Calmer, Not Faster: A New Direction for the Streets of Los Angeles

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As Los Angeles nears the end of its road-building era, it turns toward schemes for increasing traffic flow on existing roadways. People want less traffic, yet want to travel faster. The inherent conflict in these desires goes unrecognized as the political process continues to favor efforts to expand mobility by improving traffic flow. The counterproductive nature of measures taken to free up traffic are described in terms of two central districts of Los Angeles. Conflicts between place and path can be resolved by concentrating population while reducing numbers of vehicles. Tools of traffic control can be applied to cause vehicles to travel at slower and more uniform speeds. Mobility can be maintained with fewer vehicles by better use of in-vehicle capacities. The Los Angeles correction depends on changing the goal of street management from traffic maximization to traffic calming. This means balancing and integrating land uses to make it possible to walk from one activity to another; giving priority to environmentally preferable modes of travel; basing traffic flow decisions on person flows; and reducing vehicle density where there is high population density.

While Los Angeles was becoming one of the large and influential cities of the world, it also became the epitome of the automobile-dominated city. People in other cities struggling to avoid the Los Angeles fate of endless sprawl, traffic congestion, and bad air now warn of "Los Angelization."

Los Angeles is also known for spurring innovation. The fact that it is beginning to deal with some of its persistent air quality problems is being noticed around the world. The people of Los Angeles have realized that they can't simply build more roads to decongest traffic, and have affirmed tax expenditures for future rail service. Proposals for traffic relief in the near term are focused on improvement of traffic flow on existing roadways. Plans include conversion of a number of streets in central Los Angeles to one-way operation, and use of automatic traffic surveillance and control (ATSAC) systems.

On the basis of the fact that a vehicle traveling at a constant optimal speed produces less polluting emissions per mile, traffic flow improvements have been incorporated into plans for reducing air pollution. These approaches are well liked because they seem to offer a win-win situation—faster driving and cleaner air; and no one loses property, because the existing roadways are used. Yet consideration of the higher-order effects—cumulative effects caused by network feedbacks—would indicate that actions to increase traffic speed will normally worsen air quality and increase emission of greenhouse gases, because these actions increase vehicle miles traveled (VMT) (*1*).

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IMPROVING TRAFFIC FLOW

Tools of Traffic Control

Although new freeways are seldom proposed today, there are still hopes that less extreme means of easing traffic flow will not only reduce congestion, but will reduce energy and pollution costs as well. Residents exhibit a growing resistance to road widening, but still seem to accept ways of increasing traffic flows that can be applied without widening the roadway—various traffic engineering measures, including electronic control of signals, and alterations of vehicle flows within the roadways.

Of the many tools for enhancing the capacities of streets and street systems, conversion of two-way streets to one-way operation is one of the oldest means of squeezing additional flow capacity from a given network of streets. One-way streets facilitate greater flows because signals can be timed for any desired speed, and left-turn waits can be eliminated. One of the newest tools is the automatic traffic surveillance and control (ATSAC) system, by which vehicle movements are monitored in real time, and signal timing is adjusted to increase link or intersection throughput. While either one-way streets or ATSAC can be used independently of the other, the greatest gains in vehicle throughput can be made when they are used jointly. This outlook heightens the traffic engineers' desire for one-way streets.

Conflicting Goals

Traffic engineers ply their trade on behalf of a public that wants to go faster. Almost universally, people believe they should be able to live in a nice neighborhood and travel easily to all other places. The fact that these two personal goals are in conflict when they are shared by many other people is seldom contemplated. When a few people living along a narrow street object to its widening, they are thought to be selfish, unwilling to make a reasonable sacrifice for the greater good of the community. After all, the number of people passing through is likely to be far greater than the number who live along the section to be widened.

This greater good argument prevailed for a number of years in the building of freeways. Today there is great resistance to construction of more freeways, particularly in urban areas. People seem to perceive that more freeways means more time spent on freeways, rather than the easier travel that was promised.

The greater good argument is still made on behalf of vehicle flow enhancements because people don't analyze intensity of interest—that the resident spends many hours at home, whereas the person traveling past has only a fleeting interest in that neighborhood. Because people don't simultaneously occupy and travel through a place, they tend not to reconcile their dual roles as place occupier and traveler. In effect, people have dual personas—one as the place occupier, and the other as the traveler. The same person that objects to the car drivers speeding through his neighborhood becomes another person with another viewpoint while traveling through another neighborhood. The other neighborhood may not even be viewed as a neighborhood, but as a commercial district.

Links and Networks

There is still a collective wish to speed the flow of traffic because the reasons for doing it are more apparent than are the reasons for slowing it down. The primary reason for fast travel is so simple—wanting to be somewhere else and not wanting to waste time in getting there. This simple objective is supported by rationalizations such as faster travel reduces air pollution and helps the economy.

The chief obstacle to continually expanding mobility is the finiteness of the urban transportation network. People don't normally think in terms of networks. It is easier to understand one's direct interactions with the environment than to know about individual or collective relations to higher-order network effects. People don't think about how their presence on a network is contributing to the congestion of the network. Because they don't think much about the long-term collective impacts of their actions, they seldom realize that improving the traffic flow capacity at one location may lead to more traffic congestion, more energy consumption, and air pollution in the aggregate.

Even when people do think in terms of networks, they make gross simplifications. For example, places are represented in transportation models by nodes, or points. When places are reduced to points, it makes it easier to disregard them in favor of the facilities constructed for travel. When people act as decision makers to intervene in these complex networks, and change the nature of some of the links or nodes, it is generally with meager knowledge of the overall long-run consequences to the network, and especially the impacts on places in the network (*2*).

In spite of these complexities, there is growing public recognition that there are limits to mobility. In a general way, most people understand that there are system feedbacks that invalidate the simple extrapolations of the effects of easier travel along specific links. This understanding is manifested in the steadily increasing importance given to EIR's, public hearings, and development moratoriums. In a recent survey, Glickfeld and Levine (*3*) found that traffic is the single most important reason leading to the appearance of growth management measures on the ballot in California cities. These measures are evidence of the public desire to more carefully consider the consequences of interventions, whether the interventions are in the travel network or in the places served.

