Appendix A. Supplemental Information for Gateway/ Olive Drive Specific Plan EIR

Davis
California

GATEWAY/OLIVE DRIVE
SPECIFIC PLAN EIR

Supplemental Information for the Draft EIR
SCH# 95083035

Planning and Building Department
23 Russell Boulevard
Davis, California 95616

RECIRCULATED DRAFT ENVIRONMENTAL IMPACT REPORT FOR THE GATEWAY/OLIVE DRIVE SPECIFIC PLAN

The Gateway/Olive Drive Specific Plan DEIR was circulated for public comment on January 12, 1996 for 45 days. The public comment period closed on February 26, 1996. The Final EIR was released on March 6, 1996. The Planning Commission held a public hearing on March 12, 1996 to consider the Final EIR and project entitlements. At that meeting, the Commission recommended to the City Council certification of the EIR and approval of the project entitlements. Prior to City Council action on the EIR, city staff in conjunction with Caltrans agreed to prepare additional traffic analysis. After reviewing the results of the analysis it was determined that the Gateway/Olive Drive Specific Plan Draft EIR should be recirculated. This recirculation is necessary to afford the public the opportunity to review new information which shows potentially significant impacts on the side streets to the Richards Boulevard Corridor.

The Supplemental information, Draft EIR, previously published Response to Comments are available at the city of Davis Planning Division, 23 Russell Boulevard or Yolo County Public Library, 315 East 14th Street, Davis.

The city of Davis will be requesting a 30 day review period from the State Office of Planning and Research. If approved, the recirculation period will be from May 15, 1996 to June 15, 1996. All comments on the recirculated Draft EIR must be submitted to Anne Brunette, Senior Planner, 23 Russell Blvd. Davis, CA 95616 by no later than 5 p.m. on June 15, 1996. If you have questions you may call (916) 757-5610.

SUPPLEMENTAL INFORMATION TO DRAFT EIR

Introduction

This supplemental information to the Gateway/Olive Drive Specific Plan EIR is being prepared pursuant to the provisions of section 15088.5 of the California Environmental Quality Act.

CEQA Guidelines require recirculation of an EIR when significant new information is added to the EIR after public notice is given of the availability of the draft EIR for public review under Section 15087 but before certification. The provisions of 15088.5 provides guidance on what new information is considered "Significant new information" requiring circulation. The new information generated by additional traffic modeling on the Gateway/Olive Drive EIR disclosed in this document, fits into two categories, 15088.5 (1) and (2) which include identification of new significant environmental impacts and that a substantial increase in the severity of an environmental impact would result unless mitigation measures are adopted that reduce the impact to a level of insignificance. The existence of both of the conditions is supported by evidence in the record resulting the recirculation. The remaining provisions of section 15088.5 do not apply to this project.

The main focus of this information is to respond to Caltrans letter dated March 20, 1996 (attached). This supplemental information quantifies the conditions on the Caltrans westbound offramp at Richards Boulevard and the Richards Corridor caused by traffic and traffic signal timing on the Richards corridor.

While reviewing the additional information requested by Caltrans new potentially significant impacts on the environment, which did not relate to Caltrans operation were identified on the side streets to the Richards Corridor. The EIR had disclosed those impacts qualitatively but not quantitatively. The analysis resulted in one new impact and two new mitigations being added to the Draft EIR. The added impact will be reduced to less than significant with the adoption of the mitigation measures. The pages following the added language provides background information, documentation, and the traffic engineering consultant's (Dowling Associates) traffic analysis for the record.

Impact and mitigations added to DEIR (page 4.39)

Impact TC-5: The side street traffic in conjunction with the added volume to Richards Corridor, attributable to the project, will result in excessive time delays at some side streets to the Corridor during the peak hour. *(Potentially Significant).*

Mitigation TC-5.1: The developer of the Nishi property shall incorporate into the project description a 20% trip reduction requirement and TSM program for all office uses.

The majority of trips to and from the Nishi property are a result of the office uses. These trips contribute to the delays on the side streets. The City has adopted a 10% trip reduction standard in the General Plan which is then used for traffic modeling. This reduction was included in the Peak hour analysis and the TRAF/NETSIM modeling for all land uses with the exception of Nishi. It is reasonable to find that additional reductions can be achieved from the "home based work trips" (Comsis page 52-54). As noted by Comsis it is reasonable to assume that a trip reduction of up to 25% (home to work bound trips) can be achieved. This will result in a reduction of trips from the Richards corridor and reduce the impact to less than significant ***(Less-Than-Significant Impact After Mitigation)***.

Mitigation TC-5.2: As General Plan land use build-out proceeds, should excessive delay occur during the peak hour, the city of Davis shall implement one of the following mitigation measures:

A. Restrict turns to the Richards underpass at the following intersections should excessive delay occur in the future, during the peak hours on a regular basis after mitigation measures have been implemented.

Southbound E Street at First in the AM peak hour
Westbound First Street at Richards in the AM and PM peak hour

- OR -

B. Add additional lane capacity to southbound E Street at First Street and westbound First Street at Richards to reduce the delay. It is anticipated that this can occur within the existing right-of-way, through restriping or with minimal widening.

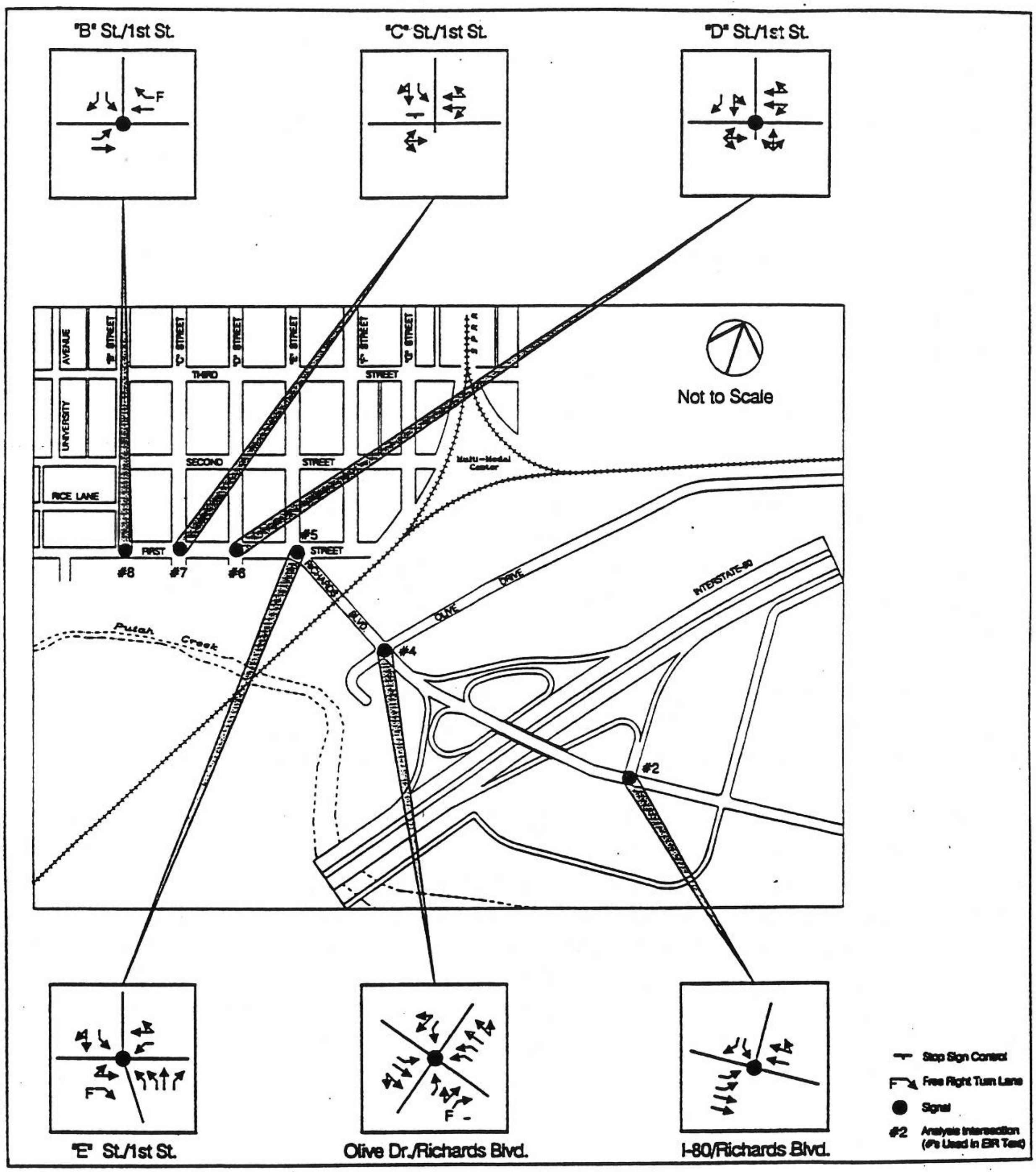
One or both of these measures would only be required if the Public Works Director determined that excessive delays were occurring on the side street approaches to the Richards Corridor and that no other operational actions could alleviate the problem. If option A is implemented, it may result in the secondary impact of increasing traffic on other Core Area streets.

Intersection level of service is measured by the average stopped delay for all the traffic processed through the intersection. Even when the level of service is acceptable, it is possible that small amounts of side street traffic may be experiencing delays. Usually the traffic that is not being well served will seek alternative routes that avoid the delays. In the event that the signal cycle length is long, (two minutes or greater), and traffic must wait in excess of two signal cycles, the implementation of turn restrictions on the delayed approach during peak periods could be imposed. In other words, should side street delays begin to exceed 4 minutes for major portions of the peak traffic periods, consideration of the mitigation strategies noted above would be appropriate. Side street delays of greater than 4 minutes are determined to be "excessive" by this Draft EIR, and, therefore, constitute the level of significant for the impact assessment.

It is anticipated that excessive delays will generally not occur due to normal driver behavior which can not be modeled for this situation. In the event that drivers continue to use the same routes regardless of the delay time, mitigation TC-5.2 will insure that excessive delay times do not occur by eliminating the movement causing the delay. This will result in vehicles using alternate routes such as B Street, Pole Line Road overcrossing, State Highway 113, or altering their time of driving to avoid the peak. *(Less-Than-Significant Impact After Mitigation).*

END OF LANGUAGE ADDED TO DRAFT EIR

CUMULATIVE WITH PROJECT MITIGATION MEASURES MAP PROVIDED FOR REFERENCE



BACKGROUND INFORMATION

California Department of Transportation (Caltrans)

Caltrans provided a comment to the Draft EIR on February 27, 1996(included in FEIR), one day after the comment period ended. Although not legally mandated because of its lateness, the city determined that the issues warranted analysis and were responded to in the Final EIR. After publication of the Final EIR staff initiated a call to Caltrans to determine their satisfaction with the response. This resulted in an agreement between the City and Caltrans that additional traffic analysis would be prepared (Caltrans letter dated March 20, 1996). The Caltrans letter requested three additional pieces of information:

1. *Supporting traffic volumes for the Cumulative Without Project - Table 4-10 in the FEIR (page 4-38).*

2. *A queuing and operational analysis of the Richard Boulevard Corridor. The main purpose of the analysis is to determine if cars stopped at the intersection of Richard Boulevard and Olive Drive back up and block the westbound freeway off-ramp.*

3. *A field verification of the number of vehicles currently stacked on the westbound freeway off-ramp at peak times. In addition, an estimate of the number of vehicles stacked on the off-ramp desiring to access west Olive Drive. The concern is that future congestion of the intersection will cause drivers exiting from westbound I-80 to stop on the off-ramp until the intersection is clear. If this occurs there could be additional stacking on the off-ramp.*

These latter two points are typically were beyond the level of detail of a specific plan EIR and beyond the scope of other EIR's pursued in Davis. However to provide full disclosure and respond directly to Caltrans the city developed the analysis on the following pages.

Caltrans was directly provided with the supporting traffic volumes for the "Cumulative Without Project - Table 4-10" (item #1 above). The background information supports the conclusions on Table 4-10 which showed the difference between the 2010 peak hour levels of service - mitigated condition with and without the project. In summary the table showed that all intersections operate at acceptable levels of service with the exception of First Street/C Street. First Street/C Street operates at unacceptable levels of service with or without the project. Caltrans is satisfied with the information and no additional discussion is necessary. Copies of the background information can be obtained from the city of Davis Planning Division.

Queuing Analysis of the Richard Boulevard Corridor

In general, a queuing analysis examines how a street operates when traffic signal timing, speed limits, lane configurations and side street traffic are taken into consideration in a complex dynamic corridor. The traffic model suggested for this analysis by Caltrans is called TRAF/NETSIM. The TRAF/NETSIM model is an operational model which is typically used to examine an existing condition. Based upon the analysis, corridor modifications can be modeled prior to making improvements such as adding or deleting travel lanes or altering signal timing. For the Richards Boulevard Corridor, the model was used to look at a future condition primarily on the corridor. To model the corridor, assumptions were made regarding future travel patterns and signalization along Richards Boulevard. The level of detail is substantially greater than with a typical travel demand model such as that used in the city's Transportation and Circulation Element (City of Davis Traffic Analysis and Travel Demand Forecasting Model). The city model is the more widely used model for examining a roadway's ability to accommodate vehicle trips (for large projects). The broader "capacity" models do not take into consideration detailed assumptions such as signal timing. A TRAF/NETSIM model is used for detailed situations where operational characteristics are being studied. The operational model has the following constraints which should be considered when reviewing the model output:

- The model does not divert trips at congestion points to simulate actual travel behavior. For instance, if a given intersection is significantly congested or experiences long delays the model fails to recognize that most drivers will take advantage of alternative routes which avoid the congestion. The trips are "forced" into the patterns as they are initially defined.

- The model is typically used for evaluating and analyzing existing situations and does not normally rely on the number of assumptions needed to run the model for future conditions.

- The level of confidence for manipulating the output of the model is low due to the number of assumptions used. In particular, if we can project the delay time at a signal for the year 2010, and the delay time seems to be too long for most drivers to wait at that location, there is no way of determining the number of vehicles that would seek alternative routes.

- Due to the inability of the model to redistribute vehicles in the peak hours, the results may represent a worst case analysis for the peak hour.

- The model is highly sensitive to change in variables. Even slight modifications to the assumptions could result in radically different results. The assumptions modeled represent a best estimate of the impact without diverting trips. If drivers use Pole Line Road, State Route 113 or uncongested streets within the Core it is likely that the model results would not show excessive queues or delays. However, there is no basis for quantitatively determining the exact number and location of the diversions.

- The model is more accurate in examining the Richards Corridor rather than true side street impacts.

Regardless of these constraints, Caltrans requested this analysis and the city completed the work in an effort to provide full disclosure. Due to the close proximity of the Richards Boulevard/Olive Drive intersection, there is the possibility for cars waiting on northbound Richards Boulevard at the intersection of Olive Drive to block the westbound freeway off-ramp. This situation currently occurs at peak hours, and will continue to occur at year 2010 General Plan buildout even with the Richards Corridor widening because of the increase in traffic. This result answers Caltrans' second question: do cars backup and block the westbound off-ramp? If they block the ramp, how many cars are stacked on the off-ramp? The table below shows the results for various scenarios to provide a basis for comparison:

Conditions Evaluated

Three scenarios were evaluated for this study. These include:

Scenario 1	Existing conditions during the AM and PM peak-hours. These runs were conducted to calibrate the model parameters (i.e., saturation flow rates and startup-delay times).
Scenario 2	Full buildout of the General Plan in 2010 plus full build-out of the Gateway/Olive Drive Specific Plan, using roadway configurations recommended for the Richards Blvd widening project and the mitigation measures identified for the Gateway/Olive Drive Specific Plan impacts. The roadway configuration was changed to reflect the current proposal for the Richards Boulevard widening project.
Scenario 3	Full buildout of the General Plan in 2010 without the Gateway/Olive Drive Specific Plan growth. The roadway configuration was changed to reflect the current proposal for the Richards Boulevard widening project. In other words, none of the Gateway/Olive Drive Specific Plan mitigation measures are included.

