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October 16, 1997

ENVIRONMENTAL DOCUMENT

Office of the Secretary
Case Control Unit
Finance Docket No. 32760
Surface Transportation Board
1925 K Street, NW, Room 700
Washington, DC 20423-0001

Attn: Elaine K. Kaiser
Chief, Section of Environmental Analysis
Environmental Filing - Reno

Subject: Formal Comments from the Washoe County Commission on the Preliminary Mitigation Plan (Reno) for the UP/SP Merger, Finance Docket No. 32760

The Washoe County Board of County Commissioners (BCC) held a public hearing on Tuesday, October 14, 1997 to review, and provide formal comments on, the Reno Mitigation Study Preliminary Mitigation Plan (PMP) for the Union Pacific (UP) and Southern Pacific (SP) merger. A copy of the staff report prepared for the public hearing is attached to his letter. Additionally, one (1) copy of a tape recording for this item on the BCC agenda is included as part of the formal comments from Washoe County on the PMP. The tape recording should be made part of the public record for this case. This letter will highlight the BCC action taken during the public hearing.

The Washoe County Commission unanimously voted (4 voting for with 1 absence) to adopt the following motion concerning formal comments on the Reno Mitigation Study PMP for the UP/SP merger:

1. Based on information provided to the Washoe County Board of County Commissioners during the public hearing concerning the Reno Mitigation Study Preliminary Mitigation Plan (PMP) for the Union Pacific (UP) and Southern Pacific (SP) merger, the Board supports and endorses the City of Reno comments on the PMP. The City of Reno comments are recorded within the *City of Reno Preliminary Mitigation Plan Comment Document* submitted on October 15, 1997 for Finance Docket No. 32760. A copy of the text of this comment document was provided to the County Commissioners during their public hearing on October 14, 1997.

2. The Board of County Commissioners further supports County staff comments on specific items within the PMP which are inadequate. These staff comments were noted in the staff report prepared for the public hearing and are as follows:

   a. No time limit is provided in the PMP for the Union Pacific Railroad to complete its inspection of railroad tracks and railroad crossings within Washoe County. Additionally, the PMP should contain specific mitigation measures requiring the Union Pacific Railroad to repair any noted deficiencies within a specified time period.

John B. Hester, AICP
Director

Jess S. Traver, P.E.
County Building Official

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b. The PMP should include a specific mitigation measure to inform residences and businesses on the south side of the railroad tracks serviced by Woodland Avenue of the emergency access route available should the railroad crossing be blocked.

c. The PMP should provide specific mitigation measures to provide for emergency access to the residential communities serviced by the following roads: Stag Lane, Del Curto Lane, and Canal Road. The PMP does not evaluate emergency access for either Stag Lane or Canal Road. Although the PMP does evaluate emergency access for Del Curto Lane, the plan does not provide costs nor alternatives to provide emergency access to that area. Additionally, the conclusion of the PMP to not mandate the construction of an emergency access route for the Del Curto Lane area is unacceptable.

d. The PMP does not discuss merger related impacts on the community of Gerlach, Nevada which lies along the Feather River route. Of particular concern is the potential for hazardous material spills and subsequent slow response times to an emergency due to the remoteness of Gerlach. The PMP should fully evaluate environmental impacts in the Gerlach area.

e. HAZMAT mitigation measures specific to the Truckee Meadows (Reno, Sparks, and south Washoe County) are not contained in the PMP. The PMP relies upon system wide mitigation conditions imposed by the STB in its Decision 44 as adequate to address HAZMAT spills in the Truckee Meadows. Mitigation measures should be specific to the Truckee Meadows area and should contain identified time periods for the Union Pacific Railroad to complete the measures. Additionally, the PMP should evaluate the potential for either ground or surface water contamination through normal operations on the railroad tracks or in the railroad yards at Sparks (e.g., oil or diesel fuel spills).

f. The PMP does not evaluate nor analyze noise impacts on the community of Verdi, Nevada. A noise evaluation, analysis, and appropriate mitigation measures for Verdi should be part of the PMP.

3. There are serious and real economic damages resulting from increased train traffic through Reno and Washoe County that need to be mitigated, whether through the Reno Mitigation Study process or outside of the process, but in some definitive manner.

4. The Preliminary Mitigation Plan inadequately addresses public safety, specifically with regard to response for maintenance and preventive maintenance.

5. The time frame for allowing increased train traffic through the Reno and Washoe County area is too short and will occur too soon. This short time frame is a disincentive to any reasonable negotiations to resolve the serious problems noted in this public hearing. The time period before allowing increased train traffic should be extended.

6. An additional reason to not proceed with increased train traffic through Reno and Washoe County, and to illustrate the inadequacy of the PMP mitigation measures, is that the PMP does not take into account that the existing rail system is inadequate for present levels of train traffic. The evidence shown in the video (taken along the railroad tracks from the Nevada State line toward Reno) highlights rotting railroad ties and totally unsafe conditions next to our water supply. The Southern Pacific Railroad knew that it was financially in trouble, so they were not making adequate repairs nor were they improving their system because they were short of cash flow. The Board of County Commissioners is opposed to expanding the train traffic levels on a system that is already inadequate for its current train traffic loads.

7. The Board of County Commissioners emphasizes the importance of an Environmental Impact Statement under the National Environmental Protection Act (NEPA) being completed for the Reno, Sparks, and Washoe County area as part of the merger.

8. Air Quality concerns noted by Dr. Jennison (Air Quality Officer for the Washoe County District Health Department) during the public hearing are not adequately addressed in the PMP. These concerns include:

   a. The railroad currently represents between 4 and 5 percent of the total inventory of oxides of nitrogen in Washoe County. If the Union Pacific Railroad increases the number of trains in the Truckee Meadows (Reno, Sparks and south Washoe County), there will be a concentration of the impacts of emissions from locomotives in the area where the majority of our citizens live.

   b. Washoe County District Health Department would like to see an air quality model run to characterize the possible impacts of the increase in oxides of nitrogen. This model would preferably be included as part of an EIS on the merger.

   c. If additional train traffic is approved as part of the merger and the Reno Mitigation Study, then mitigation measures should be enacted which will require the Union Pacific Railroad to only use their most modern and "cleanest" locomotives in the Truckee Meadows area (Reno, Sparks, and south Washoe County).

9. The Board of County Commissioners feels that the exclusion of pre-existing conditions from the Reno Mitigation Study is inadequate and does not recognize current conditions within Reno and Washoe County. The Board believes that several of the conditions proposed to be imposed as Tier 1 measures (e.g., improvements on tracks and in yards to accommodate increased train speeds, installation of four quadrant gates, installation of detectors, etc.) address pre-existing conditions and would probably be implemented by the Union Pacific Railroad as sound operational practices, or to limit their liability, regardless of the PMP.

10. The above comments will be forwarded to the Surface Transportation Board as the formal comments of the Washoe County Board of County Commissioners on the Reno Mitigation Study Preliminary Mitigation Plan for the UP/SP Merger. These comments will also be forwarded to other interested agencies and local governments, such as the City of Reno.

If you have any questions on these formal comments from the Washoe County Board of County Commissioners, please do not hesitate to call me at (702) 328-3623.

Sincerely,

Bob Webb

Bob Webb
Community Coordinator

CRW:bw

cc: City of Reno
City of Sparks
Washoe County Board of County Commissioners
John MacIntyre, County Manager

Washoe County Department of Community Development
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October 2, 1997

TO: Washoe County Commission

FROM: Bob Webb, Community Coordinator

SUBJECT: Background Report and Possible Action on the Preliminary Mitigation Plan, UP/SP Merger - Reno Mitigation Study

This memorandum provides background information on the Preliminary Mitigation Plan (PMP) prepared by the Surface Transportation Board, Section of Environmental Analysis (SEA) on the Reno Mitigation Study for the Union Pacific/Southern Pacific Railroads (UP/SP) merger. The memorandum also summarizes correspondence from Washoe County concerning the UP/SP merger and the subsequent Reno Mitigation Study.

Recommendation

Staff recommends the Washoe County Commission review the background information and recommendations from the Section of Environmental Analysis contained in the Preliminary Mitigation Plan. Staff asks the County Commissioners to provide formal comments on the PMP as part of the public review process for that document. Staff will transmit County Commission comments in writing to the Section of Environmental Analysis. All public comments on the PMP must be postmarked by October 16, 1997 to meet public review requirements imposed by the SEA.

Background

The Surface Transportation Board (STB)approved the merger of the Union Pacific and Southern Pacific railroads on August 12, 1996. The Board's decision was recorded in Decision No. 44, which contained several conditions specific to the Reno area. A copy of that decision is attached to this memorandum as enclosure 1. Condition No. 22 of the STB's decision imposed a number of measures specific to Reno, to include the requirement for SEA to conduct an additional 18 month mitigation study in Reno (condition 22c). The purpose of this study, as outlined in the PMP, was:

> "...to develop additional mitigation measures, in addition to those system-wide and corridor-specific environmental mitigation measures already imposed in Decision No. 44, that are specifically tailored to address the unique circumstances of Reno, Washoe County, and the surrounding area encompassing the former SP rail line. ...the study should focus only on *merger-related* train traffic and that mitigation of conditions resulting from the preexisting development of hotels, casinos, and other tourist-oriented businesses on both sides of the existing SP rail line in Reno...are not within the scope of the study."

John B. Hester, AICP
Director

W. Dean Diederich, AICP
Planning Manager

Jess S. Traver, P.E.
County Building
Official

Mitigation measures in the PMP are divided into two distinct levels, or tiers, as established by Decision No. 71 issued by the STB on April 15, 1997. Tier 1 are those "measures that will be mandated mitigation for UP to implement and fund entirely". Tier 2 are those "measures that are

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more far-reaching and for which implementation and funding would require voluntary participation of UP and other interested parties and can therefore not be mandated by the Board". A copy of Decision 71 is attached as enclosure 2.

SEA will consider all public comments on the PMP and issue a Final Mitigation Plan (FMP). Public review and comments on the FMP will be considered by SEA in its final recommendations to the STB. The STB will then decide what additional mitigation measures (if any) to impose on UP as part of the UP/SP merger.

Tier 1 Measures

SEA's preliminary Tier 1 recommendations for mitigation measures to the STB are shown in enclosure 4.

Tier 2 Measures

Possible Tier 2 mitigation measures are shown in enclosure 5.

Reno Study Mitigation Task Force

A Reno Study Mitigation Task Force was established by SEA on January 15, 1997. A roster of task force members is included at enclosure 3. I represented Washoe County at the majority of the task force meetings. I prepared a memorandum to the task force members in early January 1997 outlining the impacts to Washoe County of the merger. These impacts mirror the concerns expressed by the County Commission during a public hearing to discuss the merger held on March 26, 1996. A copy of that memorandum is attached as enclosure 6; however, a brief outline of those impacts is:

Public Safety:
- emergency access for isolated communities (Woodland Avenue, Stag Lane, Del Curto Lane, and Canal Road)
- existing, substandard railroad crossings
- long trains blocking multiple crossings
- speed of trains in outlying areas

Economic:
- delay to tourists at railroad crossings
- potential negative publicity to tourist based economy in the event of a major traffic accident or HAZMAT spill

Environmental:
- HAZMAT spills at railroad switching yards and/or along the railroad tracks
- potential contamination of surface and/or ground water supplies
- increased HAZMAT shipments through Gerlach
- air quality impacts of idling vehicles at railroad crossings
- air quality impacts of switch yard railroad traffic

Miscellaneous:
- noise from train whistles
- noise from passing trains
- future of the Reno Branch line and Reno intermodal facility at Parr Boulevard

I was unable to attend the last meeting of the mitigation task force on July 9, 1997 and so sent a letter to SEA outlining what I believed to be appropriate mitigation measures to consider for the PMP. A copy of that letter is at enclosure 7; however, an outline of the proposed mitigation measures (sorted according to SEA categories) is:

Pedestrian Safety/Emergency Vehicle Access/Train-Vehicle Accidents:

- evaluate and repair, as appropriate, railroad crossings in Washoe County
- inform residents and business owners of the emergency access road providing secondary access to the Woodland Avenue area
- provide emergency access to the Stag Lane, Del Curto Lane, and Canal Road areas
- provide a system which alerts emergency responder dispatch centers as to when trains are on the tracks

Derailments/Spills/Water Quality:

- develop a plan to respond to HAZMAT spills/accidents in or near Gerlach
- develop a plan to address the impact of spills and leaks of HAZMAT along railroad tracks and in railroad yards (e.g., catch basins)
- develop a plan to address train derailments and/or HAZMAT spills in the proximity of the Truckee River (includes control of train speeds and location of appropriate spill containment equipment in the Truckee Meadows)

Evaluation of PMP and Proposed Mitigation Measures

The Tier 1 and Tier 2 measures should be the primary focus when evaluating the PMP. However, other areas not mentioned as either a Tier 1 or Tier 2 measure (and not previously mentioned in the STB's Decision 44) should be brought to the attention of the SEA as public comments for possible inclusion in the PMP.

I have reviewed the main parts of the PMP and offer the following observations on the proposed mitigation measures as outlined in my letter to SEA dated July 8, 1997:

1. Evaluate and repair, as appropriate, railroad crossings in Washoe County.

   SEA noted my comment. Condition A1 from Decision 44 discusses system wide measures for track inspection and Condition A3 requires the posting of an 800 number on certain railroad crossings. However, no time line is given for track inspection and I could not find any reference to evaluating existing railroad crossings, either system wide or specifically in Washoe County.

2. Inform residents and business owners of the emergency access road providing secondary access to the Woodland Avenue area

3. Provide emergency access to the Stag Lane, Del Curto Lane, and Canal Road areas.

   Tier 1 mitigation measure number 4 would require UP to discontinue the use of "helper" locomotives in the Woodland Avenue area (note: UP officials have publicly stated that they stopped such practices in January of 1997). This measure should help alleviate railroad caused delays at the Woodland Avenue crossing. The PMP also mentions that a road south of the railroad tracks connecting Woodland Avenue to Mayberry Drive has been recently widened, paved, and a gate which restricted access has been removed. This road provides emergency access to the Woodland Avenue area if Woodland Avenue is blocked by a train. The PMP does not address public information measures to notify residences and businesses of this emergency access road.

The PMP discusses Del Curto Drive and states that, "given the low vehicular traffic levels using Del Curto Drive, that no mitigation is warranted, particularly with the possible adverse impacts to parklands and the Truckee River. Therefore, SEA does not recommend that mitigation measures for Del Curto be imposed".

There is no analysis, and therefore no discussion of possible mitigation measures, for either the Stag Lane or the Canal Road areas.

4. Provide a system which alerts emergency responder dispatch centers as to when trains are on the tracks.

Tier 1 mitigation measure number 3 proposes the installation of cameras and video monitors showing the rail line between Keystone Avenue and Lake Street.

5. Develop a plan to respond to HAZMAT spills/accidents in or near Gerlach.

6. Develop a plan to address the impact of spills and leaks of HAZMAT along railroad tracks and in railroad yards (e.g., catch basins).

7. Develop a plan to address train derailments and/or HAZMAT spills in the proximity of the Truckee River (includes control of train speeds and location of appropriate spill containment equipment in the Truckee Meadows).

The system wide mitigation measures numbered A1, A2, A5, A7, and A12 in Decision No. 44 address safety and potential HAZMAT spills. According to the PMP, SEA believes that these system wide mitigation measures "provide a high level of protection from hazardous materials events in the Reno and surrounding area". However, in order to augment these system wide measures, Tier 1 mitigation measures 13 and 14 would require SP to install an additional high, wide, shifted load detector and a hot box detector at milepost 40 (about three miles west of Reno). These additional measures would provide "optimum detection capability" in the Reno area.

The PMP does not indicate whether any of the system wide measures have been implemented in the Truckee Meadows. The PMP does not address mitigation measures for potential contamination of surface and/or ground water through normal operations along the rail lines nor at the railroad yards in Sparks. Additionally, the PMP does not evaluate the Feather River route and any potential HAZMAT occurrences in the vicinity of Gerlach.

I also evaluated the PMP with regard to comments I made to the Reno Mitigation Task Force (also included SEA representatives) in my memorandum dated January 21, 1997. I offer the following from portions of that memorandum:

a. Economic concerns (i.e., delay to tourists at railroad crossings and potential negative publicity to tourist based economy in the event of a major traffic accident or HAZMAT spill).

According to the PMP, the STB directed a review of potential environmental impacts of merger-related increased train traffic levels. Therefore, SEA determined that additional economic analysis was not required as part of the PMP.

b. Air quality impacts.

I provided a copy of the PMP to Brian Jennison, Director for the Air Quality Management Division with the District Health Department. I asked Mr. Jennison to provide his comments directly to SEA in accordance with their deadlines. As of the

submittal of this staff report, I do not have a copy of comments he may have written. If I receive a copy of his comments, I will provide them to the County Commission prior to their public hearing on October 14, 1997.

c. Noise impacts in the Verdi area.

The PMP did extensive evaluation of noise related impacts (both from train whistles and passing trains) in the Reno area. The STB was concerned about noise levels during its review of the UP/SP merger; however, the Board noted that any attempt to significantly "reduce noise levels at grade crossings would jeopardize safety, which we consider to be of paramount importance". Therefore, possible mitigation measures outlined in the PMP are included in possible Tier 2 mitigation measures.

I should note that no noise analysis was conducted in the Verdi area, though even if such analysis was done it is likely that the PMP recommendations would remain the same.

I will attend the caucus on October 13, 1997 to answer any questions you may have, to the best of my ability, on this staff report or the PMP. Please do not hesitate to call me at 328-3623 for questions or clarification on the staff report in the interim.

Bob Webb
Community Coordinator

CRW:bw

Enclosures

cc: Charles McNeely, Reno City Manager
John MacIntyre, County Manager
Merri Belaustegui-Traficanti, Deputy City Attorney, City of Reno, Mitigation Task Force contact for the City of Reno

Enclosure 1

EXCERPTS RELATING TO RENO MITIGATION STUDY

SURFACE TRANSPORTATION BOARD

Finance Docket No. 32760

UNION PACIFIC CORPORATION, UNION PACIFIC RAILROAD COMPANY, AND MISSOURI PACIFIC RAILROAD COMPANY--CONTROL AND MERGER--SOUTHERN PACIFIC RAIL CORPORATION, SOUTHERN PACIFIC TRANSPORTATION COMPANY, ST. LOUIS SOUTHWESTERN RAILWAY COMPANY, SPCSL CORP., AND THE DENVER AND RIO GRANDE WESTERN RAILROAD COMPANY

Decision No. 44

Decided: August 6, 1996

ENVIRONMENTAL CONSIDERATIONS.

Extensive Environmental Review Process. Under the National Environmental Policy Act (NEPA) and related environmental laws, the environmental effects of the merger and the ancillary abandonment and construction projects that were proposed by applicants must be considered, and we have thoroughly done so. Our environmental staff, the Section of Environmental Analysis (SEA), conducted various public outreach activities to inform the public about the proposed merger and to encourage and facilitate public participation in the environmental review process.[1]

As part of its environmental review, SEA prepared detailed analyses not only of the systemwide effects of the proposed merger, but also of particular merger-related activities that would affect individual rail line segments, rail yards, and intermodal facilities to a degree that would meet or exceed our thresholds[2] for environmental analysis. See 49 CFR

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[1] SEA sent approximately 400 consultation letters to various agencies seeking their comments. In addition, SEA consulted with federal, state, and local agencies, affected communities, UP and SP, and UP/SP's environmental consultants to gather and disseminate information about the proposal, identify potential environmental impacts, and develop appropriate mitigation measures.

[2] These thresholds ensure that those rail line segments and facilities that would experience a substantial increase in traffic as a result of the transaction are thoroughly analyzed for potential air quality, noise, transportation, and safety impacts.

1105.7(e)(5)(i) and (ii).[3] SEA conducted a thorough independent analysis, which included verifying projected rail operations; verifying and estimating noise level impacts; estimating increases in air emissions; assessing potential impacts on safety; and performing land use, habitat, surface water and wetlands surveys, ground water analyses, and historic and cultural resource surveys.

Based on the information provided by the parties and other agencies, SEA issued a comprehensive Environmental Assessment (EA) on April 12, 1996. SEA received approximately 160 comments following issuance of the EA. To address those comments and the other environmental comments received throughout the environmental review process (approximately 400 in total), SEA undertook additional environmental analysis, which culminated in the issuance of a detailed Post Environmental Assessment (Post EA) on June 24, 1996, refining some of the discussion and mitigation recommended in the EA.

As a result of its investigation, SEA concluded that the merger would result in several environmental benefits, including a systemwide net reduction of 35 million gallons of diesel fuel consumption (based on 1994 figures) from rail operations and truck-to-rail operations, systemwide improvements to air quality from reduced fuel use, and a reduction in long-haul truck miles, highway congestion and maintenance, and motor vehicle accidents.

SEA also concluded that the merger and related rail abandonments and constructions could have potential environmental effects regarding safety, air quality, noise, and transportation, including the transportation of hazardous materials, and, in the EA, SEA proposed mitigation measures addressing the environmental concerns that were raised. In the Post EA, based on further analysis and review of the environmental comments, SEA developed more comprehensive and specifically tailored mitigation recommendations. As a result of consultations with SEA, UP/SP agreed to undertake particular mitigation measures. In addition, several local communities negotiated memoranda of understanding with UP/SP to implement mitigation measures and take other appropriate actions to address their particular environmental concerns.

SEA concluded that, with the Post EA mitigation measures, the proposed merger would not significantly affect the quality of the human environment on a systemwide, regional, or local basis. We agree that the conditions recommended in the Post EA will

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[3] SEA and its independent third-party consultant conducted approximately 150 site visits. They also analyzed UP/SP's Environmental Report, operating plan, Preliminary Draft Environmental Assessment and other pleadings, all of the settlement agreements entered into during the environmental review process, and technical studies.

adequately mitigate the potential environmental impacts identified during the course of the environmental review, and we will impose those conditions here (see Appendix G).[4] We also adopt SEA's environmental analysis and the conclusions reached in the EA and the Post EA.

No Need for Environmental Impact Statement. We have considered the arguments of some parties that an environmental impact statement (EIS) is required here, but do not believe that one is needed. An EIS is required only for "major federal actions significantly affecting the quality of the human environment." 42 U.S.C. 4332(2)(C).[5] Under our environmental rules, 49 CFR 1105.6(b)(4), an EA is normally sufficient environmental documentation in rail merger cases to allow us to take the requisite "hard look" at the proposed action.[6] Moreover, interested parties received essentially the same benefits they would have received with an EIS. As the EA and Post EA show, SEA conducted a thorough and comprehensive environmental review. There was extensive notice and opportunity for input from the public and appropriate agencies throughout the process. In addition to the EA, SEA issued a detailed Post EA which contains SEA's individual responses to the comments on the

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[4] We note that the mitigation recommended in the Post EA for two proposed abandonments in Colorado (Sage to Leadville and Malta to Cañon City) has been modified to reflect our decision to permit only discontinuance of rail service, and not abandonment, at this time. Other clarifying changes have been made as well.

[5] The identification of such actions is a matter for the agency to determine, as long as the determination is not arbitrary or capricious. See Goos v. ICC, 911 F.2d 1283, 1292 (8th Cir. 1990), citing Marsh v. Oregon Natural Resources Council, 490 U.S. 360, 377 (1989).

[6] While this merger involves somewhat more trackage than other merger proposals that have come before our predecessor agency, the ICC, that does not mean that the qualitative environmental effects of this merger are greater (or different) than those of the other railroad mergers that have been considered. Similarly, the extensive trackage rights that we are granting in this decision to preserve competition generally will not create additional traffic (or potentially significant environmental impacts). Traffic that can be efficiently handled by train would be handled by train whether or not the trackage rights at issue here were granted.

EA and thus reflects not only the work of SEA but also the critical views of interested parties and agencies.

Finally, the environmental mitigation we are imposing here is far reaching and comprehensive.[7] As appropriate, it addresses impacts on a variety of levels: systemwide, rail corridor-specific, and local. There is mitigation for particular rail line segments, rail yards, intermodal facilities, and rail abandonments and constructions. In short, no EIS is required because our environmental mitigation conditions specifically address the potential environmental impacts associated with the merger and ensure there will be no significant environmental effects.[8]

Reno & Wichita. As discussed in the Post EA, in developing mitigation for two cities, Reno, NV, and Wichita, KS, SEA concluded that further, more focused mitigation studies are warranted, notwithstanding the extensive analysis (including site visits and meetings with city officials, emergency response representatives and business interests) that already has been done to identify environmental concerns and arrive at appropriate mitigation for these two communities. Nothing in the record here, however, suggests that the potential environmental effects of the merger in Reno or Wichita are so severe that implementation of the merger should not proceed prior to the

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[7] For example, with respect to safety, our mitigation includes more frequent track and train car inspections, signs on grade crossings identifying toll free numbers to call in the event of a signal malfunction, and a requirement that UP/SP provide emergency response personnel with information regarding anticipated train movements and work with communities to develop plans to deal with the transportation of hazardous materials, emergencies, and the upgrading of grade crossing signals. In addition, UP/SP will be required to equip certain trains carrying hazardous materials with two-way end-of-train devices to enhance braking capabilities on particular line segments. In response to concerns involving air pollution, UP/SP will have to reduce idling of locomotives, close box car doors on empty cars, and use more efficient locomotives when the equipment becomes available.

[8] See, e.g., Sierra Club v. DOT, 753 F.2d 120, 127 (D.C. Cir. 1985); Cabinet Mountains Wilderness v. Peterson, 685 F.2d 678, 682 (D.C. Cir. 1982).

completion of the studies.[9] To the contrary, in both Reno and Wichita the environmental impacts are limited to the effects of an increase in traffic on existing rail lines. Also, the mitigation conditions that we are imposing now assure that, while SEA conducts these studies, the environmental status quo will essentially be preserved in Reno and Wichita.[10]

As the EA and Post EA show, SEA already has carefully assessed the impact of the merger on Reno and Wichita and identified its likely environmental effects. Based on its analysis, SEA concluded that, with the systemwide and corridor-specific mitigation already imposed and the conditions to be arrived at following the independent mitigation studies, there will be no significant environmental impacts to Reno and Wichita, and we agree.

The sole purpose of the mitigation studies will be to arrive at specifically tailored mitigation plans that will ensure that localized environmental issues unique to these two communities are effectively addressed. For example, with respect to vehicular and pedestrian safety, SEA has determined that separated grade crossings and pedestrian overpasses and/or underpasses will be needed to address safety concerns on the existing rail lines in Reno and Wichita. Accordingly, the studies will identify the appropriate number and precise location

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[9] We note that the Supreme Court has rejected arguments that NEPA demands the formulation and adoption of a plan that will fully mitigate environmental harm before an agency can act. Robertson v. Methow Valley Citizens Council, 490 U.S. 332, 352-53 (1989). Rather, the deferral of a decision on specific mitigation steps until more detailed information is available is embraced in the procedures promulgated under NEPA. See Public Utilities Comm'n of California v. FERC, 900 F.2d 269, 282-3 (D.C. Cir. 1990). NEPA "does not require agencies to adopt any particular internal decisionmaking structure." Baltimore Gas & Electric Co. v. NRDC, 462 U.S. 87, 100 (1983). It is well settled that NEPA does not repeal other statutes by implication and that if the agency meets NEPA's basic requirements, it may fashion its own procedural rules to discharge its multitudinous duties. Vermont Yankee v. NRDC, 435 U.S. 519 (1978); United States v. SCRAP, 412 U.S. 669, 694 (1973).

[10] The courts have recognized that there is no violation of NEPA where proposed actions will not effect a change in the status quo. See Sierra Club v. FERC, 754 F.2d 1506, 1509-10 (9th Cir. 1985).

of highway/rail grade separations and rail/pedestrian grade separations in Reno and Wichita. With respect to air quality, we have imposed mitigation measures that reduce locomotive fuel consumption and air pollution, call for more efficient railroad equipment and operating practices, and require consultation with air quality officials.[11] As further insurance, the studies will consider additional mitigation to address the air quality effects unique to Reno and Wichita. In this merger, noise impacts would result from more frequent exposure to horn noise rather than greater intensity of sound. No additional types of noise would be introduced. To address noise impacts, we are requiring UP/SP to consult with affected counties to develop focused noise abatement plans. As the Post EA notes, however, safety dictates that railroads sound their horns at grade crossings.[12] Any attempt significantly to reduce noise levels at grade crossings would jeopardize safety, which we consider to be of paramount importance.

The studies will be conducted by SEA with the assistance of an independent third party contractor. Although retained by UP/SP, SEA will select the contractor. The contractor will work under the sole supervision, direction, and control of SEA.

The mitigation studies will include consultations with the affected communities, counties, and states, Native American tribes, the FRA, and other appropriate agencies, as well as UP/SP. There will be public notice and participation. The public will be consulted regarding the range of additional mitigation to most effectively address increased rail traffic on the existing rail lines in Reno and Wichita. SEA will prepare draft mitigation studies and make them available to the public for review and comment. After SEA assesses the comments, it will design the most effective mitigation for these particular communities to add to the mitigation that has already been imposed.

SEA's final mitigation studies and its recommended mitigation plans for Reno and Wichita will be made available to

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[11] Because trains are mobile, rather than stationary sources, air quality impacts associated with locomotive emissions are spread over a large area. Therefore, the impacts at any individual location are typically relatively minor.

[12] SEA indicates that FRA has been directed by the Swift Act generally to require that horns be sounded at all grade crossings.

the public and will be submitted to us for our review and approval. We will then issue a decision imposing specific mitigation measures. This entire process will be completed within 18 months of consummation of the merger.

In the meantime, as explained in the Post EA, during the 18-month study period UP/SP will be permitted to add only an average of two additional freight trains per day to the affected rail line segments (Chickasha, OK, to Wichita and Roseville, CA, to Sparks, NV),[13] which is below the threshold level for environmental analysis.[14] UP/SP will be prohibited from increasing traffic to the levels they projected under the merger (11.3 daily trains for Reno and 7.4 trains for Wichita) without our approval.[15] Thus, there will be no significant adverse environmental impacts to these communities while SEA, the Board, and the parties work to arrive at additional tailored mitigation for those cities.

It should be noted that the studies will focus only on the mitigation of the environmental effects of additional rail traffic through Reno and Wichita resulting from the merger.

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[13] For nonattainment areas such as Reno, our rules permit railroads to operate up to three additional trains per day. The threshold for attainment areas such as Wichita is normally an increase of eight trains or more a day. Here, we are taking a more conservative approach and will permit for Wichita only an average increase of two trains per day. In short, these limited increases for Reno and Wichita are at or below the threshold levels, and the environmental status quo will essentially be maintained. This addition of an average of two trains a day includes BNSF trains but does not include Amtrak trains, which are unrelated to the merger.

[14] We note that an existing railroad can increase its level of operations without coming to us, and without limitation. Thus, if UP and SP had not proposed this merger, SP on its own could have increased the number of trains on its line in Reno to any level it considered appropriate. Allowing an increase of up to two trains per day during the interim period takes into account that the number of trains going through Reno and Wichita might have been increased even without the merger.

[15] UP/SP will be required to file verified copies of station passing reports of train movements for Reno and Wichita on a monthly basis with SEA for the duration of the study period. We will review them to ensure compliance.

Mitigation of conditions resulting from the preexisting development of hotels, casinos, and other tourist-oriented businesses on both sides of the existing SP rail line in Reno, or the preexisting switching operations that are a primary source of the congestion associated with the existing UP line in Wichita, are not within the scope of the studies. Similarly, the construction of a new rail line now under consideration by Reno is too preliminary to be assessed now.[16]

The studies will carefully examine private and public funding options, as we believe that the cost of mitigation for Reno and Wichita should be shared. Finally, the studies will provide the parties with additional time to pursue and agree to independent and innovative mitigation plans (such as the memorandum of understanding executed by UP/SP and Truckee, CA, whereby UP/SP will share in the cost of an underpass construction project and contribute to a fund to buy back obsolete wood burning stoves).

In sum, pending determination of the exact mitigation measures to be required for Reno and Wichita, UP/SP will be subject to a traffic cap on the affected rail lines to ensure that no adverse effects to the environment will occur and existing environmental conditions will essentially remain unchanged. Because we already know the nature and general parameters of the appropriate mitigation measures for Reno and Wichita, based on our analysis of the environmental impacts and imposition of systemwide and regional mitigation, we find that, with the more specific mitigation that will be developed, the merger will not significantly affect the quality of the environment in those two locations.

Comments of EPA. On July 12, 1996, we received comments from the United States Environmental Protection Agency (EPA) on various aspects of the EA and the Post EA.[17] EPA notes that, in

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[16] Plans for such a line are only in the development stage. SEA indicates that such a project could take up to 10 years to finalize. If the contemplated construction reaches the stage of an actual proposal requiring our approval, SEA would prepare an appropriate environmental document at that point. See Kleppe v. Sierra Club, 427 U.S. 390, 410 n.20 (1976); Crounse Corp. v. ICC, 781 F.2d 1176, 1193-96 (6th Cir. 1986).

[17] SEA agreed to EPA's request for an extension of time to comment on the Post EA. We welcome EPA's input after reviewing (continued...)

analyzing air quality, the EA failed specifically to identify "maintenance" areas,[18] which it believes may have caused air quality concerns to be overlooked.[19] But maintenance areas were not ignored in SEA's analysis. For those areas that were not classified as nonattainment, SEA applied the EPA conformity emission threshold levels applicable to maintenance areas. This means that SEA analyzed both attainment and maintenance areas under the more rigorous standards applicable to maintenance areas, and that, if anything, the anticipated effects of the proposed merger on air quality are conservative. We believe that air quality has been thoroughly analyzed, and that the mitigation we are imposing here, along with the more specific measures which will be arrived at in the further mitigation studies for Reno and Wichita,[20] adequately mitigates any potential adverse air impacts.

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[17](...continued)
our environmental analysis, since, as EPA notes, it generally does not comment on EAs.

[18] There are three classifications for air quality: attainment areas, in which levels of certain pollutants are considered equal to or better than federal and state ambient air quality standards; nonattainment areas, in which levels of one or more pollutants do not meet federal and state ambient air quality standards; and maintenance areas, which were at one time nonattainment areas but have subsequently improved their air quality and are now in attainment for the relevant pollutant(s).

[19] We note that EPA does not disagree with SEA's determination that the proposed merger is not subject to EPA's regulations entitled "Determining Conformity of General Federal Actions to State or Federal Implementation Plans" (General Conformity). The General Conformity criteria do not apply directly to railroad operations, except for future locomotive emission standards. SEA properly concluded that the proposed merger does not meet the definitions in the General Conformity regulations at 40 CFR 51.852 because, as a regulatory agency, the Board does not maintain program control over railroad emissions as part of its continuing responsibilities.

[20] SEA will take into account EPA's concerns and consult with them in conducting its mitigation studies for Reno and Wichita.

EPA further states that the EA used the terms NO_2 and NO_x incorrectly. We recognize that NO_x is not a criteria pollutant under EPA and state ambient air quality standards. In assessing air quality emissions, SEA looked at emission factors applicable to NO_x, instead of NO_2, because NO_x emission factors are readily available through EPA documents and other sources, while NO_2 emissions are not. SEA based its calculations on the conservative assumption that all NO_x emissions are composed of NO_2. This conservative approach, which is widely accepted, ensured that the criteria pollutant NO_2 was adequately assessed in SEA's analysis. Moreover, by using this approach, SEA used higher NO_2 emissions than would actually be emitted.

EPA also expressed some difficulty understanding SEA's estimates of the projected net increase and decrease in air emissions with the mitigation measures we are imposing. While we believe that the text of the Post EA adequately explains the data in Tables 3-5 and 4-4, we have generated and attached as Appendix H an additional table to further clarify the net emissions reflecting mitigation.

EPA notes that some of the proposed rail line abandonments in Colorado run through or near EPA-designated Superfund sites. EPA is troubled that soil in and around the railroad lines could require remediation, that UP/SP might not be obligated to honor a consent decree, and that possible future trail use could expose the public to hazardous substances. These concerns are premature because, as discussed above, we are permitting only the discontinuance of rail service, and not abandonment of the involved lines. Thus there will be no salvage of these lines or opportunity for trail use unless and until UP/SP obtains our authority to abandon these lines.[21]

While trail use requests can be made if the abandonments are granted, any trail arrangement would not supersede the requirements of the specific laws that govern Superfund sites.[22] Nor would we thereby become involved in negotiating or enforcing consent decrees involving remediation of those sites.

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[21] At that point, we will analyze the potential environmental impacts of the proposed abandonments.

[22] See Union Pac. R.R. -- Abandonment -- Wallace Branch, ID, Docket No. AB-33 (Sub-No. 70) (ICC served Dec. 2, 1994).

EPA does not view requiring UP/SP to comply with existing federal, state, and local regulation as mitigation. We believe, however, that requiring compliance with other laws and regulations, such as FRA's safety regulations, can assist in reducing the potential environmental impacts of the actions before us. If the railroad fails to comply with conditions that we have imposed, parties can notify us and request that we (as well as the agency that has promulgated the regulation) take appropriate action.

In any event, the mitigation we are imposing here goes well beyond requiring compliance with other laws and regulations. For example, it includes more frequent track and train car inspections to reduce anticipated safety impacts and reduced idling of locomotives and the use of more efficient locomotives to offset air pollution emissions associated with the merger. Moreover, to enhance safety, UP/SP will be required to equip certain trains carrying hazardous materials with two-way end-of-train devices to improve braking capabilities on particular line segments.

EPA suggests that we failed to discuss the environmental impacts associated with the handling and disposal of waste materials for the proposed abandonments and constructions. But we have included detailed mitigation for these actions. See Appendix G, including conditions #26, #27, #62 and #63.

EPA questions whether SEA considered all the settlement agreements reached with competing railroads and trade associations. SEA specifically took all settlement agreements into account in its analysis, as the EA and Post EA show.

Finally, we disagree with EPA's suggestion that SEA should revisit its consultation efforts with Native American tribes. SEA's efforts to contact and consult with Native American tribes have been extensive. As part of its outreach activities, SEA contacted approximately 11 area offices of the Bureau of Indian Affairs to inform them about the proposed merger; three offices commented and provided the names of tribes that should be contacted. Both the EA and Post EA were distributed to 31 American Indian tribes. In addition, there was newspaper and Federal Register notice to inform all affected tribes and communities about the proposed merger and how they could participate. To ensure continued participation, SEA will contact the affected Native American tribes when initiating its mitigation studies for Reno and Wichita and invite them to participate.

APPENDIX G: ENVIRONMENTAL MITIGATING CONDITIONS

The environmental mitigating conditions imposed in Finance Docket No. 32760 are categorized as follows: (A) Systemwide, (B) Corridor-Specific, (C) Rail Line Segments, (D) Rail Yards and Intermodal Facilities, (E) Proposed Abandonments, and (F) Construction Projects. These mitigation conditions are numbered sequentially.

A. SYSTEMWIDE MITIGATION

The following systemwide mitigation conditions apply to rail line segments, rail yards, intermodal facilities, and rail line construction projects on new right-of-way.

1. UP/SP shall adopt UP's existing formula-based standards for track inspection for all rail lines of the merged system, which will increase the frequency of inspections on SP rail lines.

2. UP/SP shall adopt UP's existing tank car inspection programs for all appropriate facilities on the merged system.

3. For all highway grade crossing signals, UP/SP shall provide visible instructions designating an 800 number to be called if signal crossing devices malfunction.

4. UP/SP shall provide 800 numbers to all emergency response forces in all communities. These numbers shall provide access to UP/SP supervisors who shall provide train movement information and work cooperatively with communities in emergency situations. These numbers are not to be disclosed to the general public.

5. UP/SP shall participate on a systemwide basis in the TRANSCARE program to develop hazardous material and emergency response plans in cooperation with communities.

7. UP/SP shall adopt UP's training program for community and emergency response personnel for locations on the SP rail lines, and include personnel from SP served locations in UP's school at Pueblo, CO, for additional emergency response training.

8. UP/SP shall adopt existing UP training and operating practices that are designed to reduce locomotive fuel consumption and air pollution. These include: throttle modulation, use of dynamic braking, increased use of pacing and coasting trains, isolating unneeded horsepower, shutting down locomotives when not in use for more than an hour when temperatures are above 40 degrees, and maintaining and upgrading SP locomotives to UP standards.

9. As suggested by UP/SP, UP/SP shall extend to SP rail lines UP's program of closing boxcar doors on empty cars before movement on

the system in order to reduce wind resistance and, thereby, fuel consumption.

10. As suggested by UP/SP, UP/SP shall use its own security forces to conduct its own arrests and bookings, reducing reliance on local police forces.

11. UP/SP shall convert all railroad locomotives to the standards for visible smoke reduction that are established in the South Coast Air Quality Basin.

12. UP/SP shall adopt UP's existing policy of using head-hardened rail on curves in mountainous territory for SP rail lines to promote safer operations.

13. UP/SP shall comply with all applicable FRA rules and regulations in conducting rail operations on the merged system.

B. CORRIDOR MITIGATION

General

The following mitigation conditions apply to the Central, Southern, Northern, Illinois-Gulf Coast, and Pacific Coast (I-5) Corridors.

14. UP/SP shall implement the draft emissions standards for diesel-electric railroad locomotives that the Environmental Protection Agency (EPA) has developed. It is the Board's understanding that EPA plans to propose these standards and make them available for public comment in December 1996. Under these standards, UP/SP shall utilize newly manufactured or re-built locomotives that are more fuel efficient and produce less emissions. When this equipment becomes available, UP/SP shall assign these locomotives on a priority basis to the corridors or portions thereof specified below:

- **Southern Corridor:**
  - Fort Worth, TX, to West Colton, CA.

- **Central Corridor:**
  - Cheyenne, WY, to Hinkle, OR.
  - Chicago, IL, to Fremont, NE.
  - Ogden, UT, to Roseville, CA.
  - Denver, CO, to Grand Junction, CO.

- **Pacific Coast (I-5) Corridor:**
  - Seattle, WA, to West Colton, CA.
  - Sacramento, CA, to Bakersfield, CA.

15. To further facilitate the improvement of air quality for specific locations, UP/SP shall consult with appropriate state and local

air quality officials in the States of Arizona, California, Colorado, Illinois, Nevada, Oregon, Texas, Washington, and Wyoming, through which the Pacific (I-5), Southern, Central, and Northern Corridors extend in part. UP/SP shall advise SEA as to the status and the results of these consultations.

16. To address noise impacts, UP/SP shall consult with the affected counties that have communities that would experience an increase of 3 dBA or more as a result of the increased rail traffic over rail lines in the States of California, Colorado, Illinois, Kansas, Louisiana, Nebraska, Nevada, Oklahoma, and Texas. If appropriate, UP/SP shall develop a noise abatement plan. UP/SP shall submit the result of these consultations to SEA who will review these findings with FRA.

Specific

The following mitigation conditions apply to specific rail line segments within the Central, Southern, and Illinois-Gulf Coast Corridors.

17. UP/SP shall give priority to equipping key trains, as defined by Union Pacific Railroad Form 8620, on the corridor segments listed below with two-way end of train devices. This requirement also applies to BNSF key trains operating between Iowa Junction, LA, and Avondale, LA.

- **Central Corridor**
  - North Platte, NE, to Oakland, CA (UP and SP).
  - Cheyenne, WY, to Denver, CO (UP).

- **Southern Corridor**
  - Houston, TX, to Avondale (New Orleans), LA (SP).
  - Iowa Junction, LA, to Avondale, LA, via Kinder and Livonia (UP).
  - Houston, TX, to West Colton, CA (SP).

- **Illinois-Gulf Coast Corridor**
  - St. Louis, MO, and East St. Louis/Salem, IL, to Houston, TX, and Avondale, LA (UP and SP).

C. RAIL LINE SEGMENT MITIGATION

General

The following mitigation conditions apply to all of the rail line segments in the states identified below.

18. UP/SP shall consult with the states and appropriate local officials as well as FRA to develop a priority list for upgrading grade crossing signals, where necessary, due to increases in rail traffic resulting from the proposed merger. This process shall be undertaken for all rail line segments in the States of Arkansas, California, Colorado, Kansas, Nevada, Oregon, and Texas. UP/SP shall advise SEA as to the status and the results of these consultations.

Specific

The following detailed mitigation conditions apply to the specific rail line segments and/or locations identified below.

City of Reno

22a. UP/SP shall operate no more than a daily average count of 14.7 freight trains per day through the City of Reno. (This reflects the Base Year daily average of 13.8 trains -- 12.7 freight trains and 1.1 passenger trains -- plus 2 additional freight trains.) The addition of two freight trains per day does not exceed the Board's threshold for environmental analysis at 49 CFR 1105.7(e)(5)(ii). The 14.7 average freight train count per day does not include the following types of movements: (1) maintenance-of-way trains, (2) light locomotive movements, (3) local and industry switching train movements, (4) emergency trains operated under detour authority, for snow removal, for fire or other natural disaster purposes, and wreck removal purposes. This condition will be effective upon consummation of the merger and will continue in effect for 18 calendar months in total.

22b. For the purpose of monitoring the preceding condition, UP/SP shall file on a monthly basis with the Board verified copies of station passing reports of train movements through Reno, NV, for each day of each preceding month in the specified 18-month period. These reports shall also identify those train movements, specified in the above condition, that are excluded from the 14.7 trains per day average count.

22c. UP/SP, in consultation with and subject to the approval of SEA, shall retain an independent, third-party consultant to prepare a specific mitigation study to address the environmental effects on the City of Reno of the additional rail freight traffic projected as a result of the proposed merger. This study shall be prepared under the sole direction and supervision of SEA. It shall include a final mitigation plan based on a further study of the railway, highway, and pedestrian traffic flows and associated environmental effects on the City of Reno. This study would tailor mitigation to address environmental effects such as safety, hazardous materials transport, air quality, noise and water quality. UP/SP shall comply with the final mitigation plan developed under this study.

The study, which shall be completed within 18 months from the date of consummation of the merger, shall include the following:

- Projected post-merger increases in rail freight traffic on the Sparks to Roseville line segment.
- Consultations with the City of Reno, Washoe County, the Federal Railroad Administration, affected Native American Tribes, and other appropriate Federal, state and local agencies, and other interested parties.
- Consultations with UP/SP.
- Review of all existing information and studies including those prepared by the City of Reno, Washoe County and UP/SP.
- Independent analyses.
- With respect to vehicular and pedestrian safety, mitigation measures that identify the number and location of highway/rail grade separations and rail/pedestrian grade separations in downtown Reno.
- Funding options.
- Submission of a draft study to the public for review and comment and then issuance of a final mitigation study.

22d. SEA will submit the final mitigation study and its recommendations to the Board, which shall then issue a decision imposing mitigation. In the event UP/SP and the City of Reno and other appropriate parties reach agreement on a final mitigation plan, UP/SP and the City of Reno shall immediately notify SEA, and the Board will take appropriate action consistent with such an agreement.

Enclosure 2

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EB

SERVICE DATE - APRIL 17, 1997

SURFACE TRANSPORTATION BOARD

DECISION

Finance Docket No. 32760

UNION PACIFIC CORPORATION, UNION PACIFIC RAILROAD COMPANY, AND MISSOURI PACIFIC RAILROAD COMPANY—CONTROL AND MERGER—SOUTHERN PACIFIC RAIL CORPORATION, SOUTHERN PACIFIC TRANSPORTATION COMPANY, ST. LOUIS SOUTHWESTERN RAILWAY COMPANY, SPCSL CORP., AND THE DENVER AND RIO GRANDE WESTERN RAILROAD COMPANY

[Decision No. 71]

Decided: April 15, 1997

In Decision No. 44 (served August 12, 1996), we approved the common control and merger of the rail carriers controlled by Union Pacific Corporation (Union Pacific Railroad Company and Missouri Pacific Railroad Company) and the rail carriers controlled by Southern Pacific Rail Corporation (Southern Pacific Transportation Company, St. Louis Southwestern Railway Company, SPCSL Corp., and the Denver and Rio Grande Western Railroad Company)(collectively UP/SP), subject to various conditions, including numerous environmental mitigating conditions. As pertinent here, the environmental conditions imposed in Decision No. 44 call for further, more focused, mitigation studies to arrive at specifically tailored mitigation plans for Wichita, KS and Reno, NV, in addition to the environmental mitigation that already has been imposed, to assure that localized environmental issues unique to those two communities are effectively addressed.

After Decision No. 44 was issued, the City of Wichita and the Board of County Commissioners of Sedgwick County, KS (Wichita/Sedgwick) filed an environmental court challenge in the United States Court of Appeals for the District of Columbia Circuit. No. 96-1293, City of Wichita v. Surface Transportation Board (pet. for review filed Aug. 21, 1996) (Wichita).[2] From pleadings filed in that litigation, it became apparent that the Wichita appeal is addressed solely to the sentence in Decision No. 44 (at p. 223) stating, "The (mitigation) studies (that are

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[1] Proceedings pending before the Interstate Commerce Commission (ICC) on January 1, 1996, must be decided under the law in effect prior to that date if they involve functions retained by the ICC Termination Act of 1995, Pub. L. 104-88, 109 Stat. 803. This proceeding was pending with the ICC prior to January 1, 1996, and to functions retained under Surface Transportation Board (Board) jurisdiction pursuant to new 49 U.S.C. 11323-27. Citations are to the former sections of the statute, unless otherwise indicated.

[2] Another environmental court challenge is pending in the D.C. Circuit in No. 96-1418, City of Reno v. Surface Transportation Board (Reno). The D.C. Circuit, on its own motion, ordered the Reno and Wichita appeals consolidated with the petitions for review raising issues other than environmental issues that were filed in that court. The Board and the United States have moved to sever the Reno and Wichita appeals from the other cases seeking review of Decision No. 44 and to hold briefing in abeyance in these two cases because, unlike the other petitions seeking review of Decision No. 44, the Reno and Wichita petitions are environmental court challenges that are not ripe or final for judicial review at this time. That motion remains pending in the court.

now underway for Wichita and Reno] will carefully examine private and public funding options, as we believe that the cost of mitigation for Reno and Wichita should be shared.' Then, following an inquiry looking toward settlement of the Wichita litigation, petitioners' counsel in the Wichita case advised our General Counsel, by letter dated April 7, 1997,[1] that if the Board issues a decision clarifying that UP/SP will be required to pay 100% of the cost of mandated environmental mitigation, Wichita/Sedgwick will withdraw their appeal.

Petitioners' counsel states that Wichita/Sedgwick understands that, consistent with Decision No. 44, the Board is considering both 'base line' mitigation, i.e., mitigation including, but not limited to, the type discussed in Decision No. 44, that UP/SP would be required to implement and fund in order to increase the number of through trains operating through Wichita/Sedgwick, and alternative mitigation i.e., more expensive options. As to the latter, Wichita/Sedgwick understands that the Board may suggest funding alternatives, but such suggestions would be in no way binding. See Addendum A.

Having ascertained that UP/SP has no objection to the issuance of a decision clarifying the intent of the sentence at page 223 of Decision No. 44, quoted above, in the manner requested by Wichita/Sedgwick, it appears to us appropriate to clarify our intent with respect to developing final mitigation for Wichita and Reno. Specifically, the final environmental mitigation that will be developed for Wichita and Reno following the completion of the ongoing mitigation studies will include (in addition to the mitigation that has already been imposed) both (1) mandated or base line mitigation, which the Board will require UP/SP to implement and entirely fund, and (2) alternative mitigation that might be a more far reaching solution for all concerned, but which will not be binding absent a voluntary agreement by the parties to share costs or expend greater resources.

This action will not significantly affect either the quality of the human environment or the conservation of energy resources.

It is ordered:

1. The discussion of environmental mitigation in Decision No. 44 is clarified as set forth in this decision.

2. This decision is effective on the date of service.

By the Board, Chairman Morgan and Vice Chairman Owen.

Vernon A. Williams
Secretary

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[1] A copy of that letter is attached as Addendum A.

Enclosure 3

UP/SP MERGER
RENO MITIGATION STUDY TASK FORCE MEMBERSHIP LIST

STB Section of Environmental Analysis **Representatives and/or Contacts** Elaine K. Kaiser Program Director/Legal Counsel	
Harold McNulty Reno Co-Study Director	Vicki Rutson Reno Co-Study Director
Dave Mansen Reno Mitigation Study Project Manager	Kay Wilson Reno Mitigation Study Community Coordinator
City of Reno Representatives **Manager's Office** Merri Belaustegui Deputy City Attorney	**City of Reno Alternates** **Manager's Office** Michael E. Halley Deputy City Attorney
Engineering Steve Varela, City Engineer City of Reno Public Works	**Engineering** Tom Gribbin Pyramid Engineering
Environmental Mark Demuth MADCON Consultation Services	**Environmental** Colleen Henderson Environmental Management Associates
Emergency Services Larry Farr, Fire Marshall Reno Fire Department	**Emergency Services** Chuck Lowden Fire Chief
Jim Weston, Chief of Police Reno Police Department	Tom Robinson Reno Police Department
Reno Citizens Representative **General Interests** Steve Bradhurst	**Reno Citizens Alternates** **General Interests** No Alternate Named
River Banks Homeowners Richard Vitali	**River Banks Homeowners** No Alternate Named
Native American Representatives Paula Berkeley Paula Berkeley and Associates	**Native American Alternate** Arlan Melendez, Director Reno-Sparks Indian Colony

UP/SP MERGER
RENO MITIGATION STUDY TASK FORCE MEMBERSHIP LIST

Business Community Representative Bill Osgood, Chairperson Reno Downtown Improvement Assoc.	**Business Community Alternate** Harry York Reno-Sparks Chamber of Commerce
NFRA Representative Bob Burn, Chairperson Nevadans for Fast & Responsible Action	**NFRA Alternate** John Frankovich
Washoe County Representative Bob Webb, Community Coordinator Washoe Co. Dept. Of Comprehensive Planning	**Washoe County Alternate** Dean Diederich Principal Planner of Washoe County Department of Community Development
Regional Transportation Commission Rep. Greg Krause, Planning Manager Regional Transportation Commission	**Regional Transportation Commission Alt.** Jack Lorbeer
State of Nevada Representative Tim Crowley, Executive Assistant Nevada Governor's Office	**State of Nevada Alternate** No Alternate Named
Nevada Public Service Commission Rep Galen Denio, Commissioner Nevada Public Service Commission	**Nevada Public Service Commission Alt.** Craig Wesner, Mgr. Engineering Svcs. Nevada Public Service Commission
City of Sparks Representative Rob Pyzel, Senior Planner Planning & Community Development	**City of Sparks Alternate** Randy Mellinger Community Development Director
UP Railroad Representative Mike Hemmer Covington & Burling	**UP Railroad Alternate** Joe Guild Union Pacific Railroad
Amtrak Representative Ron Scolaro Amtrak	**Amtrak Alternate** Raymond Lang Amtrak Intercity Rail Service
State Economic Interest Representative Ken Lynn Economic Dev Authority of Western Nevada	**State Economic Interest Alternate** No Alternate Named

UP/SP MERGER
RENO MITIGATION STUDY TASK FORCE MEMBERSHIP LIST

Warehousing/Distribution Representative	Warehousing/Distribution Alternate
David Loring Dermody Properties	Scott L. Hutcherson Eagle-Picher Minerals, Inc.

Enclosure 4

FORMAL CONDITIONS FOR BOARD CONSIDERATION

The preliminary Tier 1 mitigation measures proposed in Section 8 by the Surface Transportation Board's (Board's) Section of Environmental Analysis (SEA) are restated here for public review and comment and for Board consideration as additional conditions to the UP/SP merger decision.

Table 10-1
Preliminary Tier 1 (Fully Funded by UP) Mitigation Measures for Consideration by the Board and Public

Mitigation Measure	Proposed Board Conditions
Increased Train Speeds	1. UP shall make the necessary operating changes and capital improvements such as centralized traffic control (CTC), track reconfiguration, and track rehabilitation, as appropriate in the Reno/Sparks, Nevada area, to enable trains to operate over the rail line segment between the east end of the Sparks yard (approximately Mile Post [MP] 247) and a point just west of Keystone Avenue (approximately MP 242) in Reno at a speed of 30 miles per hour. UP shall then operate, and require BN/SF to operate, all trains over the described rail line segment at a speed of 30 miles per hour **consistent with safe operating practices dictated by conditions present at the time each train traverses the segment.**
Train Location Color Video Displays	2. Subject to the written concurrence of the City of Reno, UP shall install in the new City of Reno emergency communications center (or another location if desired by the City) color video displays coordinated with the UP signal system circuitry showing the location of each train present on the rail line segment from approximately MP 245 on the west side of the Sparks Yard to MP 238 (approximately Woodland Avenue) on the west side of Reno.
Cameras and Video Monitors Showing Rail Line	3. Subject to the written concurrence of the City of Reno, UP shall install television cameras over or near the rail line along with corresponding video monitors at the same emergency communications center location that continuously show real-time conditions on the right-of-way through downtown Reno in the area bounded by and including the grade crossings at Keystone and Lake Streets.
Discontinued Use of the Addition of "Helper" Locomotives in Woodland Area	4. UP shall discontinue the practice of adding "helper" locomotives in the Woodland Avenue area.
Four-quadrant Crossing Gates at Nine Locations	5. UP shall install four-quadrant crossing gates at rail-highway crossings at Sutro, Lake, Virginia, West, Arlington, Ralston, Washington, Vine, and Keystone streets.

Table 10-1
Preliminary Tier 1 (Fully Funded by UP) Mitigation Measures for Consideration by the Board and Public

Mitigation Measure	Proposed Board Conditions
Enhanced Rail Safety Programs	6. UP shall augment its safety training programs for drivers and pedestrians including: A. Supplementing its participation in the "Operation Lifesaver" Program, and B. Supplementing existing school educational programs in Reno and Washoe County (e.g., driver's training), and C. Establishing a safety training program for Reno's downtown employees.
Pedestrian Crossing Gate "Skirts" at Six Locations	7. UP shall install devices known as pedestrian crossing gate "skirts" on pedestrian crossing gates at Lake, Center, Virginia, Sierra, West, and Arlington streets.
Electronic Warning Signs for Pedestrians at Six Locations	8. UP shall install electronic warning signs for pedestrians at Lake, Center, Virginia, Sierra, West, and Arlington streets. These signs shall be designed and constructed so that they are clearly visible and easily read by pedestrians.
Construction of a Pedestrian Grade Separation at Virginia Street	9. UP shall construct a pedestrian overpass or underpass at Virginia Street with street level access on both sides of the tracks
Construction of a Pedestrian Grade Separation at Sierra Street	10. UP shall construct a pedestrian grade overpass or underpass at Sierra Street with street level access on both side of the tracks
Prehistoric and Historic Survey for Pedestrian Underpass(es) and Monitoring During Construction for Archeological Resources	11. Prior to construction of a pedestrian underpass at either Virginia or Sierra streets, UP shall conduct a survey of potential historic and prehistoric resources in consultation with the Nevada State Historic Preservation Office (SHPO). If any such resources are discovered during construction, UP shall cease construction and consult with the SHPO.
Consultation with Native Americans	12. Prior to construction of a pedestrian underpass at either Virginia or Sierra streets, UP shall consult with Native American interests regarding possible impacts to Native American resources from underground construction. If any such resources are discovered during construction, UP shall immediately stop construction and consult with Native American interests and the SHPO.
Installation of a high, wide, shifted load detector at MP 240	13. UP shall install a high, wide, shifted load detector at MP 240 for both mainline tracks.
Installation of a Hot Box Detector at MP 240	14. UP shall install an additional hot box detector on the westbound track at MP 240.

Table 10-1
Preliminary Tier 1 (Fully Funded by UP) Mitigation Measures for Consideration by the Board and Public

Mitigation Measure	Proposed Board Conditions
Establishment of a Community Advisory Panel	15. UP shall establish a Community Advisory Panel, consisting of representatives of the Reno/Sparks/ Washoe County community, including Native Americans, who are willing to work with UP management on a regular basis to review safety, environment, and health issues associated with rail operations, particularly as they relate to the transport of hazardous materials.
Certification to the Board and Notice to the City of Reno and Washoe County of UP's Compliance with Certain Installation Requirements	16. When compliance has been completed for each of the installations required in Conditions 1, 2, 3, 5, 7, 8, 9, 10, 13, and 14 above, UP shall certify such completion to the Board, with copies to the City of Reno, and Washoe County. Each certification shall be made within two weeks of the date of compliance for each condition.
Environmental Mitigation Status in Quarterly Reports	17. UP's quarterly reports to the Board shall include the status of compliance with the environmental mitigation measures pertaining to Reno and Washoe County for the duration of the Board's oversight proceeding. Copies of these reports shall also be provided to the City of Reno and Washoe County.

quality mitigation measures would certainly be considered by the Board, as was done in Truckee, California for its air quality mitigation agreement.

Table 8.5-1 provides a summary list of possible Tier 2 mitigation measures.

Table 8.5-1
Measures Identified as Potential Tier 2 Mitigation

Mitigation Measures	Comments
Depressed Railway	• Would reduce potential environmental impacts related to the merger, but also pre-existing conditions. • Rail impacts on surrounding land uses pre-date the merger, so it would not be appropriate to require UP alone to absorb extensive costs of a depressed railway. • Casinos and hotels have consistently built their facilities next to the existing UP (formerly SP) tracks. • Impact of rail operations has been a matter of local concern for decades. In a 1980 ballot measure, the citizens of Reno considered the issue of a depressed railway. (In the 1980 ballot measure, the citizens of Reno voted down a bond issue for construction of a depressed railway through downtown Reno.) • A depressed railway would bestow substantial benefits on the City as well as private property owners in the area of the existing track. • A depressed railway would benefit the railroad. • Would involve secondary environmental impacts (e.g., construction, groundwater, emergency vehicle access). • Cannot equate benefits of a depressed railway to potential merger-related impacts only. • SEA urges the parties to continue negotiations with respect to the depressed railway, if appropriate. • If a mutually acceptable agreement were reached for a depressed railway, SEA could recommend that the Board impose an obligation upon UP to comply with such agreement.
Rail/Highway Grade Separations	• Tier 1 mitigation measures comprise a package that provides substantial additional mitigation beyond that already imposed in the Board's Decision No. 44. • Grade separations would have major property acquisition, displacement, and other impacts. • Grade separations would adversely affect vehicular access to properties that front on the adjoining streets. • Increasing train speeds serves to reduce the vehicular delay associated with merger-related increases in train traffic to below pre-merger levels, and none of the highway/rail grade separations would achieve this level of delay reduction. • The City of Reno has stated its opposition to grade separations as a mitigation measure.
Elevated Railway	• Downtown business interests and the City have raised concerns about potential adverse environmental impacts associated with an elevated railway in Reno, including the visual barrier that would be created, the associated division of the City, possible derailments and spills of hazardous materials from elevated trains, and the need to demolish existing structures over the tracks. • As with the depressed railway, a shoofly track would be needed to permit the construction.

Table 8.5-1
Measures Identified as Potential Tier 2 Mitigation

Mitigation Measures	Comments
I-80 Bypass	• No support in the Board's precedent or case law for requiring a railroad seeking merger authority to construct a new railroad line to bypass a City. • No source of funding. • Questionable feasibility. • The City has indicated that, while it does not want to drop the bypass from consideration, the depressed railway is a priority in Reno. • Private parties could pursue and fund an I-80 bypass. Doing so would require that the appropriate authority to construct and operate be sought from the Board. At that time, the Board would undertake the environmental review that was warranted for a bypass alternative.
Grade Crossing Safety Measures (Vehicular)	
• Street median barriers	• Would reduce the width of the street traffic lanes and could introduce access problems from adjoining land uses. • Not be needed with four-quadrant gates (proposed as Tier 1 mitigation).
• Conversion of existing two-way streets to one-way	• Far-reaching implications for downtown traffic circulation and businesses. • Should be part of a broader transportation, land use, and property access planning process for the areas surrounding the grade crossings. • One-way street couplets (pairs of one-way streets) were reviewed during a 1995 analysis of downtown traffic and parking to reduce traffic conflict and increase intersection capacity. Study notes that one-way streets offer some advantages but can confuse motorists, especially visitors, and can be frustrating to local motorists. • Local businesses may also oppose one-way streets because of potential access problems. • Four-quadrant gates proposed as Tier 1 mitigation eliminate advantages from the standpoint of railroad/highway safety.
Grade Crossing Safety Measures (Pedestrians)	
• Crossing guards	• Proposed Tier 1 mitigation measures include pedestrian crossing gate skirts, electronic warning signs, and pedestrian/rail grade separations, all in addition to the pedestrian warning signals and gates that currently exist at the heavily-used pedestrian crossings in Reno. • Would entail unnecessary ongoing costs.

Table 8.5-1
Measures Identified as Potential Tier 2 Mitigation

Mitigation Measures	Comments
Air Quality Measures	
• Implementing the proposed EPA locomotive emission standards	• EPA regulations not yet in place. • Would be applicable to all locomotives operating through Reno and introduce unknown costs. • Inadequate information exists to recommend at this point. • Other system-wide mitigation measures that are already imposed appear to mitigate impacts.
• Concentrating operation of new EPA-certified low-emission locomotives in Reno	
• Early Introduction of low-emission locomotives	
• Diesel engine modifications	
• Improved diesel fuels	
• Diesel exhaust after treatment	
• Use of alternative fuels	
• Offsetting the Increase in Locomotive Emissions	• Would not directly mitigate effects of the increased train levels. • Goes beyond authority of the Board and requires voluntary compliance, e.g., Truckee Memorandum of Understanding (MOU). • Other system-wide mitigation measures that are already imposed appear to mitigate impacts.

In conclusion, SEA would certainly review and consider any of the above Tier 2 mitigation measures if they were agreed upon voluntarily and became part of a memorandum of understanding between UP and appropriate interested parties.

8.6 Noise

Noise is a distinct and separate area of environmental concern, because of its paramount role in providing for the public safety. The overwhelming majority of noise generated by rail operations in Reno is that which emanates from warning horns located on the locomotives. The Board addressed the public safety implications of the train horn noise in its Decision No. 44. Specifically, the Board noted that "[a]ny attempt significantly to reduce noise levels at grade crossings would jeopardize safety, which we consider to be of paramount importance."

Enclosure 6

WASHOE COUNTY

"To Protect and To Serve"

100 E. NINTH STREET
POST OFFICE BOX 11130
RENO, NEVADA 89520-0027
PHONE: 702/328-3600
FAX #: 702/328-3648

DEPARTMENT OF COMPREHENSIVE PLANNING

January 21, 1997

TO: Reno Mitigation Task Force

FROM: Bob Webb, Community Coordinator

SUBJECT: Impacts on Washoe County

As part of the preliminary mitigation and evaluation criteria, task force members were asked to consider the impacts of the railroad merger in order to better evaluate potential mitigation measures. The following list of impacts is derived from staff reports prepared for the Washoe County Commission, comments by County Commissioners during public meetings, and the staff report prepared for the Environmental Assessment on the merger. Impacts are divided into three general categories: public safety, economic, environmental, and miscellaneous.

Public Safety:

- emergency access for isolated communities served by Woodland Avenue, Stag Lane, Del Curto Lane, and Canal Road. Canal Road is located off the Interstate 80 Patrick Exit and provides access for about 35 residences in Storey County. Concern is two fold: first, blockage of tracks during normal operations for emergency response agencies. Second, blockage during a train accident and/or hazardous material spillage for community access/ evacuation.
- existing, substandard railroad crossing throughout Washoe County.
- long trains blocking multiple crossings (particularly should a train stop and block two or more railroad crossings).
- speed of trains in outlying areas. Information supplied by Union Pacific officials show that trains will be traveling at 65 mph on tracks east of Reno (i.e., through the east Truckee Canyon) and at 45 mph on tracks west of Reno (i.e., through the Verdi area). Obviously, faster trains mean longer braking distances in case of vehicles or pedestrians on the tracks.

Economic:

- delays to tourists (pedestrian and vehicle) at railroad crossings.
- potential negative publicity to tourist based economy in the event of a major traffic accident or HAZMAT spill (similar to effects of national media attention during the 1997 floods).

Environmental:

- hazardous material spills at railroad switching yards (Sparks and Parr Boulevard) and along the railroad tracks. This impact also involves clean up of hazardous materials, even if accumulation of small amounts occurs over a long period of time.

- potential contamination of surface water (primarily Truckee River where municipal water intakes are located very close to the railroad) and groundwater supplies. This concern includes contamination due to normal operations (e.g., oil leaks from engines on the railroad bed).
- increased HAZMAT shipments on the Feather River railroad route and potential impacts to the Gerlach community.
- air quality impacts of idling vehicles waiting at railroad crossings.
- air quality impacts of switch yard railroad traffic (e.g., switching engines, adding additional engines for the climb up Donner summit).

Miscellaneous:

- noise from train whistles (County staff reports highlighted the Verdi area as a primary concern, but noise also effects nearby residences near the tracks through both Reno and Sparks).
- noise from passing trains (particularly at slow speeds, for instance in the downtown area).
- future of the Reno Branch line and the Reno intermodal facility at Parr Boulevard (particularly should there be increases in rail traffic).

Bob Webb
Community Coordinator

CRW:bw

cc: John MacIntyre, County Manager

Enclosure 7

Washoe County Department of Community Development
1001 E. Ninth St. Bldg A
Post Office Box 11130
Reno, NV 89520-0027
Tel: 702-328-3600
Fax: 702-328-3648

July 8, 1997

Elaine K. Kaiser, Chief
Harold McNulty, Reno Co-Study Director
Section of Environmental Analysis
Surface Transportation Board
1925 K Street NW
5th Floor
Washington, DC 20423

Subject: Recommended Mitigation Measures

Dear Ms. Kaiser and Mr. McNulty:

In your letter of July 2, 1997 to Charles McNeely, City Manager for the City of Reno, you stated that the Reno Mitigation Study Task Force would not meet in August as your section will be finalizing the Preliminary Mitigation Plan. Your section will issue the plan in September and the process will then move into a formal public review phase. As a member of the study task force, I have waited for the appropriate task force meeting to raise issues of concern to Washoe County as a whole and it appears as if opportunities to discuss these issues in a task force meeting will be slim (particularly since I will be unable to attend the task force meeting on July 9, 1997).

The following comments are mitigation measures which I believe should be considered as part of a larger mitigation plan for Washoe County (to include the Cities of Reno and Sparks). The comments are segregated by the appropriate categories for evaluation (provided to task force members during the meeting on June 11, 1997). These mitigation measures have appeared in a letter to you dated April 30, 1996 and were reiterated in a memorandum to the Reno Mitigation Study Task Force dated January 21, 1997.

Pedestrian Safety and/or **Emergency Vehicle Access** and/or **Train/Vehicle Accidents**

1. Evaluate existing railroad crossings (public and private) in Washoe County and repair those crossing which do not meet appropriate Federal or State regulations. Southern Pacific Railroad repaired the railroad crossing at Woodland Avenue prior to the merger and a similar effort should be provided for all crossings in Washoe County.

2. Inform residents and business owners of the emergency access road which provides secondary access should Woodland Avenue be blocked at the railroad crossing. Information should include agencies to contact should an emergency arise which would cause the need for secondary emergency access.

3. Provide emergency access to residents in the Stag Lane, Del Curto Lane, and Canal Road areas. There should be, at a minimum, discussion between railroad officials, the Public Service Commission, and appropriate County staff as to measures to be taken to provide emergency access and/or evacuation should the railroad crossings at those locations be blocked.

4. Provide a system which alerts emergency responder dispatch centers as to when trains are on the tracks. This system should be able to divide the Donner Pass corridor through

John B. Hester, AICP
Director

Jess S. Traver, P.E.
County Building Official

COMMUNITY DEVELOPMENT

Washoe County into discrete segments so that dispatchers can keep track of the progress of a train. Such a system would alert emergency responders when a crossing will be blocked so they can plan alternate routes.

Derailments/Spills/Water Quality

5. Develop a plan to respond to hazardous material spills and/or accidents in or near Gerlach, Nevada (Feather River route). The plan should identify the equipment needed for minimum response and the location of this equipment, the agency(s) (both public and private) charged with responding to an incident, and response times to an incident.

6. Develop a plan to address the impact of spills and leaks of hazardous/toxic material along the railroad tracks. The plan should provide mitigation measures to minimize the migration of leaks and spills into the ground water supply and/or into surface drainage facilities which eventually empty into the Truckee River. The plan should also address the need for structures similar to catch basins (which are required for parking lots) for the railroad tracks and railroad yards.

7. Control the speed of trains in the Truckee Canyon (Wadsworth to Verdi) adjacent to municipal water intakes on the Truckee River. Develop a plan to address train derailment and/or hazardous/toxic material spills which endanger either ground water or Truckee River water supplies. Situate appropriate emergency response and spill containment equipment in the Truckee Meadows region.

I would appreciate a written response to each of these items either separately or within the Preliminary Mitigation Plan. I also request that this letter be made part of the public record. If you have any questions, please do not hesitate to call me at (702) 328-3623.

Sincerely,

Bob Webb

Bob Webb
Community Coordinator

CRW:bw

cc: Grant Sims, Chair, Washoe County Board of County Commissioners
John MacIntyre, County Manager
John Hester, Director
Reno Mitigation Study Task Force members

Nevadans For Fast And Responsible Action

October 15, 1997

Office of the Secretary
Case Control Unit
Finance Docket No. 32760
Surface Transportation Board
1925 K Street, NW, Room 500
Washington, DC 20423-0001

Attention: Elaine K. Kaiser
Chief, Section of Environmental Analysis
Environmental Filing

Re: Reno, Nevada, Preliminary Mitigation Plan

Dear Ms. Kaiser:

The following comments are submitted on behalf of the Nevadans For Fast And Responsible Action ("NFRA") relating to the Preliminary Mitigation Plan ("PMP") prepared by the Surface Transportation Board Section of Environmental Analysis ("SEA") which proposes certain mitigation measures for the Reno area to mitigate the impacts of the merger between Southern Pacific Railroad and Union Pacific Railroad.