SOME CONSEQUENCES OF TRAFFIC IMPROVEMENTS

Although the term "traffic improvement" is used here in its usual sense, the central point of this paper is to call into question the unquestioning pursuit of traffic flow capacity, because of unintended and often unrecognized side effects. Among these effects are the increase in VMT and consequent impacts on air quality, energy security, and global warming; worsening of transit effectiveness; and neighborhood degradation.

Increase in Travel Volume

All else being equal, higher total traffic flow (i.e., higher VMT) means more energy use and more emissions. So, it would be nice if efforts to eliminate bottlenecks and congestion did not result in more VMT. There are two schools of thought on the effect of traffic flow improvements on total traffic volume. The traditional view, held by many traffic engineers, roadbuilders, and others, is that raising vehicle speeds toward their design optimums will reduce emissions and fuel usage. An opposing view that has arisen in the last 10 years is that the ability to go faster translates over time into decisions to go farther; to live farther from work, to range farther for shopping, education, entertainment, etc. This tendency is thought to neutralize any gains that might have been made initially, and ultimately to reestablish the congestion.

The pioneering work on this topic has been carried out over the last decade by Newman and Kenworthy and their associates, who took two different approaches. After first using instrumented vehicles to investigate driving cycles (*1*), they acquired and analyzed gross scale data from 32 large cities throughout the industrialized nations (*4,5*). Their work demonstrated that where people live and work at lower densities, and where workplaces are decentralized (e.g., in places like suburbs as well as low-density cities), the vehicle trips are longer and more frequent. They found that "free-flowing traffic does not lead to savings in fuel or time, or lowering of emissions in a city overall."

More recently, Holtzclaw (*6*) used actual mileage records of vehicles owned by residents of high- and low-density areas in the San Francisco Bay area to determine the relation between VMT and urban density. He found a consistent relationship, that per capita VMT is reduced 30 percent by a doubling of population density.

There are other views on these matters. In a response to Newman and Kenworthy, Gordon and Richardson said that "decentralization reduces pressures on the CBD, relieves congestion, and avoids 'gridlock'. . . . nationwide, most commuting is now suburb-to-suburb." They said that data from the 1977 and 1983–1984 Nationwide Personal Transportation Study (NPTS) "shows that there is no relationship between city size and trip lengths, times, or speeds; moreover, average commuting speeds did not decline" (*7*). In another paper, Richardson and Gordon stressed the importance of nonwork travel:

> The concept of the CBD-dominated metropolis became obsolete as both households and firms moved into the suburbs. Suburbanization made possible shorter work trips and generated more opportunities for nonwork travel, especially in larger metropolitan areas where the most dramatic changes in land use patterns occurred. The ubiquity of a wide range of commercial and service facilities in today's suburbs has created more efficient settlement patterns that save travel time and thus provide an opportunity for more leisure pursuits that involve more travel.

Lowry (*8*) sees both residences and work places dispersing into sprawling low-density patterns. In supporting the theme of Gordon and Richardson, that nonwork trips are becoming the preponderant concern, he notes that other local travel "depends heavily on private vehicles because in a low-density residential environment, distances are too great for pedestrians and volumes are too low to support public transit. . . ." He sees the need for expanding capacity on suburban streets and arterials, yet says that "however much capacity is expanded, congestion will not be far behind; it is the equilibrating factor that limits travel demand."

Using the same NPTS data used by Gordon and Richardson, Pisarski (*9*) agrees that the shift in commuter patterns toward suburb-to-suburb commutes has produced shorter trips, but he notes an opposing trend, that the suburb-to-suburb and center-city-to-center-city . . . (trips) are growing rapidly in length. "This suggests that the trip distance advantage of suburb-to-suburb travel may not last as the pattern becomes more pervasive."

A study by Cervero (*10*) also found that work trips in the suburbs may actually be growing in length, as suggested by Pisarski. In a population of 57 suburban employment centers, the employees commute an average of around 11 mi, taking around 24 min, which is farther and slower than journeys to work made by the typical suburban employee in 1980. He attributes the change to the increase in congestion and the widening jobs-housing imbalance (housing costs not matching incomes) found around suburban employment areas since 1980.

In the main these writers seem to agree on what is happening, but disagree on what, if anything, should be done about it. The depth of disagreement on normative issues is illustrated by a suggestion of Gordon and Richardson (*7*) that Newman and Kenworthy would perhaps "be well advised to seek out another planet, preferably unpopulated, where they can build their compact cities from scratch with solar-powered transit."

Gordon and Richardson, Lowry, and to a lesser extent Pisarski, give the impression of approving of sprawl development. Lowry (*8*) says

> Planners had better get used to Sprawl City, precisely because the American people invariably choose it as the better way to live. Whatever the case with water and sewer service, fire and police protection, Sprawl City is not necessarily less efficient than Compact City with respect to local travel. The critical factor in local travel is the collocation of daily destinations: home, work place, school, grocery, fast-food outlet, movie theater, bank. The evidence from daily travel surveys is that as residences, work places, and retail establishments have dispersed, they have mutually located in ways that reduce travel rather than increase it. On the other hand, as local travel becomes easier, people do more of it, so that congestion is a perpetual problem, however efficient the spatial organization and the transportation system."

There does appear to be considerable agreement that cities are still suburbanizing, that the overall densities of cities are still declining, that people are making more and more of their trips in cars. One side says it is because that is their free choice, and planning interventions are undesirable. The others would say that there could be other, equally desirable choices, but they will not be possible without intervention.

Impact of Traffic Flow Improvements on Transit

It is often claimed that bus transit is assisted by raising the speed of the entire traffic stream. Although it is true that higher transit speed means lower cost per vehicle-mile, the incentive to use transit is diminished by a general speed-up, and the overall effectiveness of transit is worsened. This is because the incentive to use transit is based on its performance relative to the automobile, and its relative performance worsens as traffic speeds increase.