TABLE 1

TRAF/NETSIM RESULTS(Delay Time and Vehicles waiting at peak hours)

	SCENARIO		
	1 Existing	2 2010/W/Gateway	3 2010/WO/Gateway
	AM/PM	AM/PM	AM/PM
Does the scenario result in obstruction of the WB I-80 off ramp at peak periods?	Yes	Yes	Yes
How long is queue on off ramp (in number of vehicles)?	1/1	5/3	3/4
Number of vehicles wanting to weave to W Olive turn lanes (in number of vehicles).[1]	1/1	4/2	2/3
1. Delay on southbound E Street at First Street (seconds)	71/84	427/192	76/95
2. Delay on westbound First Street at Richards (seconds)	83/281	379/264	76/65
3. Delay on northbound Richards at Olive Drive (seconds)	10/8	16/16	8/9
4. Delay on eastbound Olive Drive at Richards (seconds)	40/77	51/179	38/43
5. Delay on westbound Olive Drive at Richards (seconds)	32/35	168/60	51/40
6. Delay on northbound Richards at First Street (seconds)	22/31	15/25	10/18
7. Delay on southbound Richards at Olive Drive (seconds)	11/10	20/24	9/12
8. Delay on southbound D Street at First Street	10/7	54/161	45/51

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[1] Estimated from observing operations during the simulations.

The following factors are key to understanding model results.

- Five (5) cars on the off ramp are equal to only 10 percent of the length of the ramp, and do not interfere with freeway traffic.
- All delay times assume that no vehicles choose alternate routes. This tends to represent a worst case, and does not reasonably reflect expected driver behavior.
- Delays are the average during the peak showing the amount of time that a car would spend during the peak hours to move through the intersection.

In general the queuing analysis of the Richards Boulevard corridor shows that in the year 2010 the corridor will not experience queuing problems worse that those that exist today in the AM and PM peak. The corridor itself will not experience queuing problems even though side streets might under specific assumptions.

Two side streets, southbound E Street at First Street and westbound First at Richards, show long queues with scenario 2, General Plan plus Gateway. The queues show a peak AM delay of 7 minutes on E Street if vehicles do not choose an alternate route. The queues result in an average of 16 cars on E Street. The Block of E Street between First and Second Street has a capacity for 20 cars[2]. Westbound First Street at Richards shows delays of 6.5 minutes in the AM peak. The block of First Street between E and F Street is 240 feet and can accommodate 12 vehicles. The vehicles back up past the intersection of F Street and First Street in the PM peak, but do not cause stacking beyond the F Street in the AM. Scenario 2 will add 7 vehicles to those stacked on First Street east of the intersection. The capacity of this block is 28 vehicles. Scenario 2 results in 17 total vehicles on the block in both the AM and PM. This does not exceed the capacity of the block beyond F Street but does cause stacking beyond the F Street, intersection in the AM. With the adoption of the recommended mitigation the impact is reduced to less than significant by reducing delay by approximately half.

While the queuing shows delays at peak periods, the roads and intersections continue to operate at the levels disclosed in the DEIR.

For discussion purposes, it is useful to compare the delays to the actual number of vehicles experiencing the delays. What becomes clear is that the number of cars is not great, but the amount of delay is long. This is due to the need to coordinate the signal on Richards Boulevard such that the majority of vehicles using the main route in the corridor are moving.

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[2] Assumes 20 feet per car and a 400 foot block.

TABLE 2
TRAF/NETSIM RESULTS(Number of Vehicles waiting at Peak Hours)

	SCENARIO		
	1 Existing	2 2010/W/Gateway	3 2010/WO/Gateway
	AM/PM	AM/PM	AM/PM
1. Number of vehicles queued southbound E Street at First Street	9/13	16/16	9/15
2. Number of vehicles queued westbound First Street at Richards	10/17	17/17	9/14
3. Number of vehicles queued northbound Richards at West Olive Drive	12/11	10/9	8/8
4. Number of vehicles queued eastbound Olive Drive at Richards	2/10	7/17	2/5
5. Number of vehicles queued westbound Olive Drive at Richards	7/10	16/15	9/13
6. Number of vehicles queued northbound Richards at First Street	26/29	17/18	11/16
7. Number of vehicles queued southbound Richards at Olive Drive	5/7	16/27	6/9
8. Number of vehicles queued southbound D Street at First Street	1/1	6/15	3/5

With or without the additional traffic caused by the Gateway/Olive Drive Specific Plan, delays and queuing on Richards Boulevard have no significant impact on the freeway ramps and Caltrans operations. The addition of the Gateway/Olive Drive Specific Plan does, however result in more vehicle trips crossing and entering the Richards Corridor traffic flow. The additional volume of traffic can be accommodated on Richards Blvd. However, the side streets experience delays for the vehicles which choose the side street routes. Even though the number of vehicles are minimal, the delays are long.

Vehicle movements from westbound I-80 off ramp to westbound Olive Drive

The direct impact to Caltrans operation is the westbound I-80 offramp. Under existing conditions, the ramp is intermittently obstructed at the peak hours. Scenarios 2 and 3 show that the ramp will continue to be intermittently obstructed in the future condition. Scenario 3 shows the impact of full buildout of the General Plan. Scenario 2 shows the impact of full buildout of the General Plan with the Gateway project. As the Dowling analysis notes, Scenario 2 causes 5 cars to be stacked on the westbound I-80 offramp with 75% of those vehicles wishing to move to West Olive Drive. The stacked cars represent only 10% of the ramp length capacity and do not cause impacts on I-80.

Of the vehicles wishing to move from the westbound I-80 offramp to West Olive Drive, the model showed that some of the vehicles waited on the offramp for the Olive Drive/Richards Blvd intersection to clear out. The issue of concern to Caltrans is the number of vehicles waiting on the westbound offramp that wait on the ramp to make the movement rather than merging onto Richards Blvd. Due to the proximity of the Olive/Richards intersection to the offramp, this type of wait will occur. The issue would be considered significant if the waiting vehicles were causing subsequent vehicles to stack down the ramp and interfere with freeway flow.

The analysis prepared by Dowling Associates shows that this will not occur and that Caltrans operation will not be significantly affected in the peak period. No impacts or mitigations are necessary to address the concerns of Caltrans. Secondary impacts identified in the modeling effort are discussed separately.

SECONDARY IMPACTS

In reviewing the results of the TRAF/NETSIM model, the queues at various intersections became quantified necessitating a discussion which did not occur in the DEIR. The remainder of this document addresses the following: 1) Why the impact (delay) is occurring. 2) Are the previous Levels of Service identified in the DEIR still valid? 3) Are the lengths of the queues a significant adverse environmental impact?

Why are the excessive delays occurring?

The impact is occurring for two reasons. The first is the General Plan policy language prohibiting any six-lane roadways and the second is the hierarchy of roadways. As part of the 1993 adoption of the Transportation and Circulation Element EIR, the City Council adopted a level of service standard and overrode certain traffic LOS impacts. Among the impacts that were overridden was the widening of Richards Boulevard (and other key roadways) to six-lanes. The statement of overriding consideration regarding roadway widening projects is:

Performance Considerations

The Council has recognized in their deliberations that an improved level of service (e.g. LOS C instead of D) results in a greater level of required improvements (e.g. more lanes) with a greater potential for secondary impact (e.g. on adjoining land uses). A lower level of service (e.g. LOS D instead of C, or LOS E instead of D) results in greater citywide congestion, especially at key points of constriction(e.g. the freeway and railroad under- and overcrossings). Taking these implications further in terms of quality of life, the improved LOS centers the burden of impact on the specific area of the improvement. Conversely acceptance of the lower LOS, that may preclude the need for certain improvements such as the overcrossing, results in citywide degradation of traffic flow, and secondary impacts such as air quality degradation, traveler delay, and safety.

The Council's decision regarding a number of roadways and TSM reflects a balancing of the factor identified above. An overall lower LOS has been identified as appropriate for these segments when balancing competing factors.

- *2 lanes on F street, from 7th to 3rd Street*
- *2+ lane Pole Line Road Overcrossing (a particular design width and striping, as well as performance thresholds have been specified in order to maintain the balance the Council has identified, between East and South Davis, the Core Area, and citywide mobility needs)*
- *2+ lanes on Pole Line Road, from 5th to Claremont*
- *2+ lanes on B Street, from 1st to 5th Streets*
- *4+ lanes on Covell Blvd, from SR 113 SB ramp to Sycamore*
- *4+ lanes on Richards Blvd., from I-80 EB ramps to 1st Street*
- *2 lanes on 8th Street, form F to J Streets*
- *Identification of Pole Line Road (5th to Covell) and F Street (south of Covell) as "minor" instead of "major" roadways*
- *10 percent assumption for TSM*

The City Council has balanced these roadway performance considerations against the unavoidable and irreversible environmental risks identified in the EIR and has concluded that those impacts are outweighed by community benefits described herein such as small, human-scale streets, livable neighborhoods, pedestrian orientation, rejection of sprawl, and economic savings by not spending that additional money on roadway improvements.

Upon balancing the environmental risk and countervailing community benefits, the City Council has concluded that *the benefits that the City will derive from the implementation of the revised TCE project, outweigh those environmental risks.*

The City Council believes that the above-described performance issues which will result from approval of the Revised TCE project, are overridden by the significant, beneficial advantages of having a small, livable City.

The statement of override identified the impact to traffic flow and traveler delay. As subsequent EIRs are prepared they must also disclose these impacts. The subsequent EIR prepared for Gateway/Olive Drive provided more detailed quantitative information which confirmed what the TCE EIR and Gateway/Olive Drive Specific Plan Draft EIR disclosed qualitatively. The only additional details is that the significant delay is 7 minutes at the maximum during the peak hour of the day, without mitigation.

The TRAF/NETSIM model results showed long delays on side streets to the Richards Corridor assuming full build-out of the General Plan and the Gateway Plan. This is a result of optimizing the signal timing of the Richards Corridor to move the majority of vehicles through the Corridor. The projected volume of Richards Blvd. is in excess of 27,000 average daily trips(ADT), while E Street is approximately half the volume at just over 13,000 ADT. City staff and Dowling Associates confirm that the signal optimization can not be modified to resolve side street delays and queues without significant delays and queues occurring on the Corridor. Consistent with the General Plan hierarchy of streets the major arterial is given a higher priority over the local streets.

Level of Service

The Draft EIR (pg. 4-29) provided the following guidance for the determination of significance:

> Traffic impacts are considered significant if implementation of the Gateway/Olive Drive Specific Plan would reduce the level of service on roadway segments or at impacted intersections to a condition worse than LOS "D" for existing streets and intersections and LOS "C" for new facilities.

For the purposes of the Draft EIR intersection analysis for the AM and PM peak hours was conducted along First Street and Richard Boulevard for each of the development scenarios. Peak hour levels of service were determined using the 1994 Highway Capacity Manual methods for signalized and stop controlled intersections.

Based upon this analysis the DEIR identified the following impact:

Impact TC-1: The traffic generated by the project when added to the existing condition would result in worsened levels of service during the AM and PM peak hours at most of the analysis intersections (Significant Impact).

The PM peak hour level of service under the existing condition without the project is substandard at Richards Boulevard and E Street and First and D Streets. When the project is added to the existing condition, LOS "F" occurs both in the AM and the PM peak hours at most of the analyzed intersections. Table 4-8 details the levels of service with and without the project.

The DEIR (pg. 4-33 and 34) contains a mitigation which identifies improvements to five (5) intersections which reduces the impact to "Less-than-Significant Impact After Mitigation." The identified levels of service in the 2010 peak hour mitigated condition are:

> Table 4-10 shows the resultant AM and PM peak hour levels of service for the cumulative with and without project condition. When these improvements are implemented, the levels of service at all of the analysis intersections are improved *(Less-Than-Significant Impact After Mitigation)*.

Table 4-10

2010 Peak Hour Levels of Service - Mitigated Condition

Analysis Intersection	**Cumulative Without Project**				**Cumulative Plus Project**			
	AM Peak Hour		PM Peak Hour		AM Peak Hour		PM Peak Hour	
	Level of Service	Average Delay (sec/veh)	Level of Service	Average Delay (sec/veh)	Level of Service	Average Delay (sec/veh)	Level of Service	Average Delay (sec/veh)
Richards Boulevard at I-80 Eastbound ramps	B	14.8 (sec/veh)	B	14.6 (sec.veh)	B	14.8 (sec/veh)	B	14.6 (sec/veh)
Richards Boulevard at Olive Drive	B	8.6 (sec/veh)	B	11.5 (sec./veh)	C	19.1 (sec/veh)	C	21.5 (sec/veh)
Richards Boulevard/ First Street	B	14.6 (sec/veh) C	C	18.9 (sec/veh)	C	18.2 (sec/veh)	D	27.4 (sec/veh)
First Street/D Street	A	3.3 (sec/veh)	B	6.8 (sec./veh)	A	4.6 (sec/veh)	C	15.4 (sec/veh)
First Street/C Street	C	Worse Case LOS (1)	E	Worse Case LOS (1)	D	Worse Case LOS (1)	F	Worse Case LOS (1)
First Street/B Street	A	0.4 (sec/veh)	A	0.6 (sec/veh)	A	0.6 (sec/veh)	A	1.3 (sec/veh)

(1) Level of service for two-way stop sign control based upon worse case approach LOS rather than average intersection delay.

The TRAF/NETSIM model examined the operation of the Richards Boulevard Corridor and the potential for traffic queues on side streets to determine whether the findings of the Gateway/Olive Drive Specific Plan DEIR are correct. **The model results did not change the findings of the DEIR regarding intersection impacts and needed mitigations, rather it pointed out the need for additional mitigation on side streets to the corridor.**

The TRAF/NETSIM analysis provided an estimate of the vehicles queuing on the side streets (of Richards Boulevard) as a result of traffic signal timing and volumes. The DEIR Impact TC-1 (pg. 4-30) disclosed that the project would result in additional congestion at intersections, and the DEIR provides the estimate of the number of trips in the peak hour(pg. 4-32). The TRAF/NETSIM model examined the amount of time vehicles have to wait at the intersection during peak hour(on average) before proceeding.

To assess the level of significance of the TRAF/NETSIM queuing results, the constraints of the model must be taken into consideration. Based on the modeling and assumptions, the following intersections show long queues and delays as shown on tables 1 and 2:

1. Westbound First Street at Richards
2. Southbound E Street at Richards

The TRAF/NETSIM model does not model travel behavior in a congested situation with alternate travel route choices. Thus, the results represents worst case, unlikely to occur often. The 1992 Comsis report notes that drivers will alter their driving patterns to avoid congestion or delays. Each of the three identified intersections have alternate choices for direction of travel other than the choice the model assumes. It is reasonable to assume that the overall congestion is spread over various roadways or intersections. Due to the constraints of the model the impact is identified as potentially significant. Mitigation measures have been identified which will reduce the impact to less than significant. The mitigations include trip reduction requirements the Nishi property and restricting vehicle movements or adding vehicle capacity at impacted intersections.

