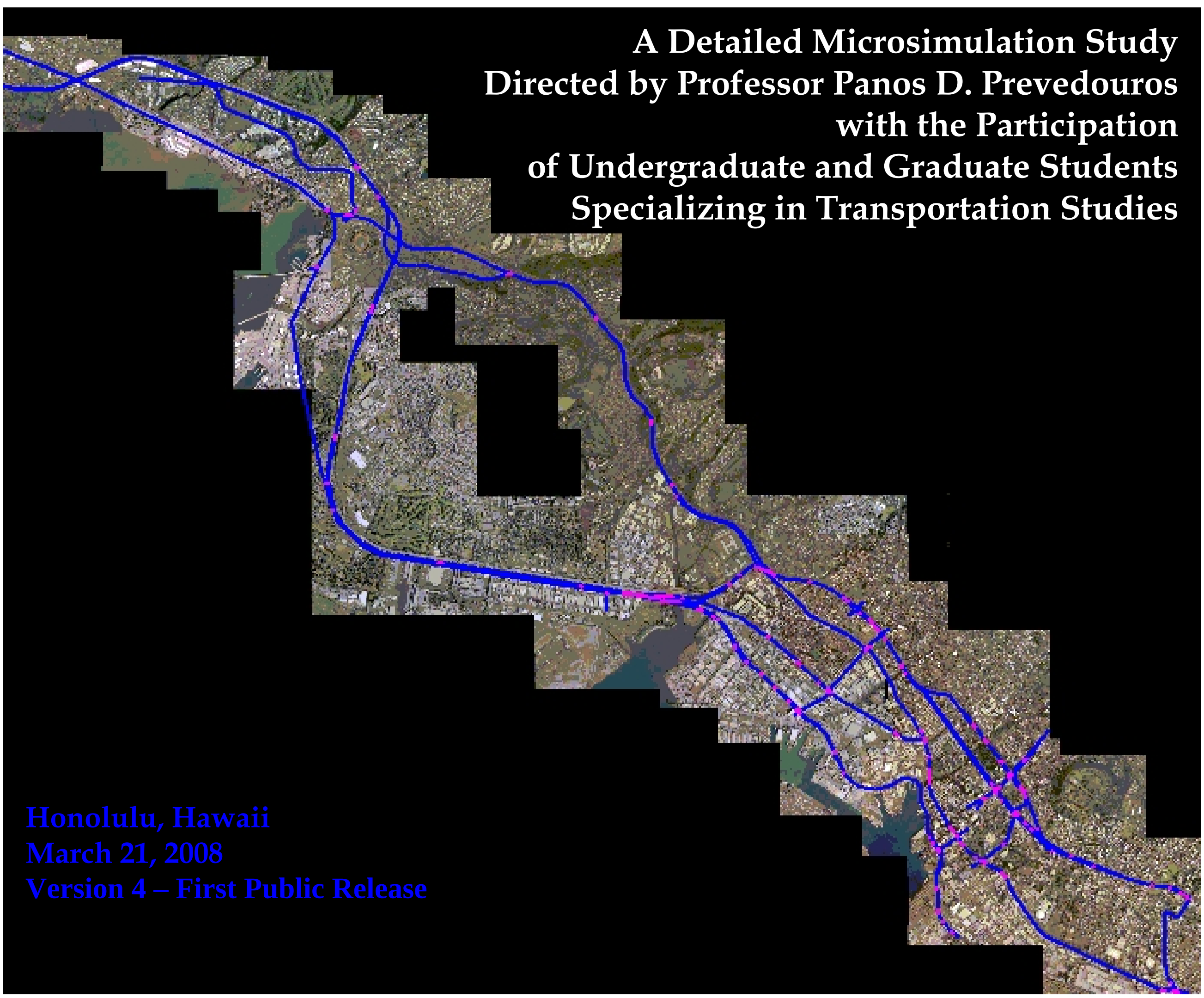
University of Hawaii at Manoa

Department of Civil and Environmental Engineering

Traffic and Transportation Laboratory

Transportation Alternatives Analysis for Mitigating Traffic Congestion between Leeward Oahu and Honolulu



A Detailed Microsimulation Study
Directed by Professor Panos D. Prevedouros
with the Participation
of Undergraduate and Graduate Students
Specializing in Transportation Studies

Honolulu, Hawaii
March 21, 2008
Version 4 – First Public Release

History of Major Report Versions

Version 1: First round of simulations from H-1/H-2 merge to Punahou/Kalakaua screen line; model parameter calibration.

Version 2: Finalized simulations of base, rail, HOT and underpass alternatives.

Version 3: Added simulations with network expanded to Ewa: Fort Weaver Road to Punahou/Kalakaua screen line.

Version 3.3: Added work on separate detailed evaluation of five underpasses.