In order to explain how speeding the general flow of traffic harms transit's relative performance, the time components of a trip must be examined. For a trip in the automobile, it is essentially just the time spent in the traffic stream. With the bus, it is the time in the traffic stream, plus the time spent waiting for a bus, plus the delays incurred while the bus is picking up other passengers along the route. Frequency of service can be improved somewhat by faster traffic speeds, but passenger-induced delay is not. Thus, by whatever factor automobile trip time is reduced, transit trip time is reduced by a smaller factor. It is not mere coincidence that transit is most productive in the cities (and in districts within cities) where traffic moves the slowest. Some evidence of this effect of traffic speeds on bus productivity is provided by SCRTD bus line data. Consider data on productivity (average boardings per bus-hour) as a function of average traffic speed where the line operates. Traffic speed is estimated from average bus travel speed by applying a passenger delay factor equal to 3 sec per passenger boarding:

$$V_T = \frac{D}{H(1 - Bd)} \tag{1}$$

where

V_T = estimated average traffic speed,
D = total daily in-service miles of the bus line,
H = total daily in-service hours of the bus line,
B = average boarding rate for the bus line, and
d = boarding delay per passenger (hr).

Data from 99 local bus lines yield the linear regression relationship shown in Figure 1:

$$\hat{B} = 167.0 - 7.14\ V_T \tag{2}$$

with $r^2 = 0.606$. This fit is artificially high because V_T is based

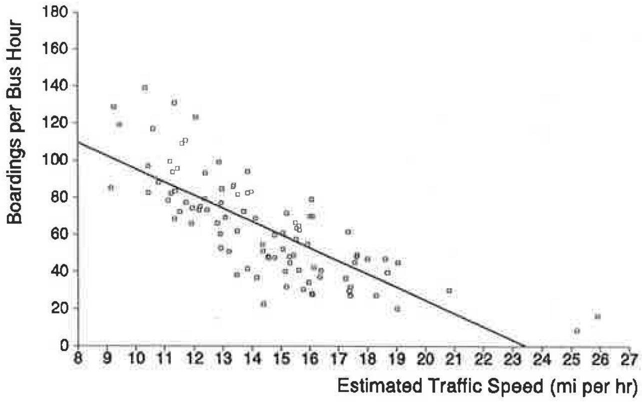

FIGURE 1 Bus line productivity as function of traffic speed.

partly on B. Without the boarding rate adjustment in the traffic speed calculation, r^2 is 0.52. The point here is not to be precise, but simply to illustrate a phenomenon that many traffic engineers choose not to believe.

This is not to suggest that the way to make bus lines productive is to slow them down! The point is that bus transit is more effective under land use and transportation equilibrium conditions that result in slower traffic. Of course, transit is even more effective if it is given a speed advantage without raising the general traffic speed, by means such as reserved bus lanes. Unfortunately, a practice more widespread than reserved bus lanes is bus turnouts. These are often touted by traffic engineers as an advantage for transit, even though their primary function is to raise average automobile speeds by lowering average bus speeds.

Aside from the general speed effect, transit is also harmed by the circuitous routings dictated by one-way streets. Walk distances are increased and route confusion is intensified. Passengers can't make a return trip by reversing course; they must find a corresponding stop on another street. The return route could be on either side of the arrival route.

Bicycles are negatively affected both by high automobile speed and by circuity. High speed differentials are dangerous and intimidating. The circuity sometimes forces cyclists to use streets on hilly terrain that they otherwise could avoid. Bicycling can never be a serious mode of nonrecreational travel until treated as if it is.

Impact on Residence Location Decisions

One of the proposed means of reducing VMT is the balancing of jobs with housing. As initially introduced in the Los Angeles region, the concept addressed only the gross balance at the subregion level. There has been much ensuing discussion, but generally the basic idea of having housing convenient to workplaces has become a well-accepted principle. Los Angeles has been actively encouraging housing construction in the central area, and a planning program has established a goal of 100,000 residents in the downtown area.

This goal is subverted by plans to increase roadway capacity for commuter traffic through the same central area, in corridors that roughly parallel the first two rail lines. Faster traffic and higher traffic volumes diminish the desirability of an area for residential use. The impact of traffic on neighborhoods was described by Appleyard et al. (*11*):

> Paired one-way street systems expanded the impact of former arterials into the neighborhoods, broadening the bands of traffic impact and the number of houses subjected to traffic. It may well be that more residences were negatively affected by conversion to one-way systems than by the freeway systems. But eventually it was the freeways that became the targets of protest. The taking of homes and jobs was more traumatic and visible than the slow incremental intrusion of traffic on residential streets.

Normal practice is to allocate high traffic volumes and higher speeds to commercial streets and lower volumes and speeds to residential streets. Unfortunately, there is too much traffic volume and not enough commercial land use for this allocation to be workable. Without enough commercial activity to line the arterials and take the abuse of heavy traffic, a large portion of the land fronting high-volume streets is used for what might be called "sacrificial residential."

The mechanisms for the long-term detrimental effects of traffic improvement are complex, but conform to common sense. In the simplest terms, the attempt to accommodate automobiles without directly charging the users for the cost they incur results in overuse, in the form of heavy traffic. The traffic negatively impacts adjacent land uses, causing people to migrate to lower-impact locations. Lower-income people and less desirable land uses take their place. The heavy traffic remains or worsens because the additional people now at the urban periphery impose an additional traffic burden on the central area.

Traffic gradually increases as measures are taken that favor through traffic over local access travel. When used to speed traffic, one-way streets are a prime example of an action that favors through traffic over local access. Their greater circuity differentially affects the people making short trips, because more of them are seeking access. The greater inconvenience of local travel adds to the incentives of local residents to relocate, whereas the greater capacity aids people passing through, and encourages more through trips. The trips passing through are longer trips, that add more VMT to the region's travel.