ATTACHMENTS:

1. Caltrans letter dated March 20, 1996
2. Dowling Associates traffic analysis
3. Dowling Associated letter to Anne Brunette dated April 30, 1996
4. Highway Capacity Manual, Characteristics of Interrupted Flow
5. Comsis report discussion of TSM

STATE OF CALIFORNIA-BUSINESS, TRANSPORTATION
PETE WILSON, Governor

ATTACHMENT 1

DEPARTMENT OF TRANSPORTATIC
DISTRICT 3, SACRAMENTO AREA OFFICE • MS 41
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March 20, 1996

HYOL020
03-YOL-80 P.M. 0.24
Gateway/Olive Drive Specific Plan
FEIR
SCH# 95083035

Ms. Anne Brunette
City of Davis
Community Development Department
23 Russell Boulevard
Davis, CA 95616

Dear Ms. Brunette:

Thank you for the opportunity to review and comment on the above referenced document. The traffic responses for this FEIR have not adequately analyzed the impacts of this development proposal on Caltrans transportation facilities. Based on our conversations with the City of Davis staff, it is Caltrans understanding that the City will not make a final decision on the FEIR until the following information is provided and Caltrans has commented on the requested items below:

COMMENTS:

- Caltrans would like to review the supporting traffic volumes for the "Cumulative Without Project -Table 4-10" in the FEIR.

- A queuing analysis of the Richards Boulevard Corridor is necessary, limited to the northbound approaches to the intersections of Richards Boulevard at First Street and Richards Boulevard (south of Olive Drive) at the I-80 offramp. The main purpose of this analysis is to determine how northbound Richards Boulevard queuing would impede I-80 offramp traffic access to Richards, causing offramp queuing.

- Caltrans needs projected traffic numbers for the a.m. peak period on the shorter westbound diagonal offramp from I-80 to Richards Boulevard with the Nishi project at buildout. The traffic projections will help determine the number of additional trips stacking on the I-80 offramp at Richards Boulevard as a result of proposed Gateway Olive Drive Specific Plan development. Caltrans believes increased I-80 offramp stacking could result from the likelihood of more northbound Richards Boulevard lane change weave movements being attempted from the I-80 offramp intersection to the left turning pocket at West Olive Drive slowing Richards Boulevard through lane traffic. Weave movements and queuing on northbound Richards Boulevard could potentially close off the I-80 offramp traffic access. The FEIR currently discloses that there will be traffic conflicts and additional queuing at the a.m. peak hour. However, more specific numerical information is needed. We agree that it is difficult to accurately calculate how the additional trips will split between the westbound I-80 offramp to Richards Boulevard and the east Olive Drive off ramp to Richards Boulevard. (To the extent that vehicle drivers use the East Olive Drive off ramp, no significant conflicts are anticipated at the Richards Boulevard intersection.)

If you have any questions regarding these comments, please contact Ken Champion at 916-324-6642.

Sincerely,

Sharon Scherzinger
for
JEFFREY PULVERMAN, Chief
Office of Transportation
Planning - Metropolitan

cc: Dana Lidster, State Clearinghouse
David Pelz, City of Davis Public Works

Dowling Associates
Transportation Engineering • Planning • Research • Education

ATTACHMENT 2

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City of Davis
Planning & Building

May 3, 1996

Ms. Anne Brunette
City of Davis
23 Russell Boulevard
Davis, California 95616

RE: Additional Traffic Impact Analysis to respond to Caltrans comments

Dear Ms. Brunette:

This report presents the results of the vehicle queuing analysis conducted by Dowling Associates for the Richards Boulevard corridor. This work was undertaken to respond to Caltrans concerns regarding the likelihood that the Gateway/Olive Drive Specific Plan traffic may back-up and/or adversely effect the I-80 freeway ramps. The analysis area includes Richards Boulevard between the EB-I-80 ramp intersection and First Street. Four signalized intersections along the Richards Boulevard corridor were included: Richards Boulevard at First Street, Richards Boulevard at Olive Drive, Richards Boulevard at the EB I-80 ramps and First Street at D Street (future conditions only). The westbound I-80 off-ramp intersection (unsignalized) was incorporated into the model and simulated as close to the existing operational characteristics as feasible. The overall objective of this work is to respond to the Gateway/Olive Drive Specific Plan EIR comment dated March 20, 1996 from Caltrans District 3. Specifically:

- A queuing analysis of the Richards Boulevard Corridor is necessary, limited to the northbound approaches to the intersections of Richards Boulevard at First Street and Richards Boulevard (south of Olive Drive) at the I-80 offramp. The main purpose of this analysis is to determine how northbound Richards Boulevard queuing would impede I-80 offramp traffic access to Richards, causing offramp queuing.

- Caltrans needs projected traffic numbers for the AM peak period on the shorter west bound diagonal offramp from I-80 to Richards boulevard with the Nishi project at buildout. The traffic projections will help determine the number of additional trips stacking on the I-80 offramp at Richards Boulevard as a result of proposed Gateway/Olive Drive Specific Plan development. Caltrans believes increased I-80 offramp stacking could result from the likelihood of more northbound Richards Boulevard lane change weave movements being attempted from the I-80 offramp intersection to the left turning pocket at West Olive Drive slowing Richards Boulevard through lane traffic. Weave movements and queuing on northbound Richards Boulevard could potentially close off the I-80 offramp traffic access. The FEIR currently discloses that there will be traffic conflicts and additional queuing at the AM peak-hour. However, more specific numerical information is needed. We agree that it is difficult to accurately calculated how the additional trips will split between the

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with offices in Oakland & the San Joaquin Valley

westbound I-80 offramp to Richards Boulevard and the east Olive Drive off ramp to Richards Boulevard. (To the extent that vehicle drivers use the East Olive Drive off ramp, no significant conflicts are anticipated at the Richards Boulevard intersection).

The Highway Capacity Model uses average stopped delay at an intersection to determine the average vehicle level of service. While NETSIM reports many operational characteristics, the most applicable to this analysis are the **maximum** number of queued vehicles and the **longest** delay in second per vehicle on each approach. The analysis was conducted for the weekday AM and PM peak-hours. For each scenario, the signalization within the corridor was optimized to reduce delays along Richards Boulevard. A summary of our findings follows.

Conditions Evaluated

Four scenarios were evaluated for this study. These include:

Scenario 1	Existing conditions during the AM and PM peak-hours. These runs were conducted to calibrate the model parameters (i.e., saturation flow rates and startup-delay times).
Scenario 2	Full buildout of the General Plan in 2010 plus the Gateway/Olive Drive Specific Plan using the roadway configuration recommended for the Richards Boulevard widening project and the mitigation measures identified for the Gateway/Olive Drive Specific Plan impacts.
Scenario 3	Full buildout of the General Plan in 2010 without the Gateway/Olive Drive Specific Plan growth. The roadway configuration was changed to reflect the current proposal for the Richards Boulevard widening project. In other words, none of the Gateway/Olive Drive Specific Plan mitigation measures are included.

Summary

A summary of the major findings of this analysis follow. Further details are provided after the summary. The table below provides a quick overview of the most important points of the traffic modeling. Scenario 1 represents the existing condition. This provides a baseline for comparison purposes.

TABLE 1
TRAF/NETSIM RESULTS

	SCENARIO		
	1	2	3
	AM/PM	AM/PM	AM/PM
Does the scenario result in obstruction of the WB I-80 off ramp at peak periods?	Yes	Yes	Yes
How long is queue on off ramp? Note #1	1/1	5/3	3/4
Of ramp queue, number to weave to W Olive turn lanes? Note #2	1/1	4/2	2/3
Delay on southbound E Street at First Street (seconds). Note #3	71/84	427/192	76/95
Delay on westbound First Street at Richards (seconds). Note #3	83/281	379/264	76/65
Delay on northbound Richards at West Olive Drive (seconds). Note #3	10/8	16/16	8/9
Delay on eastbound Olive Drive at Richards (seconds). Note #3	40/77	51/179	38/43
Delay on westbound Olive Drive at Richards (seconds). Note #3	32/35	168/60	51/40
Delay on southbound Richards at Olive Drive (seconds). Note #3	11/10	20/24	9/12
Delay on southbound D Street at First Street (seconds). Note #3	10/7	54/161	45/51

Note 1 - 5 cars are equal to 10 percent of the ramp length.
Note 2 - These results are estimated from visually observing the TRAF/NETSIM simulation.
Note 3 - The maximum delay time assumes that no vehicles choose alternate routes.

- The conditions which exist today, that is, excessive queues and delays along Richards Boulevard between I-80 and First Street are generally mitigated under Scenarios 2 and 3.
- The operational problems that do occur are associated with delays and vehicle queues on the side-street approaches. The longest delays occur on southbound E Street and westbound First Street at Richards Boulevard and on both side-street approaches of Olive Drive at Richards Boulevard (see table). The delay is 7 minutes at its worst with 16 vehicles experiencing the delay.
- The implementation of the Gateway/Olive Drive Specific Plan impacts the performance of all of the above side-street approaches. The side-street delays are at least twice as great in most cases.
- To directly address the Caltrans comment, the worst vehicle queues occur on the westbound off-ramp with the implementation of the Gateway/Olive Drive Specific Plan. Under that condition, about 5 vehicles queue in the AM and 3 during the PM peak-hours. Most of these vehicles, about 75 percent, estimated from observation of the NETSIM simulation, are stopped to secure a gap to make the left turn into westbound Olive Drive at Richards Boulevard.

Scenario 1 - Existing 1996 Condition

Under the 1996 existing condition, the Richards Boulevard Corridor is congested and excessive vehicle queues occur during both the AM and PM peak-hours. Northbound queues on Richards Boulevard at First Street cause vehicles to back-up into the Olive Drive intersection. This condition causes vehicle queues back towards the I-80 overcrossing. The westbound I-80 off-ramp is blocked during portions of the peak-hour, however, the number of vehicles queued on the ramp is only 1 in the AM peak-hour and 1 during the PM peak-hour. The southbound approach of E Street and the westbound approach of First Street at Richards Boulevard both have excessive queuing and delays during both peak-hours. The NETSIM model reflects these observed traffic characteristics.

Scenario 2 - General Plan Plus Gateway/Olive Drive Specific Plan

Under both the AM and PM peak-hours, the Richards Boulevard corridor operates with acceptable delays. Queues occur on Richards Boulevard between the I-80 westbound ramp and Olive Drive that block traffic. This condition causes queuing on the westbound off-ramp. The maximum queue on the westbound off-ramp from I-80 is 5 vehicles in the AM and 3 vehicles during the PM peak-hours. These queue lengths are not long as they represent only 10 percent (about 100 feet) of the length of the ramp. While not a direct output of the model, the queues on the westbound off-ramp were observed, during the simulation of the corridor, to be caused by vehicles exiting the freeway wanting to turn left into West Olive Drive. This condition holds for both the AM and PM peak-hour periods. Excessive queues and delays occur on both side-street approaches of Olive Drive at Richards Boulevard and the southbound E Street and westbound First Street approaches at Richards Boulevard.

Scenario 3 - General Plan Without Gateway/Olive Drive Specific Plan

Under both the AM and PM peak-hours, the Richards Boulevard corridor operates with acceptable delays. Queues occur on Richards Boulevard between the I-80 westbound ramp and Olive Drive that can potentially block traffic. This condition causes queuing on the westbound off-ramp. The maximum queue on the westbound off-ramp from I-80 is 3 vehicles in the AM and 4 vehicles during the PM peak-hours. This condition holds for both the AM and PM peak-hour periods. Queues occur on both side-street approaches of Olive Drive at Richards Boulevard and southbound E Street and westbound First Street at Richards Boulevard; however, these queues are much short than under Scenario #2.

The longest queue occurs during the PM peak-hour on northbound Richards Boulevard between First Street and Olive Drive (29 vehicles). With the addition of the Gateway/Olive Drive Specific Plan traffic, all of the approaches within the Richards Boulevard corridor will experience increased vehicle queues. Added delays will result for through and side-street traffic. This includes the northbound queue between the I-80 off-ramp and Olive Drive. This condition will result in increased queues on the westbound off-ramp.

Conclusions

- The current signalization program for the Richards Boulevard corridor maintains satisfactory traffic movement along Richards Boulevard and First Street west of E Street. The current configuration requires westbound First Street and southbound E Street at Richards Boulevard to experience excessive queues and delays.

- With the full buildout of the General Plan and the Gateway/Olive Drive Specific Plan, the Richards Boulevard corridor operates at levels of service consistent with those identified in the Gateway/Olive Drive Specific Plan Draft EIR, however, the side-street approaches at First Street and Olive Drive have excessive queues and delays.

- Without the Gateway/Olive Drive Specific Plan, the side-street delays are reduced to existing or better conditions.

- Finally, because excessive queues do not occur along Richards Boulevard, the level of service findings in the EIR are supported by this expanded analysis. Side street queues will be increased beyond the existing condition but not to a significant level, while the delays may be excessive.

Traffic Reduction Measures

To reduce the queues on the side-street approaches of Richards Boulevard requires reducing the green time for Richards Boulevard traffic. While this improves the side-street performance, it degrades to unacceptable levels the traffic performance along Richards Boulevard between First Street and I-80. The effects of the degradation in performance would result in longer queues along Richards Boulevard which would block the westbound off-ramp to I-80 and other the unsignalized side-street approaches which access Richards Boulevard. Therefore, the current signal phasing plan was maintained for the future condition. Other potential traffic reduction strategies would include:

- Full implementation of the measures found in the TDM Alternative of the Richards Boulevard DEIR (i.e., closure of UCD access from First Street).
- Reduction in the amount of allowable development for the Nishi property within the Gateway/Olive Drive Specific Plan.
- Increase the TDM requirements for Nishi beyond the current TCE policy level of 10 percent.

Should you have questions or desire additional information, please do not hesitate to call.

Sincerely,
Dowling Associates
John N. Dowden
John N. Dowden
Principal

P.S. The following is provided to clarify the modeling procedures selected for this analysis. Two traffic simulation models were used for this study: TRANSYT-7F and TRAF-NETSIM. The TRANSYT-7F model was used to optimize the signal timing within the corridor. The model does not consider queue spill-over from one intersection to the next. For this reason, the TRANSYT-7F model was being used only to develop an optimum signal timing plan for the corridor. TRAF-NETSIM was being used to evaluate queuing within the corridor. The TRAF-NETSIM model can incorporate numerous adjustments to reflect vehicle types, driver behavior and other factors. Without extensive detailed information regarding these factors for the Richards Boulevard corridor, the program default values were used. Under a few conditions such as percentage of trucks (assumed to be about 2-3 percent), the defaults will be reviewed. The models used for this study do not calculate level of service as does the Highway Capacity Manual (HCM) methodologies. The model does not divert vehicles from overly congested intersections. This causes certain intersections (queues) to look worse than what would result in the real world, assuming alternative traffic routes are available.

