP ramp and mainline data at Tustin Ranch Road ramp meter for PM rush hours on 3/9/98: (a) Ramp demand occupancy and volume, (b) Percent differences between ILD and VIP data

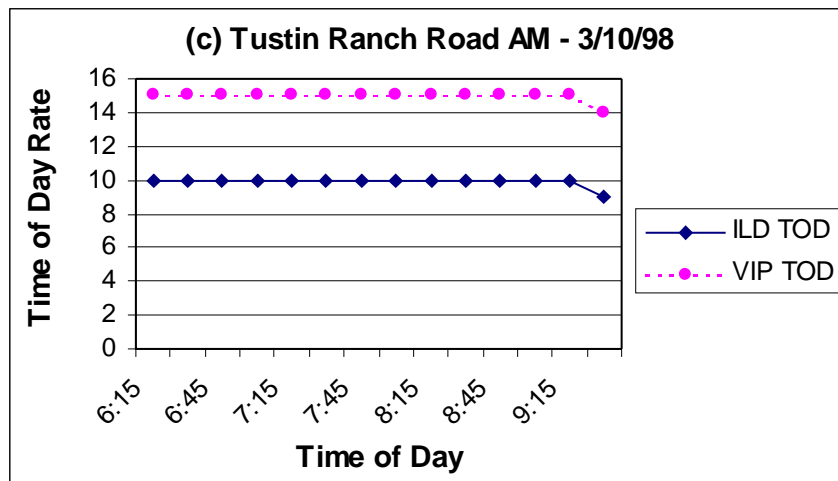
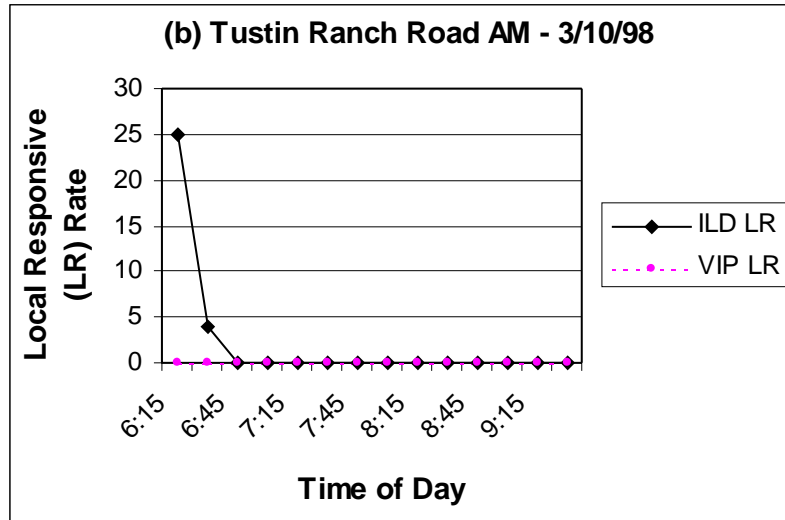
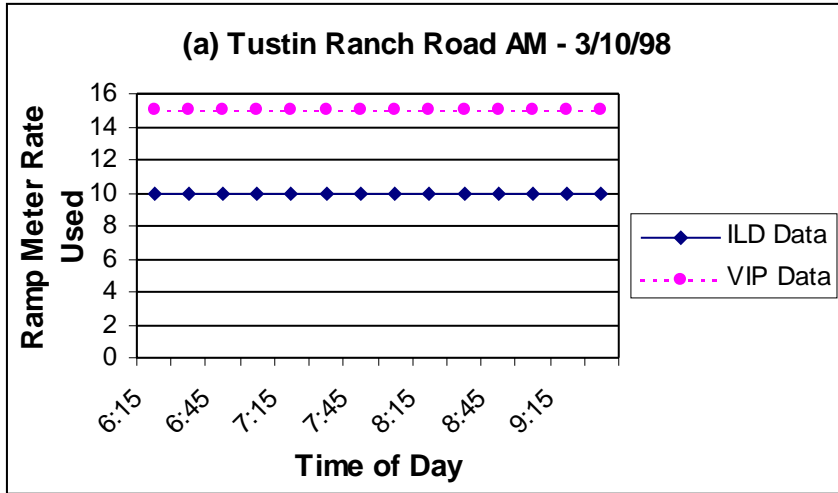


Figure J-114. Ramp meter rates (vehicles/minute) at Tustin Ranch Road for AM rush hours on 3/10/98: (a) Ramp meter rate used, (b) Local responsive rate, (c) Time of day rate

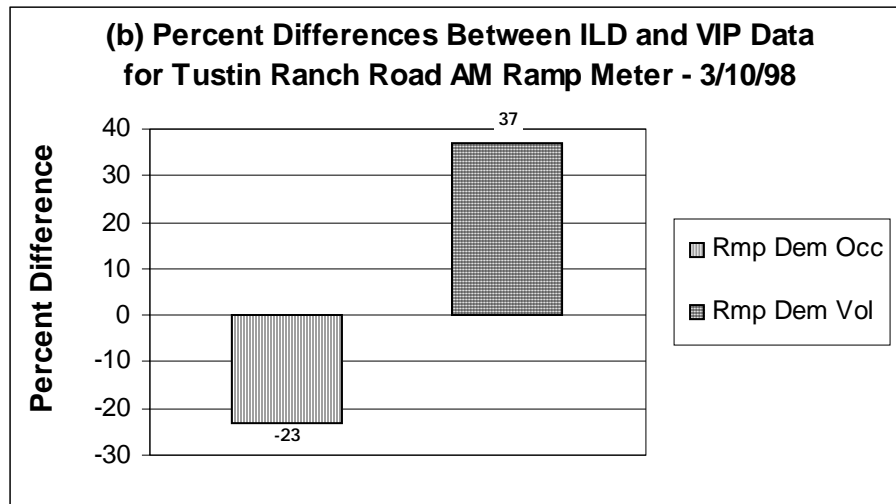
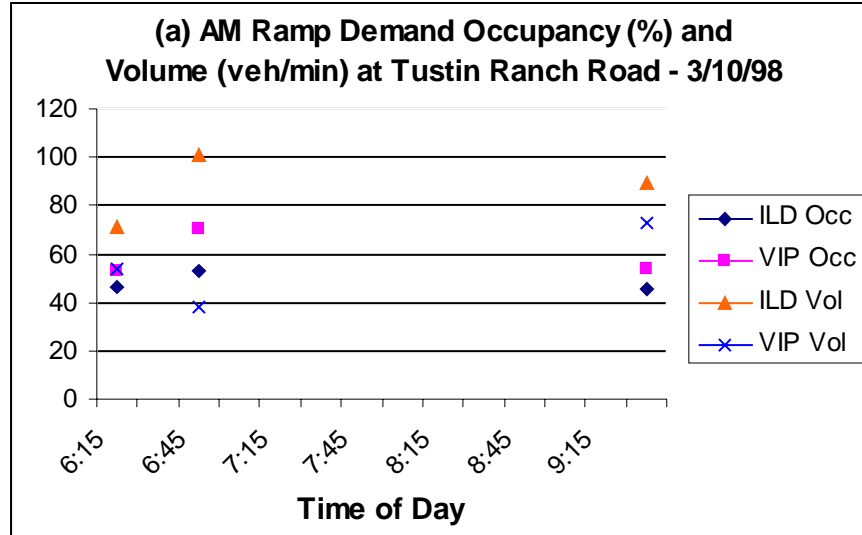


Figure J-115. ILD and VIP ramp and mainline data at Tustin Ranch Road ramp meter for AM rush hours on 3/10/98: (a) Ramp demand occupancy and volume, (b) Percent differences between ILD and VIP data

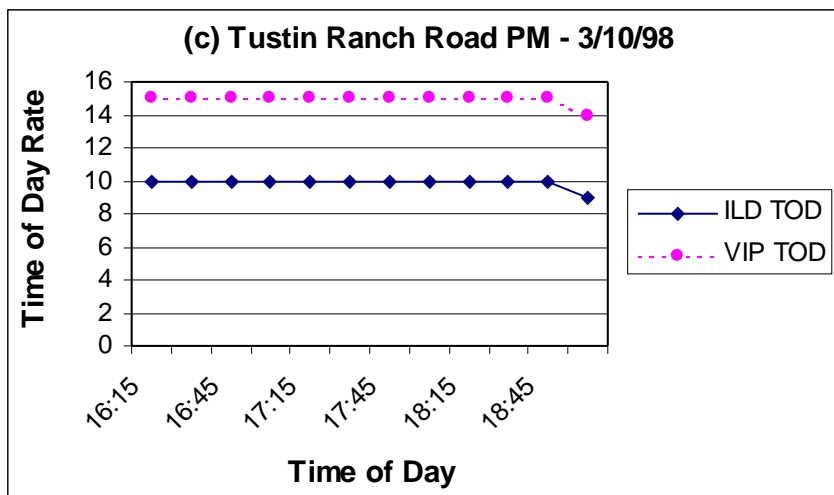
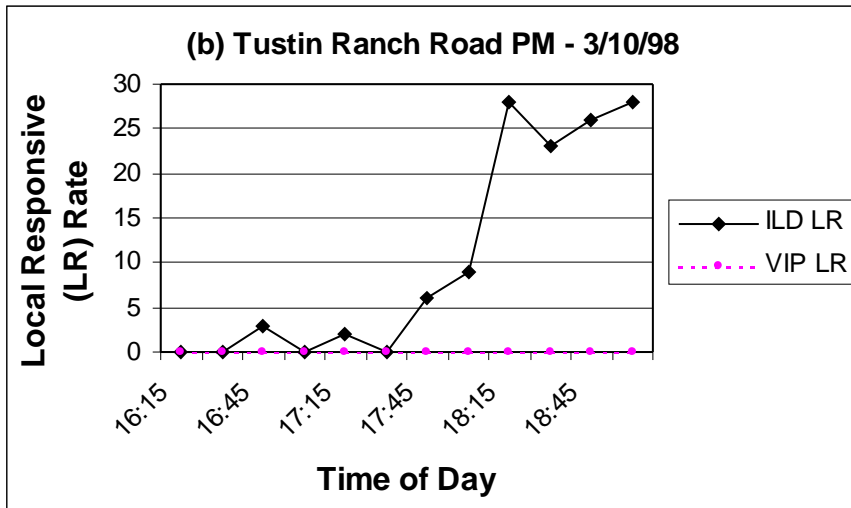
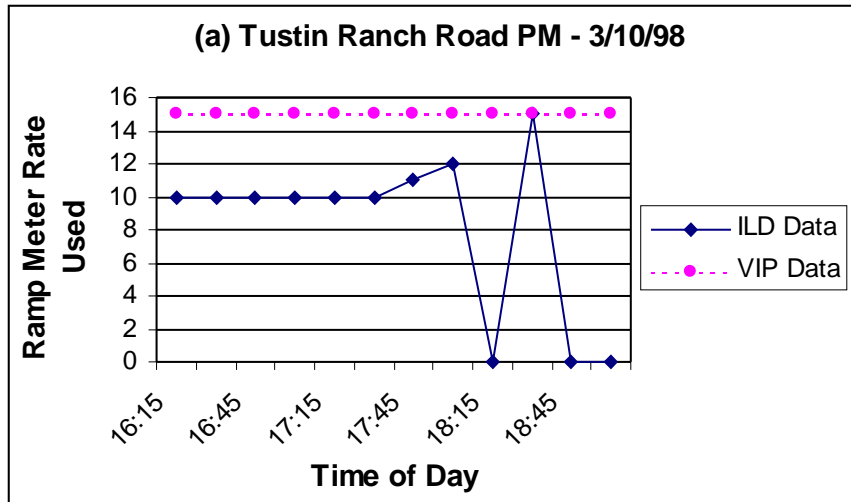