NFRA is an organization made up of a large number and variety of local businesses, civic organizations, health care providers, public safety agencies, citizen organizations and individual citizens. NFRA represents a cross-section of the Truckee Meadows community. NFRA was formed as a result of the UP/SP merger in order to insure that the impacts on the Truckee Meadows are properly identified, addressed and mitigated so as to protect the quality of life in the Truckee Meadows. NFRA had a representative, as well as an alternative, serve on the Task Force which was established to provide input to SEA.

Initially, it should be noted that NFRA was extremely frustrated by the Task Force process. As it evolved, it became clear that this process, both procedurally and substantively, was dictated by the Railroad. Few, if any, of the concerns raised by various members of the Task Force, together with suggested mitigations, were adequately addressed in the PMP. No member of the Task Force ever proposed that an increase in

561 Keystone, BOX 500, Reno, Nevada 89503 • For more information contact (702)334-6794 • Fax 323-9021

the speed of the trains through the Reno area would or should be the principal mitigation measure.

NFRA was so concerned about the PMP that it has retained independent experts to evaluate several of the technical aspects of the PMP, including the traffic and related delay analysis, the air quality evaluation, and the noise impacts. Before discussing the results of these independent studies, a few general and common sense comments relating to the PMP are appropriate.

NFRA questions whether the proposed increase of train speeds to thirty (30) miles per hour as proposed in the PMP is an effective and obtainable mitigation. Increasing train speeds through a highly congested area simply does not make sense. Indeed, even the PMP acknowledges that there will be a higher incidence of accidents and that the accidents will be more severe. This alone should result in a rejection of the PMP. The citizens of and visitors to the Reno area should not be subject to increased risk of bodily harm or death as a result of the merger.

In addition, the speed of trains cannot be adequately controlled. Many factors will affect the speed of trains through the Reno area, including pedestrian and vehicle congestion, weather, train weight, train length and the subjective perception of the train engineer. Thus, it does not appear that an increase in the speed limit will result in permanent or effective mitigation.

While the Railroad has indicated that it believes it can increase the speed of trains, it has provided no substantiation. The PMP does not provide for any consequences for the failure to maintain the increased speed. At the very least, the PMP should be modified to provide for additional mitigation in the event that an increase in the speed either cannot be obtained or is not an effective mitigation.

NFRA also has a concern about the number of projected trains upon which the entire analysis in the PMP is based. The twenty-five (25) trains per day is an average number based on the Railroad's calculations for the year 2000. Initially, this was a five-year projection between 1995 and the year 2000. However, 2000 is only a little more than two years away. Therefore, the Railroad should provide

an up-dated analysis of the number of trains projected through the year 2003. In addition, any evaluation of the future train traffic through the Reno area should consider the impacts of the Port of Oakland Project which is currently under construction and scheduled to be completed by 2002.

The principal problem with using an average number of trains is that the worst case impacts have not been evaluated. On a significant number of days, which could approach 50 percent, the number of trains through Reno will exceed 25. The Railroad has admitted that as many as 38 trains could pass through Reno on any given day. On those days when the number of trains through Reno exceeds the 25 upon which the PMP is based, the impacts on traffic delay, air quality, public safety and noise will be considerably greater than reflected in the PMP. What this means is that on a significant number of days, the mitigation recommended in the PMP (increased train speed) will not mitigate the impacts of the merger on this community. On those days, there will be increased traffic delays, increased public health and safety concerns, more delayed emergency vehicles, greater noise and an increase in air pollution. This will be the case even if the mitigation proposed in the PMP actually works, which, as indicated by the attached Reports from the independent consultants, is not likely.

Finally, with respect to the number of trains, it cannot be denied that at some point in time, it is very likely that the number of trains through Reno will increase beyond an average of 25 per day. SEA has indicated that it does not have the authority to put a limit on the number of trains through Reno. Assuming that the number of trains cannot be restricted, the Mitigation Plan should require additional mitigation if and when the number of trains through the Reno area does increase. This would at least give this community the opportunity to survive in the event that there is a significant increase in the number of trains through Reno. A tiered mitigation plan is only fair and reasonable in the circumstances. The Railroad should not be able to enjoy greater profits and success at the expense of the Reno area.

The PMP acknowledges that it has not evaluated the impacts that the merger will have on the tourism industry. This is an unfair and unreasonable limitation in the scope of the PMP. The tourism industry is the principal industry

which supports the economic viability of this community. The Railroad has no right to materially injure or otherwise impact any community's prinicpal industry. The Reno economy should not be sacrificed for the greater good of the Railroad system.

Enclosed with this letter are an original and ten copies of the following Reports prepared at the request of NFRA:

1. UP/SP Railroad Impact Analysis: Traffic/ Delay Analysis prepared by Meyer, Mohaddes Associates, Inc.

2. Analysis of Air Emission Increases Resulting From the Union Pacific and Southern Pacific Railroad Merger and Effects on the Management of the Air Resource of the Truckee Meadows Nonattainment Area prepared by Air Sciences, Inc.

3. Railroad Noise/Vibration Assessment: UP/SP Merger prepared by Brown-Buntin Associates, Inc.

These Reports are submitted for the review and consideration by the STB and, hopefully, will be incorporated into the final Mitigation Plan. These Reports show discrepancies and inaccuracies in the analyses and methodologies utilized in the PMP. Specifically, these Reports indicate that the post-merger conditions have been under estimated in the PMP, and, therefore, the proposed mitigation will not be effective or otherwise mitigate the merger impacts. These Reports indicate that the vehicle delay time in the post-merger condition will be substantially greater than set forth in the PMP, that the increased air pollution will exceed acceptable limits, that the noise impacts will be significantly greater, that more emergency calls will be disrupted or delayed and that the number of accidents will increase.

NFRA hopes the above comments, together with the enclosed technical Reports, are taken into consideration in finalizing the Mitigation Plan for the Reno area. The final Mitigation Plan should propose both effective and permanent mitigation measures to protect this community, not just to the year 2000 but permanently, from the impacts of the Railroad Merger. If the only effective and permanent mitigation measure has the impact of mitigating more than the merger impacts, that should not prevent the

implementation of such mitigation. This community is entitled to be protected from the impacts of the merger.

Respectfully Submitted,

Bob Burn, Chairman
Executive Board of NFRA,
By John Frankovich, NFRA
Task Force Alternate

JF:nz
cc: Executive Board

stb.ltr

UP/SP Railroad Merger
Impact Analysis

Traffic / Delay Analysis
Final Draft

Prepared for

Nevadans for Fast and Responsible Action

Prepared by

Meyer, Mohaddes Associates, Inc.
3010 Old Ranch Parkway, Suite 350
Seal Beach, CA 90740

October 3, 1997

J97-076

EXECUTIVE SUMMARY

This study analyzes the mobility and air quality impacts of the anticipated increase in vehicles and railroad traffic at 12 existing and 1 future at-grade crossing in the downtown area of the City of Reno. The analysis covers these crossings along the railroad track from Keystone to Sutro. The following figure, **Figure ES-1** shows the study elements.

Scenarios Analyzed

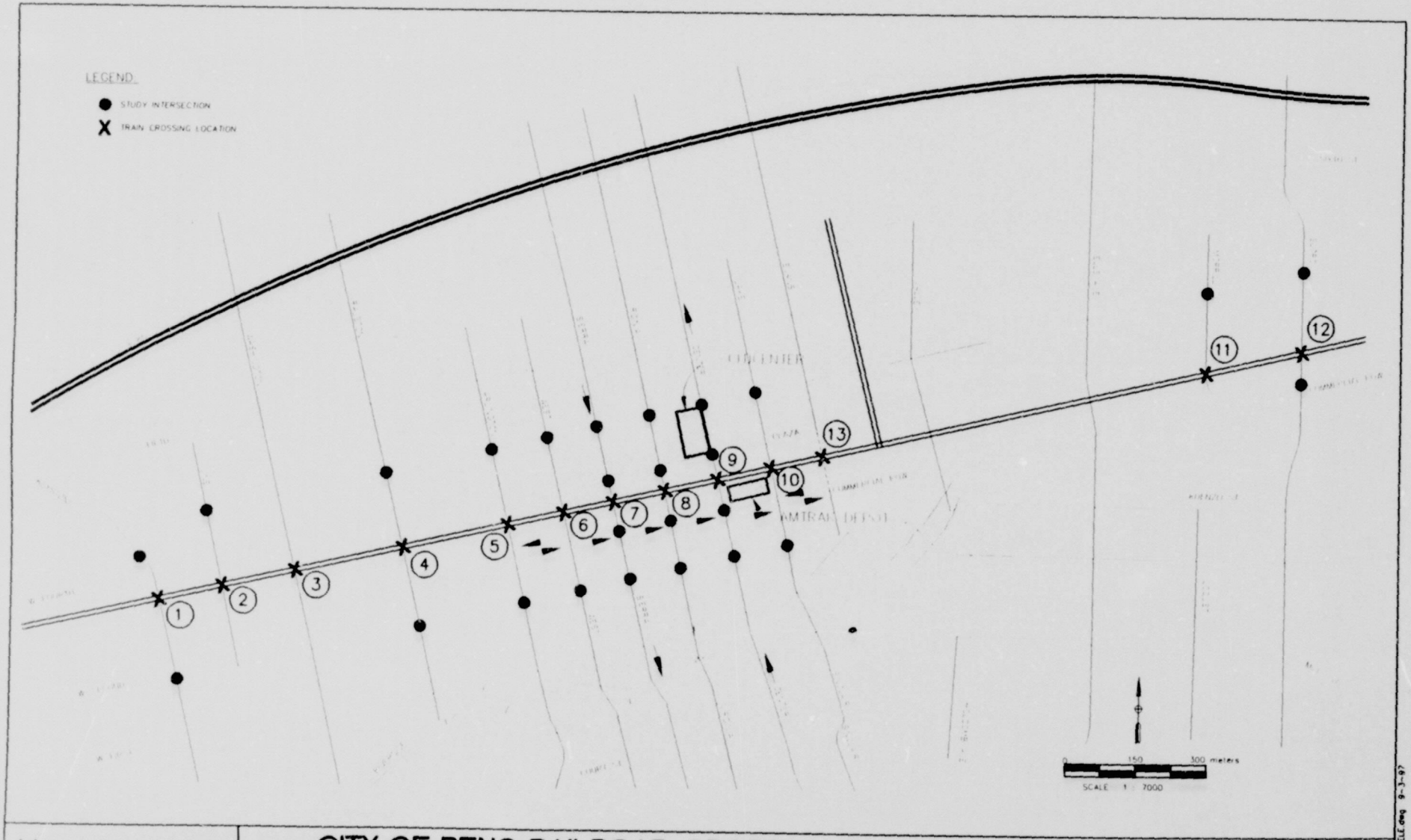
The following scenarios (**Table ES-1**) were analyzed:

TABLE ES-1
ANALYSIS SCENARIOS

Train Crossing (per day) Scenario	1995 Traffic Volumes	2000 Traffic Volumes	2007 Traffic Volumes	2015 Traffic Volumes
12.7	√	√	√	√
24.0	√	√	√	√
36.0	√	√	√	√

Baseline and Future Traffic Volumes

1995 average daily traffic volumes were primarily obtained from NDOT counts, various sources and verified by comparing with actual 1997 traffic volumes. The future traffic volumes were forecast, utilizing RTC model data for 1997, 2007 and 2015. Split percentages by peak periods, directional splits and truck percentages were calibrated using actual traffic observation and counts. Baseline (1995) and future (2000, 2007 and 2015) traffic volumes used are summarized in **Table ES-2**.



Meyer, Mohaddes Associates, Inc.
Traffic Engineering • Transportation Planning

CITY OF RENO RAILROAD CROSSING TRAFFIC AND DELAY STUDY

STUDY ELEMENTS

FIGURE ES-1

J97-068\STUDLE.dwg 9-3-97

TABLE ES-2
AVERAGE DAILY TRAFFIC (ADT) VOLUMES

Arterial	1995	2000	2007	2015
Keystone	22,100	24,300	26,000	28,000
Vine	4,185	4,600	4,920	5,320
Washington	1,875	2,100	2,250	2,430
Ralston	3,785	4,200	4,490	4,850
Arlington	15,200	16,700	17,870	19,300
West	3,200	3,500	3,745	4,050
Sierra	19,700	21,700	23,220	25,000
Virginia	14,000	15,400	16,500	17,800
Center	11,600	12,800	13,700	14,800
Lake	7,575	8,300	8,880	9,500
Evans	-	13,380	14,320	15,500
Morrill	300	300	300	300
Sutro	11,700	12,900	13,800	14,900

Rail Operation

Train speed, train length, number of trains (scenarios) and distribution of train crossings during the 24-hour period were obtained and/or verified through actual train crossing surveys, STB database and observations.

TABLE ES-3
RAIL OPERATION PARAMETERS

Characteristics	1995.00	2000.00	2007.00	2015.00
No. of Trains	12.70	12.7, 24 and 36	12.7, 24 and 36	12.7, 24 and 36
Distribution of Trains over the Day	AM Peak: 8% PM Peak: 17% Off-Peak: 75%			
Train Speed	20 mph	20 mph	20 mph	20 mph
Average Train Length	6,500'	6,500'	6,500'	6,500'

Analysis Methodology

Queuing Theory, Highway Capacity Manual of Level of Service calculation and Modified Winfrey Method were utilized for the following topics:

- Grade Crossing Delay
- Queuing Analysis
- Level of Service
- Air Quality Analysis

Model parameters such as lead and lag time before lowering and after raising crossing gate, arrival rates and departure rates were calibrated by actual count, field survey and observation when needed.

Total Daily Grade Crossing Delay

The daily grade crossing delay was calculated for each crossing and added up to get the total daily delay of the study locations. The total delay includes delay due to the time the gate is down and delay during the dissipation of the queue that is developed. Additionally, an added delay was included to account for extra delay due to the overflow of the queue into adjacent signalized intersections. The overflow vehicles will experience this extra delay while waiting for the queue to clear the intersection.

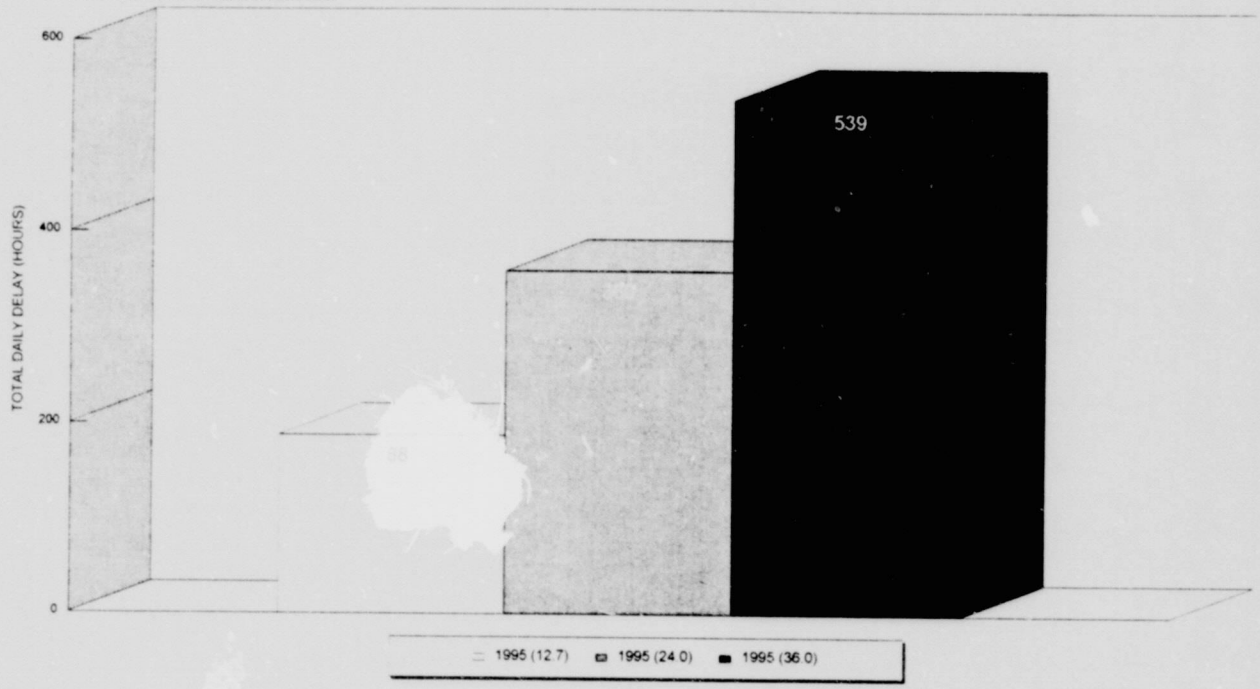
Figures ES-2 through ES-5 show the daily grade crossing delay for the studied crossings. **Table ES-4** shows a summary of the total delay findings and **Figure ES-6** shows the components of total delay due to train crossing and overflow.

TABLE ES-4
TOTAL DAILY DELAY INCLUDING INTERSECTION DELAYS
(HOURS)

Train Crossing Scenario (trains/day)	Analyzed Year			
	1995	2000	2007	2015
12.7	188	250	272	310
24.0	360	473	514	587
36.0	539	714	770	880

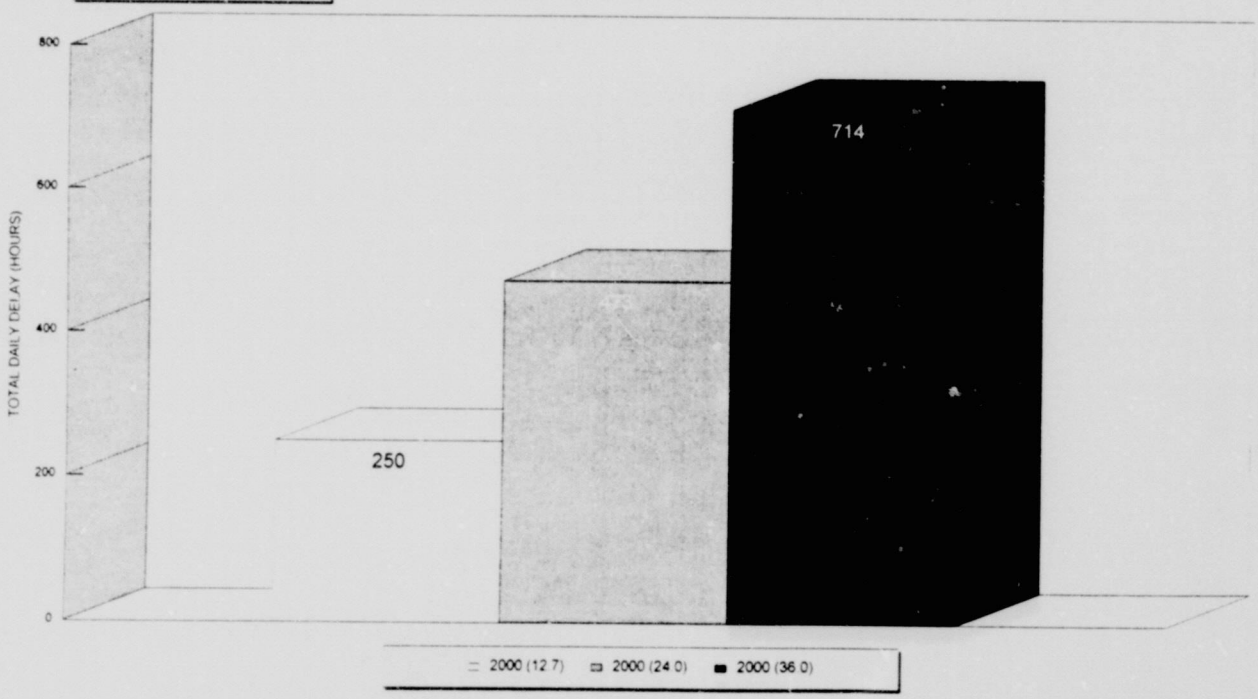
Reno Railroad Merger Study
Figure ES-2

1995 TOTAL DAILY DELAY (HOURS)
WITH INTERSECTION DELAY



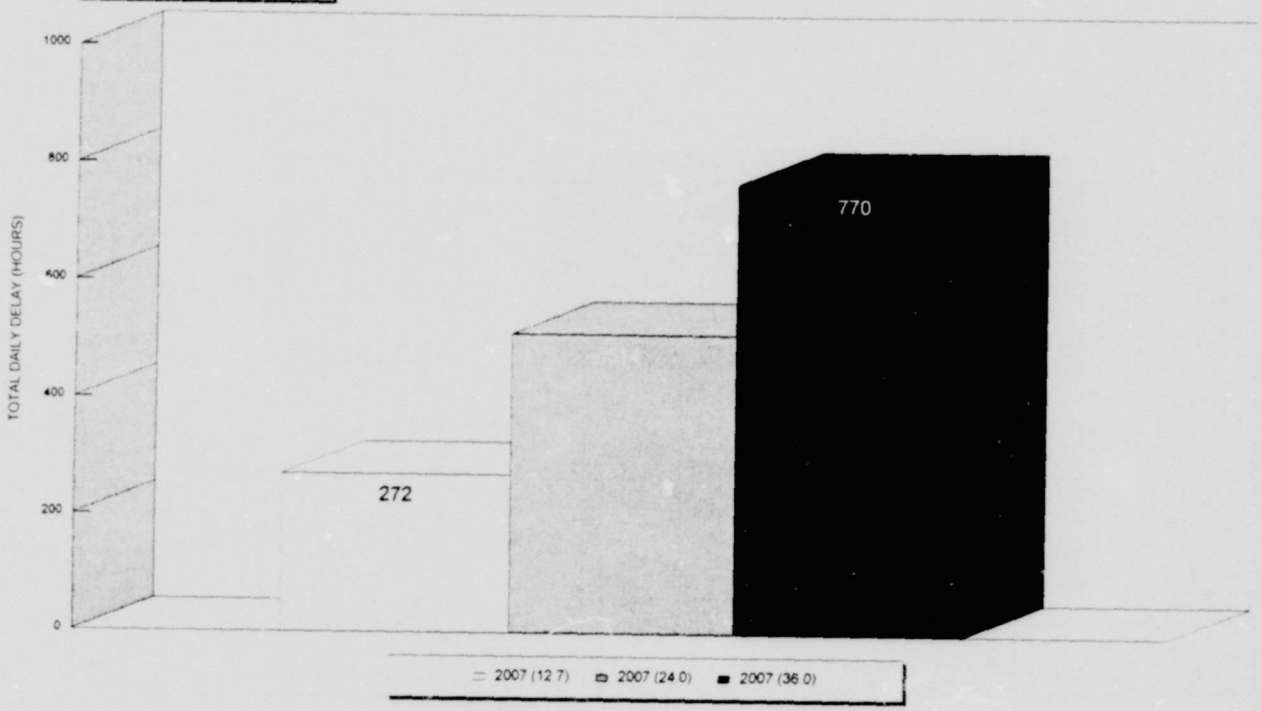
Reno Railroad Merger Study
Figure ES-3

2000 TOTAL DAILY DELAY (HOURS)
WITH INTERSECTION DELAY



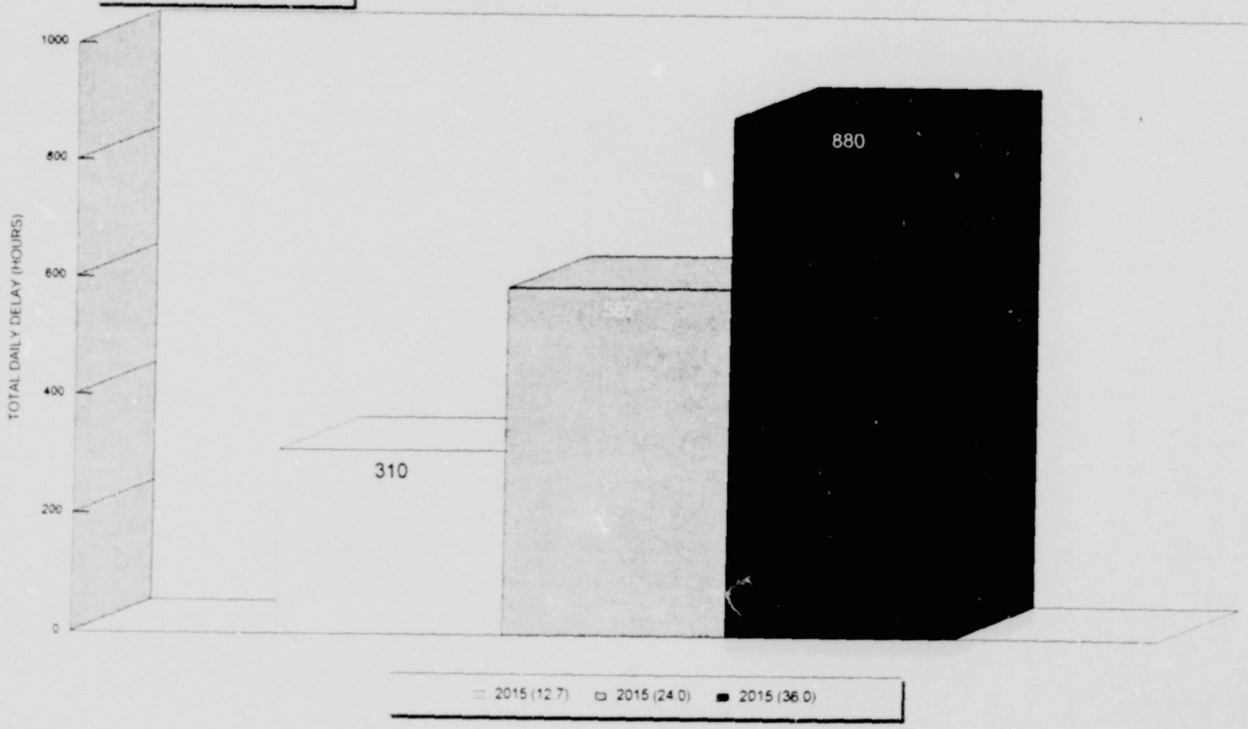
Reno Railroad Merger Study
Figure ES-4

2007 TOTAL DAILY DELAY (HOURS)
WITH INTERSECTION DELAY

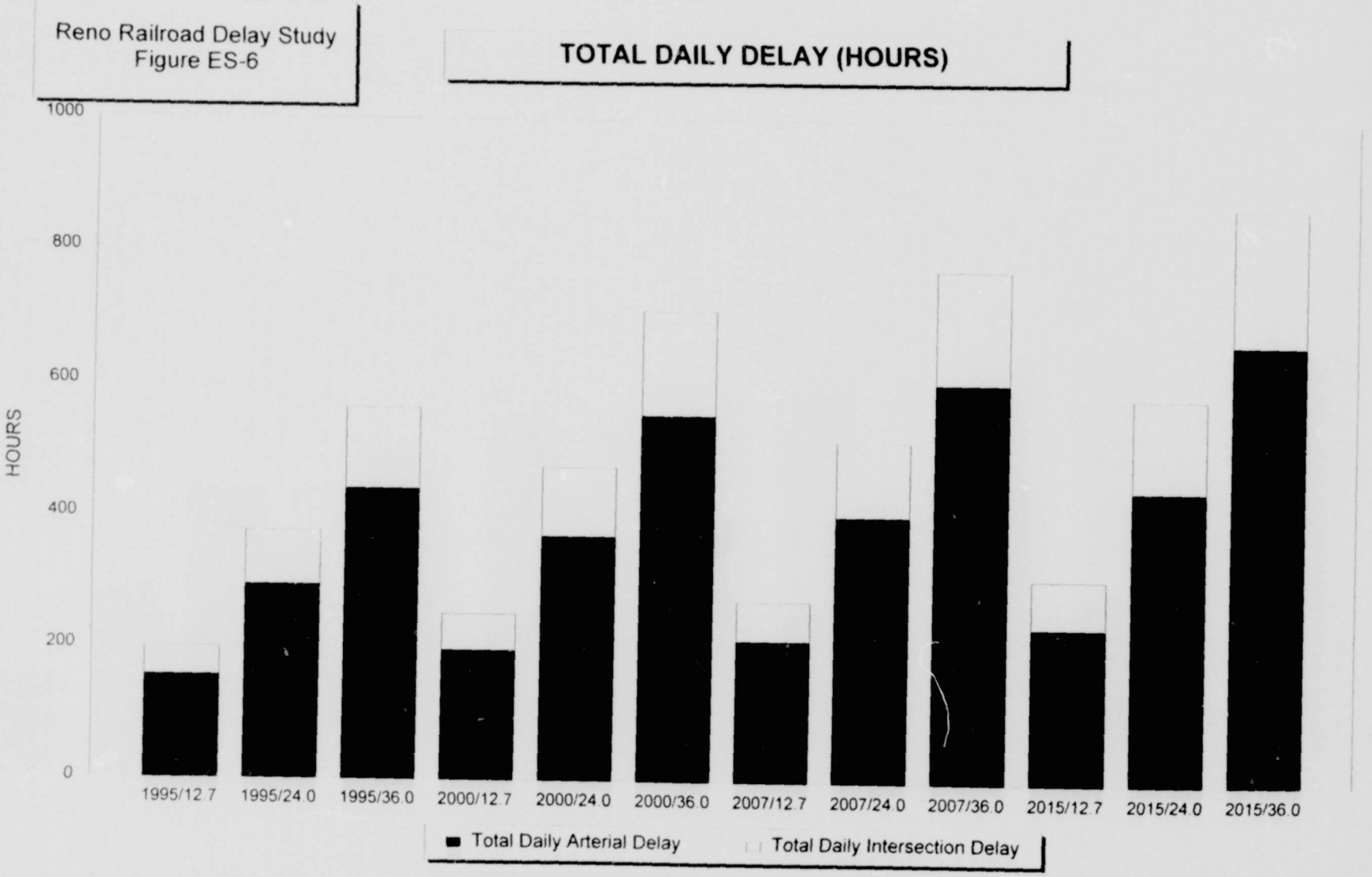


Reno Railroad Merger Study
Figure ES-5

2015 TOTAL DAILY DELAY (HOURS)
WITH INTERSECTION DELAY



Reno Railroad Delay Study
Figure ES-6



Total Queue

The number of vehicles in queue as a result of train crossing for each analysis year are shown in **Table ES-5**.

TABLE ES-5
TOTAL DAILY QUEUE (VEHICLES/DAY)

Train Crossing (per day) Scenario	1995	2000	2007	2015
12.7	4,542	5,574	5,946	6,429
24.0	8,584	10,534	11,237	12,149
36.0	12,876	15,802	16,856	18,223

Level of Service

Tables ES-6 through **ES-8** show the summary of Level of Service for all scenarios. For all years, when 12.7 trains per day cross, LOS is D. However, when additional trains are added, LOS worsens. For 24.0 trains per day in all study years, LOS is always E or better. When the number of trains are increased to 36.0 per day, then the LOS drops at a few locations to F, whereas the majority operated at LOS E.

Air Quality - Vehicular Traffic Only

Table ES-9 shows the total daily emissions for all train crossing per day scenarios.

TABLE ES-9
TOTAL ANNUAL EMISSIONS (TONS)

Train Crossing (per day) Scenario	1995	2000	2007	2015
12.7	2.46	3.06	3.44	3.79
24.0	4.64	5.78	6.51	7.16
36.0	6.97	8.67	9.76	10.74

TABLE ES-6
NUMBER OF LINKS PER LEVEL OF SERVICE (AM PEAK)

	1995			2000			2007			2015		
	12.7	24.0	36.0	12.7	24.0	36.0	12.7	24.0	36.0	12.7	24.0	36.0
A												
B												
C												
D	22	22	22	24	24	24	24	24	24	24	24	24
E												
F												

TABLE ES-7
NUMBER OF LINKS PER LEVEL OF SERVICE (PM PEAK)

	1995			2000			2007			2015		
	12.7	24.0	36.0	12.7	24.0	36.0	12.7	24.0	36.0	12.7	24.0	36.0
A												
B												
C												
D	22	20	2	24	21		22	18	1	24	19	
E		2	17		3	20		4	17		5	18
F			3			4			4			6

TABLE ES-8
NUMBER OF LINKS PER LEVEL OF SERVICE (OFF PEAK)

	1995			2000			2007			2015		
	12.7	24.0	36.0	12.7	24.0	36.0	12.7	24.0	36.0	12.7	24.0	36.0
A												
B												
C	11			12			12			12		
D	11	22	11	12	24	12	12	24	12	12	24	12
E			11			12			12			12
F												

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1.0 INTRODUCTION

The purpose of this study is to identify and assess the mobility and air quality impacts of the anticipated increase in vehicle and railroad traffic at 12 existing and one future at-grade crossings in the downtown area. The analysis covers these crossings along the railroad main line from Keystone to Sutro. **Figure 1.1** shows the study elements.

The specific objectives of this study include:

- Collect, compile, and validate required data;
- Document and assess demand and growth projections for both vehicle and rail traffic for 1995, 2000, 2007 and 2015;
- Analyze vehicle queues, delays, levels of service (LOS) and air quality impacts for the street network surrounding the 13 crossings for 1995, 2000, 2007 and 2015 traffic volumes with corresponding train crossing frequencies; and
- Document and summarize findings.

The study was accomplished under the direction of the City of Reno. Current and forecast traffic volumes were obtained from various sources including Regional Transportation Commission (RTC) model runs, the City of Reno turning movement counts, Nevada Department of Transportation (NDOT) daily traffic volume counts and the Barton Aschman report on City of Reno's Downtown Traffic and Parking Study. Rail operations forecasts were obtained from the City. A database and a software program were developed to calculate the variables under various scenarios. This report includes sections on traffic volumes, railroad operation, analysis, and summary and findings.

Following this introduction, the report is organized as follows:

Section 2.0 presents existing and forecast traffic volumes to be used in delay analysis.

Section 3.0 presents rail operation and parameters assumed for this study.

Section 4.0 presents a description of the methodology employed followed by presentation of the analysis results.

Section 5.0 presents a summary of the results and findings.

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CITY OF RENO RAILROAD CROSSING TRAFFIC AND DELAY STUDY

STUDY ELEMENTS

FIGURE 1.1

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2.0 TRAFFIC VOLUMES

2.1 Baseline 1995 Traffic

Nevada Department of Transportation (NDOT) collects daily traffic count volumes annually at specific locations throughout the State including the downtown Reno area. The 1995 NDOT traffic volumes are summarized in **Tabie 2.1** and illustrated in **Figure 2.1**. As part of the validation process, peak hour turning movement counts were collected by the City of Reno. The volumes were then used to verify the NDOT counts by converting the turning movement counts to ADT volumes. Where NDOT data were unavailable, ADT volumes were derived from the City of Reno counts and verified against other sources including the Railroad Merger Fact Finding Report (March 1996).

TABLE 2.1
1995 ADT TRAFFIC VOLUMES

Arterial	ADT	1995 PEAK HOUR AND OFF PEAK VOLUMES (vph)		
		AM Peak (1)	Off Peak	PM Peak
Keystone	22,100	2,210	804	2,210
Vine	4,185	420	152	420
Washington	1,875	190	62	190
Ralston	3,785	380	126	380
Arlington	15,200	1,520	507	1,520
West	3,200	320	107	320
Sierra	19,700	1,970	657	1,970
Virginia	14,000	1,400	467	1,400
Center	11,600	1,160	387	1,160
Lake	7,575	760	252	760
Evans (2)	-	-	-	-
Morrill	300	30	10	30
Sutro	11,700	1,170	390	1,170

Note: (1) Peak period volumes were derived from ADT. AM & PM peak volumes are each assumed to be 10 percent of daily traffic volume. This value was validated using existing ADT and turning movement count volumes. The remaining volume (or off peak) was divided evenly between the remaining 22-hours.
(2) Evans does not currently cross the railroad. It is planned to have a crossing prior to the year 2000.

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1995 ADT VOLUMES

FIGURE 2.1

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Directional splits were assumed to be as shown in **Table 2.2** below. These splits were derived from existing data collected in the Surface Transportation Board (STB) Field Observation database. The data collected included 24-hour directional counts in February 1997. Average daily traffic (ADT) volumes were split into AM peak and PM peak hourly volumes by using a factor of 10 percent for each peak period. For Sierra Street and Center Street, which are one-way streets, 100 percent of the peak hour traffic volume was assigned to the arterial. Therefore the traffic volumes are twice as high in each of the peak periods for each of these two streets.

TABLE 2.2
HOURLY TRAFFIC VOLUME
SPLIT PERCENTAGE BY PEAK PERIOD

	AM Peak	Off Peak	PM Peak
Percent of ADT	0.10	0.04	0.10
Percent Northbound	0.55	0.50	0.45
Percent Southbound	0.45	0.50	0.55

Traffic is assumed to be comprised of passenger cars only. RTC volumes used to forecast future volumes have included a passenger car equivalency factor (PCE) which converts larger vehicles such as recreational vehicles and large trucks into passenger cars. In turn, this increases the total ADT volume. Not specifically including truck percentages in the vehicle fleet results in a conservative outcome. Even if PCE factors were included, the results would still be conservative. A PCE is based on how a truck performs during all types of operations (i.e., stopping, queuing, starting, and cruising) in a weighted average fashion.

2.2 Traffic Forecast

2.2.1 2000 Traffic Volumes

ADT volumes for the year 2000 were interpolated from the RTC model data for 1997 and 2007. An average growth factor was calculated for all of the crossings. This growth factor was then applied to the 1995 data for the five year period between 1995 and 2000.

As with the 1995 data, a 10 percent peak period factor was used for each of the AM and PM peaks, and then split into their directional values according to **Table 2.2**. Intersection turning movement data used in assessing the impacts of overflow of queue into adjacent intersections were provided by the City of Reno. All volumes were adjusted to produce a year 2000 count estimate by using a 2.0 percent per year growth rate. ADT volume projections for year 2000 are summarized in **Table 2.3** and illustrated in **Figure 2.2**.

TABLE 2.3
PROJECTED YEAR 2000 TRAFFIC VOLUMES

Arterial	ADT	2000 PEAK HOUR AND OFF PEAK VOLUMES (vph)		
		AM Peak (1)	Off Peak	PM Peak
Keystone	24,300	2,340	810	2,340
Vine	4,600	460	153	460
Washington	2,100	210	70	210
Ralston	4,200	420	140	420
Arlington	16,700	1,670	557	1,670
West	3,500	350	117	350
Sierra	21,700	2,170	723	2,170
Virginia	15,400	1,540	513	1,540
Center	12,800	1,280	427	1,280
Lake	8,300	830	277	830
Evans	13,380	1,340	490	1,340
Morrill	300	30	11	30
Sutro	12,900	1,290	488	1,290

Note: (1) Peak period volumes were derived from ADT. AM & PM peak volumes are each assumed to be 10 percent of daily traffic volume. This value was validated using existing ADT and turning movement count volumes. The remaining volume (or off peak) was divided evenly between the remaining 22-hours.

2.2.2 2007 Traffic Volumes

Year 2007 traffic volumes were estimated using a one percent growth rate per year estimated from 2007 and 2015 RTC model data. The average one percent per year growth rate was then applied to the 2000 data. A peak period split of 10 percent of the ADT volume for the one-hour AM and one-hour PM peak period was used. The remaining ADT volume was divided evenly across the remaining 22-hours and used as the off peak volumes. ADT volumes and peak one-hour volumes are summarized in **Table 2.4**, and illustrated in **Figure 2.3**.

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2000 ADT VOLUMES

FIGURE 2.2

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TABLE 2.4
PROJECTED YEAR 2007 TRAFFIC VOLUMES

Arterial	ADT	2007 PEAK HOUR AND OFF PEAK VOLUMES (vph)		
		AM Peak (1)	Off Peak	PM Peak
Keystone	26,000	2,600	945	2,600
Vine	4,920	490	179	490
Washington	2,250	225	82	225
Ralston	4,490	450	163	450
Arlington	17,870	1,790	650	1,790
West	3,745	375	136	375
Sierra	23,220	2,320	844	2,320
Virginia	16,500	1,650	600	1,650
Center	13,700	1,370	500	1,370
Lake	8,880	890	323	890
Evans	14,320	1,430	520	1,430
Morrill	300	30	11	30
Sutro	13,800	1,380	500	1,380

Note: (1) Peak period volumes were derived from ADT. AM & PM peak volumes are each assumed to be 10 percent of daily traffic volume. This value was validated using existing ADT and turning movement count volumes. The remaining volume (or off peak) was divided evenly between the remaining 22-hours.

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CITY OF RENO RAILROAD CROSSING TRAFFIC AND DELAY ANALYSIS

2007 ADT VOLUMES

FIGURE 2.3

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2.2.3 2015 Traffic Volumes

After estimating year 2007 traffic volumes, a one percent per year average growth rate was applied to the 2007 data to estimate the year 2015 data. **Table 2.5** summarizes the peak hour and ADT volume estimates. Peak hour splits from the AM and PM peaks were considered to be 10 percent of the ADT volumes, as assumed in all other years. Directional splits shown previously in **Table 2.2** were used to breakdown traffic volume data into northbound and southbound movements. ADT volumes are illustrated in **Figure 2.4**.

TABLE 2.5
PROJECTED YEAR 2015 TRAFFIC VOLUMES

Arterial	ADT	2015 PEAK HOUR AND OFF PEAK VOLUMES (vph)		
		AM Peak (1)	Off Peak	PM Peak
Keystone	28,000	2,800	1,020	2,800
Vine	5,320	532	193	532
Washington	2,430	243	88	243
Ralston	4,850	485	180	485
Arlington	19,300	1,930	700	1,930
West	4,050	400	150	400
Sierra	25,000	2,500	910	2,500
Virginia	17,800	1,780	650	1,780
Center	14,800	1,480	540	1,480
Lake	9,500	950	350	950
Evans	15,500	1,550	540	1,550
Morrill	300	30	11	30
Sutro	14,900	1,490	540	1,490

Note: (1) Peak period volumes were derived from ADT. AM & PM peak volumes are each assumed to be 10 percent of daily traffic volume. This value was validated using existing ADT and turning movement count volumes. The remaining volume (or off peak) was divided evenly between the remaining 22-hours.

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CITY OF RENO RAILROAD CROSSING TRAFFIC AND DELAY ANALYSIS

2015 ADT VOLUMES

FIGURE 2.4

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3.0 RAIL OPERATION

3.1 Train Speed

For both the pre-merger and post-merger, train speed is assumed to be 20 miles her hour. This speed will be for eastbound as well as westbound. The maximum allowable speeds in the downtown Reno are 25 mph for freight trains and 30 mph for passenger trains.

3.2 Train Length

An average post-merger train length of 6,500 feet was used for this analysis.

3.3 Number of Trains

The train counts for pre-merger is 12.7 SP trains per day and 1.1 passenger trains per day. The post-merger train counts will include 20 UP/SP trains, 4 BN/Santa Fe trains, and 1.1 passenger trains. For this report's analysis, 12.7 trains per day was used for pre-merger and 24 trains per day for post-merger at year 2000. **Table 3.1** shows 1995 and 2000 train crossing splits.

TABLE 3.1
1995 AND PROJECTED FUTURE AVERAGE
DAILY TRAIN VOLUMES THROUGH RENO

Source of Train	Number of Trains		
	1995 [1]	Projected for Five Years Following UP/SP Merger [2]	Increase
Amtrak [3]	1.1	1.1	0.0
Burlington Northern / Santa Fe	0.0	4.0	4.0
Union Pacific/Southern Pacific	12.7	20.0	7.3
Daily Total	13.8	25.1	11.3

Notes: [1] Based on train statistics provided by UP/SP.
[2] Based on UP/SP Operating Plan and verified statements filed with the Surface Transportation Board. 1995 & 1996
[3] Amtrak train operations are not under the jurisdiction of the Surface Transportation Board

3.4 Distribution of Trains over 24 Hours of the Day

The STB database provides detailed information on train arrivals and type of trains over a 24-hour period. The data were collected for seven days. The number of trains per peak period were determined for each day of observation. Based on the average train arrivals across a seven day period, the percent of trains per peak were determined. The distribution shown in **Table 3.2** was used for all scenarios.

TABLE 3.2
DISTRIBUTION OF TRAINS PER PEAK HOUR

	% of Total Daily Trains	Trains Per Day		
		12	24	36
AM Peak	0.08	1	2	3
PM Peak	0.17	2	4	8
Off Peak	0.75	9.7	18	25
Total	1.00	12.7	24.0	36.0

4.0 ANALYSIS

This section presents the analysis of mobility impacts associated with the interaction of trains and roadway vehicles at the railroad grade crossings in the downtown area. Four specific topics have been investigated.

- Grade Crossing Delay
- Queuing Analysis
- Level of Service
- Air Quality Analysis

Taken as a set, these parameters provide a basis for characterizing highway system mobility and air quality in the vicinity of the crossings.

Analysis of each of these parameters has been accomplished for each of the 13 crossings in the study area, for each time frame under consideration. The scenarios analyzed in this report are shown below. The roadway traffic and rail forecasts which were presented in **Section 2.0**, along with additional data obtained as part of the data collection effort, were used as a basis for the analysis. This section summarizes the methodologies and the analysis.

	1995	2000	2007	2015
12.7	√	√	√	√
24.0	√	√	√	√
36.0	√	√	√	√

4.1 Methodologies

4.1.1 Grade Crossing Delay

The methodology incorporated in this analysis is based upon the Queuing Theory as suggested in the 1982 edition of Traffic Engineering Handbook (Institute of Transportation Engineers, 2nd Edition, 1982, pp. 465-468) and is based upon the following principal factors affecting operations at grade crossings:

- Gate Blockage Time
- Vehicle Arrival Rate
- Vehicle Departure Rate

Gate Blockage Time

Gate Blockage is the total time consumed by a single crossing gate activation event and theoretically consists of the total of the following times.

- Lead Time - Required legal 20 seconds advance warning time plus time to begin lowering crossing gate — typically 8 seconds
- Train Passage Time - Time for train to pass through the crossing — equal to train length divided by speed
- Clearance Time - Time for train followed by a 50 foot clearance zone to clear the cross street roadway — also computed from distance and train speed
- Lag Time - Time to raise gate and commence dispersion of queue following train passage — typically 8 seconds

Gate blockage time was observed for a period of 5 days and documented for the crossings at Keystone, Arlington, Sierra, Virginia, and Center and the theoretical gate blockage time was adjusted to account for actual observation. For other locations, calculations were made taking into account the items described above. An average of 222 seconds (3.7 minutes) per train crossing was used.

Arrival Rate

The vehicular arrival rate is dependent upon the roadway traffic level and it is calculated as the average arrival rate during the analysis time periods. For example, for the morning 2-hour peak period with a total of 2400 vehicles, the arrival rates is 20 vehicles/minute.

Departure Rate

As the vehicular arrival rate varies in accordance with the overall traffic level on the street, following a crossing gate activation there is a queue of vehicles waiting to cross. Therefore, these vehicles will have a higher departure rate than arrival rate once the crossing clears. This queue dispersion is similar to what occurs when vehicles enter an intersection once a signal turns from red to green. This rate (for a level crossing in good condition having a low-to-moderate truck percentage) is about one vehicle every 2.5 seconds, or 48 vehicles per minute for a 4-lane roadway. The presence of higher levels of heavy vehicles in the traffic stream adversely affects this rate, as does grade (elevation) changes or poor roadway crossing condition (i.e., smoothness). For this analysis, the departure rate of one vehicle every 2.5 seconds was used.

Vehicle Hours of Delay

Once the gate blockage time, arrival and departure rates are established, the vehicle hours of delay parameter is computed by the following formula:

$$T = T_g^2 * q / (2 * (1 - q/d)) / 60$$

Where:

T - Delay (vehicle-hours)

T_g - Gate Blockage Time (minutes)

q - Vehicle Arrival Rate (vehicles/minute)

d - Vehicle Departure Rate (vehicle/minute)

The above equation indicates the computations necessary to characterize the gate blocking time and vehicle delay for a single train passage. In order to apply the methodology, total gate blockage and vehicle-hours of delay were computed separately for each of the three time periods during the day: AM peak, PM peak, and off peak. For the AM peak and PM peak one-hour peak periods were selected. The one-hour peak periods used in this chapter are:

- AM Peak: 7 - 8 AM
- PM Peak: 5 - 6 PM

All other volume was evenly distributed across a 22-hour period. Once delay for each peak period was calculated for each train crossing occasion, the delay was then multiplied by the number of train crossings during the three periods.

Total peak period delay = Delay per Train Crossing * Number of Train Crossings in Peak Period.

Total daily delay is therefore equivalent to the sum of the delays for all peak period.

These vehicular flow parameters, including total gate downtime, were evaluated against the mix of trains projected to be present at each crossing. The train-related parameters obtained from the empirical data included:

- Train Length
- Train Speed
- Period of Operation
- Total Number of Trains/day

Additional Delay due to Overflow of the Queue Through Adjacent Intersections

For this analysis, it was necessary to evaluate the impacts of queue due to the railroad crossing which overflowed into the adjacent intersections. When overflow occurred, the additional volume was added to the existing intersection turning movement volumes. Cycle lengths and green splits for each of the adjacent intersections were used to determine the additional delay. In order to determine how many cycles it will take to clear a queue, the number of vehicles that will proceed through the intersection per cycle had to be determined:

Vehicles per Green = Green Time per Cycle * Approach Flow Rate

If all vehicles were not cleared on the first cycle, then the remaining vehicles would be forced to wait through another complete cycle. Total delay to the all vehicles remaining in queue would therefore be,

Delay per Cycle = Red Time per Cycle * Vehicles Remaining in Queue

Delay continues to be calculated until all vehicles initially in the queue are cleared. The total delay due to the intersection is then added to the total delay due to vehicles in queue. It should be noted that during

queue dissipation, arriving vehicles are joining the back of the queue and experiencing delay. Those vehicles' delay was assumed as part of normal intersection delay. As normal intersection delay will not change, it was not considered as part of this analysis. Total intersection is the sum of the delay per cycle until the queue clears. It can be calculated as follows:

Total Delay = Number of Vehicles Through Intersection during 1st Cycle * Delay per Vehicle per Cycle +
Number of Vehicles Through Intersection during 2nd Cycle * Delay per Vehicle per Cycle * 2 +
Number of Vehicles Through Intersection during 3rd Cycle * Delay per Vehicle per Cycle * 3 +
etc...

When the number of vehicles in queue is fewer than the number of vehicles through the intersection during the green phase, then the queue is determined to have cleared. Total delay is the sum of the delays to all vehicles in queue until the queue clears.

4.1.2 Queuing Analysis

Queuing has been computed based upon multiplying the vehicular arrival rate by the time over which queuing developed. In other words:

$N = q * T$

Where:

N - Number of vehicles in queue (average)

q - Vehicle arrival rate (vehicle/minute)

T - Elapsed time of queue formation (minutes)

The total length of queue is then estimated at 20 feet per vehicle divided by the number of lanes, and this distance is compared to the length available for storage.

For queuing purposes, the one-hour peak AM and PM hour volumes were considered, since the greatest queues will occur during these one-hour peaks. It should also be pointed out that the queues which have been identified are based upon average arrival rates specified in **Section 4.1.1**. Variation of flow within the peak hours will invariably lead to somewhat higher queues during varying times of the day. However, as roadway flow increases, the queuing variation in the peak diminishes.

4.1.3 Level of Service

Roadway and Arterial Levels of Service

Roadway level of service (LOS) is based on *average through-vehicle traffic speed* for the segment, or entire roadway under consideration. The average travel speed is computed to the segment considering the total stopped delay for through movements.

Arterial level of service, by contrast, is defined in terms of *average travel speed* of all through vehicles on the arterial. It is strongly influenced by the average delay on that segment. On a given facility, increasing traffic flow can substantially degrade the arterial level of service.

The following general statements may be made regarding arterial level of service.

1. *LOS A* describes primarily free-flow operations at average travel speed, usually about 90 percent of the free-flow speed for the arterial classification. Vehicles are completely unimpeded in their ability to maneuver within the traffic stream. Stopped delay at signalized intersections or other locations is minimal.

2. *LOS B* represents reasonably unimpeded operations at average travel speeds, usually about 70 percent of the free-flow speed for the arterial classification. The ability to maneuver within the traffic stream is only slightly restricted and stopped delays are not bothersome. Drivers are not generally subjected to appreciable tension.

3. *LOS C* represents stable operations; however, ability to maneuver and change lanes in mid-block locations may be more restricted than at LOS B, and longer queues, adverse signal coordination, or both may contribute to lower average travel speed of about 50 percent of the average free-flow speed for the arterial classification. Motorists will experience appreciable tension while driving.

4. *LOS D* borders on a range in which small increases in flow may cause substantial increases in delay and hence decreases in arterial speed. LOS D may be due to adverse signal progression, inappropriate signal timing, high volumes, or some combination of these factors. Average travel speeds are about 40 percent of free-flow speed.

5. *LOS E* is characterized by significant delays and average travel speed of one-third the free-flow speed or less. Such operations are caused by some combination of adverse progression, high signal density, high volumes, extensive delays at critical intersections, and inappropriate signal timing.

6. *LOS F* characterizes arterial flow at extremely low speed below one-third to one-fourth of the free-flow speed. Intersection congestion is likely at critical signalized locations, with high delays and extensive queuing. Adverse progression is frequently a contributor to this condition.

Table 4.1 contains the arterial average speeds associated with these six arterial LOS definitions based on average travel speed over the arterial segment being considered. It should be noted that if demand volume exceeds capacity at any point on the facility, average travel speed may not be a good measure of the arterial level of service. Thus, intersection volume-to-capacity ratios greater than 1.0 will probably result in a unacceptable level of service on the arterial. The arterial classifications in **Table 4.1** are explained in **Table 4.2**.

Impact of Train Crossing on Level of Service

For this analysis, level of service for each arterial was evaluated for both a train crossing and no train crossing condition. When the train crosses an arterial link, the level of service for the link approaches F as the speed on the arterial approaches zero. After the train leaves the crossing, the level of service returns to normal. Level of service was therefore calculated for the worst case scenario, that all trains expected

to arrive during the peak period will arrive during the peak one-hour period. To determine the level of service with the crossing, the average speed along the arterial was broken into two components:

$$\text{Average Speed (during train)} = (\text{Gate Crossing Speed} * (\frac{\text{Gate Crossing Time} * \text{Number of Crossings}}{3600})$$

$$\text{Average Speed (without train)} = \text{Arterial Speed} * (3600 \text{ sec} - \frac{(\text{Gate Crossing Time}) * \text{Number of Crossings}}{3600})$$

The total average speed is equivalent to:

Average Speed = Average Speed (during train) + Average Speed (without train)

Average Speed is therefore calculated in feet per second.

Once the average speed is calculated, the level of service for the arterial can be estimated using the methodology previously described and shown in **Table 4.1** below.

TABLE 4.1
ARTERIAL LEVELS OF SERVICE

ARTERIAL CLASSIFICATION			
	I	II	III
Range of free-flow speeds (mph)	45 to 35	35 to 30	35 to 25
Typical free-flow speeds (mph)	40	33	27
Level of Service	**Average Travel Speed (MPH)**		
A	≥ 35	≥ 30	≥ 25
B	≥ 28	≥ 24	≥ 19
C	≥ 22	≥ 18	≥ 13
D	≥ 17	≥ 14	≥ 9
E	≥ 13	≥ 10	≥ 7
F	< 13	< 10	< 7

TABLE 4.2
ARTERIAL CLASSIFICATIONS ACCORDING TO FUNCTIONAL AND DESIGN CATEGORIES

FUNCTIONAL CATEGORY		
Design Category	**Principal Arterial**	**Minor Arterial**
Typical Suburban	I	II
Intermediate	II	II or III
Typical Urban	I or II	III

Intersection Congestion Levels

The performance of intersections is measured through analysis of capacity and level of service. **Table 4.3** describes LOS definitions for signalized intersections.

Capacity is the maximum flow rate of traffic which can pass through an intersection under prevailing conditions, and is evaluated in terms of volume to capacity (v/c) ratio. Values for v/c ratio can be from 0.00 (no volume) to 1.00 (when flow rate equals capacity). Actual v/c ratio cannot exceed 1.00, although the ratio of future projected demand to capacity can exceed 1.0. For present conditions, the volume (number) is the actual measured output of the intersection, not the input volume levels on the approaches to the intersection. However, for future conditions, the demand levels for each movement (i.e., approach volume) is the numerator, and can be higher than the capacity (demand). Where the v/c ratio exceeds 0.90 to 0.95, changes in geometric or signal design should be considered.

LOS is used as a measure of effectiveness for the quality of traffic flow through an intersection. It is similar to a "report card" rating, based on average vehicle delay. Level of service A, B and C indicate conditions where vehicles move freely. Level of service D and E are progressively worse. For signalized intersections, level of service F represents conditions where the average delay for all vehicles through the intersection exceeds 60 seconds per vehicle, generally indicated by long queues and delays. Under this operating condition, delay is highly variable, and it is difficult to estimate average delay accurately because congestion extends into and is affected by adjacent intersections.

While the signalized LOS is based on average delay, a high v/c ratio (i.e. greater than 0.90) can also be indicative of poor intersection performance. In cases where oversaturation occurs (i.e., high v/c ratio), queuing and delays can be substantial and lane blockages or turn lane storage problems can exacerbate operating problems. Therefore, queuing conditions and staking needs must also be evaluated for existing and future conditions.

TABLE 4.3
LEVEL OF SERVICE DEFINITIONS
SIGNALIZED INTERSECTIONS

Level of Service	Vehicle Delay (secs.)	Volume to Capacity Ratio	Description
A	≤5.00	0.00 - 0.60	**Free Flow/Insignificant Delays:** No approach phase is fully utilized by traffic and no vehicle waits longer than one red indication.
B	5.1 - 15.0	0.61 - 0.70	**Stable Operation/Minimal Delays:** An occasional approach phase is fully utilized. Many drivers begin to feel somewhat restricted within platoons of vehicles.
C	15.1 - 25.0	0.71 - 0.80	**Stable Operation/Acceptable Delays:** Major approach phases fully utilized. Most drivers feel somewhat restricted.
D	25.1 - 40.0	0.81 - 0.90	**Approaching Unstable/Tolerable Delays:** Drivers may have to wait through more than one red signal indication. Queues may develop but dissipate rapidly, without excessive delays.
E	40.1 - 60.0	0.91 - 1.00	**Unstable Operation/Significant Delays**: Volumes at or near capacity. Vehicles may wait though several signals cycles. Long queues from upstream from intersection.
F	≥61.0	1.01 - up	**Forces Flow/Excessive Delays:** Represents jammed conditions. Intersection operates below capacity with low volumes. Queues may block upstream intersections and will "build" rather than stay constant.

Source: *Highway Capacity Manual*, Transportation Research Board, Special Report No. 209, Washington D.C., 1994; and *Circular 212*, Transportation Research Board, 1980.

4.1.4 Air Quality Analysis Related to Vehicular Traffic

The air quality impact related to train crossing as a result of additional stop delay to vehicular traffic only is estimated here using the Modified Winfrey Method (MWM). The MWM is recommended as an appropriate air quality model by various Transportation and Air Quality professionals for estimating the emissions benefit of localized TSM projects. The model can be applied to a specific arterial or area-wide as required for the project. This model has been validated using the Federal Emission Reduction Calculation Methodology. The procedure adopted for this project to estimate air quality impact is the best approximation available at this time. The MWM formula for estimating the air quality impact is described below.

Modified Winfrey Method

$$C_t = [\{ N_{sv} * (T_d * C_d) + T_a * C_a) \} = \{ (T_{iv} * C_{iv}) + (T_{cv} * C_{cv}) \}] V * 260$$

Where,

C_t = Total emissions (grams/year)

N_{sv} = Number of stops per vehicle (stops/vehicle)

T_d = Average time for deceleration (second/stop)
C_d = The emission factor for deceleration (grams/second)

T_a = Average time for acceleration (second/stop)
C_a = The emission factor for acceleration (grams/second)

T_{iv} = Average idle time (seconds/vehicle)
C_{iv} = The emission factor for idling (grams/second)

T_{cv} = Average cruise time 9 seconds/vehicle
C_{cv} = The emission factor for cruising (grams/second)

V = Total traffic volume incurring delay during peak period

260 = Number of commuting days per year

Air Quality Input Data

The majority of the data required for estimating the total emissions using the MWM were collected as part of the data gathering process described earlier, and the remaining rates for calculations of emissions are obtained from **Table 4.4**.

The following briefly describes the use of MWM in estimating the total emissions using field data and the emission rates in **Table 4.4**.

N_{sv} = Number of stops per vehicle (stops/vehicle) in the test section

T_d = Average time for deceleration (second/stops) = 7.09 seconds
C_d = The emission factor for deceleration

T_a = Average time for acceleration (second/stop) = 7.50 seconds
C_a = The emission factor for acceleration

T_{iv} = Average idle time along route (seconds/vehicle)

C_{iv} = The emission factor for idling

T_{ev} = Average cruise time (seconds/vehicle) = [Average total time - (Average acceleration time + Average deceleration time + Average idle time)]

C_{cv} = The emission factor for cruising

V = Total volume incurring delay (peak period)

Table 4.4 shows the emission factors used in estimating emissions of CO, NO_x and ROG.

TABLE 4.4
CONSTANT ENGINE EMISSION FACTORS FOR MWM

Condition	CO (gr./sec.)	NO_x (gr./sec.)	ROG (gr./sec.)	Time (sec.)
Idle	0.00191	0.00124	0.0012	
Cruise	0.00488	0.00945	0.00334	
Acceleration	0.06781	0.02178	0.01155	7.5
Deceleration	0.00177	0.00256	0.00119	7.09
gr. = grams; sec. = seconds Source: Texas Transportation Institute. "An Emission Model for Arterial Streets." 1992				

The air quality impacts are estimated by the software program using the traffic and air quality data which are already incorporated in the program. No air quality data input is required in estimating the air quality impacts.

4.2 Analysis Results

4.2.1 Grade Crossing Delay

Arterial Delay

The measurement of delay is broken into two parts, delay due to the time the gate is down and delay during the dissipation of a queue. The additional delay due to overflow of the queue through adjacent intersection is discussed later in this section. **Figure 4.1** is a graphical representation of the delay model utilized in determining total delay. The area below the arrival rate curve, which is shaded in, represents the total delay for all vehicles. In more practical terms, the total delay is the sum of the individual delays computed for each vehicle impacted per train crossing.

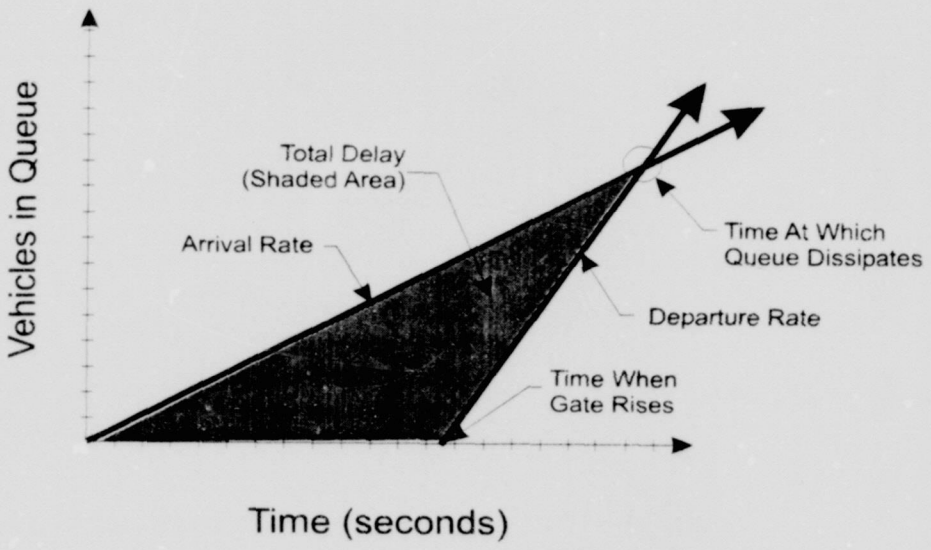


Figure 4.1 - Queue Theory, Graphical Representation

In 1995, total daily delay is estimated to be 155 hours with 12.7 trains per day. With an increase to 24.0 trains per day, total delay increases to 294 hours, an 89 percent increase over the 12.7 trains per day scenario. When 36.0 trains per day occur, total daily delay increases to 438 hours, 193 percent increase over the 1995 delays. Total daily delays for all scenarios are summarized in **Table 4.5** and **Figures 4.2** through **4.5**.

With traffic volume growth alone, total daily delay for all scenarios (12.7, 24.0 and 36.0) in year 2000 will increase by 26 percent over 1995 delays. For 12.7 trains per day, total daily delay is expected to be 195 hours. With the increase from 12.7 to 24.0, total daily increases to 367 hours. Total daily delay for 36.0 trains per day is estimated to be 551 hours in 2000.

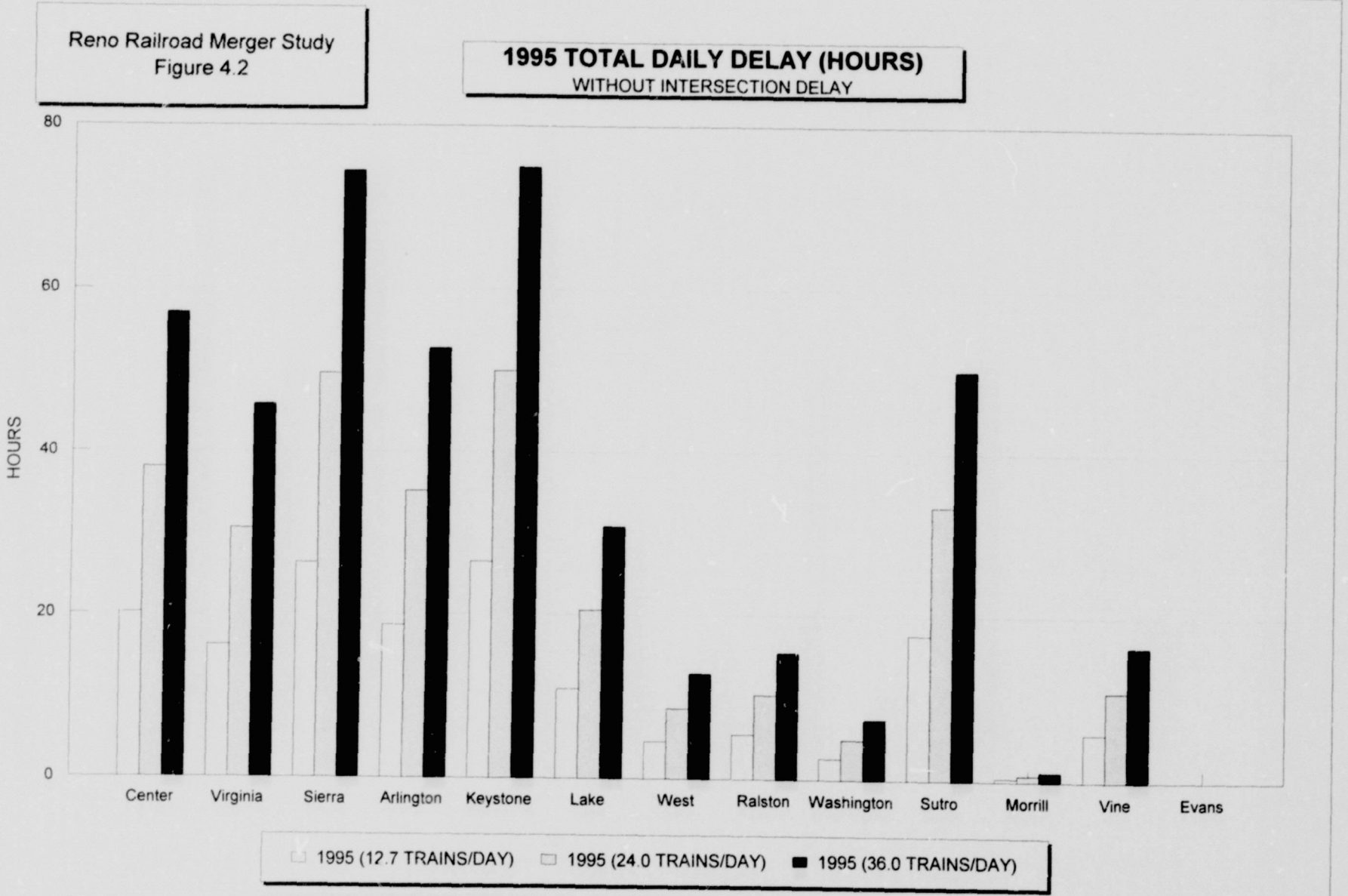
Total daily delay for year 2007 is expected to increase by 32 percent for all three scenarios over the 1995 total daily delays. Total daily delay for the 12.7 and 24.0 train scenarios are 212 and 400 hours respectively. With the increase to 36.0 trains per day, the total daily delay increases to 597 hours.

In the [illegible] scenario, the total daily delay for 2015 is estimated to be 50 percent greater than 1995 values with total daily delays of 232, 441, and 661 hours for 12.7, 24.0 and 36.0 trains per day, respectively.