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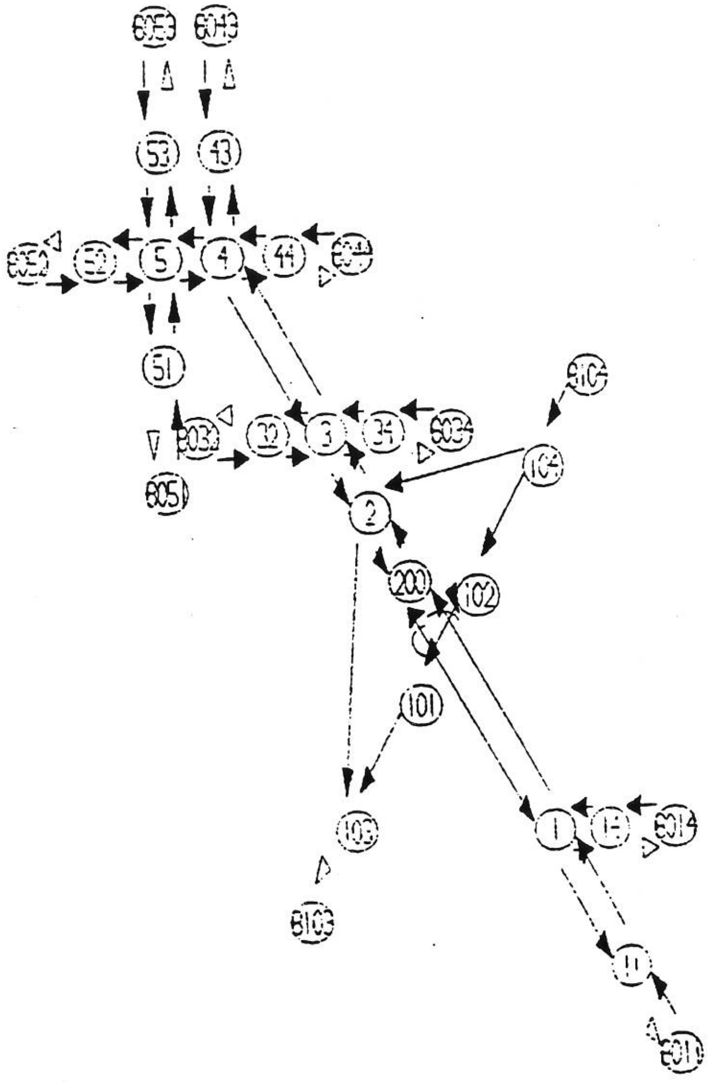
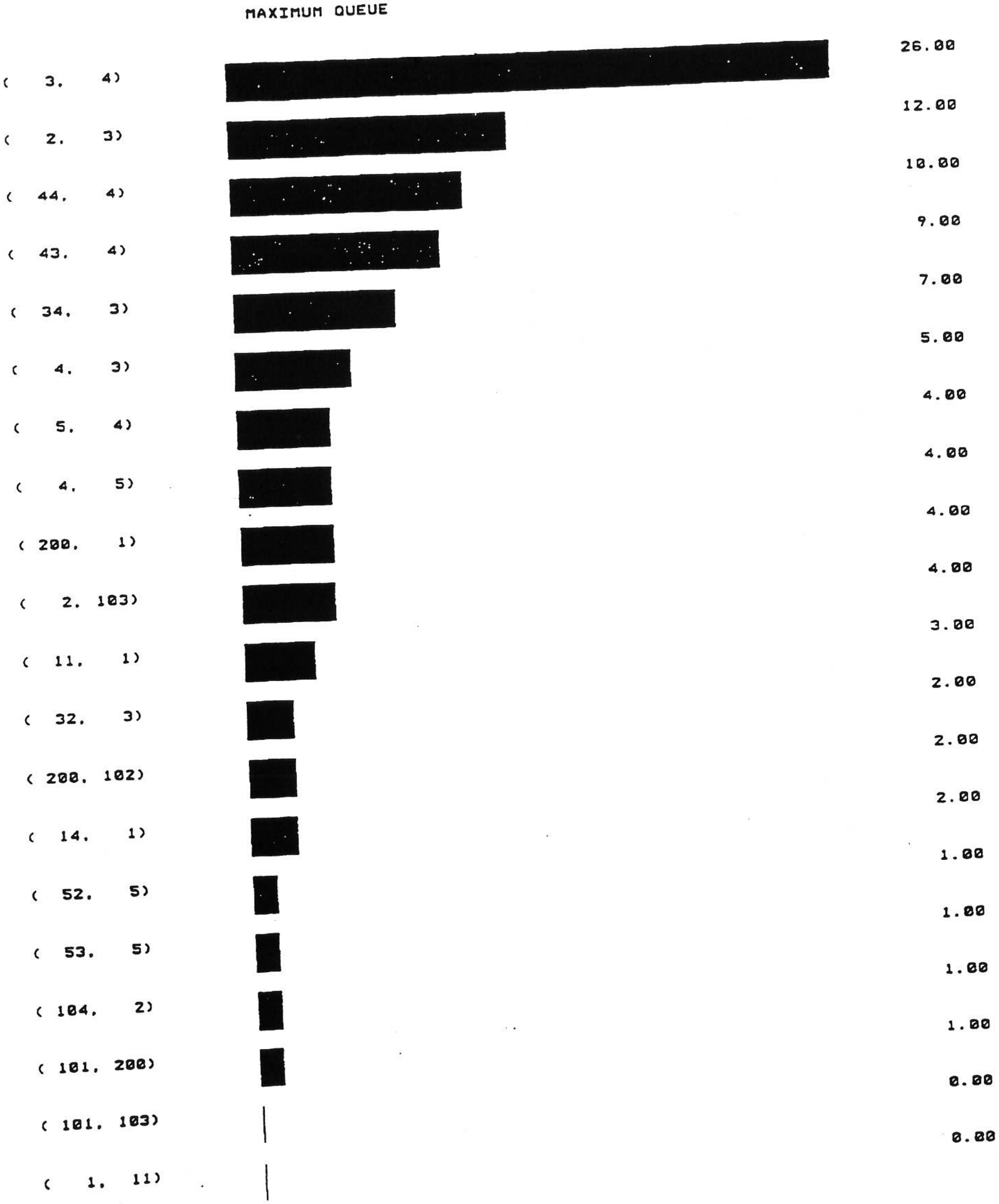