Figure J-116. Ramp meter rates (vehicles/minute) at Tustin Ranch Road for PM rush hours on 3/10/98: (a) Ramp meter rate used, (b) Local responsive rate, (c) Time of day rate

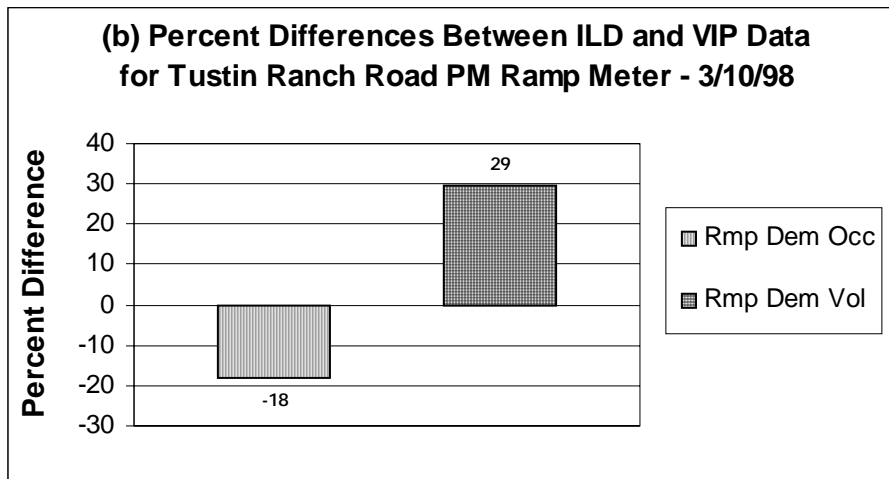
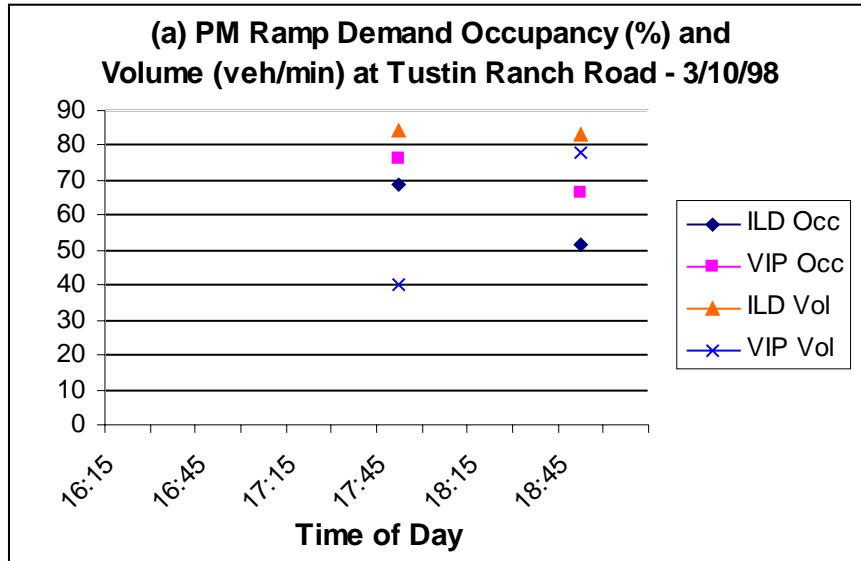


Figure J-117. ILD and VIP ramp and mainline data at Tustin Ranch Road ramp meter for PM rush hours on 3/10/98: (a) Ramp demand occupancy and volume, (b) Percent differences between ILD and VIP data

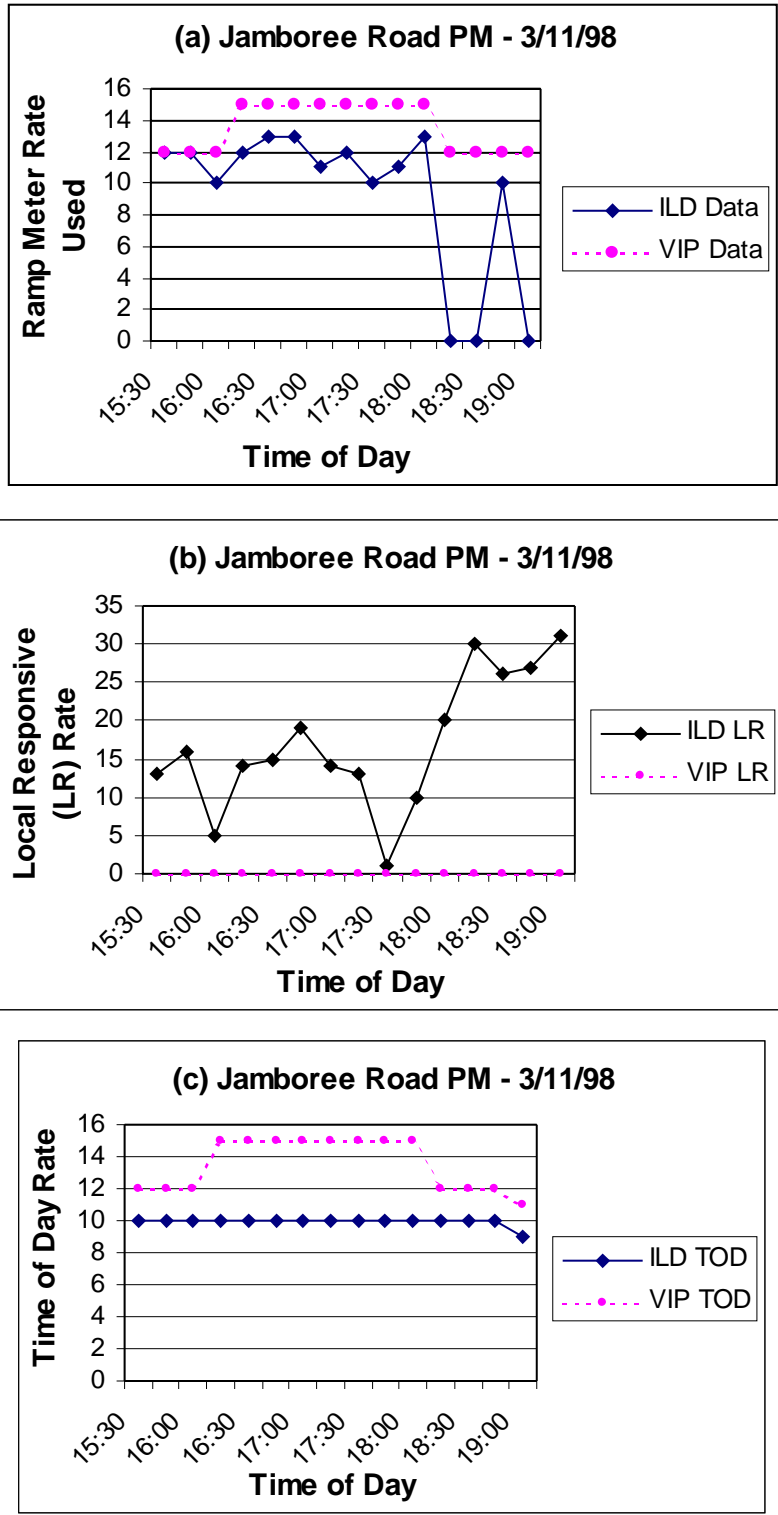


Figure J-118. Ramp meter rates (vehicles/minute) at Jamboree Road for PM rush hours on 3/11/98: (a) Ramp meter rate used, (b) Local responsive rate, (c) Time of day rate