Version 4: Supplemental results on energy consumption estimates – First public release.

Version 5: Supplemental information from a questionnaire survey.

Disclaimer

Abstract

The rail system currently under consideration for the Honolulu Fixed Guideway project will cost over $5 billion, reducing total travel time by an average of 6% and delivering worse traffic congestion than today's H-1 freeway after completion. Is this the most cost effective solution for Oahu's traffic congestion problem?

A comprehensive study: To address this question, Dr. Panos D. Prevedouros at the University of Hawaii's Department of Civil and Environmental Engineering together with 16 students prepared Hawaii's largest-ever simulation study of five different congestion relief alternatives. Over 100 pages of research and gigabytes of data summarize the following key findings:

Rail transit (Cost: $5 Billion): Using data from the city-generated Alternatives Analysis and simulating a commute from the H1/H2 merge to Aloha tower, a rail transit line would reduce H-1 congestion approximately 3%, reducing drive times from 34 to 33 minutes. A rail commuter would make the same trip in approximately 41 minutes. Note that rail takes longer than driving.

HOT lanes (Cost: $1 Billion): The proposed HOT lanes facility is a reversible two- or three-lane highway on which buses and vehicles with 5 passengers or more travel for free at an average speed of 60mph (vs. rail's average 25mph). Unused capacity on HOT lanes is made available to private vehicles via an electronically computed toll which adjusts the price to keep lanes full but free flowing. Average toll price during peak commute times is estimated to be $3.50 per vehicle. HOT lanes need less or no tax subsidy; similar systems across the nation are privately funded.

HOT lanes would reduce H-1 congestion by 35%, reducing drive times from 34 to 22 minutes. An express bus commuter would make the same trip in 12.7 minutes. The greatest benefit of HOT lanes would accrue to those who never use them; they would pay no added taxes or tolls yet would experience dramatically reduced congestion.

Pearl Harbor Tunnel (Cost: $3-5 billion): A reversible 2-lane tunnel under the entrance of Pearl Harbor would connect to the Nimitz Viaduct. Drive times from Ewa to downtown would be reduced from 65 to 11 minutes and the load reduction on Ft. Weaver Road and H-1 Fwy. would bring those commuter times down from 65 to 40 minutes. The toll would have to be at least three times higher than for the HOT lanes to pay for the large cost of this option.

Four underpasses throughout urban Honolulu (Cost: $50M): One of the most cost-effective projects: introducing free-flowing underpasses in four of Honolulu's busiest intersections delivers a substantial reduction in urban traffic congestion. Overall impact on travel times are nearly equal to rail's performance, at a 99% cost savings.

Rail is the worst global warmer. Excluding New York City, transit averages 310 grams of carbon emissions per passenger mile, compared with 307 for the average 2006 model car and 147 grams from a Toyota Prius. Fuel efficiency trends clearly indicate that vehicles in 2030 will be largely non-polluting, whereas rail will still be drawing its power from today's fossil-fueled power plants.

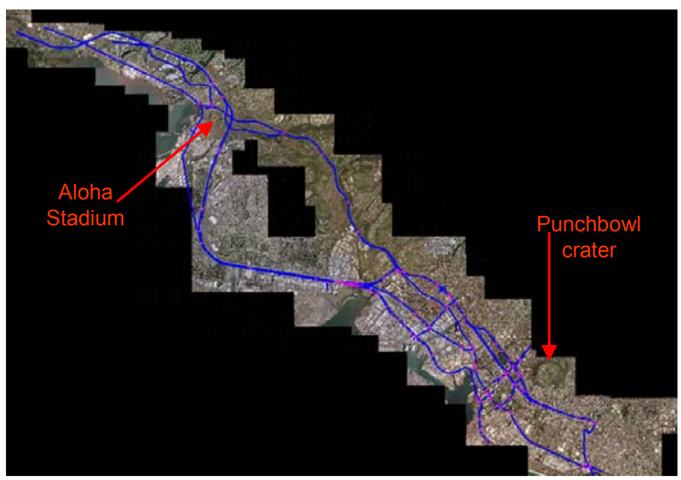
Bleak outlook. Rail's immense construction costs and operating losses will preclude the use of funding for other transportation solutions. This combined with rail's dismal performance will perpetuate Oahu's unacceptable levels of traffic congestion for residents and visitors alike.

Executive Summary

Traffic conditions on Oahu are poor along most commuter routes for at least four hours on any typical weekday. Despite the relatively small population, the density of traffic on its major thoroughfares approaches the jam capacity of parking lots. Many segments on the H-1 freeway and primary arterials operate at or under 20 mph for extended periods along the peak direction and access to Waikiki and the Ala Moana areas is slow during most daylight hours. The worst conditions are observed on the H-1 freeway between Kunia Interchange and the University Avenue Interchange.