POLICY AND PLANNING CONFLICTS

The attempts to provide for more traffic, even as concerns about neighborhood traffic impacts grow, are a result of conflicting policies. Inconsistent policies coexist in part because most network impacts develop over a long time. The effort to ease a congestion problem by speeding and enlarging the flow of vehicles discourages uses like housing and neighborhood services, and ultimately results in migration, longer trips, and more congestion.

Politicians are placed in the middle. It is easy for people in their residential personas to demand that the politicians do something about neighborhood automobile impacts, while in their automobile-driver personas they insist on free-flowing thoroughfares. The politician can't reasonably be blamed for support of conflicting policies when heated demands for resolution are hopelessly in conflict.

There are many examples of these developing conflicts, but they are most acute in the high-activity areas. Two specific cases in Los Angeles will serve to illustrate the problems created by attempts to speed traffic.

The Central Business District

The CBD (Figure 2) provides the best illustration of the embarrassments of successful traffic engineering. Over the years the flows have been improved, but the primary result has been more cars, not more people. The number of people entering downtown has only increased 5 percent since 1955 but the number of automobiles entering has increased 23 percent (*12*). This modest increase in the number of vehicles has had a disproportionate impact on congestion because of the automobile's demand for street space and storage.

In the past, when faced with congestion, the standard approach has been to expand street-carrying capacity, either by expanding the streets themselves or by redesign. Accommodating more vehicles has only aided the spread of automobile use. In 1939, the number of passengers per car entering downtown was 1.51; in 1955 it declined to 1.46 and in 1984 it declined to 1.36.

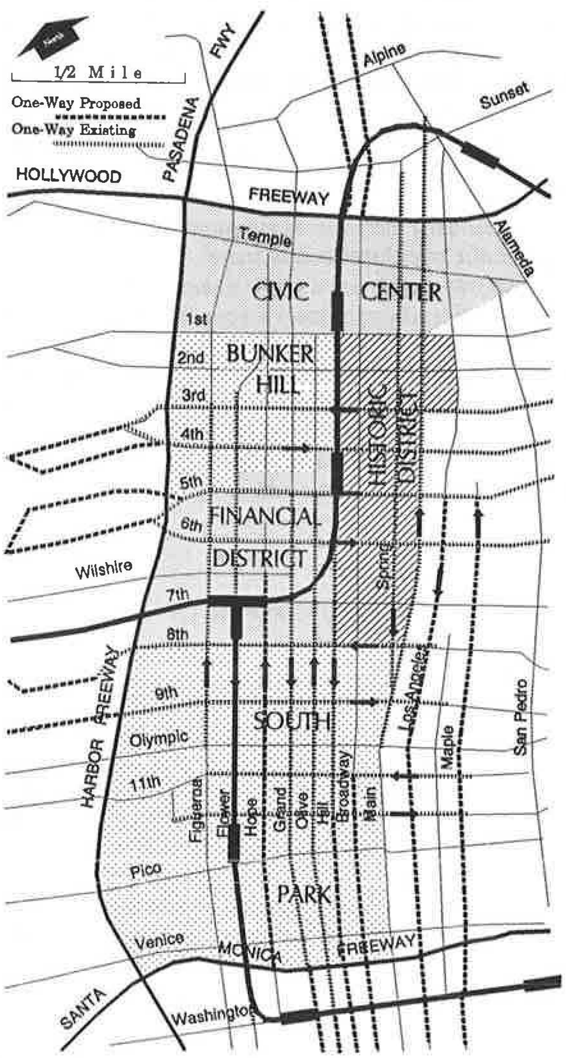

FIGURE 2 Los Angeles CBD.

The CBD is seeing massive development of new office space, and the beginnings of an advance toward downtown housing. There is a formal interagency effort to plan for access and circulation, with some hopes for avoiding the pedestrian-hostile environments created years earlier in the renewal of Bunker Hill.

Yet here is where the movement toward one-way streets continues to be both strong and—except for Broadway—seemingly unquestioned. Some of the one-way streets have been in place for many years. Subway construction provided the excuse to add some more (Hill, Figueroa, and Flower Streets). Although one-way streets were justified as ways to cope with subway construction, they are unlikely to return to their former two-way operation once the construction is complete. To the contrary, the goal is to extend the one-way operations, far beyond the CBD in some cases (*13*).

Support for Rail Investment

Until now, downtown employees have had a limited choice: either overcrowded buses or underutilized automobiles, all running together in a gradually slowing stream of traffic. The rail lines now being constructed will provide an alternative means of access to the CBD for a large number of workers. How effective the rail lines turn out to be will depend in large measure on how well supported they are by governmental and private sector policies.

Local supportive actions for rail transit are a prerequisite for federal funds. In 1978, the U.S. Department of Transportation (DOT) came out with its Policy Toward Rail Transit. Under the heading, "Controlling the Cost and Increasing the Effectiveness of Rail Transit," the policy stated the following:

> Localities proposing to build rail transit with Federal assistance will be required to commit themselves to the development and implementation of a program of local supportive policies and actions designed to enhance the proposed system's cost-effectiveness, patronage and prospect for economic viability (*14*).

Among the supportive measures that DOT considered appropriate were "pricing, regulatory or traffic control measures aimed at managing the peak period use of automobiles with[in] rail corridors (e.g., traffic metering, tolls, higher parking fees, elimination of employer-subsidized parking)."

There is a serious question as to whether this investment in rail transit is going to be adequately supported by local actions, as required by DOT policy. It is inconceivable that the traffic control measures anticipated in the federal policy could include adding automobile capacity in the same areas served by the rail transit. If the rail service is properly supported, it would make additional automobile capacity unnecessary. If the automobile capacity is there, it will be taken up by additional through traffic, and rail effectiveness will be weakened. Yet plans for saving the historic core include construction of five multistory parking structures, in an area that is still heavily transit oriented.

The current plans of continual roadway widening and traffic flow enhancement are simply a continuation of practices that began in the 1920s. However, even then planners knew that "even if a city doubled the width of its streets, traffic would eventually rise to its previous level of intensity. . . . It was improbable . . . that the city could increase the capacity of the streets beyond the ability of the public to purchase automobiles" (*15*).