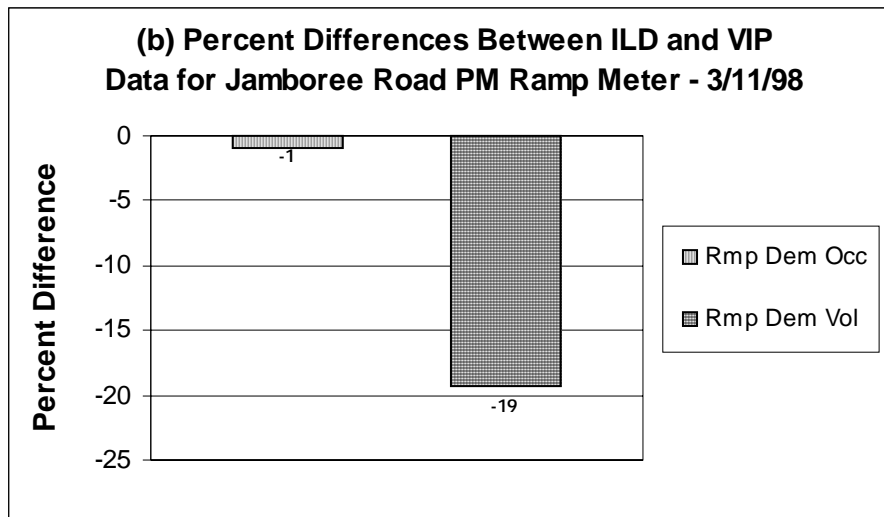
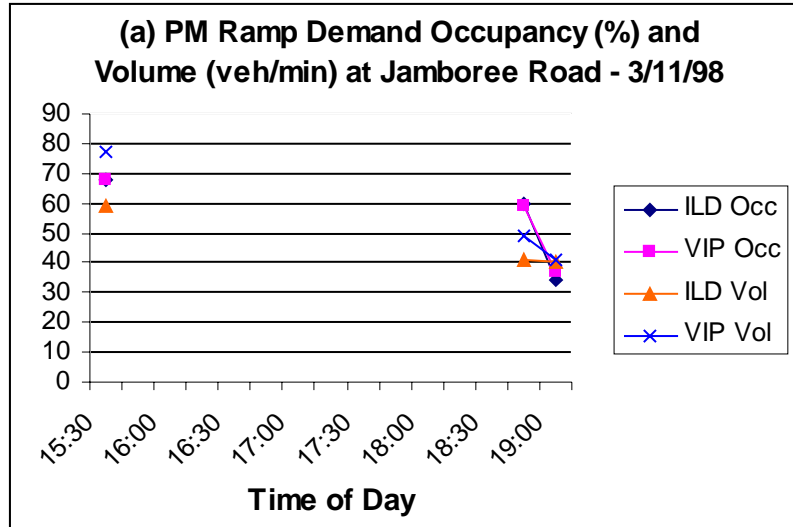


Figure J-119. ILD and VIP ramp and mainline data at Jamboree Road ramp meter for PM rush hours on 3/11/98: (a) Ramp demand occupancy and volume, (b) Percent differences between ILD and VIP data

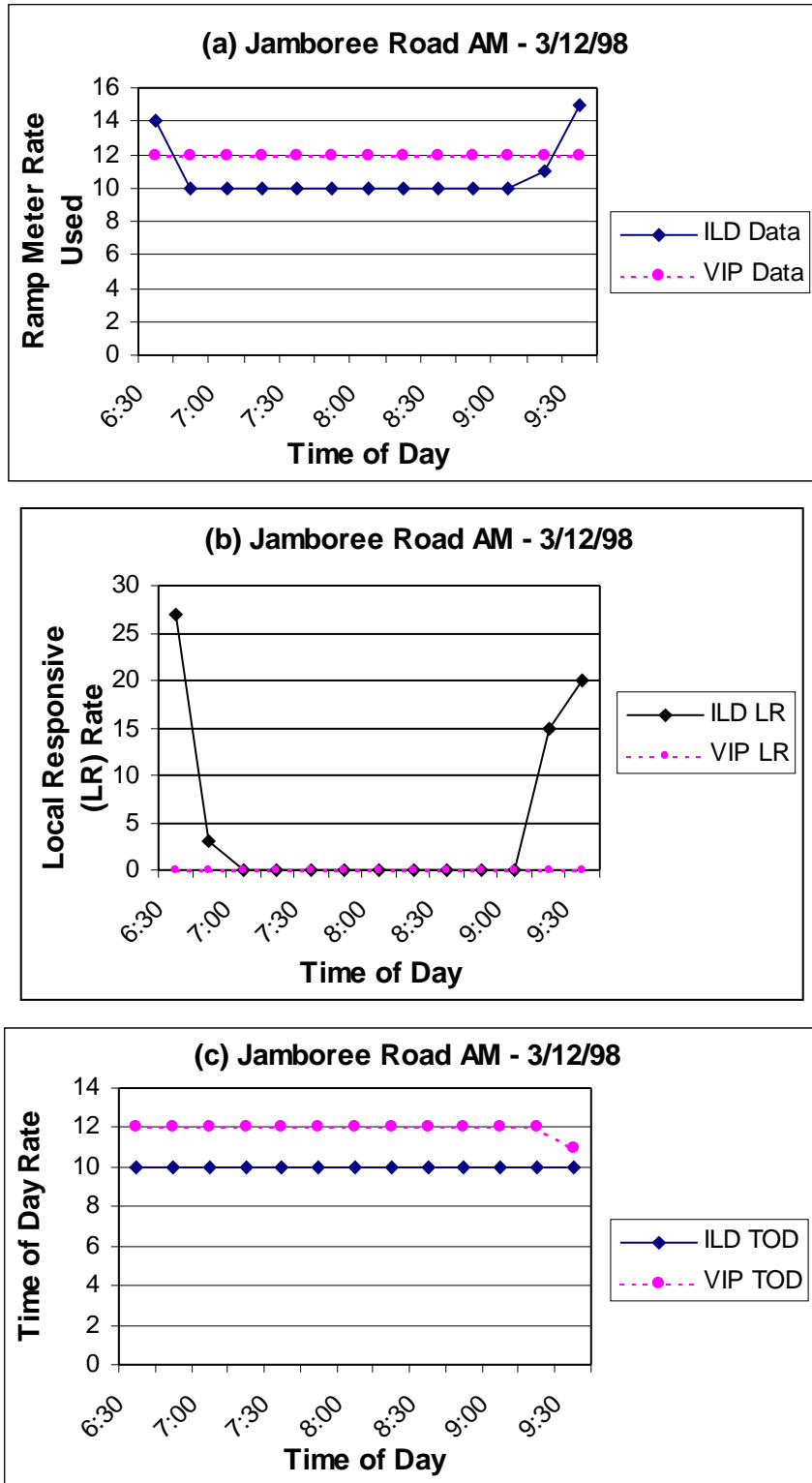


Figure J-120. Ramp meter rates (vehicles/minute) at Jamboree Road for AM rush hours on 3/12/98: (a) Ramp meter rate used, (b) Local responsive rate, (c) Time of day rate

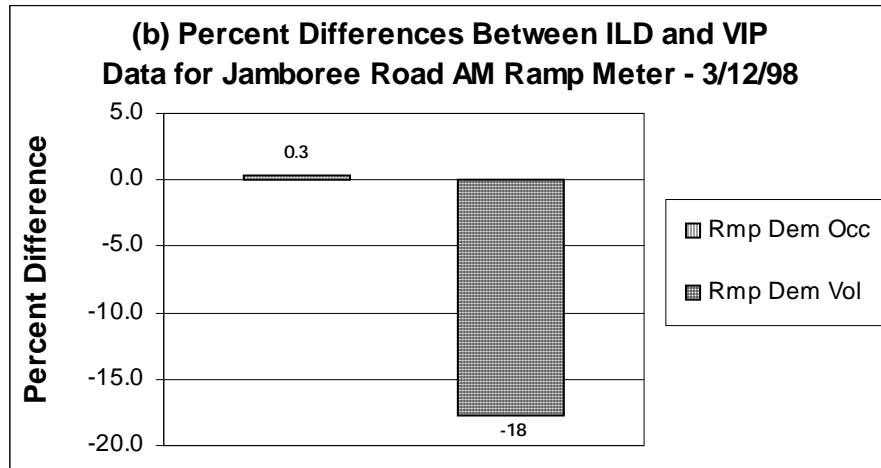
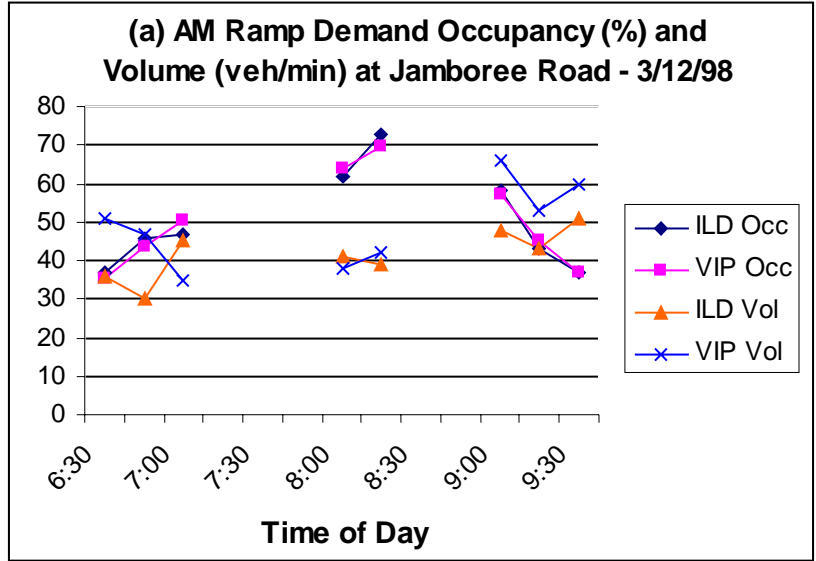


Figure J-121. ILD and VIP ramp and mainline data at Jamboree Road ramp meter for AM rush hours on 3/12/98: (a) Ramp demand occupancy and volume, (b) Percent differences between ILD and VIP data