TABLE 4.5
TOTAL DAILY DELAY PER CROSSING HOURS
NOT INCLUDING INTERSECTION DELAY

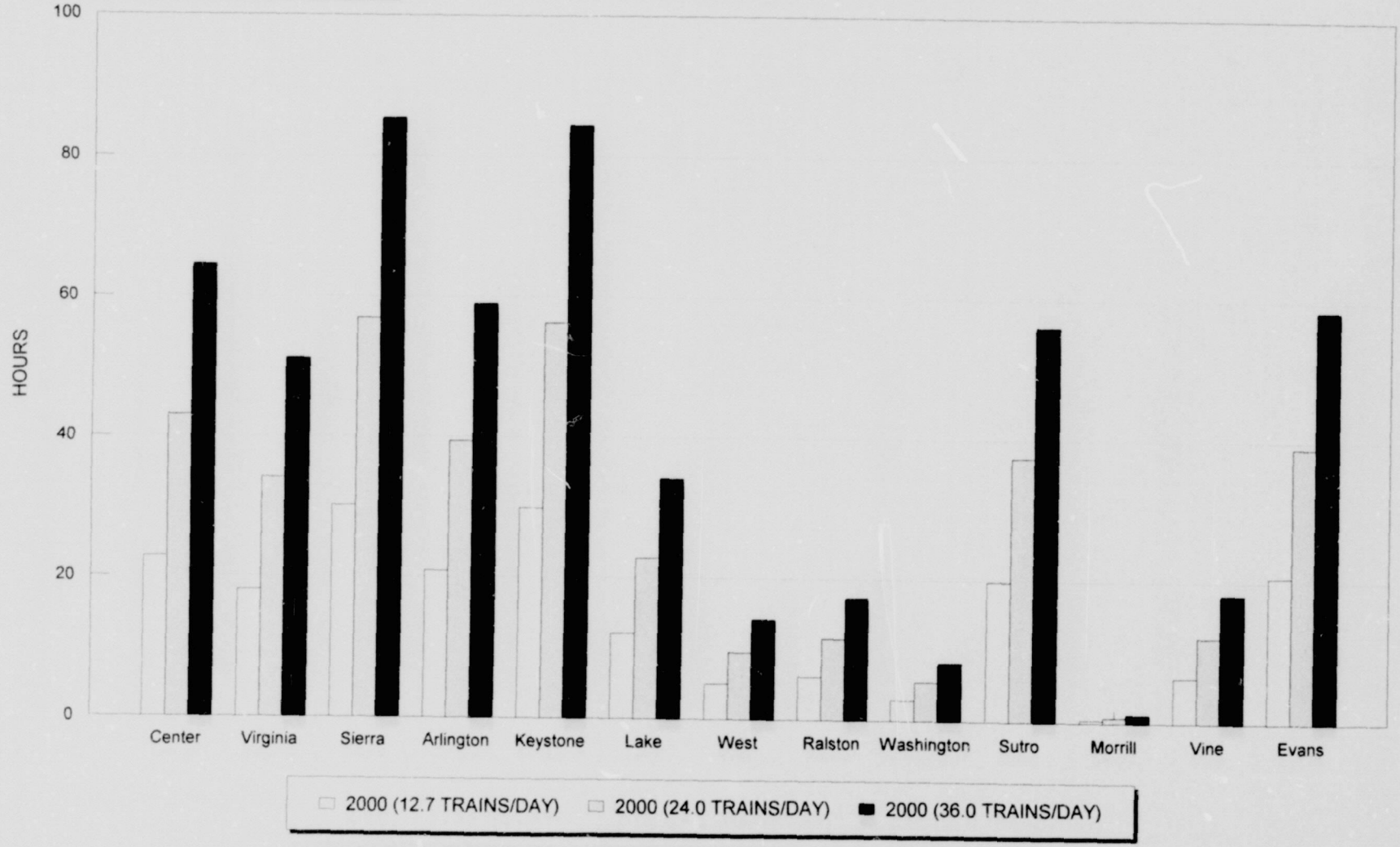
	1995			2000			2007			2015		
	12.7 Trains per day	24.0 Trains per day	36.0 Trains per day	12.7 Trains per day	24.0 Trains per day	36.0 Trains per day	12.7 Trains per day	24.0 Trains per day	36.0 Trains per day	12.7 Trains per day	24.0 Trains per day	36.0 Trains per day
Keystone	26	50	75	30	56	84	33	61	92	36	68	102
Vine	6	11	16	6	12	18	7	13	19	7	14	21
Washington	3	5	7	3	5	8	3	6	9	3	6	9
Ralston	5	10	15	6	12	17	7	12	19	7	14	21
Arlington	19	35	53	21	39	59	23	43	64	25	47	70
West	5	9	13	5	9	14	5	10	15	6	11	17
Sierra	26	50	74	30	57	85	33	63	94	38	71	107
Virginia	16	31	46	18	34	51	20	37	55	21	41	61
Center	20	38	57	23	43	65	25	47	70	27	51	76
Lake	11	21	31	12	23	34	13	25	37	14	27	40
Evans	--	--	--	21	39	59	22	41	61	24	46	69
Morrill	0	1	1	0	1	1	0	1	1	0	1	1
Sutro	18	33	50	20	37	56	21	41	61	24	44	67
Total	155	294	438	195	367	551	212	400	597	232	441	661

Reno Railroad Merger Study
Figure 4.2

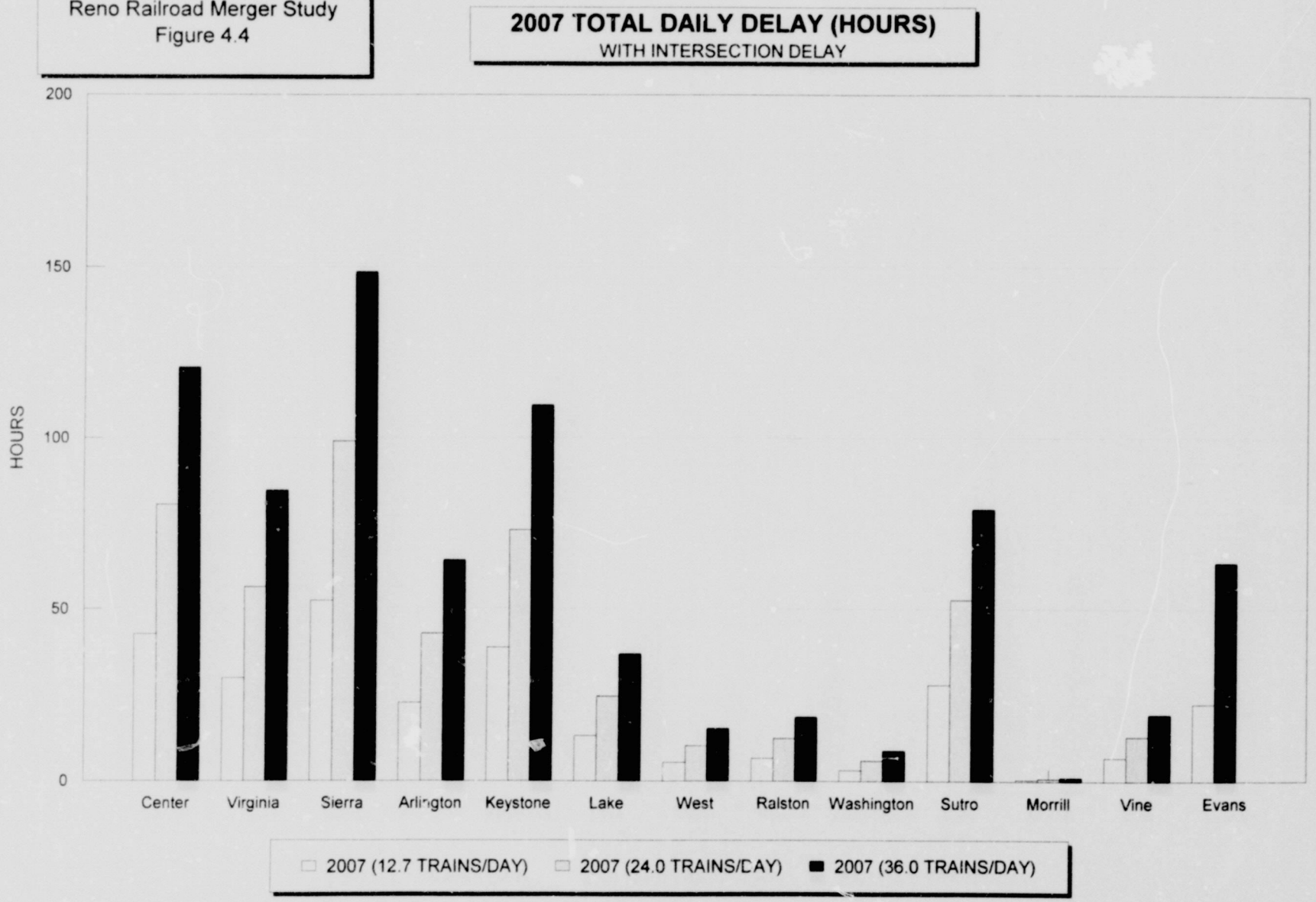


Reno Railroad Merger Study
Figure 4.3

2000 TOTAL DAILY DELAY (HOURS)
WITHOUT INTERSECTION DELAY



Reno Railroad Merger Study
Figure 4.4



Intersection Delay

Where queues exceed the available capacity and vehicles overflow into the adjacent intersections, total delays along the arterial and at the intersection increase. **Tables 4.6** shows which intersections will be impacted by the queue. In both 1995 and 2000, six intersections are expected to be impacted. Delays at all intersections are expected to be 60 seconds per vehicle per cycle, for all vehicles impacted by the queue. In 2007 and 2015, no additional intersections will be impacted, however at the intersections of 2nd/Virginia and 2nd/Center, the off peak will become impacted due to the increase in traffic volume during the off peak. For all crossings, the total number of vehicles and total intersection delay will increase, as shown in **Tables 4.7** and **4.8**.

Total Daily Delay Including Intersection Delay

The total daily delay is therefore equivalent to the arterial delay plus the added delay due to overflow at the intersections. The total delays are summarized in **Table 4.9**. As shown in the table, the total delay in 1995 for 12.7 trains per day is expected to be 188 hours, an increase of 21 percent resulting in the increase in delay from the intersection analysis. With the increase to 24 trains per day, the total daily delay increases to 360 hours per day, which is 91 percent greater than the delay for 12.7 trains per day. In turn, the total delay for the 36 trains per day scenario is expected to be 539 hours, an increase of 188 percent over the 12.7 train scenario.

Total delay in the year 2000 with including the delay due to both arterial and intersection impacts is expected to be 34 percent greater than the 1995 values for all scenarios. For 2007, the increase over 1995 is expected to be 44 percent. The greatest increase in total delay will occur in the 36 trains per day scenario where the total daily delay for all crossings is expected to be 46 higher for all scenarios.

Reno Railroad Merger Study
Figure 4.5

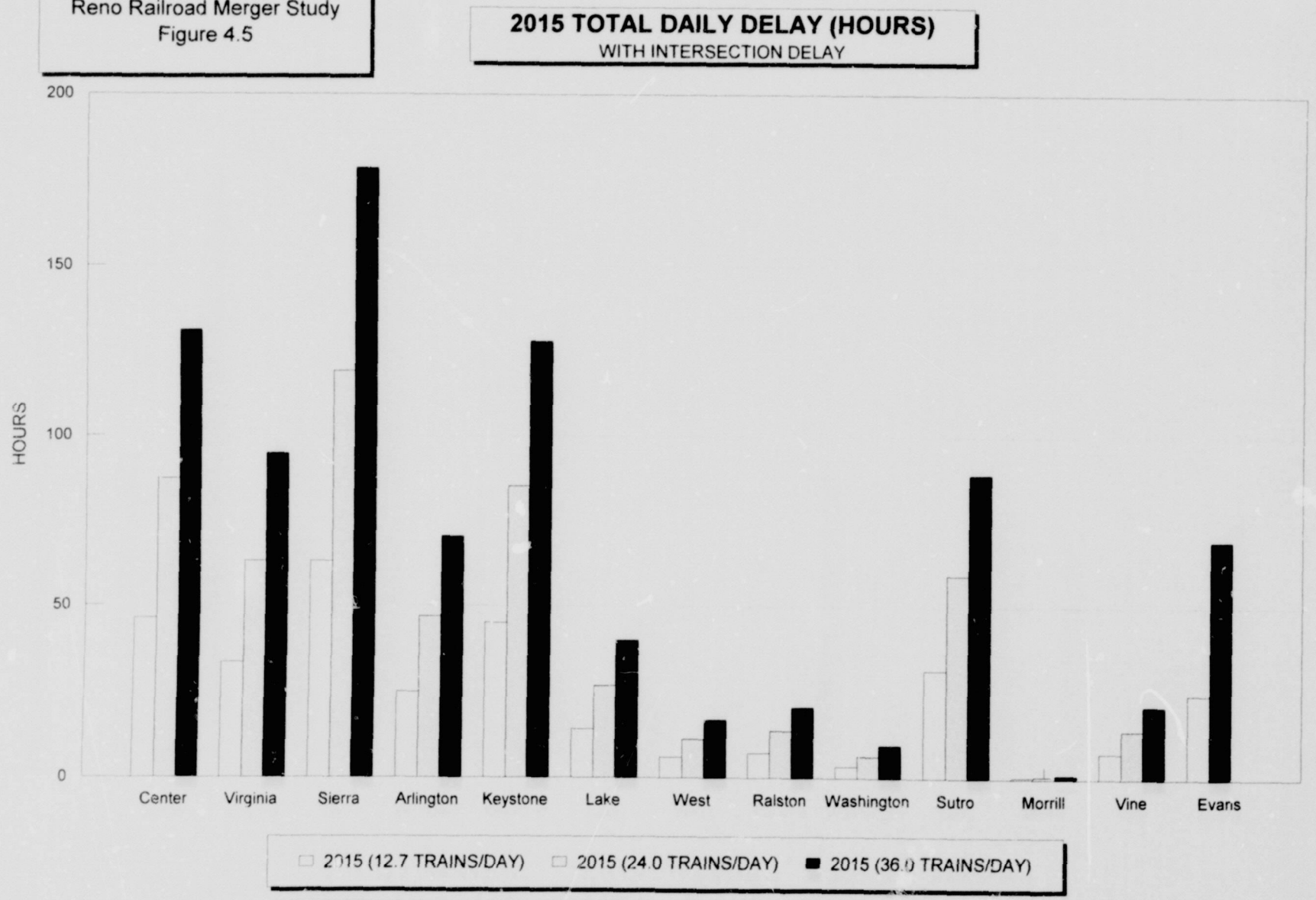


TABLE 4.6
INTERSECTIONS IMPACTED BY QUEUE OVERFLOW

	1995			2000			2007			2015		
	AM Peak	PM Peak	Off Peak	AM Peak	PM Peak	Off Peak	AM Peak	PM Peak	Off Peak	AM Peak	PM Peak	Off Peak
2nd / Keystone												
2nd / Ralston												
2nd / Arlington												
2nd / West												
2nd / Virginia	X	X		X	X		X	X	X	X	X	X
2nd / Center	X	X		X	X		X	X	X	X	X	X
2nd / Lake												
2nd / Evans												
Commercial Row / Sutro	X	X		X	X		X	X		X	X	
4th / Keystone	X	X		X	X		X	X		X	X	
4th / Vine												
4th / Ralston												
4th / Arlington												
4th / West												
4th / Sierra	X	X	X	X	X	X	X	X	X	X	X	X
4th / Virginia	X	X	X	X	X	X	X	X	X	X	X	X
4th / Lake												
4th / Evans												
4th / Sutro												

TABLE 4.7
TOTAL INTERSECTION DELAY PER TRAIN CROSSING
DUE TO OVERFLOW OF QUEUE (HOURS)

	1995		2000		2007		2015	
	AM	PM	AM	PM	AM	PM	AM	PM
2nd/Virginia	0.4	0.5	0.7	0.7	0.9	0.9	1.1	1.1
2nd/Center	1.0	5.6	1.6	6.6	1.9	7.4	2.1	8.0
Commercial Row/ Sutro	2.0	0.9	2.6	1.2	3.0	1.5	3.5	2.0
4th/Keystone	0.4	0.5	0.6	2.0	0.9	2.4	2.2	3.1
4th/Sierra	5.6	5.7	6.5	6.6	3.6	7.2	7.8	8.1
4th/Virginia	0.6	2.1	0.8	1.0	1.0	3.0	1.1	3.4

TABLE 4.8
OVERFLOW INTO ADJACENT INTERSECTION PER RAIL CROSSING
(VEHICLES PER LANE)

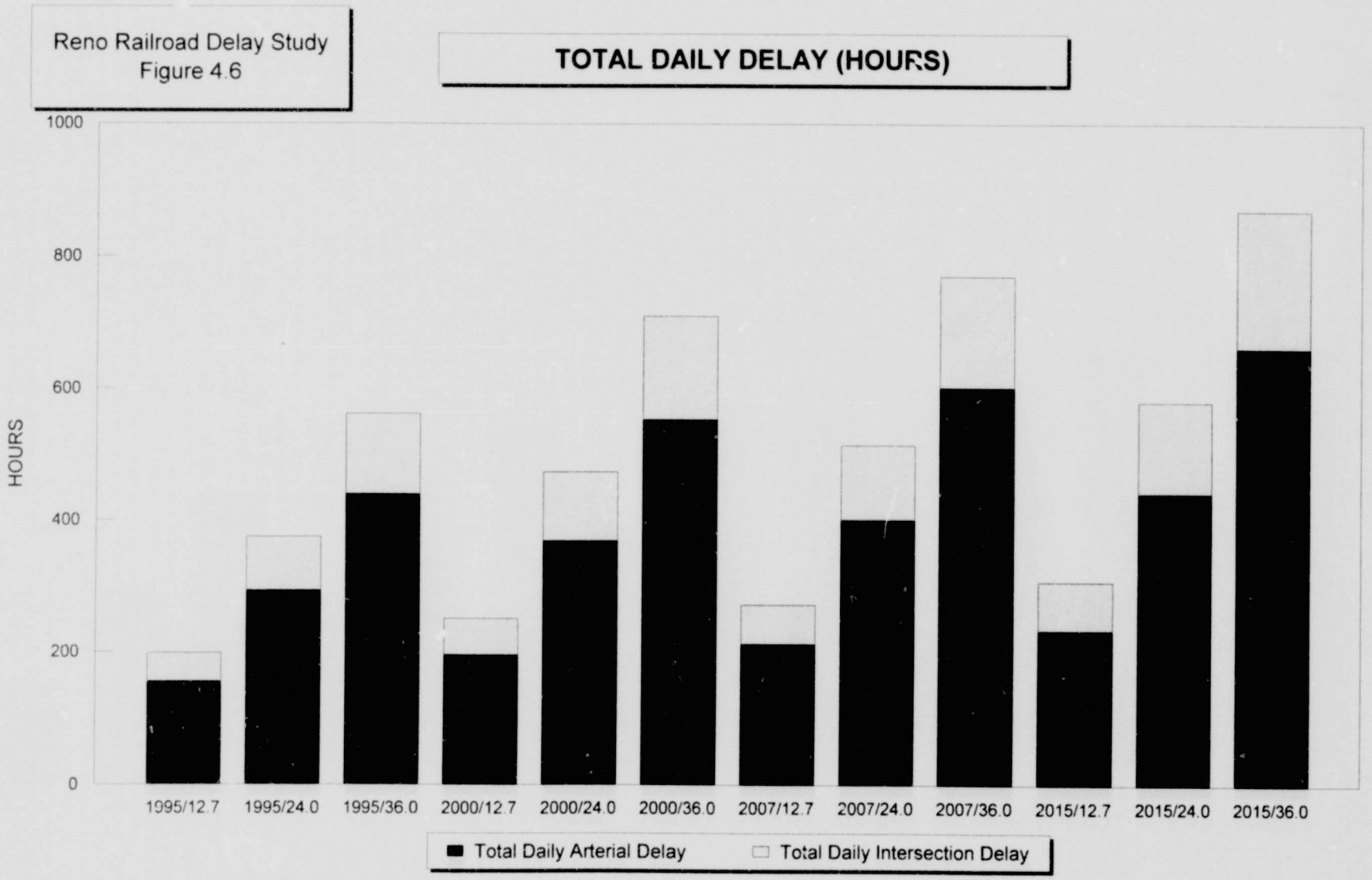
	1995			2000			2007			2015		
	AM	PM	OFF PEAK	AM	PM	OFF PEAK	AM	PM	OFF PEAK	AM	PM	OFF PEAK
2nd/Virginia	12	12		16	17		20	20	2	24	25	5
2nd/Center	17	59		23	69		27	77	1	31	83	3
Commercial Row/ Sutro	29	17		36	23		41	27		47	32	
4th/Keystone	11	30		17	38		22	45		28	53	
4th/Sierra	65	65	27	74	75	32	81	82	36	90	90	41
4th/Virginia	13	32	1	17	38	3	20	42	5	24	48	8

TABLE 4.9
TOTAL DAILY DELAY
INCLUDING INTERSECTION DELAY (HOURS)

	1995			2000			2007			2015		
	12.7 Trains per day	**24.0** Trains per day	**36.0** Trains per day	**12.7** Trains per day	**24.0** Trains per day	**36.0** Trains per day	**12.7** Trains per day	**24.0** Trains per day	**36.0** Trains per day	**12.7** Trains per day	**24.0** Trains per day	**36.0** Trains per day
Keystone	28	47	71	35	67	98	39	73	110	46	87	130
Vine	6	11	16	6	12	18	7	13	19	7	14	21
Washington	3	5	7	3	5	8	3	6	9	3	6	9
Ralston	5	10	15	6	12	17	7	12	19	7	14	21
Arlington	19	35	53	21	39	59	23	43	64	25	47	70
West	5	9	13	5	9	14	5	10	15	6	11	17
Sierra	40	80	120	50	96	145	52	99	149	65	122	182
Virginia	22	43	64	27	50	76	30	56	84	35	63	95
Center	27	57	86	39	73	110	43	80	120	46	87	135
Lake	11	21	31	12	23	34	13	25	37	14	27	40
Evans	--	--	--	21	39	59	22	42	64	24	46	69
Morrill	0	1	1	0	1	1	0	1	1	0	1	1
Sutro	22	41	62	25	47	75	28	54	79	32	62	90
Total	188	360	539	250	473	714	272	514	770	310	587	880

Note: Shading indicates change from arterial analysis.

Reno Railroad Delay Study
Figure 4.6



4.2.2 Queuing

Arterial Queue
The length of queue is directly related to the average flow rate along the arterial, or the ADT volume. Therefore, Keystone and Virginia which have the highest volume, also have the longest queues.

As shown in the table, the total number of vehicles queued in 1995 with 12.7 trains per day is estimated to be 4,542 vehicles. With 24.0 trains per day the number of vehicles queued increases to 8,584 vehicles. The total number of vehicles expected to queue with 36.0 trains per day exceeds 12,876 vehicles per day. The results of the analysis for all scenarios are shown in **Table 4.10** and **Figures 4.7** through **4.10**.

In 2000, the total number of vehicles queued is expected to increase by 23 percent for all scenarios. With 12.7 trains per day, this increase translates to 5,574 vehicles per day. Therefore total number of queued vehicles for 24.0 and 36.0 trains per day are estimated to be 10,534 and 15,802 vehicles respectively.

The total number of queued vehicles by 2007 are expected to increase by 27 percent over 1995 values. For 12.7 trains per day, the total number vehicles queued is expected to be 5,946 vehicles per day. With the increase in trains from 12.7 to 24.0, the total daily queued vehicles increases to 11,237 vehicles per day. As the number of trains increase to 36.0, total daily queued vehicles increases to 16,856 vehicles per day.

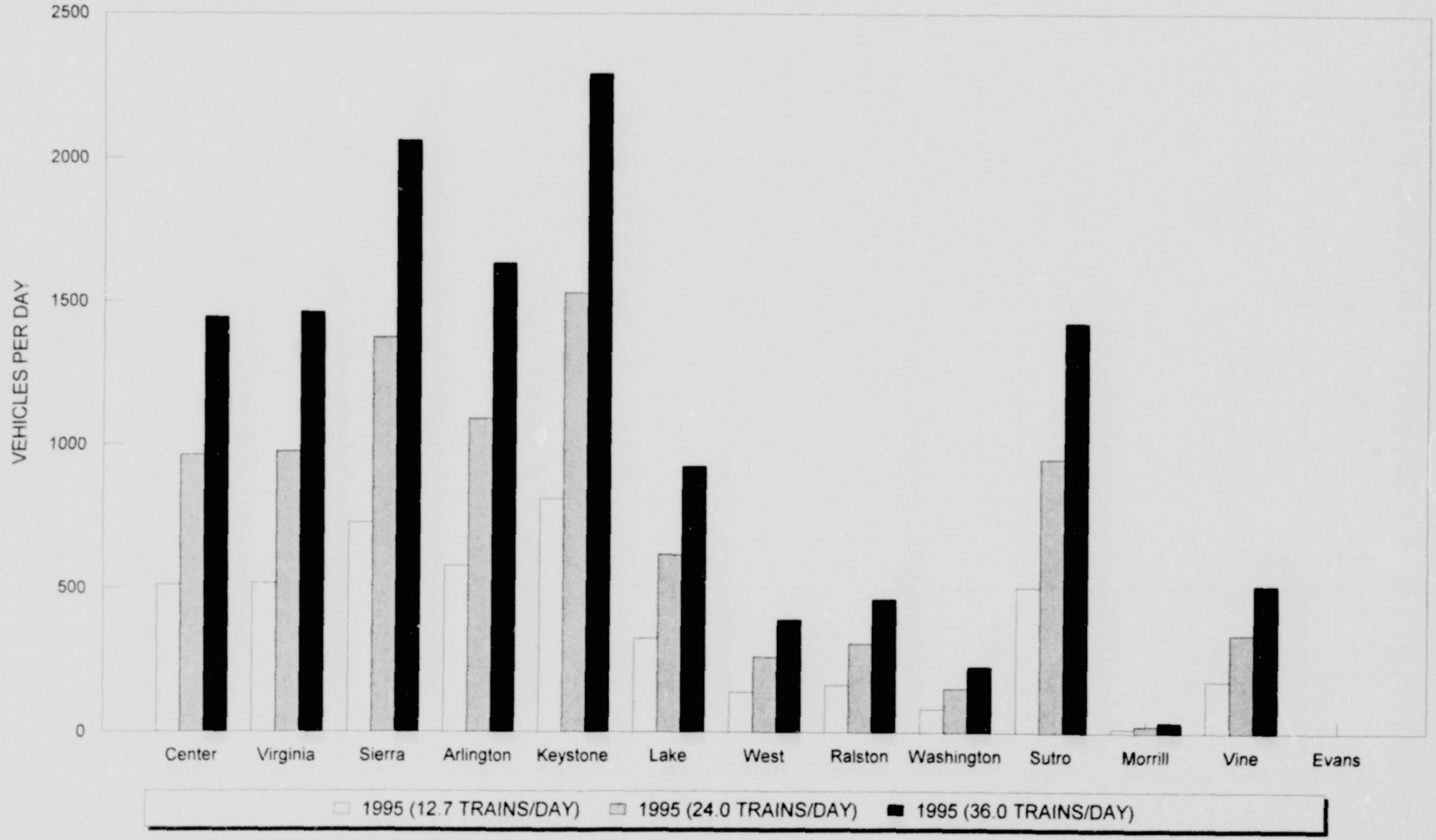
With the increase in traffic volumes, the total daily queued vehicles for 2015 increased by 42 percent over the 1995 totals. This increase translates to 6,429 vehicles per day for the 12.7 trains per day, 12,149 for 24 trains per day and 18,223 vehicles for the 36 trains per day scenario.

TABLE 4.10
TOTAL DAILY QUEUE PER RAIL CROSSING (VEHICLES)

	1995			2000			2007			2015		
	12.7 Trains per day	**24.0** Trains per day	**36.0** Trains per day	**12.7** Trains per day	**24.0** Trains per day	**36.0** Trains per day	**12.7** Trains per day	**24.0** Trains per day	**36.0** Trains per day	**12.7** Trains per day	**24.0** Trains per day	**36.0** Trains per day
Keystone	809	1,529	2,293	889	1,681	2,521	952	1,798	2,698	1,029	1,944	2,916
Vine	180	340	510	198	374	561	211	398	597	228	431	646
Washington	81	152	229	90	171	256	97	183	274	103	195	293
Ralston	163	308	461	181	341	512	193	366	548	210	398	597
Arlington	577	1,090	1,635	634	1,197	1,796	679	1,284	1,925	732	1,384	2,076
West	138	260	390	150	285	427	160	305	457	176	333	500
Sierra	727	1,375	2,062	801	1,514	2,271	856	1,619	2,428	927	1,751	2,627
Virginia	515	976	1,464	568	1,074	1,610	609	1,150	1,726	657	1,240	1,860
Center	510	964	1,447	563	1,064	1,596	603	1,139	1,708	638	1,206	1,808
Lake	326	615	923	357	674	1,012	383	723	1,085	413	780	1,170
Evans	--	--	--	575	1,087	1,631	597	1,127	1,691	662	1,252	1,877
Morrill	13	24	37	13	24	37	13	24	37	13	24	37
Sutro	503	951	1,425	555	1,048	1,572	593	1,121	1,682	641	1,211	1,816
Total	4,542	8,584	12,876	5,574	10,534	15,802	5,946	11,237	16,856	6,429	12,149	18,223

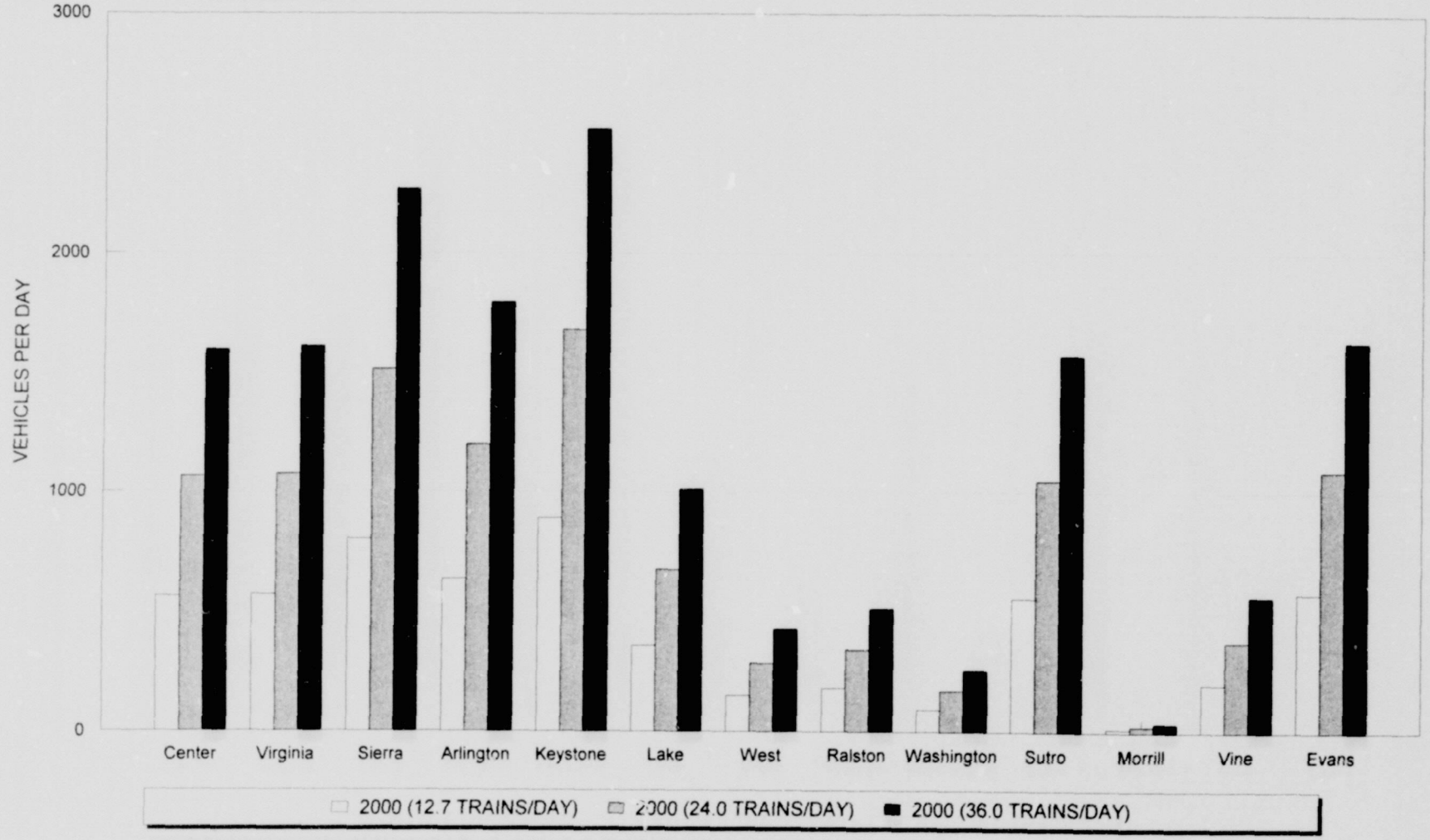
Reno Railroad Merger Study
Figure 4.7

1995 TOTAL DAILY NUMBER OF VEHICLES QUEUED



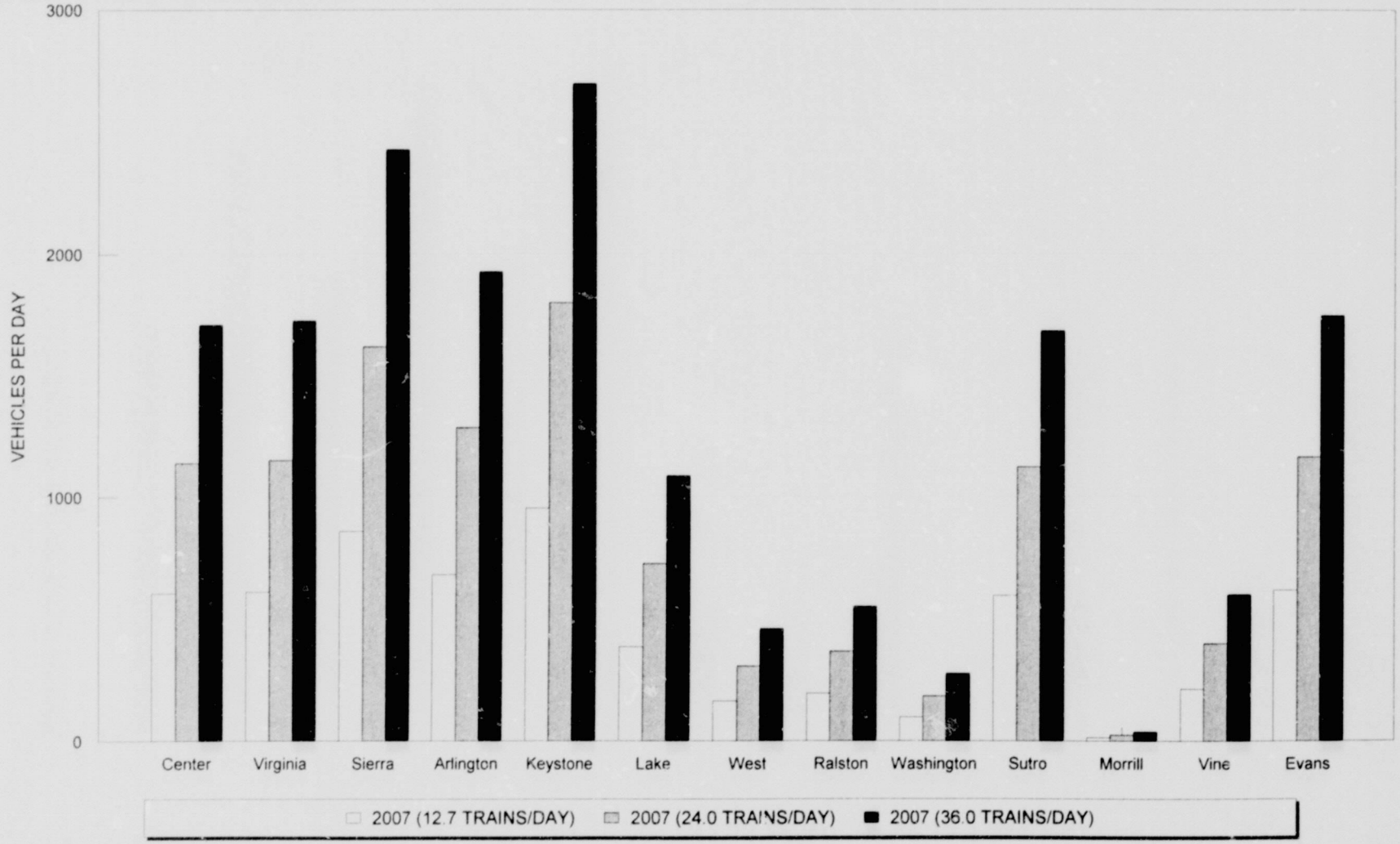
Reno Railroad Merger Study
Figure 4.8

2000 TOTAL DAILY NUMBER OF VEHICLES QUEUED



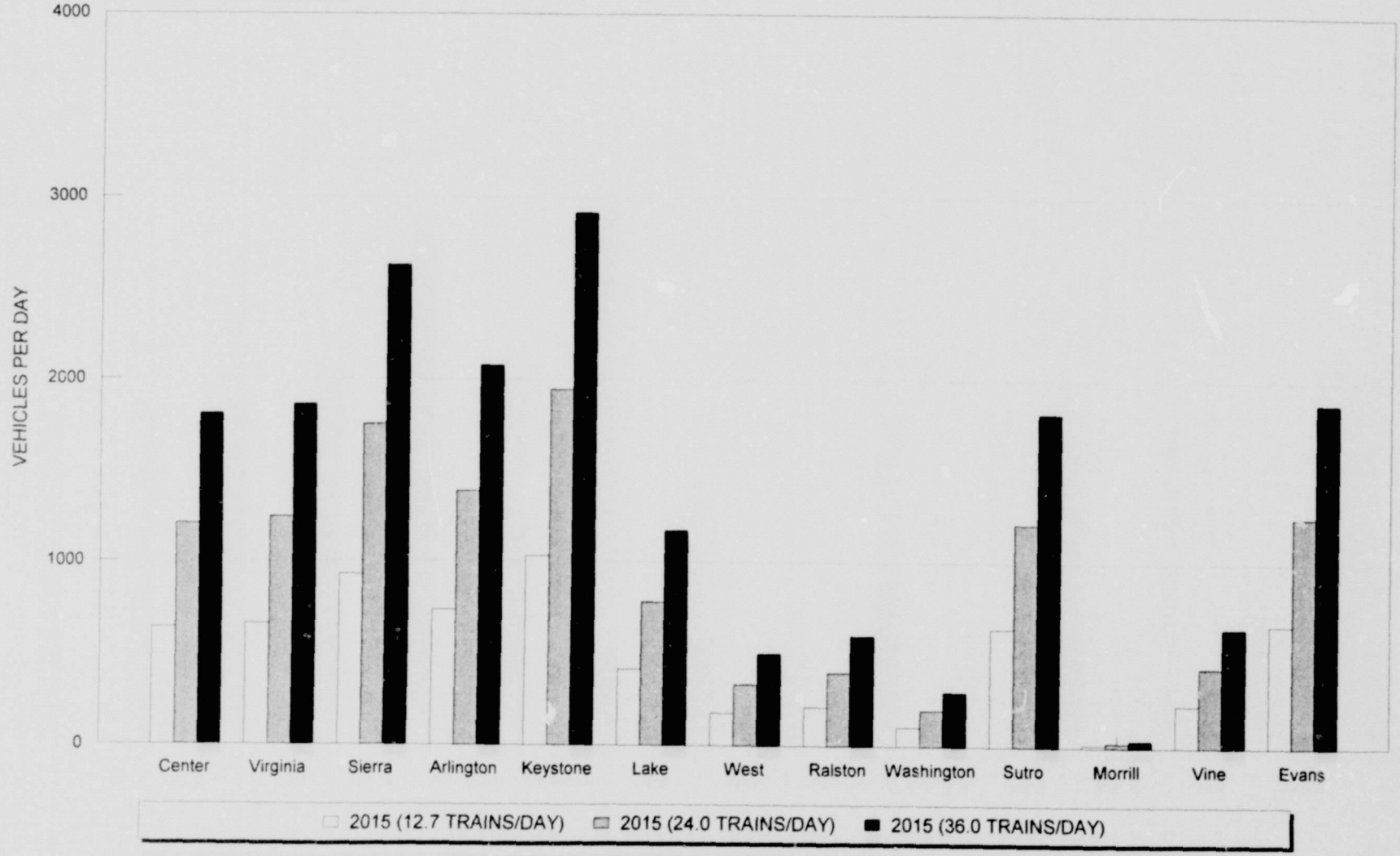
Reno Railroad Merger Study
Figure 4.9

2007 TOTAL DAILY NUMBER OF VEHICLES QUEUED



Reno Railroad Merger Study
Figure 4.10

2015 TOTAL DAILY NUMBER OF VEHICLES QUEUED



Overflow Queue into Adjacent Intersections

Delays will significantly increase as the vehicles in queue exceed the available capacity for storing the vehicles. The available capacity is defined by the area between the crossing gate and the adjacent intersections as shown in **Figure 4.11** below. Queues which exceed the available capacity overflow into the adjacent intersection and have a negative impact on the operating conditions of that intersection. In 1995 and 2000, six intersections are impacted in the AM peak and PM peak and two in the off peak. The intersections of Sierra/4th Street and Virginia/4th Street will be impacted during each peak period in all scenarios. By 2007 and 2015, four intersections overflow in all three peak periods. Both 2nd/Virginia and 2nd/Center become impacted in 2007 and 2015.

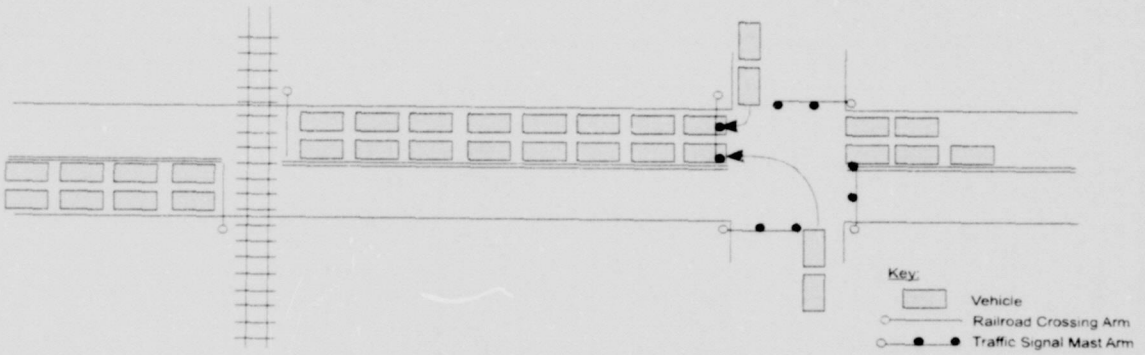


Figure 4.11 - Overflow of Queue into Adjacent Intersection

Queues form when the arrival rate exceeds the departure rate at any given location. When the train crossing gate is lowered, the departure rate is equal to zero and the arrival rate remains constant forming a queue. Vehicles continue to queue until the gate is raised, at which time vehicles depart at a rate of 0.53 vehicles per second. The queue is considered to have cleared when vehicles arriving continue through the crossing at a free flow rate. As stated, the time over which the queue dissipates is directly related to the length of queue and overflow into adjacent intersections. The time over which the queue dissipates for the AM and PM peak period is summarized in **Tables 4.11**.

TABLE 4.11
TIME OF QUEUE DISSIPATION
(SECONDS)

	AM PEAK								PM PEAK							
	NORTHBOUND				SOUTHBOUND				NORTHBOUND				SOUTHBOUND			
	1995	2000	2007	2015	1995	2000	2007	2015	1995	2000	2007	2015	1995	2000	2007	2015
Keystone	182	187	191	196	300	303	367	522	197	204	208	215	279	524	477	628
Vine	236	237	238	240	223	223	223	223	237	239	240	242	224	243	224	247
Washington	234	236	237	239	243	246	248	251	235	237	238	240	259	241	268	244
Ralston	249	252	255	258	240	242	243	245	251	255	258	262	252	264	259	273
Arlington	211	217	222	229	245	258	269	284	215	222	228	235	292	241	341	260
West	244	246	248	251	243	246	248	250	246	249	251	254	259	256	267	263
Sierra	---	---	---	---	538	541	544	547	---	---	---	---	215	307	228	365
Virginia	285	350	535	358	312	312	372	372	387	393	398	404	462	589	522	605
Center	371	436	440	444	---	---	---	---	730	745	757	768	---	---	---	---
Lake	249	252	254	257	272	279	285	292	251	255	257	261	333	263	371	271
Evans	--	275	277	285	---	235	235	237	--	280	283	292	---	298	244	314
Morrill	224	224	224	224	257	261	265	269	224	224	224	224	285	224	301	224
Sutro	627	632	637	642	232	233	234	235	511	518	583	589	239	294	242	316

4.2.3 Level of Service

As discussed in the Methodology section of this report, level of service defines the operating conditions of a facility. Level of Service (LOS) ranges from A to F, where A is the best operating condition and F is worst. **Figures 4.12** through **4.15** show the LOS for each study arterial for normal operating conditions without the impact of the train crossing for all intersections. As shown, all arterials operate at a level of service C during all peak periods.

Level of service for an arterial is determined by calculating the average arterial speed. When a train crossing occurs, the average speed is reduced to near zero. Therefore the average arterial speed during the peak period is also reduced. At several locations, the reduction in speed resulted in a change in LOS. **Figures 4.16** through **4.27** show the LOS for each peak period for all twelve scenarios. The total number of links with each level of service are shown in the **Tables 4.12** through **4.14** for each peak period.

As shown in the tables, the increase in traffic volumes and increase in number of trains had little impact on the level of service for all crossings. For all scenarios, level of service remained D or better for a links. For this analysis, a link is defined as one direction along an arterial. For example, Virginia is equal to two links, one in each direction.

In the PM peak, shown in **Table 4.14**, several locations experience a reduction in level of service from E to F due to the increase in number of trains from 12.7 to 24.0 and from 24.0 to 36.0. The majority of links by 2015 will operate at LOS C or D with 12.7 trains per day. However with the increase in trains to 36.0 per day, most levels of service drop to LOS E.

Off peak levels of service remain at or better for all scenarios. With 36.0 trains per day, all three scenarios will have links where LOS drops from D to E.

A/A/A = ARTERIAL LEVEL OF SERVICE (am/pm/off)

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CITY OF RENO RAILROAD CROSSING TRAFFIC AND DELAY ANALYSIS

1995 ARTERIAL LEVEL OF SERVICE WITHOUT TRAIN

FIGURE 4.12

97L087-088\CAD\LOS-WOT.DWG

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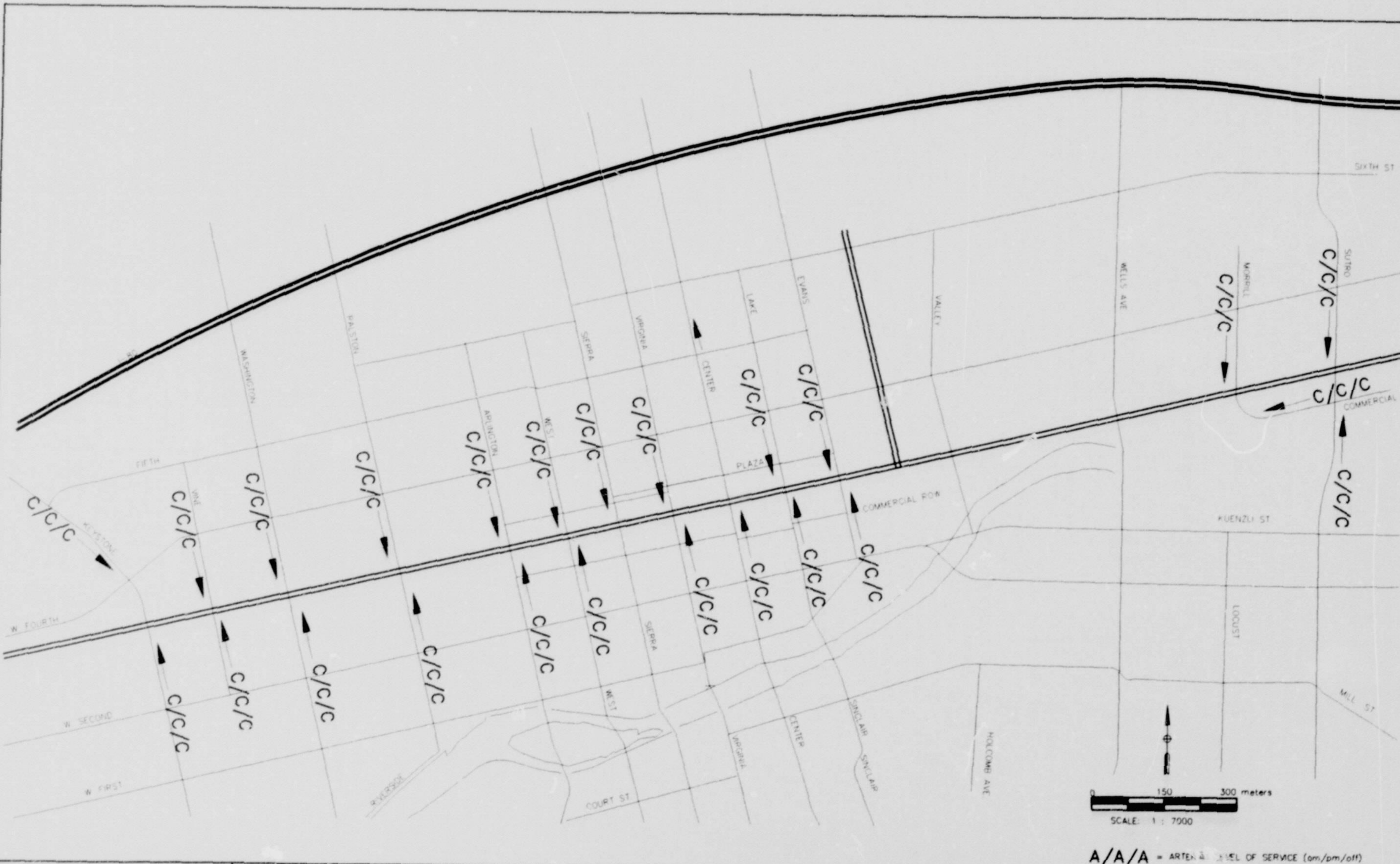
CITY OF RENO RAILROAD CROSSING TRAFFIC AND DELAY ANALYSIS

2000 ARTERIAL LEVEL OF SERVICE WITHOUT TRAIN

FIGURE 4.13

97\97-068\CAD\LOS-WOT2.DWG



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2007 ARTERIAL LEVEL OF SERVICE WITHOUT TRAIN

FIGURE 4.14

A/A/A = ARTERIAL LEVEL OF SERVICE (am/pm/off)

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2015 ARTERIAL LEVEL OF SERVICE WITHOUT TRAIN

FIGURE 4.15

97\97-068\CAD\LOS-WO14.DWG

TABLE 4.12
NUMBER OF LINKS PER LEVEL OF SERVICE (AM PEAK)

	1995			2000			2007			2015		
	12.7	24.0	36.0	12.7	24.0	36.0	12.7	24.0	36.0	12.7	24.0	36.0
A												
B												
C												
D	22	22	22	24	24	24	24	24	24	24	24	24
E												
F												

TABLE 4.13
NUMBER OF LINKS PER LEVEL OF SERVICE (PM PEAK)

	1995			2000			2007			2015		
	12.7	24.0	36.0	12.7	24.0	36.0	12.7	24.0	36.0	12.7	24.0	36.0
A												
B												
C												
D	22	20	2	24	21		22	18	1	24	19	
E		2	17		3	20		4	17		5	18
F			3			4			4			6

TABLE 4.14
NUMBER OF LINKS PER LEVEL OF SERVICE (OFF PEAK)

	1995			2000			2007			2015		
	12.7	24.0	36.0	12.7	24.0	36.0	12.7	24.0	36.0	12.7	24.0	36.0
A												
B												
C	11			12			12			12		
D	11	22	11	12	24	12	12	24	12	12	24	12
E			11			12			12			12
F												

A/A/A = ARTERIAL LEVEL OF SERVICE (am/pm/off)

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CITY OF RENO RAILROAD CROSSING TRAFFIC AND DELAY ANALYSIS

2000 ARTERIAL LEVEL OF SERVICE WITH 36 TRAINS/DAY

FIGURE 4.21

97\97-068\CAD\LOS-W17.DWG

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1995 ARTERIAL LEVEL OF SERVICE WITH 12.7 TRAINS/DAY

FIGURE 4.16

(V:\97-068\CAD\97-068-WT.DWG)

A/A/A = ARTERIAL LEVEL OF SERVICE (am/pm/off)

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CITY OF RENO RAILROAD CROSSING TRAFFIC AND DELAY ANALYSIS

1995 ARTERIAL LEVEL OF SERVICE WITH 24.0 TRAINS/DAY

FIGURE 4.17

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CITY OF RENO RAILROAD CROSSING TRAFFIC AND DELAY ANALYSIS

1995 ARTERIAL LEVEL OF SERVICE WITH 36.0 TRAINS/DAY

FIGURE 4.18

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2000 ARTERIAL LEVEL OF SERVICE WITH 12.7 TRAINS/DAY

FIGURE 4.19

97\J97-068\CAD\LOS-WT2.DWG

A/A/A = ARTERIAL LEVEL OF SERVICE (am/pm/off)

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CITY OF RENO RAILROAD CROSSING TRAFFIC AND DELAY ANALYSIS

2000 ARTERIAL LEVEL OF SERVICE WITH 24 TRAINS/DAY

FIGURE 4.20

87\87-068\CAD\LOS-MT3.DWG

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CITY OF RENO RAILROAD CROSSING TRAFFIC AND DELAY ANALYSIS

2007 ARTERIAL LEVEL OF SERVICE WITH 12.7 TRAINS/DAY

FIGURE 4.22

97\97-068\CAD\LOS-WTB.DWG

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CITY OF RENO RAILROAD CROSSING TRAFFIC AND DELAY ANALYSIS

2007 ARTERIAL LEVEL OF SERVICE WITH 24 TRAINS/DAY

FIGURE 4.23

97\J097-068\CAD\LOS-WTB.DWG

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CITY OF RENO RAILROAD CROSSING TRAFFIC AND DELAY ANALYSIS

2007 ARTERIAL LEVEL OF SERVICE WITH 36 TRAINS/DAY

FIGURE 4.24

97\97-068\CAD\LOS-W17.DWG

A/A/A = ARTERIAL LEVEL OF SERVICE (am/pm/off)

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CITY OF RENO RAILROAD CROSSING TRAFFIC AND DELAY ANALYSIS

2015 ARTERIAL LEVEL OF SERVICE WITH 12.7 TRAINS/DAY

FIGURE 4.25

97-088\CAD\LOS-MTL3.DWG

A/A/A = ARTERIAL LEVEL OF SERVICE (am/pm/off)

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CITY OF RENO RAILROAD CROSSING TRAFFIC AND DELAY ANALYSIS

2015 ARTERIAL LEVEL OF SERVICE WITH 24 TRAINS/DAY

FIGURE 4 26

97\97-068\CAD\LOS-WIT11.DWG

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CITY OF RENO RAILROAD CROSSING TRAFFIC AND DELAY ANALYSIS

2015 ARTERIAL LEVEL OF SERVICE WITH 36 TRAINS/DAY

FIGURE 4.27

97-083\CAD\LOS-W112.DWG

4.2.4 Air Quality Analysis Related to Vehicular Traffic

As the number of vehicles in queue increase, the number of stops and starts also increase. Vehicles which idle, stop and start produce more emissions than vehicles which do not. Therefore, with the increase in traffic volumes between 1995 and 2015 and also with the addition of trains, the number of starts and stops will increase producing more emissions.

In 1995, total emissions per crossing in 1995 are estimated to be 2.46 tons per year. With the increase in number of trains per day from 12.7 to 24.0, total emissions increase by 88 percent to 4.64 tons per year. As the number of trains increase to 36.0 trains per day, total emissions per crossing increase to 6.97 tons per year, 183 percent greater than the emissions for 12.7 train crossings per day. Total daily emissions per rail crossing are shown in **Figures 4.28** through **4.31** and summarize in **Table 4.15**.

As traffic volumes increase in 2000, total daily emissions increase by 24 percent for all scenarios. For 12.7 trains per day, total annual tons of pollutants are estimated to be 3.05. This number increase to 5.78 with the increase in trains from 12.7 to 24.0. As the number of trains increase to 36.0, total emissions increase to 8.67 tons per year.

Total daily emissions for 2007 increase by 40 percent over the 1995 values. This translates to 3.44 tons per year with 12.7 train crossings, 6.51 tons per year with 24.0 train crossings, and 976 tons per year for 36.0 train crossings.

For 2015, total daily emission increase by 54 percent over 1995, resulting in 3.79 tons per year for 12.7 trains per day. After the merger, total daily emissions increase to 7.16 and 10.74 tons per year for 24.0 and 36.0 trains crossings respectively.

When traffic spills over into adjacent intersections, emissions per cycle will also increase. Though this analysis was not complete for this study, the overflow traffic will add to the overall impact on the environmental conditions. As the number of trains and traffic volumes increase, the queue lengths increase causing a greater spill over into adjacent intersections. As the number of cycles needed to clear the queue increase, so do the emissions. It is therefore safe to assess that an increase in number of trains will increase the total amount of pollutants emitted into the air.

Components of Total Delay and Queue for Air Quality Analysis

Total daily delay includes the following two components:

- Delay while vehicles are decelerating to a stop and accelerating from a stopping position
- Delay while vehicles are stopped (Idle Time)

Each component of the delay may have a different impact on the results of the air quality analysis. The acceleration and deceleration are directly dependant upon the speed at which vehicles depart and approach the rail crossing. As speed increases, the time to accelerate to a certain speed and decelerate to a complete stop increases. Likewise, as speed decreases, time to accelerate and decelerate decreases. For this project speeds through the downtown area is 25 mph for project arterials.

AASHTO (American Association of State Highway and Transportation Officials) publishes a set of guidelines entitled, *A Policy on Geometric Design of Highways and Streets*. This widely accepted

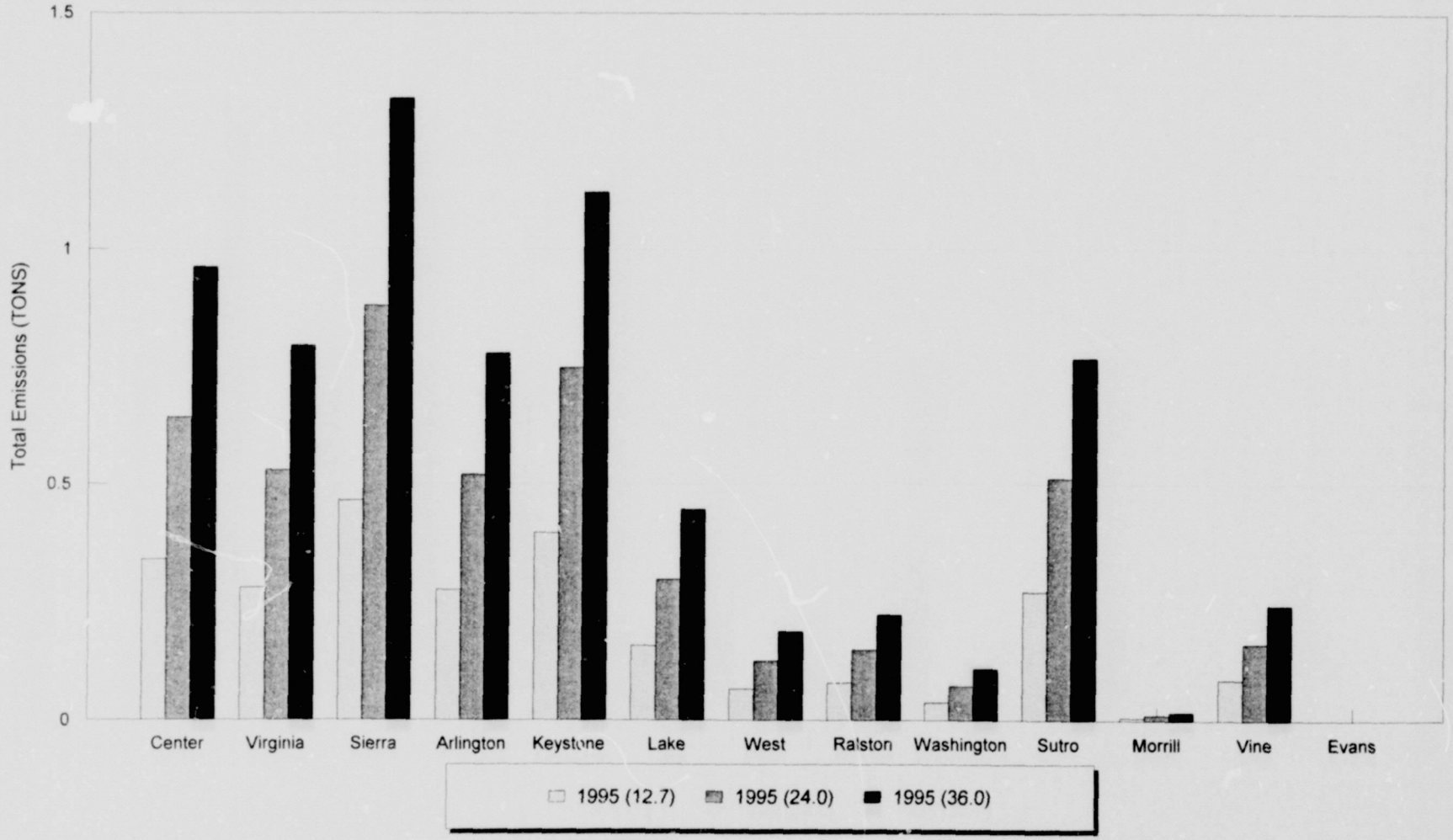
publication provides pertinent information regarding acceleration and deceleration rates for passenger car vehicles. The 1990 version of these guidelines state that acceleration time for vehicles traveling from zero to 25 mph is approximately 7.5 seconds per vehicle (pp. 750). For deceleration, stopping distance is determined to be 125 feet for a 25 mph speed limit (pp. 40). Deceleration time can be calculated as the time to come to a stop with an average speed of 12.5 mph during deceleration. The deceleration time is calculated to be 7.09 seconds. Total acceleration /deceleration time is 14.59 seconds. This translates to about 9 percent of the total delay as shown in **Table 4.15**. Correspondingly, the total idle time is approximately 91 percent of the total daily delay.

TABLE 4.15
TOTAL ANNUAL EMISSIONS PER RAIL CROSSING (TONS)

	1995			2000			2007			2015		
	12.7 Trains per Day	**24.0** Trains per Day	**36.0** Trains per Day	**12.7** Trains per Day	**24.0** Trains per Day	**36.0** Trains per Day	**12.7** Trains per Day	**24.0** Trains per Day	**36.0** Trains per Day	**12.7** Trains per Day	**24.0** Trains per Day	**36.0** Trains per Day
Keystone	0.40	0.75	1.12	0.46	0.87	1.30	0.52	0.99	1.48	0.58	1.10	1.65
Vine	0.09	0.16	0.24	0.09	0.18	0.27	0.11	0.20	0.30	0.11	0.22	0.32
Washington	0.04	0.07	0.11	0.04	0.08	0.12	0.05	0.09	0.14	0.05	0.10	0.15
Ralston	0.08	0.15	0.22	0.09	0.17	0.25	0.10	0.19	0.28	0.11	0.20	0.31
Arlington	0.27	0.52	0.78	0.30	0.57	0.86	0.34	0.65	0.98	0.37	0.71	1.06
West	0.07	0.12	0.19	0.07	0.14	0.21	0.08	0.15	0.23	0.09	0.17	0.25
Sierra	0.47	0.88	1.32	0.52	0.99	1.49	0.57	1.08	1.62	0.65	1.23	1.85
Virginia	0.28	0.53	0.79	0.32	0.60	0.90	0.36	0.69	1.03	0.40	0.75	1.13
Center	0.34	0.64	0.96	0.39	0.73	1.09	0.44	0.82	1.23	0.47	0.88	1.32
Lake	0.16	0.30	0.45	0.17	0.33	0.49	0.20	0.37	0.55	0.21	0.40	0.60
Evans	--	--	--	0.29	0.54	0.81	0.32	0.61	0.92	0.35	0.66	0.99
Morrill	0.01	0.01	0.02	0.01	0.01	0.02	0.01	0.01	0.02	0.01	0.01	0.02
Sutro	0.27	0.51	0.77	0.30	0.58	0.86	0.35	0.66	0.98	0.38	0.72	1.08
Total	2.48	4.64	6.97	3.05	5.79	8.67	3.45	6.51	9.76	3.78	7.15	10.73

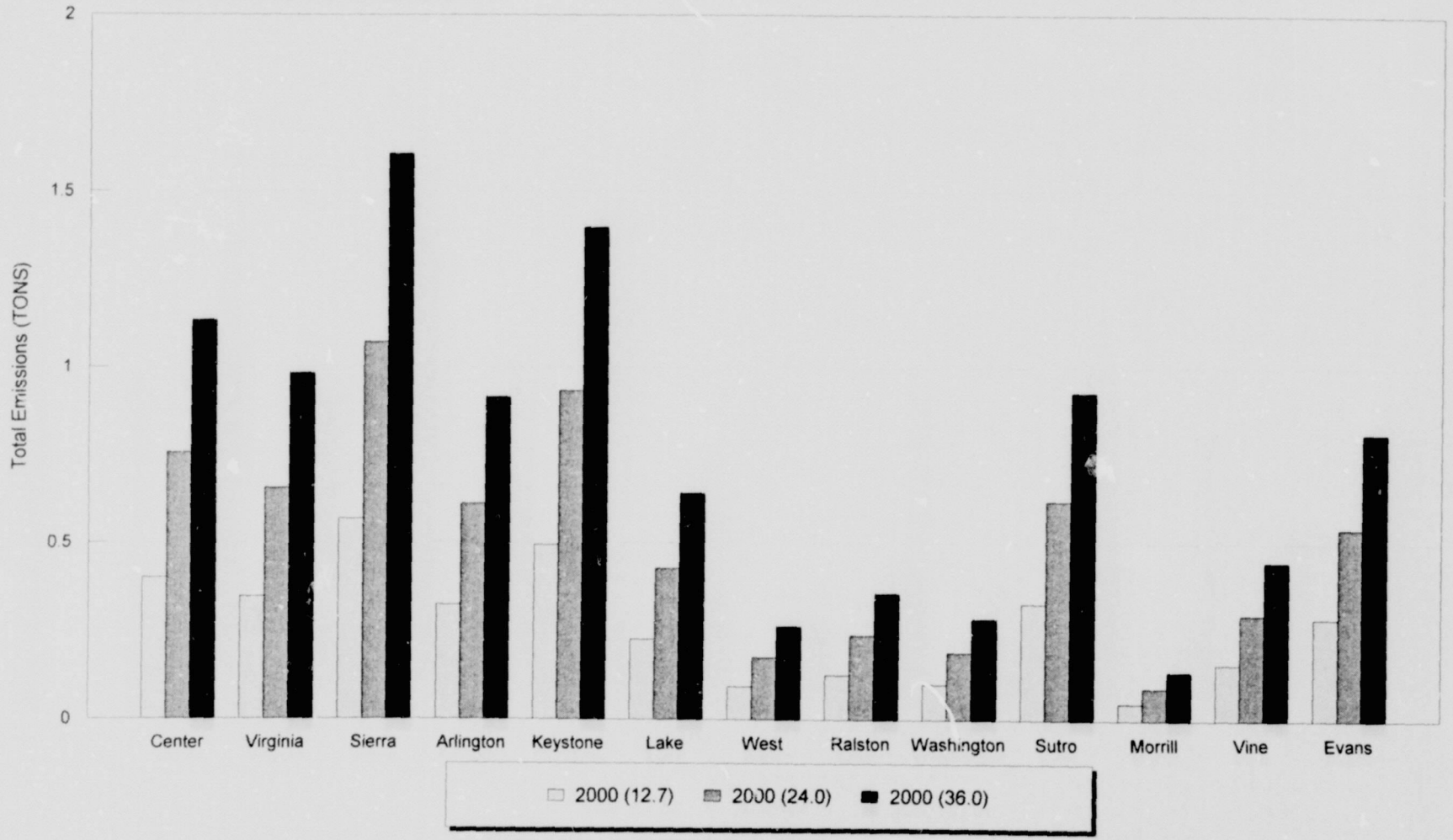
Reno Railroad Merger Study
Figure 4.28

1995 TOTAL ANNUAL EMISSIONS (TONS)



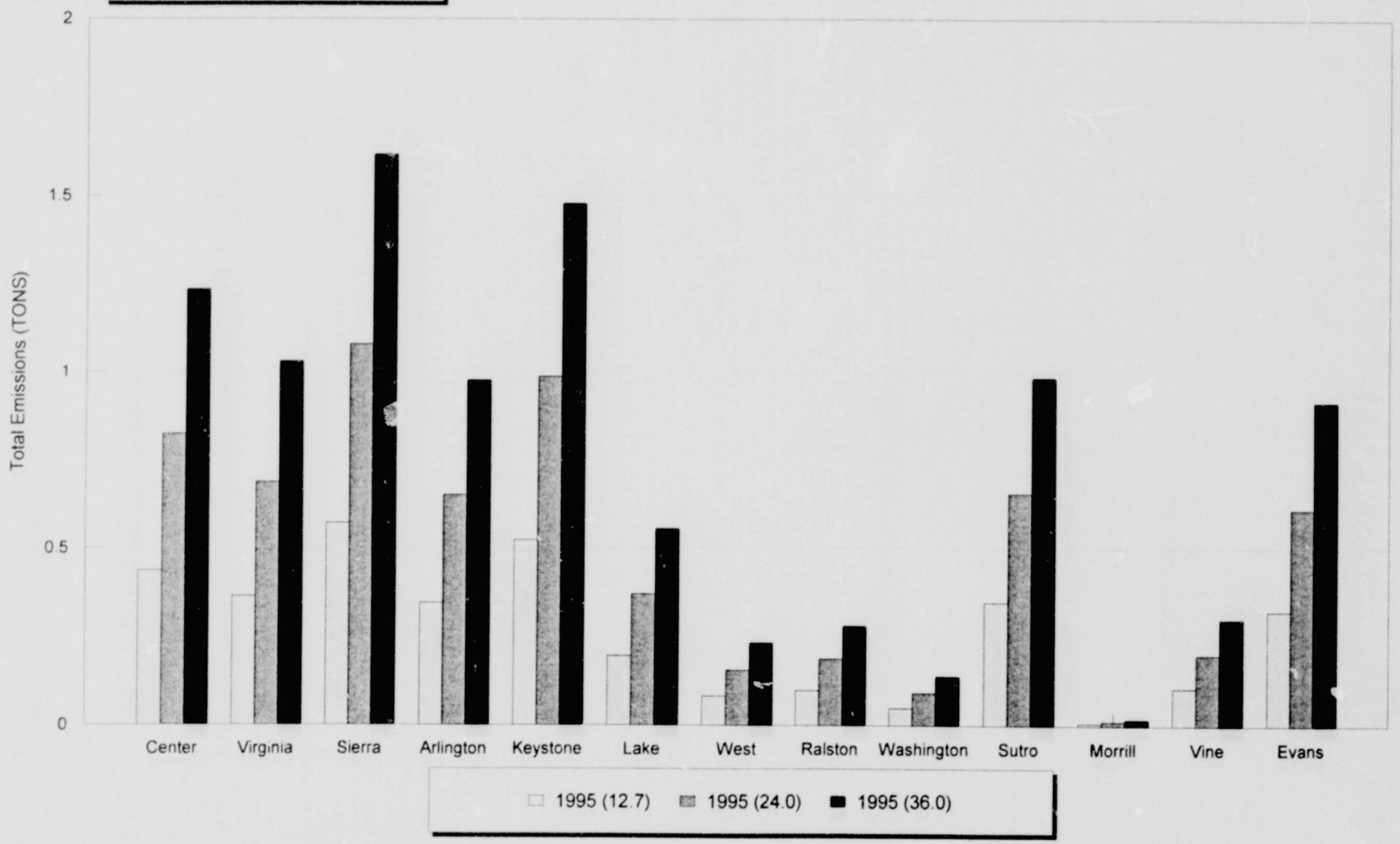
Reno Railroad Merger Study
Figure 4.29

2000 TOTAL ANNUAL EMISSIONS (TONS)



Reno Railroad Merger Study
Figure 4.30

2007 TOTAL ANNUAL EMISSIONS (TONS)



Reno Railroad Merger Study
Figure 4.31

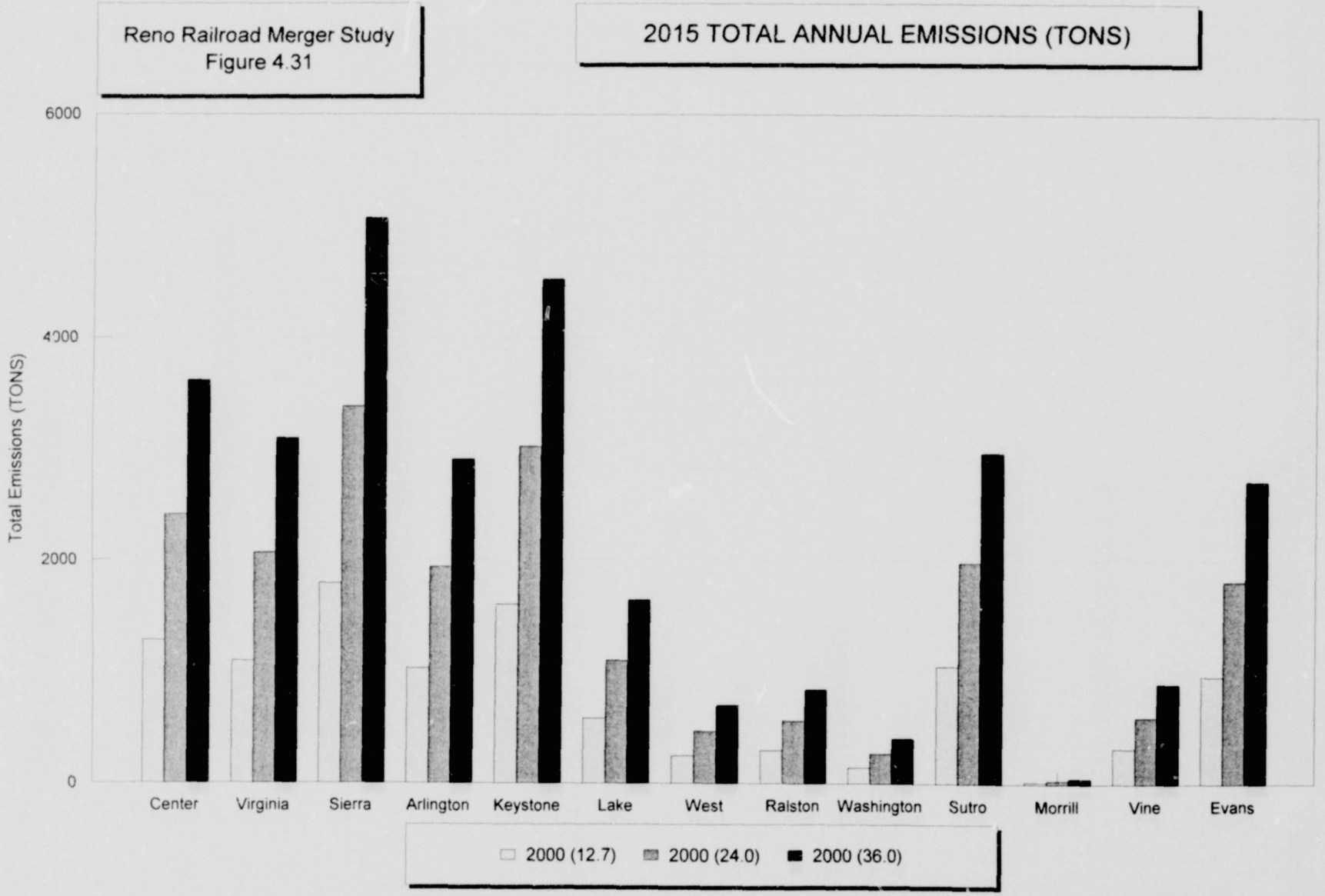


TABLE 4.16
COMPONENTS OF TOTAL DELAY FOR AIR QUALITY ANALYSIS

Study Year	Trains Per Day	Total Daily Delay (Includes Accel/Decel Time) (hours)	Total Daily Queue (vehicles)	Acceleration/Deceleration Per Vehicle (seconds)	Total Acceleration/ Deceleration (hours)	Accel/Decel. Percentage of Total Daily Delay	Idle Time Percentage of Total Daily Delay
1995	12.7	188	4,542	14.59	18.41	9.79%	90.21%
	24	360	8,584	14.59	34.79	9.66%	90.34%
	36	539	12,876	14.59	52.18	9.68%	90.32%
2000	12.7	250	5,574	14.59	22.59	9.04%	90.96%
	24	473	10,534	14.59	42.69	9.03%	90.97%
	36	714	15,802	14.59	66.23	8.96%	91.04%
2007	12.7	272	5,946	14.59	24.10	8.86%	91.14%
	24	514	11,237	14.59	45.54	8.86%	91.14%
	36	770	16,856	14.59	68.31	8.87%	91.13%
2015	12.7	310	6,429	14.59	26.03	8.40%	91.60%
	24	587	12,149	14.59	49.24	8.39%	91.61%
	36	880	18,223	14.59	73.85	8.39%	91.61%
					Average	8.99%	91.01%

5.0 SUMMARY AND FINDINGS

5.1 Procedure Summary

This study analyzed the mobility and air quality impacts of the anticipated increase in vehicles and railroad traffic at 12 existing and 1 future at-grade crossing in the downtown area of the City of Reno.