Wilshire Center

In the Wilshire Center area (Figure 3), a cooperative planning process developed an approach to traffic and development in keeping with the larger goals of the region. The Wilshire Center Plan (*16*), a concept plan produced with private funds in cooperation with the City Planning Department, proposed a variety of transportation management measures intended to accommodate development by reducing trip rates rather than by increasing flows.

But this plan is not the only one for the area. The traffic engineering proposals produced by the Los Angeles Department of Transportation would convert Sixth Street to one-way east in order to create a high-volume through route. Seventh Street would provide for one-way west travel, assuming that it will also be pushed through the Ambassador Hotel site, where it deadends. This plan conflicts with the Wilshire Center Plan, which envisions Sixth Street as having the role of an intensive pedestrian, local shopping, and restaurant area to complement Wilshire. Where the Wilshire Center Plan tries to foster local access, controlled traffic flow, and encouragement of pedestrian activity, the traffic engineering plan attempts to develop an efficient conduit for travel through the area, ensuring more noise and fumes for adjacent businesses, and greater barriers to pedestrian crossings. The Department of Public Works is already in the process of widening the Sixth Street roadway at the expense of the sidewalks, and to the detriment of recently completed adaptive restorations of local retail establishments that would cater to pedestrian traffic.

This is an example of how local travel is often thwarted in order to make regional travel easier. If people making local trips are unable to travel west on Sixth Street, they are unlikely to go to Seventh Street for the westbound trip. They may travel on Wilshire instead, or cut through the adjacent high-density housing areas, creating "rat-runs" of major proportions. How buses are to be routed, when a one-way street pair straddles a two-way street, is not clear. If good bus service was a real objective, these kinds of proposals would never be made.

On another set of streets, the same traffic proposal also illustrates the undeclared degradation of residential areas by traffic management decisions. One way to take advantage of spare capacity of a low-use street when it is adjacent to a heavy traffic street is the creation of a one-way pair. By dividing the flow equally, greater flow is permitted overall. Plans to make Eighth and Ninth Streets a one-way pair would be a classic illustration of Appleyard's caution about one-way streets. The traffic currently carried by a busy commercial street (Eighth Street) would be divided, to inundate a high-density residential street (Ninth Street) with traffic. It would be surprising if any of the residents of the multistory apartment houses along Ninth Street have any inkling of these plans, or if they do, what the impact on their lives would be if the plans were to be implemented. Over the years, the owners of the affected properties have bought and sold in conditions of relatively low traffic. The coupling of the residential street with a major arterial will clearly be harmful to residential property values, but the owners will not be compensated.

SOME ALTERNATIVE WAYS OF DEALING WITH TRAFFIC

Do Americans really choose sprawl as the better way to live, as Lowry suggests? Could there be a better choice, or at least alternatives for those who would choose them? Even if sprawl

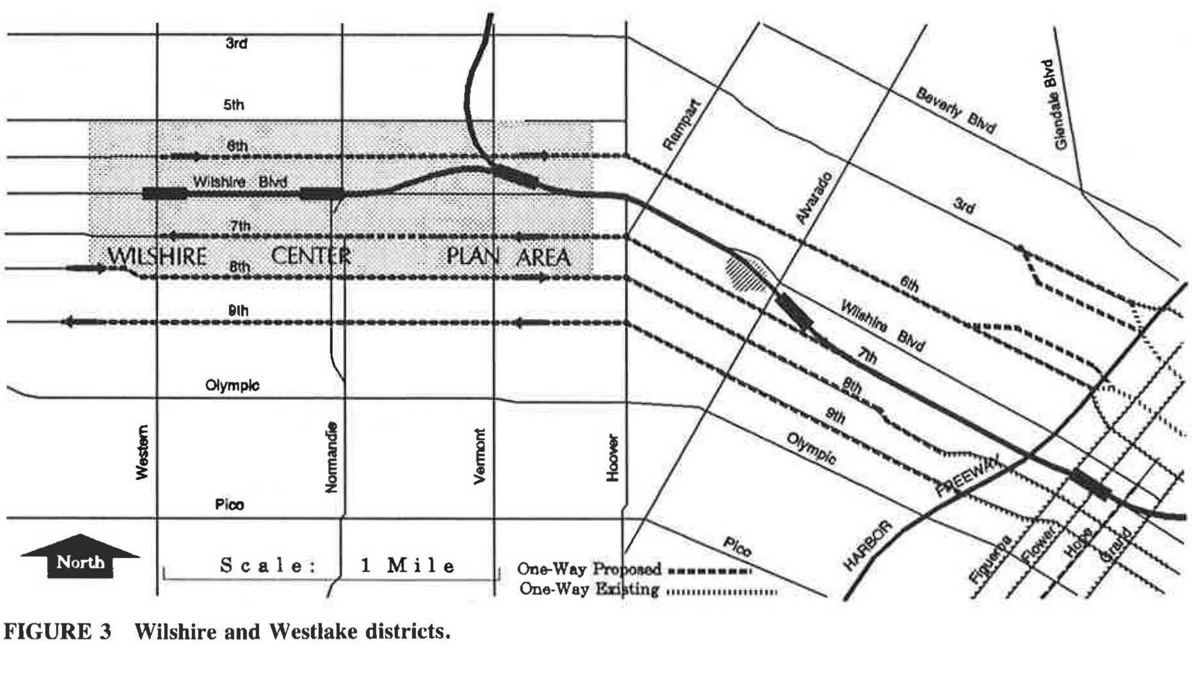

FIGURE 3 Wilshire and Westlake districts.

is the collective preference, how long will Americans retain the freedom to use energy at 5 times the world average rate, and contribute to global warming in similar disproportion? At this juncture in world history, it might behoove Americans to begin thinking seriously about sustainable urban form, i.e., what arrangement of land use patterns would be viable when people are limited to their per capita share of the world's diminishing resources? Sprawl does not appear to be an acceptable option under this fundamental ground rule, although a multicenter urban form could be. Clearly, there are policy conflicts in current approaches to land use and transportation. Some programs support enhanced livability of central areas, whereas other programs would sacrifice the quality of central areas to speed traffic to outlying areas. The policy conflicts have arisen because of changing goals. Some people embrace containment and concentration of urban development, whereas others continue working toward earlier goals of easy mobility, which leads inexorably to sprawling development.