For the third or fourth time in recent memory, some public officials are looking into 19th century technology, rail, to "solve" traffic congestion, although when pressed with facts that rail has not relieved congestion anywhere in the U.S. they sidestep the critical demand for traffic congestion relief and present rail transit as a desirable "transportation alternative." However, smaller sums of public funds can provide a much better outcome in terms of improvement to traffic conditions, and many of the non-rail alternatives are more sustainable and have a smaller carbon footprint, that is, they are superior in terms of energy and pollution for the planet.

Based on the process so far, it is quite obvious that Honolulu has not learned much from experiences elsewhere. In the 2006 Alternative Analysis (AA), the City and County of Honolulu's Department of Transportation Services evaluated alternatives which would provide congestion relief along the corridor between Kapolei and Downtown Honolulu. The alternatives examined were sufficiently manipulated to conclude that the Rail Transit Alternative would be the recommended Locally Preferred Alternative (LPA.) The Environmental Impact Statement (EIS) phase of the federally-mandated NEPA process began in December 2005; the chosen alternative, currently called "a fixed guideway," is being reviewed to determine its potential impacts.



Because of Mayor Hannemann's stated preference for the rail alternative, because of the significant drawbacks of rail transit (several of which are summarized this report,) and because other sound alternatives for congestion relief were designed to fail in the City's AA, the University of Hawaii Congestion Study (UHCS) group made a laborious attempt using detailed microsimulation to provide a fuller list of alternatives and some precise quantification of their effect on traffic congestion. Not only UHCS conducted the largest microsimulation study ever done in Hawaii but also our study of Honolulu with Vissim compares quite impressively with those conducted by major consultancies and universities in the mainland. The alternatives investigated included the following:

- **Rail** modeled as having a 6.5% or a 3.25% traffic reduction on H-1 Fwy., Kamehameha Hwy., Moanalua Fwy. The 6.5% scenario is optimistic and its results are an upper bound of what a highly successful *TheRail*[1] is likely to do to network traffic congestion.
- **Four Underpasses** which provide free-flow movement to heavy movements at four busy intersections.
- **A 2-lane or 3-lane HOT expressway** from the H-1/H-2 merge to Iwilei with a bus ramp to Fort Street Mall and a left turn underpass to Alakea St.
- A **combination** of the 2- and 3-lane HOT lanes and the four underpasses.
- **Pearl Harbor Car Ferry** system whereby a large barge transports vehicles across the mouth of Pearl Harbor with a connection to Lagoon Drive through the airport.
- **Pearl Harbor Tunnel** is a reversible 2-lane relatively short tunnel under the entrance of Pearl Harbor with cut-and-cover sections through the Honolulu International airport, priority lanes along Lagoon Drive and direct connection to the Nimitz Viaduct. Nimitz Viaduct is a 2-lane reversible "flyover" from the Keehi interchange (spaghetti junction) to Iwilei. This project has completed environmental review during the second Gov. Cayetano administration and can be put to bid at any time.

HOT expressways are primarily express high-occupancy-vehicle and public transit highways with the ability to zip traffic along at 60 miles per hour by applying a congestion-dependent toll for low occupancy vehicles so that the facility does not get inundated (and jammed) with an amount of traffic that exceeds the capacity of the facility. As a result, buses can travel 10 miles in about 10 minutes. To put this in context, a city bus would be able to travel from the Waikele Shopping Center to Aloha Tower in about 20 minutes at the height of morning rush hour. No other mass transit facility can provide such a high level of service that can actually persuade some motorists to leave their private vehicles at home and choose the express bus. On HOT expressways all buses and vanpools travel free of charge at all times.

The public, private or joint operator of the HOT lanes has the ability to set the desired level of occupancy. For example, the proposed HOT lanes on Oahu could be the *HI-5 Expressway* on which all vehicles with five or more people in them would travel for free at all times.

A 2- or 3-lane reversible highway can serve several thousand vehicles per hour. For example, a 2-lane facility can serve about 3,000 buses in one hour. But there are no 3,000 buses and large vans in all of Oahu to fill the facility. Therefore, such a highway has a lot of room available to serve low occupancy vehicles. If too many low occupancy vehicles are allowed on it, then the highway will jam, and the speed will be much less than 60 mph. How can this be controlled? With variable tolls that start at $1 for low occupancy vehicles and grow to about $5 at the height of the peak hour. In this way, fewer vehicles enter the HOT highway and its service is maintained at 60 mph. The average toll charge during the morning commute period is expected to be around $3.50 in current values.