Scenarios Analyzed

The following scenarios were analyzed:

Train Crossing Scenario (trains/day)	1995 Traffic Volumes	2000 Traffic Volumes	2007 Traffic Volumes	2015 Traffic Volumes
12.7	√	√	√	√
24.0	√	√	√	√
36.0	√	√	√	√

Existing and Future Traffic Volumes

1995 average daily traffic volumes were primarily obtained from NDOT counts, various sources and verified by comparing with actual 1997 traffic volumes. The future traffic volumes were forecast, utilizing RTC model data for 1997, 2007 and 2015 split percentages by peak periods, directional splits and truck percentages were calibrated using actual traffic observation and counts.

Rail Operation

Train speed, train length, number of trains (scenarios) and distribution of train crossings during the 24-hour period were obtained and/or verified through actual train crossing surveys, STB database and observations.

Analysis Methodology

Queuing Theory, Highway Capacity Manual of Level of Service calculation and Modified Winfrey Method were utilized for the following topics:

- Grade Crossing Delay
- Queuing Analysis
- Level of Service
- Air Quality Analysis

Model parameters were calibrated by actual count, field survey and observation.

5.2 Findings

Total Daily Grade Crossing Delay

Figures 5.1 through **5.4** show the daily grade crossing delay. These results are summarized in **Table 5.1**

TABLE 5.1
TOTAL DAILY DELAY INCLUDING INTERSECTION DELAYS

Train Crossing Scenario (trains/day)	1995	2000	2007	2015
12.7	188	250	272	310
24.0	360	473	514	587
36.0	539	714	770	880

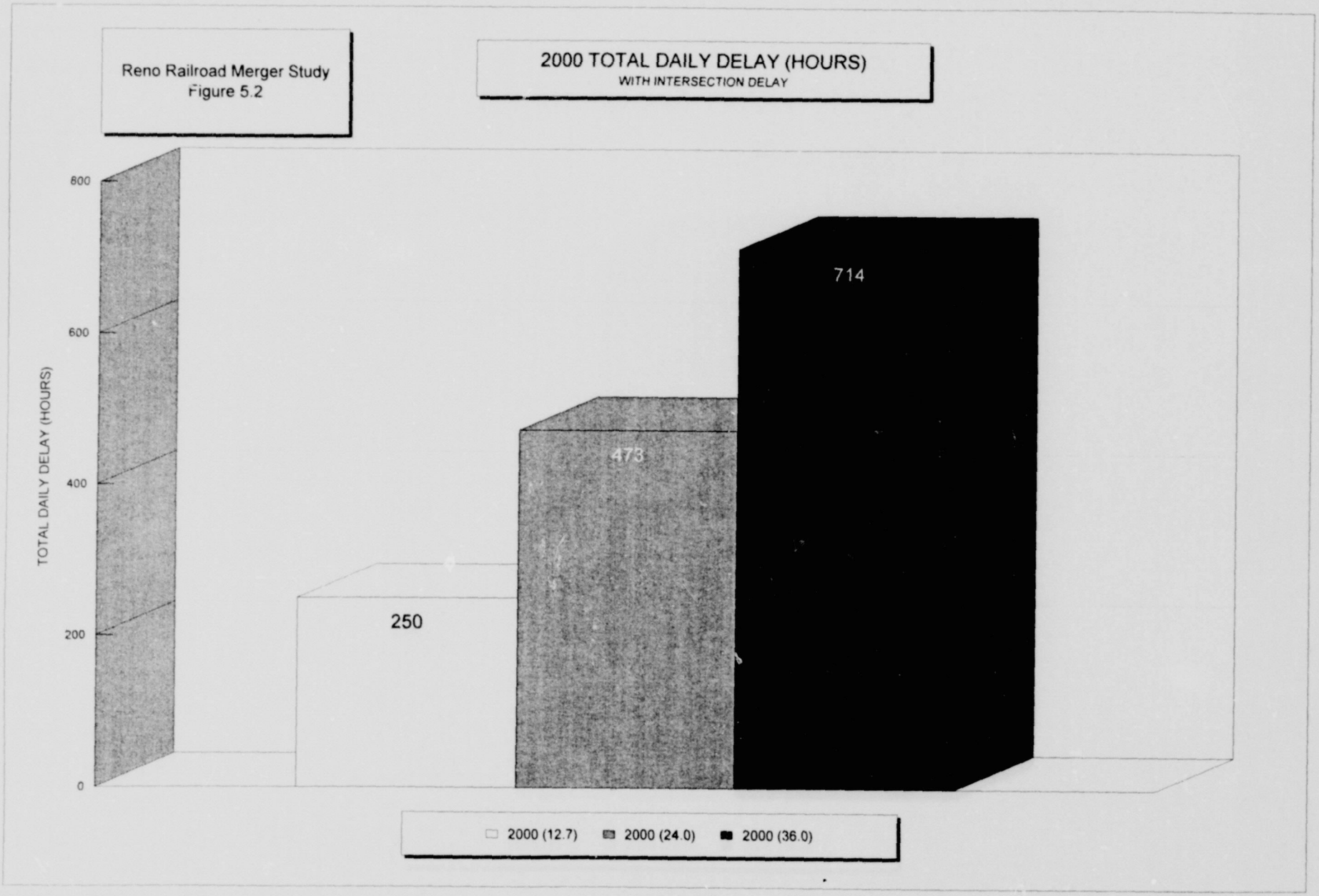
Total Queue

Table 5.2 and **Figure 5.5** through **5.8** show the expected total daily number of vehicles in queue for all scenarios.

TABLE 5.2
TOTAL DAILY QUEUE (VEHICLES)

Train Crossing Scenario (trains/day)	1995	2000	2007	2015
12.7	4,542	5,574	5,946	6,429
24.0	8,584	10,534	11,237	12,149
36.0	12,876	15,802	16,856	18,223

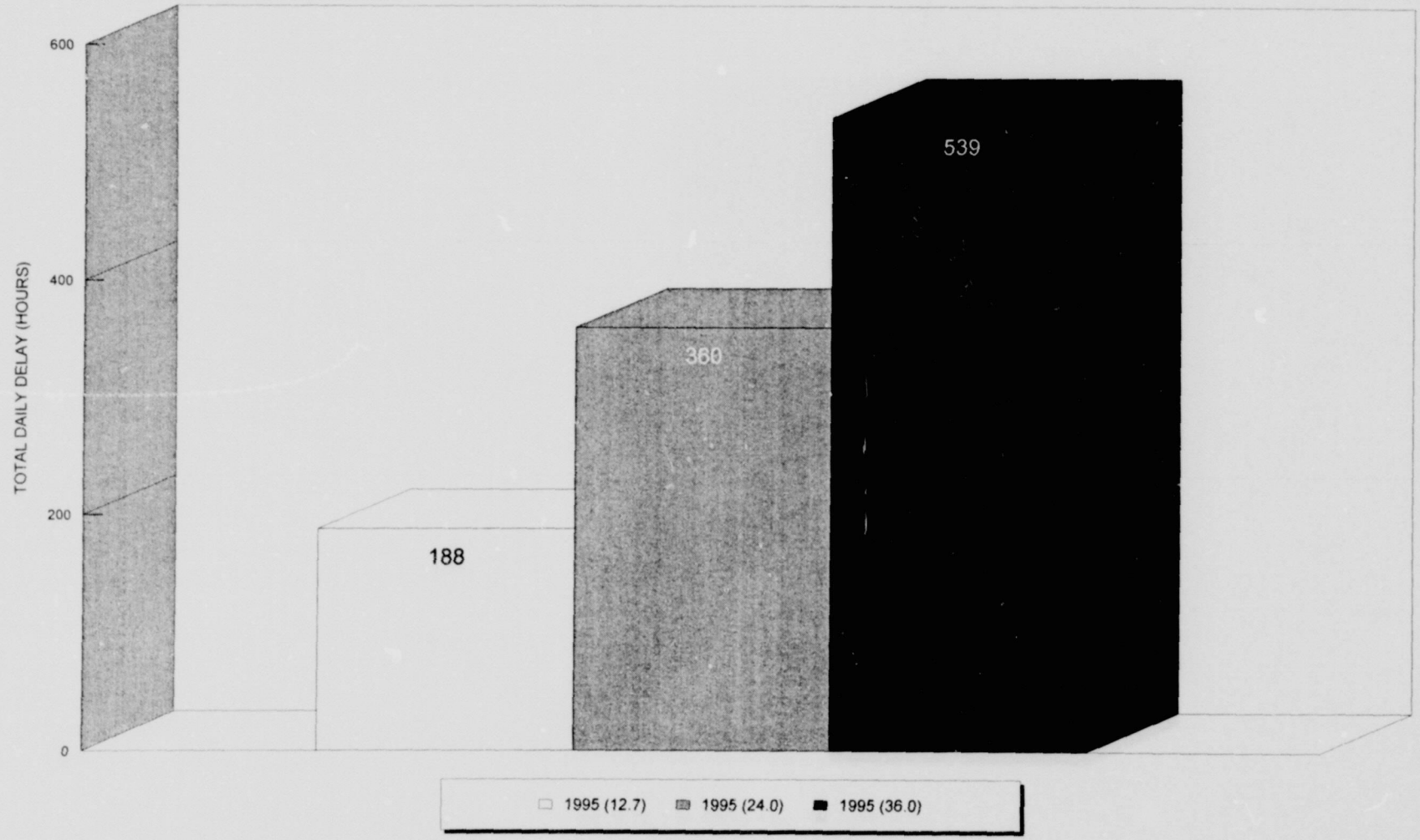
Reno Railroad Merger Study
Figure 5.2



Reno Railroad Merger Study
Figure 5.1

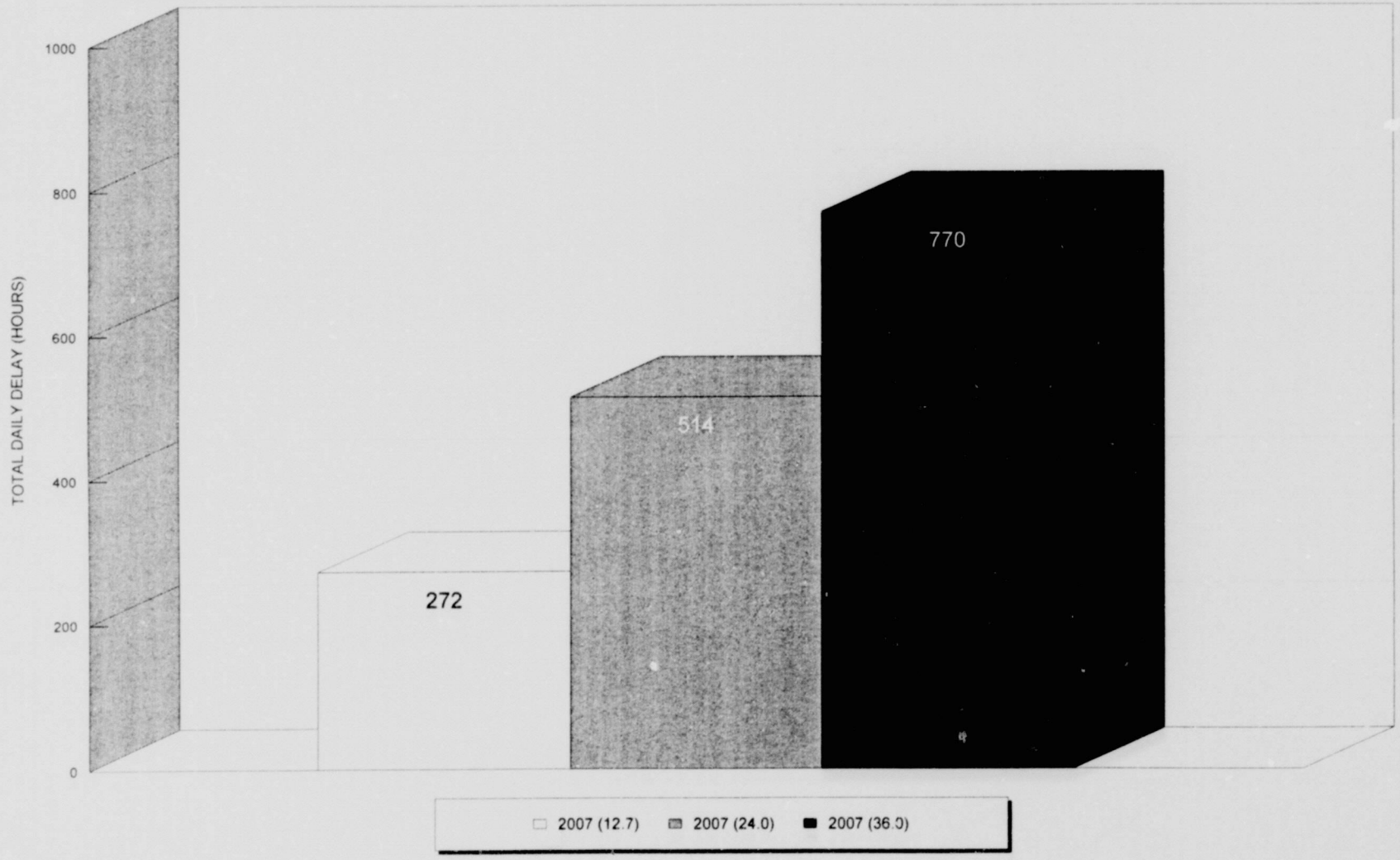
1995 TOTAL DAILY DELAY (HOURS)

WITH INTERSECTION DELAY

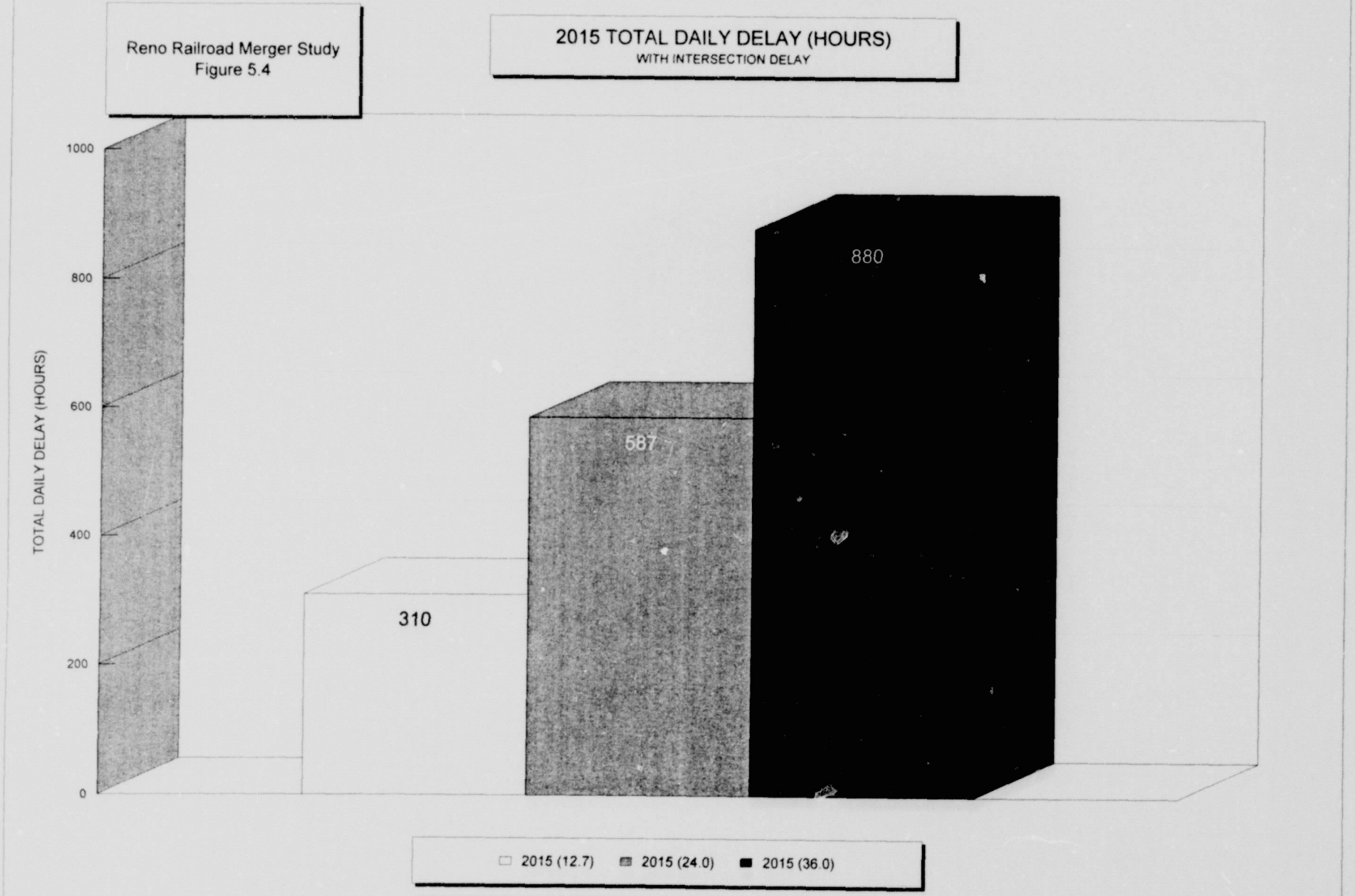


Reno Railroad Merger Study
Figure 5.3

2007 TOTAL DAILY DELAY (HOURS)
WITH INTERSECTION DELAY

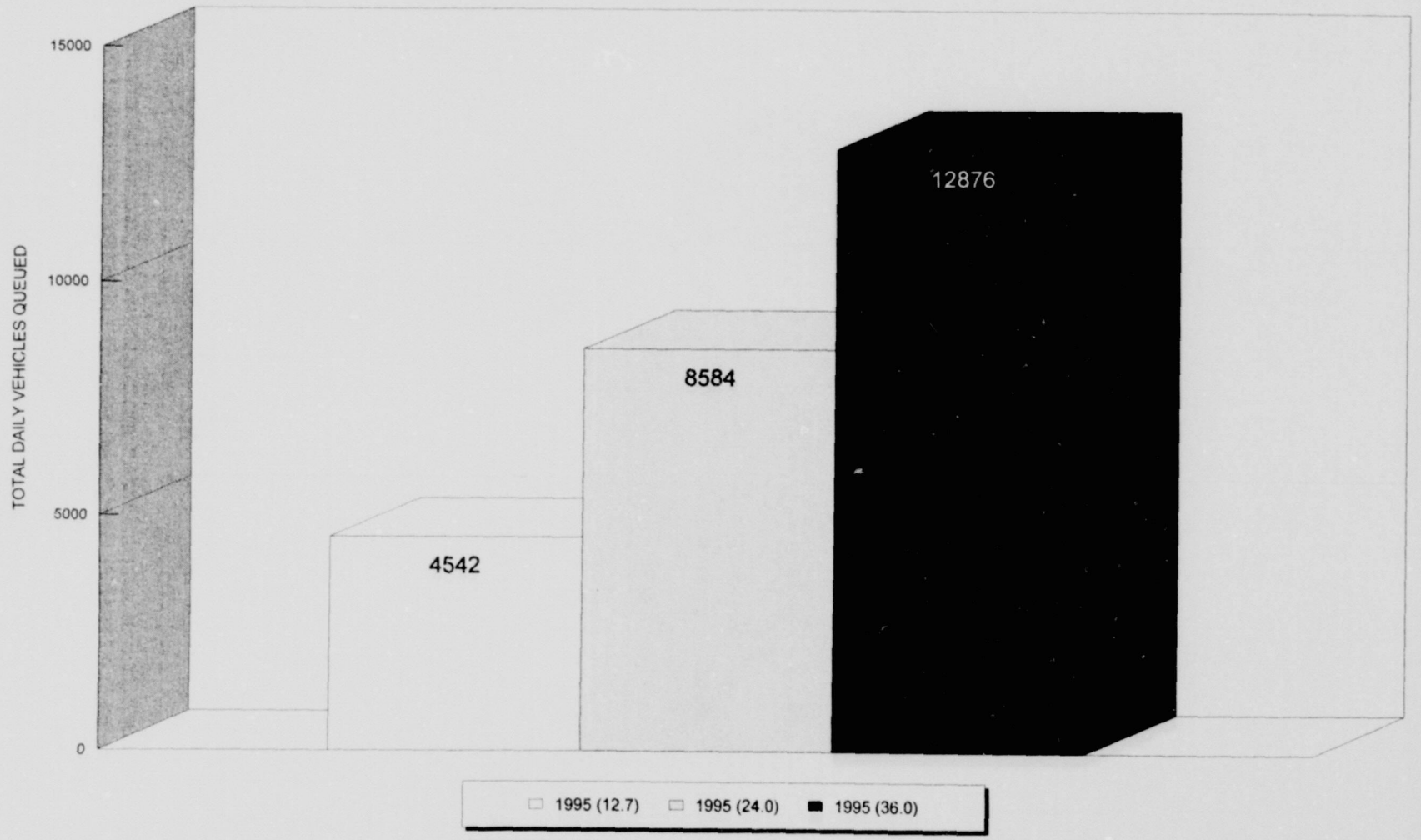


Reno Railroad Merger Study
Figure 5.4

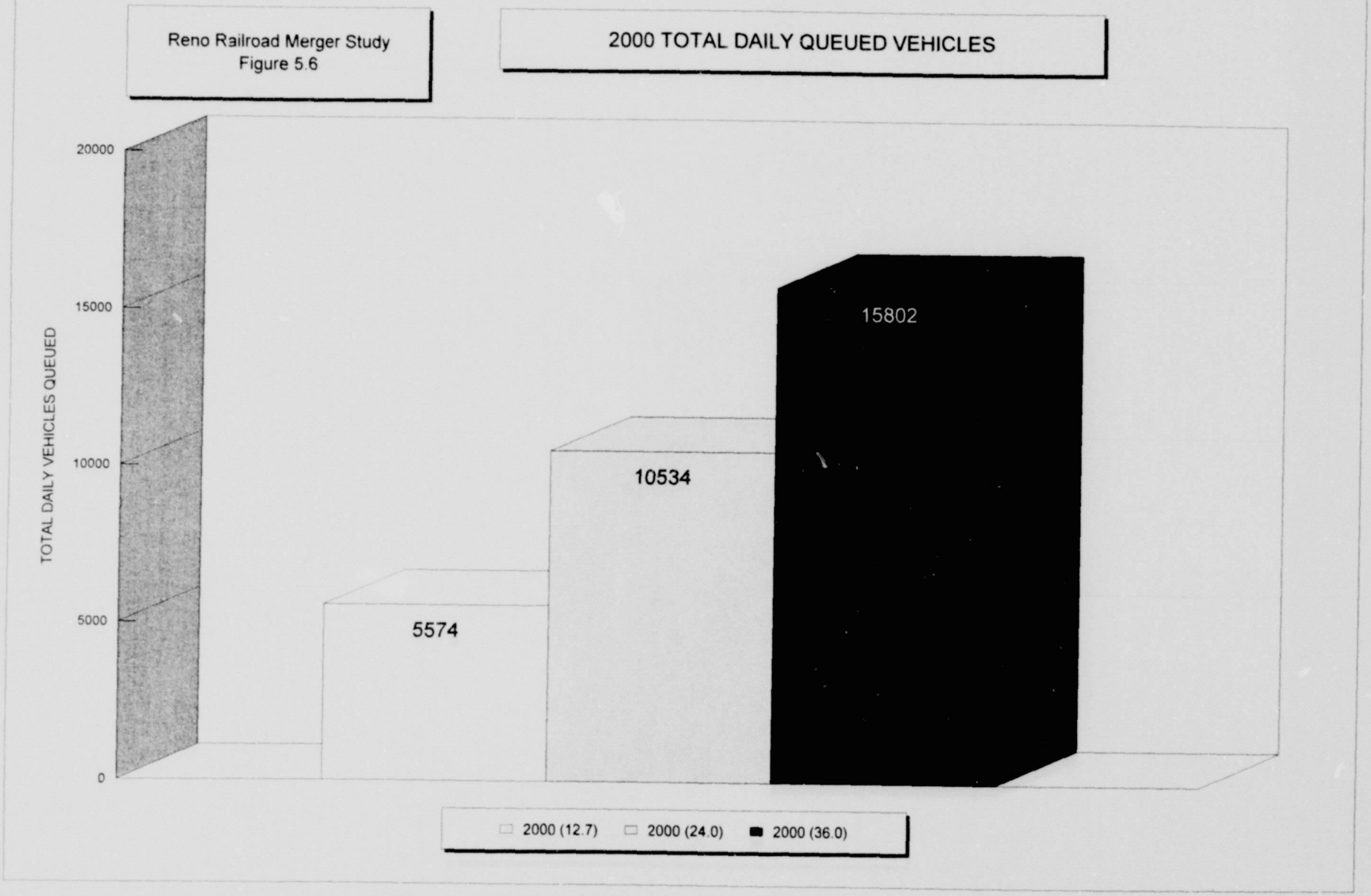


Reno Railroad Merger Study
Figure 5.5

1995 TOTAL DAILY QUEUED VEHICLES

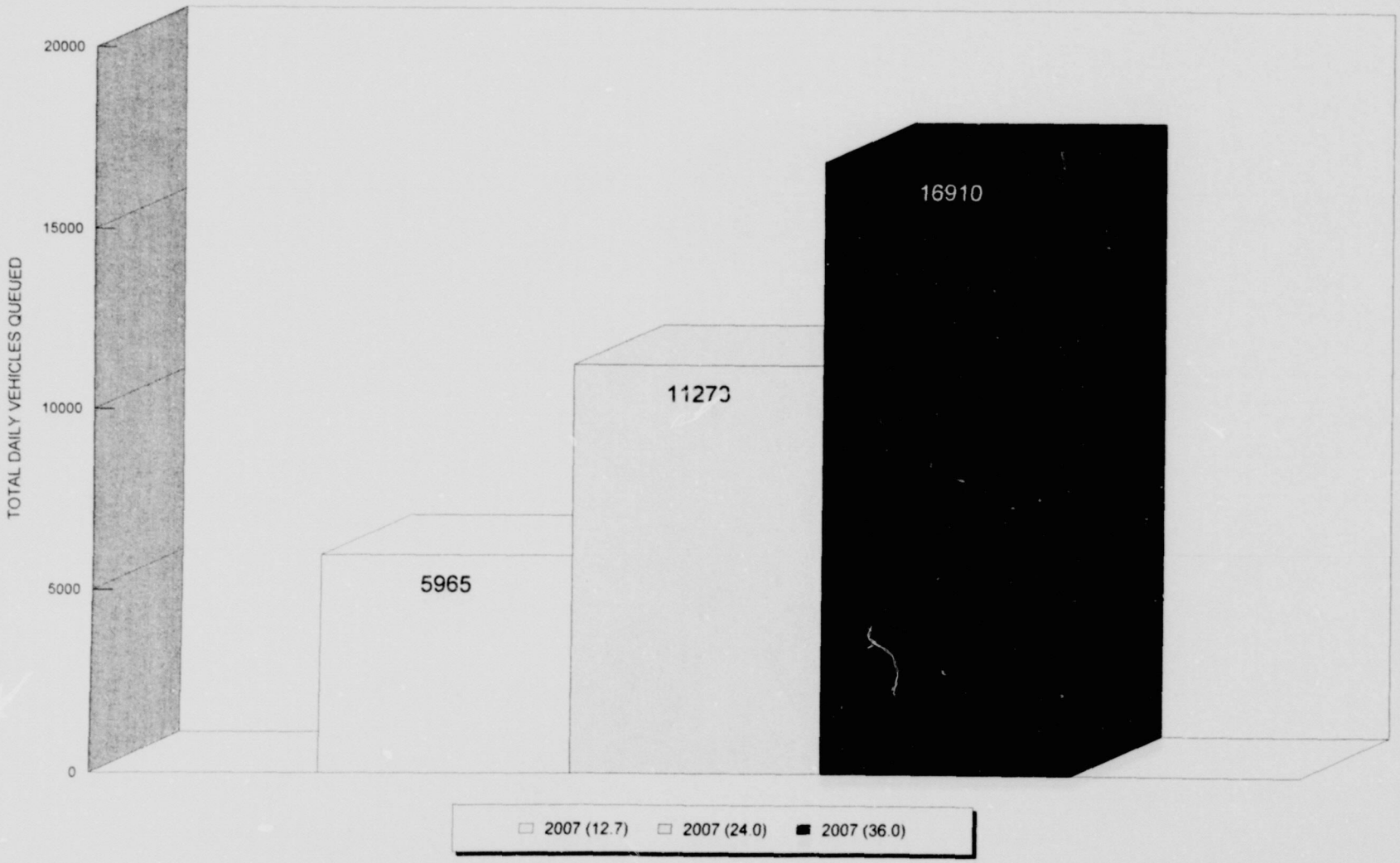


Reno Railroad Merger Study
Figure 5.6



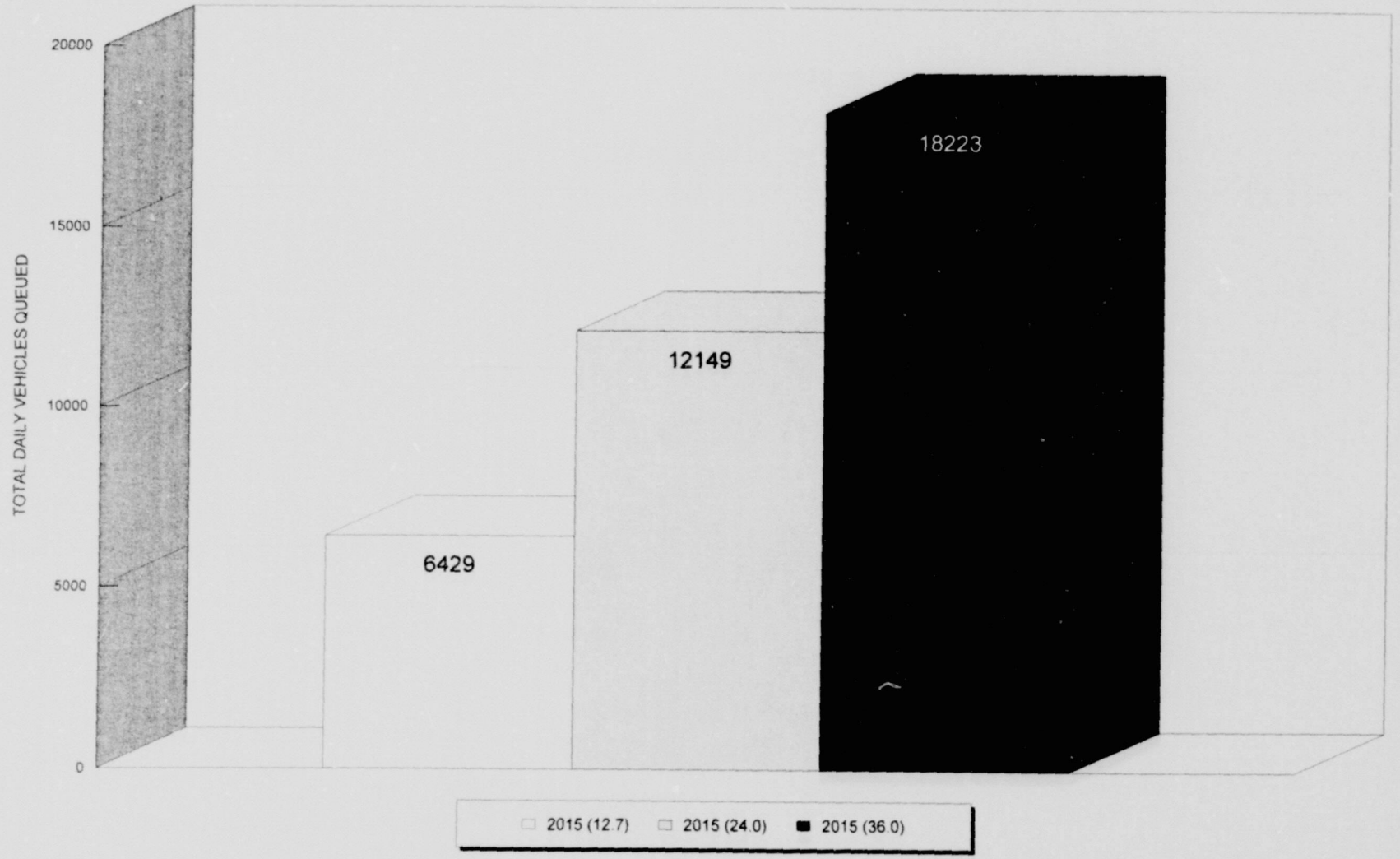
Reno Railroad Merger Study
Figure 5.7

2007 TOTAL DAILY QUEUED VEHICLES



Reno Railroad Merger Study
Figure 5.8

2015 TOTAL DAILY QUEUED VEHICLES



Air Quality - Vehicular Traffic Only

Table 5.3 and **Figure 5.9** through **5.12** show the annual emissions (in tons) for all scenarios.

TABLE 5.3
TOTAL ANNUAL EMISSIONS (TONS)

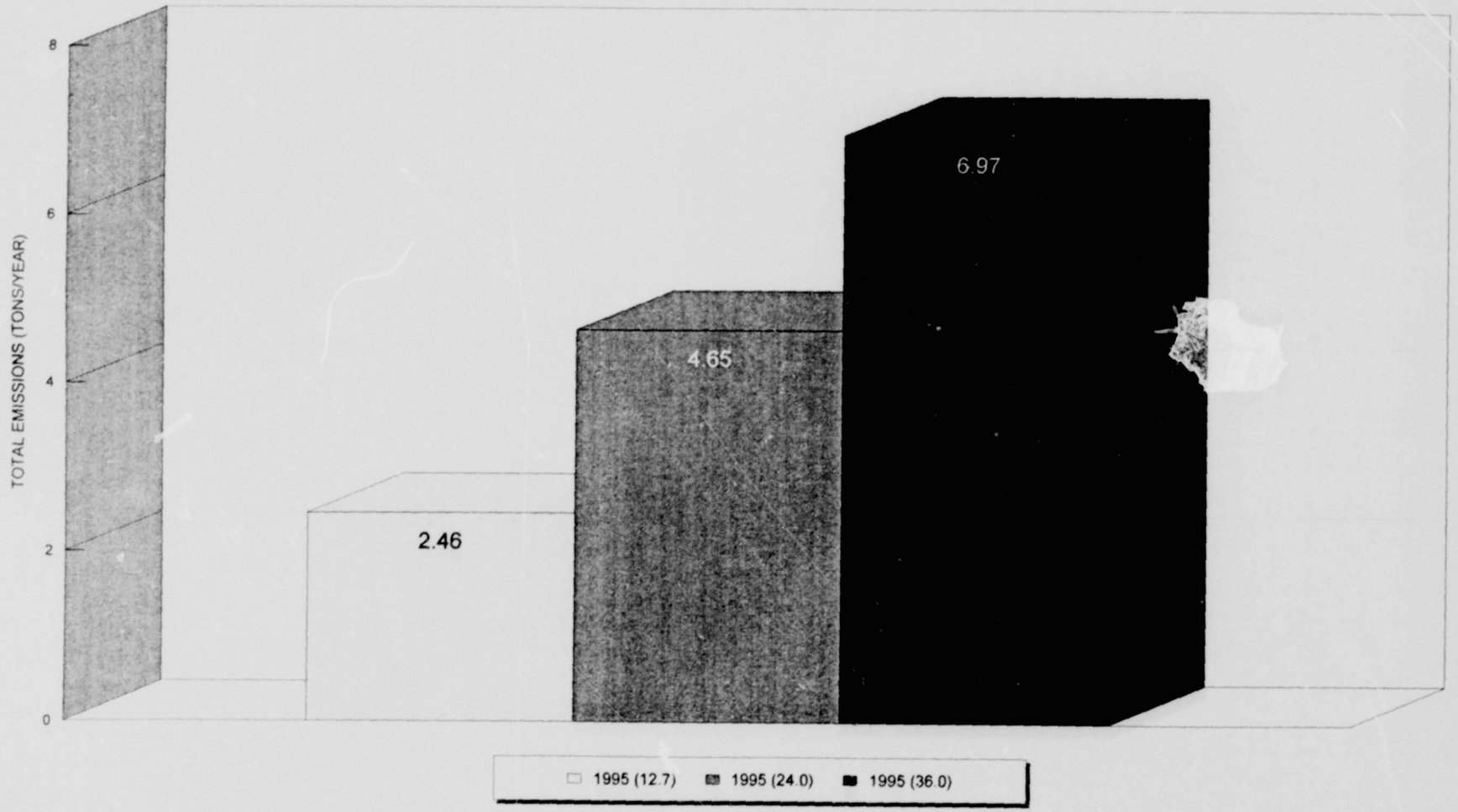
Train Crossing Scenario (trains/day)	1995	2000	2007	2015
12.7	2.46	3.06	3.44	3.79
24.0	4.64	5.78	6.51	7.16
36.0	6.97	8.67	9.76	10.74

Level of Service

Tables 5.4 through **5.6** show the summary of Level of Service for scenarios. For all years, when 12.7 trains per day cross, LOS is D, However, when additional trains are added, LOS worsens. For 24.0 trains per day in all study years, LOS is always E or better. When the number of trains are increased to 36.0 per day, then the LOS drops at a few locations to F, whereas the majority operated at LOS E.

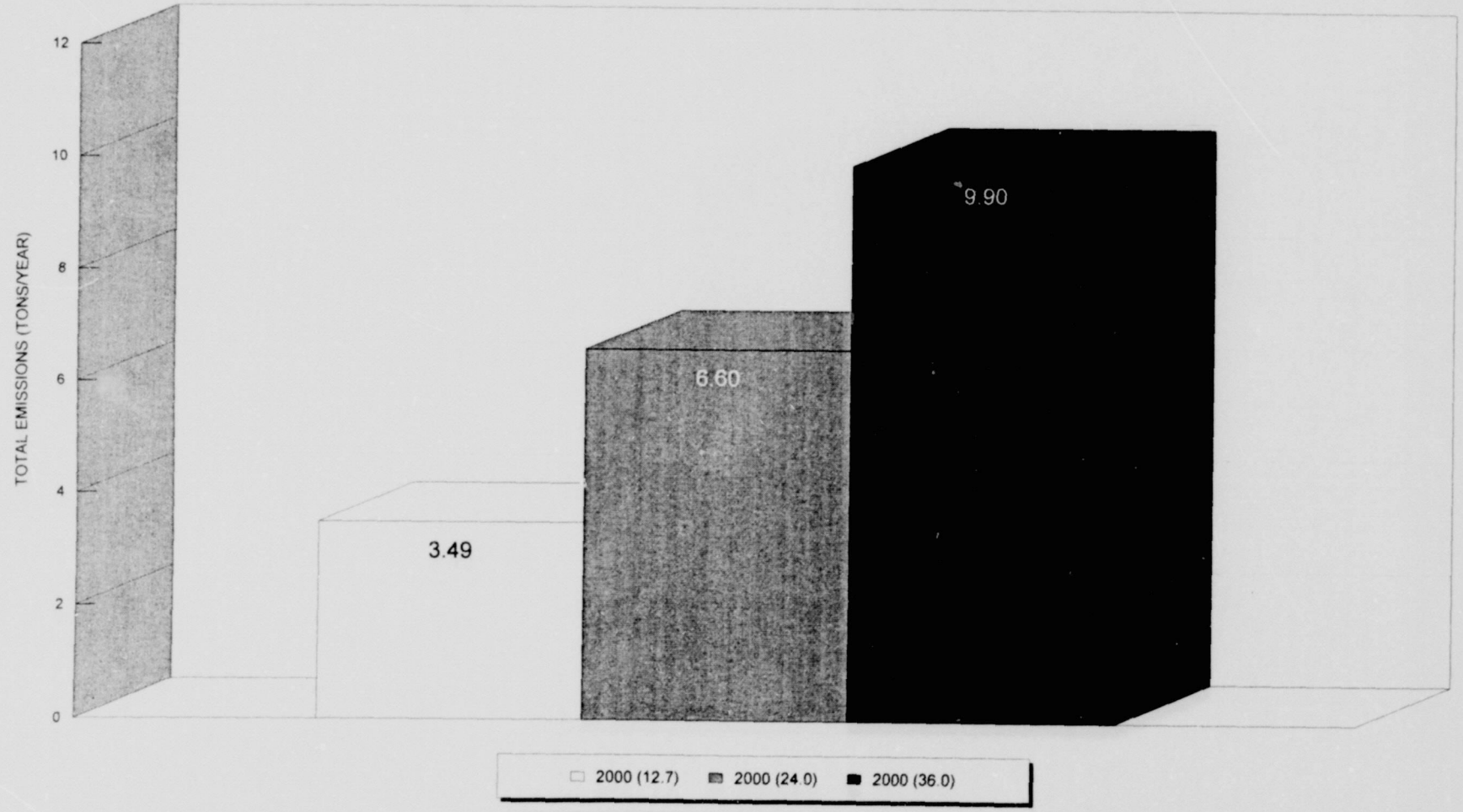
Reno Railroad Merger Study
Figure 5.9

1995 TOTAL ANNUAL EMISSIONS (TONS)

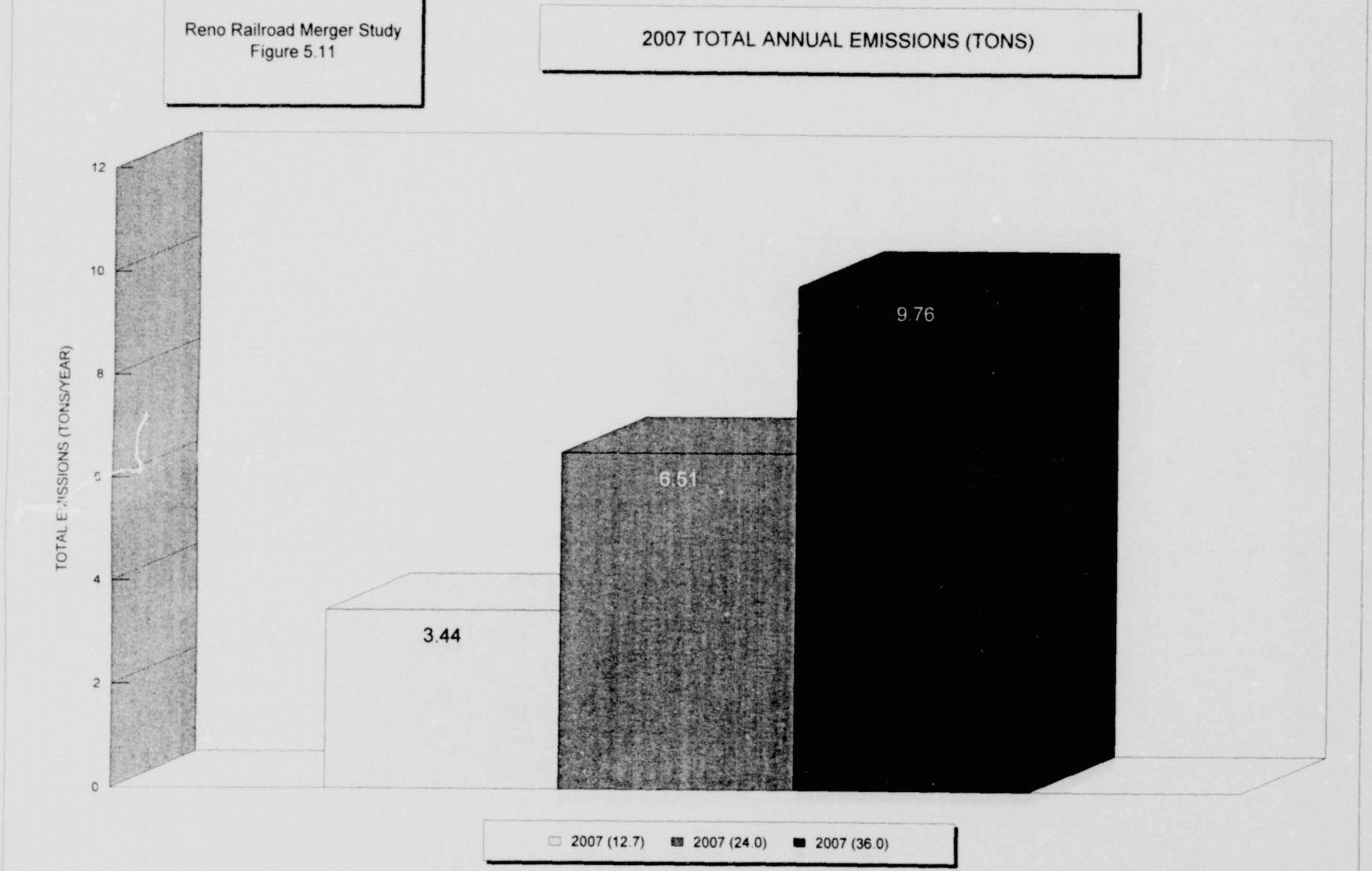


Reno Railroad Merger Study
Figure 5.10

2000 TOTAL ANNUAL EMISSIONS (TONS)



Reno Railroad Merger Study
Figure 5.11



Reno Railroad Merger Study
Figure 5.12

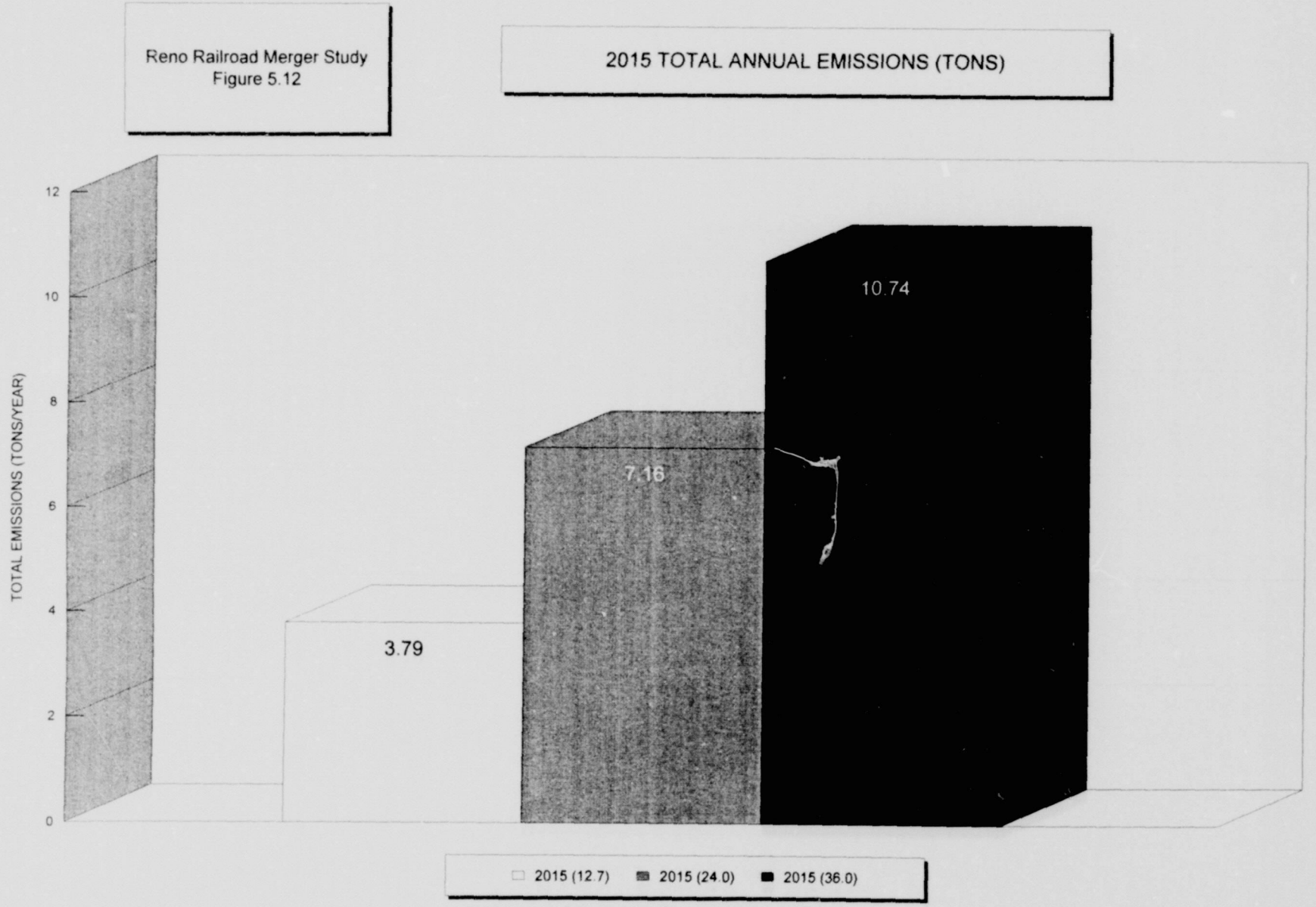


TABLE 5.4
NUMBER OF LINKS PER LEVEL OF SERVICE (AM PEAK)

	1995			2000			2007			2015		
	12.7	24.0	36.0	12.7	24.0	36.0	12.7	24.0	36.0	12.7	24.0	36.0
A												
B												
C												
D	22	22	22	24	24	24	24	24	24	24	24	24
E												
F												

TABLE 5.5
NUMBER OF LINKS PER LEVEL OF SERVICE (PM PEAK)

	1995			2000			2007			2015		
	12.7	24.0	36.0	12.7	24.0	36.0	12.7	24.0	36.0	12.7	24.0	36.0
A												
B												
C												
D	22	20	2	24	21		22	18	1	24	19	
E		2	17		3	20		4	17		5	18
F			3			4			4			6

TABLE 5.6
NUMBER OF LINKS PER LEVEL OF SERVICE (OFF PEAK)

	1995			2000			2007			2015		
	12.7	24.0	36.0	12.7	24.0	36.0	12.7	24.0	36.0	12.7	24.0	36.0
A												
B												
C	11			12			12			12		
D	11	22	11	12	24	12	12	24	12	12	24	12
E			11			12			12			12
F												

APPENDIX A
ADT Traffic Volume Data

A.1 ▪ NDOT ADT TRAFFIC VOLUME COUNTS
A.2 ▪ RTC PLANNING MODEL VOLUMES
A.3 ▪ 1995 AND 2015 ADT VOUMES FROM THE "RAILROAD MERGER FACT FINDING REPORT" FIGURES 11 AND 23

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Meyer, Mohaddes Associates, Inc.

CONTACT REPORT

Date: August 27, 1997 **J/P Number:** J97-068

Meeting By: Daw Hagerty

Contact Name: Mike Einwick / Steve Bunnell **Phone:**
City of Reno

Subject: Railroad Delay Study

SUMMARY I met with Mr. Einwick and Mr. Bunnell at City Hall on Tuesday, August 26th. We discussed several issues pertaining to traffic data for the Reno UP/SP Rail Merger Study. Mr. Bunnell provided me with several PM peak and AM peak period count summaries collected in late 1996 and 1997. These count sheets were for: Lake, Center, Sierra, Arlington, and Ralston at 2nd Street and 4th Street. At Sierra Street the counts were taken in the AM peak and all others were taken in the PM peak. The City is in the process of collecting additional counts. The schedule for this data collection is attached. Mr. Bunnell said he would fax all new counts to our office.

We also discussed the methodology which MMA will follow for estimating year 2000 ADT volumes. I explained that we will take an average growth rate determined from the RTC model data and apply that rate to the 1995 volumes used in our analysis. For data between 2007 and 2015, we will use the average growth rate determined from those model runs. We agreed that the NDOT ADT volumes were the most accurate data available for the 1995 traffic volumes and therefore should be used in our analysis. City collected counts will be used to verify the accuracy of those counts.

I also asked Mr. Einwick about signal pre-emption for rail crossings. Pre-emption occurs at the intersections closest to the tracks along Sierra, Virginia, Center and Sutro. Pre-emption allows for a clearance time where through movements are green, then the signal goes to flash until the train has cleared. After the train clears, the north-south movement returns immediately to green, allowin queued vehicles to clear.

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old
7-11 LOT

8-26 HS (1) Keystone ε 2nd

" " ε 4th

~~8-27 HS (2) Arkansas ε 2nd~~

8-26 EH (1) " ε 4th

5-25 EH (3) Virginia ε 2nd

3-27 EH (2) " ε 4th

8-25 HS (3) Vine ε 4th

8-27 A HS West ε 4th

" ε 2nd

Morrill ε 4th

Sutro ε 4th

~~Sierra ε Commercial~~

(4) " Plaza 8-29 EH

Virginia ε [illegible]

Virginia ε Plaza

(5) Center ε 2nd

Center ε Plaza

Commercial ε Sutro

RENO RAILROAD DELAY STUDY

ADT Volumes

Arterial	1995 Data (Calculated)	1997 RTC Planning Model	2007 RTC Planning Model	2000 Data (1) (Calculated)
Keystone	22,100	25,700	28,400	24,300
Vine	4,185	2,900	900	4,600
Washington	1,875	2,100	200	2,100
Ralston	3,785	3,500	2,800	4,200
Arlington	15,200	2,600	14,900	16,700
West	3,200			3,500
Sierra	19,700	9,400	7,000	21,700
Virginia	14,000	17,000	26,000	15,400
Center	11,600	11,500	11,000	12,800
Lake	7,575	9,000	5,400	8,300
Evans	--	--	12,500	13,380
Morrill	300			300
Sutro	11,700	11,700	13,700	12,900
Total Vol.		95,400	122,800	
Average Growth Rate			0.02	

Notes:

(1) 1995 Data Converted to 2000 Data based the average growth rate of 2% per year.

RENO RAILROAD DELAY STUDY
ADT Volumes by Source

Arterial	1995 NDOT ADT Volumes	1995 Railroad Merger Report	1997 RTC Planning Model	1997 STB Field Observation Database	2007 RTC Planning Model	2015 Railroad Merger Report	2015 RTC Planning Model	1995 Data (1)
Keystone	22,100		25,700	38,000	28,400		32,200	22,100
Vine	4,185		2,900		900		100	4,185
Washington	1,875	2,000	2,100		200	1,900	2,000	1,875
Ralston	3,785	2,800	3,500		2,800	3,300	2,800	3,785
Arlington	8,415	15,200	2,600	16,400	14,900	20,300	15,000	15,200 (3)
West		3,200				4,000		3,200
Sierra	19,700	8,000	9,400	9,700	7,000	18,200	7,000	19,700
Virginia	14,000	15,200	17,000	15,000	26,000	22,000	27,800	14,000
Center	11,600	12,000	11,500	7,123	11,000	15,500	10,600	11,600
Lake	7,575	9,500	9,000		5,400	12,800	3,600	7,575
Morrill								300 (2)
Evans	--	--	--	--	12,500	13,100	17,100	--
Sutro	11,700		11,700		13,700		12,300	11,700
Total Vol.			95,400		122,800		130,500	
Growth Rate (per year)					0.02		0.01	

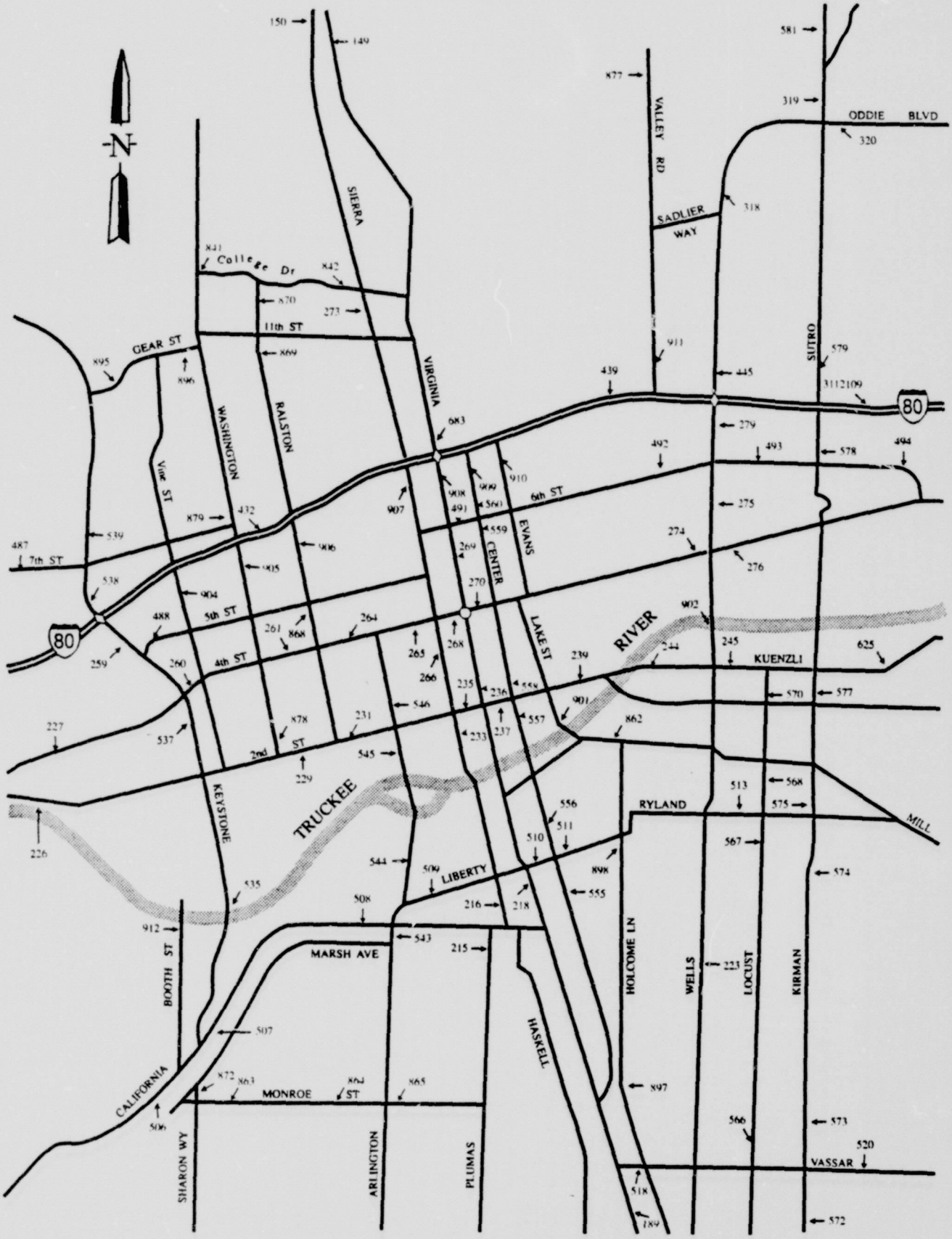
Notes:

(1) 1997 Traffic Volumes converted to 1995 Traffic Volumes using 1% growth rate per year.

(2) Traffic Volume for Morrill Street estimated by Mike Einwick, City of Reno.

(3) Since the model data for Arlington (1997) is significantly different from all other volumes for this arterial, 1995 data from the Railroad Merger report will be used.

APPENDIX A.1
NDOT ADT TRAFFIC VOLUME COUNTS



CENTRAL RENO

WASHOE COUNTY

TABLE 3 - ANNUAL AVERAGE DAILY TRAFFIC AT PORTABLE TRAFFIC COUNT STATIONS -

STATION	1986	1987	1988	1989	1990	1991	1992	1993	1994	199
31-0225	SR-647 (W 4th St)., 0.15 mile west of SR-648 (W 2nd St).									
HRLY 95	4905	4710	5830	5760	6870	6950	7440	8100	10000	862
31-0226	SR-648 (W 2nd St)., 300 feet east of SR-647 (W 4th St).									
HRLY 93	5200	5310	5780	5700	5970	5760	5140	4450	5200	544
31-0227	SR-647 (W 4th St)., 0.25 mile east of SR-648 (W 2nd St).									
	5355	5695	6200	6215	6735	6815	7210	7850	8800	830
31-0229	SR-648 (W 2nd St)., 200 feet west of Ralston Street.									
HRLY 95									7200	700
31-0231	SR-648 (W 2nd St)., 100 feet east of Ralston Street.									
HRLY 95										691
31-0233	SR-660 (N Sierra St)., 75 feet south of SR-648 (W 2nd St).									
									8000	782
31-0235	SR-648 (W 2nd St)., 100 feet west of SR-430 (N Virginia St).									
HRLY 95									10200	880
31-0236	SR-430 (N Virginia St)., 100 feet north of SR-648 (W 2nd St).									
									13900	1400
31-0237	SR-648 (E 2nd St)., 150 feet east of SR-430 (N Virginia St).									
										583
31-0239	Kuenzli St., West of the Truckee River Bridge at separation of eastbound and westbound lanes.									
HRLY 96									5700	582
31-0244	Kuenzli Ln., 25 feet east of Park Street.									
HRLY 96									6600	674
31-0245	Kuenzli Ln., 250 feet east of SR-663 (Wells Ave).									
HRLY 96	8540	8755	8515	7955	6660	6600	6200	5835	5900	608

WASHOE COUNTY

TABLE 3 - ANNUAL AVERAGE DAILY TRAFFIC AT PORTABLE TRAFFIC COUNT STATIONS -

STATION	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
31-0249	SR-648 (E 2nd St)., 300 feet west of SR-667 (Kietzke Ln).									13300
31-0250 HRLY 96	SR-667 (Kietzke Ln)., 250 feet south of SR-648 (E 2nd St). 20500	20500	19000	19600	19900	17800	18000	18800	19100	18900
31-0251 HRLY 95	SR-648 (E 2nd St)., 0.15 mile east of SR-667 (Kietzke Ln). 19000	18400	18400	17700	17275	15500	15200	16300	16500	15900
31-0253 HRLY 95	SR-648 (Glendale Ave)., 0.1 mile west of SR-650 (McCarran Blvd). 13000	13200	14575	14335	13650	13200	13150	14300	14640	1440(
31-0254 HRLY 95	SR-650 (McCarran Blvd)., 0.1 mile north of SR-648 (Glendale Ave). 30900	31800	32800	32100	29500	28150	27300	29500	30250	3060(
31-0255	SR-650 (McCarran Blvd)., 0.1 mile south of SR-648 (Glendale Ave). 20800	21000	21900	21200	20000	19300	17550	19950	20330	2060(
31-0256	East Greg St., 100 feet east of SR-650 (McCarran Blvd).								16900	1720(
31-0257 HRLY 95	SR-650 (McCarran Blvd)., 0.5 mile north of Mill St. 18400	19500	20700	20500	21750	20800	20750	21800	23200	2330(
31-0258 HRLY 95	SR-650 (McCarran Blvd)., 0.1 mile south of Mill St. 14400	16400	16400	16400	17000	16000	16400	16400	17900	1850(
31-0259 HRLY 96	SR-657 (Keystone Ave)., 0.1 mile south of I-80 and 100 feet north of 5th Street. 30740	31400	30000	30700	27300	29500	29800	32700	32800	3420(
31-0260	SR-647 (W 4th St)., 100 feet east of SR-657 (Keystone Ave). 11700	11100	11600	11500	11250	11350	10850	11250	11700	996(
31-0261	SR-647 (W 4th St)., 150 feet east of Washington Street. 11800	11200	11750	11650	11400	11500	11000	12900	13400	1070(

WASHOE COUNTY

TABLE 3 - ANNUAL AVERAGE DAILY TRAFFIC AT PORTABLE TRAFFIC COUNT STATIONS -

STATION	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
31-0535	SR-657 (Keystone Ave)., 100 feet south of Jones Street.									
	15500	16000	15250	15600	14035	13250	13950	13500	14000	14000
31-0537	SR-657 (Keystone Ave)., 100 feet south of SR-647 (W 4th St).									
	22000	24310	23200	21700	21000	19300	20300	20800	22700	22100
31-0538 HRLY 95	SR-657 (Keystone Ave)., Between the I-80 westbound ramps and W 7th St.									
	31000	28600	26900	27500	24400	28100	26300	26765	28000	28800
31-0539 HRLY 94	SR-657 (Keystone Ave)., 200 feet north of W 7th St.									
	17000	14500	15800	15200	14800	15700	14700	16385	17100	17600
31-0541	SR-657 (Keystone Ave)., 300 feet north of Coleman Drive.									
	2585	2795	3120	3300	3680	3750	3985	4020	3910	4145
31-0543	Arlington Ave., 25 feet north of Marsh Avenue.								13300	13200
31-0544	Arlington Ave., 125 feet north of W Liberty St.								16600	17500
31-0545 HRLY 95	Arlington Ave., 200 feet south of SR-648 (W 2nd St).								12500	13000
31-0546	Arlington Ave., 100 feet north of SR-648 (W 2nd St).									841
31-0547	US-395., N/B off-ramp of the Cold Springs Valley Intch, 50' north of US-395.									
	1250	1580	1850	2010	2075	2230	2210	2315	2415	2430
31-0549	US-395., S/B on-ramp of the Cold Springs Valley Intch, 25' S of the cross traffic road.									
	1280	1495	1830	1995	2060	2225	2210	2315	2400	2360
31-0555	South Center St., 100 feet south of E Liberty St.									812

WASHOE COUNTY

TABLE 3 - ANNUAL AVERAGE DAILY TRAFFIC AT PORTABLE TRAFFIC COUNT STATIONS -

TATION	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
1-0264	SR-647 (W 4th St)., 115 feet east of Ralston Street.									
	14400	13800	14100	13950	14000	12300	11600	12850	13500	10000
1-0265	SR-647 (W 4th St)., 150 feet west of SR-660 (N Sierra St).									
RLY 96	15300	14700	14800	14600	14700	14000	13250	15400	16000	11900
1-0266	SR-660 (N Sierra St)., 150 feet south of SR-647 (W 4th St).									
									20200	19700
1-0268	SR-647 (W 4th St)., 100 feet west of SR-430 (N Virginia St).									
RLY 93	15400	14800	15000	15000	15100	14400	14400	15000	15600	15100
1-0269	SR-430 (N Virginia St)., 300 feet north of SR-647 (4th St).									
									13000	13100
1-0270	SR-647 (E 4th St)., 220 feet east of SR-430 (N Virginia St).									
RLY 94	15000	14200	14600	14700	13900	13900	13400	14700	13700	13200
1-0273	SR-660 (N Sierra St)., 75 feet south of Imperial Way.									
	7310	8365	7675	8155	8210	7505	7525	7615	7900	8110
1-0274	SR-647 (E 4th St)., 200 feet west of SR-663 (Wells Ave).									
	13900	13600	14250	14535	12850	14600	14000	15335	14200	13700
1-0275	SR-663 (Wells Ave) underpass., 150 feet north of SR-647 (4th St).									
RLY 96										1930
1-0276	SR-647 (E 4th St)., 220 feet east of SR-663 (Wells Ave).									
RLY 93	13300	13000	13000	13260	13200	13450	13000	12675	13700	13200
1-0279	SR-663 (Wells Ave)., 200' North of 6th St for S/B and 100' North of 6th street for N/B.									
RLY 96										30800
1-0280	SR-647 (E 4th St)., 0.15 mile west of Tacchino Street.									
	13400	13600	13700	14300	13300	12450	11350	14000	14400	14700

WASHOE COUNTY

TABLE 3 - ANNUAL AVERAGE DAILY TRAFFIC AT PORTABLE TRAFFIC COUNT STATIONS -

STATION	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
31-0556	South Center St., 100 feet north of E Liberty St.								6600	6250
31-0557	South Center St., 100 feet north of First Street.								10300	9750
31-0558 EARLY 96	South Center St., 200 feet north of SR-648 (E 2nd St).								12000	11600
31-0559	North Center St., 100 feet south of E 6th St.								7000	7130
31-0560	North Center St., 100 feet north of E 6th St.								8000	9130
31-0564	Locust St., 100 feet north of SR-653 (E Plumb Ln).								5900	6070
31-0566	Locust St., 100 feet north of Vassar St.	2555	2365	2380	2400	2515	2310	2110	2300	2180
31-0567	Locust St., 300 feet south of Ryland St.	2595	2590	2640	3300	3700	2465	2390	2750	2580
31-0568	Locust St., 25 feet north of Ryland St.									1215
31-0570	Locust St., 200 feet north of SR-648 (E 2nd St).								1430	1530
31-0571	Kirman Ave., 100 feet north of SR-653 (E Plumb Ln).								4800	5005
31-0572	Kirman Ave., 100 feet south of Vassar St.								3000	3300

WASHOE COUNTY

TABLE 3 - ANNUAL AVERAGE DAILY TRAFFIC AT PORTABLE TRAFFIC COUNT STATIONS -

STATION	1986	1987	1988	1989	1990	1991	1992	1993	1994	199
31-0573	Kirman Ave., 100 feet north of Vassar St.									
	2710	2365	2345	2530	3290	3175	2950	2815	3000	330
31-0574	Kirman Ave., 125 feet south of Ryland St.									
HRLY 94	2665	2325	1950	2340	3565	2915	2995	3025	3100	342
31-0575	Kirman Ave., 75 feet north of Willow Street.									
	2775	2420		3215	5795	5430	5500	4300	4300	479
31-0577	Kirman Ave., 100 feet north of SR-648 (E 2nd St).									
									7500	718
31-0578	Sutro St., 150 feet north of E 6th St.									
	8735	8470	8635	8560	13630	13000	11200	12100	11300	1170
31-0579	Sutro St., 200 feet south of East 9th Street.									
									11900	1180
31-0581	Sutro St., 150 feet north of Wedekind Road.									
	7210	8250	8310	8895	9050	9320	9725	8710	9100	926
31-0582	Sutro St., 300 feet south of SR-651 (N McCarran Blvd).									
HRLY 95	6065	6100	6175	7400	7140	7055	6990	6100	6600	797
31-0583	SR-667 (Kietzke Ln)., 300 feet south of Gentry Way.									
HRLY 96	26300	26800	25800	27200	26400	25600	25600	27300	26600	2620
31-0584	SR-668 (South Rock Blvd)., 400' N of Mill St, just S of the Truckee River Bridge.									
HRLY 93	8975	8830	8845	9835	9685	9035	10100	9900	10180	936
31-0585	SR-668 (South Rock Blvd)., 0.15 mile south of SR-648 (Glendale Rd).									
HRLY 95	19900	19000	17800	18400	19500	18000	19000	18200	18695	1800
31-0586	SR-668 (Rock Blvd)., 75 feet north of "D" Street.									
HRLY 95										1580

WASHOE COUNTY

TABLE 3 - ANNUAL AVERAGE DAILY TRAFFIC AT PORTABLE TRAFFIC COUNT STATIONS -

TATION		1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
31-0868	Ralston Street., 150 feet north of SR-647 (W Fourth St).								2795	3100	3785
31-0869	Ralston Street., 200 feet north of West Tenth Street.								1650	1700	1760
31-0870	Ralston Street., 100 feet north of Imperial Blvd.								435	450	445
31-0871 HRLY 93	Sharon Way., Between Donna Drive and Bergner Lane.								2300	2600	2970
31-0872	Sharon Way., 50 feet south of Marsh Avenue.								2875	2860	2730
31-0873	Sierra Madre Drive., Between Matich Drive and Reggie Road.								1470	1650	1575
31-0874	Silverada Blvd., Between Tom Sawyer Drive and Carville Drive.								4555	4500	4540
31-0875	Silverada Blvd., Between SR-663 (Oddie Blvd) and Paradise Drive.								8150	7900	8690
31-0876	Silverada Blvd., 0.1 mile north of Oddie Blvd.								7975	7500	8000
31-0877	Valley Road., 250 feet north of Manogue Road.								2980	3600	3365
31-0878 HRLY 95	Washington Street., 200 feet north of West Second Street.								1695	1600	1875
31-0879	Washington Street., 200 feet south of University Terrace.								4255	5000	5000

TABLE 3 - ANNUAL AVERAGE DAILY TRAFFIC AT PORTABLE TRAFFIC COUNT STATIONS -

STATION	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
31-0892	Fourth Street., 100 feet north of Tasker Way.							3475	3250	3265
31-0893	Fourth Street., Between Galleron Way and Devere Way.							2720	2540	2690
31-0894	Fourth Street, 100' north of Queen Way.							1210	1250	1275
31-0895	Gear Street., 400 feet west of Williams Avenue.							960	790	820
31-0896	Gear Street., 50 feet east of Vine Street.							600	600	635
31-0897	Holcomb Lane., Between Burns Street and Wonder Street.							6380	6800	6785
31-0898	Holcomb Lane., Between Stewart Street and east Liberty Street.							3650	3800	4250
31-0900	Clean Water Way., Over Steamboat Creek, at the West end of structure.							240	250	235
31-0901	Lake Street., Bridge over Truckee River, in the middle of the structure.							4600	6900	7575
31-0902 IRLY 96	SR-663 (Wells Ave) underpass., 0.1 mi north of Kuenzli.							3175	3200	3410
31-0903	Mountain View., Grade separation, 190 feet north of Mountain View Cemetary.							20	30	35
31-0904	Vine Street., Grade separation, 200 feet south of University Terrace.							2240	2600	4185

WASHOE COUNTY

TABLE 3 - ANNUAL AVERAGE DAILY TRAFFIC AT PORTABLE TRAFFIC COUNT STATIONS -

STATION	1986	1987	1988	1989	1990	1991	1992	1993	1994	199
31-0905	Washington Street., Grade separation, 160 feet south of 7th Street.							4570	5100	462
31-0906 HRLY 93	Ralston Street., Grade separation, 190 feet north of Elm Street.							3660	4100	372
31-0907 HRLY 96	Sierra Street., Grade separation, 75 feet south of the westbound on-ramp to I-80.							11320	9800	920
31-0908 HRLY 96	Virginia Street., Grade separation, 120 feet south of 8th Street.							16300	18800	1900
31-0909	Center Street., Grade separation, 80 feet south of I-80 westbound off-ramp.							3415	3400	413
31-0910	Evans Street., Grade separation, 70 feet north of 8th Street.							2450	2650	188
31-0911	Valley Road., Grade separation, 130 feet north of 8th Street.							4235	5000	486
31-0912	Booth Street., 100' s of bridge over the Truckee River & guy wire west for Idlewild Dr.							4760		620
31-0913 HRLY 95	I-80., .2 mi east of the Vista Blvd Intch.							20680	21730	2268
31-0930 HRLY 95	SR-431., 0.15 mile east of the Callahan Ranch Road.							7450	8420	887
31-0931 HRLY 95	SR-651 (N McCarran Blvd)., 0.1 mile east of Kings Row.							11800	13260	1360
31-0933 HRLY 95	I-80., W/B on-ramp of the Robb Drive Intch, 200' west of the cross traffic road.							285	295	35

APPENDIX A.2
RTC PLANNING MODEL VOLUMES

- 1997
- 2007
- 2015

EXISTING WEEKDAY TRAFFIC IN 00's *

* SOME ADT VOLUMES WERE DERIVED FROM PM AND AADT COUNTS.