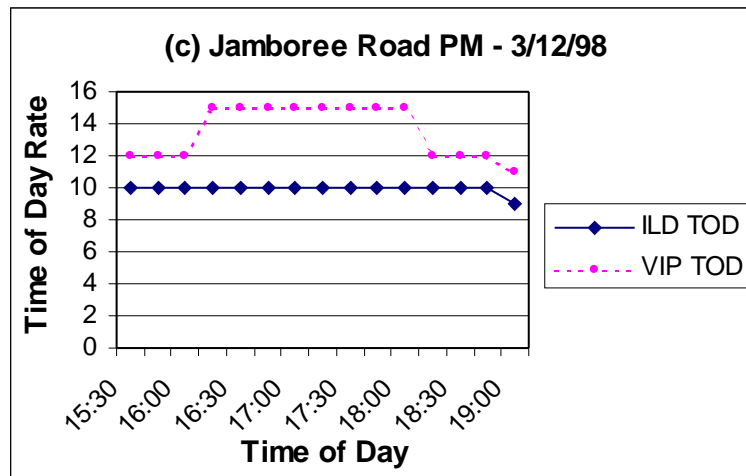
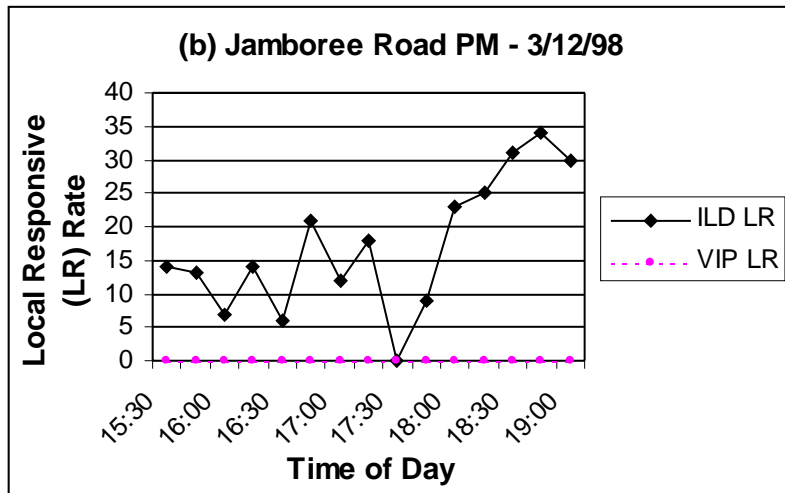
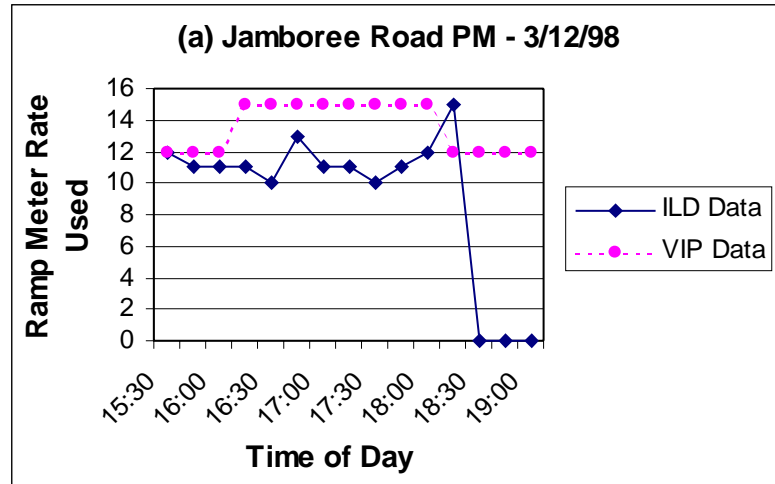


Figure J-122. Ramp meter rates (vehicles/minute) at Jamboree Road for PM rush hours on 3/12/98: (a) Ramp meter rate used, (b) Local responsive rate, (c) Time of day rate

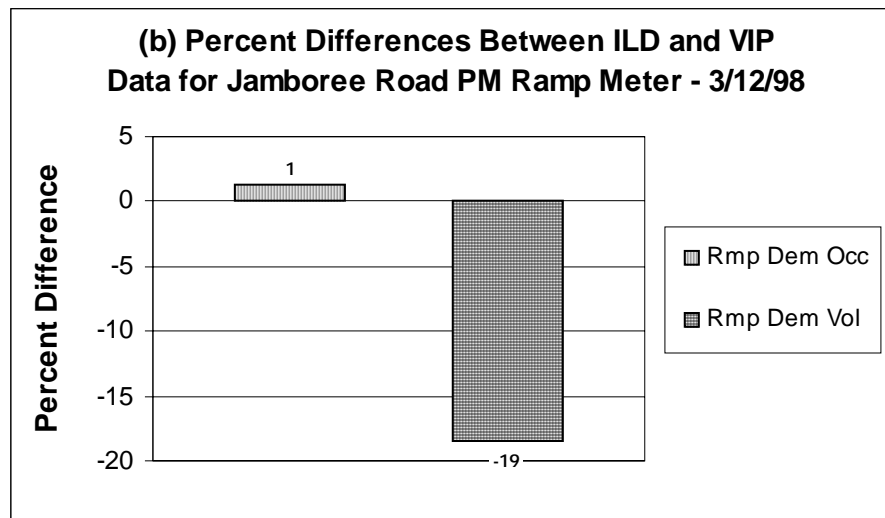
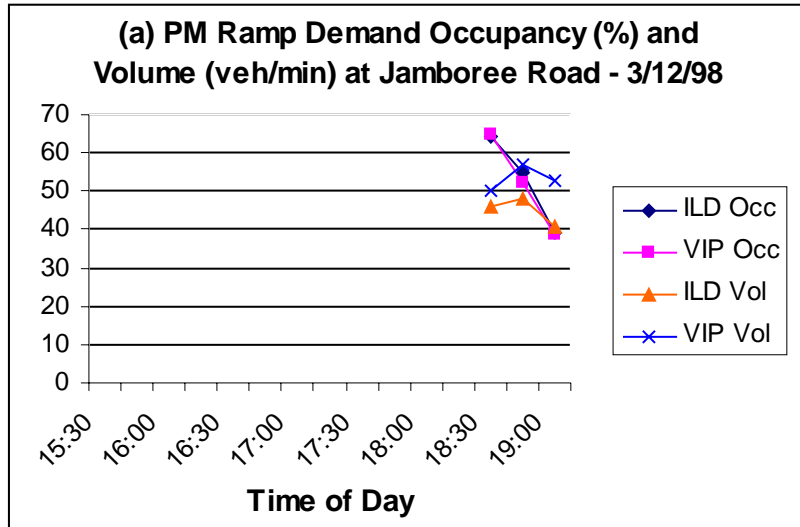


Figure J-123. ILD and VIP ramp and mainline data at Jamboree Road ramp meter for PM rush hours on 3/12/98: (a) Ramp demand occupancy and volume, (b) Percent differences between ILD and VIP data

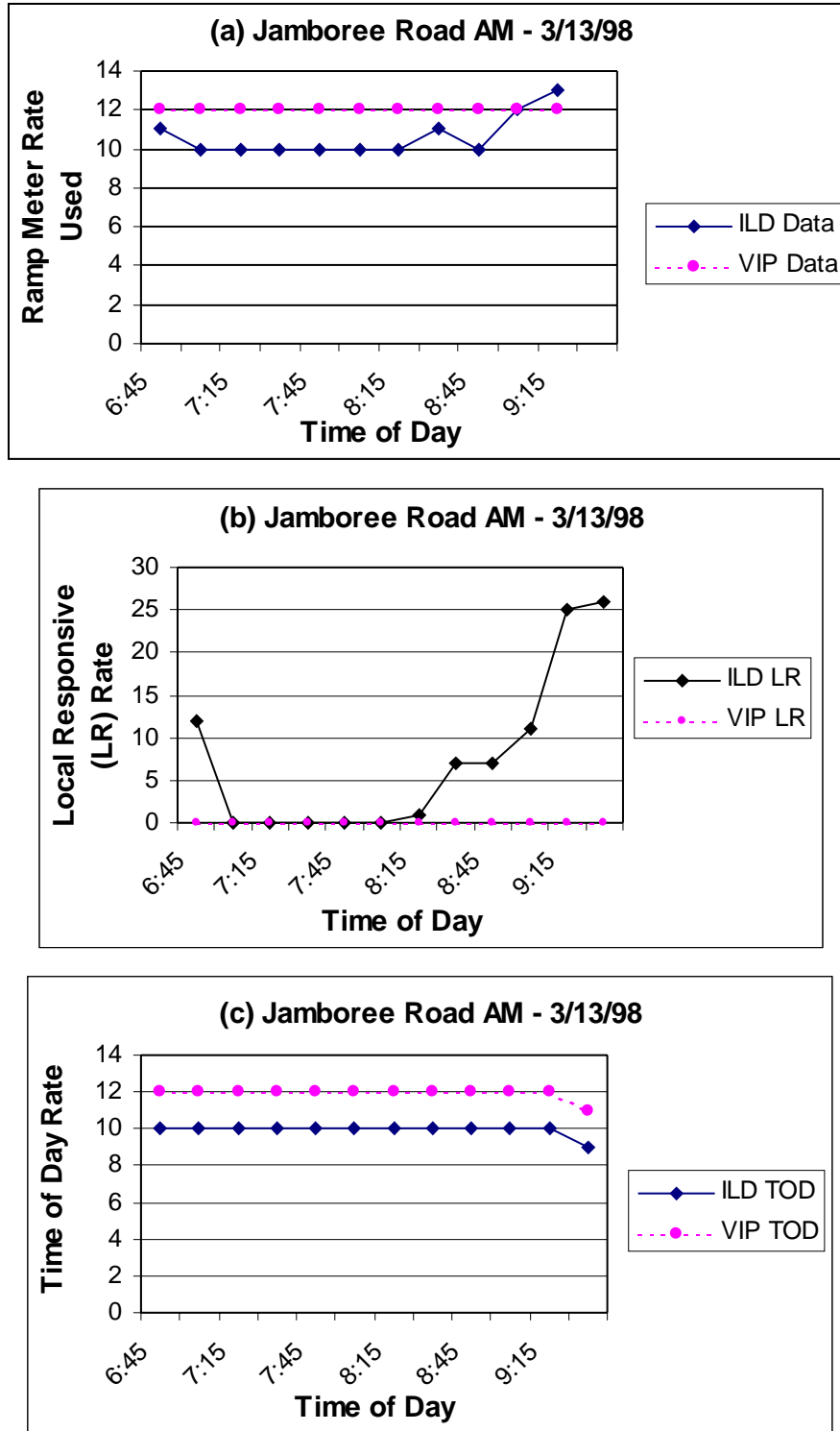


Figure J-124. Ramp meter rates (vehicles/minute) at Jamboree Road for AM rush hours on 3/13/98: (a) Ramp meter rate used, (b) Local responsive rate, (c) Time of day rate