The key to the success of a reversible HOT facility is to design proper ramps for it, as follows. Four ramps to provide access to the HOT lanes from the H-1 and H-2 freeways, and the

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[1] **Throughout the study we often call the proposed rapid rail transit alternative *TheRail*, to match existing *TheBus* and *TheBoat* monikers of Oahu's public transportation services.**

Farrington and Kamehameha highways. A ramp to Aiea and Hekaha business area. A ramp near Pearl Harbor to serve the strong employment in the area. A ramp into Aloha Stadium to serve events and use the mostly empty parking lot as a park-and-ride facility for express buses. A connection to H-3 freeway is desirable. A ramp onto Lagoon Drive to serve the airport and Mapunapuna. A ramp onto Waiakamilo Street to serve Kalihi. A ramp onto Nimitz Highway, at the point where it widens to four lanes, to serve Honolulu's center and points beyond. The HOT expressway can be configured to work in four different ways, depending on traffic loads and traffic management needs: full inbound, from Waikele to town, full outbound, from town to Waikele, during the typical weekday afternoon travel period, and split inbound and split outbound anchored at Aloha Stadium.

The proposed HOT expressway has two more important features: (1) A City Bus only elevated lane from the end of the HOT lanes in Iwilei to Hotel Street bus transit station which provides a full free flow speed travel for buses from the H-1/H-2 merge to the heart of downtown. This is shown in Figure 4.3. And, (2) a Bus Rapid Transit (BRT) couplet running along King and Beretania Streets with connections to Hotel St. and from there to the HOT lanes. This was proposed in 2002 instead of the ill-conceived "in-town" BRT plan of the City which was planned to operate on Kapiolani and Ala Moana Boulevards.

Urban underpasses separate the main flows of busy arterial streets without creating an interchange. They have advantages such as ability to fit within existing roadway space, can preserve several turning movements, reduce traffic conflicts as well as conflicts with pedestrians, and have the potential to dramatically reduce delays with no road widening. Underpasses are a "win-win" arrangement for both intersecting streets. The vehicles using the underpass receive in essence a constant green light and their delay is reduced to practically zero. Since a large portion of the traffic has been removed from the at-grade part of the intersection, all the rest of the vehicles receive larger shares of green resulting in substantially reduced delays. In addition, the conflicts of vehicles with pedestrians at the intersection are reduced substantially. Our traffic simulation results display substantial improvements. The largest improvement, as expected, is for the vehicles using the underpass which typically improves from level-of-service (LOS) F to LOS A. In all cases, overall intersection LOS improves by at least one level; for example, the LOS for the Pali/Vineyard intersection improves from F to C, which reflects a "day and night" difference in peak hour traffic operations.

Any transportation alternative that involves several hundred million dollars in infrastructure costs has to provide a substantial congestion relief in order to be deemed cost-effective and appropriate for public financing. First we report travel times between the H-1/H-2 merge and Aloha Tower/Alakea Street in downtown Honolulu . In the optimistic case of *TheRail* removing 6.5% of cars from H-1 and Moanalua freeways and from Kamehameha Hwy. , the result is that car travel time will be reduced from 34 to 33 minutes, a reduction of 3%. Typically changes under 5% are not noticeable in a traffic network. A rail passenger will need 41 minutes, which is 8.4 minutes longer than a car using the congested H-1 freeway. A more realistic scenario is that a rail transit system will remove about 3% of cars on the three major roadways mentioned above. In this case, rail transit does not improve travel times at all.

On the 2-lane HOT lane expressway, an express bus will make this trip in 12.7 minutes or 64% faster than today. A car that did not pay a toll but did the trip on the free route along H-1 freeway and Nimitz Hwy. will make the trip in 22.1 minutes or 35% faster than today. The 3-lane HOT lane expressway scenario shows that travel time improvement would be even higher. Good reasons for building a 3-lane reversible expressway instead of a 2-lane one are that capacity is 50% more at a cost that is about 15% more and a 3-lane facility would be more able to aid in evacuations and emergencies, as well as provide a dedicated bus lane, should this become a necessity or financing requirement.

The travel times indicate that the commute trips from Ewa to downtown are very long. If a quick ferry (barge) service is provided, then the travel time from Ewa to downtown can be reduced to about 37 minutes, or by 44%. This is feasible for up to 500 vehicles per hour, with two or three large barges. A tunnel that connects directly to Lagoon Drive will provide a rather grand travel time reduction from 65 minutes to 11 minutes. This should come as no surprise because the length of this trip becomes 23% shorter: 13.6 instead of 17.7 miles (Ewa to Iwilei), and made at free flow speeds for the entire length of it. The toll tunnel has the potential to remove a substantial amount of traffic from Ft. Weaver Road and the H-1 Fwy., therefore, the trip along those free routes is also expected to be reduced significantly, to about 40.3 minutes.