Regional Transportation Commission Planning Department 07/17/97 \1997_567\elnwckex.wor

2007 MODEL FORECAST – WEEKDAY TRAFFIC IN 00's

Regional Transportation Commission Planning Department 07/17/97 \1997_567\einwck07.wor

2015 MODEL FORECAST -- WEEKDAY TRAFFIC IN 00's

Regional Transportation Commission Planning Department 07/17/97 \1997_567\elnwck15.wor

APPENDIX A.3
RAILROAD MERGER FACT FINDING REPORTADT VOLUMES

- 1995 - FIGURE 11
- 2015 - FIGURE 23

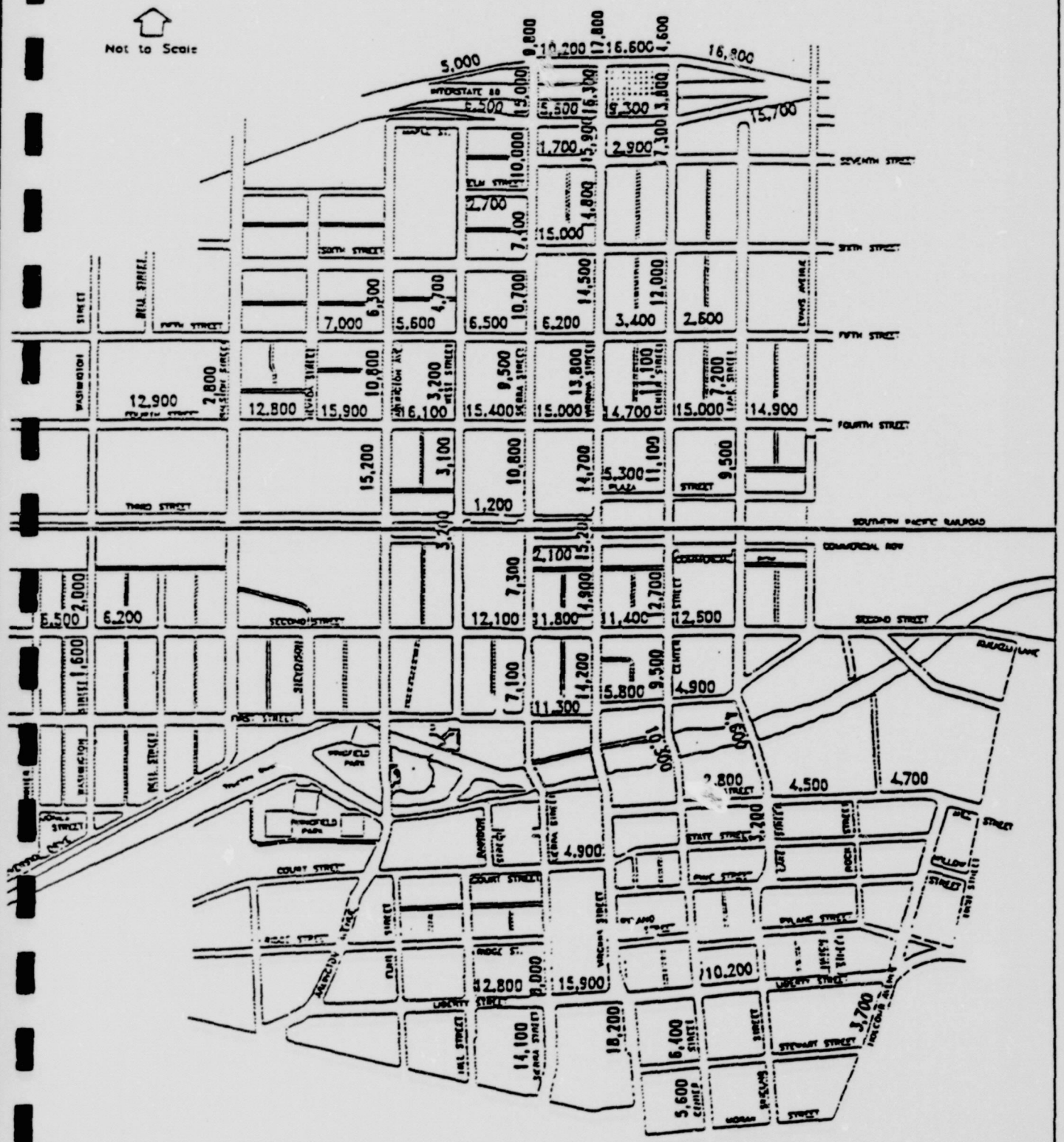


Figure 11

EXISTING AVERAGE DAILY TRAFFIC VOLUMES

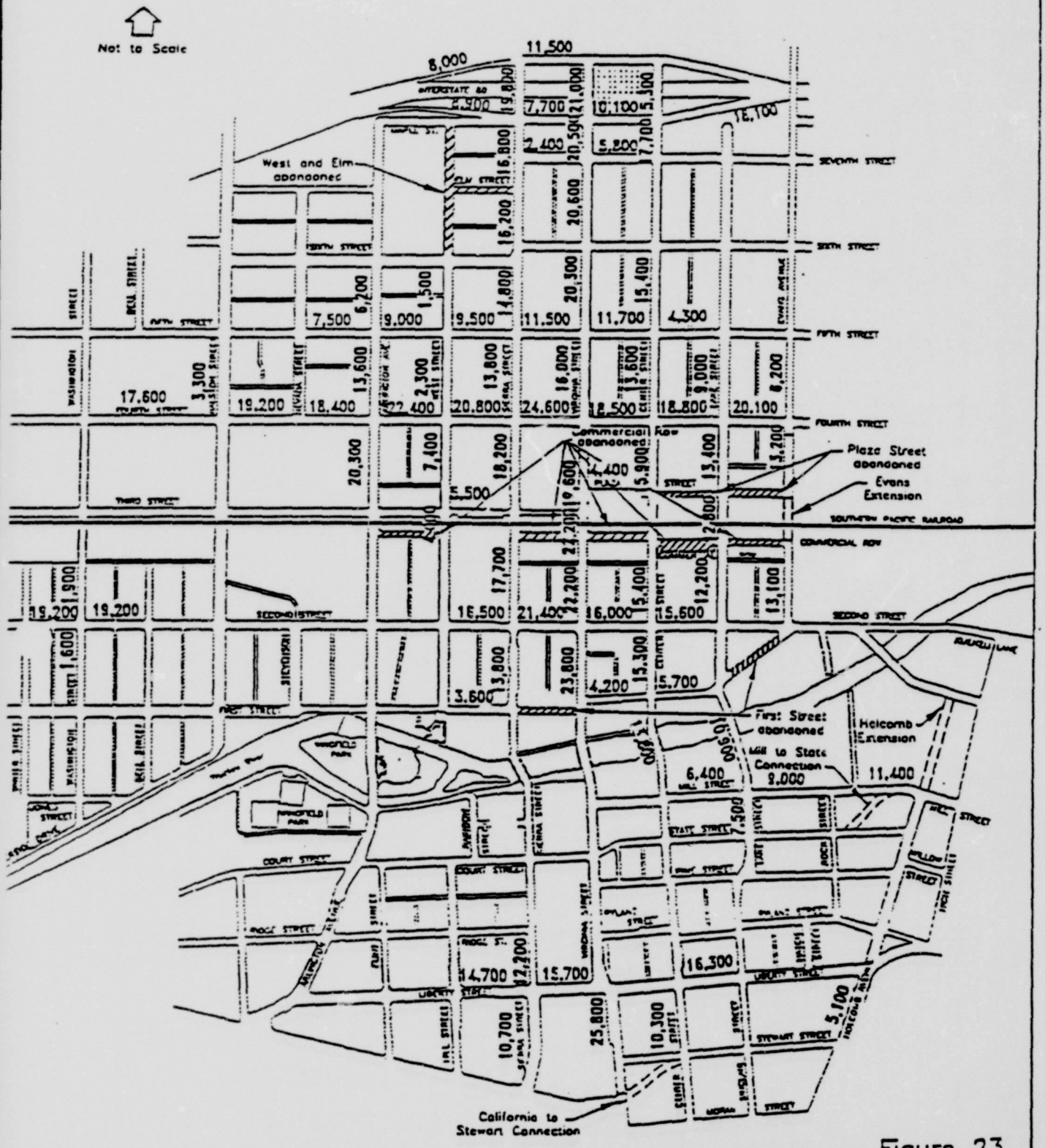


Figure 23

YEAR 2015 AVERAGE DAILY TRAFFIC VOLUMES (Modified Network)

APPENDIX B
CITY COLLECTED TURNING MOVEMENT VOLUMES

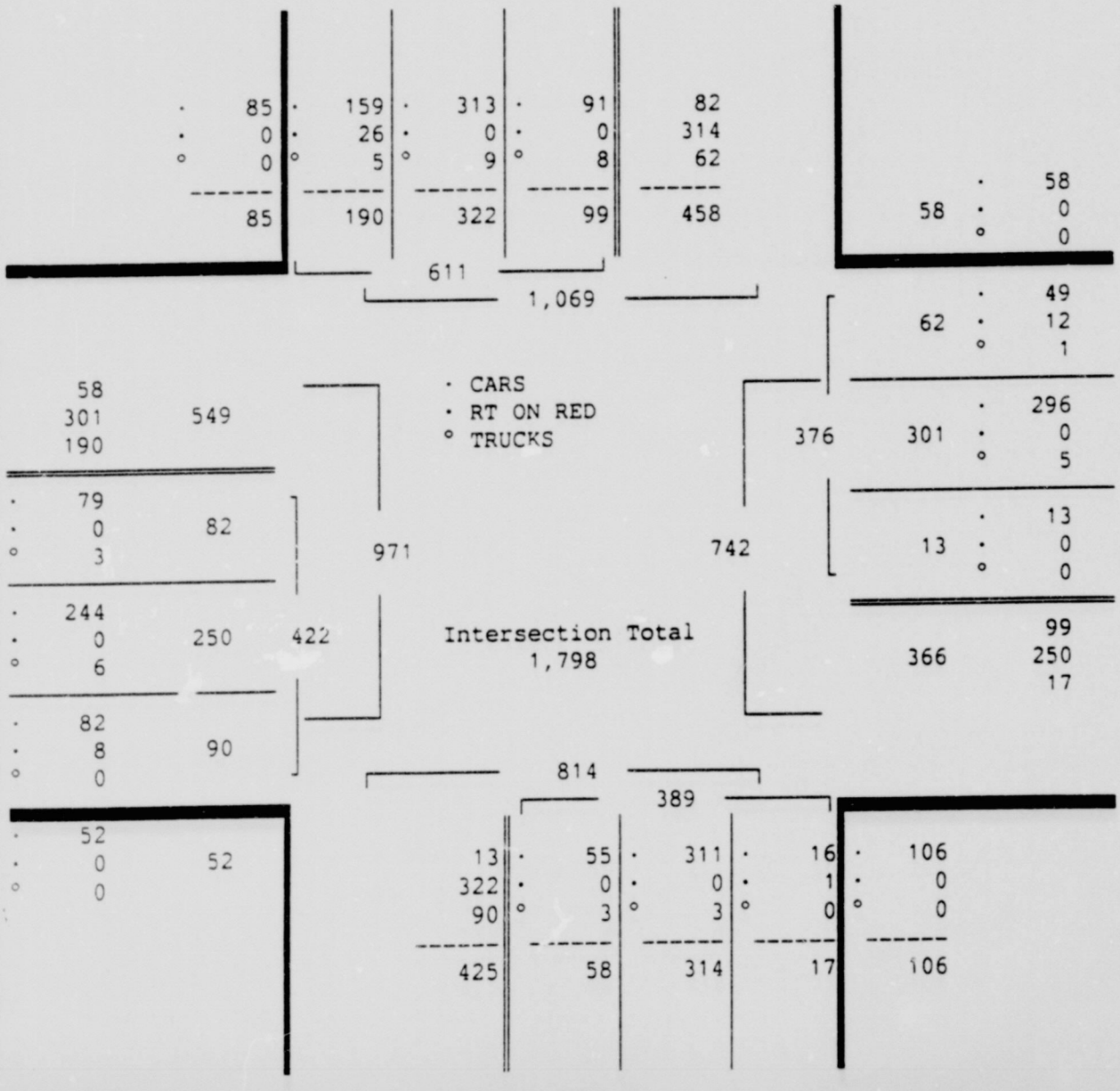
Weather: SUNNY 68
[illegible]NTED BY EH
[illegible]4/97 PM
LAKE & SECOND STREET

2 ND STREET & LAKE STREET
CITY OF RENO
5/5/1997
MONDAY

Site Code : 00000196
Start Date: 03/14/[illegible]
File I.D. : 2NDLAK[illegible]
Page : 2

CARS, RT ON RED, TRUCKS

	Southbound				Westbound				Northbound				Eastbound				Tot
	Left	Thru	Right	Other	Left	Thru	Right	Other	Left	Thru	Right	Other	Left	Thru	Right	Other	
Date 03/14/97																	
Peak Hour Analysis By Entire Intersection for the Period: 16:15 to 17:45 on 03/14/97																	
Peak start	16:45				16:45				16:45				16:45				
Volume	99	322	190	85	13	301	62	58	58	314	17	106	82	250	90	52	
Percent	14%	46%	27%	12%	3%	69%	14%	13%	12%	63%	3%	21%	17%	53%	19%	11%	
Pk total	696				434				495				474				
Highest	17:00				17:00				17:00				17:30				
Volume	32	90	64	15	5	87	16	21	12	105	5	23	24	62	28	20	
Hi total	201				129				145				134				
PHF	.87				.84				.85				.88				



Weather:CLOUDY 67

/1997

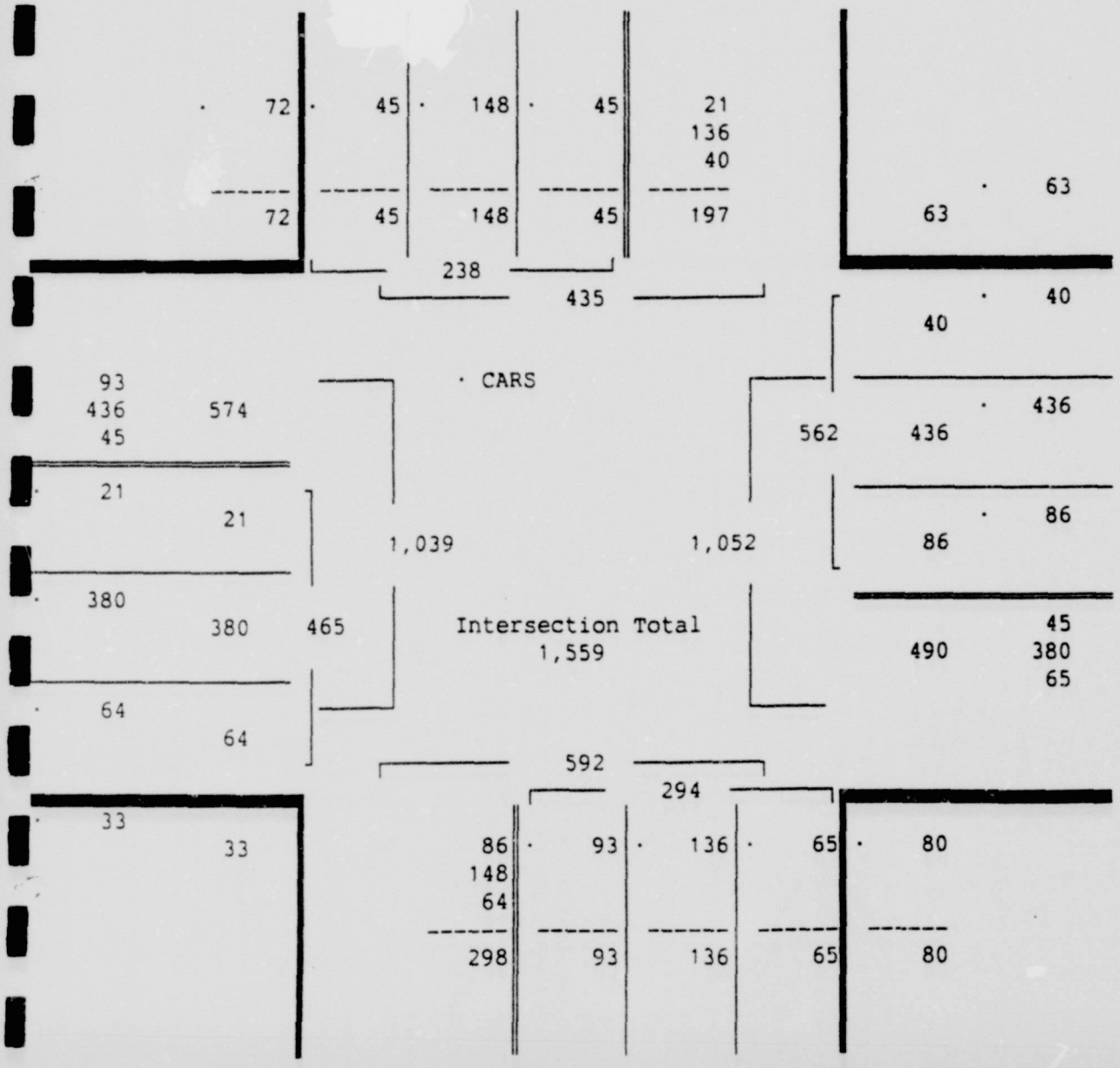
LAKE & FOURTH

LAKE STREET & FOURTH STREET
CITY OF RENO
4/15/1997
TUESDAY

Site Code : 0000024
Start Date: 04/15/9
File I.D. : LAK4THP
Page : 2

CARS

	Southbound				Westbound				Northbound				Eastbound				Tota
	Left	Thru	Right	Other	Left	Thru	Right	Other	Left	Thru	Right	Other	Left	Thru	Right	Other	
Date 04/15/97																	
Peak Hour Analysis By Entire Intersection for the Period: 16:00 to 17:00 on 04/15/97																	
Peak start	16:00				16:00				16:00				16:00				
Volume	45	148	45	72	86	436	40	63	93	136	65	80	21	380	64	33	
Percent	15%	48%	15%	23%	14%	70%	6%	10%	25%	36%	17%	21%	4%	76%	13%	7%	
Pk total	310				625				374				498				
Highest	16:15				16:30				16:30				16:00				
Volume	7	48	10	18	18	102	13	37	25	31	14	44	5	108	18	4	
Hi total	83				170				114				135				
PHF	.93				[illegible]				.82				.92				



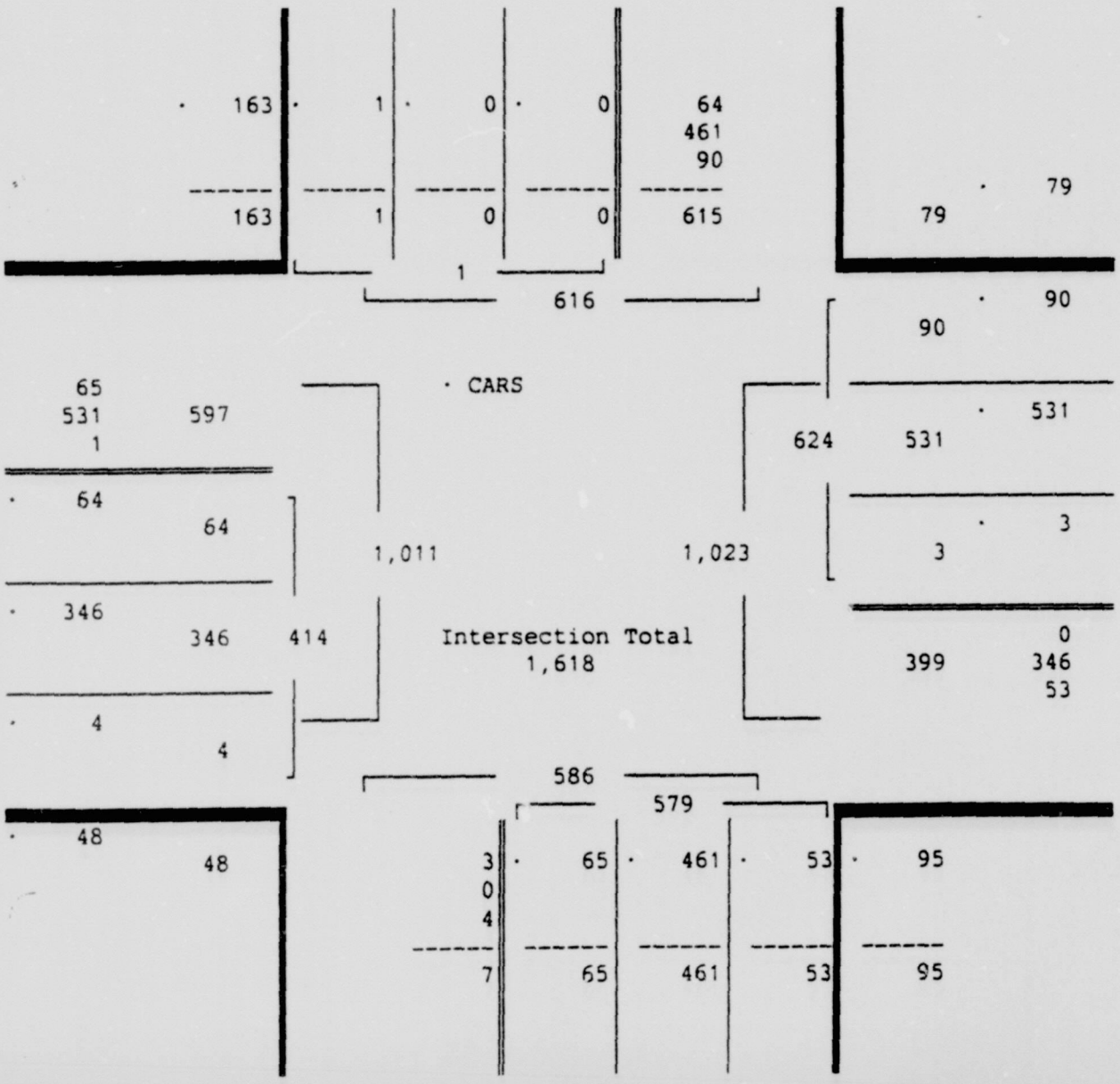
Weather: CLEAR 68
C[illegible]TED BY EH
[illegible]0/97 PM
4TH STREET & CENTER STREET

4TH CENTER
CITY OF RENO
03-10-1997
MONDAY

Site Code : 0000019[illegible]
Start Date: 03/10[illegible]
File I.D. : 4THCE[illegible]
Page : 2

CARS

	From North				From East				From South				From West				
	Other	Right	Thru	Left	Other	Right	Thru	Left	Other	Right	Thru	Left	Other	Right	Thru	Left	Tota
Date 03/10/97																	
Peak Hour Analysis By Entire Intersection for the Period: 16:30 to 17:30 on 03/10/97																	
Peak start	16:30				16:30				16:30				16:30				
Volume	163	1	0	0	79	90	531	3	95	53	461	65	48	4	346	64	
Percent	99%	1%	0%	0%	11%	13%	76%	0%	14%	8%	68%	10%	10%	1%	75%	14%	
Pk total	164				703				674				462				
Highest	16:45				17:00				17:00				16:30				
Volume	73	0	0	0	16	29	161	0	16	10	190	19	13	0	98	22	
Hi total	73				206				235				133				
PHF	.56				.85				.72				.87				



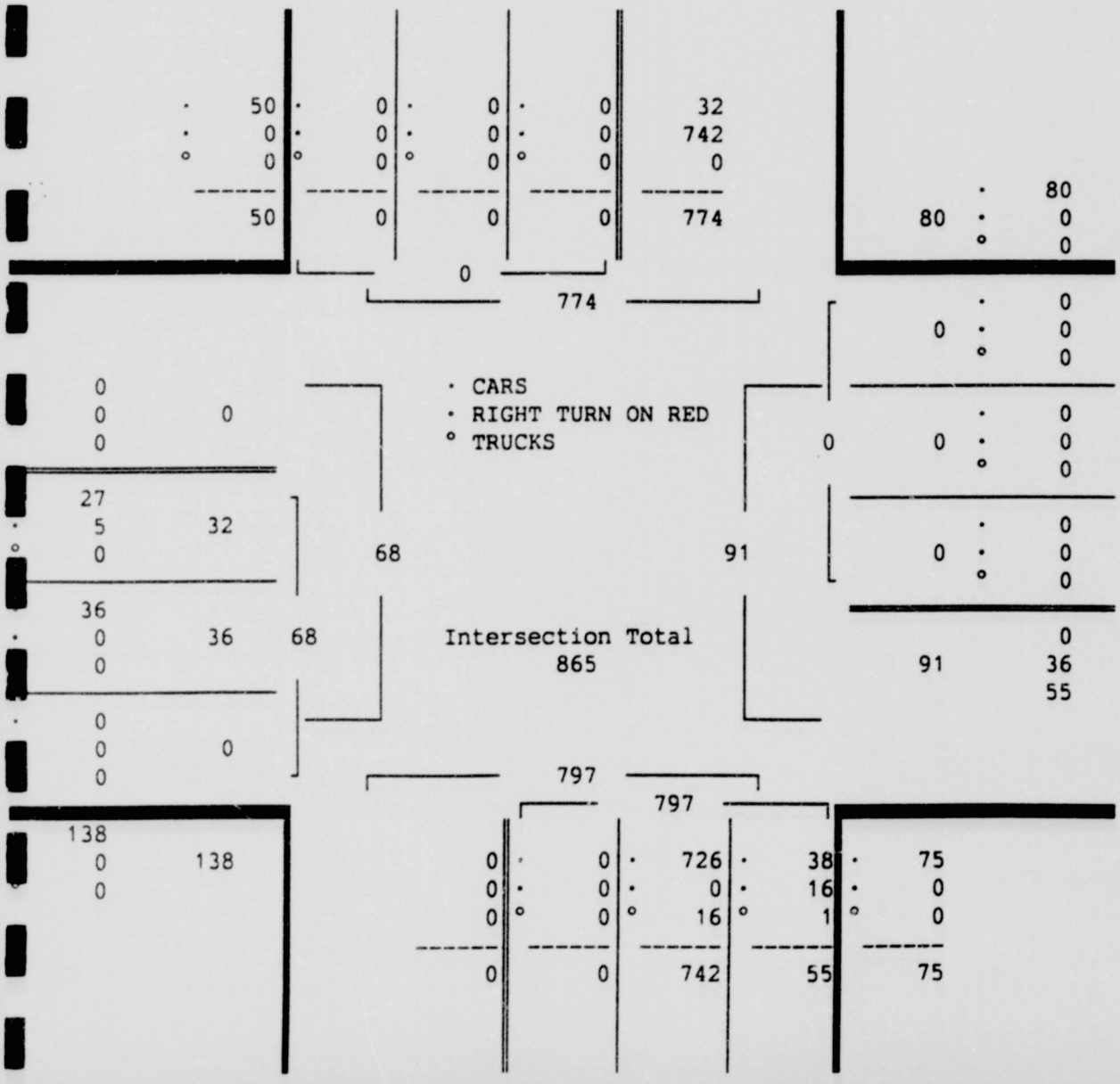
CENTER STREET AND COMMERCIAL ROW
CITY OF RENO
JULY 22, 1997
TUESDAY

Weather: SUNNY/94F
[illegible]ted by: EH
[illegible]: JULY 22, 1997
Street names: CENTER AND COMMERCIAL

Site Code : 00000291
Start Date: 07/22/97
File I.D. : CENCOMPM
Page : 2

CARS, RIGHT TURN ON RED, TRUCKS

	Southbound				Westbound				Northbound				Eastbound				
	Left	Thru	Right	Other	Left	Thru	Right	Other	Left	Thru	Right	Other	Left	Thru	Right	Other	Total
Date 07/22/97																	
Peak Hour Analysis By Entire Intersection for the Period: 16:31 to 17:31 on 07/22/97																	
Peak start	16:31				16:31				16:31				16:31				
Volume	0	0	0	50	0	0	0	80	0	742	55	75	32	36	0	138	
Percent	0%	0%	0%	100%	0%	0%	0%	100%	0%	85%	6%	9%	16%	17%	0%	67%	
PK total	50				80				872				206				
Highest	16:31				17:16				17:01				17:01				
Volume	0	0	0	15	0	0	0	25	0	232	21	18	13	11	0	48	
PK total	15				25				271				72				
PHF	.83				.80				.80				.72				



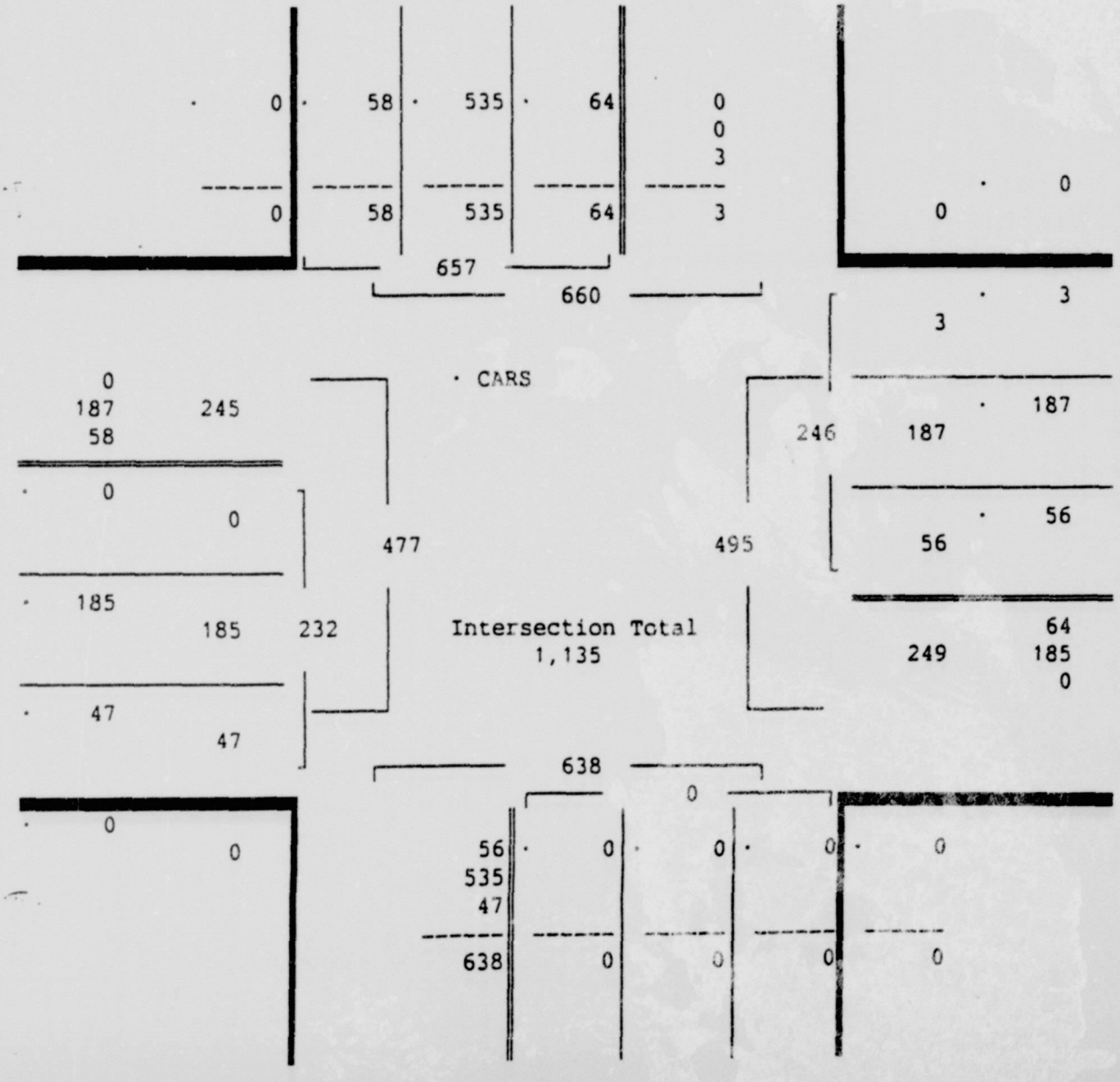
Weather: COLD & CLOUDY
COUNTED BY EH
'21/97 AM
SIERRA & 2ND

SIERRA & 2ND STREET
CITY OF RENO
02-21-1997
FRIDAY

Site Code : 000001
Start Date: 02/21/
File I.D. : SIE
Page : 2

CARS

	From North				From East				From South				From West			
	Other	Right	Thru	Left	Other	Right	Thru	Left	Other	Right	Thru	Left	Other	Right	Thru	Left
Date 02/21/97																
Peak Hour Analysis By Entire Intersection for the Period: 07:30 to 08:30 on 02/21/97																
Peak start	08:00				08:00				08:00				08:00			
Volume	0	58	535	64	0	3	187	56	0	0	0	0	0	47	185	0
Percent	0%	9%	81%	10%	0%	1%	76%	23%	0%	0%	0%	0%	0%	20%	80%	0%
Pk total	657				246				0				232			
Highest	08:45				08:15				07:30				08:45			
Volume	0	18	153	13	0	2	55	14	0	0	0	0	0	11	56	0
Hi total	184				71				0				67			
PHF	.89				.87				.0				.87			

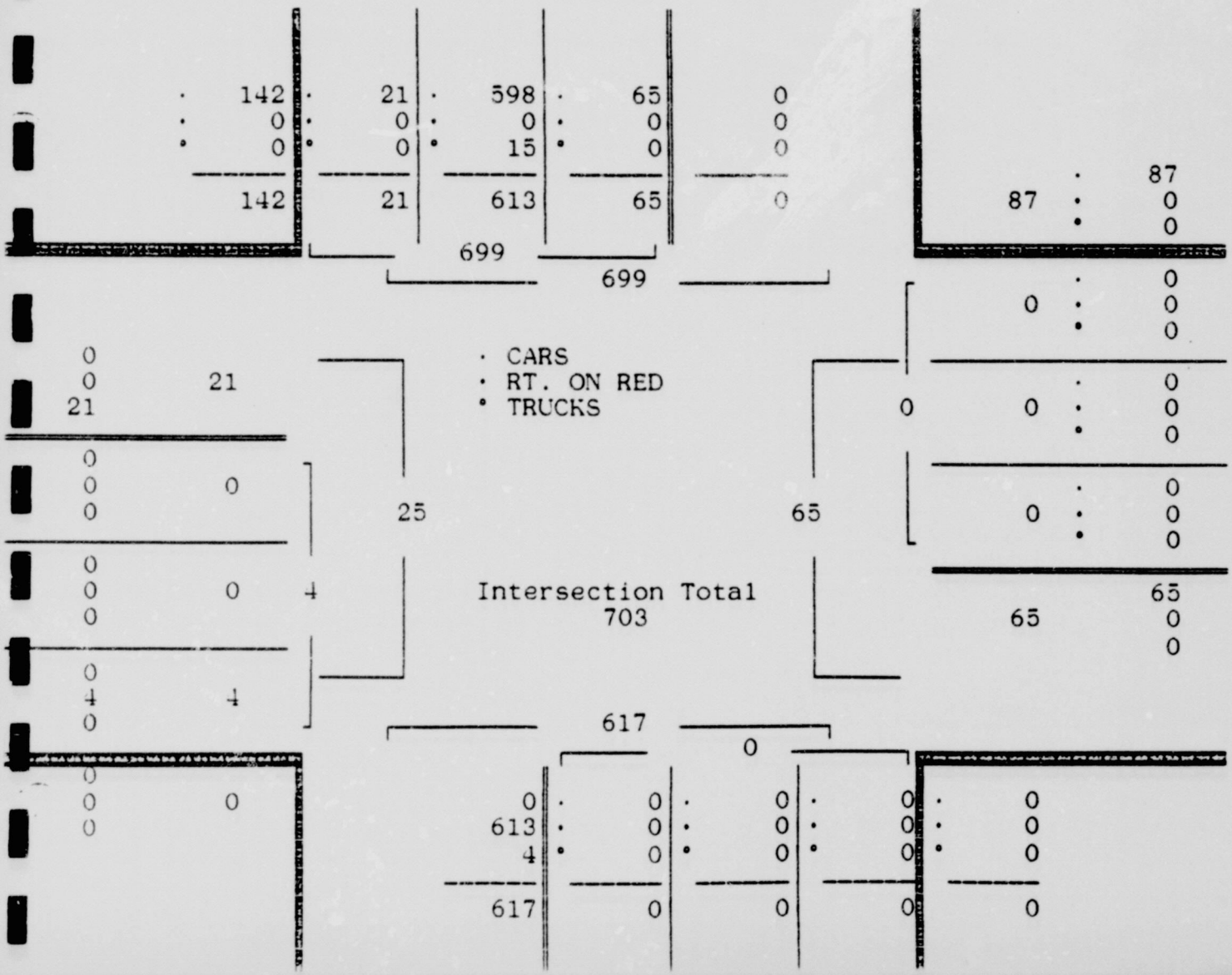


SIERRA & COMMERCIAL ROW
CITY OF RENO
09/03/96
TUESDAY, PM

CARS, RT. ON RED, TRUCKS

Site Code : 00000126
Start Date: 09/03/96
File I.D. : SIEPMCOM
Page : 1

	Southbound				Westbound				Northbound				Eastbound				
	Other	Right	Thru	Left	Other	Right	Thru	Left	Other	Right	Thru	Left	Other	Right	Thru	Left	Total
09/03/96																	
Peak Hour Analysis By Entire Intersection for the Period: 16:00 to 17:00 on 09/03/96																	
Peak start	16:00				16:00				16:00				16:00				
Volume	142	21	613	65	87	0	0	0	0	0	0	0	0	4	0	0	
Percent	17%	2%	73%	8%	100%	0%	0%	0%	0%	0%	0%	0%	0%	100%	0%	0%	
PHF total	841				87				0				4				
Peak start	16:00				16:00				16:00				16:30				
Volume	49	3	190	22	36	0	0	0	0	0	0	0	0	1	0	0	
PHF total	269				36				0				3				
PHF	.78				.60				.0				.33				



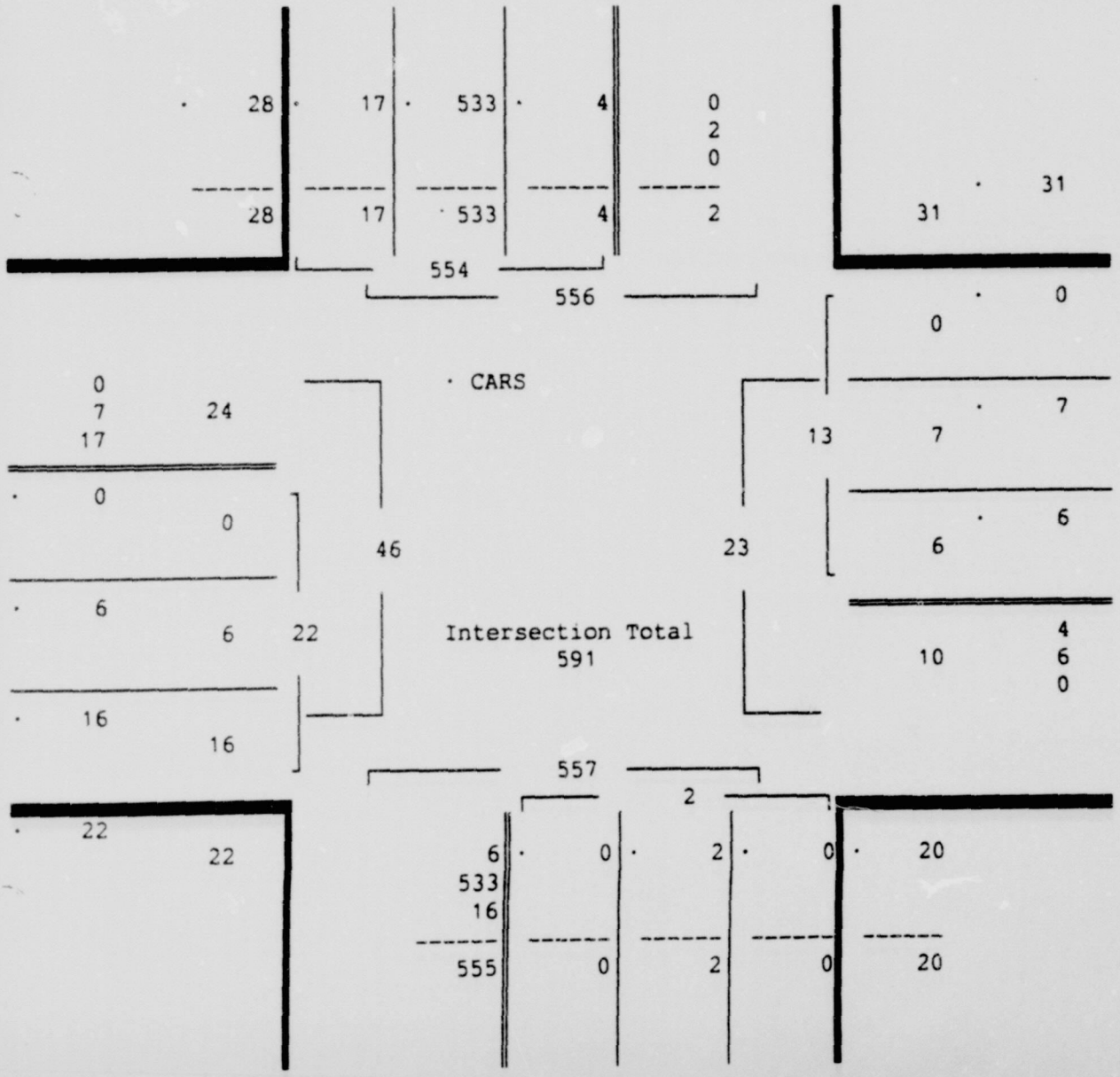
Weather: SNOWING 25
NTED BY JP
23/97 AM
SIERRA & 3RD STREET

SIERRA & 3RD STREET
CITY OF RENO
01-23-1997
THURSDAY

Site Code : 00000174
Start Date: 01/23/
File I.D. : SIE3RD
Page : 2

CARS

	From North				From East				From South				From West				
	Other	Right	Thru	Left	Other	Right	Thru	Left	Other	Right	Thru	Left	Other	Right	Thru	Left	Total
Date 01/23/97																	
Peak Hour Analysis By Entire Intersection for the Period: 07:30 to 08:30 on 01/23/97																	
Peak start	07:45				07:45				07:45				07:45				
Volume	28	17	533	4	31	0	7	6	20	0	2	0	22	16	6	0	
Percent	5%	3%	92%	1%	70%	0%	16%	14%	91%	0%	9%	0%	50%	36%	14%	0%	
Pk total	582				44				22				44				
Highest	07:45				08:15				07:45				08:15				
Volume	9	3	157	1	10	0	1	3	5	0	1	0	8	2	4	0	
Hi total	170				14				6				14				
PHF	.86				.79				.92				.79				



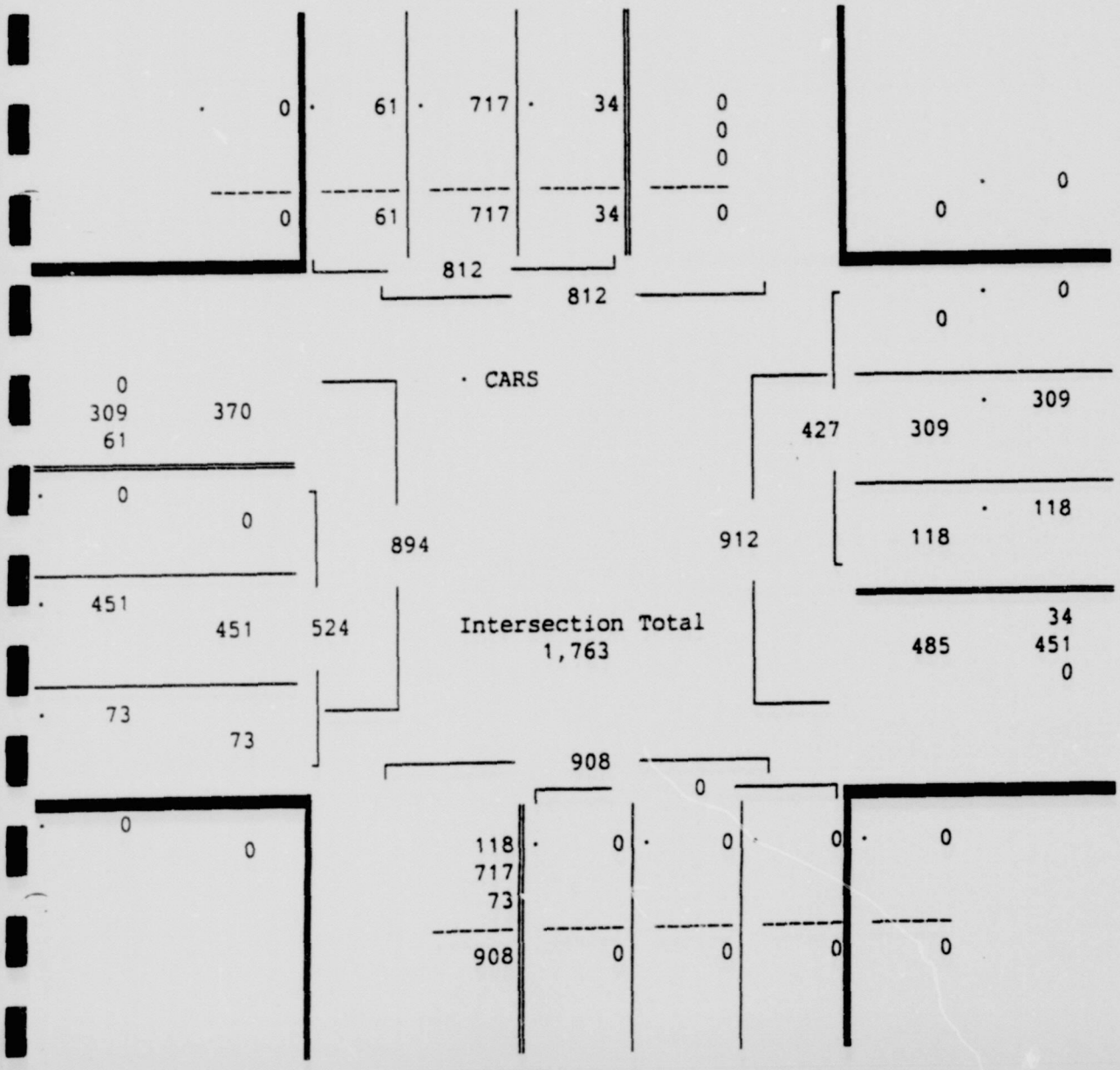
Weather: COLD & CLOUDY
COUNTED BY EH
/26/97 AM
SIERRA STREET & FOURTH STREET

SIERRA STREET & FOURTH STREET
CITY OF RENO
02-26-1997
WEDNESDAY

Site Code : 0000018
Start Date: 02/26/9
File I.D. : SIE4THA
Page : 2

CARS

	From North				From East				From South				From West				Tot
	Other	Right	Thru	Left	Other	Right	Thru	Left	Other	Right	Thru	Left	Other	Right	Thru	Left	
Date 02/26/97																	
Peak Hour Analysis By Entire Intersection for the Period: 07:15 to 08:15 on 02/26/97																	
Peak start	07:45				07:45				07:45				07:45				
Volume	0	61	717	34	0	0	309	118	0	0	0	0	0	73	451	0	
Percent	0%	8%	88%	4%	0%	0%	72%	28%	0%	0%	0%	0%	0%	14%	86%	0%	
Pk total	812				427				0				524				
Highest	07:45				08:30				07:15				07:45				
Volume	0	18	216	7	0	0	87	37	0	0	0	0	0	18	132	0	
Hi total	239				124				0				150				
PHF	.85				.86				.0				.87				



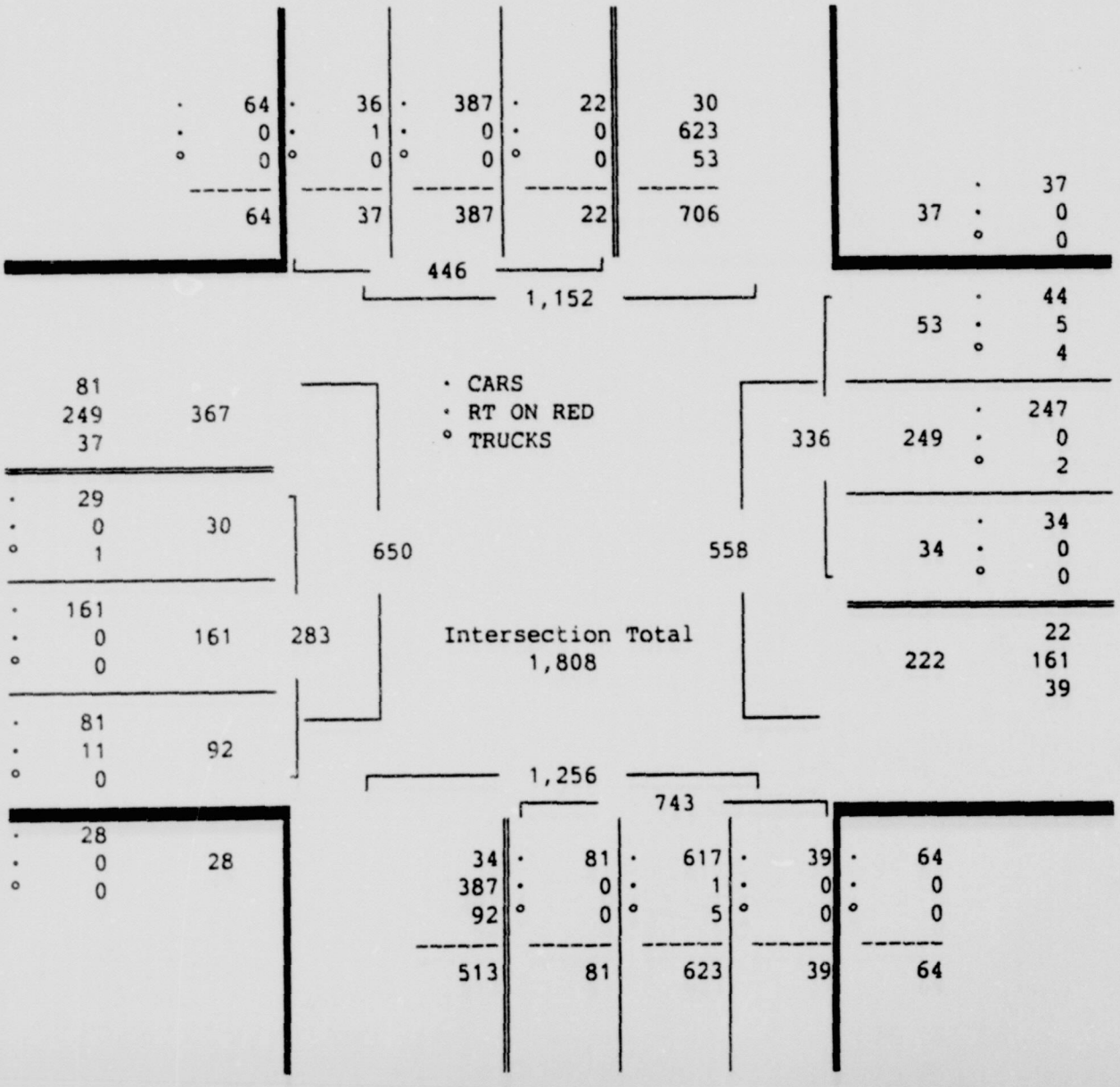
Weather :CLEAR 65
COUNTED BY JP
11/04/96 PM
ARLINGTON & 2ND

ARLINGTON AVENUE AND SECOND STREET
CITY OF RENO
NOVEMBER 4, 1996
MONDAY

Site Code : 00000154
Start Date: 11/04/
File I.D. : ARL2ND
Page : 2

CARS, RT ON RED, TRUCKS

	Southbound				Westbound				Northbound				Eastbound				
	Left	Thru	Right	Other	Left	Thru	Right	Other	Left	Thru	Right	Other	Left	Thru	Right	Other	Tot
Date 11/04/96																	
Peak Hour Analysis By Entire Intersection for the Period: 17:30 to 18:30 on 11/04/96																	
Peak start	17:30				17:30				17:30				17:30				
Volume	22	387	37	64	34	249	53	37	81	623	39	64	30	161	92	28	
Percent	4%	76%	7%	13%	9%	67%	14%	10%	10%	77%	5%	8%	10%	52%	30%	9%	
Pk total	510				373				807				311				
Highest	18:00				18:15				18:00				18:15				
Volume	9	107	14	19	11	84	6	14	20	198	12	24	7	44	27	11	
Hi total	149				115				254				89				
PHF	.86				.81				.79				.87				



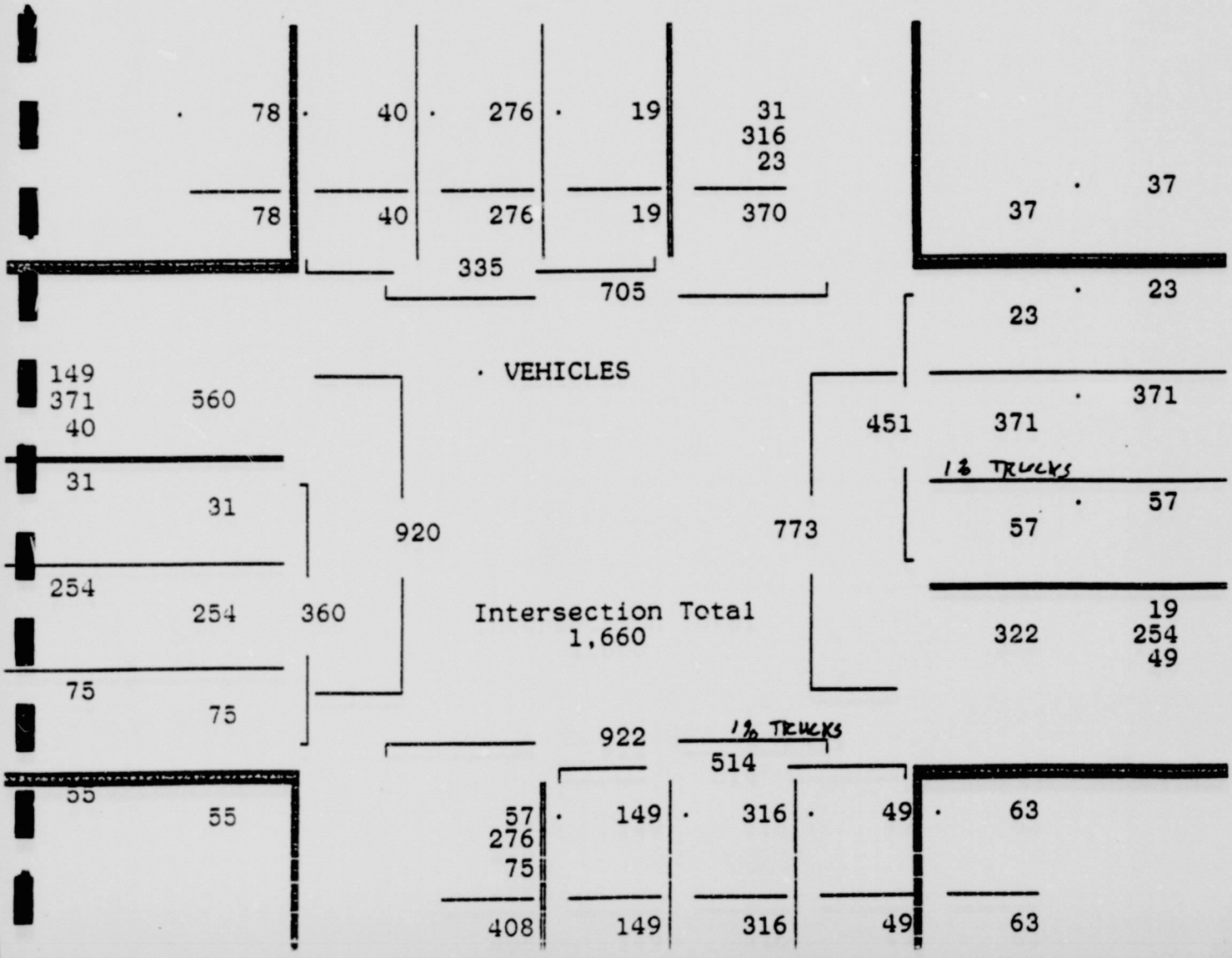
ther: CLEAR 8F
NTED BY TJ & TM
2 96
INGTON & FOURTH PM

ARLINGTON & FOURTH
CITY OF RENO.
08/28/96
WEDNESDAY PM

Site Code : 00000124
Start Date: 08/28/96
File I.D. : ARLFOUPM
Page : 1

VEHICLES

	Southbound				Westbound				Northbound				Eastbound				
	Other	Right	Thru	Left	Other	Right	Thru	Left	Other	Right	Thru	Left	Other	Right	Thru	Left	Total
e 08/28/96																	
Hour Analysis By Entire Intersection for the Period: 16:45 to 17:45 on 08/28/96																	
Start 16:45					16:45				16:45				16:45				
ume	78	40	276	19	37	23	371	57	63	49	316	149	55	75	254	31	
t	19%	10%	67%	5%	8%	5%	76%	12%	11%	8%	55%	26%	13%	18%	61%	7%	
tal	413				488				577				415				
hest	17:00				17:15				17:15				17:00				
ume	24	15	95	5	12	7	103	18	7	12	116	53	19	19	67	13	
tal	139				140				188				118				
	.74				.87				.77				.88				



Weather: SUNNY 67

1997

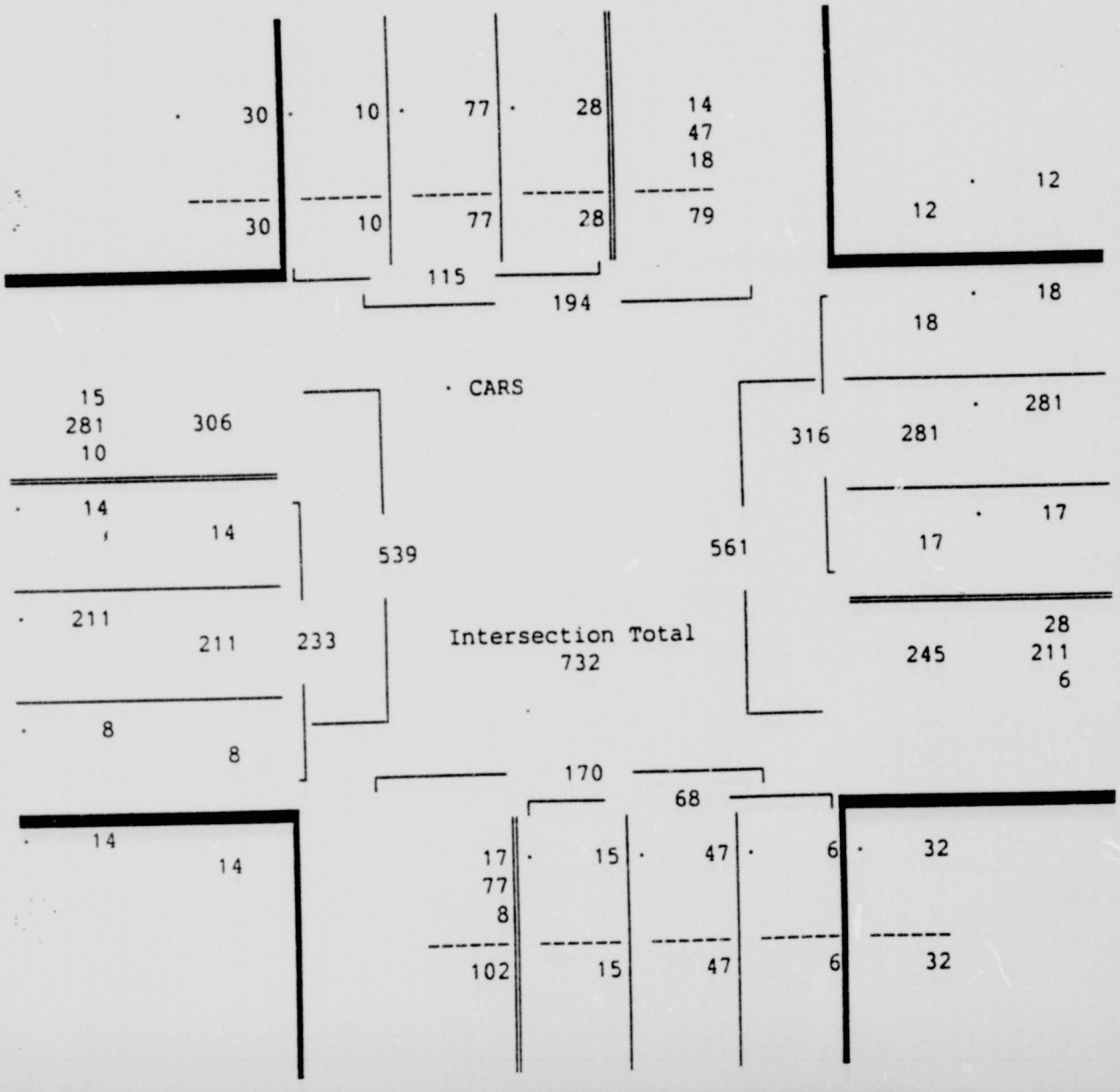
RALSTON & 2ND

RALSTON STREET & SECOND STREET
CITY OF RENO
4/14/1997
MONDAY

Site Code : 00000242
Start Date: 04/14/
File I.D. : RAL2ND
Page : 2

CARS

	Southbound				Westbound				Northbound				Eastbound				To
	Left	Thru	Right	Other	Left	Thru	Right	Other	Left	Thru	Right	Other	Left	Thru	Right	Other	
Date 04/14/97																	
Peak Hour Analysis By Entire Intersection for the Period: 16:30 to 17:30 on 04/14/97																	
Peak start	16:30				16:30				16:30				16:30				
Volume	28	77	10	30	17	281	18	12	15	47	6	32	14	211	8	14	
Percent	19%	53%	7%	21%	5%	86%	5%	4%	15%	47%	6%	32%	6%	85%	3%	6%	
Pk total	145				328				100				247				
Highest	17:00				17:15				17:15				17:15				
Volume	8	22	2	16	5	88	5	5	5	11	4	9	4	54	6	6	
Hi total	48				103				29				70				
PHF	.76				.80				.86				.88				



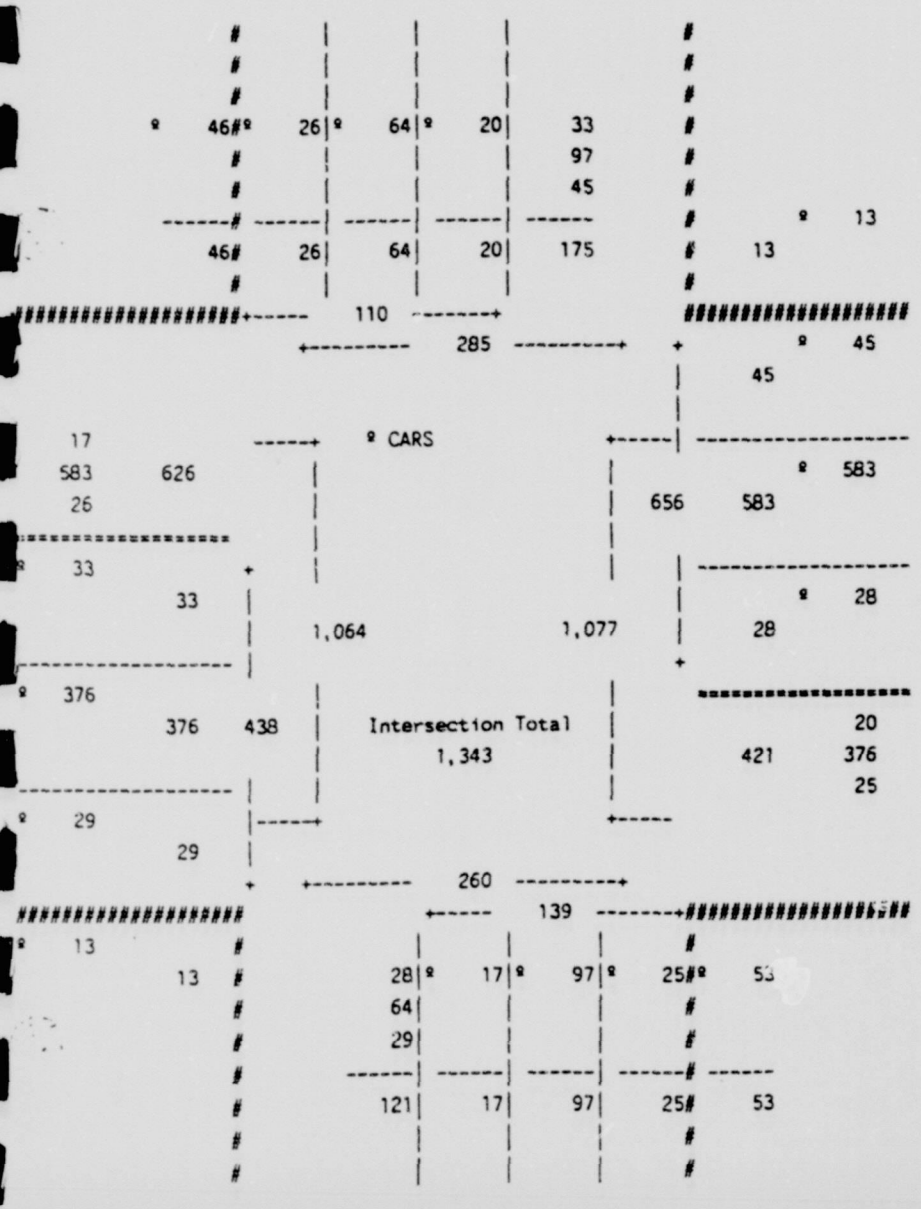
Weather: SUNNY 80
[illegible]nted by: EH
1997
RALSTON & 4TH

RALSTON STREET & FOURTH STREET
CITY OF RENO
5/15/1997
THURSDAY

Site Code : 00000249
Start Date: 05/15/97
File I.D. : RAL4THPM
Page : 2

CARS

	Southbound				Westbound				Northbound				Eastbound				
	Left	Thru	Right	Other	Left	Thru	Right	Other	Left	Thru	Right	Other	Left	Thru	Right	Other	Total
Date 05/15/97																	
Peak Hour Analysis By Entire Intersection for the Period: 16:01 to 18:01 on 05/15/97																	
Peak start	16:46				16:46				16:46				16:46				
Volume	20	64	26	46	28	583	45	13	17	97	25	53	33	376	29	13	
Percent	13%	41%	17%	29%	4%	87%	7%	2%	9%	51%	13%	28%	7%	83%	6%	3%	
Pk total	156				669				192				451				
Highest	17:31				17:01				16:46				17:31				
Volume	7	16	12	11	13	157	14	2	4	22	10	17	4	113	6	2	
Pli total	46				186				53				125				
PHF	.85				.90				.91				.90				



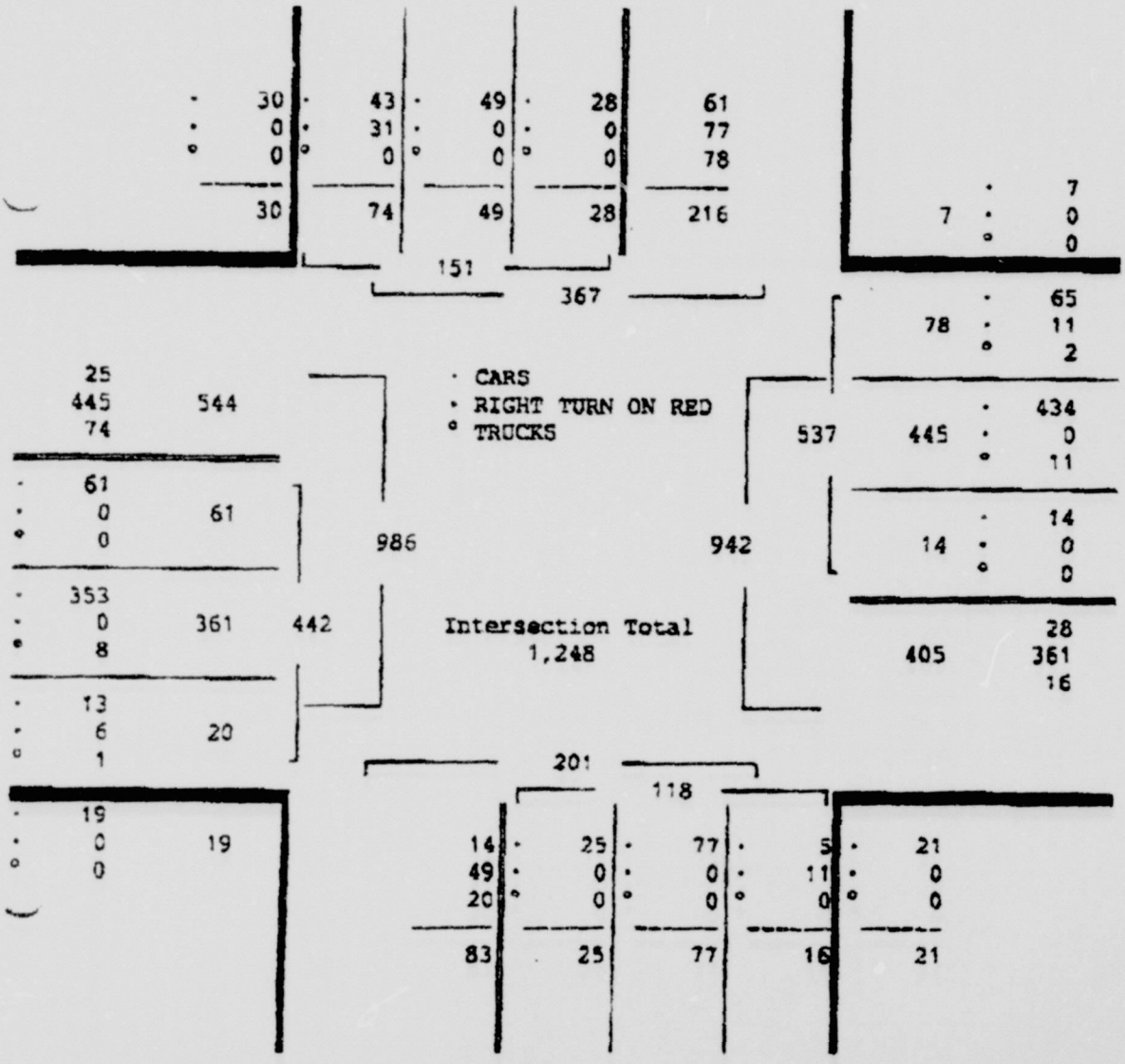
Weather: SUNNY/BSF
Counted by: HS
Date: AUGUST 28, 1997
Street names: VINE AND FOURTH