If we are trying to reduce VMT by making higher density central city living more acceptable, the slow incremental intrusion described by Appleyard (*11*) should concern us. There may be no more freeways built in Los Angeles, but there are many plans for widenings, channelizing, conversions to one-way streets, "smart streets," and "superstreets." Whether through creation of one-way streets or by advanced methods of traffic control, these will have a serious negative impact on the willingness of people to live in high-density neighborhoods.

If society's goals include energy efficiency, air quality, and reduced traffic stress, and if sustainable urban form is one of the means to those ends, policies should promote population concentration and reduced automobile dependence. Concentration of people and automobiles is untenable. Elsewhere in the world, in the United States, and even elsewhere in California, there are examples of populations living by choice in high-density urban areas. Where we have attempted to concentrate people and automobiles, the environment deteriorates; people with choice move away and people with less choice replace them.

If we are to move toward attainment of these three related goals, we could begin with a new direction for transportation: focus on the pedestrian. We have to go back and look at the kinds of urban development and transportation decisions that encouraged people to get into their cars for the most modest of trip purposes. We have to ask how new decisions can reverse this process while avoiding perceptions that life quality is being further eroded. The fact that the ultimate goal will take many years to attain is no reason not to start in the right direction.

Encouragement for Pedestrians

People will walk more when walking is made safer and more pleasant. Enhancements of traffic flow almost always degrade the pedestrian environment, by increasing danger and by making walking inconvenient.

Most of the concerns about pedestrian safety in this country are manifested as "pedestrian control," a euphemism for keeping people out of the way of vehicles, rather than keeping vehicles from running into pedestrians. This subtle but important distinction results in such measures as: traffic light buttons that the pedestrian must push to get a walk signal; the walk signal itself, which limits the portion of the green phase available to the pedestrian; and the pedestrian bridge or tunnel, which requires the pedestrian to climb up and down stairs to let the cars travel through without hindrance.

Other practices discourage walking. The emphasis on off-street parking leads to numerous conflicts on the sidewalk. Even though pedestrians have the legal right of way on sidewalks, they are commonly ignored by drivers either wishing to hurry out of the traffic stream, or into it. The provision for right-turn-on-red is good for traffic flow but endangers the pedestrian. The wide streets that look so good to an automobile driver can be a formidable obstacle to a pedestrian trying to cross. But turnouts not only reduce bus speeds, but have the effect of lengthening the crosswalks and reducing the width of the sidewalk at the location where people stand to wait for the bus, thus further narrowing the effective sidewalk width for pedestrians. The elimination of crosswalks at nonsignalized intersections, based on a single study which concluded that they result in pedestrian overconfidence, leads to further driver disregard for the pedestrian.

Children are arguably the primary victims of the deteriorated pedestrian environment. This result has put pressure on families with children to abandon the central city if they are able. Even in the suburbs, the dangers of street crossings and the distances to the locations of children's activities have caused parents to become chauffeurs, creating automobile trips that would be completely unnecessary in an environment that is less hostile to pedestrians.

The safety of children is the central reason for the pioneering work in Holland on the woonerf, begun in Delft in the mid-1970s. Appleyard (*11*) provides a description:

> A "woonerf" is a residential area where traffic flows are generally between 100 to 300 vehicles per hour during the peak period. The design features of the "woonerf" are:
>
> 1. The sharing of the street space between vehicles and pedestrians. To this end curb distinctions between the sidewalks and street pavement are eliminated.
> 2. Conveying the impression that the whole street space is usable by pedestrians. To this end abrupt changes in path direction, vertical features, surface changes, and plantings and street furniture are all designed as obstacles to vehicle travel and to create a residential atmosphere.

While the woonerf addresses the immediate environs of the dwelling, other actions will be needed to enable pedestrian access to everyday needs, e.g., shopping for groceries and other merchandise, going to school, and local recreation. The most basic change that is required is the reduction of the distances between these primary activities. An emphasis on mixed-use zoning will help, but if the requisite change in land use pattern is to be extensive enough and rapid enough, ways must be found to permit mixing in currently unmixed areas, in addition to mixing uses in new developments. This is not likely to be easy.

Where traffic engineering choices must be made between facilitating through traffic or local traffic (often having to do with restrictions of turning movements), an emphasis on local travel will bring reduced speeds, and will be more friendly to pedestrians. Lanes will not be added, because fewer lanes mean less risk in crossing streets.

Traffic Calming

By using some of the many available techniques to divert and slow traffic in residential areas, the "rat-running" through those areas will be curtailed. Although some traffic will disappear, some of it will be pushed back onto the arterials and they will become more congested. Traffic on the arterials will have to be addressed.

Whereas traditional traffic engineering practitioners would remedy the increased congestion with more arterial capacity, the Germans have taken a different approach. They recognized that spot applications of the woonerf can create inequities for nonincluded neighbors, either in adjacent residential zones or on heavier traffic streets, and concluded that a more comprehensive treatment of wide areas was needed. They have carried the philosophy of the woonerf higher in the hierarchy of travel networks, by a program of area-wide traffic restraint. They call it Verkehrsberuhigung, which translates as "traffic calming" (*17*).

Although the Los Angeles approach to traffic congestion is presently oriented to boosting traffic flow, it could be reoriented toward traffic calming. Rather than see how much traffic can be squeezed through traffic lanes and intersections, the new philosophy would be to determine how many vehicles are acceptable at all times and places, and use the tools of traffic control to limit the numbers of vehicles accordingly. In their resident personas, most people recognize that high speeds are more of a problem than congestion, and that enforcement is a weak option for curtailing high speeds. Traffic engineering techniques should be used in combinations for smoothing the flows of traffic, while avoiding provision of more capacity. The goal should be to allow traffic to move at a relatively constant speed, with a minimum of queuing and stops and starts, and with higher speeds inhibited at all times. The determination of the levels of traffic and the speeds to be allowed should be made at the appropriate community or neighborhood level through democratic processes. Such questions are not a matter for traffic engineers or transportation organizations to decide.