	TOTAL TRAVEL TIME
Rail: 3.25% traffic reduction	-6%
Four Underpasses	-5%
3-lane HOT and Four Underpasses	-34%
Pearl Harbor Tunnel	-15%

KEY			
	small change; likely not worth the cost	large improve-ment; a likely solution	very large improve-ment

In addition to travel times, (1) there are other important measures of performance such as average speed, number of stoppages and network throughput, and (2) there is a whole street network between Waikele and Moiliili. Detailed results are presented in the report. They boil down to these estimated travel time improvements. Rail transit fails to produce results that would make it at least a small solution to congestion. It is interesting that the network wide impacts of a massive $5 billion rail line are basically the same as the traffic benefits of four underpasses costing around $50 million to build.

The ferry option does not have significant network impacts but it provides substantial relief for 500 vehicles per hour from Ewa and Ewa Beach to Lagoon Drive. It is therefore highly advisable that the ineffective, unreliable and expensive *TheBoat* is replaced by *TheFerry*. From a network performance standpoint the tunnel will offer a substantial relief to traffic congestion.

Twenty Year Cost per Peak Hour Commuter is a critical measure that lets the reader compare long term effectiveness (bang for the buck.) Using this cost-effectiveness criterion is easy to show the fallacy of providing alternatives such as *TheBoat*, which cost the taxpayers one million dollars to remove one driver from the road. The proposed rail transit is even worse as a cost of $4,192,000. This is the cost for serving one on (ex) car commuter over 20 years. Notably, our 20-year figure (which includes installation, operation and maintenance costs) does not include the necessary refurbishment of rail transit, which typically runs in the billions every 20 to 30 years. The Operating and Maintenance cost shown for highway alternatives include repaving and tunnel cleaning. The comparative HOT lane cost is $84,000 and the Pearl Harbor tunnel cost is $392,000. Additional important measures are compared in the table on page ix.

Fuel Consumption for One Peak Hour (in US gallons) Change from Base of ~97,000 gallons		
ALTERNATIVE	**Motor Fuel**	**Motor Fuel plus Diesel at HECO for Rail**
Rail: 6.5% traffic reduction	-2.6%	-0.3%
Rail: 3.25% traffic reduction	-0.4%	1.9%
HOT Lanes and Four Underpasses	-40.5%	-40.5%

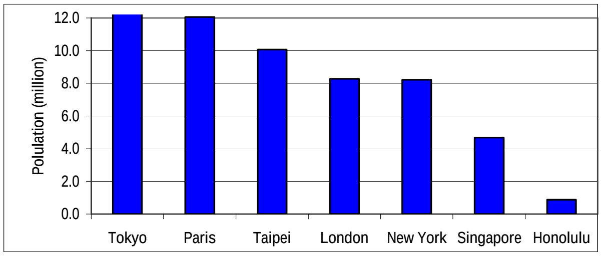
Last but not least, rail will likely worsen Oahu's dependency on oil. Simulation results clearly show the large benefits obtained when real solutions are implemented. Congestion reduction results in substantial savings in fuel consumption, which is a reduction on energy dependency.

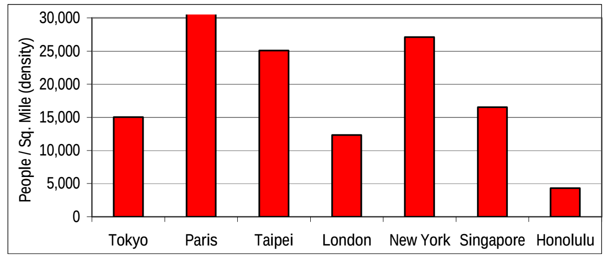
In conclusion, by all accounts, the only reason that rail may be the solution is only because a handful of elected officials say so. Simply put, Hawaii is still a place where elected officials call the solutions upfront, and then require that public and private sector professionals prove them right. This was clearly the case with the 2006 Alternatives Analysis. The increased general excise tax combined with the future tax increases to sustain *TheRail* and the worsening traffic congestion will generate a strong and perennial loss to Oahu's economy. Not only do projects such as *TheRail* and *TheBoat* not resolve congestion but they also consume most of Oahu's transportation taxes leaving little funds for highway and bottleneck improvement. The proposed rail line should be expected to have significant negative implications to the Ko'Olina and Disney resorts, the Campbell Industrial Park, Barbers Point Harbor as well as the entire leeward Oahu since highway congestion will be far worse with it in 2030 making all these places hard to access, therefore undesirable for commerce, businesses, tourists and residents alike.

A reversible HOT lane expressway from Waikele to Iwilei, combined with a handful of underpasses, traffic signal upgrades and optimization, and a Bus Rapid Transit that runs along King and Beretania Streets are the main ingredients to providing the solution to both congestion and mobility issues on Oahu at a cost that the local tax base can afford. In turn these will improve development opportunities, quality of life and social welfare.