VINE STREET AND FOURTH STREET
CITY OF RENO
AUGUST 28, 1997
THURSDAY

CARS, RIGHT TURN ON RED, TRUCKS

Site Code : 0000C3
Start Date: 08/28/
File I.D. : VIN4THS
Page : 2

	Southbound				Westbound				Northbound				Eastbound				
	Other	Right	Thru	Left	Other	Right	Thru	Left	Other	Right	Thru	Left	Other	Right	Thru	Left	Total
Date 08/28/97																	
Peak Hour Analysis By Entire Intersection for the Period: 16:15 to 17:15 on 08/28/97																	
Peak start	16:15				16:15				16:15				16:15				
Volume	30	74	49	28	7	78	445	14	21	16	77	25	19	20	361	61	
Percent	17%	41%	27%	15%	1%	14%	82%	3%	15%	12%	55%	18%	4%	4%	78%	13%	
Pk total	181				544				139				461				
Highest	16:45				17:00				17:00				16:45				
Volume	9	29	16	5	1	24	142	4	0	5	28	6	12	8	88	21	
Hi total	59				171				37				129				
PHF	.77				.80				.94				.89				



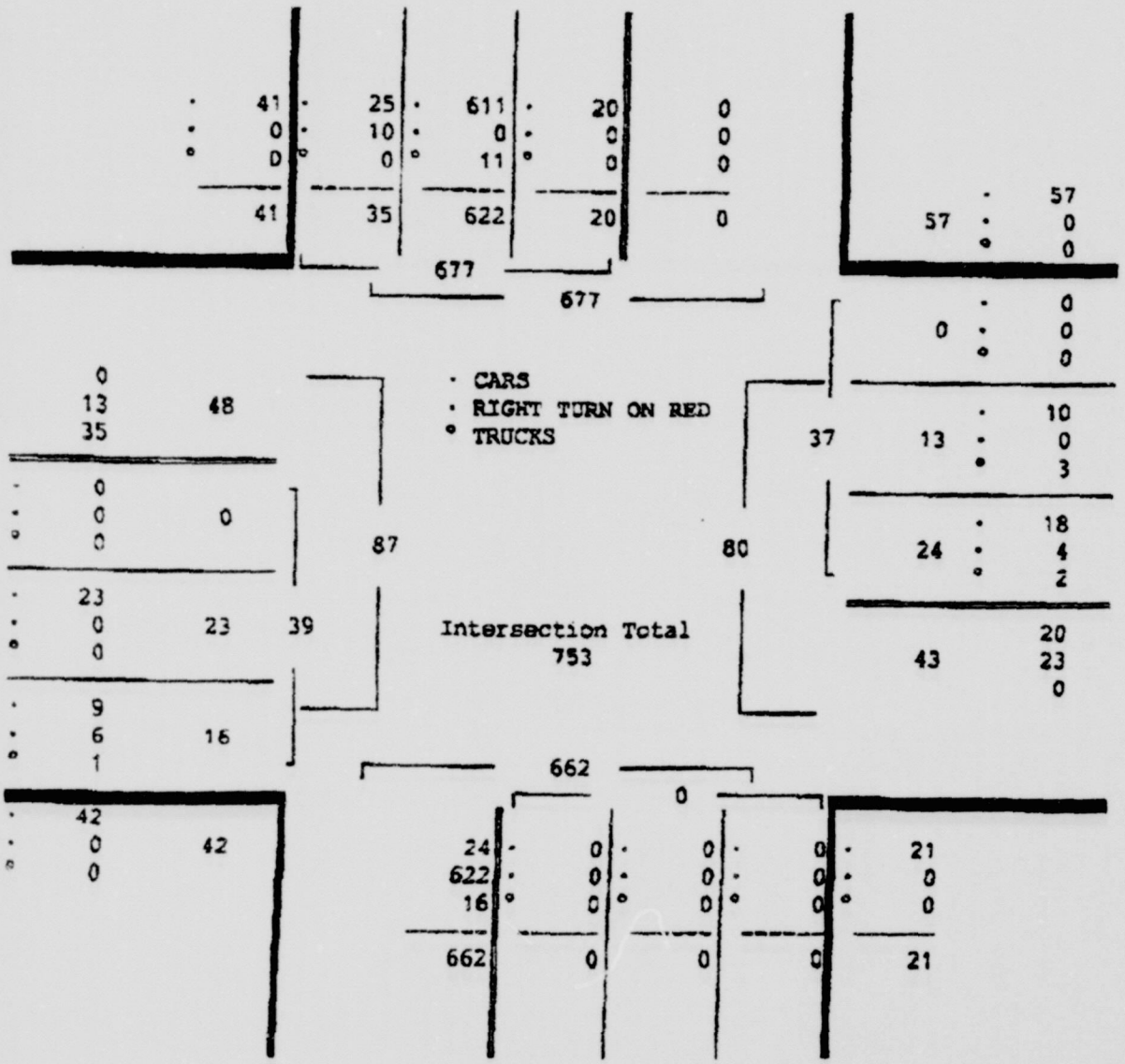
Weather: SUNNY/45F
Counted by: EH
Date: AUGUST 29, 1997
Street names: SIERRA AND THIRD

SIERRA STREET AND THIRD STREET
CITY OF RENO
AUGUST 29, 1997
FRIDAY

CARS, RIGHT TURN ON RED, TRUCKS

Site Code : 000003
Start Date: 08/29/
File I.D. : SIETHI
Page : 2

	Southbound				Westbound				Northbound				Eastbound				
	Other	Right	Thru	Left	Other	Right	Thru	Left	Other	Right	Thru	Left	Other	Right	Thru	Left	Tota
Date 08/29/97																	
Peak Hour Analysis By Entire Intersection for the Period: 07:46 to 08:46 on 08/29/97																	
Peak start	07:46				07:46				07:46				07:46				
Volume	41	35	622	20	57	0	13	24	21	0	0	0	42	16	23	0	
Percent	6%	5%	87%	3%	61%	0%	14%	26%	100%	0%	0%	0%	52%	20%	28%	0%	
Pk total	718				94				21				81				
Highest	07:46				08:01				08:01				08:16				
Volume	6	12	208	5	22	0	2	5	7	0	0	0	9	7	14	0	
Hi total	231				29				7				30				
PHF	.78				.81				.75				.68				



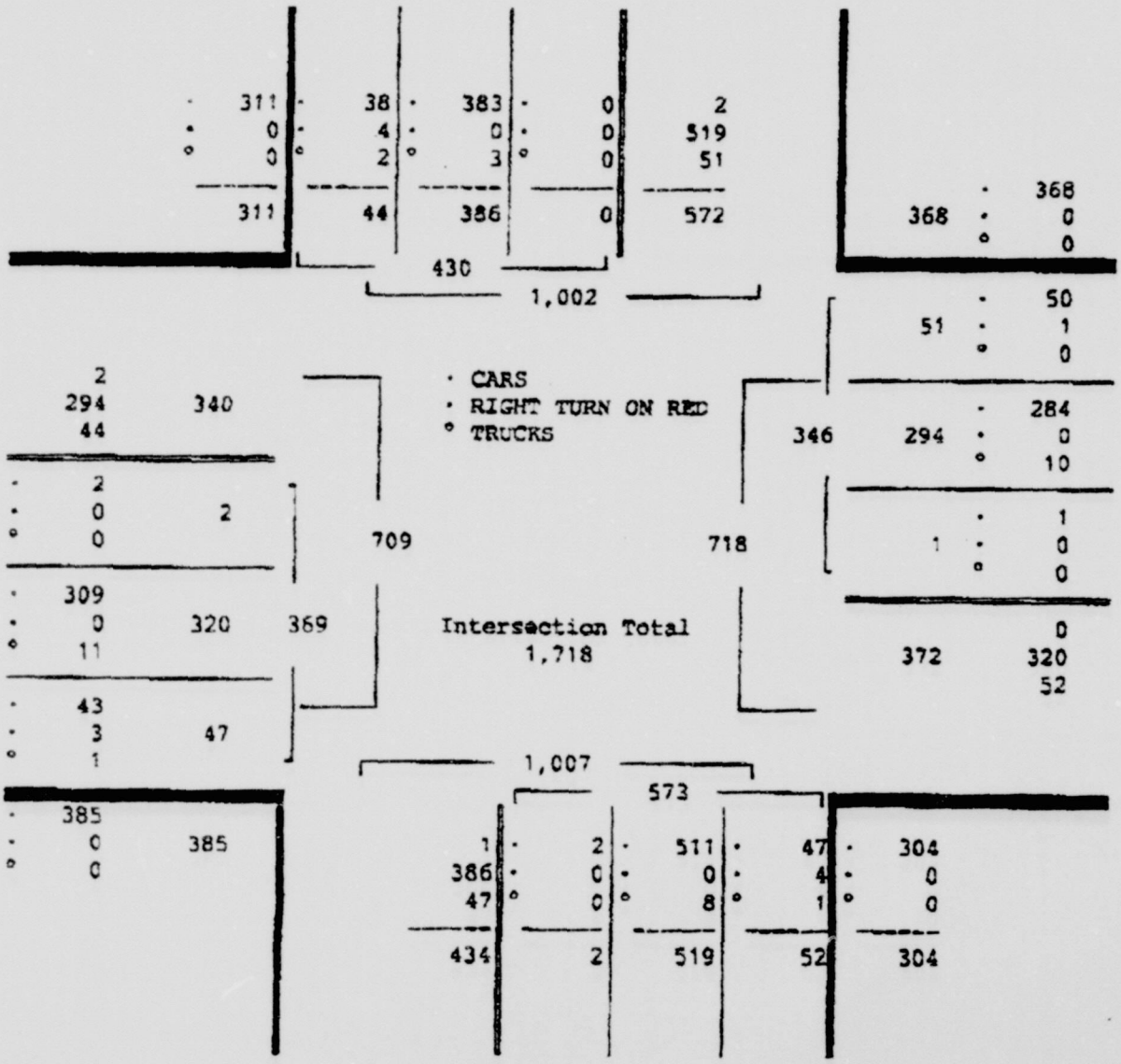
Weather: SUNNY/85F
Counted by: EH
Date: AUGUST 28, 1997
Street names: VIRGINIA AND SECOND

VIRGINIA STREET AND SECOND STREET
CITY OF RENO
AUGUST 28, 1997
THURSDAY

CARS, RIGHT TURN ON RED, TRUCKS

Site Code : 0000030
Start Date: 08/28/9
File I.D. : VIR2NOP
Page : 2

	Southbound				Westbound				Northbound				Eastbound				
	Other	Right	Thru	Left	Other	Right	Thru	Left	Other	Right	Thru	Left	Other	Right	Thru	Left	Total
Date 08/28/97																	
Peak Hour Analysis By Entire Intersection for the Period: 16:00 to 17:00 on 08/28/97																	
Peak start	16:00				16:00				16:00				16:00				
Volume	311	44	386	0	368	51	294	1	304	52	519	2	385	47	320	2	
Percent	42%	6%	52%	0%	52%	7%	41%	0%	35%	6%	59%	0%	51%	6%	42%	0%	
Pk total	741				714				877				754				
Highest	16:30				16:00				16:00				16:00				
Volume	88	12	104	0	127	9	70	0	102	17	125	0	152	14	80	1	
Hi total	204				206				244				247				
PHF	.91				.87				.90				.76				



APPENDIX C
FIELD OBSERVATIONS

- TRAFFIC COMPOSITION
- TRAIN CROSSING OBSERVATIONS
- INTERSECTION GEOMETRIES
- ARTERIAL QUEUE CAPACITY

Reno Rail Delay Study
Traffic Composition Observation
(August 26, 1997)

Lake/Center/Virginia/Sierra/West
Along these arterials, traffic is primarily composed of passenger cars, trucks and vans (96%). Approximately 2 percent of the traffic is composed of tourist busses or casino shuttles and two percent are delivery vehicles. Shuttles and busses tend to remain within the limits of the immediate downtown area.

Arlington/Ralston/Washington/Vine
These arterials service primarily residential areas. The streets are narrower and Ralston provides a bicycle lane along the curbside parking lane. Along these facilities traffic volumes are low and consist primarily of passenger cars, trucks and vans (99%).

Keystone
Keystone directly accesses I-80 and is primarily surrounded by commercial/retail establishments. Traffic is a mix of passenger vehicles (92%), delivery trucks (6%) and semi trucks (2%). South of the train tracks land use is primarily industrial and residential. Traffic patterns tend to show more passenger vehicles (98%) than other types (2%).

Sutro
Sutro near Fourth Street is primarily commercial/retail with minimal industrial uses. However immediately across the train tracks the land use is primarily industrial. Therefore the mix of vehicles include an overwhelming percentage of work trucks, trash trucks and semis (30%). The remaining 70 percent of the traffic are passenger vehicles including cars and personal trucks.

Reno Rail Delay Study
Train Crossing Observations

10:20 AM Lake Street

- Vehicle storage capacity between tracks and Commercial Row on the south side of the street filled. The vehicles then left the intersection of Commercial Row clear. Approximated 6 vehicles per lane queued beyond Commercial Row. On the north side, traffic queues approximately equal to the south side (15-20 vehicles)
- The intersection of Commercial Row and Lake Street is not signalized.
- Arm up/down time was not counted.
- Traffic volume primarily passenger cars and buses or shuttles for the casinos.

11:40 AM Virginia Street

- Gate down time = 30 seconds (computed from when flashing and bells began to when train arrived at crossing)
- Gate up time = 8-9 seconds (computed from train cleared to when first vehicle crossed the tracks)
- Observed from south side of train tracks.
- Vehicular makeup was mostly passenger vehicles with about 1 percent casino/tourist buses and shuttles. No large trucks on Virginia Street.
- There is storage capacity for about one passenger car per lane between the tracks and Commercial Row. This capacity filled by vehicles turning off of Commercial Row onto Virginia Street.
- Queues extended beyond the adjacent intersection of 2nd/Virginia.
- Problem Noticed: Signal timing between 2nd/Virginia and Plaza/Commercial Row/Virginia and 4th/Virginia is completely off after the train crossing occurs. When the pre-emption is over, traffic signals at Plaza/Commercial Row go to green for the north-south movement. This allows a majority of the vehicle in the queue between the tracks and 2nd/Virginia to clear. When Plaza/Commercial goes to red north-south, 2nd/Virginia goes to green north-south, generating a new queue. This queue then clears and the signals switch again. This lack of synchronization causes the traffic to continuously queue without the train. It took greater than 8 cycles for the traffic to re-stabilize.
- Phasing at Commercial Row/Plaza/Virginia is oddly split. What is the reason for this?

2:40 PM Keystone Avenue

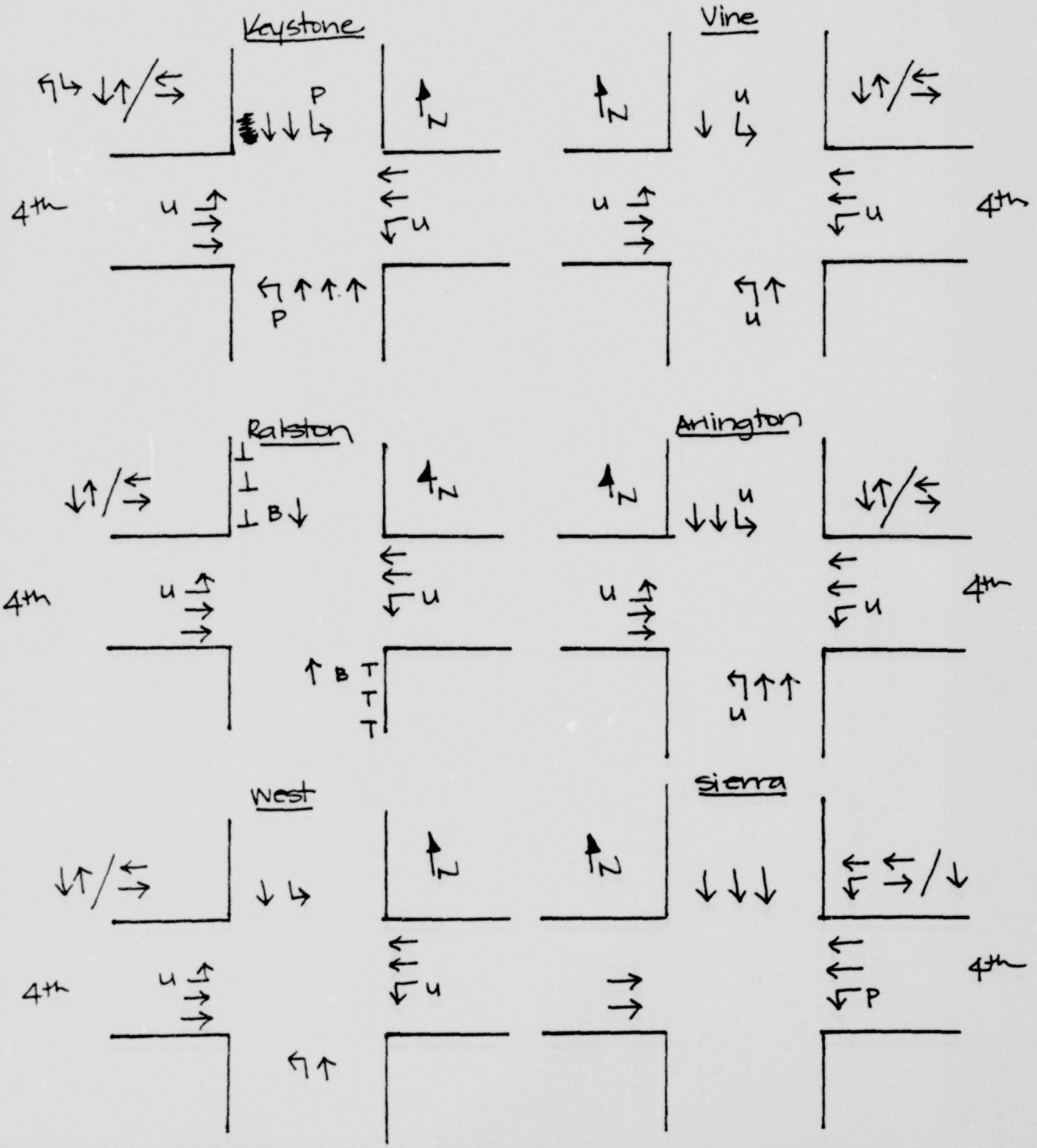
- Gate down time = 25 seconds
- Gate up time = 8 seconds
- Total Gate Down Time = 81 seconds
- Location of Observation - North side of tracks.
- Short train, comparatively.

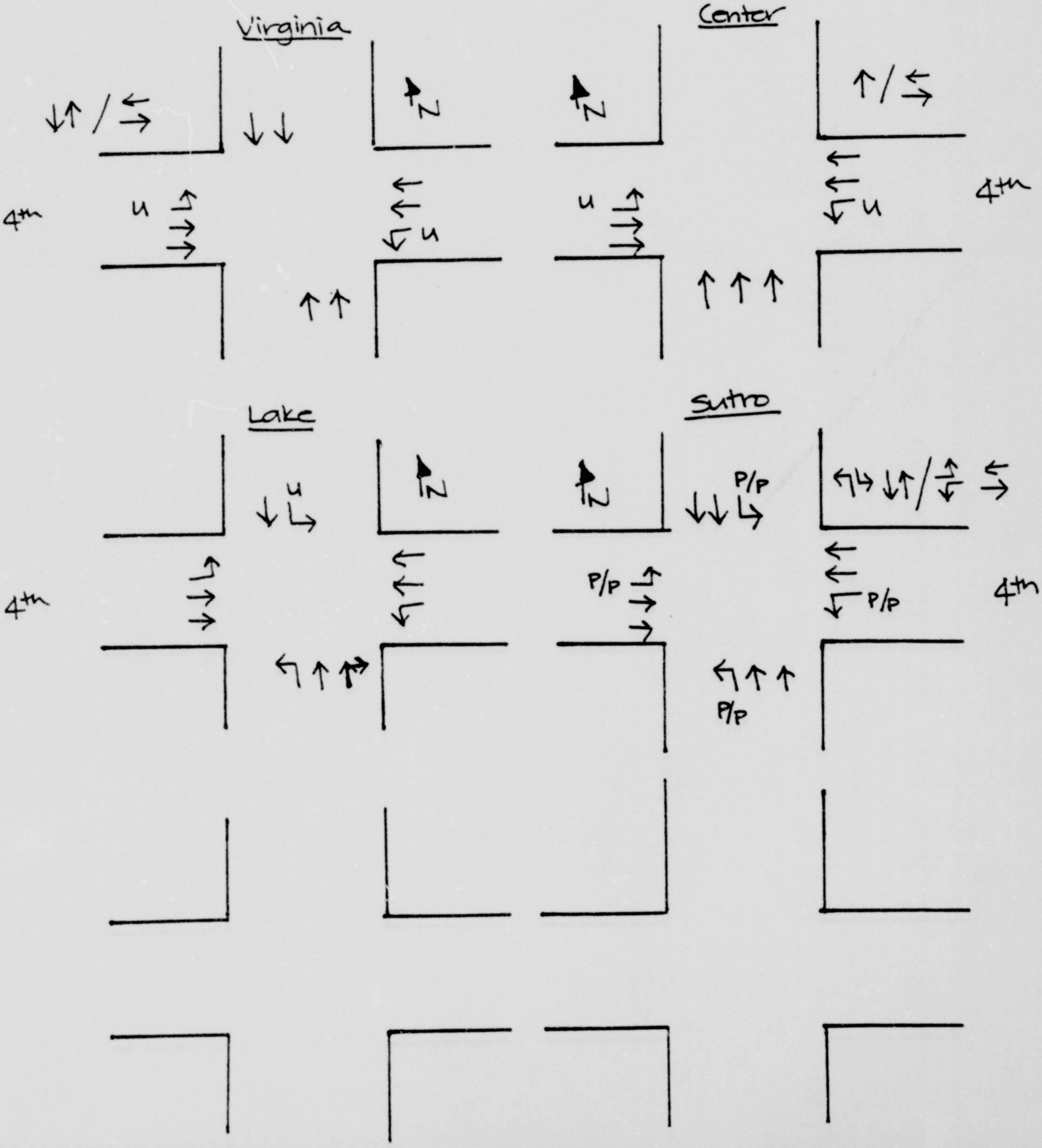
- Vehicles along Keystone did not queue beyond the storage capacity, therefore there was no impact on the adjacent intersection of 4th/Keystone.
- Vehicle make up - mostly passenger cars with some work size trucks (Ford/Chevrolet full size truck with flat bed or trailer)(approximately 1-2 percent), few larger trucks (less than 1 percent), no semi trucks.
- I-80 is directly accessible from Keystone Avenue north of the tracks. The surrounding area is mostly commercial/retail or residential. Much less tourist traffic through this area.

3:00 PM Keystone Avenue

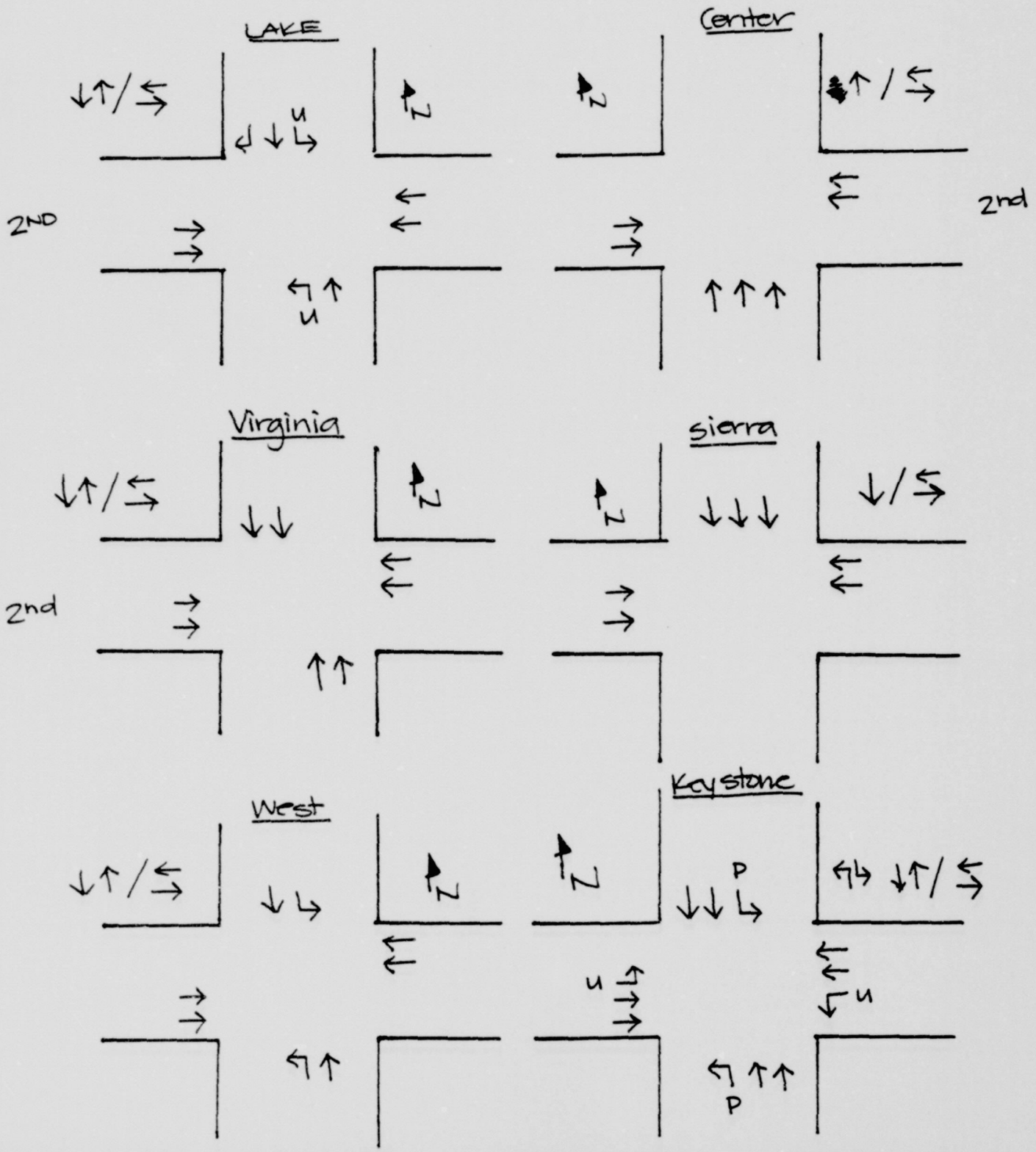
- Gate down time = 27 seconds
- Gate up time = 11 seconds
- Total Gate Down Time = 163 seconds
- Queue overflowed into intersection of 4th/Keystone. Approximately 13 vehicles per lane queued at the intersection.
- After train cleared, took one cycle to return intersection operating conditions to normal. Minimal adverse effects on the operating conditions.

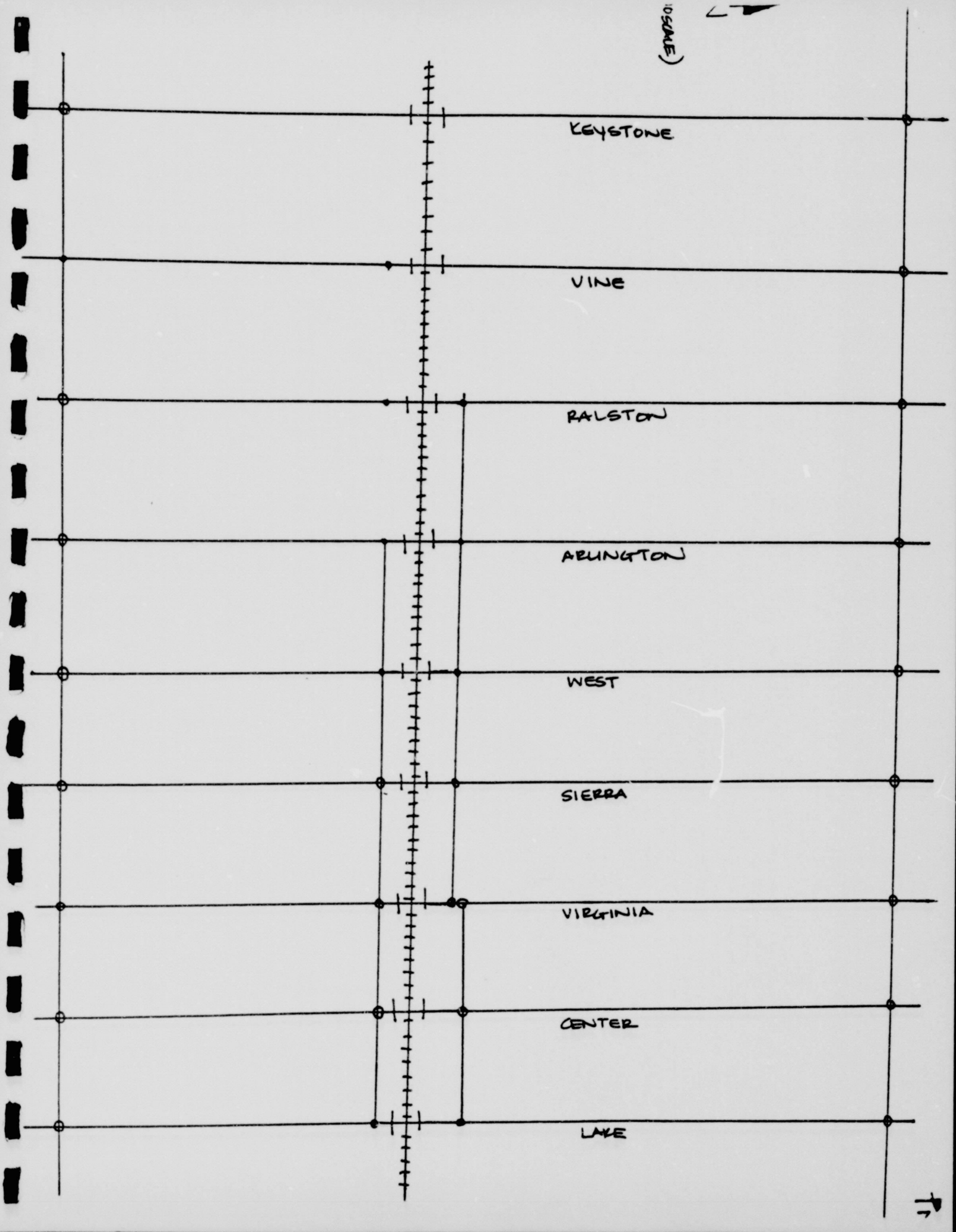
- RENO RAIL DELAY STUDY
- FOURTH STREET INT INVENTORY
- P= PROTECTED LEFT
- P/p = PROTECTED/PERMITTED LEFT
- U= UNPROTECTED LEFT
- B = BIKE LANE
- T = PARKING (METERED)

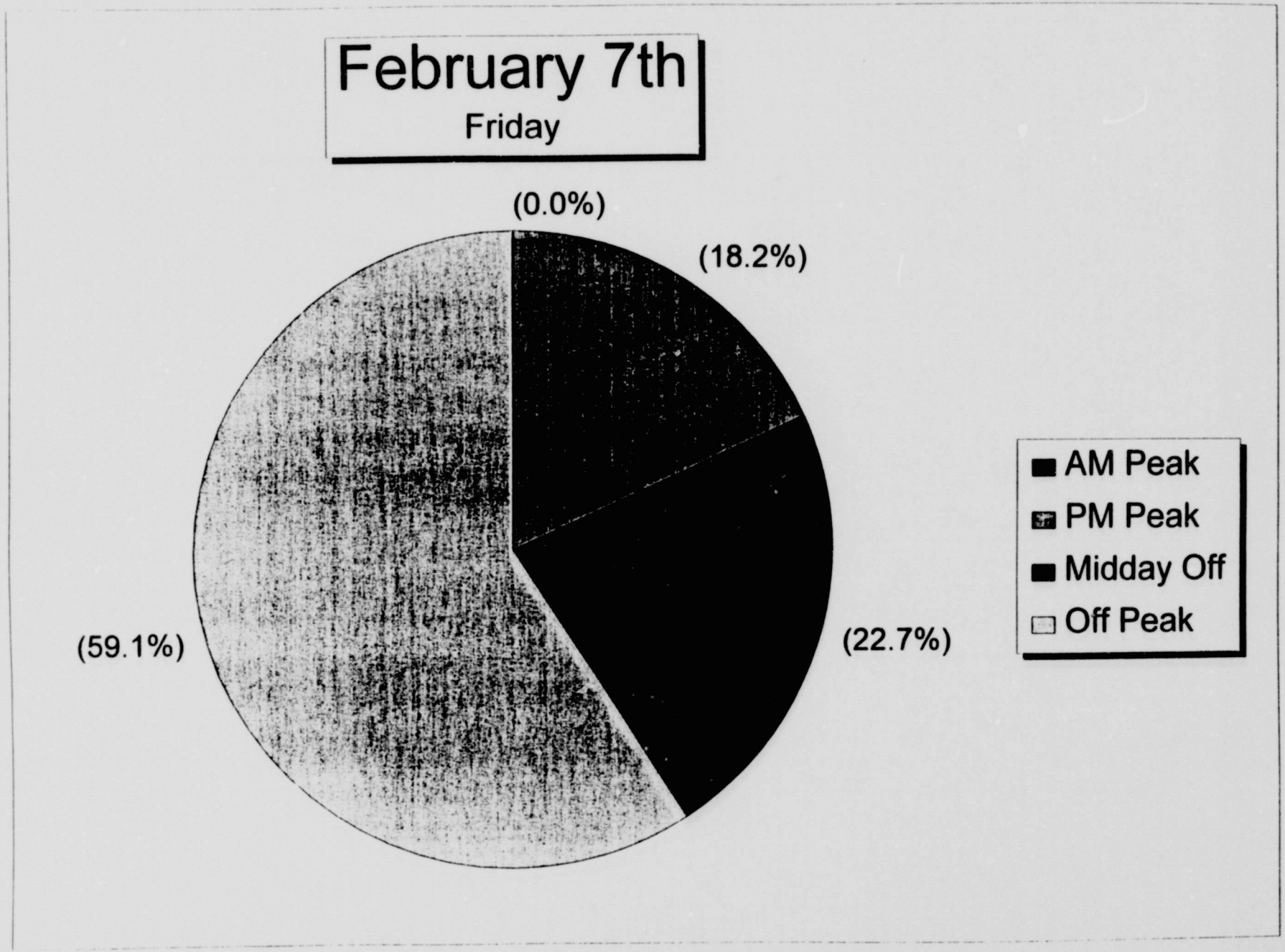



Virginia
Center
4th
4th
u
u
u
u
N
N
Lake
Sutro
4th
4th
u
N
N
P/P
P/P
P/P
P/P

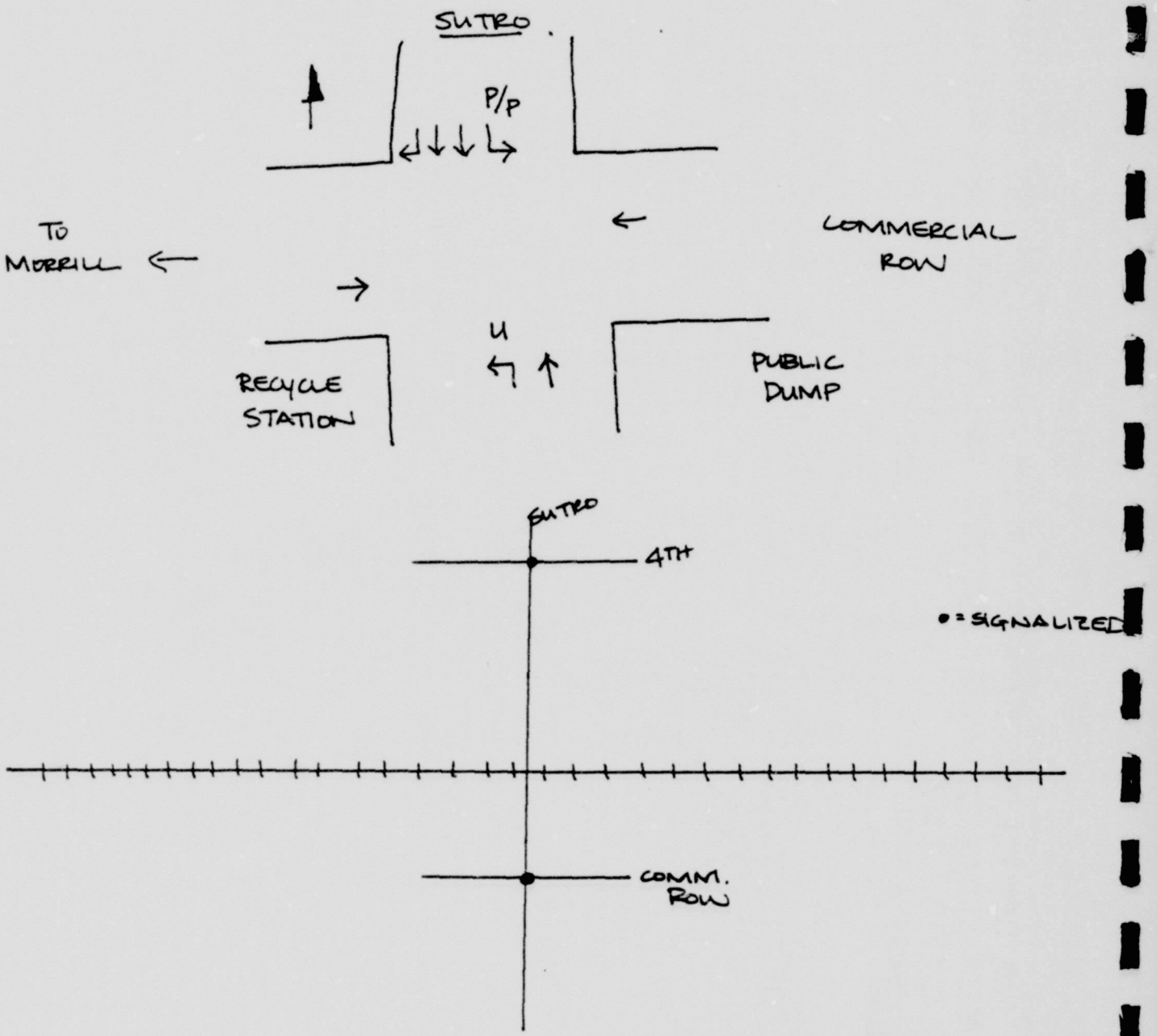
- KENO DELAY STUDY
- SECOND STREET INVENTORY
- P= PROTECTED LEFT
- P/P = PROTECTED/PERMITED
- U= UNPROTECTED LEFT
- B = BIKE LANE
- T= METERED PARKING




(NO SCALE)
KEYSTONE
VINE
RALSTON
ARLINGTON
WEST
SIERRA
VIRGINIA
CENTER
LAKE


February 7th
Friday
(0.0%)
(18.2%)
(59.1%)
(22.7%)
AM Peak
PM Peak
Midday Off
Off Peak

RENO RAIL DELAY STUDY:



- TRAFFIC COMPOSITION: (BASED ON 10MIN PM PEAK COUNT)
  - 2% TRASH TRUCKS
  - 1% SEMI TRUCKS
  - 20% PERSONAL MINI-TRUCK
  - 26% WORK/FULL SIZE TRUCK
  - 51% PASSENGER CARS.

APPENDIX D
TRAFFIC SIGNAL PLANS

CITY OF RENO

TRAFFIC SIGNAL TIMING SHEET

Location: Virginia & Commercial/Plaza Date: 08/20/96 Time: _____

Timing installed by: VMS pin read Controller Type: 820A

VMS number: 024 Intersection No: 146 Address: 1 2 3 4 Start In: FL RE

Start Time: 8.0 Sec Start Up Ø's : 1 2 3 4 / 5 6 7 8 Start In: Ylw Grn

PHASE/ DIRECTION	Ø1 3D	Ø2 N/S	Ø3 CL	Ø4 E/W	Ø5	Ø6	Ø7 DUMMY	Ø8	OL A 1+2+3	OL B 2+3+4	OL C 2+4+7	OL D
PED WALK	7	10		10					FOLLOW	FOLLOW	FOLLOW	
PED PROTECT	6	2		7					PARENT	PARENT	PARENT	
ADD PER/ ACT												
INITIAL	4	4	4	4			4					
MAXIMUM INITIAL												
EXTENSION	2.0	2.0	2.0	2.0			2.0					
MIN EXTENSION												
BEFORE REDUCE												
TIME TO REDUCE												
MAX GREEN	10	30	8	15			8					
MAX II GREEN	21	27	5	17			5					
YELLOW CLR	3.0	3.0	3.0	3.0			3.0					
RED CLR	.5	.5	.5	1.0			.5					
OL GRN EXT												
LOCKING												
MIN RECALL												
MAX RECALL	X	X	X	X			X					
PED RECALL	X	X		X								
SOFT RECALL												
FIELD FLASH												
FLASH PHASE												
OVERRIDE												
DUAL ENTRY												
COND SERV												
RED REVERT	4											
MIN YELLOW	3											

Cabinet turn on Date: _____ Time: _____

Timings authorized by: _____ Date: _____

Title: _____ Last revised Date: _____

Timing Sheet updated from controller by: Dave Walsh Date: 08/20/96

rev. 8/96

TRAFFIC SIGNAL TIMING SHEET

Location: Sierra & 3rd/Commercial/Plaza Date: 08/20/96 Time: _____

Timing installed by: VMS pin read Controller Type: 820

vMS number: 020 Intersection No: 123 Address: 1 2 3 4 Start In: FL RED

Start Time: 8.0 Sec Start Up Ø's : 1 2 3 4 / 5 6 7 8 Start In: Ylw Grn

PHASE/ DIRECTION	Ø1 EB COMM	Ø2 SB	Ø3 TRACK	Ø4 E/W 3RD	Ø5	Ø6	Ø7	Ø8	OL A 2+3+4	OL B	OL C	OL D
PED WALK	5	7		7								
PED PROTECT	9	12		12								
ADD PER/ ACT												
INITIAL	4	4	8	4								
MAXIMUM INITIAL												
EXTENSION	2.0	2.0	2.0	2.0								
MIN EXTENSION												
BEFORE REDUCE												
TIME TO REDUCE												
MAX GREEN	16	24	8	16								
MAX II GREEN	16	24	8	24								
YELLOW CLR	4.0	4.0	4.0	4.0					4.0			
RED CLR	0.0	0.0	0.0	0.0					0.0			
OL GRN EXT												
LOCKING												
MIN RECALL												
MAX RECALL	X	X	X	X								
PED RECALL	X	X		X								
SOFT RECALL		X										
FIELD FLASH												
FLASH PHASE												
OVERRIDE												
DUAL ENTRY												
COND SERV												
RED RVRT	4											
MIN YELLOW	3											

Cabinet turn on Date: _____ Time: _____

Timings authorized by: _____ Date: _____

Title: _____ Last revised Date: _____

Timing Sheet updated from controller by: Dave Walsh Date: 08/20/96

rev. 8/96

TRAFFIC SIGNAL TIMING SHEET

Location: 2nd & West Date: 08/06/96 Time: 14:07

Timing installed by: _____ Controller Type: 111

VMS number: 17 Intersection No: 120 Address: 1 2 3 4 Start In: FL RED

Start Time: N/A Start Up Ø's : 1 2 3 4 / 5 6 7 8 Start In: Ylw Grn

PHASE/ DIRECTION	Ø1 N/S	Ø2 E/W	Ø3	Ø4	Ø5	Ø6	Ø7	Ø8	OL A	OL B	OL C	OL
PED WALK												
PED PROTECT	10	10										
ADD PER/ ACT												
INITIAL												
MAXIMUM INITIAL												
EXTENSION												
MIN EXTENSION												
BEFORE REDUCE												
TIME TO REDUCE												
MAX GREEN	31	52										
MAX II GREEN												
YELLOW CLR	4	4										
RED CLR												
OL GRN EXT												
LOCKING												
MIN RECALL												
MAX RECALL												
PED RECALL												
SOFT RECALL												
FIELD FLASH	R	Y										
FLASH PHASE												
OVERRIDE												
DUAL ENTRY												
COND SERV												

Cabinet turn on Date: _____ Time: _____

Timings authorized by: _____ Date: _____

Title: _____ Last revised Date: _____

Timing Sheet updated from controller by: Robert Swanfelt Date: 08/06/96

rev. 8/96

TRAFFIC SIGNAL TIMING SHEET

Location: 2nd & Ralston Date: 08/06/96 Time: 14:24

Timing installed by: taken from controller Controller Type: 111

VMS number: 015 Intersection No: 119 Address: 1 2 3 4 Start In: FL RED

Start Time: N/A Start Up Ø's : 1 2 3 4 / 5 6 7 8 Start In: Ylw Grn

PHASE/ DIRECTION	Ø1 N/S	Ø2 E/W	Ø3	Ø4	Ø5	Ø6	Ø7	Ø8	OL A	OL B	OL C	OL D
PED WALK												
PED PROTECT	10	10										
ADD PER/ ACT												
INITIAL												
MAXIMUM INITIAL												
EXTENSION												
MIN EXTENSION												
BEFORE REDUCE												
TIME TO REDUCE												
MAX GREEN	20	32										
MAX II GREEN												
YELLOW CLR	4	4										
RED CLR												
OL GRN EXT												
LOCKING												
MIN RECALL												
MAX RECALL												
PED RECALL												
SOFT RECALL												
FIELD FLASH	R	Y										
FLASH PHASE												
OVERRIDE												
DUAL ENTRY												
COND SERV												

Cabinet turn on Date: _____ Time: _____

Timings authorized by: _____ Date: _____

Title: _____ Last revised Date: _____

Timing Sheet updated from controller by: Robert Swanfelt Date: 08/06/96

rev. 8/96

TRAFFIC SIGNAL TIMING SHEET

Location: 2nd & Lake Date: 08/07/96 Time: 11:30

Timing installed by: taken from controller Controller Type: 111

VMS number: 011 Intersection No: 118 Address: 1 2 3 4 Start In: FL RED

Start Time: N/A Start Up Ø's : 1 2 3 4 / 5 6 7 8 Start In: Ylw Grn

PHASE/ DIRECTION	Ø1 N/S	Ø2 E/W	Ø3	Ø4	Ø5	Ø6	Ø7	Ø8	OL A	OL B	OL C	OL D
PED WALK												
PED PROTECT	10	10										
ADD PER/ ACT												
INITIAL												
MAXIMUM INITIAL												
EXTENSION												
MIN EXTENSION												
BEFORE REDUCE												
TIME TO REDUCE												
MAX GREEN	32	22										
MAX II GREEN												
YELLOW CLR	3.5	4.0										
RED CLR												
OL GRN EXT												
LOCKING												
MIN RECALL												
MAX RECALL												
PED RECALL												
SOFT RECALL												
FIELD FLASH	R	R										
FLASH PHASE												
OVERRIDE												
DUAL ENTRY												
COND SERV												

Cabinet turn on Date: _____ Time: _____

Timings authorized by: _____ Date: _____

Title: _____ Last revised Date: _____

Timing Sheet updated from controller by: Robert Swanfelt Date: 08/07/96

rev. 8/96

TRAFFIC SIGNAL TIMING SHEET

Location: 2nd & Arlington _____ Date: 08/07/96 Time: 11:24

Timing installed by: taken from controller Controller Type: 111

VMS number: 013 Intersection No: 115 Address: 1 2 3 4 Start In: FL RED

1 2 3 4

Start Time: N/A Start Up Ø's : 5 6 7 8 Start In: Ylw Grn

PHASE/ DIRECTION	Ø1 N/S	Ø2 E/W	Ø3	Ø4	Ø5	Ø6	Ø7	Ø8	OL A	OL B	OL C	OL D
PED WALK												
PED PROTECT	10	10										
ADD PER/ ACT												
INITIAL												
MAXIMUM INITIAL												
EXTENSION												
MIN EXTENSION												
BEFORE REDUCE												
TIME TO REDUCE												
MAX GREEN	36	32										
MAX II GREEN												
YELLOW CLR	4	4										
RED CLR												
OL GRN EXT												
LOCKING												
MIN RECALL												
MAX RECALL												
PED RECALL												
SOFT RECALL												
FIELD FLASH	R	R										
FLASH PHASE												
OVERRIDE												
DUAL ENTRY												
COND SERV												

Cabinet turn on Date: _____ Time: _____

Timings authorized by: _____ Date: _____

Title: _____ Last revised Date: _____

Timing Sheet updated from controller by: Robert Swanfelt Date: 08/07/96

Rev. 8/96

TRAFFIC SIGNAL TIMING SHEET

Location: Keystone & 4th Date: 09/18/96 Time: 13:15

Timing installed by: taken from controller Controller Type: 820A

VMS number: 152 Intersection No: 038 Address: 1 2 3 4 Start In: FL RED

Start Time: 8.0 Sec Start Up Ø's : 1 2 3 4 / 5 6 7 8 Start In: Ylw Grn

PHASE/ DIRECTION	Ø1 SLT	Ø2 NB	Ø3	Ø4 E/W	Ø5 NLT	Ø6 SB	Ø7	Ø8	OL A	OL B	OL C	OL D
PED WALK		7		7		7						
PED PROTECT		12		14		12						
ADD PER/ ACT		2.0										
INITIAL	6	6		4	4	6						
MAXIMUM INITIAL	6	6		4	4	6						
EXTENSION	2.0	2.0		2.0	2.0	2.0						
MIN EXTENSION	1.0	1.0		1.0	1.0	1.0						
BEFORE REDUCE	4	6		4	4	6						
TIME TO REDUCE	11	29		21	8	29						
MAX GREEN	15	35		25	12	35						
MAX II GREEN	12	35		25	12	35						
YELLOW CLR	3.0	3.4		3.4	3.0	3.4						
RED CLR	1.0	.5		.5	1.0	.5						
OL GRN EXT												
LOCKING		Y		Y		Y						
MIN RECALL												
MAX RECALL												
PED RECALL		X		X		X						
SOFT RECALL		X				X						
FIELD FLASH	R	R		R	R	R						
FLASH PHASE		X				X						
OVERRIDE	X	X		X		X						
DUAL ENTRY												
LAG PHASES	X			X	X							
MIN YELLOW	3.0											
RED REVERT	4.0											
SIM GAP	YES											

Cabinet turn on Date: _____ Time: _____

Timings authorized by: _____ Date: _____

le: _____ Last revised Date: _____

Timing Sheet updated from controller by: Robert Swanfelt Date: 09/18/96

rev. 8/96

TRAFFIC SIGNAL TIMING SHEET

Location: Center & Commercial/Plaza Date: 08/19/96 Time: _____

Timing installed by: VMS pin read Controller Type: 820

VMS number: 001 Intersection No: 005 Address: 1 2 3 4 Start In: FL RED

Start Time: 8.0 Sec Start Up Ø's : 1 2 3 4 / 5 6 7 8 Start In: Ylw Grn

PHASE/ DIRECTION	Ø1	Ø2 NB	Ø3 RR TRACK	Ø4 E/W	Ø5	Ø6	Ø7	Ø8	OL A 2+3	OL B	OL C	OL D
PED WALK		16		7								
PED PROTECT		6		10								
ADD PER/ ACT												
INITIAL		5	3	5								
MAXIMUM INITIAL												
EXTENSION		1.0	1.0	1.0								
MIN EXTENSION												
BEFORE REDUCE												
TIME TO REDUCE												
MAX GREEN		40	8	20								
MAX II GREEN		37	8	23								
YELLOW CLR		3.4	3.4	3.0					3.4			
RED CLR		.5	.5	.5					.5			
OL GRN EXT												
LOCKING												
MIN RECALL												
MAX RECALL		X	X	X								
PED RECALL		X		X								
SOFT RECALL												
FIELD FLASH												
FLASH PHASE												
OVERRIDE												
DUAL ENTRY												
COND SERV												
MIN YELLOW	3											
RED RVRT	4											

Cabinet turn on Date: _____ Time: _____

Timings authorized by: _____ Date: _____

Title: _____ Last revised Date: _____

Timing Sheet updated from controller by: Dave Walsh Date: 08/19/96

rev. 8/96

TRAFFIC SIGNAL TIMING SHEET

Location: 4th & West Date: 09/17/96 Time: 14:45

Timing installed by: VMS pin read Controller Type: 111-2phas

vMS number: 037 Intersection No: 031 Address: 1 2 3 4 Start In: FL RED

Start Time: N/A Start Up Ø's : 1 2 3 4 / 5 6 7 8 Start In: Yiw Grn

PHASE/ DIRECTION	Ø1 N/S	Ø2 E/W	Ø3	Ø4	Ø5	Ø6	Ø7	Ø8	OL A	OL B	OL C	OL D
PED WALK												
PED PROTECT	10	10										
ADD PER/ACT												
INITIAL												
MAXIMUM INITIAL												
EXTENSION												
MIN EXTENSION												
BEFORE REDUCE												
TIME TO REDUCE												
MAX GREEN	20	52										
MAX II GREEN												
YELLOW CLR	4.0	4.0										
RED CLR												
OL GRN EXT												
LOCKING												
MIN RECALL												
MAX RECALL												
PED RECALL												
SOFT RECALL												
FIELD FLASH	R	Y										
FLASH PHASE												
OVERRIDE												
DUAL ENTRY												
COND SERV												
RED REVERT												
MIN YELLOW												

Cabinet turn on Date: _____ Time: _____

Timings authorized by: _____ Date: _____

itle: _____ Last revised Date: _____

Timing Sheet updated from controller by: Robert Swanfelt Date: 09/17/96

rev. 8/96

TRAFFIC SIGNAL TIMING SHEET

Location: 4th & Vine Date: 09/18/96 Time: 09:00

Timing installed by: VMS pin read Controller Type: 820

VMS number: 040 Intersection No: 030 Address: 1 2 3 4 Start In: FL RED

Start Time: 8.0 Sec Start Up Ø's : 1 2 3 4 / 5 6 7 8 Start In: Ylw Grn

PHASE/ DIRECTION	Ø1 N/S	Ø2 E/W	Ø3	Ø4	Ø5	Ø6	Ø7	Ø8	OL A	OL B	OL C	OL D
PED WALK	7	7										
PED PROTECT	15	15										
ADD PER/ ACT												
INITIAL	4	4										
MAXIMUM INITIAL	4	4										
EXTENSION	2	2										
MIN EXTENSION	1	1										
BEFORE REDUCE	4	4										
TIME TO REDUCE	16	26										
MAX GREEN	20	30										
MAX II GREEN	24	30										
YELLOW CLR	3.0	3.4										
RED CLR	1.0	.5										
OL GRN EXT												
LOCKING	N	N										
MIN RECALL												
MAX RECALL												
PED RECALL		X										
SOFT RECALL												
FIELD FLASH	R	R										
FLASH PHASE		X										
OVERRIDE												
DUAL ENTRY												
COND SERV												
RED REVERT	8.0											
MIN YELLOW	3.0											

Cabinet turn on Date: _____ Time: _____

Timings authorized by: _____ Date: _____

Title: _____ Last revised Date: _____

Timing Sheet updated from controller by: Robert Swanfelt Date: 09/18/96

rev. 8/96

[illegible] TIMING SHEET

Location: 4th & Sutro Date: 09/18/96 Time: 10:15

Timing installed by: taken from controller Controller Type: 820

MS number: 147 Intersection No: 028 Address: 1 2 3 4 Start In: FL RED

Start Time: 8.0 Sec Start Up Ø's : 1 2 3 4 / 5 6 7 8 Start In: Ylw Grn

PHASE/ DIRECTION	Ø1 SLT	Ø2 NB	Ø3 WLT	Ø4 EB	Ø5 NLT	Ø6 SB	Ø7 ELT	Ø8 WB	OL A	OL B	OL C	OL D
PED WALK		7		7		7		7				
PED PROTECT		14		14		14		14				
ADD PER/ ACT												
INITIAL	4	4	4	4	4	4	4	4				
MAXIMUM INITIAL	4	4	4	4	4	4	4	4				
EXTENSION	2.0	3.0	2.0	3.0	2.0	3.0	2.0	3.0				
MIN EXTENSION	1.0	.5	1.0	.5	1.0	.5	1.0	.5				
BEFORE REDUCE	4	4	4	4	4	4	4	4				
TIME TO REDUCE	8	26	8	26	8	26	8	26				
MAX GREEN	10	35	10	35	10	35	10	35				
MAX II GREEN	10	28	10	28	10	28	10	28				
YELLOW CLR	3.0	4.0	3.0	4.0	3.0	4.0	3.0	4.0				
RED CLR	0	0	0	0	0	0	0	0				
OL GRN EXT												
LOCKING	N	N	N	N	N	N	N	N				
MIN RECALL												
MAX RECALL												
PED RECALL												
SOFT RECALL												
FIELD FLASH	R	R	R	Y	R	R	R	Y				
FLASH PHASE		X			X							
OVERRIDE												
DUAL ENTRY												
COND SERV												
MIN YELLOW	3.0											
RED REVERT	4.0											
SIM GAP	YES											

Cabinet turn on Date: _____ Time: _____

Timings authorized by: _____ Date: _____

itle: _____ Last revised Date: _____

Timing Sheet updated from controller by: Robert Swanfelt Date: 09/18/96

rev. 8/96

TRAFFIC SIGNAL TIMING SHEET

Location: 4th & Ralston Date: 09/18/96 Time: 08:30

Timing installed by: VMS pin read Controller Type: 820A

VMS number: 039 Intersection No: 025 Address: 1 2 3 4 Start In: FL RED

Start Time: 8.0 Sec Start Up Ø's : 1 2 3 4 / 5 6 7 8 Start In: Ylw Grn

PHASE/ DIRECTION	Ø1	Ø2 N/S	Ø3	Ø4 E/W	Ø5	Ø6	Ø7	Ø8	OL A	OL B	OL C	OL D
PED WALK		10		10								
PED PROTECT		12		10								
ADD PER/ ACT												
INITIAL		4		4								
MAXIMUM INITIAL												
EXTENSION		2.0		2.0								
MIN EXTENSION												
BEFORE REDUCE												
TIME TO REDUCE												
MAX GREEN		25		25								
MAX II GREEN												
YELLOW CLR		4.0		4.0								
RED CLR		0		0								
OL GRN EXT												
LOCKING												
MIN RECALL												
MAX RECALL				X								
PED RECALL				X								
SOFT RECALL												
FIELD FLASH		R		R								
FLASH PHASE				X								
OVERRIDE												
DUAL ENTRY												
COND SERV												
RED REVERT	4.0											
MIN YELLOW	3.0											

Cabinet turn on Date: _____ Time: _____

Timings authorized by: _____ Date: _____

Title: _____ Last revised Date: _____

Timing Sheet updated from controller by: Robert Swanfelt Date: 09/18/96

rev. 8/96

Location: 4th & Lake Date: 09/17/96 Time: 13:30

Timing installed by: VMS pin read Controller Type: 820

...S number: 033 Intersection No: 024 Address: 1 2 3 4 Start In: FL RED

Start Time: 8.0 Sec Start Up Ø's : 1 2 3 4 / 5 6 7 8 Start In: Ylw Grn

PHASE/ DIRECTION	Ø1	Ø2 NB	Ø3	Ø4 EB	Ø5	Ø6 SB	Ø7	Ø8 WB	OL A	OL B	OL C	OL D
PED WALK		7		7		7		7				
PED PROTECT		14		14		14		14				
ADD PER/ ACT												
INITIAL		4		4		4		4				
MAXIMUM INITIAL												
EXTENSION		2.0		2.0		2.0		2.0				
MIN EXTENSION												
BEFORE REDUCE												
TIME TO REDUCE												
MAX GREEN		30		30		30		30				
MAX II GREEN		30		30		30		30				
YELLOW CLR		4.0		4.0		4.0		4.0				
RED CLR		0		0		0		0				
OL GRN EXT												
LOCKING		x		x		x		x				
MIN RECALL												
MAX RECALL		x		x		x		x				
PED RECALL		x		x		x		x				
SOFT RECALL												
FIELD FLASH		R		R		R		R				
FLASH PHASE				x				x				
OVERRIDE		x		x		x		x				
DUAL ENTRY		x		x		x		x				
COND SERV												
RED REVERT	4.0											
MIN YELLOW	3.0											

Cabinet turn on Date: Time:

Timings authorized by: Date:

tle: Last revised Date:

Timing Sheet updated from controller by: Robert Swanfelt Date: 09/17/96

rev. 8/96

TRAFFIC SIGNAL TIMING SHEET

Location: 4th & Arlington Date: 09/17/96 Time: 15:00

Timing installed by: VMS pin read Controller Type: 111-20

vMS number: 038 Intersection No: 022 Address: 1 2 3 4 Start In: ~~FL RED~~

Start Time: N/A Start Up Ø's : 1 2 3 4 / 5 6 7 8 Start In: Ylw Grn

PHASE/ DIRECTION	Ø1 N/S	Ø2 E/W	Ø3	Ø4	Ø5	Ø6	Ø7	Ø8	OL A	OL B	OL C	OL D
PED WALK												
PED PROTECT	10	10										
ADD PER/ ACT												
INITIAL												
MAXIMUM INITIAL												
EXTENSION												
MIN EXTENSION												
BEFORE REDUCE												
TIME TO REDUCE												
MAX GREEN	40	49										
MAX II GREEN												
YELLOW CLR	4.0	4.0										
RED CLR	0	0										
OL GRN EXT												
LOCKING												
MIN RECALL												
MAX RECALL												
PED RECALL												
SOFT RECALL												
FIELD FLASH	R	R										
FLASH PHASE												
OVERRIDE												
DUAL ENTRY												
COND SERV												

Cabinet turn on Date: _____ Time: _____

Timings authorized by: _____ Date: _____

Title: _____ Last revised Date: _____

Timing Sheet updated from controller by: Robert Swanfelt Date: 09/18/96

rev. 8/96

APPENDIX E
STB DATABASE

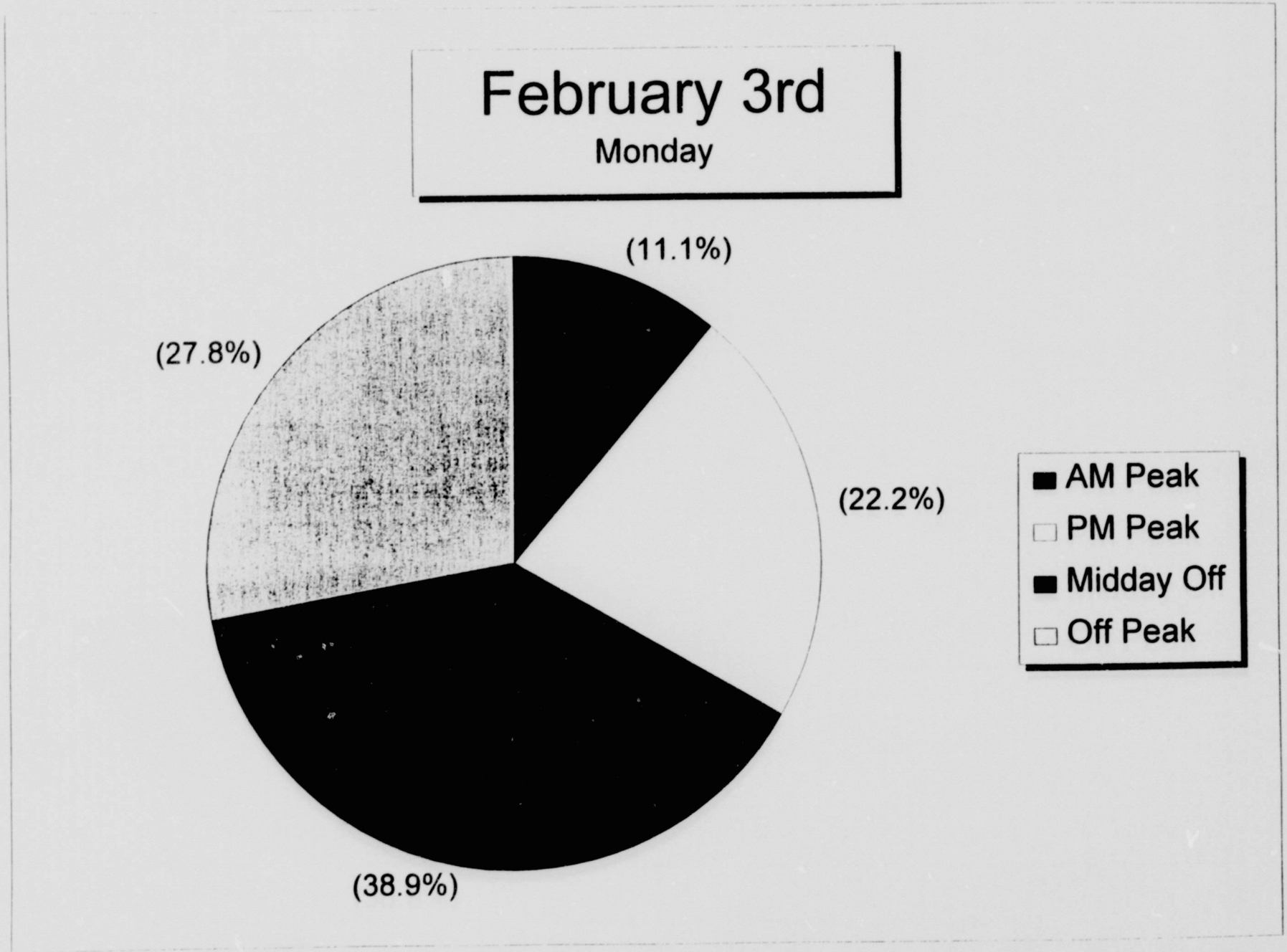
DISTRIBUTION OF TRAINS DURING EACH PEAK PERIODOBSERVED FOR SEVEN DAYS

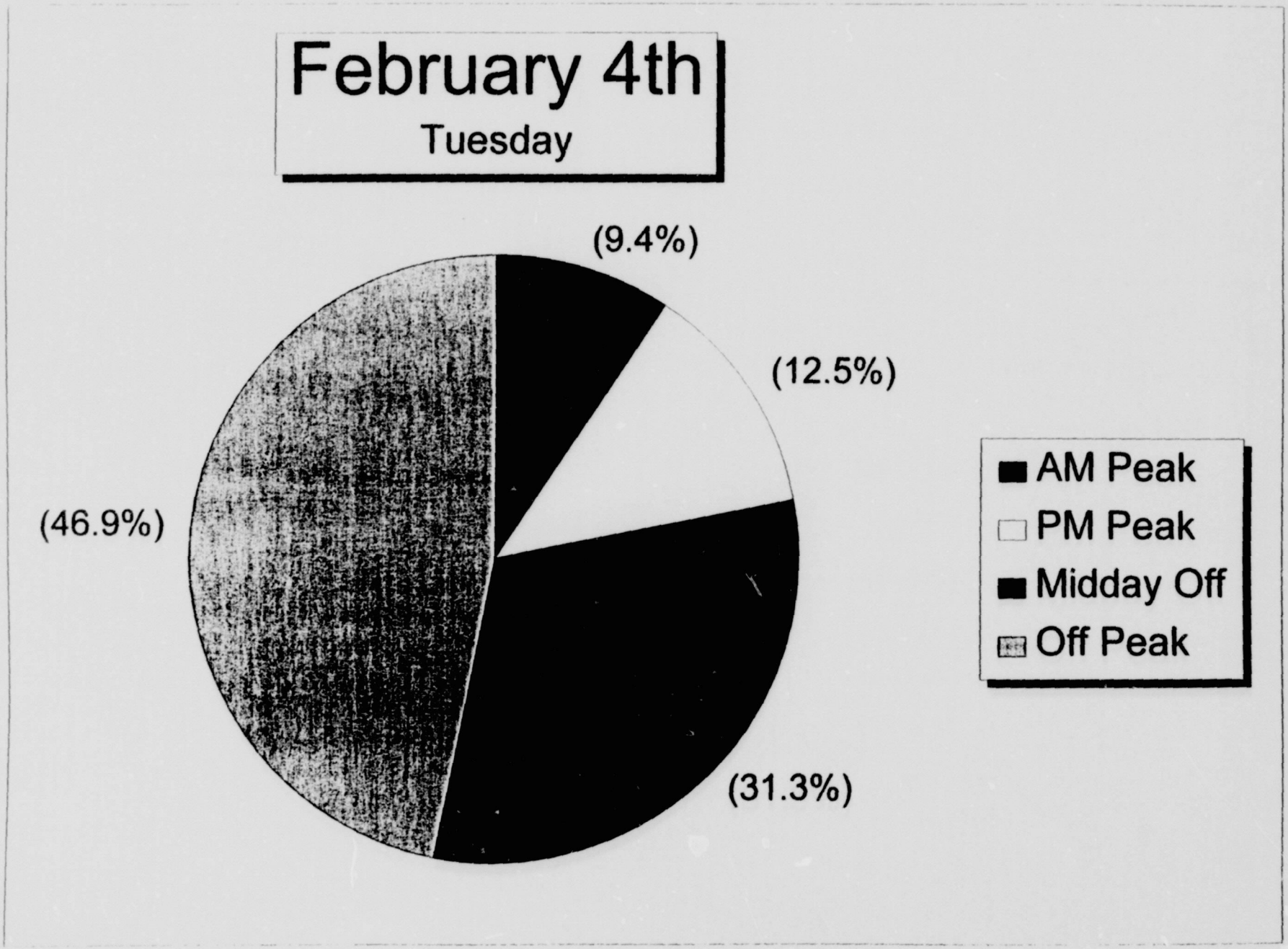
CITY OF RENO - RAILROAD DELAY STUDY
STB Database
Train Frequency Per Peak Period

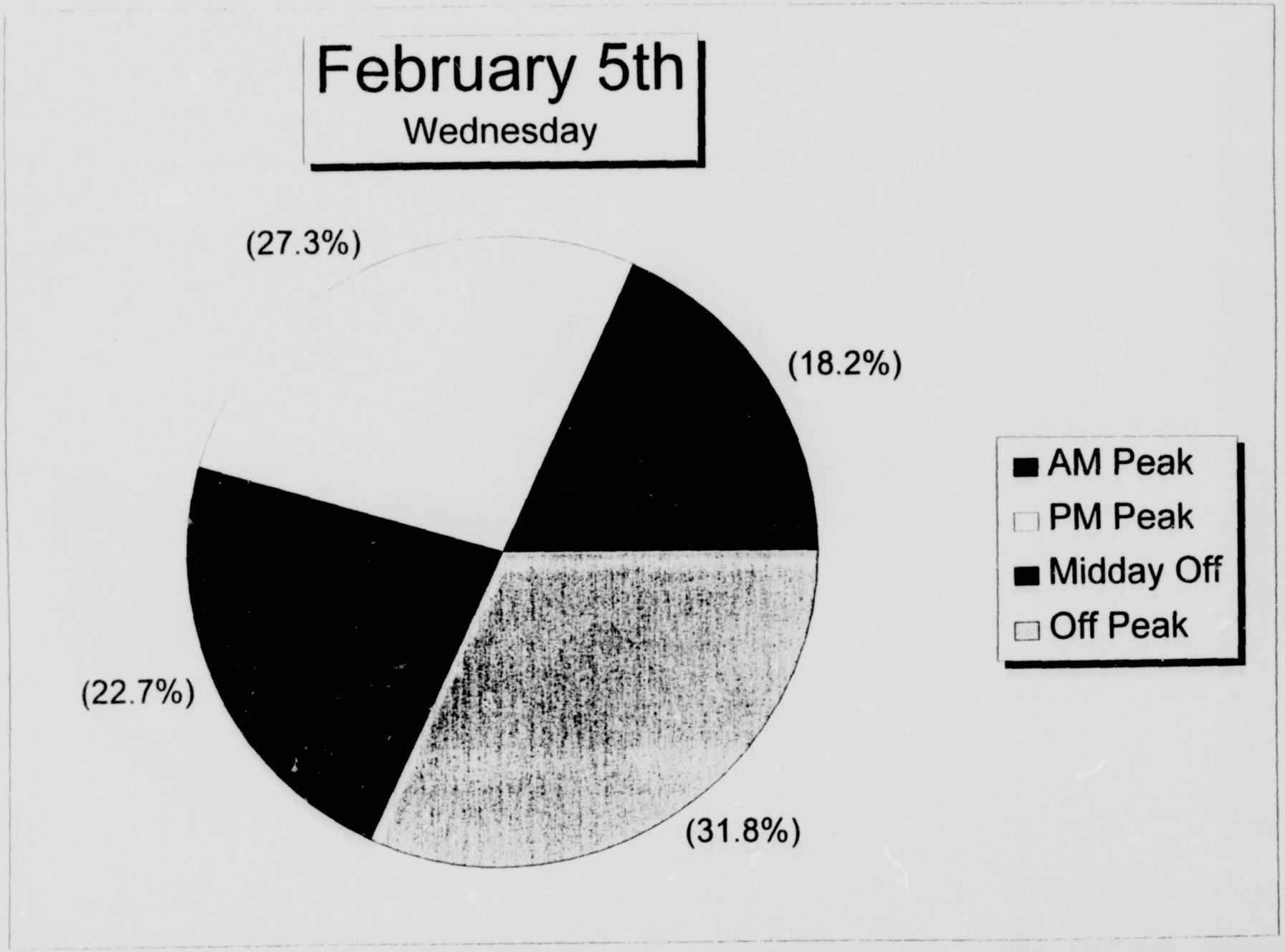
	02/03/97	02/04/97	02/05/97	02/06/97	02/07/97	02/08/97	02/09/97	Total Trains/Week	Average Trains/Day	Percent of Total
AM Peak	2	3	4	2	0	0	4	15	2	0.09
PM Peak	4	4	6	2	4	2	3	25	4	0.15
Midday Off	7	10	5	9	5	6	8	50	7	0.29
Off Peak	5	15	7	10	13	18	12	80	11	0.47
Total	18	32	22	23	22	26	27	170	24	1.00