Transit Capacity Enhancement

Clamping down on excessive traffic would have the effect of reducing mobility, if no compensatory actions were taken. Mobility can be maintained while reducing the numbers of vehicles, if the capacity in vehicles is increased.

In the central part of the Los Angeles region today, an awkward situation exists, in which transit vehicles are filled to capacity on roadways that are at their vehicle flow capacity. People can't get out of their cars and into transit vehicles because the capacity can't be provided, because the funds are unavailable. The single-occupant vehicle (SOV) drivers are unable or unwilling to share rides in automobiles. So we talk about squeezing a little more vehicle flow onto the roadways by electronics or one-way streets.

Where existing transit capacity is already fully used, the most cost-effective solution would be to transfer funds heretofore available for increasing vehicle flows, to build transit capacity at the same locations. Ideally, the funds would come from the vehicle users, through a congestion fee. Less ideal means may have to suffice for awhile, but no additional vehicle flow capacity should be contemplated without first considering the possibility of using the same funds for enhancing transit capacity. Having the SOV driver pay for building up the capacity of transit is justified on several grounds: that the remaining SOV drivers benefit directly from having others switch to transit, that the subsidization of the automobile has been the primary cause of the thinning of transit service, and that the SOV driver is responsible for most of the pollution and congestion.

One of the potential sources of funds for transit capacity enhancement is the trip fee imposed on projects that burden the transportation system. Too often such fees are conceived as a way of purchasing additional capacity for automobiles, further exacerbating the problems they are intended to solve, and further weakening transit. If the stated purpose of the fee is to provide road capacity, the fact that construction of additional road capacity is likely to result in a worsening environmental problem in the long run makes it difficult or impossible to demonstrate a nexus between a fee imposed on development and a remedy that the expenditure would provide. In other words, if there would be only a temporary improvement, followed by a consequent worsening of regionwide traffic, the fee designated for road capacity is ultimately only a penalty.

One option for a trip fee is to capitalize the future cost of transit service to the site and contract for a perpetual level of service. Something on the order of $5,000 would provide the transit subsidy required to service that trip in perpetuity, on the basis of some reasonable assumptions:

$$C_P = 2C_bN_T \tag{3}$$

where

C_P = total public cost of all future trips represented by the daily arrival and departure of one person via transit,
C_b = average public cost (subsidy) per one-way (linked) transit trip, and
N_T = trip accumulation factor, the number of all future trips represented by one daily trip.

Using RTD figures, the subsidy per one-way trip, C_b, is given by

$$C_b = (\text{cost per boarding}) \times (\%\ \text{subsidy}) \times (\text{boardings per linked trip}) = \$1.27 \times 0.55 \times 1.3 = \$0.91.$$

The trip accumulation factor, N_T, is just like a present worth factor used to convert a stream of income into a single present value. By using a discount factor, the time value of money is accounted for, as well as uncertainties or risks. Here, the total term is 25 years, and the discount rate is 10 percent. Each daily trip corresponds to about 300 annual trips. These assumptions give N_T a value of 2,785 trips.

Therefore, using Equation 3, the public cost of all future round trips is

$$C_P = 2 \times \$0.91 \times 2{,}785 = \$5{,}070.$$

Designating the fee for continual future transit service has some advantages over the trip fee that is either undesignated or slated for road enhancements:

- For each tripmaker to be accommodated by transit, the developer can avoid the cost of a parking space (if permitted by parking codes to make this substitution);
- The community would benefit because transit service would be more frequent; and
- Additional cars, and the need for additional road capacity, would be avoided.

One disadvantage of designating a fee in this way is that a decision may be required at the time a project is undertaken about which entity should provide the service and the nature of the service itself. For that reason, it might be better to have an undesignated fee (i.e., a tax). San Francisco is an example of a city that imposes a fee on new development to support transit service. At $5 per square foot, the San Francisco fee appears to be too low to cover the added cost of future service, but it is a step in the right direction.

Land Use Balance

Encouragement of pedestrians, calming of traffic, and increasing transit capacity are all ways of accommodating trips that will be generated. We must also pay attention to the way the trips are generated. Land use arrangement is the key to the numbers and lengths of vehicle trips likely to occur. A closer coupling of complementary land uses would foster more foot travel, bicycle, and transit riding, and thereby reduce the number of motor vehicle trips.

Job-housing balance is important; the attention it has received recently is justified. But it will be ineffective in reducing vehicle trips unless carried out at the neighborhood and community scales (in areas of, say, no greater than 4 square miles). Although subregional balance (the current emphasis) has the potential of reducing the lengths of some of the automobile trips, it is unlikely to reduce their number as long as people still have to jump in their cars to get a loaf of bread. To the extent that jobs are put in the suburbs where housing is in excess, there is no reasonable assurance that average automobile trip lengths would decline at all, if Pisarsky (*9*) is correct in contending that any favorable trip distance advantage obtained when jobs follow residences to the suburbs is only temporary. The most likely result would be continued expansion of housing into rural lands, to take advantage of the additional suburban jobs and the lower cost of undeveloped land still further out. Transit ridership will be significant.

The gradual formation of land use patterns to accommodate the automobile has solidified the need for the car, primarily by making walking trips impractical. If an individual can't make many necessary trips conveniently on foot or on bicycle, and those trips add up to a justification of car ownership, a car is bought and then used for virtually all trips, because the incremental cost of a single automobile trip is so low. In Los Angeles, this may be a first car, but more likely a second car.