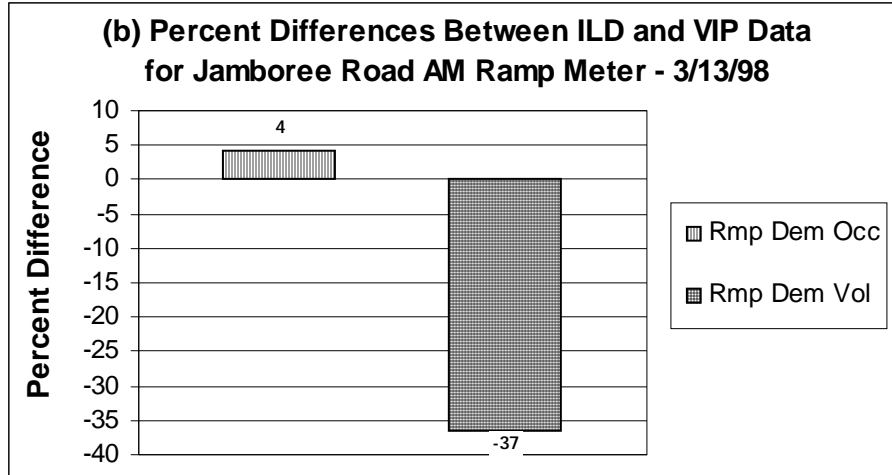
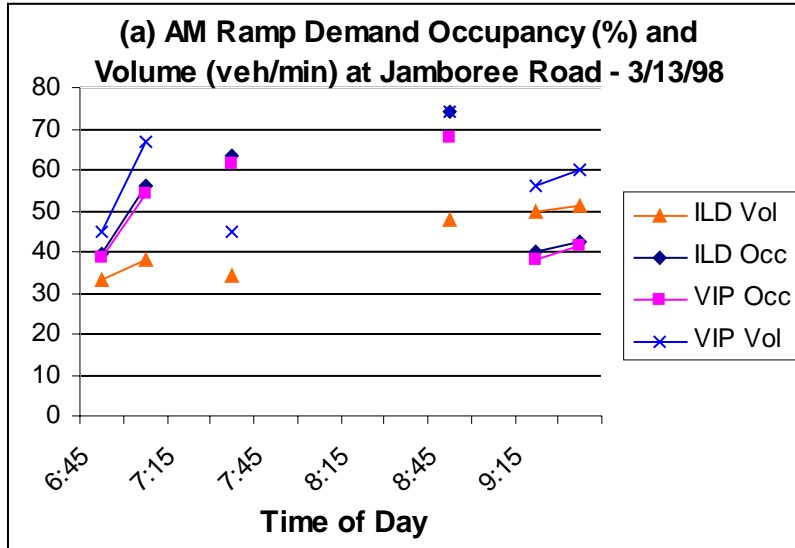


Figure J-125. ILD and VIP ramp and mainline data at Jamboree Road ramp meter for AM rush hours on 3/13/98: (a) Ramp demand occupancy and volume, (b) Percent differences between ILD and VIP data

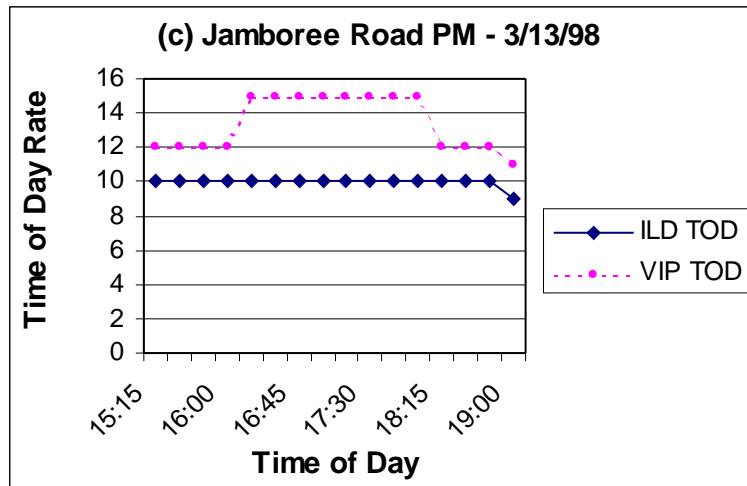
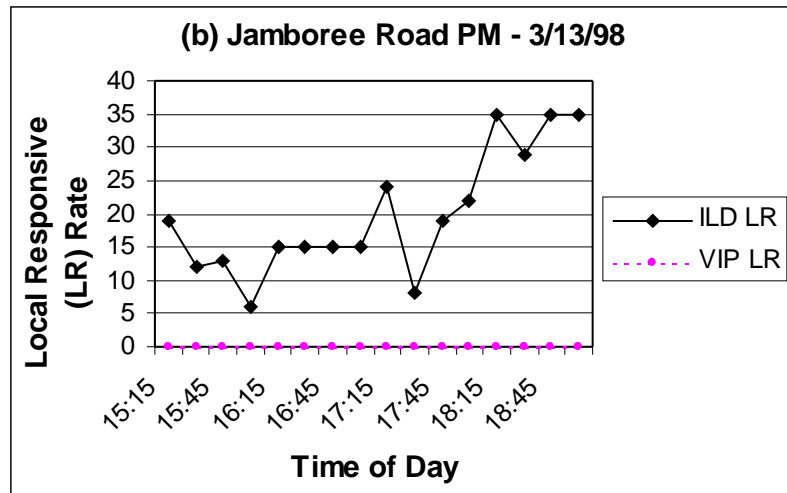
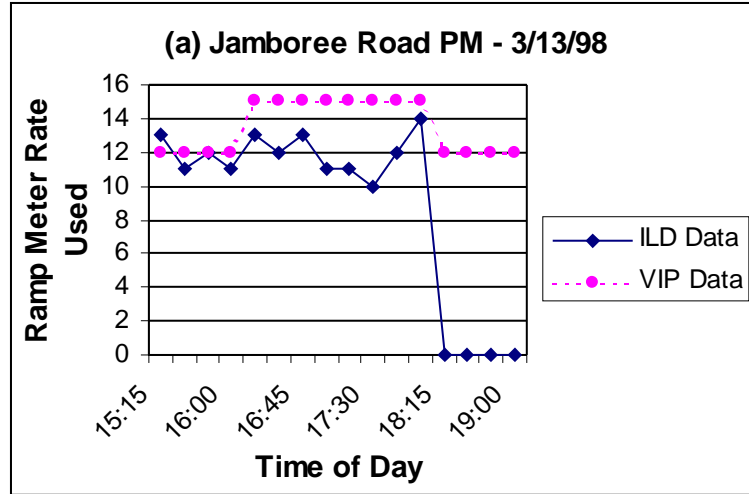


Figure J-126. Ramp meter rates (vehicles/minute) at Jamboree Road for PM rush hours on 3/13/98: (a) Ramp meter rate used, (b) Local responsive rate, (c) Time of day rate

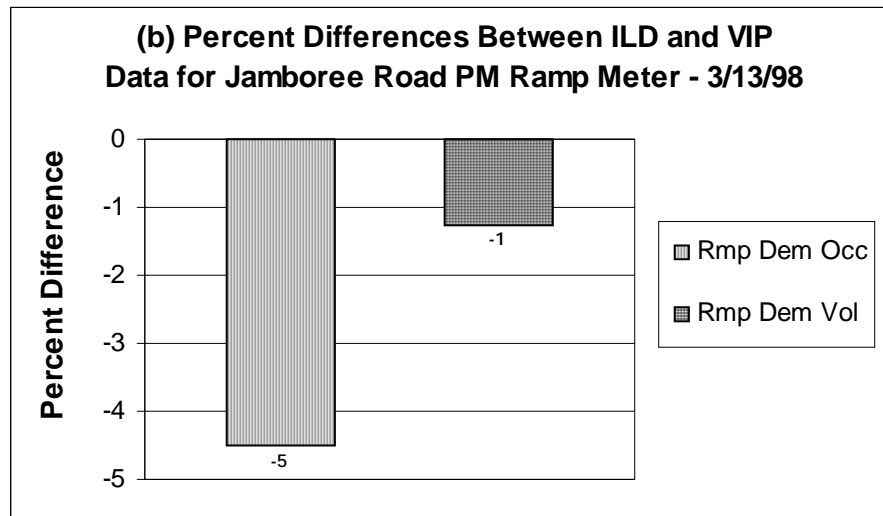
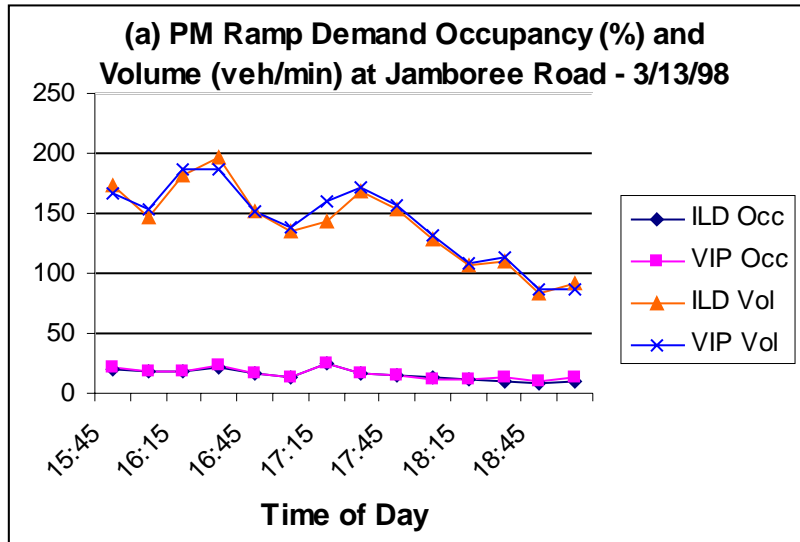