Additional highlights of reasons why the proposed rapid transit rail system defies logic are as follows:

- Honolulu's metropolitan area population rank is very low at 56th in the nation with a population of 880,000 which includes the entire island. The smallest US metropolitan area with rapid transit is Cleveland, Ohio with a rank of 15 and population of 3,000,000.
- Light Rail by definition uses extensive lengths of at-grade alignment, whereas Honolulu's rail has no at-grade lengths and it is by definition a "heavy rail," or "rapid transit" system. The smallest US city with a light rail system is Buffalo, New York with a rank of 43 and population of 1.2 million. Buffalo's system is tiny at 6.6 miles, relative to the 28 to 34 mile proposal for Oahu.
- People often refer to large rail systems in world capitals. Here are some sample comparisons of magnitudes, starting with two island metropolitan cities: **Singapore** has a population of 4.7 million and a density of 16,392 people per square mile. **Taipei** in Taiwan has a population of 2.6 million and a density of 25,031 people per square mile. There are large metrorail systems in London, New York City, Paris and Tokyo among others. The respective densities of these cities are 12,331 for **London**, 27,083 for **New York City**, 52,921 for **Paris** and 35,559 for **Tokyo**. The density in urban **Honolulu** is 4,337 people per square mile. In terms of population, London is the least populous of these four large cities. Entire Oahu has a population eight times smaller than London. The graphs on the next page show how tiny Honolulu is in comparison.





- Rapid transit rail was built in Jan Juan, Puerto Rico and it has a dismal performance since it attracts less than one third of its projected 80,000 ridership. *TheRail* expects over 128,000 riders for Oahu's 0.9 million people, whereas the much poorer (and thus more dependent on transit) Puerto Rico of 3.8 million people generate fewer than 30,000 trips!
- In general, U.S. metrorail ridership numbers are dismal for new systems. In comparing the actual average weekday boardings in the transit agency's forecast year with the projected boardings for that year which were made at the AA/DEIS decision point, the average for all 19 projects for which data were available is 65%. Only three exceeded their projections (by between 1% and 34%), and the range among those falling short is very wide—from a low of 6% (Jacksonville people mover) to many others in the 40%-60% range, with others in the 70%-80% range. Some rail projects with fairly high percentages achieved them simply by aiming low: BART's Colma extension got 86% of what it projected, but that amounted to only 13,060 weekday boardings, for a very costly heavy-rail line; likewise for Baltimore's heavy-rail Johns Hopkins extension, averaging only 10,128 weekday boardings. For comparison, Honolulu's minimum expectation is for about 90,000 riders for its minimum operating segment of 20 miles.
- Rail is 19^{th} century polluting technology. In the U.S., excluding the New York metro area which has an exceptionally high transit mode share compared to anywhere else in the USA, transit averages 310 grams per passenger mile, compared with 307 for the average 2006 model car and 328 for the overall car fleet in 2006. The 2007 Toyota Prius hybrid car measures at 147, and a 2008 Peugeot hybrid diesel (available in Europe) at 101. Both are comparable or better than New York metro area transit (140). However, technology is moving toward more efficient and less intensive greenhouse gas vehicles. In 2030 vehicles will be largely non-polluting, whereas rail will be a fossil energy relic.
- Based on Arizona DOT analysis, HOT lanes are roughly ten times cheaper per passenger mile than light rail which is estimated at up to 35 cents per passenger mile. Comparing this to the over 700 cents per passenger mile of *TheRail* proposal, makes it clear that a $5 billion rail project is entirely inappropriate for Honolulu.
- The failure of Sound Transit in Seattle is a luminous prediction of rail for Oahu: In 1996, officials affirmed that the construction of Sound Transit would cost $3.9 billion and be completed in 10 years. In 2007, costs skyrocketed to $15 billion with an estimated completion time of 24 years. With an expected 351,000 riders on the rail system, the cost to take one passenger vehicle off the roadway would be roughly $100,000 per person.
- This quote from the Seattle Time editorial also tells it like it is: "Consider Portland. That city opened its first light-rail line two decades ago, and has built several of them, all of which replaced bus lines. Overall, Greater Portland is no less car-dependent than Seattle. Its congestion has gotten worse, just as it has here. Many Portlanders are proud of light rail, but the last three times new light-rail plans have been on the ballot in the Portland area, the people rejected them. Maybe they learned something."
- Unlike the relative simplicity of highways, metro rail (heavy and light rail) is a complex electromechanical system with literally millions of wearing and weathering components, in addition to those destroyed by misuse or vandalism. Consider this quote from the Santa Clara Times: "At 35, BART is getting old. The transit system's board approved a 25-year road map that foresees the need to spend $11.4 billion on hardware and equipment."