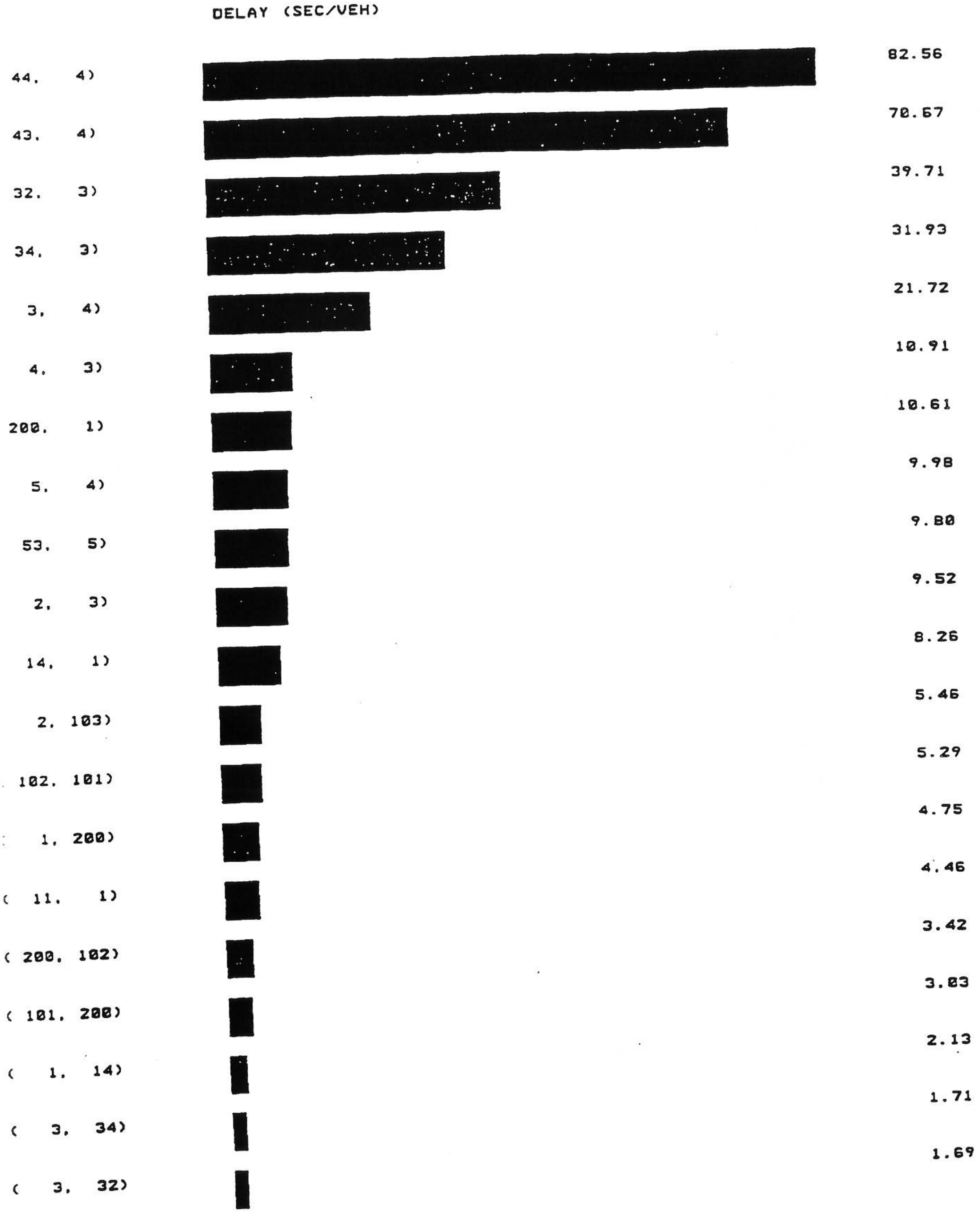
Netsim Network

20 LINKS SORTED BY HIGHEST MAXIMUM QUEUE



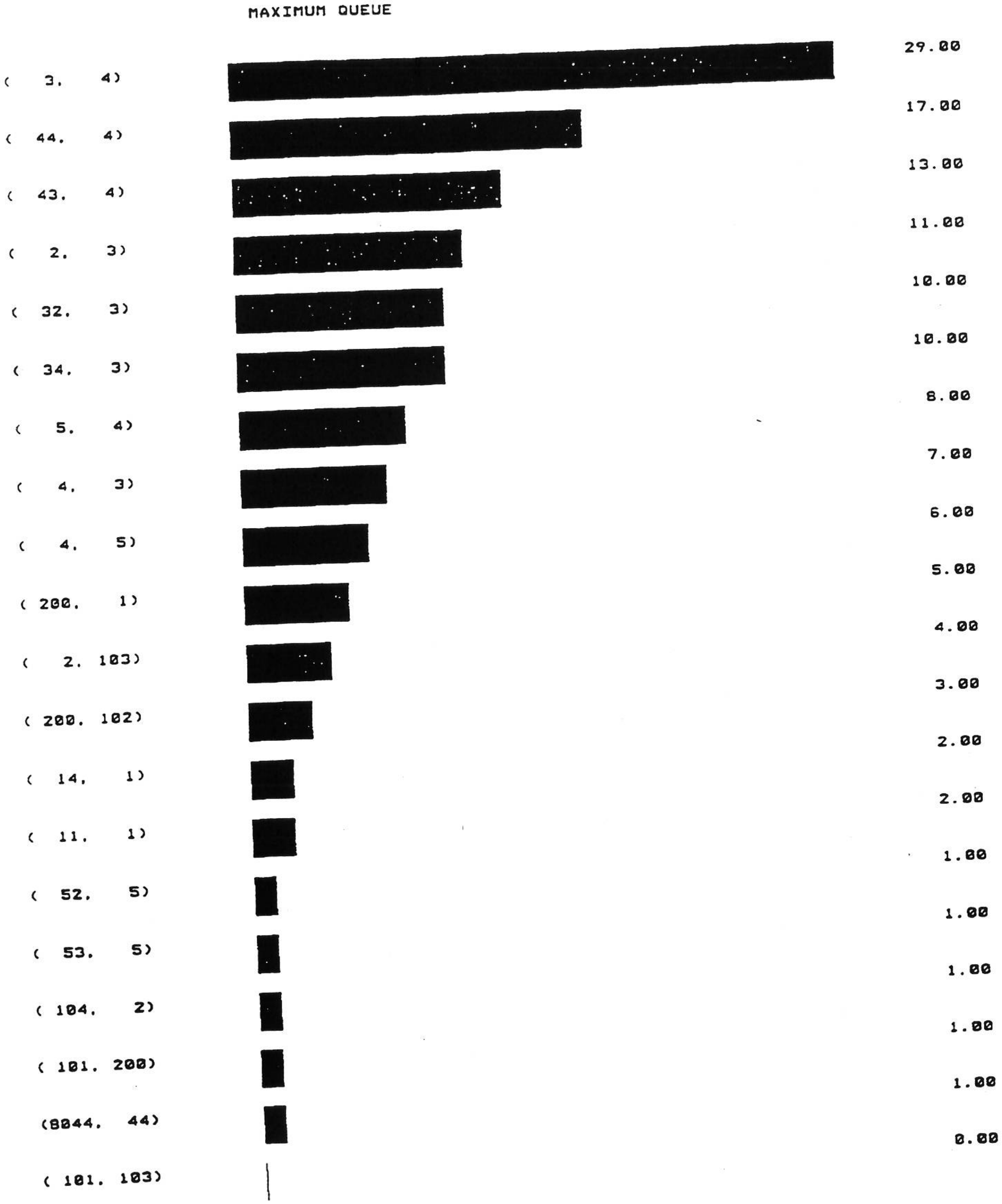
Existing-AM Peak-Hour

20 LINKS SORTED BY HIGHEST DELAY (SEC/VEH)



Existing-AM Peak-Hour

20 LINKS SORTED BY HIGHEST MAXIMUM QUEUE



Existing-PM Peak-Hour

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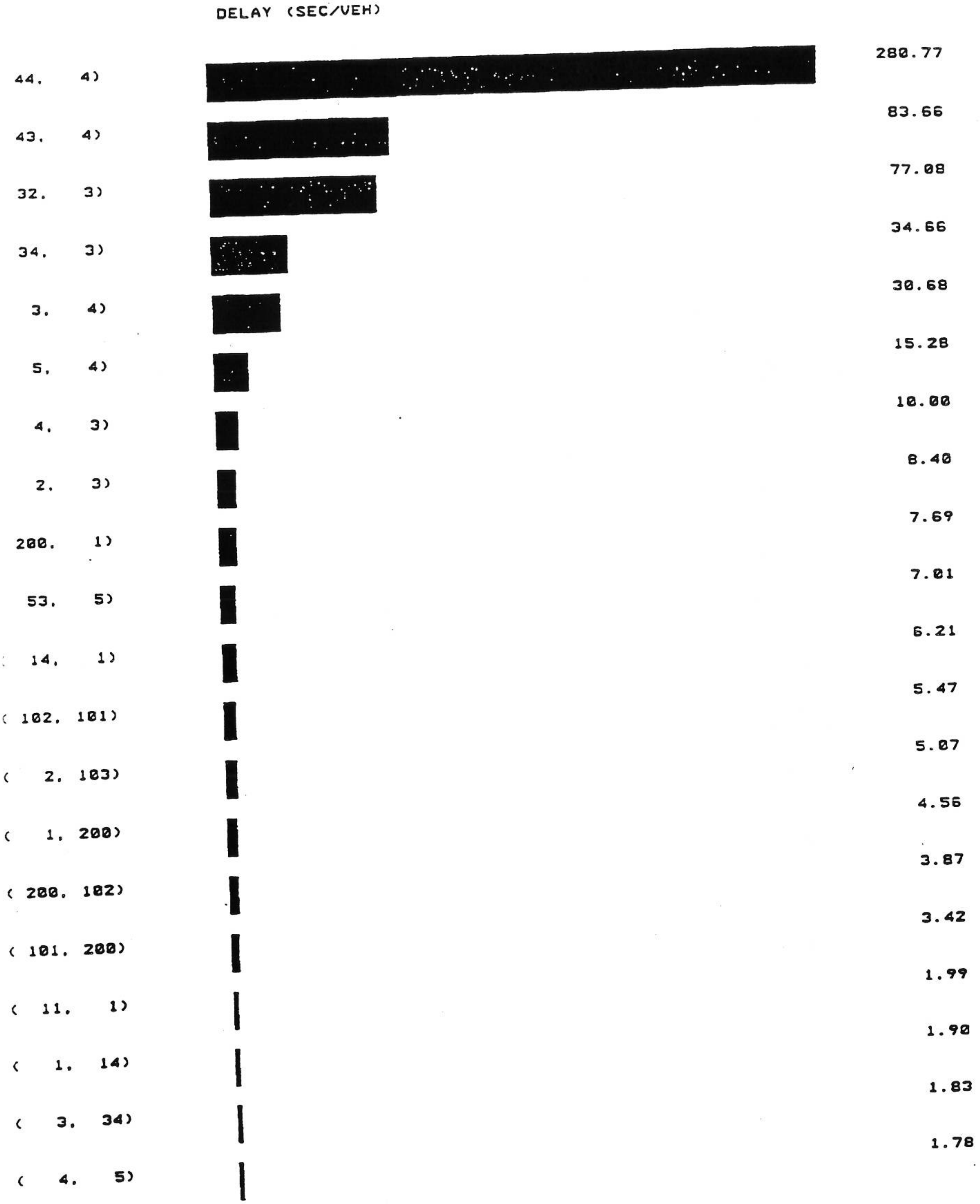
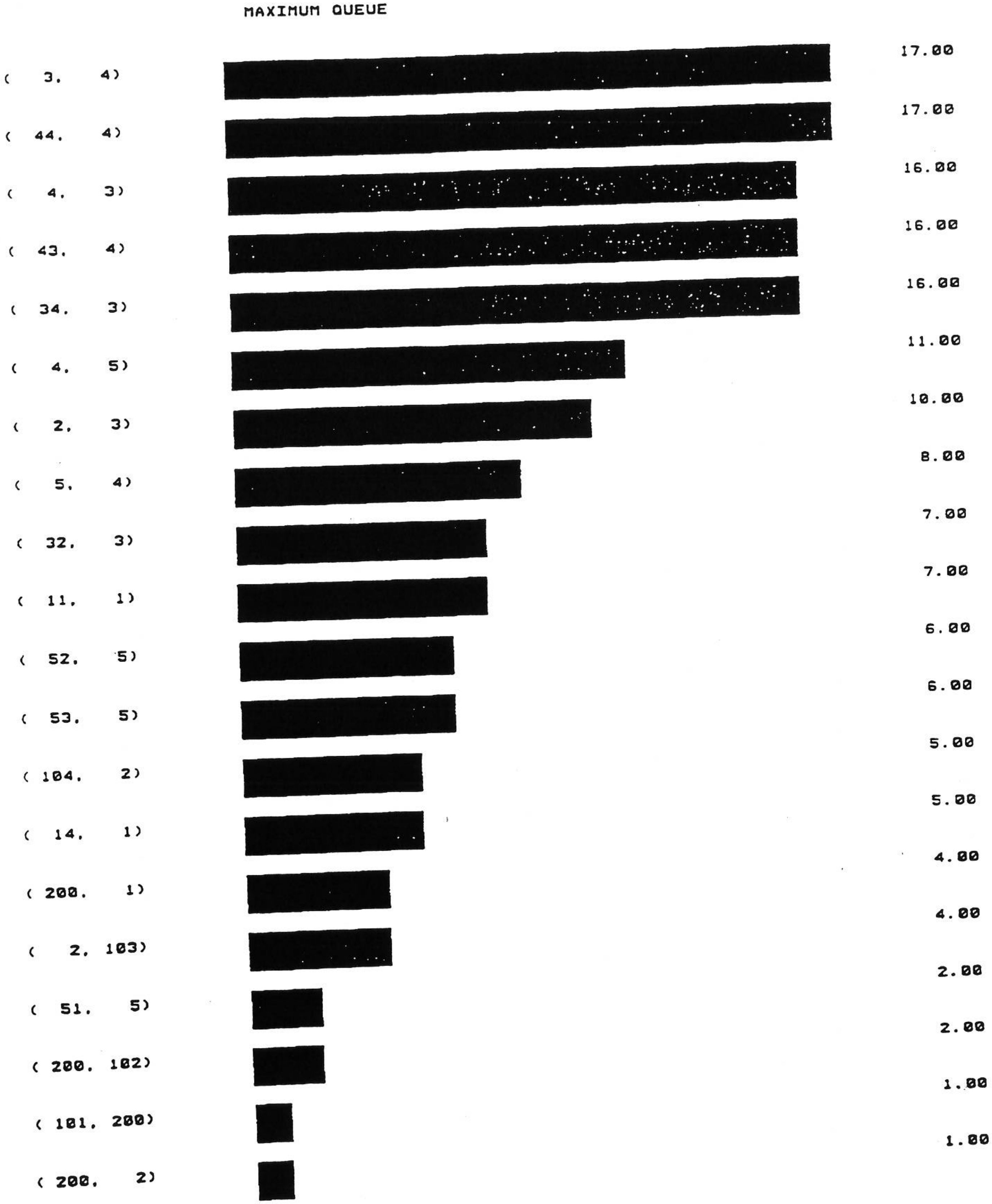


Existing-PM Peak-Hour

20 LINKS SORTED BY HIGHEST MAXIMUM QUEUE



**Full Buildout with Gateway - AM Peak-Hour
(4-lane Richards)**

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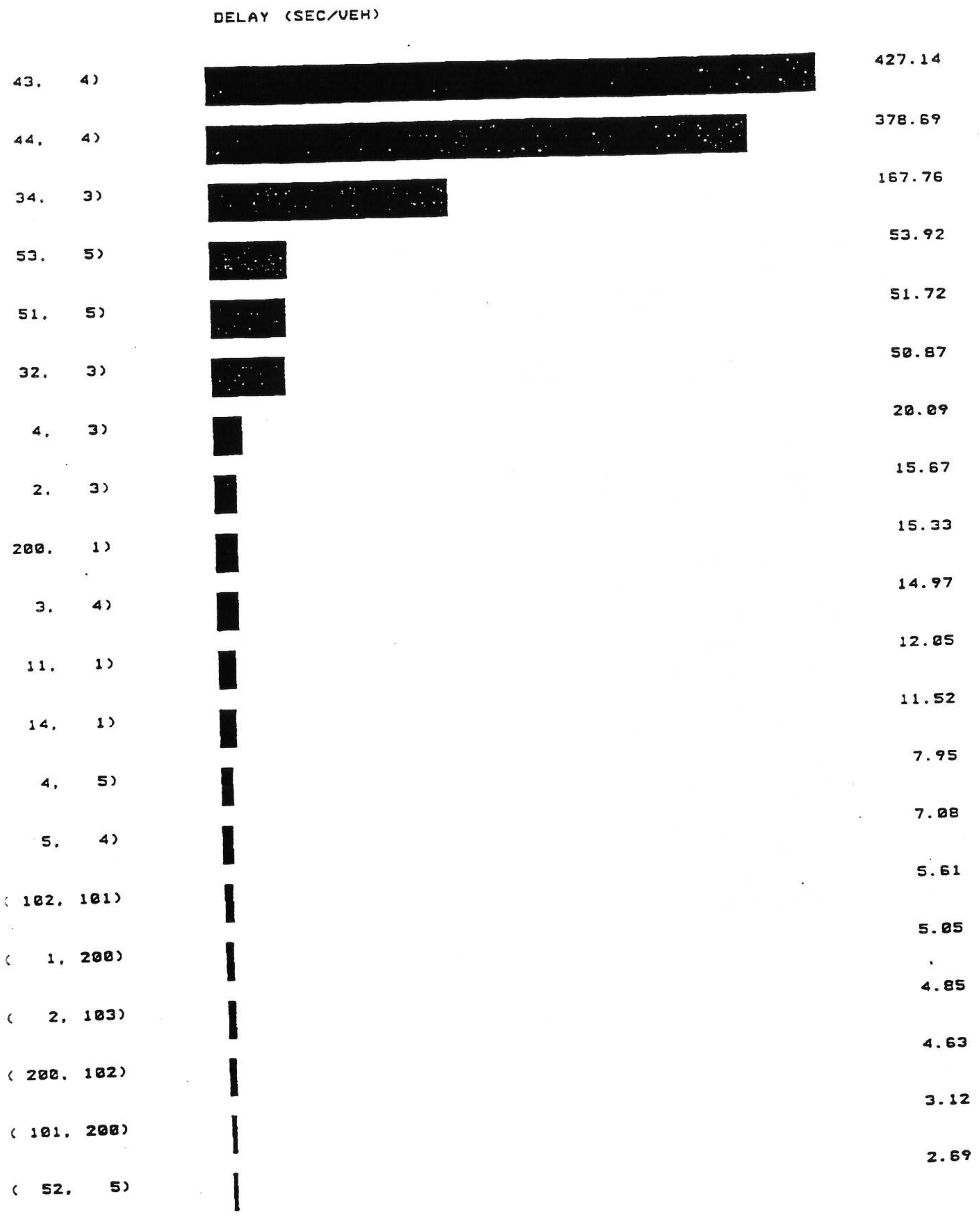
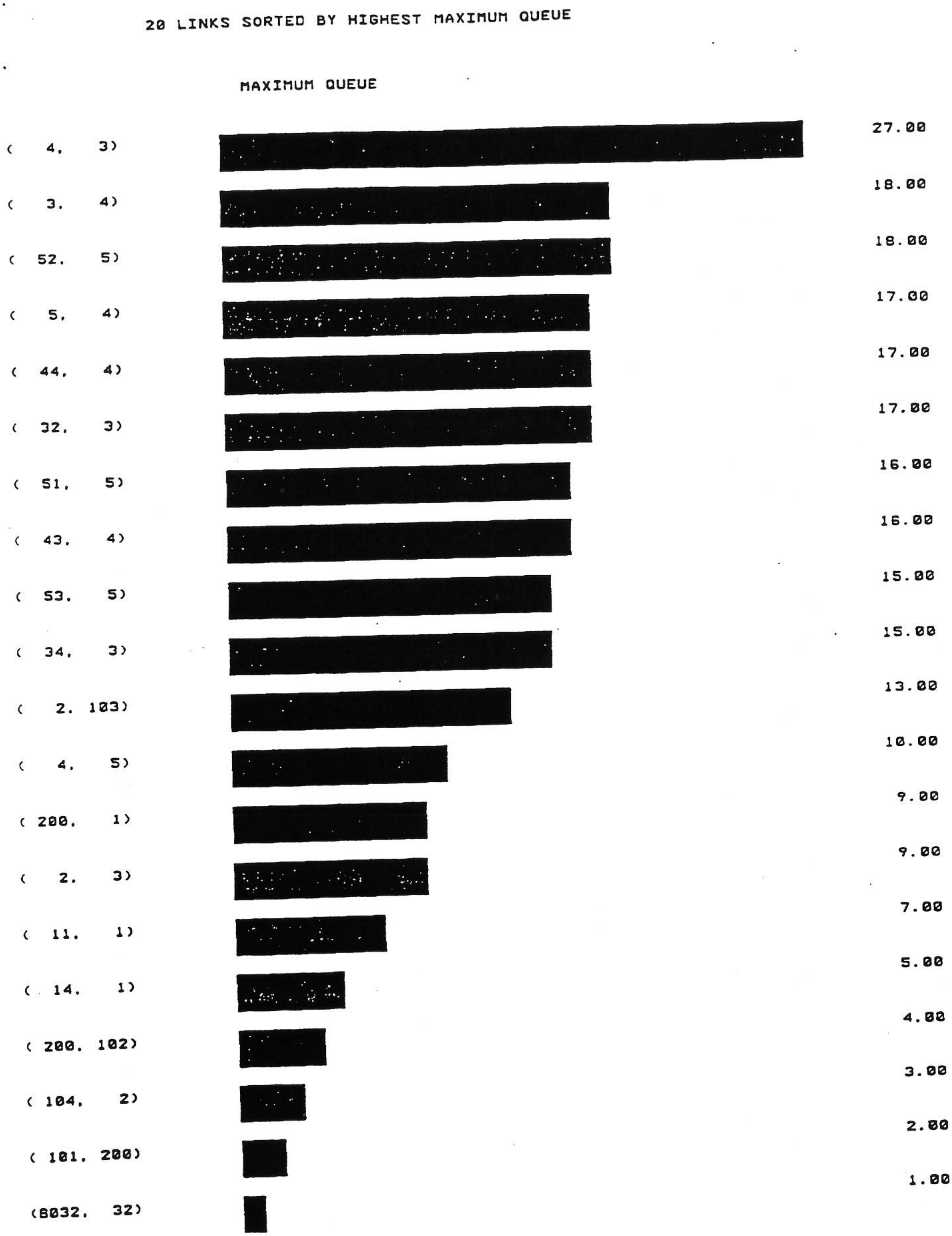
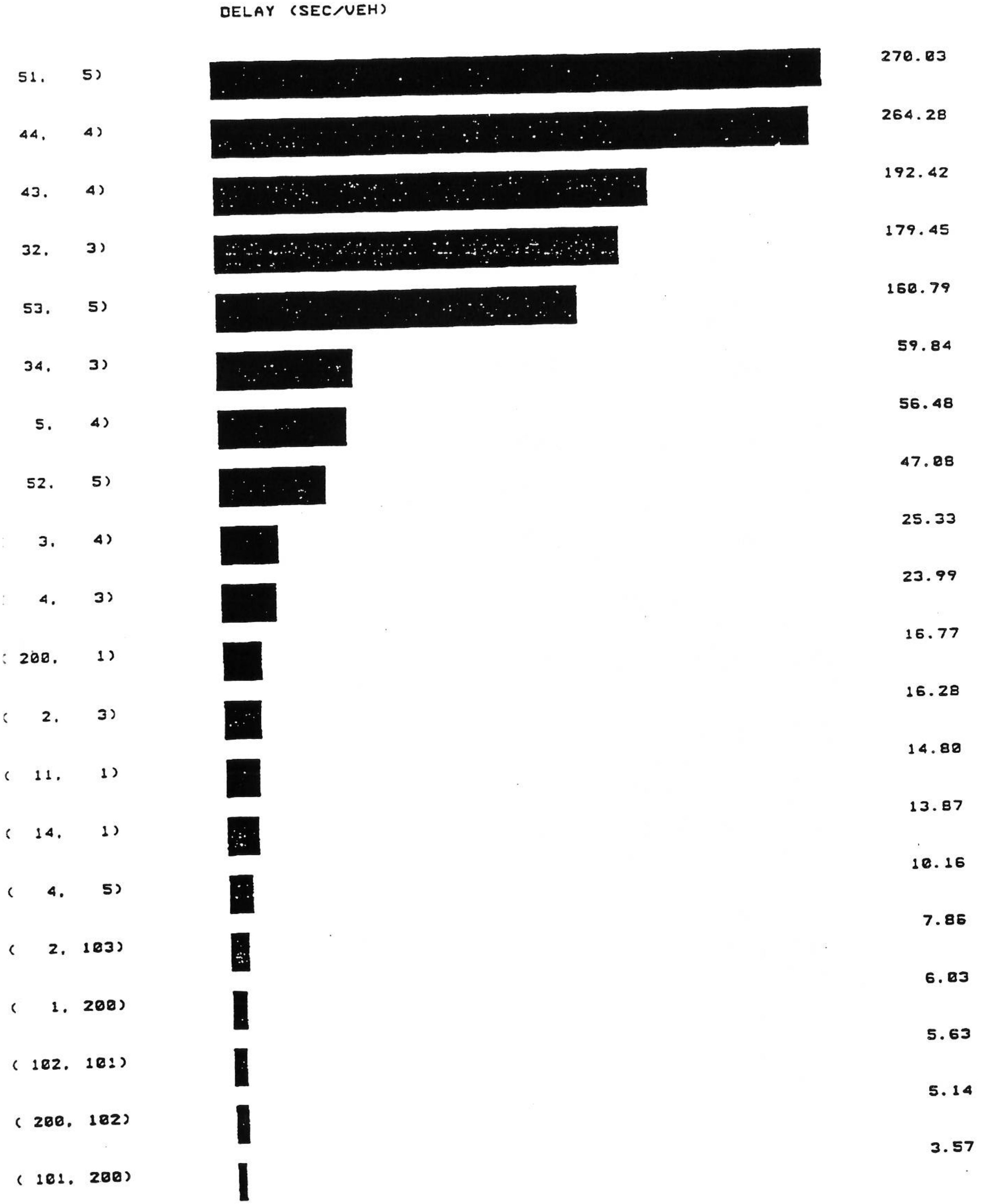