Figure J-127. ILD and VIP ramp and mainline data at Jamboree Road ramp meter for PM rush hours on 3/13/98: (a) Ramp demand occupancy and volume, (b) Percent differences between ILD and VIP data

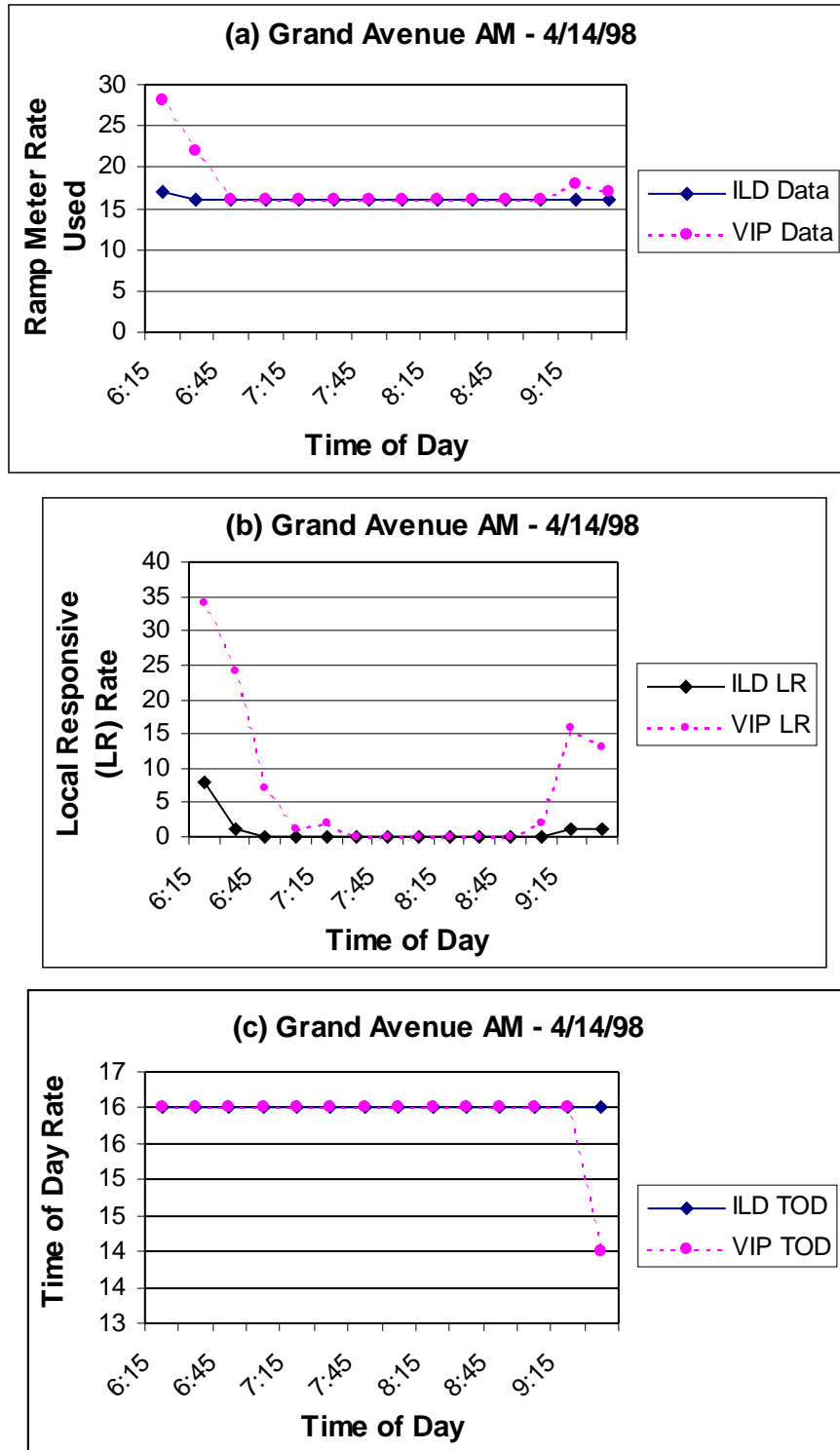


Figure J-128. Ramp meter rates (vehicles/minute) at Grand Avenue for AM rush hours on 4/14/98: (a) Ramp meter rate used, (b) Local responsive rate, (c) Time of day rate

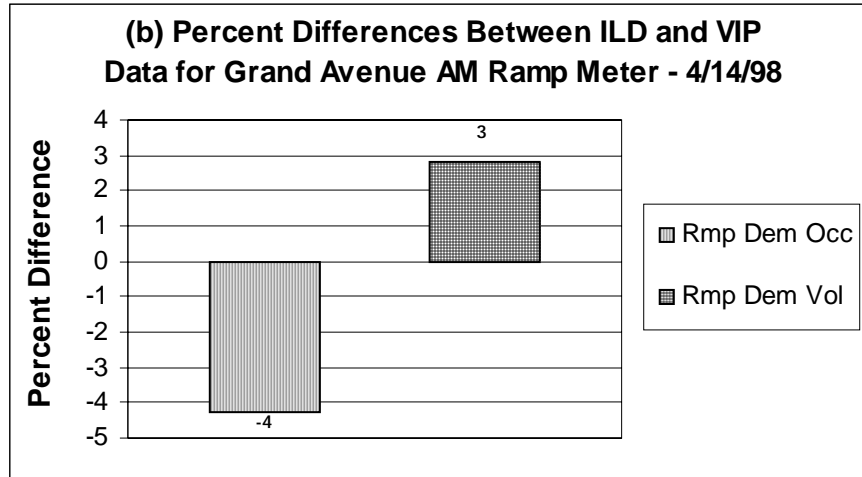
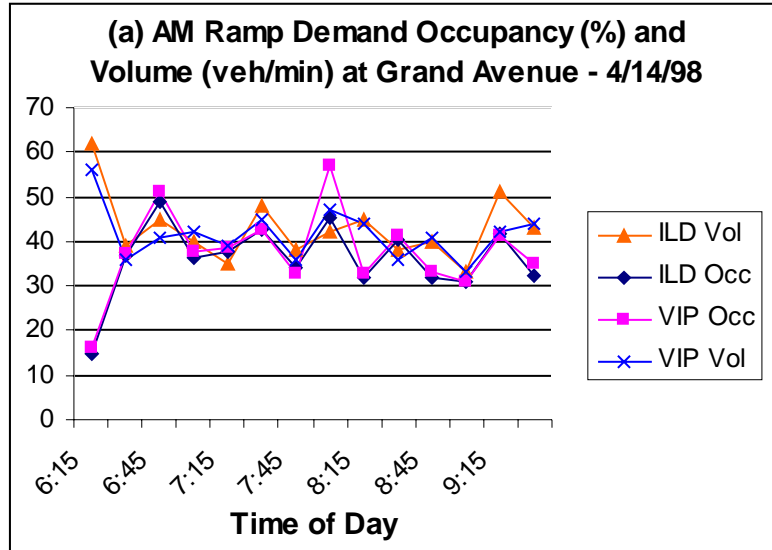


Figure J-129. ILD and VIP ramp and mainline data at Grand Avenue ramp meter for AM rush hours on 4/14/98: (a) Ramp demand occupancy and volume, (b) Percent differences between ILD and VIP data