Table E.S.1. Comparison of Selected Transportation Alternatives

	TheRail	TheBoat	HOT lanes	Toll Tunnel
COST				
Capital Cost (Billion)	$5-6	Lease (in O&M)	$0.90	$3-5
Likely Local Tax Burden to Build It	$5,000,000,000	Lease (in O&M)	$400,000,000	$1,250,000,000
Tax Burden per Oahu Resident	$5,523	$6	$442	$1,381
Annual O&M Cost	$64,400,000	$6,000,000	$11,500,000	$14,300,000
Fare or Toll	$2 / Person	$2 / Person	$1-$3 / Car	$2-$6 / Car
GET Increase	Yes, from 4.1% to 4.7%	None	None	None
Property Tax Increase	40%	No	No	No
Likely Peak Hour, Peak Direction People Moved*	1,500	120	7,540	3,910
20 Year Cost per Peak Hour Commuter	**$4,192,000**	**$1,000,000**	**$83,554**	**$392,839**
Year Fully Completed (20 miles of Rail)	2018+	2007	2015	2016
Crime: Needs Transit Police	Yes	No	No	No
Uses U.S. Technology / Know How to Maintain	No/No	Yes/Yes	Yes/Yes	Yes/Yes
Funding Eligibility FHWA - FTA - PPP	No-25%-No	No-25%-No	80%-10%-50%	80%-No-50%
CONSTRUCTION				
Large Parking Lots	4 Planned Need More	Yes, 2	No	No
New Electric Power Plant	Yes	No	No	No
Stations	21-29	2	No Need	No Need
Overall Investment and Construction Risk, 10 is best	4.2	10	6.8	2.1

	TheRail	TheBoat	HOT lanes	Toll Tunnel
PERFORMANCE				
Average Speed	25 mph	20 mph	60 mph	50 mph
Kapolei to Downtown (minutes, approx.)	65	80	25	15
Waikele to Waikiki Corridor Travel Time Reduction	**-6%**	**0%**	**-34%**	**-15%**
Slow Downs or Shut Downs	Power Failure, Mech. Failure, Suicide, Strike, Crime	Mech. Failure, Strike, Crime	Very Few Crashes on Freeflow Lanes without Trucks	Very Few Crashes on Freeflow Lanes without Trucks
SERVICE TO COMMUNITY				
Affects *TheBus*	Very Negative	Mostly Neutral	Very Positive	Somewhat Positive
Support Express Routes	No	No	Yes	Yes
Serves Public Buses, Tour Buses, and Vanpools	No	No	Yes, Free	Yes
Helps Business, Tourism and Economy	No	No	Yes	Yes
Good Option for Unemployed, Seniors, Disabled	No	No	Yes	Yes
Connects to King / Beretania Bus Rapid Transit to UH?	Transfer	Transfer	Express, Direct	Express, Direct
Emergency Response	No	No	Fast and Wide-spread	Fast but Limited
OTHER CHARACTERISTICS				
Noise Pollution	Steel Wheels on Steel Rails	No Impact	Very Little Noise	Most Quiet Highway Option
Carbon Footprint (Pollution)	Very High Because Roadways Remain Clogged	Relatively Huge Consumption per Passenger Mile	Lowest Because It Resolves Congestion	Second Lowest; It Resolves Some Congestion
Future Solar, Hydrogen, Battery Technologies	Old, Fixed Technology	Old, Fixed Technology	Markets and People Adapt	Markets and People Adapt

(*) TheRail and *TheBoat* number of people include those who were drivers. Those who switched to rail from vanpools and *TheBus* are not counted because they were not significant contributors to traffic congestion.

(**) All figures in approximate year 2005 to 2007 time frame.

Table of Contents

List of Tables

List of Figures

About the study supervising professor and lead author

Panos D. Prevedouros, Ph.D. is Professor of Traffic and Transportation Engineering, at the Department of Civil and Environmental Engineering of the University of Hawaii at Manoa. He is the developer and coordinator, of UH's Traffic and Transportation Laboratory (TTL).

Dr. Prevedouros is a member of several national committees on transportation and he chairs the Freeway Simulation Subcommittee of the Transportation Research Board (TRB), a unit of the National Academy of Engineering. In August 2006 he became the president of the Hawaii Highway Users Alliance.

He is the co-author of *Transportation Engineering and Planning* published by Prentice-Hall and author of over 100 research reports and technical papers. He is the 2005 recipient of the Van Wagoner Award of the Institute of Transportation Engineers.

In June 2006 Dr. Prevedouros co-organized the 1st International Symposium on Freeway Operations in Athens, Greece, and he's currently organizing the 2nd Symposium on Freeway Operations in Honolulu to occur in June 2009. These conferences are a joint production of the TRB and the U.S. Department of Transportation along with several local public and private sponsors.