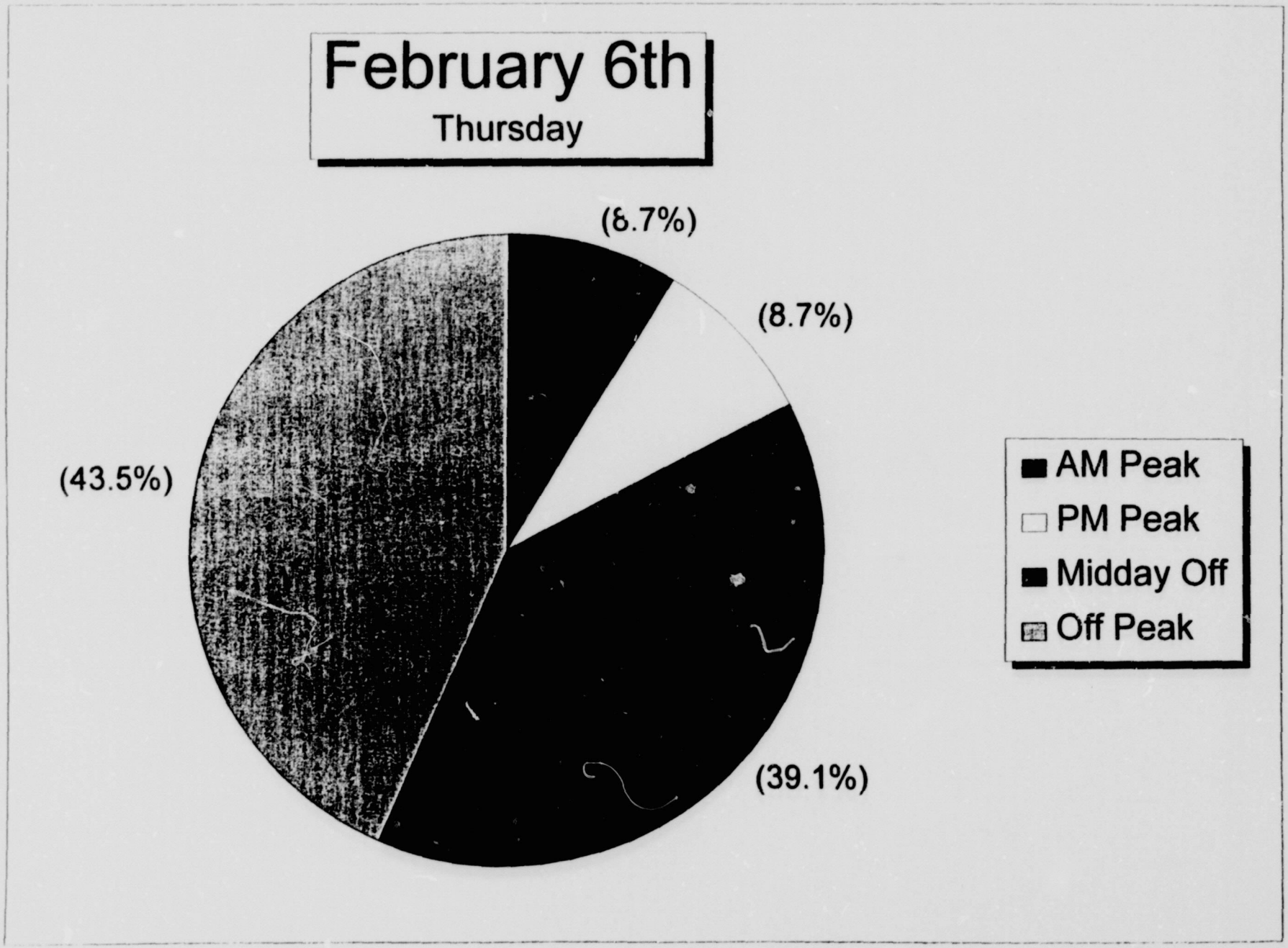
AM Peak: 7:00 am - 9:00 am
PM Peak: 4:00 pm - 6:00 pm
Midday Off: 9:00 am - 4:00 pm
Off Peak: 6:00 pm - 7:00 am

	Percent of Total	12.70 Trains/Day	24.00 Trains/Day	36.00 Trains/Day
AM Peak	0.09	1.12	2.12	3.18
PM Peak	0.15	1.87	3.53	5.29
Midday Off	0.29	3.74	7.06	10.59
Off Peak	0.47	5.98	11.29	16.94
Total	1.00	12.70	24.00	36.00


February 3rd
Monday
(11.1%)
(27.8%)
(22.2%)
(38.9%)
AM Peak
PM Peak
Midday Off
Off Peak

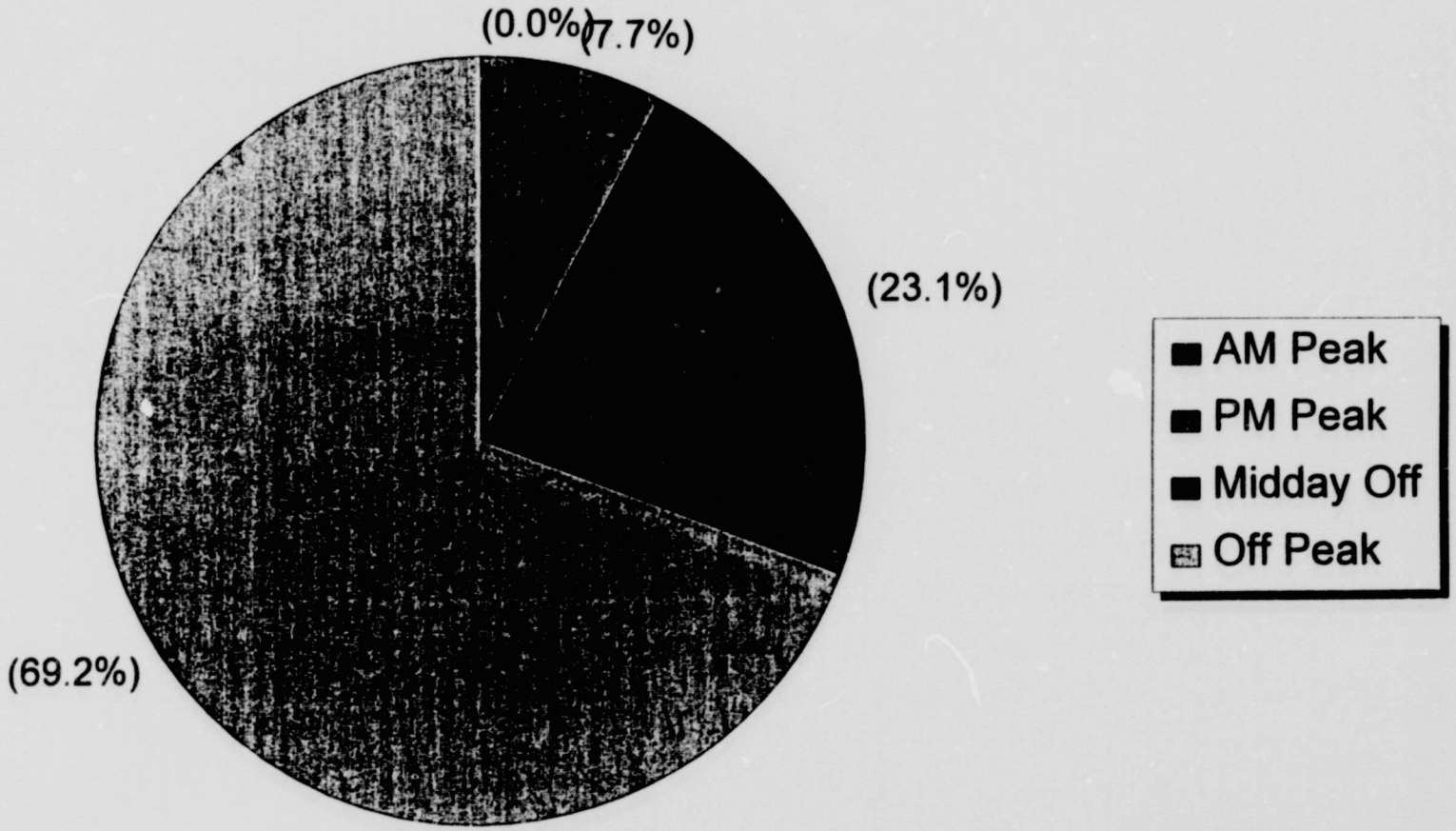

February 4th
Tuesday
(9.4%)
(12.5%)
(46.9%)
(31.3%)
AM Peak
PM Peak
Midday Off
Off Peak

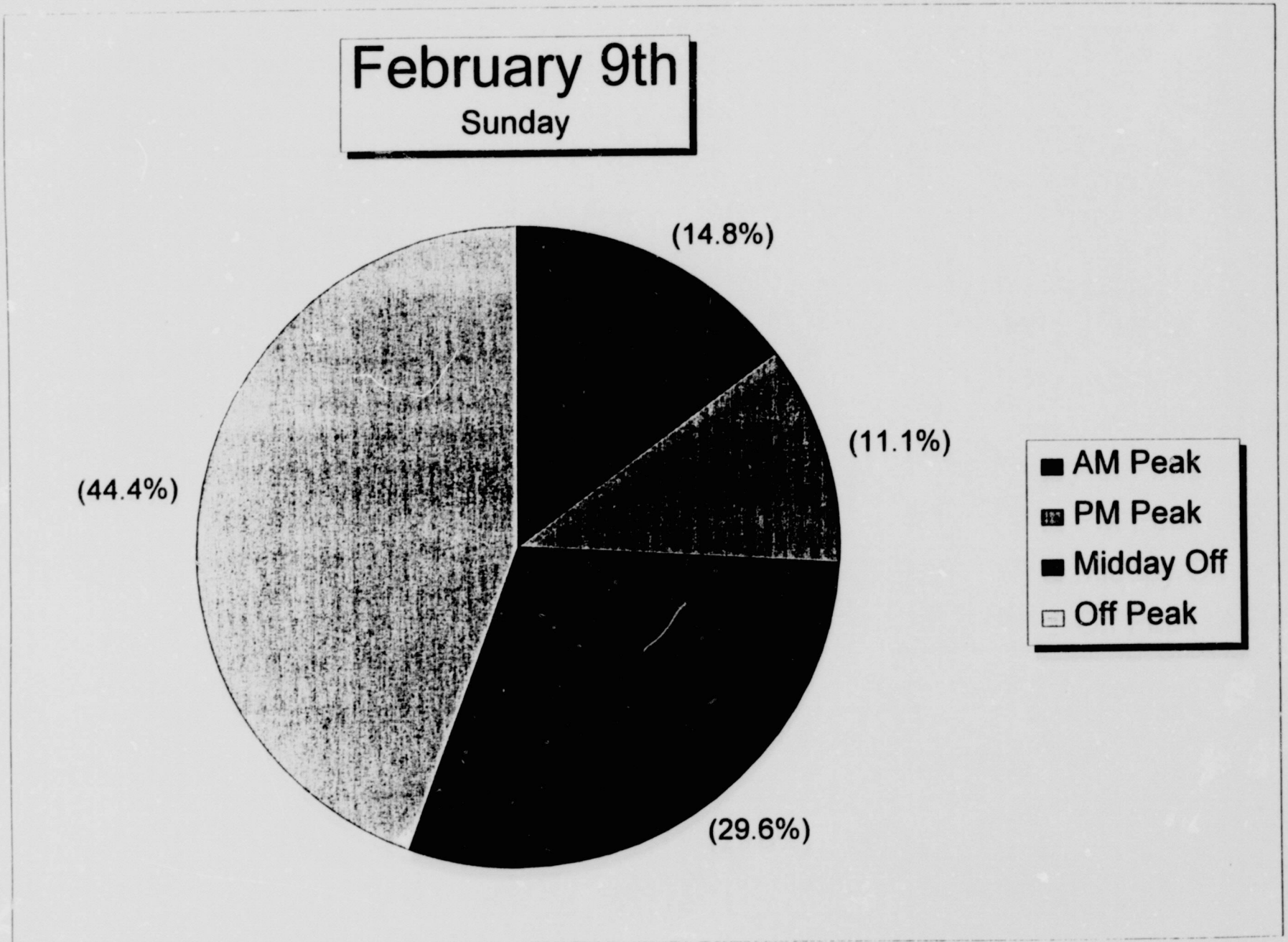

February 5th
Wednesday
(27.3%)
(18.2%)
(22.7%)
(31.8%)
AM Peak
PM Peak
Midday Off
Off Peak


February 6th
Thursday
(8.7%)
(8.7%)
(43.5%)
(39.1%)
AM Peak
PM Peak
Midday Off
Off Peak

February 8th

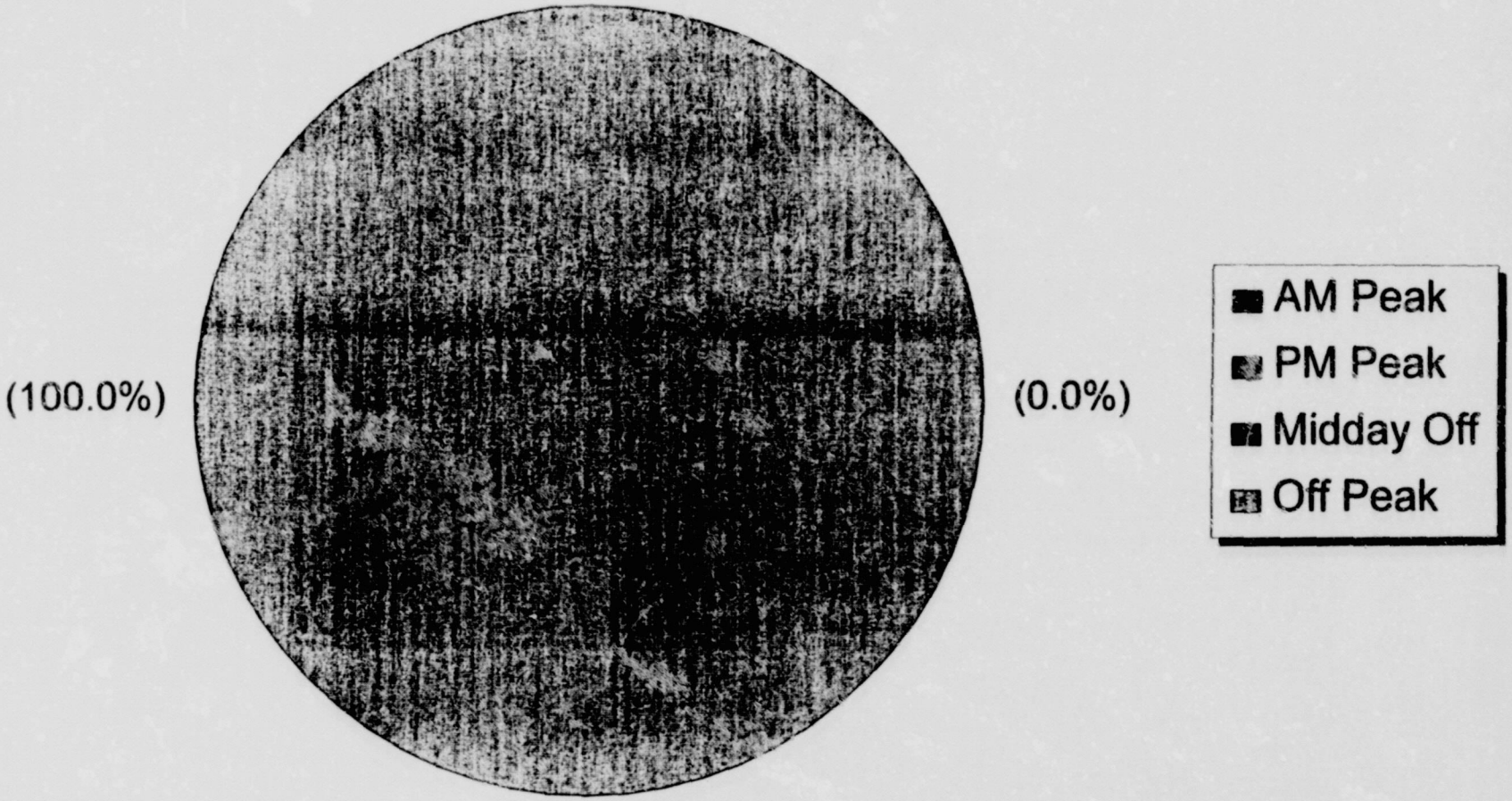
Saturday




February 9th
Sunday
(14.8%)
(11.1%)
(44.4%)
(29.6%)
AM Peak
PM Peak
Midday Off
Off Peak

February 10th

Monday



APPENDIX F
DATA INPUT FILES

1995

- AM PEAK
- PM PEAK
- OFF PEAK

2000

- AM PEAK
- PM PEAK
- OFF PEAK

2007

- AM PEAK
- PM PEAK
- OFF PEAK

2015

- AM PEAK
- PM PEAK
- OFF PEAK

CITY OF RENO - RAILROAD DELAY STUDY
QUEUE AND DELAY ANALYSIS
AM PEAK - YEAR 1995

	Length of Train feet	Speed of Train mph	Gate Down Time (average)	ADT Volume (veh/day)	Peak Hr Volume (veh/hr)	q(1) veh/hour		No. of Lanes lanes		Dist. to Nearest Int feet	
						Northbound	Southbound	Northbound	Southbound	Northbound	Southbound
Center	6500	20	152	11600	1160	1160		3.00	0.00	220.00	180.00
Virginia	6500	20	132	14000	1400	770	630	2.00	2.00	210.00	150.00
Sierra	6500	20	152	19700	1970		1970	0.00	3.00	210.00	160.00
Arlington	6500	20	165	15200	1520	836	684	2.00	2.00	560.00	540.00
Keystone	6500	20	143	22100	2210	1216	995	3.00	2.00	580.00	330.00
Lake	6500	20	222	7575	758	417	341	2.00	2.00	550.00	530.00
West	6500	20	222	3200	320	176	144	1.00	1.00	560.00	550.00
Ralston	6500	20	222	3785	379	208	170	1.00	1.00	570.00	540.00
Washington	6500	20	222	1875	188	103	84	1.00	1.00	580.00	530.00
Sutro	6500	20	222	11700	1170	644	527	2.00	2.00	220.00	560.00
Morrill	6500	20	222	300	30	17	14	1.00	1.00	820.00	560.00
Vine	6500	20	222	4185	419	230	188	2.00	2.00	540.00	577.00
Evans											

	Gate Down Time (average)	q(1) veh/sec		d(1) veh/sec	
		Northbound	Southbound	Northbound	Southbound
Center	152	0.32		1.59	
Virginia	132	0.21	0.18	1.06	1.06
Sierra	152		0.55		1.59
Arlington	165	0.23	0.19	1.06	1.06
Keystone	143	0.34	0.28	1.59	1.06
Lake	222	0.12	0.09	1.06	1.06
West	222	0.05	0.04	0.53	0.53
Ralston	222	0.06	0.05	0.53	0.53
Washington	222	0.03	0.02	0.53	0.53
Sutro	222	0.18	0.15	1.06	1.06
Morrill	222	0.00	0.00	0.53	0.53
Vine	222	0.06	0.05	1.06	1.06
Evans	0	0.00	0.00	0	0

	Northbound - Average							Distance to Adjacent Int. (feet)	Overflow Intersection?	Vehicles Affected by Overflow veh/ln
	Maximum Queue veh	Maximum Queue veh/ln	Maximum Queue feet/ln	Queue Dissipates sec	Total Delay sec	Average Delay sec	Maximum Delay sec			
Center	49	16	326.52	38.63	4668.38	60.60	152.00	220.00	yes	5
Virginia	28	14	282.33	33.37	2334.45	52.68	132.00	210.00	yes	4
Sierra										
Arlington	38	19	383.17	46.29	4047.94	64.43	165.00	560.00	no	
Keystone	48	16	321.88	38.55	4382.91	56.32	143.00	580.00	no	
Lake	26	13	256.45	27.16	3189.52	98.70	221.59	550.00	no	
West	11	11	216.67	22.52	1322.25	100.58	221.59	560.00	no	
Ralston	13	13	256.28	27.14	1593.58	98.71	221.59	570.00	no	
Washington	6	6	126.95	12.66	743.48	104.81	221.59	580.00	no	
Sutro	40	20	396.09	44.95	5278.70	92.11	221.59	220.00	yes	9
Morrill	1	1	20.31	1.93	113.51	109.84	221.59	820.00	no	
Vine	14	7	141.68	14.22	1670.51	104.11	221.59	540.00	no	
Evans										

** Average Vehicle Length = 20 feet

	Southbound - Average							Distance to Adjacent Int. (meters)	Overflow Intersection?	Vehicles Affected by Overflow
	Maximum Queue veh	Maximum Queue veh/ln	Maximum Queue meters/ln	Queue Dissipates sec	Total Delay sec	Average Delay sec	Maximum Delay sec			
Center										
Virginia	23	12	231.00	26.10	1826.07	55.10	132.00	150.00	yes	4
Sierra	83	28	554.52	79.77	9638.87	49.84	152.00	160.00	yes	20
Arlington	31	16	313.50	36.03	3151.22	67.71	165.00	540.00	no	
Keystone	40	20	395.04	50.40	3820.08	52.87	143.00	330.00	yes	3
Lake	21	10	209.82	21.74	2552.73	100.90	221.59	530.00	no	
West	9	9	177.27	18.09	1062.22	102.43	221.59	550.00	no	
Ralston	10	10	209.68	21.72	1275.44	100.90	221.59	540.00	no	
Washington	5	5	103.87	10.25	602.04	105.90	221.59	530.00	no	
Sutro	32	16	324.08	35.47	4165.32	95.51	221.59	560.00	no	
Morrill	1	1	16.62	1.58	92.72	110.01	221.59	560.00	no	
Vine	12	6	115.92	11.50	1351.01	105.33	221.59	577.00	no	
Evans										

** Average Vehicle Length = 6.1 meters (20 feet)

CITY OF RENO - RAILROAD DELAY STUDY
QUEUE AND DELAY ANALYSIS
PM PEAK - YEAR 1995

	Length of Train (meters)	Speed of Train (m/sec)	Gate Down Time (sec)	ADT Volume (veh/day)	Peak Hr Volume (veh/hr)	q(1) veh/hour		No. of Lanes lanes		Dist. to Nearest Int meters	
						Northbound	Southbound	Northbound	Southbound	Northbound	Southbound
Center	6500	20	271	11600	1160	1160		3.00	0.00	220.00	180.00
Virginia	6500	20	162	14000	1400	630	770	2.00	2.00	210.00	150.00
Sierra	6500	20	153	19700	1970		1970	0.00	3.00	210.00	160.00
Arlington	6500	20	164	15200	1520	684	836	2.00	2.00	560.00	540.00
Keystone	6500	20	152	22100	2210	995	1216	3.00	2.00	580.00	330.00
Lake	6500	20	222	7575	758	341	417	2.00	2.00	550.00	530.00
West	6500	20	222	3200	320	144	176	1.00	1.00	560.00	550.00
Ralston	6500	20	222	3785	379	170	208	1.00	1.00	570.00	540.00
Washington	6500	20	222	1875	188	84	103	1.00	1.00	580.00	530.00
Sutro	6500	20	222	11700	1170	527	644	2.00	2.00	220.00	550.00
Morrill	6500	20	222	300	30	14	17	1.00	1.00	820.00	560.00
Vine	6500	20	222	4185	419	188	230	2.00	2.00	540.00	577.00
Evans	6500	20	222								

	Gate Down Time (average)	q(1) veh/sec		d(1) veh/sec	
		Northbound	Southbound	Northbound	Southbound
Center	271	0.32	0.00	1.2	0
Virginia	162	0.18	0.21	0.8	0.8
Sierra	153	0.00	0.55	0	1.2
Arlington	164	0.19	0.23	0.8	0.8
Keystone	152	0.28	0.34	1.2	0.8
Lake	222	0.09	0.12	0.8	0.8
West	222	0.04	0.05	0.4	0.4
Ralston	222	0.05	0.06	0.4	0.4
Washington	222	0.02	0.03	0.4	0.4
Sutro	222	0.15	0.18	0.8	0.8
Morrill	222	0.00	0.00	0.4	0.4
Vine	222	0.05	0.06	0.8	0.8
Evans					

	Northbound - Average									
	Maximum Queue veh	Maximum Queue veh/ln	Maximum Queue meters/ln	Queue Dissipates sec	Total Delay sec	Average Delay sec	Maximum Delay sec	Distance to Adjacent int. (feet)	Overflow Intersection ?	Vehicles Affected by Overflow veh/ln
Center	87	29	582.15	99.48	16175.61	99.12	271.00	220	yes	59
Virginia	28	14	283.50	45.36	2939.33	63.28	162.00	210	yes	12
Sierra										
Arlington	31	16	311.60	51.08	3350.98	62.53	164.00	560	no	
Keystone	42	14	279.93	45.46	4145.59	58.50	152.00	580	no	
Lake	21	10	209.82	29.75	2636.79	97.68	221.59	550	no	
West	9	9	177.27	24.62	1091.17	99.72	221.59	560	no	
Ralston	10	10	209.68	29.73	1317.41	97.69	221.59	570	no	
Washington	5	5	103.87	13.79	611.23	104.30	221.59	580	no	
Sutro	32	16	324.08	49.57	4393.88	90.54	221.59	220	yes	17
Morrill	1	1	16.62	2.10	92.94	109.76	221.59	820	no	
Vine	12	6	115.92	15.50	1374.20	103.55	221.59	540	no	
Evans										

** Average Vehicle Length = 20 feet

	Southbound - Average									
	Maximum Queue veh	Maximum Queue veh/ln	Maximum Queue feet/ln	Queue Dissipates sec	Total Delay sec	Average Delay sec	Maximum Delay sec	Distance to Adjacent int. (feet)	Overflow Intersection ?	Vehicles Affected by Overflow
Center										
Virginia	35	17	346.50	59.12	3830.88	59.34	162.00	150	yes	32
Sierra	84	28	558.17	128.26	11774.23	41.61	153.00	160	yes	65
Arlington	38	19	380.84	67.08	4400.21	58.20	164.00	540	no	
Keystone	51	26	513.21	111.00	6748.67	43.92	152.00	330	yes	30
Lake	26	13	256.45	37.48	3321.84	94.77	221.59	530	no	
West	11	11	216.67	30.85	1367.41	97.25	221.59	550	no	
Ralston	13	13	256.28	37.45	1659.64	94.78	221.59	540	no	
Washington	6	6	126.95	17.09	757.54	102.86	221.59	530	no	
Sutro	40	20	396.09	63.76	5651.24	86.04	221.59	560	no	
Morrill	1	1	20.31	2.57	113.83	109.53	221.59	560	no	
Vine	14	7	141.68	19.25	1706.10	101.94	221.59	577	no	
Evans										

** Average Vehicle Length = 20 feet

CITY OF RENO - RAILROAD DELAY STUDY
QUEUE AND DELAY ANALYSIS
OFF PEAK - YEAR 1995

	Length of Train feet	Speed of Train mph	Gate Down Time (average)	ADT Volume (veh/day)	Average Volume (veh/hr)	q(1) veh/hour		No. of Lanes lanes		Dist. to Nearest Int meters	
						Northbound	Southbound	Northbound	Southbound	Northbound	Southbound
Center	6500	20	222	11600	464	464		3.00	0.00	220.00	180.00
Virginia	6500	20	222	14000	560	308	252	2.00	2.00	210.00	150.00
Sierra	6500	20	222	19700	788		788	0.00	3.00	210.00	160.00
Arlington	6500	20	222	15200	608	334	274	2.00	2.00	560.00	540.00
Keystone	6500	20	222	22100	884	486	398	3.00	2.00	580.00	330.00
Lake	6500	20	222	7575	303	167	136	2.00	2.00	550.00	530.00
West	6500	20	222	3200	128	70	58	1.00	1.00	560.00	550.00
Ralston	6500	20	222	3785	151	83	68	1.00	1.00	570.00	540.00
Washington	6500	20	222	1875	75	41	34	1.00	1.00	580.00	530.00
Sutro	6500	20	222	11700	468	257	211	2.00	2.00	220.00	560.00
Morrill	6500	20	222	300	12	7	5	1.00	1.00	820.00	560.00
Vine	6500	20	222	4185	167	92	75	2.00	2.00	540.00	577.00
Evans	6500	20	222								

	Gate Down Time (average)	q(1) veh/sec		d(1) veh/sec	
		Northbound	Southbound	Northbound	Southbound
Center	222	0.13		1.59	
Virginia	222	0.09	0.07	1.06	1.06
Sierra	222		0.22		1.59
Arlington	222	0.09	0.08	1.06	1.06
Keystone	222	0.14	0.11	1.59	1.06
Lake	222	0.05	0.04	1.06	1.06
West	222	0.02	0.02	0.53	0.53
Ralston	222	0.02	0.02	0.53	0.53
Washington	222	0.01	0.01	0.53	0.53
Sutro	222	0.07	0.06	1.06	1.06
Morrill	222	0.00	0.00	0.53	0.53
Vine	222	0.03	0.02	1.06	1.06
Evans					

	Northbound - Average							Distance to Adjacent Int. (feet)	Overflow Intersection?	Vehicles Affected by Overflow veh/ln
	Maximum Queue veh	Maximum Queue veh/ln	Maximum Queue feet/ln	Queue Dissipates sec	Total Delay sec	Average Delay sec	Maximum Delay sec			
Center	29	10	190.40	19.55	3443.53	101.81	221.59	220.00	no	
Virginia	19	9	189.58	19.46	2284.92	101.85	221.59	210.00	no	
Sierra								210.00		
Arlington	21	10	205.83	21.28	2499.58	101.09	221.59	560.00	no	
Keystone	30	10	199.51	20.57	3623.57	101.38	221.59	580.00	no	
Lake	10	5	102.58	10.12	1188.42	105.96	221.59	550.00	no	
West	4	4	86.67	8.49	498.51	106.71	221.59	560.00	no	
Ralston	5	5	102.51	10.11	593.80	105.96	221.59	570.00	no	
Washington	3	3	50.78	4.90	287.53	108.40	221.59	580.00	no	
Sutro	16	8	158.44	16.03	1882.39	103.32	221.59	220.00	no	
Morrill	0	0	8.13	0.77	45.17	110.41	221.59	820.00	no	
Vine	6	3	56.67	5.48	643.42	108.12	221.59	540.00	no	
Evans										

** Average Vehicle Length = 20 feet

	Southbound - Average							Distance to Adjacent Int. (feet)	Overflow Intersection?	Vehicles Affected by Overflow
	Maximum Queue veh	Maximum Queue veh/ln	Maximum Queue meters/ln	Queue Dissipates sec	Total Delay sec	Average Delay sec	Maximum Delay sec			
Center										
Virginia	16	8	155.11	15.67	1840.10	103.48	221.59	150.00	yes	1
Sierra	49	16	323.36	35.38	6231.92	95.54	221.59	160.00	yes	27
Arlington	17	8	168.41	17.11	2010.01	102.85	221.59	540.00	no	
Keystone	24	12	244.86	25.79	3028.64	99.25	221.59	330.00	no	
Lake	8	4	83.93	8.21	964.34	106.84	221.59	530.00	no	
West	4	4	70.91	6.90	405.05	107.45	221.59	550.00	no	
Ralston	4	4	83.87	8.21	481.84	106.84	221.59	540.00	no	
Washington	2	2	41.55	3.99	234.31	108.84	221.59	530.00	no	
Sutro	13	6	129.63	12.94	1520.14	104.68	221.59	560.00	no	
Morrill	0	0	6.65	0.63	36.93	110.48	221.59	560.00	no	
Vine	5	2	46.37	4.46	524.08	108.61	221.59	577.00	no	
Evans										

** Average Vehicle Length = 6.1 meters (20 feet)

CITY OF RENO - RAILROAD DELAY STUDY
QUEUE AND DELAY ANALYSIS
AM PEAK - YEAR 2000

	Length of Train (feet)	Speed of Train (feet/sec)	Gate Down Time (average)	FUTURE ADT VOL. (veh/day)	Peak Hr Volume (veh/hr)	q(1) veh/hour		No. of Lanes lanes		Dist. to Nearest Int feet	
						Northbound	Southbound	Northbound	Southbound	Northbound	Southbound
Center	6500	20	152	12800	1280	1280		3	0	220	180
Virginia	6500	20	132	15400	1540	847	693	2	2	210	150
Sierra	6500	20	152	21700	2170		2170	0	3	210	160
Arlington	6500	20	165	16700	1670	919	752	2	2	560	540
Keystone	6500	20	143	24300	2430	1337	1094	3	2	580	330
Lake	6500	20	222	8300	830	457	374	2	2	550	530
West	6500	20	222	3500	350	193	158	1	1	560	550
Ralston	6500	20	222	4200	420	231	189	1	1	570	540
Washington	6500	20	222	2100	210	116	95	1	1	580	530
Sutro	6500	20	222	12900	1290	710	581	2	2	220	560
Morrill	6500	20	222	300	30	17	14	1	1	820	560
Vine	6500	20	222	4600	460	253	207	2	2	540	577
Evans	6500	20	222	13380	1338	736	602	2	2	550	530

	Gate Down Time (average)	q(1) veh/sec		d(1) veh/sec	
		Northbound	Southbound	Northbound	Southbound
Center	152	0.36		1.59	0
Virginia	132	0.24	0.19	1.06	1.06
Sierra	152		0.60	0	1.59
Arlington	165	0.26	0.21	1.06	1.06
Keystone	143	0.37	0.30	1.59	1.06
Lake	222	0.13	0.10	1.06	1.06
West	222	0.05	0.04	0.53	0.53
Ralston	222	0.06	0.05	0.53	0.53
Washington	222	0.03	0.03	0.53	0.53
Sutro	222	0.20	0.16	1.06	1.06
Morrill	222	0.00	0.00	0.53	0.53
Vine	222	0.07	0.06	1.06	1.06
Evans	222	0.20	0.17	1.06	1.06

	Northbound - Average										Vehicles Affected by Overflow veh/ln
	Maximum Queue veh	Maximum Queue veh/ln	Maximum Queue feet/ln	Queue Dissipates sec	Total Delay sec	Average Delay sec	Maximum Delay sec	Distance to Adjacent Int. (feet)	Overflow Intersection?		
Center	54	18	360.30	43.78	5290.42	59.00	152.00	220	yes		23
Virginia	31	16	310.57	37.66	2634.49	51.35	132.00	210	yes		16
Sierra											
Arlington	42	21	420.98	52.30	4574.03	62.64	165.00	560	no		
Keystone	53	18	353.93	43.56	4952.12	54.81	143.00	580	no		
Lake	28	14	280.99	30.11	3536.27	97.54	221.59	550	no		
West	12	12	236.98	24.87	1460.12	99.62	221.59	560	no		
Ralston	14	14	284.38	30.52	1792.37	97.38	221.59	570	no		
Washington	7	7	142.19	14.28	838.44	104.09	221.59	580	no		
Sutro	44	22	436.72	50.61	5943.75	90.20	221.59	220	yes		36
Morrill	1	1	20.31	1.93	113.51	109.84	221.59	820	no		
Vine	16	8	155.73	15.73	1847.93	103.45	221.59	540	no		
Evans	45	23	453.81	53.04	6240.74	89.59	222.00	550	no		

** Average Vehicle Length = 6.1 meters (20 feet)

	Southbound - Average									Vehicles Affected by Overflow
	Maximum Queue veh	Maximum Queue veh/ln	Maximum Queue meters/ln	Queue Dissipates sec	Total Delay sec	Average Delay sec	Maximum Delay sec	Distance to Adjacent Int. (meters)	Overflow Intersection?	
Center										
Virginia	25	13	254.10	29.29	2049.20	54.01	132.00	150	yes	17
Sierra	92	31	610.81	92.81	11214.93	47.19	152.00	160	yes	74
Arlington	34	17	344.44	40.46	3538.45	66.25	165.00	540	no	
Keystone	43	22	434.36	57.44	4353.10	51.01	143.00	330	yes	17
Lake	23	11	229.90	24.04	2823.56	99.95	221.59	530	no	
West	10	10	193.89	19.94	1170.76	101.65	221.59	550	no	
Ralston	12	12	232.67	24.36	1430.66	99.82	221.59	540	no	
Washington	6	6	116.34	11.55	678.05	105.31	221.59	530	no	
Sutro	36	18	357.32	39.76	4669.18	93.94	221.59	560	no	
Morrill	1	1	16.62	1.58	92.72	110.01	221.59	560	no	
Vine	13	6	127.41	12.71	1492.67	104.79	221.59	577	no	
Evans	37	19	371.30	41.59	4893.48	93.49	222.00	530	no	

** Average Vehicle Length = 6.1 meters (20 feet)

CITY OF RENO - RAILROAD DELAY STUDY
QUEUE AND DELAY ANALYSIS
PM PEAK - YEAR 2000

	Length of Train (feet)	Speed of Train (feet/sec)	Gate Down Time (sec)	FUTURE ADT VOL (veh/day)	Peak Hr Volume (veh/hr)	q(1) veh/hour		No. of Lanes lanes		Dist. to Nearest Int feet	
						Northbound	Southbound	Northbound	Southbound	Northbound	Southboun
Center	6500	20	271	12800	12[P]	1280		3 00	0 00	220 00	180 00
Virginia	6500	20	162	15400	1540	693	847	2 00	2 00	210 00	150 00
Sierra	6500	20	153	21700	2170		2170	0 00	3 00	210 00	160 00
Arlington	6500	20	164	16700	1670	752	919	2 00	2 00	560 00	540 00
Keystone	6500	20	152	24300	2430	1094	1337	3 00	2 00	580 00	330 00
Lake	6500	20	222	8300	830	374	457	2 00	2 00	550 00	530 00
West	6500	20	222	3500	350	158	193	1 00	1 00	560 00	550 00
Ralston	6500	20	222	4200	420	189	231	1 00	1 00	570 00	540 00
Washington	6500	20	222	2100	210	95	116	1 00	1 00	580 00	530 00
Sutro	6500	20	222	12900	1290	581	710	2 00	2 00	220 00	560 00
Morrill	6500	20	222	300	30	14	17	1 00	1 00	820 00	560 00
Vine	6500	20	222	4600	460	207	253	2 00	2 00	540 00	577 00
Evans	6500	20	222	13380	1338	602	736	2 00	2 00	550 00	530 00

	Gate Down Time (average)	q(1) veh/sec		d(1) veh/sec	
		Northbound	Southbound	Northbound	Southbound
Center	271	0 36	0 00	1 2	0
Virginia	162	0 19	0 24	0 8	0 8
Sierra	153	0 00	0 60	0	1 2
Arlington	164	0 21	0 26	0 8	0 8
Keystone	152	0 30	0 37	1 2	0 8
Lake	222	0 10	0 13	0 8	0 8
West	222	0 04	0 05	0 4	0 4
Ralston	222	0 05	0 06	0 4	0 4
Washington	222	0 03	0 03	0 4	0 4
Sutro	222	0 16	0 20	0 8	0 8
Morrill	222	0 00	0 00	0 4	0 4
Vine	222	0 06	0 07	0 8	0 8
Evans	222	0 17	0 20	0 8	0 8

	Northbound - Average									
	Maximum Queue veh	Maximum Queue veh/ln	Maximum Queue feet/ln	Queue Dissipates sec	Total Delay sec	Average Delay sec	Maximum Delay sec	Distance to Adjacent Int. (feet)	Overflow Intersection?	Vehicles Affected by Overflow veh/ln
Center	96	32	642 37	114 11	18553 52	95 35	271 00	220	yes	59
Virginia	31	16	311 85	51 33	3326 40	61 51	162 00	210	yes	17
Sierra										
Arlington	34	17	342 35	57 90	3798 42	60 60	164 00	560	no	
Keystone	46	15	307 80	51 51	4698 14	56 76	152 00	580	no	
Lake	23	11	229 90	33 02	2926 76	96 43	221 59	550	no	
West	10	10	193 89	27 21	1206 03	98 68	221 59	560	no	
Ralston	12	12	232 67	33 48	1483 67	96 25	221 59	570	no	
Washington	6	6	116 34	15 56	689 73	103 52	221 59	580	no	
Sutro	36	18	357 32	55 94	4958 30	88 46	221 59	220	yes	23
Morrill	1	1	16 62	2 10	92 94	109 76	221 59	820	no	
Vine	13	6	127 41	17 16	1521 02	102 83	221 59	540	no	
Evans	37	19	370 61	58 57	5191 56	87 63	221 59	550	no	

** Average Vehicle Length = 6 1 meters (20 feet)

	Southbound - Average									
	Maximum Queue veh	Maximum Queue veh/ln	Maximum Queue feet/ln	Queue Dissipates sec	Total Delay sec	Average Delay sec	Maximum Delay sec	Distance to Adjacent Int. (feet)	Overflow Intersection?	Vehicles Affected by Overflow
Center										
Virginia	38	19	381 15	67 49	4373 57	57 18	192 00	150	yes	38
Sierra	92	31	614 83	154 42	14176 05	38 07	153 00	160	yes	75
Arlington	42	21	418 43	76 80	5037 77	55 85	164 00	540	no	
Keystone	56	28	564 30	131 62	8002 20	40 73	152 00	330	yes	38
Lake	28	14	280 99	41 74	3699 66	93 23	221 59	530	no	
West	12	12	236 98	34 19	1515 39	95 98	221 59	550	no	
Ralston	14	14	284 38	42 34	1876 37	93 02	221 59	540	no	
Washington	7	7	142 19	19 32	856 37	101 91	221 59	530	no	
Sutro	44	22	436 72	72 43	6420 32	83 50	221 59	560	no	
Morrill	1	1	20 31	2 57	113 83	109 53	221 59	560	no	
Vine	16	8	155 73	21 34	1891 58	101 06	221 59	577	no	
Evans	45	23	452 97	76 05	6741 21	82 48	221 59	530	no	

** Average Vehicle Length = 6 1 meters (20 feet)

CITY OF RENO - RAILROAD DELAY STUDY
QUEUE AND DELAY ANALYSIS
OFF PEAK - YEAR 2000

	Length of Train feet	Speed of Train mph	Gate Down Time (average)	ADT Volume (veh/day)	Average Volume (veh/hr)	q(1) veh/hour		No. of Lanes		Lane Width feet	
						Northbound	Southbound	No. lanes	Southbound	Northbound	Southbound
Center	6500	20	222	12800	512	512		1.00	1.00	550.00	550.00
Virginia	6500	20	222	15400	616	339	277	2.00	2.00	550.00	550.00
Sierra	6500	20	222	21700	868		868	0.00	2.00	0.00	550.00
Arlington	6500	20	222	16700	668	367	301	2.00	2.00	550.00	550.00
Keystone	6500	20	222	24300	972	535	437	3.00	2.00	550.00	550.00
Lake	6500	20	222	8300	332	183	149	2.00	2.00	550.00	550.00
West	6500	20	222	3500	140	77	63	1.00	1.00	550.00	550.00
Ralston	6500	20	222	4200	168	92	76	1.00	1.00	570.00	540.00
Washington	6500	20	222	2100	84	46	38	1.00	1.00	530.00	530.00
Sutro	6500	20	222	12900	516	284	232	2.00	2.00	220.00	550.00
Morrill	6500	20	222	300	12	7	5	1.00	1.00	820.00	550.00
Vine	6500	20	222	4600	184	101	83	2.00	2.00	540.00	577.00
Evans	6500	20	222	13380	535	294	241	2.00	2.00	550.00	550.00

	Gate Down Time (average)	q(1) veh/sec		q(1) veh/sec	
		Northbound	Southbound	Northbound	Southbound
Center	222	0.14		1.59	
Virginia	222	0.09	0.08	1.06	1.06
Sierra	222		0.24		1.59
Arlington	222	0.10	0.08	1.06	1.06
Keystone	222	0.15	0.12	1.59	1.06
Lake	222	0.05	0.04	1.06	1.06
West	222	0.02	0.02	0.53	0.53
Ralston	222	0.03	0.02	0.53	0.53
Washington	222	0.01	0.01	0.53	0.53
Sutro	222	0.08	0.06	1.06	1.06
Morrill	222	0.00	0.00	0.53	0.53
Vine	222	0.03	0.03	1.06	1.06
Evans	222	0.08	0.07	1.06	1.06

	Northbound - Average									
	Maximum Queue veh	Maximum Queue veh/ln	Maximum Queue feet/ln	Queue Dissipates sec	Total Delay sec	Average Delay sec	Maximum Delay sec	Distance to Adjacent Int. (feet)	Overflow Intersection?	Vehicles Affected by Overflow veh/ln
Center	32	11	210.13	21.77	3834.79	100.80	221.59	220.00	no	
Virginia	21	10	208.56	21.59	3535.67	100.96	221.59	210.00	no	
Sierra								210.00		
Arlington	23	11	226.15	23.61	2772.53	100.13	221.59	560.00	no	
Keystone	33	11	219.36	22.83	4021.65	100.48	221.59	580.00	no	
Lake	11	6	112.40	11.14	1367.83	100.49	221.59	550.00	no	
West	5	5	94.79	9.32	547.21	100.34	221.59	560.00	no	
Ralston	6	6	113.75	11.28	662.22	100.63	221.59	570.00	no	
Washington	3	3	56.88	5.50	322.69	100.11	221.59	530.00	no	
Sutro	17	9	174.60	17.80	2090.93	102.56	221.59	220.00	no	
Morrill	0	0	8.13	0.77	45.17	110.61	221.59	820.00	no	
Vine	6	3	62.29	6.04	708.97	107.60	221.59	540.00	no	
Evans	18	9	181.19	18.52	2175.27	102.25	221.59	550.00	no	

** Average Vehicle Length = 20 feet

	Southbound - Average									
	Maximum Queue veh	Maximum Queue veh/ln	Maximum Queue feet/ln	Queue Dissipates sec	Total Delay sec	Average Delay sec	Maximum Delay sec	Distance to Adjacent Int. (feet)	Overflow Intersection?	Vehicles Affected by Overflow
Center										
Virginia	17	9	170.63	17.36	2038.53	102.75	221.59	150.00	yes	2
Sierra	53	18	356.19	39.61	6977.70	99.99	221.59	160.00	yes	32
Arlington	19	9	185.03	18.95	2225.33	102.07	221.59	540.00	no	
Keystone	27	13	269.23	28.69	3369.16	99.10	221.59	330.00	no	
Lake	9	5	91.89	9.03	1080.78	100.66	221.59	530.00	no	
West	4	4	77.56	7.57	444.32	107.14	221.59	550.00	no	
Ralston	5	5	93.07	9.14	536.85	106.41	221.59	540.00	no	
Washington	2	2	46.53	4.48	263.00	108.60	221.59	530.00	no	
Sutro	14	7	142.93	14.36	1686.16	104.05	221.59	560.00	no	
Morrill	0	0	6.65	0.63	36.83	110.45	221.59	560.00	no	
Vine	5	3	50.97	4.91	577.20	108.36	221.59	577.00	no	
Evans	15	7	148.24	14.93	1753.13	103.60	221.59	530.00	no	

** Average Vehicle Length = 6.1 meters (20 feet)

CITY OF RENO - RAILROAD DELAY STUDY
QUEUE AND DELAY ANALYSIS
AM PEAK - YEAR 2007

	Length of Train feet	Speed of Train mph	Gate Down Time (average)	ADT Volume (veh/day)	Peak Hr Volume (veh/hr)	q(1) veh/hour		No. of Lanes lanes		Dist. to Nearest Int feet	
						Northbound	Southbound	Northbound	Southbound	Northbound	Southbound
Center	6500	20	152	13700	1370	1370		3.00	0.00	220.00	180.00
Virginia	6500	20	132	16500	1650	908	743	2.00	2.00	210.00	150.00
Sierra	6500	20	152	23200	2320		2320	0.00	3.00	210.00	160.00
Arlington	6500	20	165	17900	1790	985	806	2.00	2.00	560.00	540.00
Keystone	6500	20	143	26000	2600	1430	1170	3.00	2.00	580.00	330.00
Lake	6500	20	222	8900	890	490	401	2.00	2.00	550.00	530.00
West	6500	20	222	3750	375	206	169	1.00	1.00	560.00	550.00
Ralston	6500	20	222	4500	450	248	203	1.00	1.00	570.00	540.00
Washington	6500	20	222	2250	225	124	101	1.00	1.00	580.00	530.00
Sutro	6500	20	222	13800	1380	759	621	2.00	2.00	220.00	560.00
Morrill	6500	20	222	300	30	17	14	1.00	1.00	820.00	560.00
Vine	6500	20	222	4900	490	270	221	2.00	2.00	540.00	577.00
Evans	6500	20	222	14320	1432	788	644	2.00	2.00	550.00	530.00

	Gate Down Time (average)	q(1) veh/sec		d(1) veh/sec	
		Northbound	Southbound	Northbound	Southbound
Center	152	0.38		1.59	
Virginia	132	0.25	0.21	1.06	1.06
Sierra	152		0.64		1.59
Arlington	165	0.27	0.22	1.06	1.06
Keystone	143	0.40	0.33	1.59	1.06
Lake	222	0.14	0.11	1.06	1.06
West	222	0.06	0.05	0.53	0.53
Ralston	222	0.07	0.06	0.53	0.53
Washington	222	0.03	0.03	0.53	0.53
Sutro	222	0.21	0.17	1.06	1.06
Morrill	222	0.00	0.00	0.53	0.53
Vine	222	0.07	0.06	1.06	1.06
Evans	222	0.22	0.18	1.06	1.06

	Northbound - Average									
	Maximum Queue veh	Maximum Queue veh/ln	Maximum Queue feet/ln	Queue Dissipates sec	Total Delay sec	Average Delay sec	Maximum Delay sec	Distance to Adjacent Int. (feet)	Overflow Intersection?	Vehicles Affected by Overflow veh/ln
Center	58	19	385.63	47.83	5779.45	57.81	152.00	220.00	yes	8
Virginia	33	17	332.75	41.19	2881.39	50.30	132.00	210.00	yes	6
Sierra										
Arlington	45	23	451.23	57.37	5016.99	61.22	165.00	560.00	no	
Keystone	57	19	378.69	47.62	5413.94	53.64	143.00	580.00	no	
Lake	30	15	301.30	32.61	3829.53	96.58	221.59	550.00	no	
West	13	13	253.91	26.86	1577.06	98.82	221.59	560.00	no	
Ralston	15	15	304.69	33.03	1939.48	96.42	221.59	570.00	no	
Washington	8	8	152.34	15.37	902.48	103.61	221.59	580.00	no	
Sutro	47	23	467.19	55.02	6461.39	88.76	221.59	220.00	yes	12
Morrill	1	1	20.31	1.93	113.51	109.84	221.59	820.00	no	
Vine	17	8	165.89	16.84	1977.60	102.97	221.59	540.00	no	
Evans	48	24	484.79	57.63	6768.18	87.93	221.59	550.00	no	

** Average Vehicle Length = 20 feet

	Southbound - Average									
	Maximum Queue veh	Maximum Queue veh/ln	Maximum Queue meters/ln	Queue Dissipates sec	Total Delay sec	Average Delay sec	Maximum Delay sec	Distance to Adjacent Int. (meters)	Overflow Intersection?	Vehicles Affected by Overflow
Center										
Virginia	27	14	272.25	31.89	2230.94	53.16	132.00	150.00	yes	6
Sierra	98	33	653.04	103.60	12518.51	45.20	152.00	160.00	yes	25
Arlington	37	18	369.19	44.15	3860.74	65.09	165.00	540.00	no	
Keystone	46	23	464.75	63.23	4792.30	49.58	143.00	330.00	yes	7
Lake	25	12	246.52	25.98	3051.60	99.17	221.59	530.00	no	
West	10	10	207.74	21.50	1262.50	101.00	221.59	550.00	no	
Ralston	12	12	249.29	26.31	1544.98	99.04	221.59	540.00	no	
Washington	6	6	124.64	12.42	729.20	104.92	221.59	530.00	no	
Sutro	38	19	382.24	43.07	5058.25	92.77	221.59	560.00	no	
Morrill	1	1	16.62	1.58	92.72	110.01	221.59	560.00	no	
Vine	14	7	135.72	13.59	1595.99	104.39	221.59	577.00	no	
Evans	40	20	396.65	45.02	5287.58	92.09	221.59	530.00	no	

** Average Vehicle Length = 6.1 meters (20 feet)

CITY OF RENO - RAILROAD DELAY STUDY
QUEUE AND DELAY ANALYSIS
PM PEAK - YEAR 2007

	Length of Train (meters)	Speed of Train (m/sec)	Gate Down Time (sec)	ADT Volume (veh/day)	Peak Hr Volume (veh/hr)	q(1) veh/hour		No. of Lanes lanes		Dist. to Nearest Int meters	
						Northbound	Southbound	Northbound	Southbound	Northbound	Southboun
Center	6500	20	271	13700	1370	1370		3.00	0.00	220.00	180.00
Virginia	6500	20	162	16500	1650	743	908	2.00	2.00	210.00	150.00
Sierra	6500	20	153	23200	2320		2320	0.00	3.00	210.00	160.00
Arlington	6500	20	164	17900	1790	806	985	2.00	2.00	560.00	540.00
Keystone	6500	20	152	26000	2600	1170	1430	3.00	2.00	580.00	330.00
Lake	6500	20	222	8900	890	401	490	2.00	2.00	550.00	530.00
West	6500	20	222	3750	375	169	206	1.00	1.00	560.00	550.00
Ralston	6500	20	222	4500	450	203	248	1.00	1.00	570.00	540.00
Washington	6500	20	222	2250	225	101	124	1.00	1.00	580.00	530.00
Sutro	6500	20	222	13800	1380	621	759	2.00	2.00	220.00	560.00
Morrill	6500	20	222	300	30	14	17	1.00	1.00	820.00	560.00
Vine	6500	20	222	4900	490	221	270	2.00	2.00	540.00	577.00
Evans	6500	20	222	14320	1432	644	788	2.00	2.00	550.00	530.00

	Gate Down Time (average)	q(1) veh/sec		d(1) veh/sec	
		Northbound	Southbound	Northbound	Southbound
Center	271	0.38	0.00	1.2	0
Virginia	162	0.21	0.25	0.8	0.8
Sierra	153	0.00	0.64	0	1.2
Arlington	164	0.22	0.27	0.8	0.8
Keystone	152	0.33	0.40	1.2	0.8
Lake	222	0.11	0.14	0.8	0.8
West	222	0.05	0.06	0.4	0.4
Ralston	222	0.06	0.07	0.4	0.4
Washington	222	0.03	0.03	0.4	0.4
Sutro	222	0.17	0.21	0.8	0.8
Morrill	222	0.00	0.00	0.4	0.4
Vine	222	0.06	0.07	0.8	0.8
Evans	222	0.18	0.22	0.8	0.8

	Northbound - Average							Distance to Adjacent Int. (feet)	Overflow Intersection ?	Vehicles Affected by Overflow veh/ln
	Maximum Queue veh	Maximum Queue veh/ln	Maximum Queue meters/ln	Queue Dissipates sec	Total Delay sec	Average Delay sec	Maximum Delay sec			
Center	103	34	687.54	125.85	20463.90	92.53	271.00	220	yes	77
Virginia	33	17	334.13	56.27	3646.53	60.12	162.00	210	yes	20
Sierra										
Arlington	37	18	366.95	63.68	4177.34	59.07	164.00	560	no	
Keystone	49	16	329.33	56.46	5148.89	55.42	152.00	580	no	
Lake	25	12	246.52	35.79	3172.50	95.39	221.59	550	no	
West	10	10	207.74	29.41	1303.61	97.81	221.59	560	no	
Ralston	12	12	249.29	36.26	1606.99	95.21	221.59	570	no	
Washington	6	6	124.64	16.76	742.73	103.01	221.59	580	no	
Sutro	38	19	382.24	60.92	5399.32	86.91	221.59	220	yes	27
Morrill	1	1	16.62	2.10	92.94	109.76	221.59	820	no	
Vine	14	7	135.72	18.37	1628.44	102.31	221.59	540	no	
Evans	40	20	396.65	63.87	5661.42	86.00	221.59	550	no	

** Average Vehicle Length = 20 feet

	Southbound - Average							Distance to Adjacent Int. (feet)	Overflow Intersection ?	Vehicles Affected by Overflow
	Maximum Queue veh	Maximum Queue veh/ln	Maximum Queue feet/ln	Queue Dissipates sec	Total Delay sec	Average Delay sec	Maximum Delay sec			
Center										
Virginia	41	20	408.38	74.53	4829.69	55.48	162.00	150	yes	42
Sierra	99	33	657.33	177.48	16292.66	35.42	153.00	160	yes	82
Arlington	45	22	448.49	85.18	5587.78	53.97	164.00	540	no	
Keystone	60	30	603.78	149.90	9114.13	38.26	152.00	330	yes	45
Lake	30	15	301.30	45.37	4021.87	91.96	221.59	530	no	
West	13	13	253.91	37.04	1641.73	94.93	221.59	550	no	
Ralston	15	15	304.69	45.99	2038.22	91.75	221.59	540	no	
Washington	8	8	152.34	20.83	923.30	101.27	221.59	530	no	
Sutro	47	23	467.19	79.30	7028.54	81.60	221.59	560	no	
Morrill	1	1	20.31	2.57	113.83	109.53	221.59	560	no	
Vine	17	8	165.89	22.88	2027.68	100.43	221.59	577	no	
Evans	48	24	484.79	83.41	7393.07	80.50	221.59	530	no	

** Average Vehicle Length = 20 feet

CITY OF RENO - RAILROAD DELAY STUDY
QUEUE AND DELAY ANALYSIS
OFF PEAK - YEAR 2007

	Length of Train feet	Speed of Train mph	Gate Down Time (average)	ADT Volume (veh/day)	Average Volume (veh/hr)	q(1) veh/hour		No. of Lanes lanes		Dist. to Nearest Int meters	
						Northbound	Southbound	Northbound	Southbound	Northbound	Southbound
Center	6500	20	222	13700	548	548		3.00	0.00	220.00	180.00
Virginia	6500	20	222	16500	660	363	297	2.00	2.00	210.00	150.00
Sierra	6500	20	222	23200	928		928	0.00	3.00	210.00	160.00
Arlington	6500	20	222	17900	716	394	322	2.00	2.00	560.00	540.00
Keystone	6500	20	222	26000	1040	572	468	3.00	2.00	580.00	330.00
Lake	6500	20	222	8900	356	196	160	2.00	2.00	550.00	530.00
West	6500	20	222	3750	150	83	68	1.00	1.00	560.00	550.00
Ralston	6500	20	222	4500	180	99	81	1.00	1.00	570.00	540.00
Washington	6500	20	222	2250	90	50	41	1.00	1.00	580.00	530.00
Sutro	6500	20	222	13800	552	304	248	2.00	2.00	220.00	560.00
Morrill	6500	20	222	300	12	7	5	1.00	1.00	820.00	560.00
Vine	6500	20	222	4900	196	108	88	2.00	2.00	540.00	577.00
Evans	6500	20	222	14320	573	315	258	2.00	2.00	550.00	530.00

	Gate Down Time (average)	q(1) veh/sec		d(1) veh/sec	
		Northbound	Southbound	Northbound	Southbound
Center	222	0.15		1.59	
Virginia	222	0.10	0.08	1.06	1.06
Sierra	222		0.26		1.59
Arlington	222	0.11	0.09	1.06	1.06
Keystone	222	0.16	0.13	1.59	1.06
Lake	222	0.05	0.04	1.06	1.06
West	222	0.02	0.02	0.53	0.53
Ralston	222	0.03	0.02	0.53	0.53
Washington	222	0.01	0.01	0.53	0.53
Sutro	222	0.08	0.07	1.06	1.06
Morrill	222	0.00	0.00	0.53	0.53
Vine	222	0.03	0.02	1.06	1.06
Evans	222	0.09	0.07	1.06	1.06

	Northbound - Average									
	Maximum Queue veh	Maximum Queue veh/ln	Maximum Queue feet/ln	Queue Dissipates sec	Total Delay sec	Average Delay sec	Maximum Delay sec	Distance to Adjacent Int. (feet)	Overflow Intersection?	Vehicles Affected by Overflow veh/ln
Center	34	11	224.87	23.46	4132.92	100.19	221.59	220.00	yes	1
Virginia	22	11	223.44	23.29	2735.83	100.26	221.59	210.00	yes	2
Sierra								210.00		
Arlington	24	12	242.40	25.50	2994.68	99.36	221.59	560.00	no	
Keystone	35	12	234.72	24.60	4334.02	99.72	221.59	580.00	no	
Lake	12	6	120.52	11.98	1407.54	105.11	221.59	550.00	no	
West	5	5	101.56	10.01	588.06	106.00	221.59	560.00	no	
Ralston	6	6	121.88	12.13	712.11	105.05	221.59	570.00	no	
Washington	3	3	60.94	5.90	346.57	107.92	221.59	580.00	no	
Sutro	19	9	186.88	19.15	2249.46	101.98	221.59	220.00	no	
Morrill	0	0	8.13	0.77	45.17	110.41	221.59	820.00	no	
Vine	7	3	66.35	6.44	756.55	107.67	221.59	540.00	no	
Evans	19	10	193.92	19.94	2341.85	101.65	221.59	550.00	no	

** Average Vehicle Length = 20 feet

	Southbound - Average									
	Maximum Queue veh	Maximum Queue veh/ln	Maximum Queue meters/ln	Queue Dissipates sec	Total Delay sec	Average Delay sec	Maximum Delay sec	Distance to Adjacent Int. (feet)	Overflow Intersection?	Vehicles Affected by Overflow
Center										
Virginia	18	9	182.81	18.70	2196.43	102.17	221.59	150.00	yes	5
Sierra	57	19	380.81	42.88	7553.35	92.83	221.59	160.00	yes	36
Arlington	20	10	198.32	20.44	2399.98	101.44	221.59	540.00	no	
Keystone	29	14	288.07	30.98	3637.81	97.21	221.59	330.00	no	
Lake	10	5	98.61	9.71	1140.41	106.14	221.59	530.00	no	
West	4	4	83.10	8.13	477.22	106.88	221.59	550.00	no	
Ralston	5	5	99.72	9.82	576.89	106.09	221.59	540.00	no	
Washington	2	2	49.86	4.81	282.19	108.44	221.59	530.00	no	
Sutro	15	8	152.90	15.43	1811.99	103.58	221.59	560.00	no	
Morrill	0	0	6.65	0.63	36.93	110.48	221.59	560.00	no	
Vine	5	3	54.29	5.24	615.74	108.23	221.59	577.00	no	
Evans	16	8	158.66	16.05	1885.21	103.31	221.59	530.00	no	

** Average Vehicle Length = 6.1 meters (20 feet)

CITY OF RENO - RAILROAD DELAY STUDY
QUEUE AND DELAY ANALYSIS
AM PEAK - YEAR 2015

	Length of Train (feet)	Speed of Train (feet/sec)	Gate Down Time (average)	FUTURE ADT VOL. (veh/day)	Peak Hr Volume (veh/hr)	q(1) veh/hour		No. of Lanes lanes		Dist. to Nearest Int feet	
						Northbound	Southbound	Northbound	Southbound	Northbound	Southbound
Center	6500	20	152	14500	1450	1450		3	0	220	180
Virginia	6500	20	132	17800	1780	979	801	2	2	210	150
Sierra	6500	20	152	25100	2510		2510	0	3	210	160
Arlington	6500	20	165	19300	1930	1062	869	2	2	560	540
Keystone	6500	20	143	28100	2810	1546	1265	3	2	580	330
Lake	6500	20	222	9600	960	528	432	2	2	550	530
West	6500	20	222	4100	410	226	185	1	1	560	550
Ralston	6500	20	222	4900	490	270	221	1	1	570	540
Washington	6500	20	222	2400	240	132	108	1	1	580	530
Sutro	6500	20	222	14900	1490	820	671	2	2	220	560
Morrill	6500	20	222	300	30	17	14	1	1	820	560
Vine	6500	20	222	5300	530	292	239	2	2	540	577
Evans	6500	20	222	15400	1540	847	693	2	2	550	530

	Gate Down Time (average)	q(1) veh/sec		d(1) veh/sec	
		Northbound	Southbound	Northbound	Southbound
Center	152	0.40		1.59	0
Virginia	132	0.27	0.22	1.06	1.06
Sierra	152		0.70	0	1.59
Arlington	165	0.29	0.24	1.06	1.06
Keystone	143	0.43	0.35	1.59	1.06
Lake	222	0.15	0.12	1.06	1.06
West	222	0.06	0.05	0.53	0.53
Ralston	222	0.07	0.06	0.53	0.53
Washington	222	0.04	0.03	0.53	0.53
Sutro	222	0.23	0.19	1.06	1.06
Morrill	222	0.00	0.00	0.53	0.53
Vine	222	0.08	0.07	1.06	1.06
Evans	222	0.24	0.19	1.06	1.06

	Northbound - Average									
	Maximum Queue veh	Maximum Queue veh/ln	Maximum Queue feet/ln	Queue Dissipates sec	Total Delay sec	Average Delay sec	Maximum Delay sec	Distance to Adjacent Int. (feet)	Overflow Intersection?	Vehicles Affected by Overflow veh/ln
Center	61	20	408.15	51.57	6231.43	58.75	152.00	220	yes	31
Virginia	36	18	358.97	45.55	3186.74	49.07	132.00	210	yes	24
Sierra										
Arlington	49	24	486.52	63.59	5560.59	59.55	165.00	560	no	
Keystone	61	20	409.27	52.89	6012.95	52.19	143.00	580	no	
Lake	33	16	325.00	35.58	4179.09	95.47	221.59	550	no	
West	14	14	277.60	29.70	1743.98	97.70	221.59	560	no	
Ralston	17	17	331.77	36.45	2140.24	95.15	221.59	570	no	
Washington	8	8	162.50	16.47	967.12	103.13	221.59	580	no	
Sutro	50	25	504.43	60.60	7117.29	87.00	221.59	220	yes	47
Morrill	1	1	20.31	1.93	113.51	109.84	221.59	820	no	
Vine	18	9	179.43	18.33	2152.39	102.33	221.59	540	no	
Evans	52	26	522.32	63.33	7451.69	86.36	222.00	550	no	

** Average Vehicle Length = 6.1 meters (20 feet)

	Southbound - Average									
	Maximum Queue veh	Maximum Queue veh/ln	Maximum Queue meters/ln	Queue Dissipates sec	Total Delay sec	Average Delay sec	Maximum Delay sec	Distance to Adjacent Int. (meters)	Overflow Intersection?	Vehicles Affected by Overflow
Center										
Virginia	29	15	293.70	35.07	2453.40	52.15	132.00	150	yes	24
Sierra	106	35	706.52	118.71	14344.39	42.67	152.00	160	yes	90
Arlington	40	20	398.06	48.62	4251.67	63.72	165.00	540	no	
Keystone	50	25	502.29	70.87	5371.20	47.61	143.00	330	yes	28
Lake	27	13	263.91	28.29	3322.26	98.25	221.59	530	no	
West	11	11	227.13	23.72	1392.95	100.08	221.59	550	no	
Ralston	14	14	271.45	28.95	1700.26	97.99	221.59	540	no	
Washington	7	7	132.95	13.30	780.73	104.52	221.59	530	no	
Sutro	41	21	412.71	47.23	5547.39	91.33	221.59	560	no	
Morrill	1	1	16.62	1.58	92.72	110.01	221.59	560	no	
Vine	15	7	146.80	14.77	1734.96	103.87	221.59	577	no	
Evans	43	21	427.35	49.26	5796.20	90.84	222.00	530	no	

** Average Vehicle Length = 6.1 meters (20 feet)

CITY OF RENO - RAILROAD DELAY STUDY
QUEUE AND DELAY ANALYSIS
PM PEAK - YEAR 2015

	Length of Train (feet)	Speed of Train (feet/sec)	Gate Down Time (sec)	FUTURE ADT VOL (veh/day)	Peak Hr Volume (veh/hr)	q(1) veh/hour		No. of Lanes lanes		Dist. to Nearest Int feet	
						Northbound	Southbound	Northbound	Southbound	Northbound	Southbound
Center	6500	20	271	14500	1450	1450		3 00	0 00	220 00	180 00
Virginia	6500	20	162	17800	1780	801	979	2 00	2 00	210 00	150 00
Sierra	6500	20	153	25100	2510		2510	0 00	3 00	210 00	160 00
Arlington	6500	20	164	19300	1930	869	1062	2 00	2 00	560 00	540 00
Keystone	6500	20	152	28100	2810	1265	1546	3 00	2 00	580 00	330 00
Lake	6500	20	222	9600	960	432	528	2 00	2 00	550 00	530 00
West	6500	20	222	4100	410	185	226	1 00	1 00	560 00	550 00
Ralston	6500	20	222	4900	490	221	270	1 00	1 00	570 00	540 00
Washington	6500	20	222	2400	240	108	132	1 00	1 00	580 00	530 00
Sutro	6500	20	222	14900	1490	671	820	2 00	2 00	220 00	560 00
Morrill	6500	20	222	300	30	14	17	1 00	1 00	820 00	560 00
Vine	6500	20	222	5300	530	239	292	2 00	2 00	540 00	577 00
Evans	6500	20	222	15400	1540	693	847	2 00	2 00	550 00	530 00

	Gate Down Time (average)	q(1) veh/sec		d(1) veh/sec	
		Northbound	Southbound	Northbound	Southbound
Center	271	0 40	0 00	1 2	0
Virginia	162	0 22	0 27	0 8	0 8
Sierra	153	0 00	0 70	0	1 2
Arlington	164	0 24	0 29	0 8	0 8
Keystone	152	0 35	0 43	1 2	0 8
Lake	222	0 12	0 15	0 8	0 8
West	222	0 05	0 06	0 4	0 4
Ralston	222	0 06	0 07	0 4	0 4
Washington	222	0 03	0 04	0 4	0 4
Sutro	222	0 19	0 23	0 8	0 8
Morrill	222	0 00	0 00	0 4	0 4
Vine	222	0 07	0 08	0 8	0 8
Evans	222	0 19	0 24	0 8	0 8

	Northbound - Average							Distance to Adjacent Int. (feet)	Overflow Intersection?	Vehicles Affected by Overflow veh/ln
	Maximum Queue veh	Maximum Queue veh/ln	Maximum Queue feet/ln	Queue Dissipates sec	Total Delay sec	Average Delay sec	Maximum Delay sec			
Center	109	36	727 69	136 92	22262 60	90 02	271 00	220	yes	83
Virginia	36	18	360 45	62 42	4044 53	58 47	162 00	210	yes	25
Sierra										
Arlington	40	20	395 65	70 81	4645 13	57 27	164 00	560	no	
Keystone	53	18	355 93	62 90	5736 87	53 75	152 00	580	no	
Lake	27	13	265 91	39 10	3466 06	94 18	221 59	550	no	
West	11	11	227 13	32 56	1443 16	96 60	221 59	560	no	
Ralston	14	14	271 45	40 07	1775 66	93 83	221 59	570	no	
Washington	7	7	132 95	17 97	796 26	102 49	221 59	580	no	
Sutro	41	21	412 71	67 24	5960 31	85 00	221 59	220	yes	32
Morrill	1	1	16 62	2 10	92 94	109 76	221 59	820	no	
Vine	15	7	146 80	20 01	1773 38	101 62	221 59	540	no	
Evans	43	21	426 56	70 22	6223 70	84 14	221 59	550	no	

** Average Vehicle Length = 6 1 meters (20 feet)

	Southbound - Average							Distance to Adjacent Int. (feet)	Overflow Intersection?	Vehicles Affected by Overflow
	Maximum Queue veh	Maximum Queue veh/ln	Maximum Queue feet/ln	Queue Dissipates sec	Total Delay sec	Average Delay sec	Maximum Delay sec			
Center										
Virginia	44	22	440 55	83 43	5406 18	53 47	162 00	150	yes	48
Sierra	107	36	711 17	212 17	19477 32	32 05	153 00	160	yes	90
Arlington	48	24	483 57	95 73	6279 92	51 78	164 00	540	no	
Keystone	65	33	652 54	176 03	10702 80	35 22	152 00	330	yes	53
Lake	33	16	325 00	49 74	4409 21	90 48	221 59	530	no	
West	14	14	277 60	41 14	1823 40	93 45	221 59	550	no	
Ralston	17	17	331 77	51 02	2261 11	90 06	221 59	540	no	
Washington	8	8	162 50	22 36	991 06	100 64	221 59	530	no	
Sutro	50	25	504 43	88 13	7811 60	79 27	221 59	560	no	
Morrill	1	1	20 31	2 57	113 83	109 53	221 59	560	no	
Vine	18	9	179 43	24 95	2211 84	99 58	221 59	577	no	
Evans	52	26	521 35	92 32	8182 95	78 21	221 59	530	no	