Full Buildout with Gateway - AM Peak-Hour
(4-lane Richards)



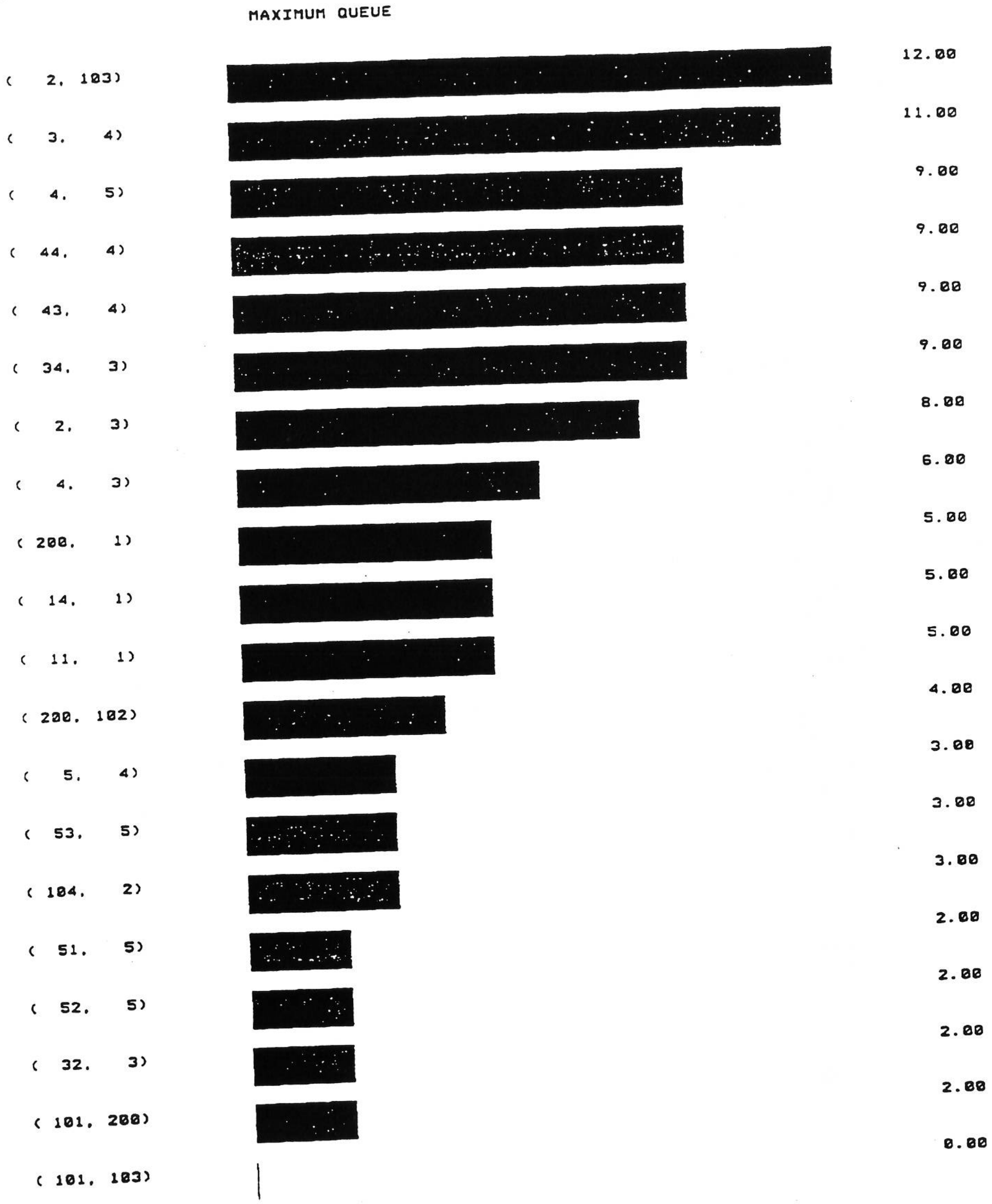
Full Buildout with Gateway - PM Peak-Hour (4-lane Richards)

20 LINKS SORTED BY HIGHEST DELAY (SEC/VEH)



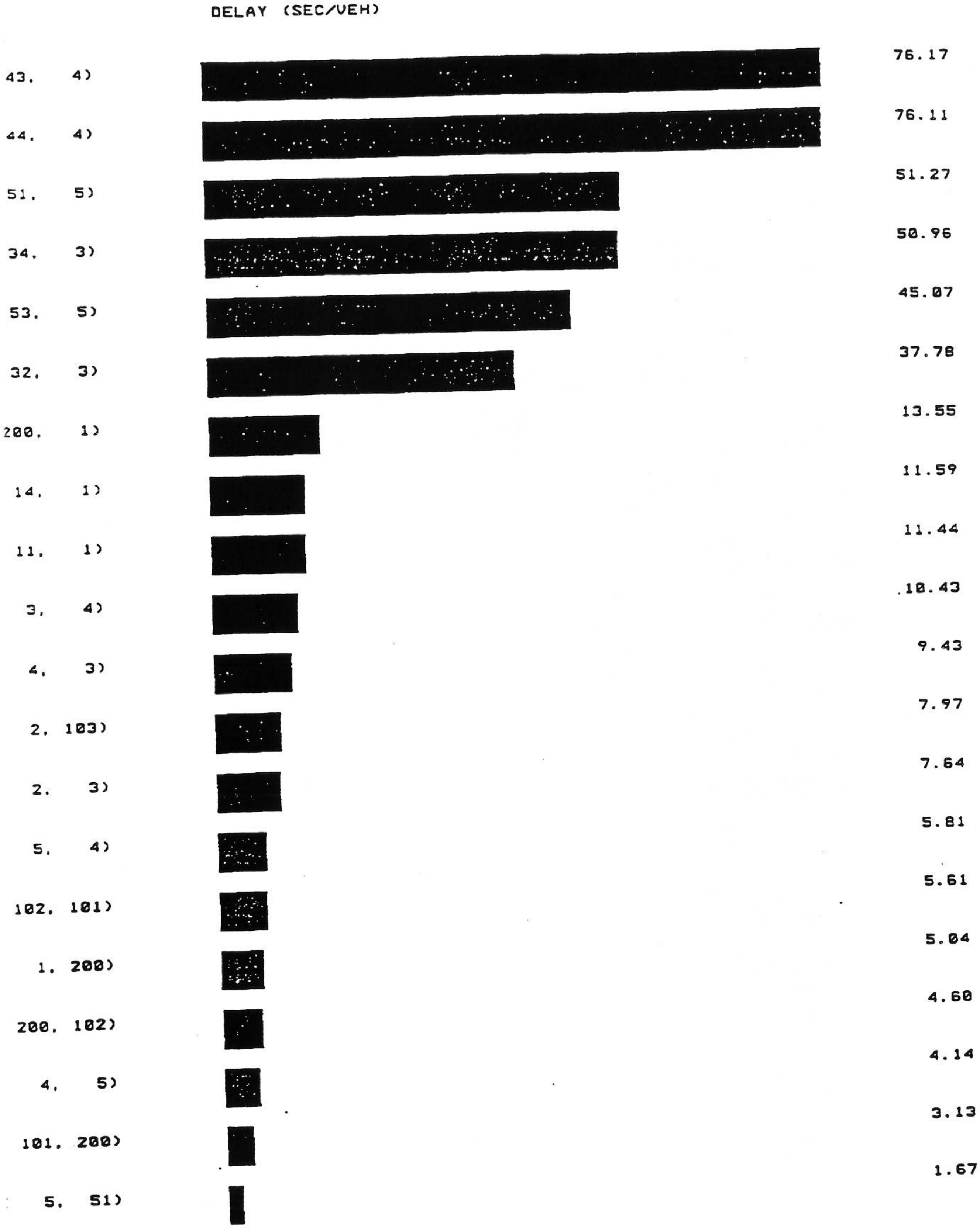
Full Buildout with Gateway - PM Peak-Hour
(4-lane Richards)

20 LINKS SORTED BY HIGHEST MAXIMUM QUEUE



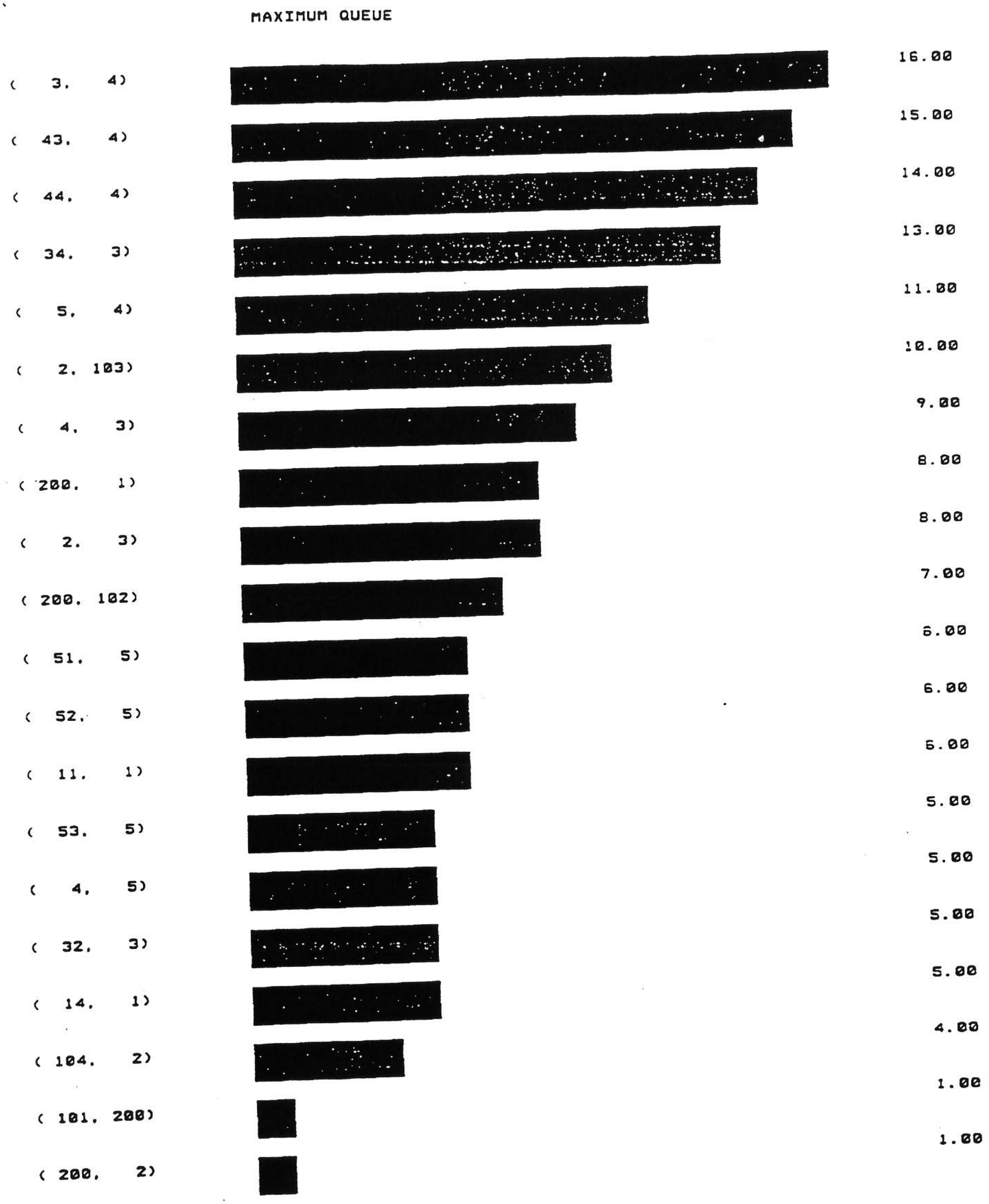
Full Buildout without Gateway - AM Peak-Hour
(4-lane Richards)