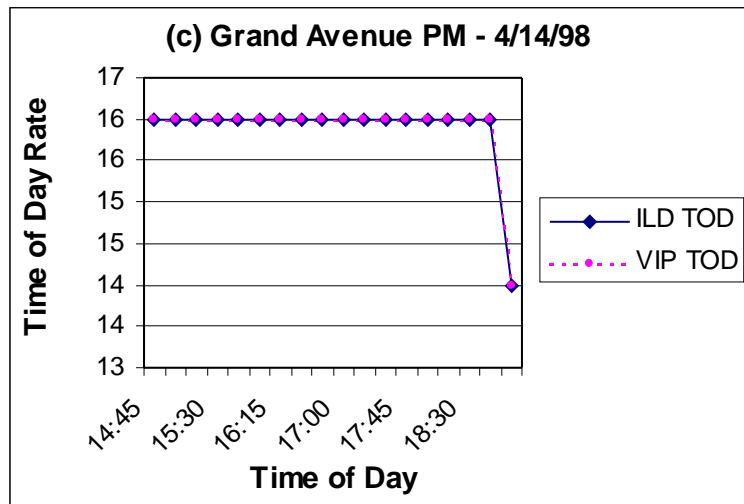
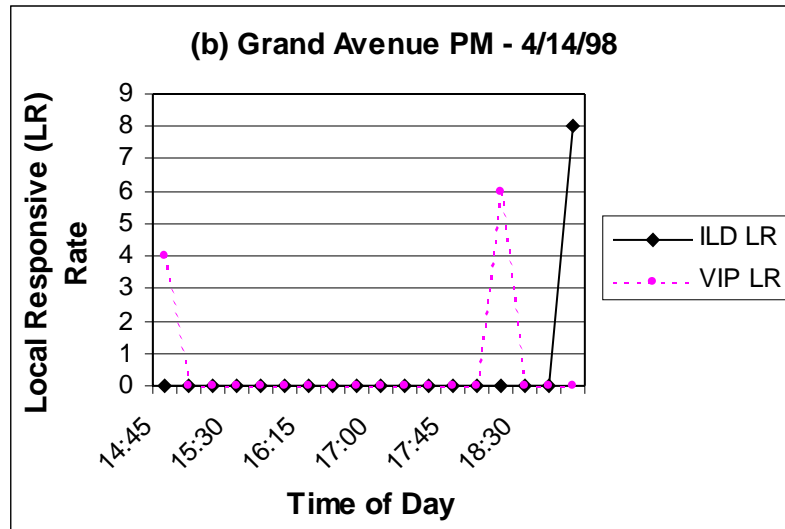
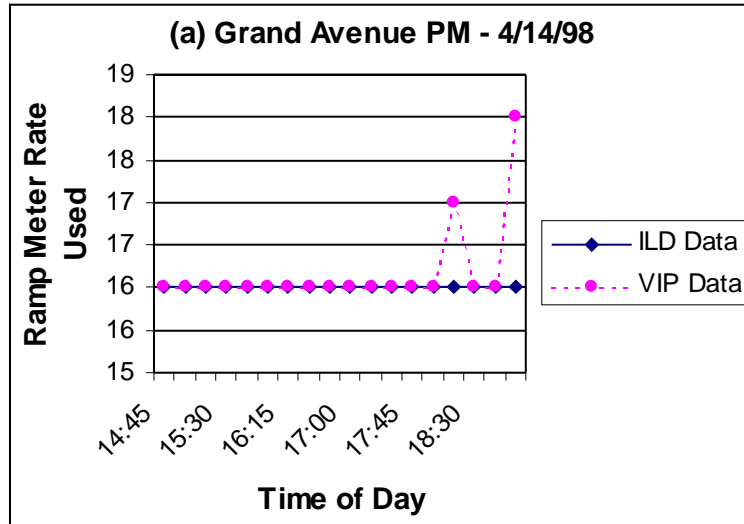


Figure J-130. Ramp meter rates (vehicles/minute) at Grand Avenue for PM rush hours on 4/14/98: (a) Ramp meter rate used, (b) Local responsive rate, (c) Time of day rate

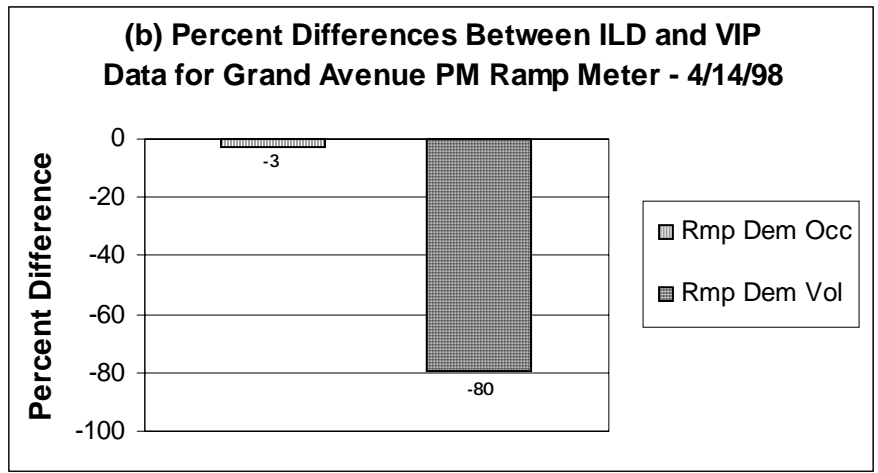
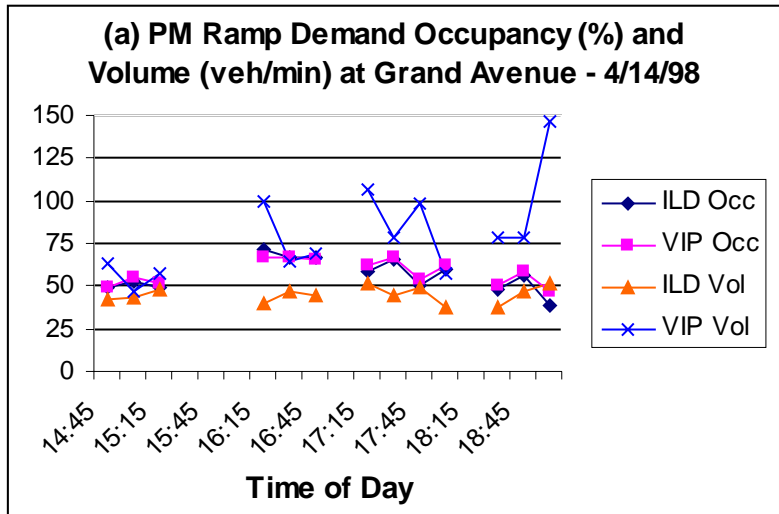


Figure J-131. ILD and VIP ramp and mainline data at Grand Avenue ramp meter for PM rush hours on 4/14/98: (a) Ramp demand occupancy and volume, (b) Percent differences between ILD and VIP data

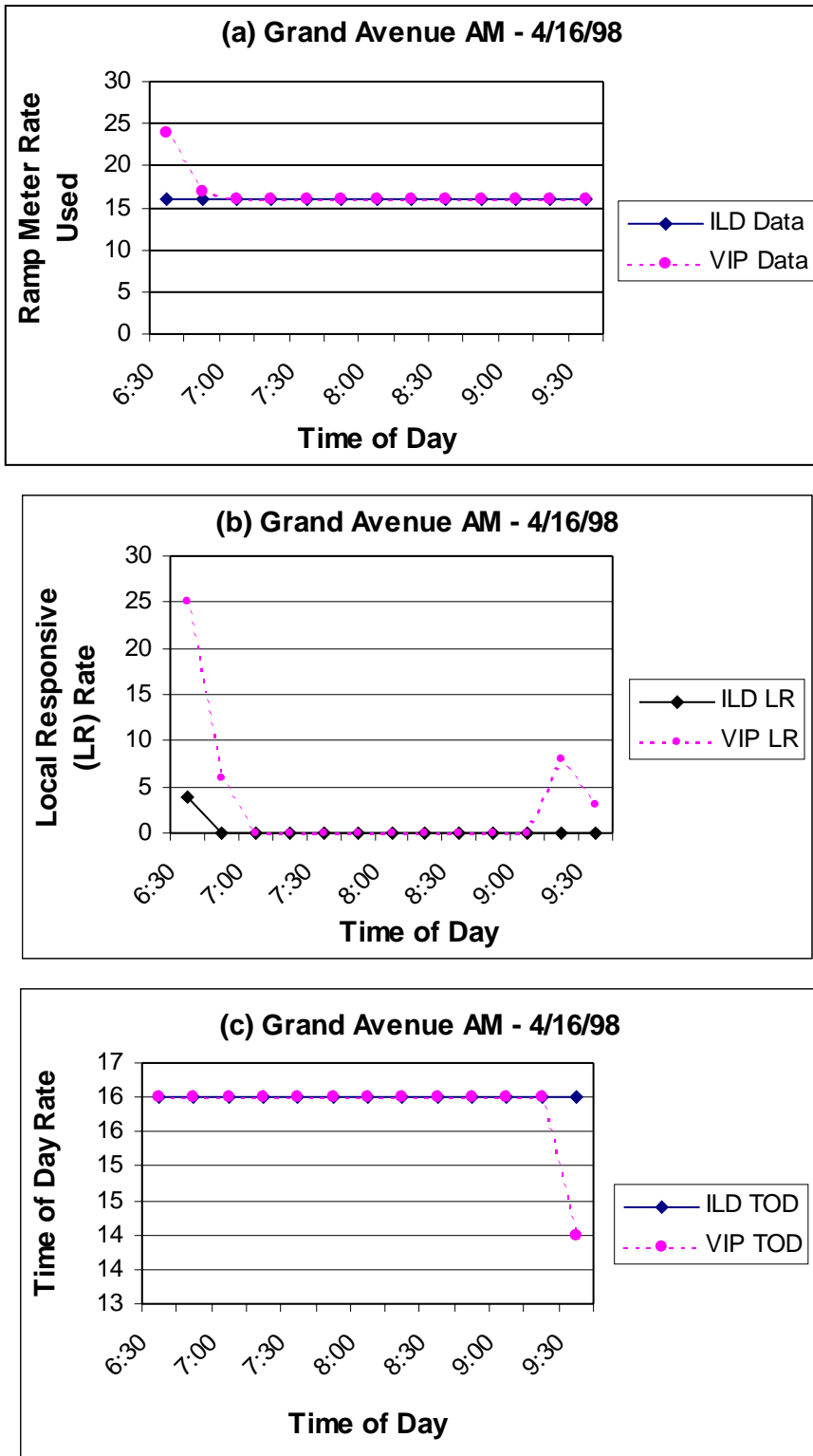


Figure J-132. Ramp meter rates (vehicles/minute) at Grand Avenue for AM rush hours on 4/16/98: (a) Ramp meter rate used, (b) Local responsive rate, (c) Time of day rate