CITY OF RENO - RAILROAD DELAY STUDY
QUEUE AND DELAY ANALYSIS
OFF PEAK - YEAR 2015

	Length of Train feet	Speed of Train mph	Gate Down Time (average)	ADT Volume (veh/day)	Average Volume (veh/hr)	q(1) veh/hour		No. of Lanes lanes		Dist. to Nearest Int feet	
						Northbound	Southbound	Northbound	Southbound	Northbound	Southbound
Center	6500	20	222	14500	580	580		3 00	0 00	220 00	180 00
Virginia	6500	20	222	17800	712	392	320	2 00	2 00	210 00	150 00
Sierra	6500	20	222	25100	1004		1004	0 00	3 00	210 00	160 00
Arlington	6500	20	222	19300	772	425	347	2 00	2 00	560 00	540 00
Keystone	6500	20	222	28100	1124	618	506	3 00	2 00	580 00	330 00
Lake	6500	20	222	9600	384	211	173	2 00	2 00	550 00	530 00
West	6500	20	222	4100	164	90	74	1 00	1 00	560 00	550 00
Ralston	6500	20	222	4900	196	108	88	1 00	1 00	570 00	540 00
Washington	6500	20	222	2400	96	53	43	1 00	1 00	580 00	530 00
Sutro	6500	20	222	14900	596	328	268	2 00	2 00	220 00	560 00
Morrill	6500	20	222	300	12	7	5	1 00	1 00	820 00	560 00
Vine	6500	20	222	5300	212	117	95	2 00	2 00	540 00	577 00
Evans	6500	20	222	15400	616	339	277	2 00	2 00	550 00	530 00

	Gate Down Time (average)	q(1) veh/sec		d(1) veh/sec	
		Northbound	Southbound	Northbound	Southbound
Center	222	0 16		1 59	
Virginia	222	0 11	0 09	1 06	1 06
Sierra	222		0 28		1 59
Arlington	222	0 12	0 10	1 06	1 06
Keystone	222	0 17	0 14	1 59	1 06
Lake	222	0 06	0 05	1 06	1 06
West	222	0 03	0 02	0 53	0 53
Ralston	222	0 03	0 02	0 53	0 53
Washington	222	0 01	0 01	0 53	0 53
Sutro	222	0 09	0 07	1 06	1 06
Morrill	222	0 00	0 00	0 53	0 53
Vine	222	0 03	0 03	1 06	1 06
Evans	222	0 09	0 08	1 06	1 06

	Northbound - Average									
	Maximum Queue veh	Maximum Queue veh/ln	Maximum Queue feet/ln	Queue Dissipates sec	Total Delay sec	Average Delay sec	Maximum Delay sec	Distance to Adjacent Int. (feet)	Overflow Intersection?	Vehicles Affected by Overflow veh/ln
Center	36	12	238 61	24 98	4401 47	99 57	221 59	220 00	yes	3
Virginia	24	12	241 04	25 34	2976 03	99 43	221 59	210 00	yes	5
Sierra								210 00		
Arlington	26	13	261 35	27 74	3258 22	98 47	221 59	560 00	no	
Keystone	38	13	253 68	26 83	4726 46	98 83	221 59	580 00	no	
Lake	13	7	130 00	12 98	1524 73	104 66	221 59	550 00	no	
West	6	6	111 04	11 00	645 67	105 56	221 59	560 00	no	
Ralston	7	7	132 71	13 27	779 20	104 54	221 59	570 00	no	
Washington	3	3	65 00	6 31	370 33	107 73	221 59	580 00	no	
Sutro	20	10	201 77	20 82	2445 61	101 28	221 59	220 00	no	
Morrill	0	0	8 13	0 77	45 17	110 41	221 59	820 00	no	
Vine	7	4	71 77	6 98	820 25	107 41	221 59	540 00	no	
Evans	21	10	208 54	21 59	2535 67	100 96	221 59	550 00	no	

** Average Vehicle Length = 20 feet

	Southbound - Average									
	Maximum Queue veh	Maximum Queue veh/ln	Maximum Queue feet/ln	Queue Dissipates sec	Total Delay sec	Average Delay sec	Maximum Delay sec	Distance to Adjacent Int. (feet)	Overflow Intersection?	Vehicles Affected by Overflow
Center										
Virginia	20	10	197 22	20 31	2385 34	101 49	221 59	150 00	yes	8
Sierra	62	21	411 99	47 14	8303 53	91 36	221 59	160 00	yes	41
Arlington	21	11	213 84	22 19	2606 49	100 71	221 59	540 00	no	
Keystone	31	16	311 34	33 86	3976 53	96 11	221 59	330 00	no	
Lake	11	5	106 36	10 51	1234 36	105 78	221 59	530 00	no	
West	5	5	90 85	8 92	523 55	106 51	221 59	550 00	no	
Ralston	5	5	108 58	10 74	630 66	105 67	221 59	540 00	no	
Washington	3	3	53 18	5 13	301 44	108 29	221 59	530 00	no	
Sutro	17	8	165 09	16 75	1967 34	103 01	221 59	560 00	no	
Morrill	0	0	6 65	0 63	36 93	110 48	221 59	560 00	no	
Vine	6	3	58 72	5 68	667 29	108 03	221 59	577 00	no	
Evans	17	9	170 03	17 36	2038 53	102 75	221 59	530 00	no	

** Average Vehicle Length = 6 1 meters (20 feet)

APPENDIX G
DELAY RESULTS

- 1995
- 2000
- 2007
- 2015

DELAY SUMMARY

Total Delay Per Peak Period - NORTHBOUND

	AM Peak						PM Peak						Off Peak						Total					
Year	1995	1995	1995	2000	2000	2000	1995	1995	1995	2000	2000	2000	1995	1995	1995	2000	2000	2000	1995	1995	1995	2000	2000	2000
Trains/Day	12.7	24	36	12.7	24	36	12.7	24	36	12.7	24	36	12.7	24	36	12.7	24	36	12.7	24	36	12.7	24	36
Trains/Peak	1.0	1.9	2.9	1.0	1.9	2.9	2.2	4.1	6.1	2.2	4.1	6.1	9.5	18.0	27.0	9.5	18.0	27.0	9.5	18.0	27.0	9.5	18.0	27.0
Center	79	149	224	90	169	254	582	1100	1650	668	1262	1892	547	1033	1550	609	1150	1726	1208	2282	3424	1366	2581	3872
Virginia	40	75	112	45	84	126	106	200	300	120	226	339	363	685	1028	403	761	1141	508	960	1440	567	1071	1607
Sierra	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Arlington	69	130	194	77	146	220	121	228	342	137	258	387	397	750	1125	440	832	1248	586	1107	1661	654	1236	1855
Keystone	74	140	210	84	158	238	149	282	423	169	319	479	571	1087	1631	638	1206	1810	799	1509	2264	891	1684	2527
Lake	54	102	153	60	113	170	95	179	269	105	199	299	189	357	535	208	392	589	338	638	957	373	705	1057
West	22	42	63	25	47	70	39	74	111	43	82	123	79	150	224	87	164	246	141	266	399	155	293	439
Ralston	27	51	76	30	57	86	47	90	134	53	101	151	94	178	267	105	199	298	169	319	478	188	357	535
Washington	13	24	36	14	27	40	22	42	62	25	47	70	46	86	129	51	97	145	80	152	227	90	171	256
Sutro	89	169	253	101	190	285	158	299	448	178	337	506	299	565	847	332	627	941	546	1032	1549	611	1155	1732
Morrill	2	4	5	2	4	5	3	6	9	3	6	9	7	14	20	7	14	20	12	24	35	12	24	35
Vine	28	53	80	31	59	89	49	93	140	55	103	155	102	193	290	113	213	319	180	340	510	199	375	563
Evans	0	0	0	106	200	300	0	0	0	187	353	530	0	0	0	345	653	979	0	0	0	638	1205	1808
Total	497	939	1409	664	1255	1883	1372	2593	3889	1743	3294	4942	2697	5097	7646	3338	6307	9461	4566	8629	12944	5745	10857	16286

Total Delay Per Peak Period - SOUTHBOUND

	AM Peak						PM Peak						Off Peak						Total					
Year	1995	1995	1995	2000	2000	2000	1995	1995	1995	2000	2000	2000	1995	1995	1995	2000	2000	2000	1995	1995	1995	2000	2000	2000
Trains/Day	12.7	24	36	12.7	24	36	12.7	24	36	12.7	24	36	12.7	24	36	12.7	24	36	12.7	24	36	12.7	24	36
Trains/Peak	1.0	1.9	2.9	1.0	1.9	2.9	2.2	4.1	6.1	2.2	4.1	6.1	9.5	18.0	27.0	9.5	18.0	27.0	9.5	18.0	27.0	9.5	18.0	27.0
Center	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Virginia	31	58	88	35	66	98	138	260	391	157	297	446	292	552	828	324	612	917	461	871	1306	516	975	1462
Sierra	163	308	463	190	359	538	424	801	1201	510	964	1446	989	1870	2804	1108	2093	3140	1576	2979	4468	1808	3416	5124
Arlington	53	101	151	60	113	170	158	299	449	181	343	514	319	603	905	353	668	1001	531	1003	1505	594	1123	1685
Keystone	65	122	183	74	139	209	243	459	688	288	544	816	481	909	1363	535	1011	1516	788	1490	2235	897	1694	2541
Lake	43	82	123	48	90	136	120	226	339	133	252	377	153	289	434	168	318	477	316	597	895	349	660	990
West	18	34	51	20	37	56	49	93	139	55	103	155	64	122	182	71	133	200	131	248	373	145	274	411
Ralston	22	41	61	24	46	69	60	113	169	68	126	191	76	145	217	85	161	242	158	298	447	177	334	502
Washington	10	19	29	11	22	33	27	52	77	31	58	87	37	70	105	42	79	118	75	141	212	84	159	238
Sutro	71	133	200	79	149	224	203	384	576	231	437	655	241	456	684	268	506	759	515	974	1460	578	1092	1638
Morrill	2	3	4	2	3	4	4	8	12	4	8	12	6	11	17	6	11	17	12	22	33	12	22	33
Vine	23	43	65	25	48	72	61	116	174	68	129	193	83	157	236	92	173	260	167	316	475	185	350	524
Evans	0	0	0	83	157	235	0	0	0	243	458	688	0	0	0	278	526	789	0	0	0	604	1141	1711
Total	500	945	1418	850	1229	1844	1487	2811	4216	1968	3720	5580	2743	5183	7775	3329	6291	9436	4730	8939	13408	5948	11240	16859

TOTAL DAILY DELAY

	AM Peak						PM Peak						Off Peak						Total					
Trains/Day	1995	1995	1995	2000	2000	2000	1995	1995	1995	2000	2000	2000	1995	1995	1995	2000	2000	2000	1995	1995	1995	2000	2000	2000
Trains/Peak	12.7	24	36	12.7	24	36	12.7	24	36	12.7	24	36	12.7	24	36	12.7	24	36	12.7	24	36	12.7	24	36
Center	1.0	1.9	2.9	1.0	1.9	2.9	2.2	4.1	6.1	2.2	4.1	6.1	9.5	18.0	27.0	9.5	18.0	27.0	9.5	18.0	27.0	9.5	18.0	27.0
Center	79	149	224	90	169	254	582	1100	1650	668	1262	1892	547	1033	1550	609	1150	1726	1208	2282	3424	1366	2581	3872
Virginia	70	133	200	79	150	225	244	460	691	277	524	785	655	1238	1856	726	1372	2058	969	1831	2747	1083	2046	3069
Sierra	163	308	463	190	359	538	424	801	1201	510	964	1446	989	1870	2804	1108	2093	3140	1576	2979	4468	1808	3416	5124
Arlington	122	230	346	137	260	389	279	527	791	318	601	901	716	1353	2029	793	1499	2249	1117	2110	3165	1249	2360	3540
Keystone	139	262	394	158	298	447	392	741	1111	457	864	1295	1056	1996	2993	1173	2217	3326	1587	2999	4498	1788	3379	5068
Lake	97	184	276	108	204	305	214	405	608	238	451	676	342	646	969	376	710	1066	653	1235	1852	722	1365	2047
West	40	76	114	45	84	126	88	167	251	98	185	278	143	271	407	157	297	446	272	515	772	300	567	850
Ralston	49	92	138	55	103	155	107	202	304	121	228	343	171	323	484	190	360	540	326	617	925	366	691	1037
Washington	23	43	65	26	49	73	49	93	140	56	105	158	83	157	235	93	176	264	155	293	439	174	329	494
Sutro	160	302	453	180	340	509	361	683	1025	409	774	1161	540	1021	1531	600	1133	1700	1062	2006	3009	1189	2246	3370
Morrill	3	7	10	3	7	10	7	14	21	7	14	21	13	25	37	13	25	37	24	45	68	24	45	68
Vine	51	97	145	57	107	160	111	209	314	123	232	348	185	350	525	204	386	579	347	656	985	384	725	1087
Evans	0	0	0	189	356	534	0	0	0	429	811	1217	0	0	0	624	1179	1768	0	0	0	1242	2346	3519
TOTAL	997	1884	2826	1315	2484	3726	2859	5403	8105	3712	7014	10521	5440	10280	15421	6666	12598	18897	155	293	439	195	368	552

CITY OF RENO - RAILROAD DELAY STUDY
Summary of Results

AM PEAK - Northbound

Year	Maximum Vehicles in Queue		Total Delay (minutes)						Average Delay (sec/veh)	
Trains/Day			1995 12.7	1995 24	1995 36	2000 12.7	2000 24	2000 36		
Trains/Peak	1995	2000	1	2	3	1	2	3	1995	2000
Center	49	54	79.05	149.39	224.08	89.58	169.29	253.94	95	98
Virginia	28	31	39.53	74.70	112.05	44.61	84.30	126.46	83	85
Sierra	0	0	0.00	0.00	0.00	0.00	0.00	0.00		
Arlington	38	42	68.55	129.53	194.30	77.45	146.37	219.55	106	109
Keystone	48	53	74.22	140.25	210.38	83.86	158.47	237.70	91	93
Lake	26	28	54.01	102.06	153.10	59.88	113.16	169.74	124	126
West	11	12	22.39	42.31	63.47	24.72	46.72	70.09	122	123
Ralston	13	14	26.98	50.99	76.49	30.35	57.36	86.03	124	126
Washington	6	7	12.59	23.79	35.69	14.20	26.83	40.25	117	118
Sutro	40	44	89.39	168.92	253.38	100.65	190.20	285.30	133	136
Morrill	1	1	1.92	3.63	5.45	1.92	3.63	5.45	112	112
Vine	14	16	28.29	53.46	80.18	31.29	59.13	88.70	118	119
Evans	0	45	0.00	0.00	0.00	105.68	199.70	299.56		138
TOTAL	274	347	497	939	1409	664	1255	1883	111	115

AM PEAK - Southbound

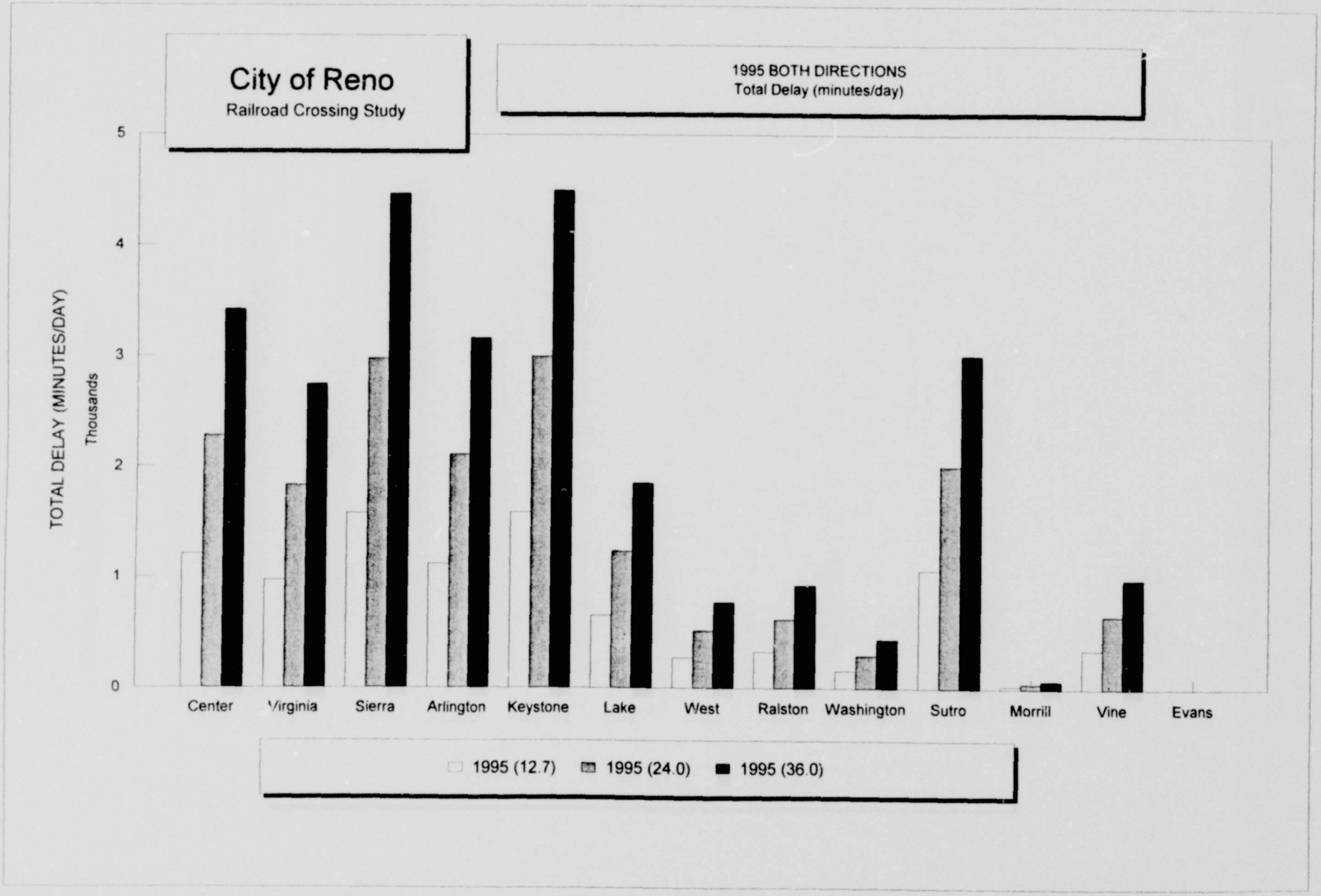
Year	Maximum Vehicles in Queue		Total Delay (minutes)						Average Delay (sec/veh)	
Trains/Day			1995 12.7	1995 24	1995 36	2000 12.7	2000 24	2000 36		
Trains/Peak	1995	2000	1	2	3	1	2	3	1995	2000
Center	0	0	0.00	0.00	0.00	0.00	0.00	0.00		
Virginia	23	25	30.92	58.43	87.65	34.70	65.57	98.36	79	81
Sierra	83	92	163.22	308.44	462.67	189.91	358.88	538.32	116	122
Arlington	31	34	53.36	100.84	151.26	59.92	113.23	169.85	101	103
Keystone	40	43	64.69	122.24	183.36	73.71	139.30	208.95	97	100
Lake	21	23	43.23	81.69	122.53	47.81	90.35	135.53	122	123
West	9	10	17.99	33.99	50.99	19.82	37.46	56.20	120	121
Ralston	10	12	21.60	40.81	61.22	24.23	45.78	68.67	122	123
Washington	5	6	10.19	19.27	28.90	11.48	21.70	32.55	116	117
Sutro	32	36	70.53	133.29	199.94	79.06	149.41	224.12	129	131
Morrill	1	1	1.57	2.97	4.45	1.57	2.97	4.45	112	112
Vine	12	13	22.88	43.23	64.85	25.28	47.77	71.65	117	117
Evans	0	37	0.00	0.00	0.00	82.86	156.59	234.89		132
TOTAL	267	331	500	945	1418	650	1229	1844	112	115

PM PEAK - Northbound

Year	Maximum Vehicles in Queue		Total Delay (minutes)						Average Delay (sec/veh)	
Trains/Day			1995 12.7	1995 24	1995 36	2000 12.7	2000 24	2000 36		
Trains/Peak	1995	2000	2	4	6	2	4	6	1995	2000
Center	87	96	582.05	1099.94	1649.91	667.62	1261.64	1892.46	185	193
Virginia	28	31	105.77	199.87	299.81	119.69	226.20	339.29	104	107
Sierra	0	0	0.00	0.00	0.00	0.00	0.00	0.00		
Arlington	31	34	120.58	227.87	341.80	136.68	258.29	387.44	108	111
Keystone	42	46	149.17	281.90	422.85	169.05	319.47	479.21	99	102
Lake	21	23	94.88	179.30	268.95	105.31	199.02	298.53	126	127
West	9	10	39.26	74.20	111.30	43.40	82.01	123.01	123	124
Ralston	10	12	47.40	89.58	134.38	53.39	100.89	151.33	126	128
Washington	5	6	21.99	41.56	62.35	24.82	46.90	70.35	118	119
Sutro	32	36	158.11	298.78	448.18	178.42	337.16	505.75	136	139
Morrill	1	1	3.34	6.32	9.48	3.34	6.32	9.48	112	112
Vine	12	13	49.45	93.45	140.17	54.73	103.43	155.14	119	119
Evans	0	37	0.00	0.00	0.00	186.81	353.03	529.54		140
TOTAL	279	344	1372	2593	3889	1743	3294	4942	123	127

PM PEAK - Southbound

Year	Maximum Vehicles in Queue		Total Delay (minutes)						Average Delay (sec/veh)	
Trains/Day			1995 12.7	1995 24	1995 36	2000 12.7	2000 24	2000 36		
Trains/Peak	1995	2000	2	4	6	2	4	6	1995	2000
Center	0	0	0.00	0.00	0.00	0.00	0.00	0.00		
Virginia	35	38	137.85	260.50	390.75	157.38	297.40	446.10	111	115
Sierra	84	92	423.68	800.65	1200.97	510.10	963.97	1445.96	141	154
Arlington	38	42	158.33	299.21	448.82	181.28	342.57	513.85	116	120
Keystone	51	56	242.84	458.91	688.36	287.95	544.15	816.22	131	142
Lake	26	28	119.53	225.89	338.83	133.13	251.58	377.37	130	132
West	11	12	49.20	92.98	139.48	54.53	103.05	154.57	126	128
Ralston	13	14	59.72	112.86	169.28	67.52	127.59	191.39	130	132
Washington	6	7	27.26	51.51	77.27	30.82	58.23	87.35	119	120
Sutro	40	44	203.35	384.28	576.43	231.02	436.58	654.87	143	147
Morrill	1	1	4.10	7.74	11.61	4.10	7.74	11.61	112	112
Vine	14	16	61.39	116.01	174.02	68.07	128.63	192.94	120	121
Evans	0	45	0.00	0.00	0.00	242.57	458.40	687.60		149
TOTAL	318	395	1487	2811	4216	1968	3720	5580	125	131

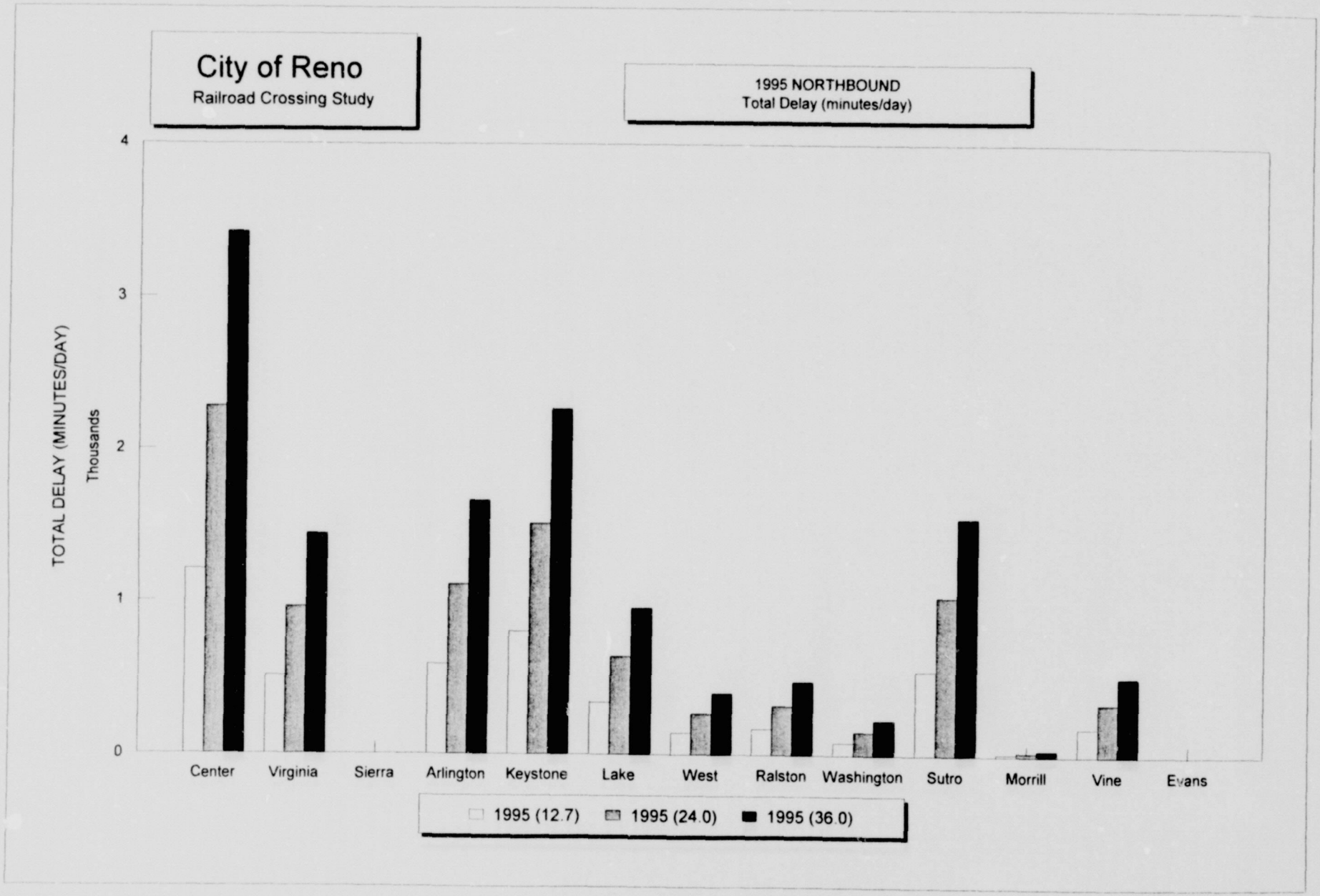

City of Reno
Railroad Crossing Study
1995 BOTH DIRECTIONS
Total Delay (minutes/day)
TOTAL DELAY (MINUTES/DAY)
Thousands
0
1
2
3
4
5
Center
Virginia
Sierra
Arlington
Keystone
Lake
West
Ralston
Washington
Sutro
Morrill
Vine
Evans
1995 (12.7)
1995 (24.0)
1995 (36.0)

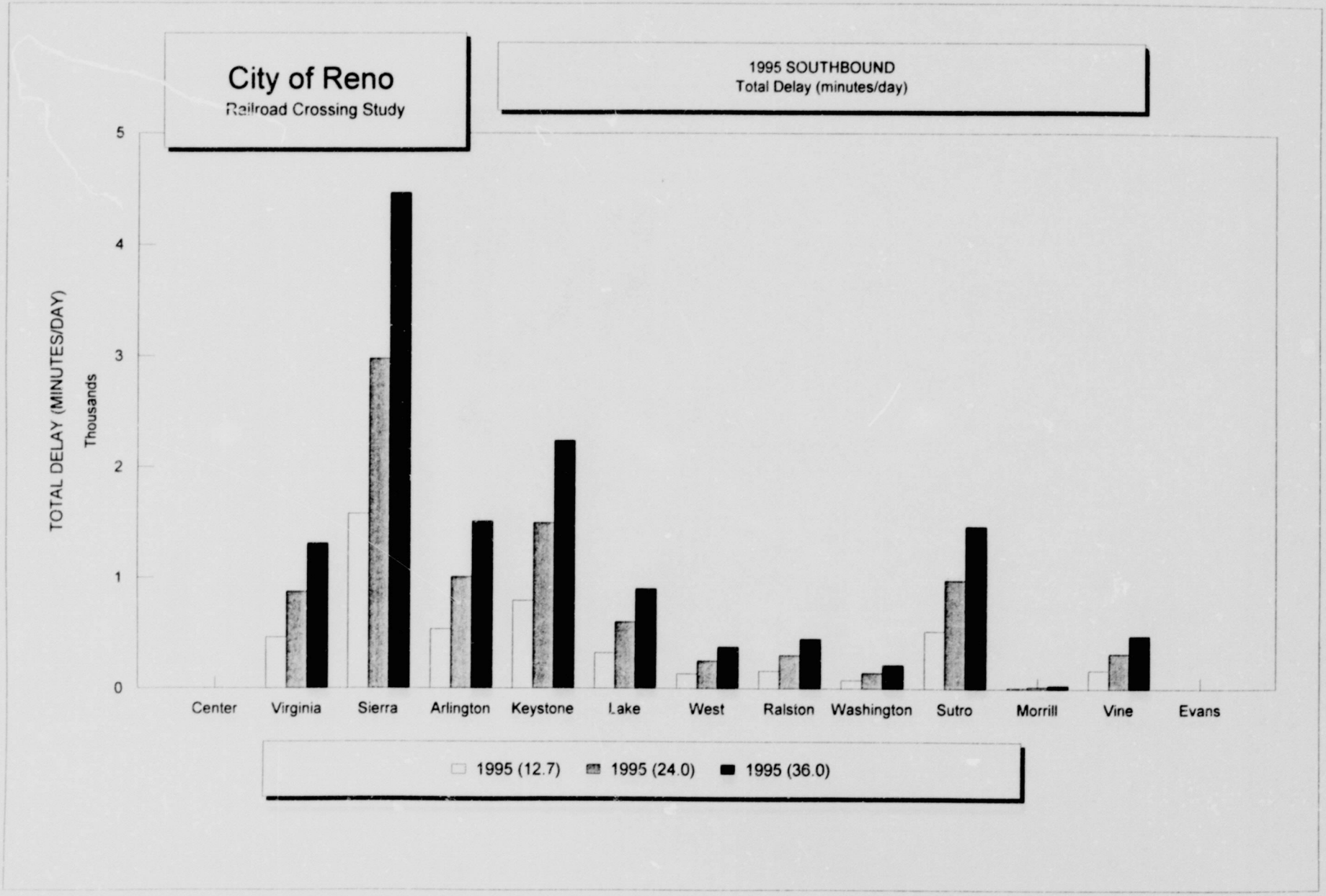
OFF PEAK - Northbound

Year	Maximum Vehicles in Queue		Total Delay (minutes)						Average Delay (sec/veh)	
			1995	1995	1995	2000	2000	2000		
Trains/Day			12.7	24	36	12.7	24	36		
Trains/Peak	1995	2000	10	18	27	10	18	27	1995	2000
Center	29	32	546.66	1033.06	1549.59	608.77	1150.42	1725.64	121	122
Virginia	19	21	362.73	685.48	1028.21	402.54	760.70	1141.05	121	122
Sierra	0	0	0.00	0.00	0.00	0.00	0.00	0.00		
Arlington	21	23	396.81	749.87	1124.81	440.14	831.76	1247.64	121	123
Keystone	30	33	575.24	1087.07	1630.61	638.41	1206.44	1809.65	121	122
Lake	10	11	188.66	356.53	534.79	207.63	392.36	588.55	116	116
West	4	5	79.14	149.55	224.33	86.87	164.16	246.24	115	115
Ralston	5	6	94.27	178.14	267.21	105.13	198.67	298.00	116	116
Washington	3	3	45.65	86.26	129.39	51.26	96.87	145.30	113	114
Sutro	16	17	298.83	564.72	847.07	331.94	627.29	940.93	119	120
Morrill	0	0	7.17	13.55	20.33	7.17	13.55	20.33	111	111
Vine	6	6	102.14	193.03	289.54	112.55	212.69	319.03	114	114
Evans	0	18	0.00	0.00	0.00	345.32	652.58	978.87		120
TOTAL	142	175	2697	5097	7646	3338	6307	9461	117	118

OFF PEAK - Southbound

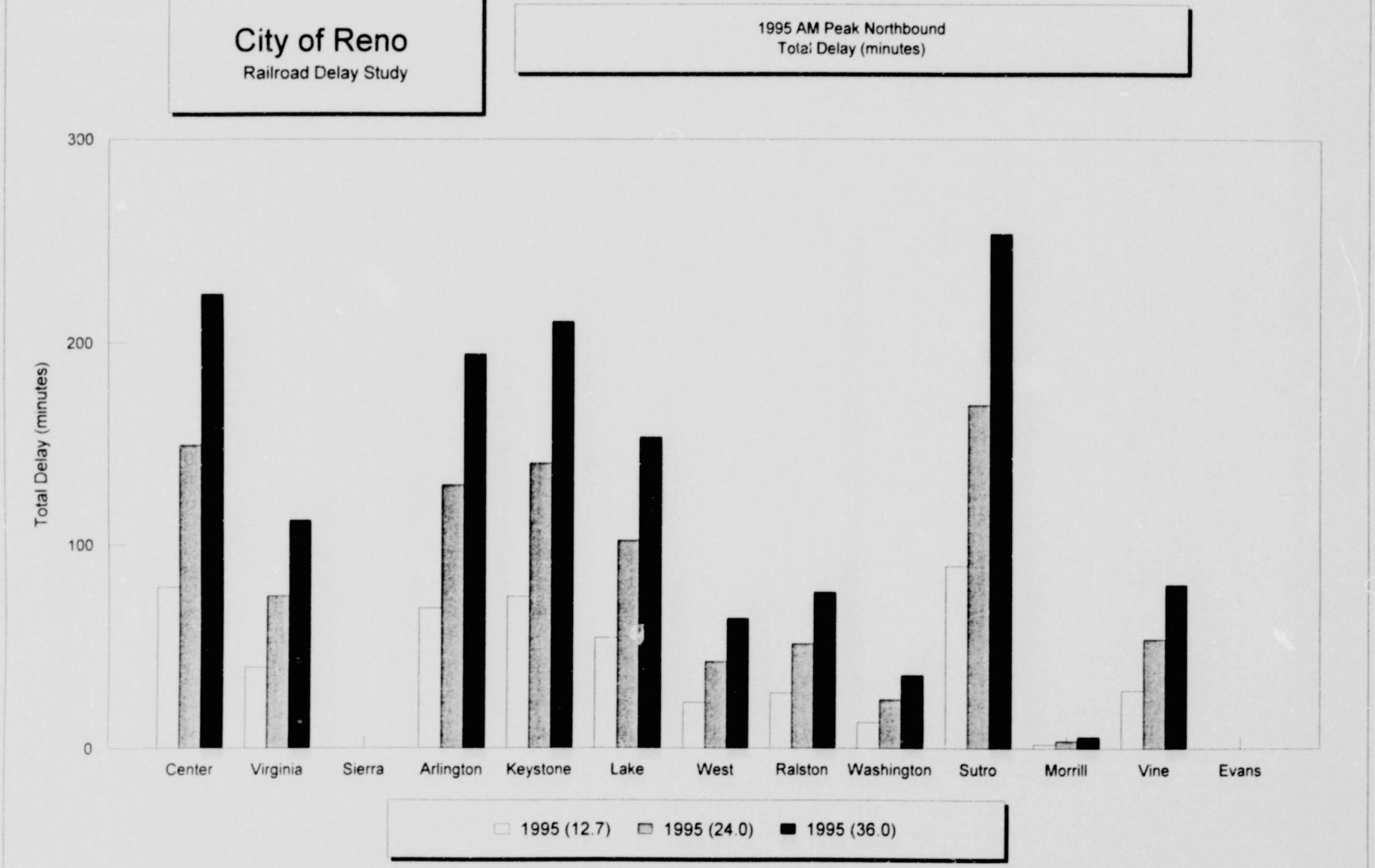
Year	Maximum Vehicles in Queue		Total Delay (minutes)						Average Delay (sec/veh)	
			1995	1995	1995	2000	2000	2000		
Trains/Day			12.7	24	36	12.7	24	36		
Trains/Peak	1995	2000	10	18	27	10	18	27	1995	2000
Center	0	0	0.00	0.00	0.00	0.00	0.00	0.00		
Virginia	16	17	292.12	552.03	828.05	323.62	611.56	917.34	119	119
Sierra	49	53	989.32	1869.58	2804.37	1107.71	2093.31	3139.96	128	131
Arlington	17	19	319.09	603.00	904.50	353.27	667.60	1001.40	119	120
Keystone	24	27	480.80	908.59	1362.89	534.85	1010.75	1516.12	124	125
Lake	8	9	153.09	289.30	433.95	168.34	318.12	477.18	115	115
West	4	4	64.30	121.51	182.27	70.54	133.30	199.94	114	115
Ralston	4	5	76.49	144.55	216.83	85.22	161.05	241.58	115	115
Washington	2	2	37.20	70.29	105.44	41.75	78.90	118.35	113	113
Sutro	13	14	241.32	456.04	684.06	267.68	505.85	758.77	117	118
Morrill	0	0	5.86	11.08	16.62	5.86	11.08	16.62	111	111
Vine	5	5	83.20	157.22	235.84	91.63	173.16	259.74	113	113
Evans	0	15	0.00	0.00	0.00	278.31	525.94	788.91		118
TOTAL	141	171	2743	5183	7775	3329	6291	9436	117	118


City of Reno
Railroad Crossing Study
1995 NORTHBOUND
Total Delay (minutes/day)
TOTAL DELAY (MINUTES/DAY)
Thousands
4
3
2
1
0
Center
Virginia
Sierra
Arlington
Keystone
Lake
West
Ralston
Washington
Sutro
Morrill
Vine
Evans
1995 (12.7)
1995 (24.0)
1995 (36.0)


City of Reno
Railroad Crossing Study
1995 SOUTHBOUND
Total Delay (minutes/day)
TOTAL DELAY (MINUTES/DAY)
Thousands
5
4
3
2
1
0
Center
Virginia
Sierra
Arlington
Keystone
Lake
West
Ralston
Washington
Sutro
Morrill
Vine
Evans
1995 (12.7)
1995 (24.0)
1995 (36.0)

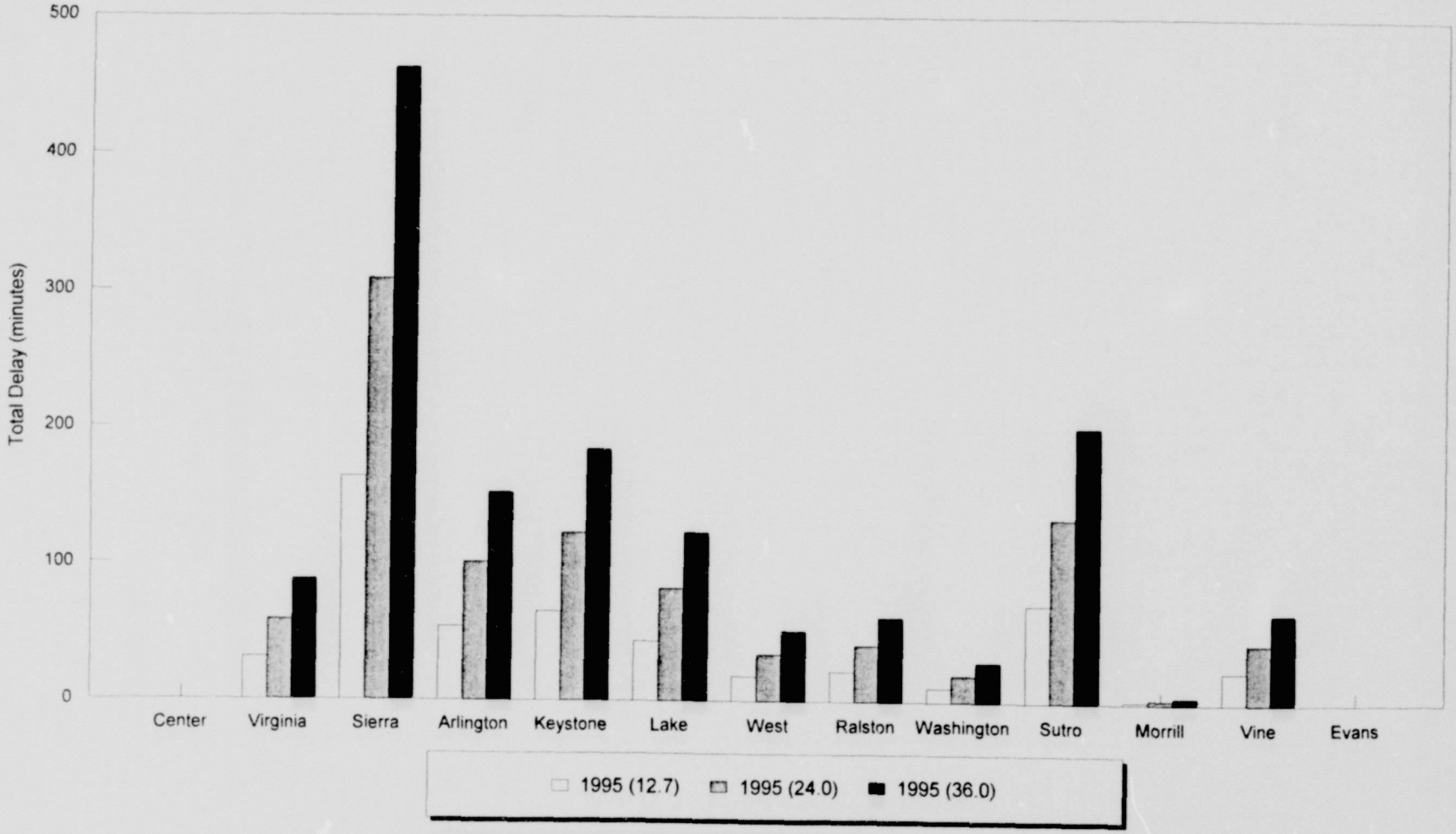
City of Reno

Railroad Delay Study



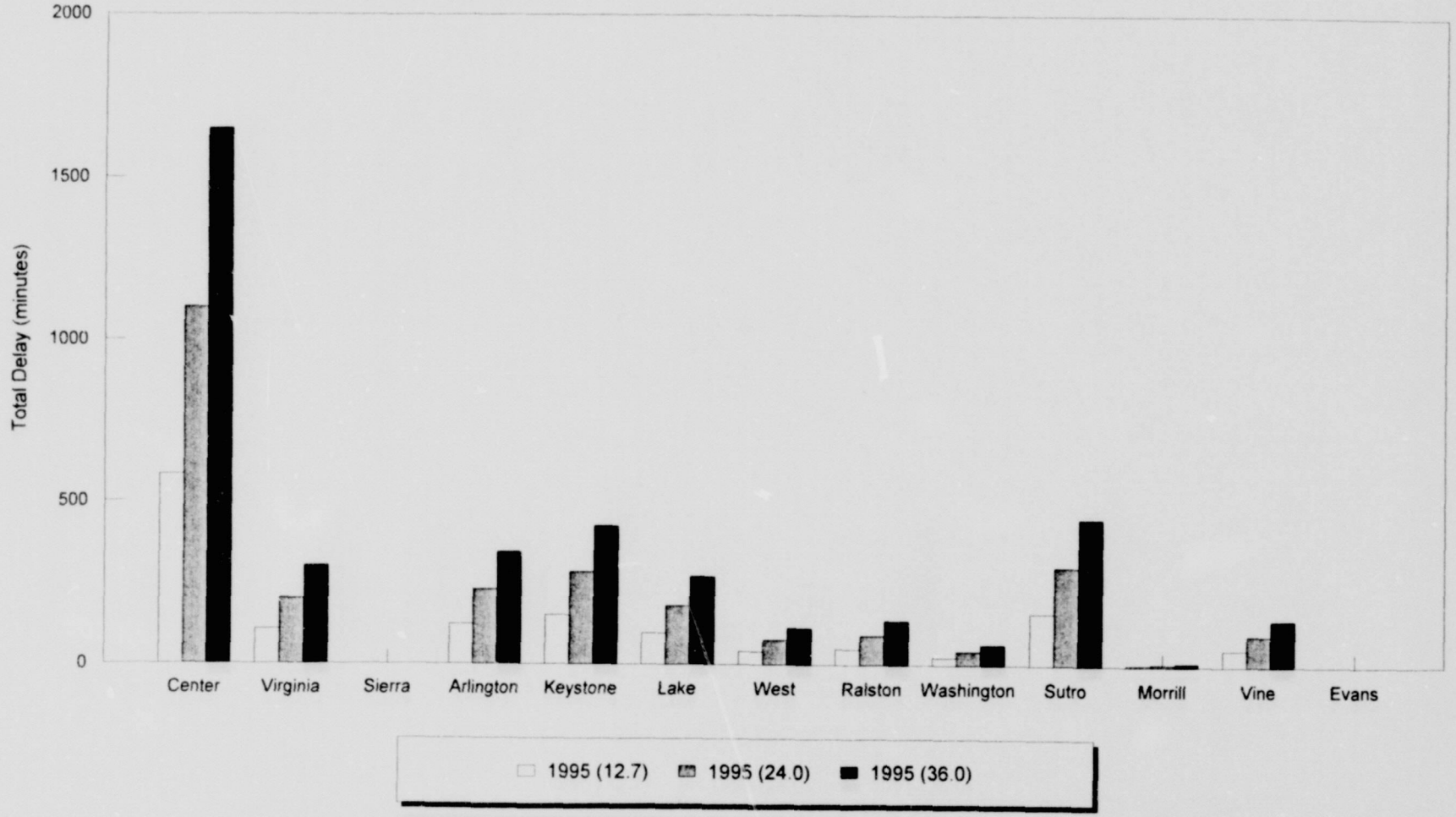
City of Reno
Railroad Delay Study

1995 AM Peak Southbound
Total Delay (minutes)



City of Reno
Railroad Delay Study

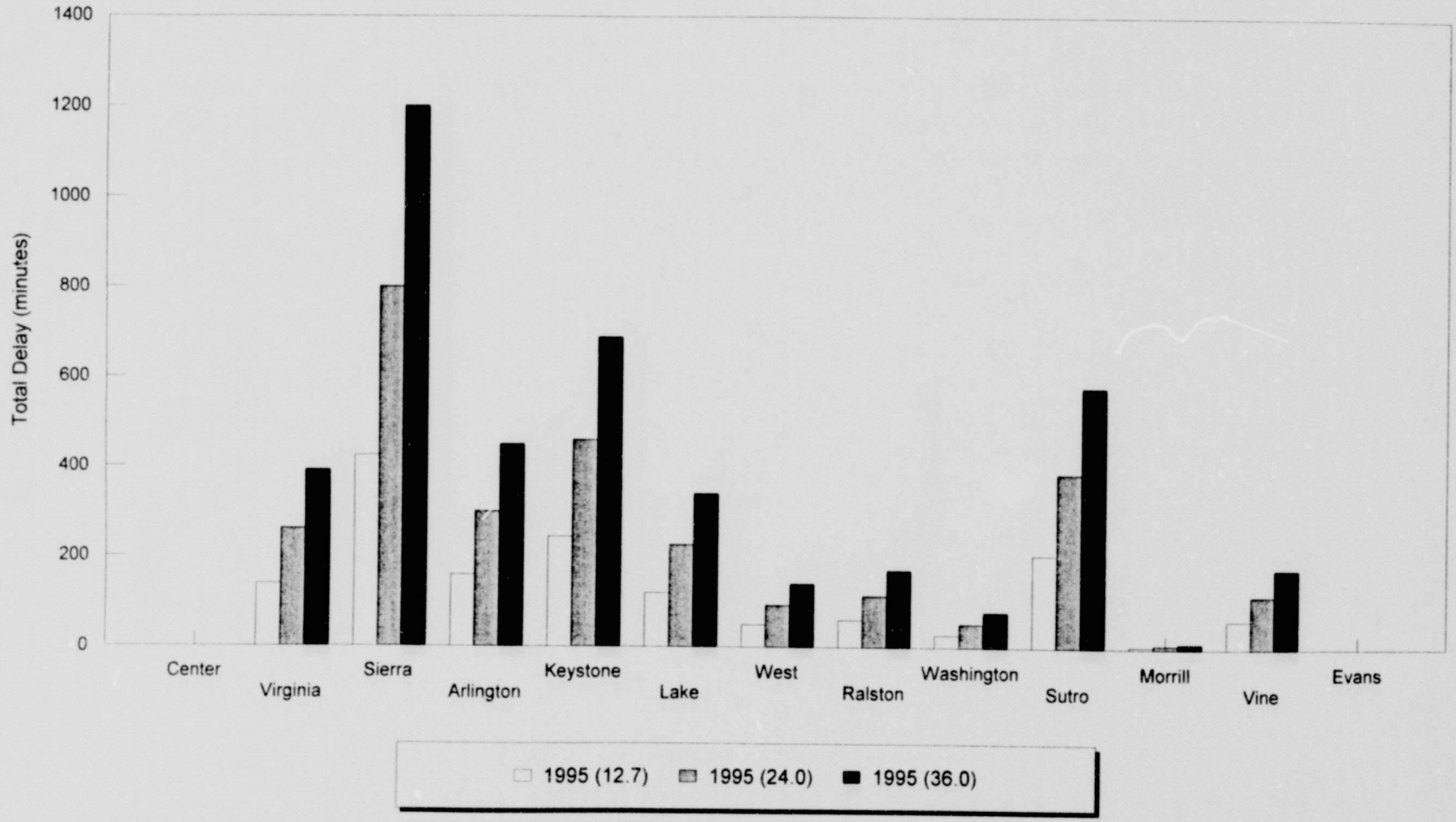
1995 PM Peak Northbound
Total Delay (minutes)

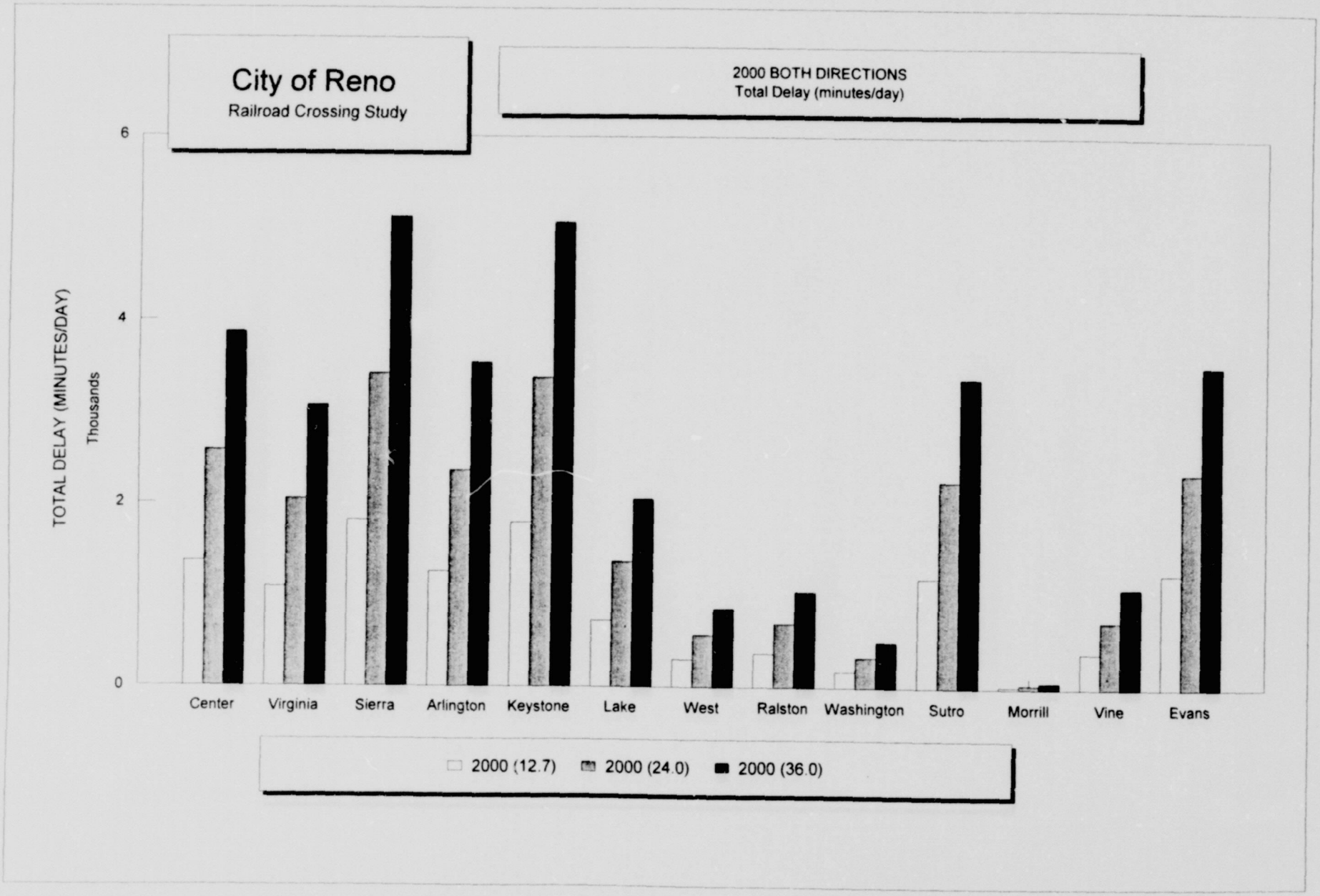


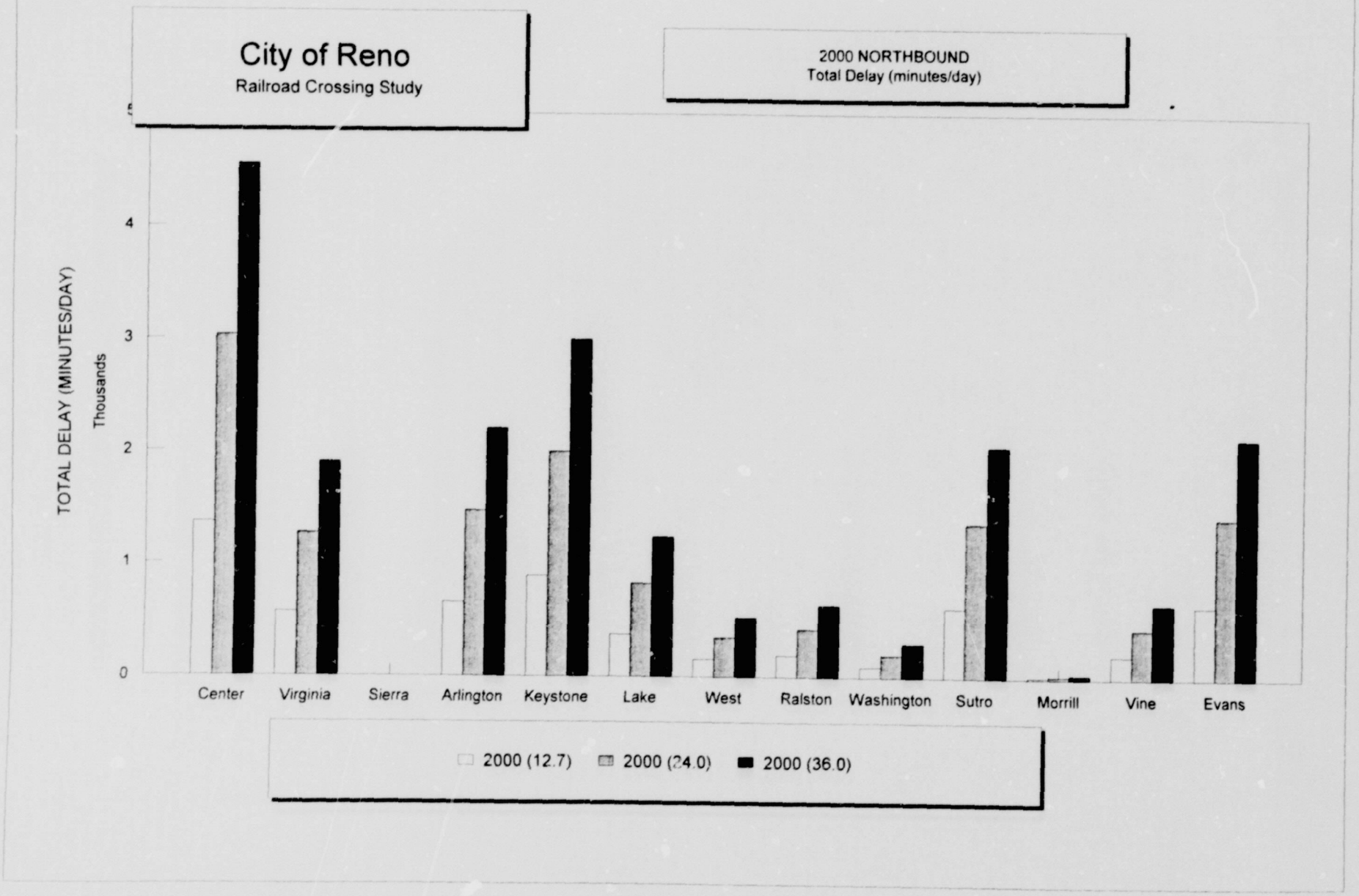
City of Reno

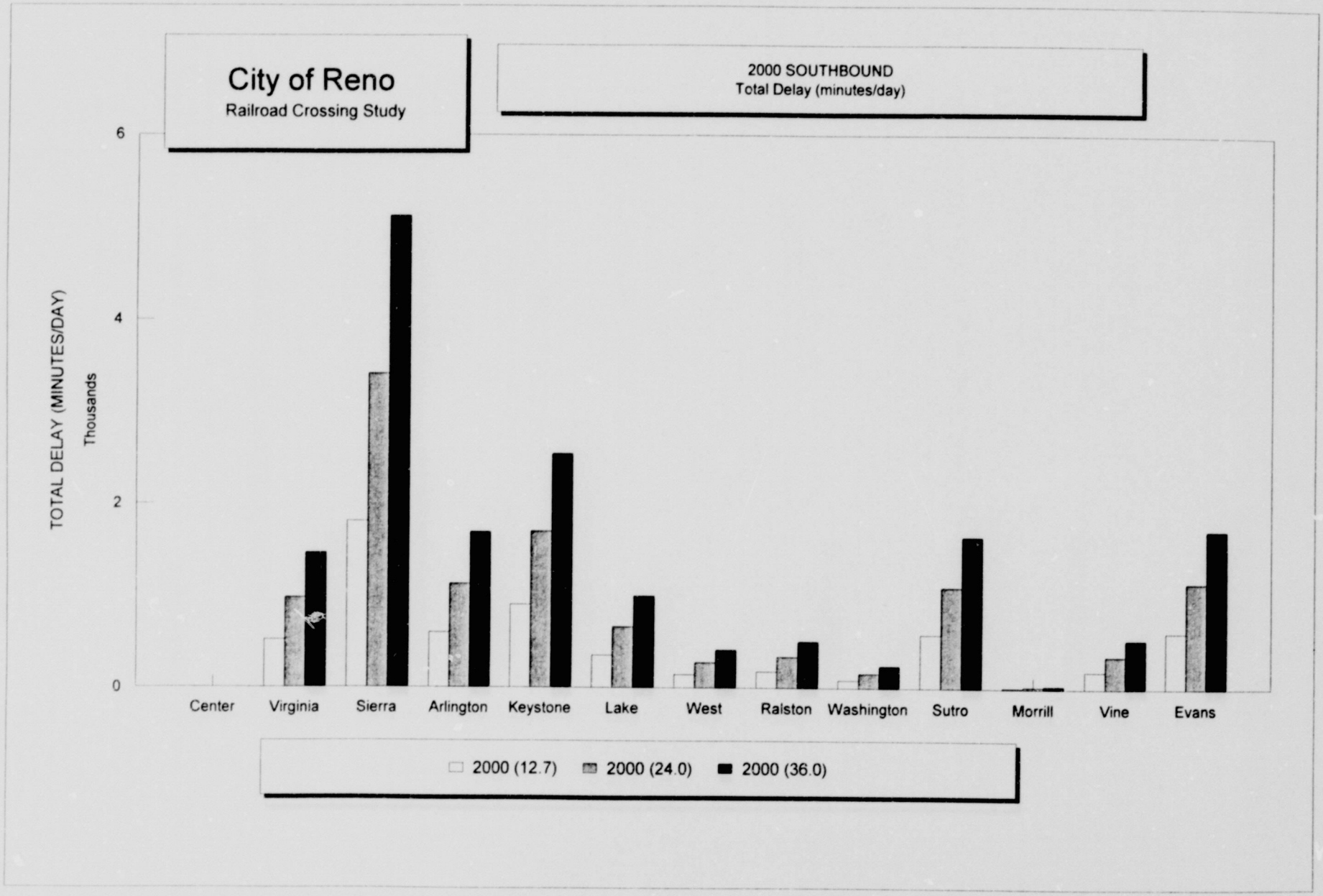
Railroad Crossing Study

1995 PM Peak Southbound
Total Delay (minutes)




City of Reno
Railroad Crossing Study
2000 BOTH DIRECTIONS
Total Delay (minutes/day)
TOTAL DELAY (MINUTES/DAY)
Thousands
6
4
2
0
Center
Virginia
Sierra
Arlington
Keystone
Lake
West
Ralston
Washington
Sutro
Morrill
Vine
Evans
2000 (12.7)
2000 (24.0)
2000 (36.0)

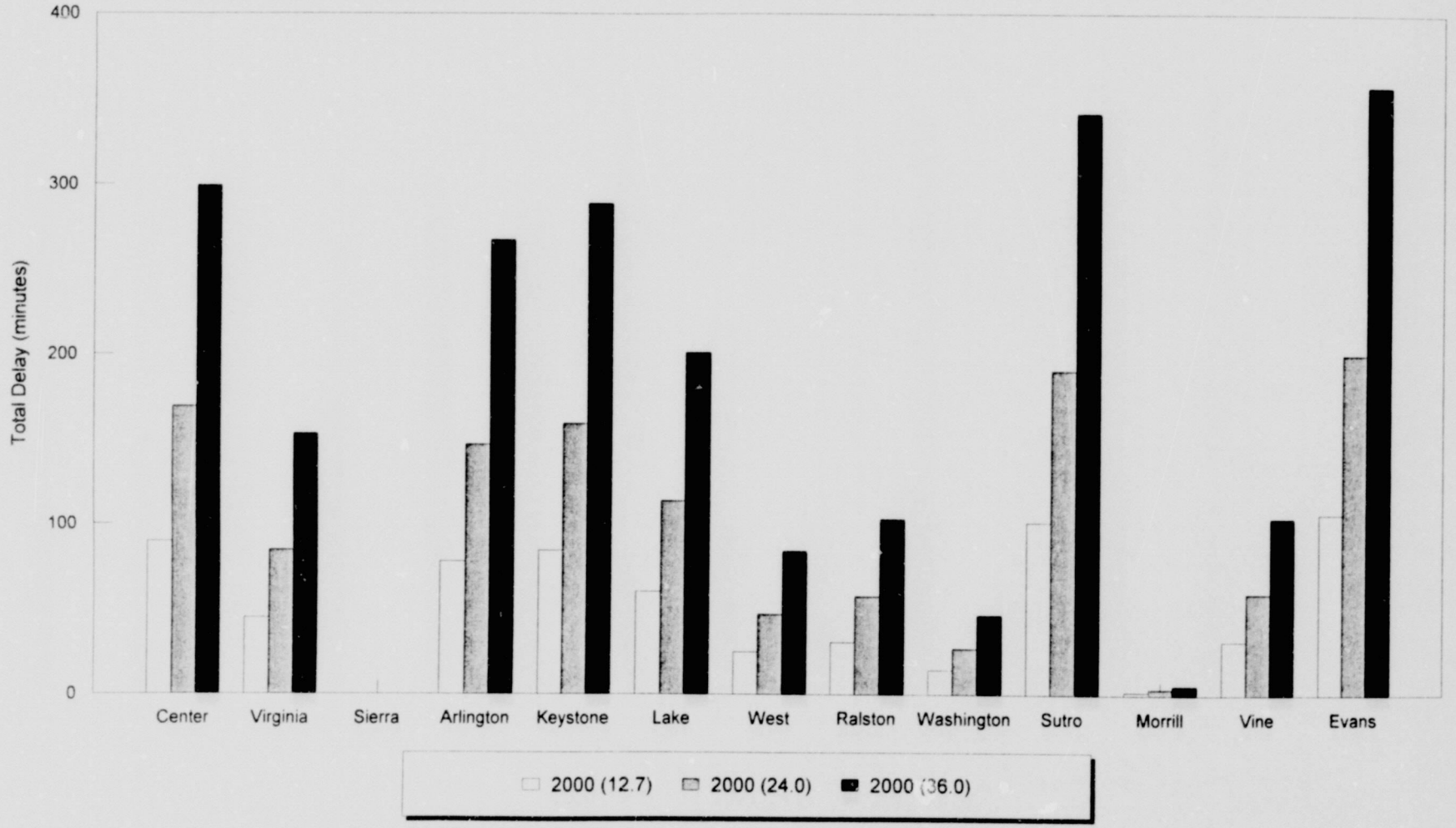

City of Reno
Railroad Crossing Study
2000 NORTHBOUND
Total Delay (minutes/day)
TOTAL DELAY (MINUTES/DAY)
Thousands
0
1
2
3
4
Center
Virginia
Sierra
Arlington
Keystone
Lake
West
Ralston
Washington
Sutro
Morrill
Vine
Evans
2000 (12.7)
2000 (24.0)
2000 (36.0)


City of Reno
Railroad Crossing Study
2000 SOUTHBOUND
Total Delay (minutes/day)
TOTAL DELAY (MINUTES/DAY)
Thousands
6
4
2
0
Center
Virginia
Sierra
Arlington
Keystone
Lake
West
Ralston
Washington
Sutro
Morrill
Vine
Evans
2000 (12.7)
2000 (24.0)
2000 (36.0)

City of Reno

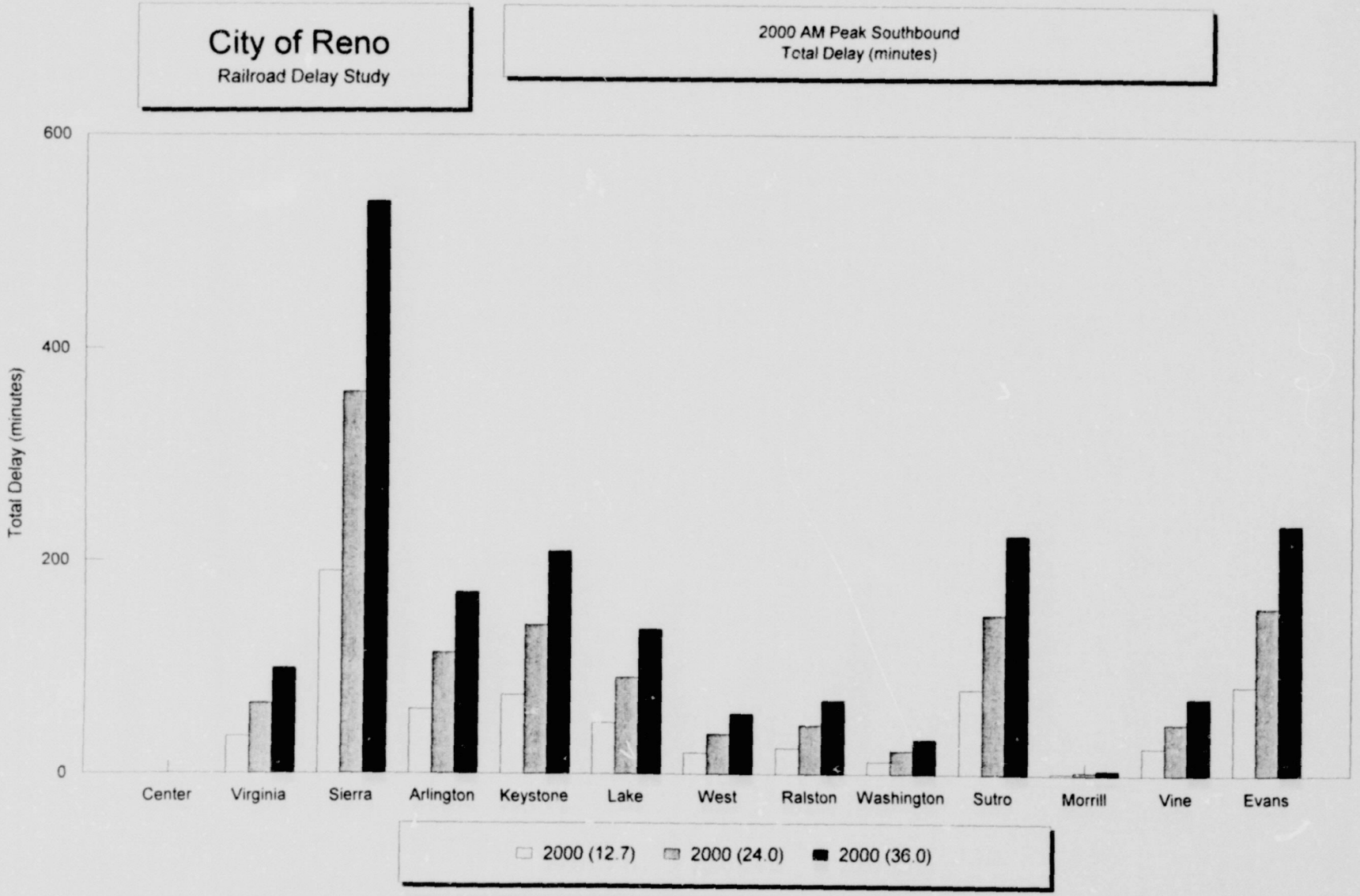
Railroad Delay Study

2000 AM Peak Northbound
Total Delay (minutes)



City of Reno

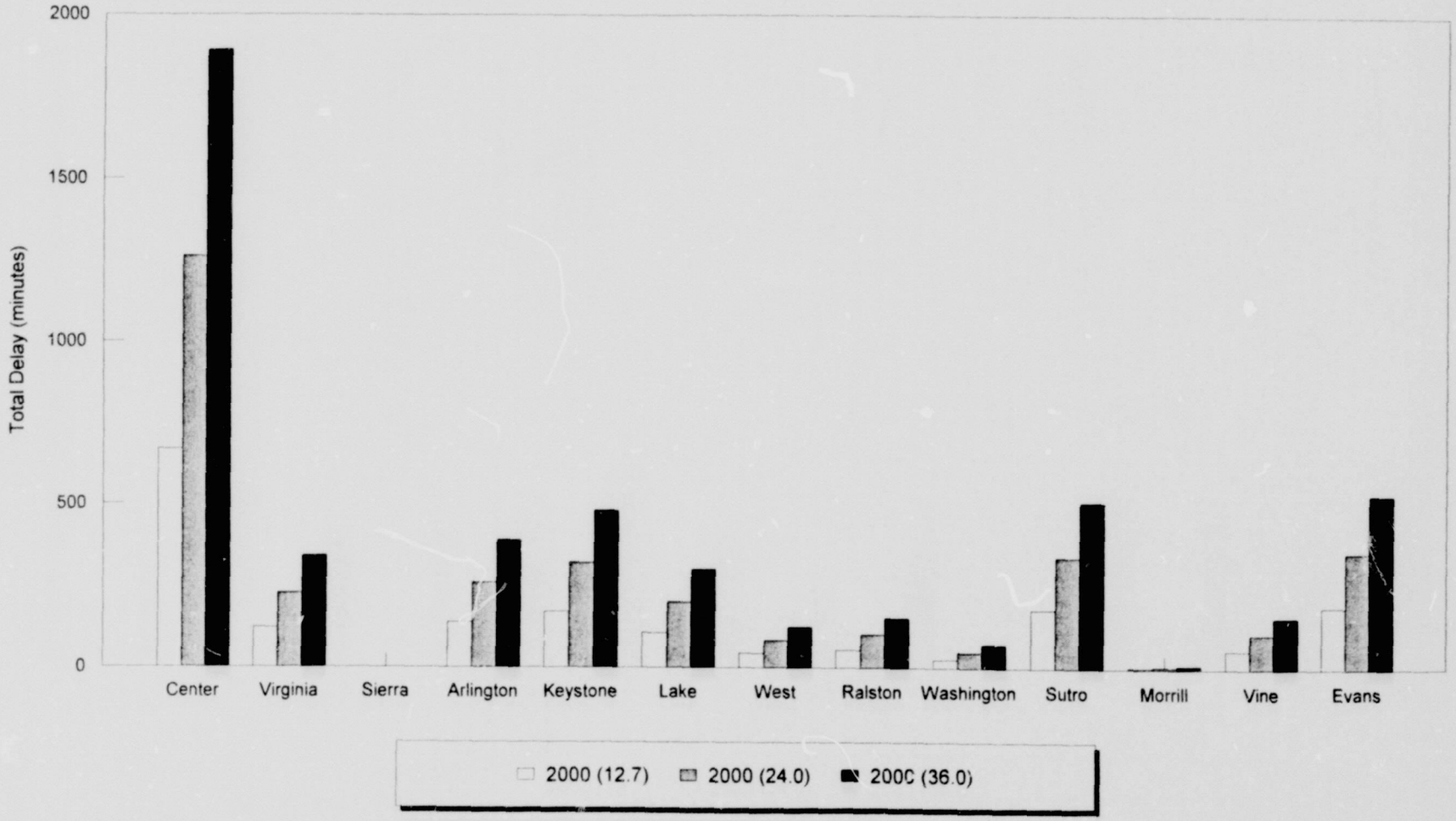
Railroad Delay Study



City of Reno

Railroad Delay Study

2000 PM Peak Northbound
Total Delay (minutes)



City of Reno

Railroad Crossing Study

2000 PM Peak Southbound
Total Delay (minutes)