20 LINKS SORTED BY HIGHEST DELAY (SEC/VEH)



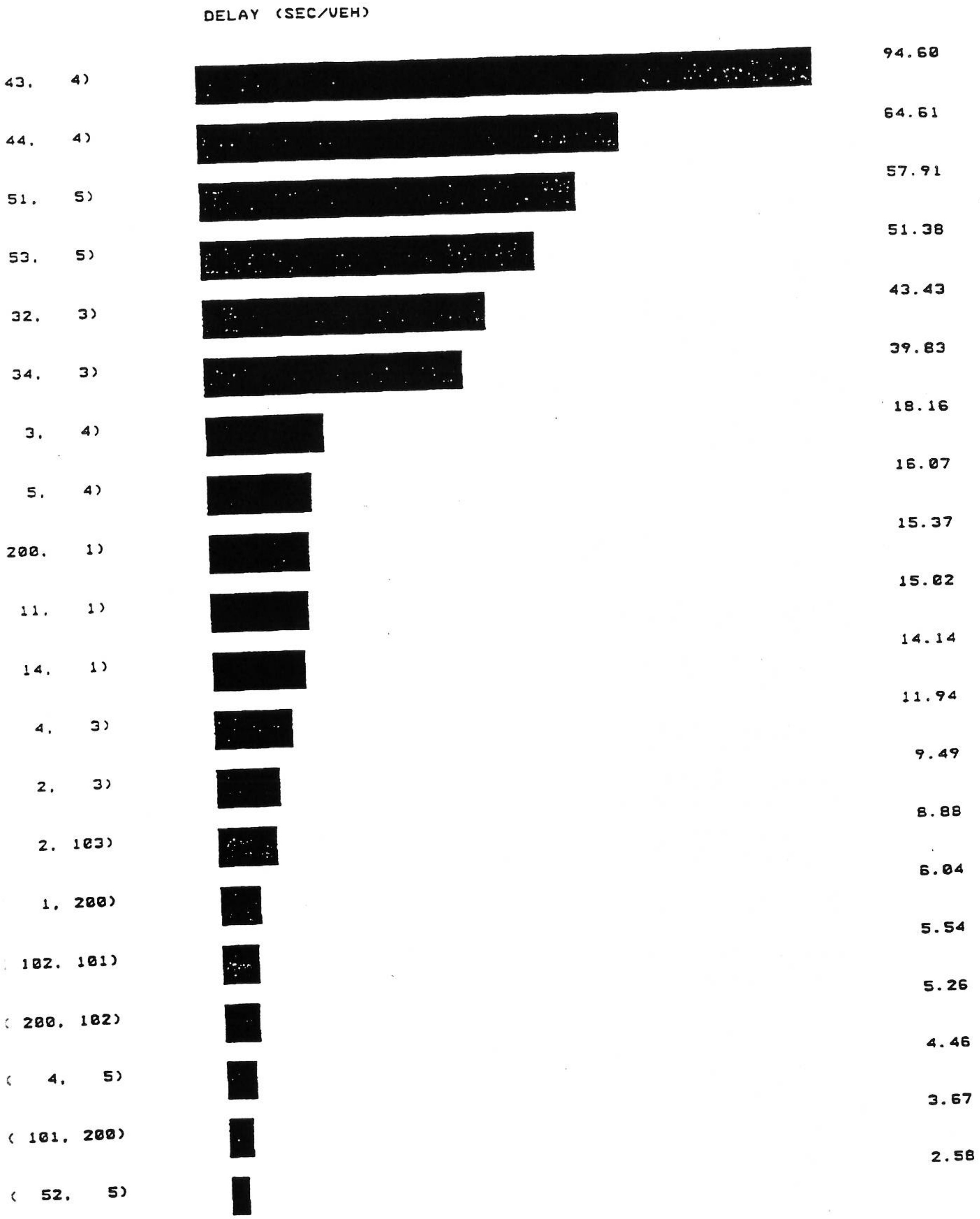
Full Buildout without Gateway - AM Peak-Hour
(4-lane Richards)

20 LINKS SORTED BY HIGHEST MAXIMUM QUEUE



Full Buildout without Gateway - PM Peak-Hour
(4-lane Richards)

20 LINKS SORTED BY HIGHEST DELAY (SEC/VEH)



Full Buildout without Gateway - PM Peak-Hour
(4-lane Richards)

ATTACHMENT 3

Dowling Associates
Transportation Engineering • Planning • Research • Education

April 30, 1996

Mr. Anne Brunette
City of Davis
23 Russell Blvd.
Davis, CA 95616

Dear Ms. Brunette:

You requested our professional judgment on various specific questions as a result of the TRAF/NETSIM modeling work conduced by Dowling Associates for the Gateway/Olive Drive Specific Plan EIR and Richards Boulevard Corridor EIR projects. As you are aware, the TRAF/NETSIM model showed vehicle queues and delays at several intersections along the Richards Boulevard which are now subject to interpretation by the city in the CEQA process. I have provided the following responses to your specific questions:

Does the TRAF/NETSIM model divert vehicle trips to other intersections as a result of congestion? In other words, does it model likely driver behavior?

No. The TRAF/NETSIM model is an simulation model designed to examine the characteristics of interrupted flow on a corridor given specific inputs (i.e., traffic volumes, intersection and roadway geometry and signal phasing and timing) conditions. The model considers both the corridor (major street) and side streets. Normally, the engineer using the model would develop a signal timing scenario, for the entire corridor, that would minimize total delay in the system. For the Richards Boulevard corridor, the amount of traffic along Richards Boulevard is so high that optimizing the signal timing to reduce side street delays would result in creating failure (excessive queuing) on Richards Boulevard. Therefore, the results of our work reflect a compromise. That is, the signalization and timing characteristics input into the TRAF/NETSIM model produce optimum conditions along Richards Boulevard while creating the least impacts on the side streets. Regardless, no provision was made in the analysis to divert traffic because of excessive side street delays to other routes.

The TRAF/NETSIM model can not model the dispersion, but rather shows the worse potential impact to the side streets, as if drivers were forced to remain on the congested routes with no alternatives. In the model, that was prepared for the City of Davis, this occurred at, southbound E Street at First, westbound First Street at Richards, and westbound Olive Drive at Richards.

Is the model typically used to project future traffic conditions based upon long-term land use build-out?

No. It models at a very fine level of detail and is designed to simulate complex operations under known traffic count conditions. The model is one of a series of tools which can be used to evaluate the performance of a specific set of traffic volumes and signalization parameters (phasing, timing and progressions) in terms of resultant vehicle queues, delays, and other utilization factors.

Does the modeling represent a worse case analysis?

Yes. The model results are the maximum queues and delays that will occur during the period being simulated. For this work, two periods were evaluated: the AM and PM peak-hours. The numbers presented in the model results are worse case. For instance, in the AM, when workers are driving to the Gateway project the greatest delay during the peak-hour is seven minutes on E Street only if drivers do not alter their driving habitats to avoid the congestion, which we know intuitively they will. The AM and PM peak-hours are the times during the day when congestion is highest and delays are at the greatest levels. The peak-hour represents the times when the greatest number of vehicles are trying to use Richards Boulevard. The other portions of the day, the traffic volumes are less which results in better levels of service, reduced amounts of delay and fewer queued vehicles.

The peak-hours are selected for analysis based upon General Plan level of service standards. The TRAF/NETSIM model was used to determine if the traffic congestion at one intersection would adversely effect the operations of an adjacent up-stream intersection. Table 4-10 of the DEIR demonstrates the average peak-hour levels of service that will occur at the effected intersections within the corridor. As the TRAF/NETSIM analysis found that none of the traffic would adversely impact any of the adjacent up-stream intersections, the level of service values published in the EIR remain valid. The TRAF/NETISM delay and queuing information reflect the worse case (maximum peak condition) that may occur during the entire peak-hour. Both pieces of information are valuable in that one shows the worse case (maximum queues and delays) while the other shows the average (DEIR Table 4-10) performance for the entire intersection during the peak-hour. The average is within the city identified acceptable level of service.

How accurate is the TRAF/NETSIM model for determining impacts to side streets?

The TRAF/NETSIM model is a powerful tool for operational analysis. As used for the Richards Boulevard Corridor analysis, the model is based on traffic projections and planned facilities rather an existing conditions. The model results are only as good as the projections. Generally, traffic counts taken for the existing condition can vary up to ± 10 percent. In the real world, the actual future conditions and resultant peak-hour traffic volumes will be dependent upon actual growth and driver travel patterns. If capacity is added to other routes in the City, travel patterns can change. These changes may divert traffic to alternative routes. Further, if excessive congestion does occur along side street approaches, drivers may choose to stagger their work hours, car pool or select other routes to use. In other words, the input data for the TRAF/NETSIM model is only as good as the traffic projections. Generally, travel forecasting is considered very respectable when the errors are within 10 percent.

Can Level-of-Service (LOS) be derived from the TRAF/NETSIM model?

The TRAF/NETIMS model, as opposed to the Highway Capacity Manual, **does not** calculate intersection level of service. The level of service of individual approaches can be determined from TRAF/NETSIM output data if specific factors are applied to the delay information published by the NETSIM computer model. The resultant level of service, for the approach, would reflect the average condition through the simulation period (i.e., peak-hour). Based upon the number of assumptions used to develop the model for the future condition, it is not advisable to use the model output to determine LOS.

LOS standards are typically a policy level decision. Currently, the City of Davis uses a LOS D as the CEQA threshold for establishing significance. Under the Highway Capacity Manual methodology, the level of service is an average of the various legs of the intersection over the peak-hour. This is the tool the City of Davis (and most cities) use as the policy indicator for traffic analysis and the need for improvements. Looking at each leg of every intersection with all operational aspects modeled is an enormous and expensive undertaking. And, it could lead to recommendations for roadway improvements and geometry far in excess of the day-to-day needs.

To determine future roadway conditions and roadway requirements, the City of Davis used a travel demand forecasting model termed MINUTP. That model projected average daily traffic conditions throughout the City and was used to establish roadway level of service under the buildout of the General Plan. Using the City of Davis travel demand forecasting model, the average level-of-service for roadways would be met along the Richards Corridor. The expected intersection levels are more properly determined for operational and planning purposes by using the Highway Capacity Manual methodology as done in the EIR. The results of the TRAF/NETSIM model should only be used to identify the resultant operational characteristics of the corridor and side streets given a specific set of traffic volumes, roadway and intersection geometry, and planned signal coordination and phasing.

What is the effect of requiring a 20 percent reduction (i.e., Transportation Demand Management - TDM policy) in peak-hour trips from the Gateway Nishi project?

This option was not run in our model; however, the following effects in traffic flows could result from this kind of policy change. The traffic using the side streets would be reduced to and from the Nishi project. This condition would reduce the amount of time vehicles must wait on the side street to enter the Richards Boulevard Corridor. The result, assuming no other changes in travel patterns, would be reduced queues and delays on the side streets, specially, Southbound E Street, westbound First Street (between F and E Streets) and on both approaches of Olive Drive at Richards Boulevard.

Has such a TDM percentage been achieved?

Yes, but on a limited basis. The Fireman's Fund development in Novato, California and Bishop Ranch in Pleasanton both have achieved higher than normal TDM level (10 percent TDM is the goal generally achieved within the Bay Area).

When does TDM work best?

The most successful TDM programs are directed at employment centers rather than the residential areas. Large employers, with 100 or more employees, have been most successful. These sites can manage their work force and provide incentives to a higher number of employees (in-house) than can be achieved by smaller stand-alone employers. Large office developments, such as Bishop Ranch, have Transportation Demand Management coordinators funded by the tenants associations, within the development, who can cross individual firm boundaries and encourage ride-sharing and other TDM measures within the overall development.

What TDM techniques work best?

While various options for reducing single occupant vehicles (SOV) are available, carpooling works best to reduce the total number of vehicles accessing a site or planning area (such as the downtown core).

Shifting the hours that employees arrive and depart work is the next best thing to encourage. These strategies termed, staggered hours or flex-time, can substantially help in diverting traffic to other times of the day when the overall traffic using the street system is less. This diversion produces two effects: first, the levels of peak-hour traffic are reduced with improvements in the levels of service, and second, a more efficient use of the area roadways is achieved.

Sincerely,
Dowling Associates

John N. Dowden
John N. Dowden
Principal

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ATTACHMENT 4

HIGHWAY CAPACITY MANUAL

Special Report 209

TRANSPORTATION RESEARCH BOARD
National Research Council
Washington, D.C. 1985

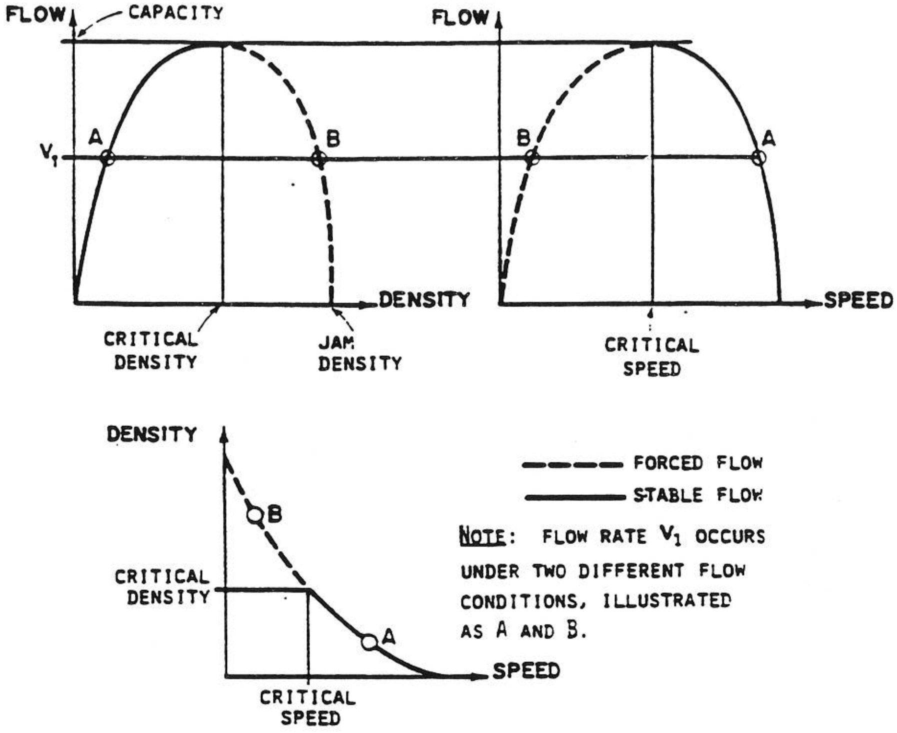

Figure 1-1. Relationships among speed, density, and rate of flow on uninterrupted flow facilities.

is considered to be unstable. This represents forced or breakdown flow. The low-density, high-speed side of the curves is the stable flow region. It is this flow region on which capacity analysis focuses. Levels-of-service A through E are defined on the stable side of the curves, with the maximum flow boundary of level-of-service E placed at capacity for uninterrupted flow facilities.

Characteristics of Interrupted Flow

Interrupted flow is far more complex than uninterrupted flow. Flow on an interrupted flow facility is usually dominated by points of fixed operation, such as traffic signals, STOP, and YIELD signs. These all operate quite differently, and have differing impacts on overall flow. Chapter 9 contains a detailed discussion of flow at signalized intersections, and Chapter 10 contains similar information for STOP and YIELD signs. Chapter 11 discusses arterial flow.

1. *The concept of green time at signalized intersections*—The most significant source of fixed interruptions on interrupted flow facilities is traffic signals. At traffic signals, flow in each movement or set of movements is periodically halted. Thus, movement on a given set of lanes is only possible for a portion of total time, because the signal prohibits movement during some periods. Only the time during which the signal is effectively green is available for movement. For example, if one set of lanes at a signalized intersection receives a 30-sec green phase out of a 90-sec total cycle, only 30/90 or one-third of total time is available for movement on the subject lanes. Thus, out of each hour of real time, only 20 min are available for flow on the lanes. If the lanes could accommodate a maximum rate of flow of 3,000 vph when the signal is green, they could accommodate a total rate of flow of only 1,000 vph, as only one-third of each hour is available as green.

As signal timings are subject to change, it is convenient to express capacities and service flow rates for signalized intersections in terms of "vehicles per hour of green" (vphg). In the previous example, the maximum rate of flow would be stated as 3,000 vphg. This can be converted to a real-time value by multiplying by the ratio of effective green time to cycle length for the signal.