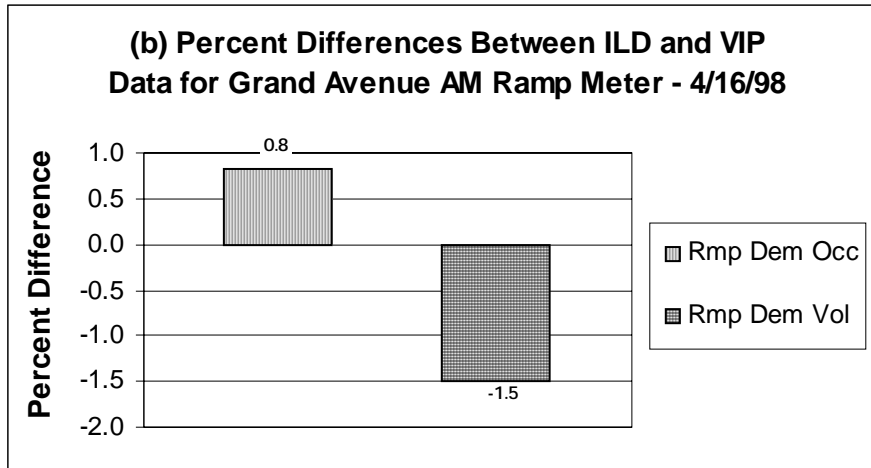
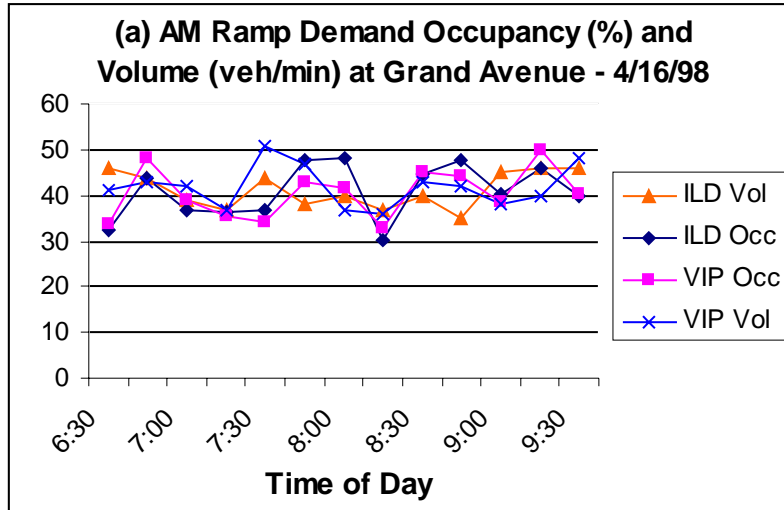


Figure J-133. ILD and VIP ramp and mainline data at Grand Avenue ramp meter for AM rush hours on 4/16/98: (a) Ramp demand occupancy and volume, (b) Percent differences between ILD and VIP data

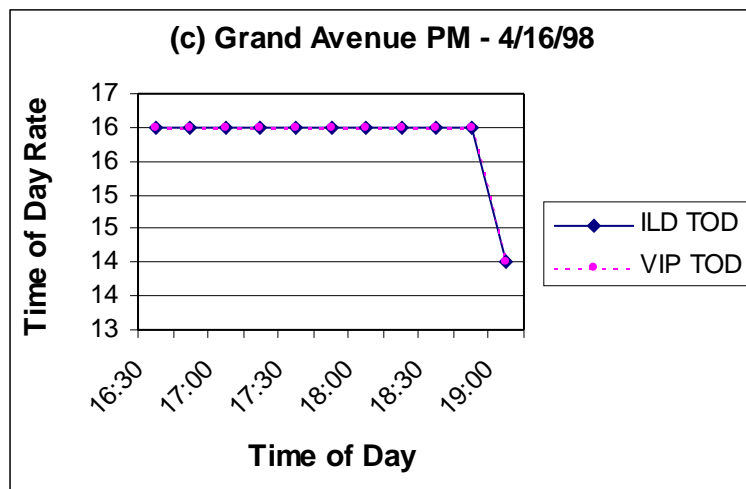
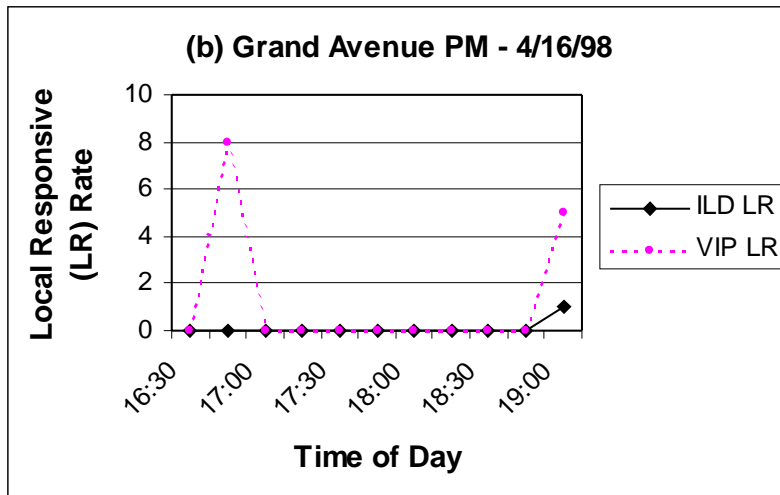
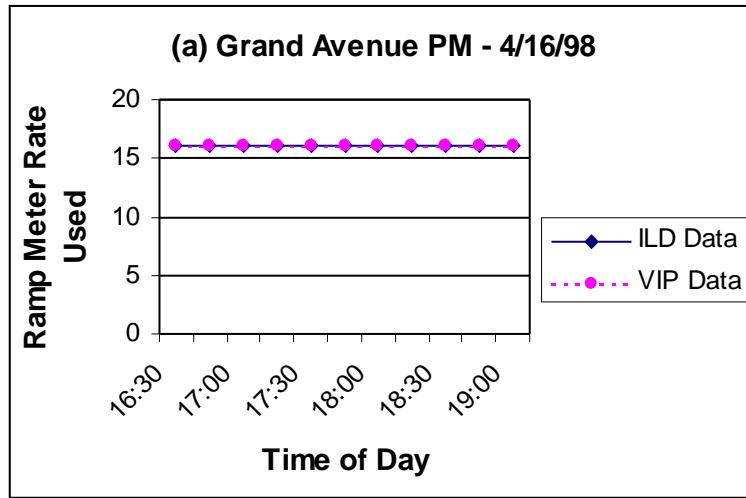


Figure J-134. Ramp meter rates (vehicles/minute) at Grand Avenue for PM rush hours on 4/16/98: (a) Ramp meter rate used, (b) Local responsive rate, (c) Time of day rate

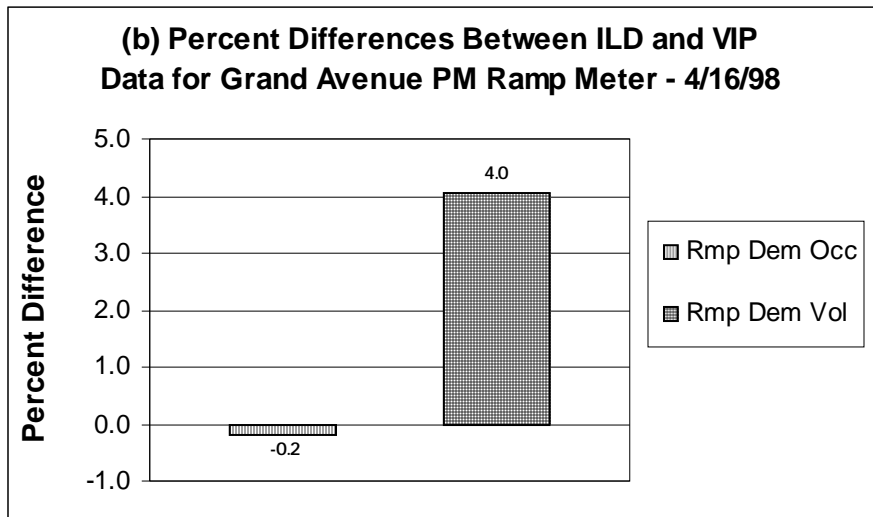
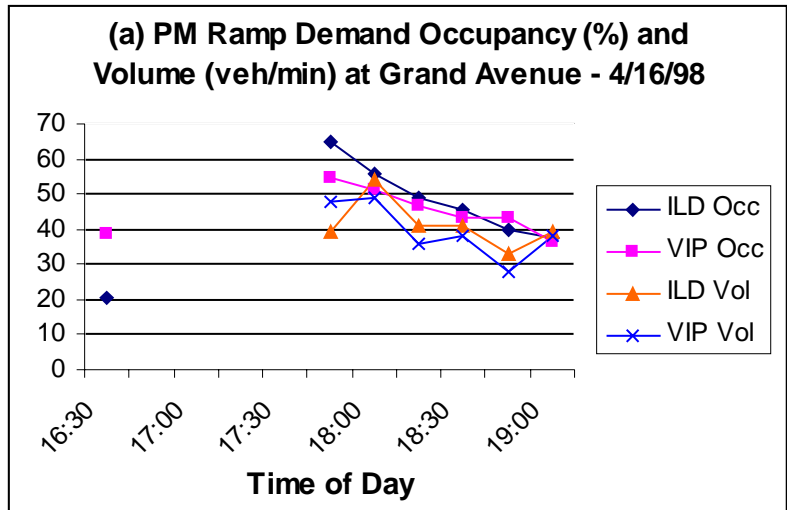


Figure J-135. ILD and VIP ramp and mainline data at Grand Avenue ramp meter for PM rush hours on 4/16/98: (a) Ramp demand occupancy and volume, (b) Percent differences between ILD and VIP data

15-Minute Averages of 170 Controller Output Data Based on VIP and ILD Measurements