There is more to be balanced than jobs and housing. Most trips (81 percent in the region) don't even connect jobs to housing. Just as housing was, over the years, separated from job sites, commercial and retail activity has tended toward consolidation in megacenters. The accumulation of businesses that once served neighborhoods into region-serving specialty centers (e.g., lumber and hardware sales) has come about partly because the general public pays such a large portion of the cost of goods distribution (when customers travel long distances over subsidized roads). Because these costs aren't paid either by the seller or the customer, the seller can disregard them.

In order to foster more optimal arrangements of land use, the emerging trend toward mixed-use zoning should be accelerated. Insofar as possible, all of the costs of transportation should be made tangible to the user, as well as avoidable via choice of mode.

Applying Holtzclaw's (*6*) result (that per capita VMT is reduced 30 percent by a doubling of population density) in the Los Angeles basin, if new development is located in areas of 12,000 persons per square mile density, rather than 3,000, there will be a 40 percent saving of VMT. Holtzclaw also concludes that allowing jobs to concentrate at the center will also help to reduce VMT, a conclusion that suggests reconsideration of certain aspects of the current job-housing balance policy of the Los Angeles basin. This result says that it is far more advantageous to an air basin to have infill development than to permit development to occur on open land at the perimeter.

Traffic Engineering Objectives and Practices

In spite of big plans to reduce emissions, the reality is that the Los Angeles region is still making every permissible effort to increase vehicle flows and accommodate the automobile. Such notions as getting the most traffic flow through available street widths, running cars at higher speeds "to reduce emissions," and eliminating bottlenecks, are still in regional plans ostensibly aimed at attaining higher air quality. Now that there is to be consideration of global warming in the region's air quality measures, there is even more reason to question actions that would increase vehicle flows.

Transportation departments and traffic engineers operate within a framework of expectations prescribed by local government officials, and they in turn respond to their constituents. In their driver personas, the citizens expect the engineers to make traffic go faster. Traffic engineers could just as well work toward an alternative set of goals, if asked. Their tools, such as one-way streets, roadway geometrics, physical control devices, and ATSAC, can be used just as easily to adjust traffic flows to desired levels instead of maximum levels.

A more up-to-date set of goals and objectives is needed. By focusing on the pedestrian, and on improving neighborhood environments, new traffic engineering objectives can be specified. The objectives would be based on how much vehicle traffic is acceptable—the more people in a given area, the fewer vehicles per capita. At some point, the absolute number of vehicles should decline.

One way of giving due consideration to the pedestrian is to focus on the person-capacity of intersections, rather than the vehicle capacity. If pedestrians, cyclists, and transit riders were to be considered as the equivalent of car drivers at each intersection, there might well be intersections where maximum flows would be achieved with no cars at all. In effect this is what has been done in most of the other large cities outside the United States. It has become quite common to reserve most of the street space in the centers of the cities for pedestrians, with high-capacity transit for getting people to and from those areas.

Instead of generally speeding traffic, ATSAC should be used in conjunction with measured or expected pedestrian and transit passenger movements, to limit vehicle flows to acceptable levels. This is likely to require shorter traffic cycles for encouraging transit operation and bicycle and pedestrian flow.

The use of one-way streets should be reexamined. They have merit for limiting automobile traffic in sensitive areas, but their use for increasing street capacity is questionable. A research report by Harwood (*18*) notes that earlier beliefs that one-way intersections were more efficient, which were included in the *1965 Highway Capacity Manual*, were later contradicted by opposite findings. Harwood further notes the circuity effect that increases total traffic volumes and consequently increases air pollution levels.

There should be no one-way operation of transit service. One-way automobile lanes should be used only to provide acceptable street conditions for transit and bicycle operations, not to allow more cars to move faster. They are useful for limiting traffic in residential neighborhoods.

In areas where pedestrian cross-traffic is desirable, the pedestrian barrier factor of the vehicle stream should be considered. Transit has the potential for providing a high level of access to a site without destroying the pedestrian environment. A bus coming every minute with 40 people is much less a barrier to pedestrian cross-traffic than its equivalent, one car every 2 sec. This principle is one reason why the Denver bus mall is so successful. Even though buses run at frequent intervals, pedestrians cross the bus way freely, and the accident rate is nil.

CONCLUSION

Street improvement doesn't have to mean more traffic, more vehicle miles, more noise and more air pollution. Streets are a multipurpose resource. The rights of way of a city belong to its people, not to its automobiles. The fact that cars and trucks have gobbled up a steadily greater portion of the region's land area for the past 70 years does not mean the process cannot be reversed.

The reversal can come about by changing the goal of street management from traffic maximization to traffic calming. We do want to get the most out of our investment in street space, but most doesn't mean the most cars.

The most important actions to be taken are the following:

- Balance Land Uses. Make it possible to walk from one activity to another. When there is a goal of improving the balance between housing and jobs, we should no longer think of some areas as commercial, and thus subject to higher traffic levels. Allow fine-scale mixing of land uses, based on direct accounting for impacts.
- Give the Advantage to the Environmentally Preferable Modes of Travel. Priority should be given to pedestrians, then bicyclists, then transit, then multioccupant vehicles, and only then to SOVs.
- Determine How Much Traffic is Acceptable Before Applying Traffic Engineering Methods. Determine how much traffic should be allowed at each location, and make sure traffic control measures support that amount and no more.
- Base Traffic Flow Decisions on Person Flows, Not Vehicle Flows. In general, on streets with more pedestrians than vehicles, sidewalks should be widened and roadways narrowed.
- Above a Certain Population Density, Reduce Vehicle Densities. Higher combined residential and employment population densities present an opportunity for good transit service. Accommodating additional automobiles only prevents all modes from being effective.
- Direct Project Funding Toward Moving People. Rather than increase vehicle flow by adding lanes or by use of electronics, raise transit-carrying capacity and reduce the number of vehicles, using the same funds that would otherwise be available to increase vehicle flows.

The scourge of pervasive, intrusive motor vehicle traffic can be conquered, even in Los Angeles. The most difficult part of the task is the reorientation of thinking and expectations. The cost and the personal adjustments required will be less onerous than what would be required of us if we continue on our present course.

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