2. *Saturation flow rate and lost times at signalized intersections*—At signalized intersections, traffic on all lanes will be periodically stopped. When the signal turns green, the dynamics of starting a standing queue of vehicles must be considered. Figure 1-2 illustrates a queue of vehicles stopped at a signal. When the signal turns green, the queue begins to move. The headways between vehicles can be observed as they cross the curb line of the intersection. The first headway would be the elapsed time, in seconds, between the initiation of the green and the crossing of the rear of the first vehicle over the curb line. The second headway would be the elapsed time between the crossing of rear of the first and second vehicles over the curb line. Subsequent headways would be similarly measured.

The driver of the first vehicle in the queue must observe the signal change to green and react to the change by taking his/her foot off the brake, and accelerating through the intersection. The first headway will be comparatively long as a result of this process. The second vehicle in the queue follows a similar process, except that the reaction and acceleration period can partially occur while the first vehicle is beginning to move. The second vehicle will be moving faster than the first as it crosses the curb line, because it has an additional vehicle length in

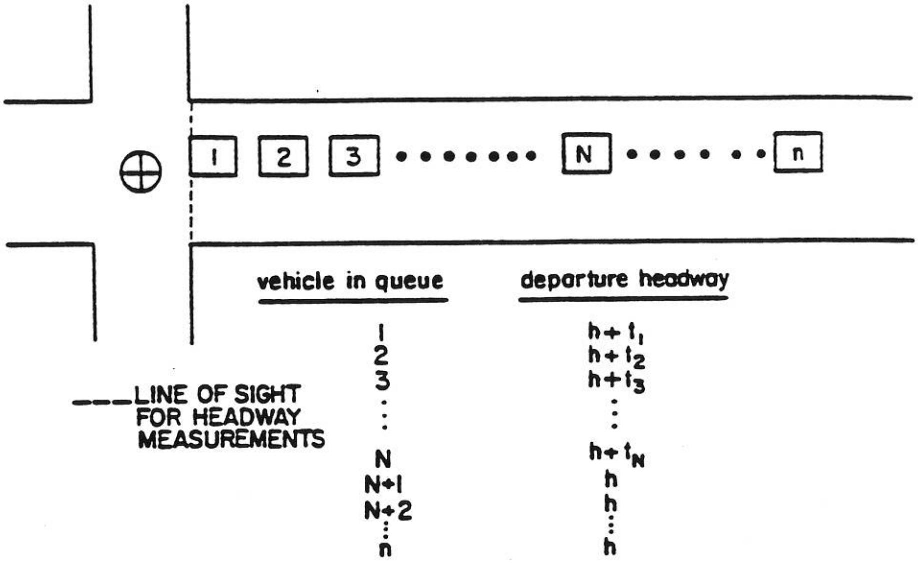

Figure 1-2. Conditions at a traffic interruption.

which to accelerate. Its headway will still be comparatively long, but is generally less than that of the first vehicle. The third and fourth vehicles follow a similar procedure, each achieving a slightly lower headway than the preceding vehicle. After some number of vehicles, "N" in Figure 1-2, the effect of the start-up reaction and acceleration has dissipated. Successive vehicles now move through past the curb line at their desired speed as a uniform moving queue until the last vehicle in the original queue has passed. The headway for these vehicles will be relatively constant.

In Figure 1-2, this constant average headway is denoted as "h" and is achieved after "N" vehicles. The headways for the first N vehicles are, on the average, greater than h, and are expressed as $h + t_i$, where t_i is the incremental headway for the ith vehicle due to the start-up reaction and acceleration. As i increases from 1 to N, t_i decreases.

Figure 1-3 shows a conceptual plot of headways measured as described previously. For purpose of illustration only, N is assumed to = 6, i.e., the start-up and acceleration increment disappears after the 6th vehicle.

The value h is defined as the *saturation headway*, and is estimated as the constant average headway between vehicles which occurs after the 6th vehicle in the queue and continues until the last vehicle in the initial queue clears the intersection. The saturation headway is the amount of time consumed by a vehicle in a stable moving queue as it passes through a signalized intersection on the green, assuming that a continuous queue of vehicles is available to move through the intersection.

Saturation flow rate is defined as the flow rate per lane at which vehicles can pass through a signalized intersection in such a stable moving queue. By definition, it is computed as:

$$s = 3{,}600/h \qquad (1\text{-}6)$$

where:

s = saturation flow rate, in vphgpl;
h = saturation headway, in sec; and
3,600 = number of seconds per hour.

The saturation flow rate represents the number of vehicles per hour per lane that can pass through an intersection if the green signal were available for the full hour, and the flow of vehicles were never halted. This assumes that in addition to a full hour of green being available, the average headway of all vehicles entering the intersection is h seconds.

The reality of flow at a signalized intersection is that flow is periodically halted. Each time flow is halted, it must be started again, and it will experience start-up reaction and acceleration headways illustrated in Figure 1-3 for the first N vehicles. In Figure 1-3, the first six vehicles in the queue experience headways longer than h. The increments, t_i, are called *start-up lost times*. The total start-up lost time for these vehicles is the sum of these increments, or:

$$l_1 = \sum_{i=1}^{N} t_i \qquad (1\text{-}7)$$

where:

l_1 = total start-up lost time, sec; and
t_i = lost time for the ith vehicle in queue, in sec.

Each time a queue of vehicles receives a green signal, it will consume h seconds per vehicle, plus the start-up lost time, l_1, assuming that there are at least N vehicles in the queue.

Each time a stream of vehicles is stopped, another source of lost time is experienced. As one stream of vehicle stops, safety requires that there be some clearance time before a conflicting

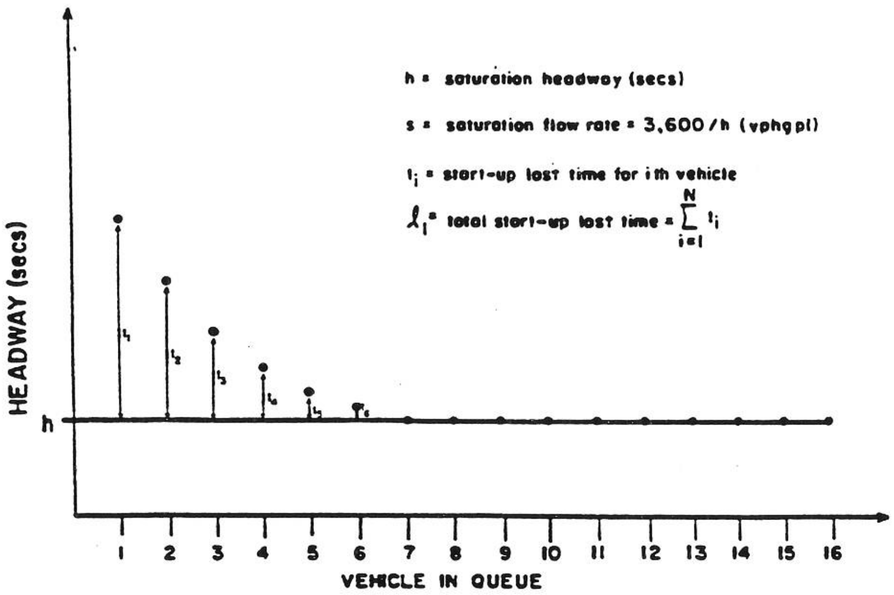

Figure 1-3. Saturation flow rate and lost time.

stream of traffic is allowed to enter the intersection. During this period, no vehicles use the intersection. This interval is called *clearance lost time*, l_2.

In practice, signal cycles provide for this clearance through the use of "change intervals," that may include yellow and/or all red indications. Drivers generally do not observe this entire interval and do use the intersection during some portion of it. The clearance lost time, l_2, is the portion of this change interval that is *not used* by motorists.

The relationship between saturation flow rate and lost times is a critical one. For any given lane or movement, vehicles use the intersection at the saturation flow rate for a period of time equaling *the available green time plus the change interval minus the start-up and clearance lost times*. As the lost times are experienced each time a movement is started and stopped, the total amount of time lost over an hour is related to the signal timing. If a signal has a 60-sec cycle length, it will start and stop each movement 60 times per hour, and the total lost time per movement will be $60(l_1 + l_2)$. If the signal has a 30-sec cycle, each movement will be stopped and started 120 times per hour, and the total lost time per movement will be $120(l_1 + l_2)$, twice as much as for the 60-sec cycle.

The amount of lost time impacts capacity. The foregoing logic suggests that the capacity of the intersection increases with increasing cycle length. This is somewhat offset by observations that the saturation headway, *h*, may increase if the length of continuous green indication becomes very long. Other intersection features may offset the reductive capacity impact of short cycles, such as turning lanes. Where left-turn lanes and phases exist, longer cycle lengths may cause the left-turn lane to overflow, thus reducing capacity by blocking through lanes.

As cycle length is increased, the average stopped-time delay per vehicle also tends to increase, assuming that adequate capacity is provided. Delay, however, is a complex variable that is affected by many variables, of which cycle length is only one.

Chapter 9 contains a complete discussion and presentation of analytic relationships among saturation headway, saturation flow rate, lost times, signal timing parameters, and delay.

3. *Flow at* STOP *and* YIELD *signs*—A driver at a STOP or YIELD sign faces a judgmental task. A gap must be selected in the major street flow through which to execute the desired movement. Thus, the capacity of STOP- or YIELD-controlled intersection approaches depends on two critical factors:

a. The distribution of available gaps in the major street traffic stream.

b. The distribution of gaps acceptable to minor street drivers.

The distribution of available gaps in the major street traffic stream depends on the total volume on the street, its directional distribution, the number of lanes on the major street, and the degree and type of platooning which exists in the traffic stream.

Gap acceptance characteristics depend on the type of maneuver (left, through, right) which must be executed by the minor street vehicle, the number of lanes on the major street, the speed of major street traffic, the sight distances, the length of time the minor street vehicle has been waiting, and the driver characteristics (eyesight, reaction time, age, etc.).

Chapter 10 describes flow at STOP- and YIELD-controlled interesection approaches, and analytic relationships relating critical variables to capacity.

4. *Delay*—A critical performance measure on interrupted flow facilities is delay. Delay is a general term that can be interpreted to mean a number of things. Average stopped-time delay is the principal measure of effectiveness used in evaluating level of service at signalized intersections.

Stopped-time delay is the time an individual vehicle spends stopped in a queue while waiting to enter an intersection.

Average stopped-time delay is the total stopped delay experienced by all vehicles in an approach or lane group during a

TRANSPORTATION SYSTEMS MANAGEMENT

The City of Davis has a substantial commitment to a policy of trip reduction through what has been called "transportation systems management" (TSM) in the past and more currently is referred to as "travel demand management" (TDM). By either name, the policy will entail a set of coordinated policy actions on the part of the City and the community as a whole to reduce the actual number of trips made during the course of a typical workday and particularly during the peak hour of travel.

It is not the intent of this report to recommend specific TDM actions. A level of TDM impact has been implicitly built into the travel forecasts for the City as a set of reductions to the trip generation forecasts. The January 1991 Revision of the General Plan Transportation and Circulation Element contained scenarios which required nominal overall reductions of 10 and 20 percent respectively. More specifically, the net reduction of travel was about 8 and 16 percent respectively because the percent reductions in travel were not applied to all the trip purposes. Specifically, non-home-based trips, trips with neither an origin nor destination at a residence were excluded.

The City Council directed that the current forecasts be based upon a 0 percent reduction and a 10 percent reduction in travel. The 10 percent reduction was to be interpreted as achieving the same net effective reduction as that expected to be achieved in the January 1991 Plan revision; i.e. about 8 percent overall. The Council also directed that the consultant use its best judgement in spreading the trip reductions among those trip purposes which are most amenable to reduction through travel demand management. The Council also directed that one alternative (the General Plan Alternative) be studied without the TDM reductions to test the impact on specific facilities of potentially not meeting the 10 percent objective.

The objectives associated with travel demand management are of two kinds. Those principal objectives which are associated with the reduction of peak hour trips are the following:

- Reduction of physical impacts associated with street widenings.
- Reduction of costs associated with construction and mitigation of construction impacts.

The second kind of objective is associated with the reduction of daily trips (total trips). The major impacts are the following:

- Reduction of auto vehicle emissions.
- Reduction of energy consumption.

Table 17 represents the percentage reductions in specific trip purposes that have been proposed for the purposes of developing travel forecasts. It is important to note that these do not represent a recommendation on a specific set of measures. They simply represent at this time the most feasible set of trip purposes to which to apply measures to achieve the desired net effect of a specified reduction in overall travel.

Table 17
Percentage TSM Reductions by Purpose

Productions		Attractions	
Home Based Work Trips	25%	Home Based Work Trips (All Attractions)	25%
Home Based Other Trips	3%	Home Based Other Trips (UC Davis Trips Only)	15%
Non-Home Based Trips	0%	Non-Home Based Trips	0%

The net effect of these assumptions is a reduction in peak hour trips of about 10 percent. The impact on total daily trips is not as great, as a disproportionately high percentage of home-based-work trips take place during the morning and evening peak hours. It is home-based-work trips which are most amenable to reduction and therefore carry the highest assumed reduction. The overall daily impact is therefore not as great as the impact in the peak hours. Under the assumptions above the overall daily impact would be approximately 6 percent.

These percentage reductions can reasonably be achieved with appropriate public actions. This level of reduction will not be painless, however, and will require substantial commitment and potential cost to the city and local area employers to achieve.

A substantial percentage of this goal has already been met since 1986 with the inception of improved bus services in the City, and more attractive Sacramento public transit for individuals commuting out of Davis into the Sacramento area. As of 1990 about 2.5 percent of all work trips made by Davis residents were made by public transportation.

Home-based-work trips are concentrated upon in the assumed reductions. In general, they are more easily reduced because:

- the concentration of employment in limited locations in the City and elsewhere in the region facilitates both public transit service and ridesharing;
- the concentration of work trips in the peak period similarly facilitates public transportation and ride sharing (approximately 45 to 50 percent of all home-based-work trips take place in the two peak hours of the morning and evening rush. Because of this concentration, reductions in the peak hours (if not in total) can be achieved by actions to achieve a spreading of the peak such as employer

sanctioned flex hour programs;

- many reduction policies can be most effectively implemented through either voluntary or mandatory employer based actions.

Home-based-other trips are predominantly shopping trips, along with social trips and recreational trips. It is assumed that a relatively small impact (estimated at 3%) can be made on home-based-other trip productions. Home-based-other attractions at UC Davis are largely student trips. It is assumed that, despite the already stringent limitations on such trips, the University may be able to gain a further reduction of 15 percent in such trips.

These trips do not lend themselves as easily to ridesharing because:

- the diverse set of destinations involved mitigate against ridesharing;
- the need to carry bulky packages (shopping bags for example) make it difficult and uncomfortable to use either public transportation or bicycles;
- the spread of trips throughout the day, with the normal infrequency of transit services during the off-peak periods, makes transit much less appealing for this kind of trip (only about 10 to 15 percent of all daily home-based-other trips take place in the two peak hours).

Non-home-based trips are even more difficult to serve than the preceding two types. These are trips with neither an origin nor a destination at the home. They are made up of primarily short personal trips which are chained together - a trip from work to the dry cleaners and then to home in the evening is a typical example. This category is also heavily comprised of commercial delivery trips. In addition this category of trips suffers from all of the difficulties associated with home-based-other trips noted above. This category, too, has about 10 to 15 percent of all such daily trips made in the two peak periods.