Dr. Prevedouros served in the Transit Advisory Task Force in 2006 and in the Technology Selection Expert Panel in 2008 of the City Council of Honolulu.

Dr. Prevedouros' extensive expertise is available at: www.eng.hawaii.edu/~panos/

1. Introduction

1.1. What's the "Traffic Status" on Oahu?

There is no doubt that traffic conditions on Oahu are poor along most commuter routes for at least four hours on any typical weekday. Despite the relatively small population and the modestly high residential and employment densities on Oahu, the density on its major thoroughfares approaches the jam capacity of parking lots. Many segments on the H-1 freeway and primary arterials operate at or under 20 mph for extended periods along the peak direction and access to Waikiki and the Ala Moana areas is difficult during most daylight hours. The worst conditions are observed on the H-1 freeway between Kunia Interchange and the University Avenue Interchange.

Unfortunately, one more time, the third or fourth in recent memory, public officials are looking in the past and in 19th century technology, rail, to "solve" traffic congestion. The Federal Transit Administration based on extensive experience from the supermajority of urban areas in the U.S. declares that rail is a transportation alternative but not an effective solution to traffic congestion. Too few motorists divert on rail systems to cause a measurable, let alone substantial change in road operations level of service. Indeed, offering alternative transportation modes should be a priority, as long as they are cost-effective. Spending about five billion dollars to serve less than 3% of Oahu's trips (the City's Alternatives Analysis says this) is entirely unwise. Smaller sums of public funds (that is, taxes) can provide a much better outcome in terms of improvement to traffic conditions, and many of the non-rail alternatives are more sustainable and have a smaller carbon footprint (that is, they are superior in terms of energy and pollution concerns for the planet.)

The current "traffic status" or surface transportation conditions and plans on Oahu may be summarized as follows:

- Oahu is in a desperate need of an engineered master plan to address and mitigate traffic congestion.
- In 2001, the previous city administration and the same consultant found that rail was unaffordable and Bus Rapid Transit (BRT) was a superior and less expensive alternative.

- ❖ Defective Alternative Analysis (AA) which, despite its gross favoritism for a rail system, contains important truths such as: (1) traffic congestion from west Oahu to Honolulu will be much worse in 2030 with rail, (2) in 2030 all trips between Aiea and UH will be made faster by car than by rail, and (3) the smallest and cheapest rail alternative will cost about $5 billion.
- ❖ There is a general lack of knowledge on transportation alternatives and their current and future implications, at all levels of government and decision making.
- ❖ Rail is a politician's agenda, not a solution from proper analysis to address congestion. There is strong political influence on transportation policy by both administrators and legislators. Typically, transportation problems are solved by government specialists, expert consultants and transportation suppliers working collaboratively and competitively to solve the problem. Nationally and internationally, administrators and legislators are stakeholders in this process, but Hawaii has the third world distinction that "leaders" call the solutions upfront, and then require that public and private sector professionals prove them right.

1.2. Accountability Helps Avoid Banana Republic Decisions

In the turn of the millennium, Washington State citizens lost patience with the transportation policies of their government. Bowing to pressures, in 2006, the Legislature of the State of Washington passed a bill directing the State Auditor's Office to conduct an independent, comprehensive performance audit of transportation related agencies.[2] The overall conclusion of the report is that over the next five years, taking specific actions could reduce hours of traffic delay by 15% to 20% which would save the average commuter some 10 hours of delay each year and the region some $300 million to $400 million in travel time and vehicle operating costs per year. The report also mentions that "the environmental and economic impacts of reduced vehicle emissions and improved access between employees and employers could potentially reach $300 million to $400 million, for a total economic impact to the Puget Sound region of $600 million to $800 million per year." The six recommended actions and guiding principles are:

1. Investments to improve vehicle flow **using existing infrastructure and resources**. The ability to manage congestion will require adding new lanes of highway.

[2] Washington State DOT, Managing and Reducing Congestion in Puget Sound, Performance Audit Report, http://www.sao.wa.gov/reports/auditreports/auditreportfiles/ar1000006.pdf, 2007.

2. Increasing efforts to have people use **carpools, transit and telecommuting**.
3. Coordinating **traffic lights** on major arterials.
4. Continuing to improve **operational efficiency**.
5. Transportation investments — highways and transit alike — should be measured, in part, based on how many **hours of delay** can be **reduced for each million dollars of investment**.
6. A **commitment to reducing congestion** is needed from the Department and the Legislature, with goals and milestones that can be tracked. The Department should make reducing congestion a primary goal. While the Department has been a national leader in many aspects of congestion management, it has not identified reducing congestion as a priority. A clear commitment to reducing congestion — after meeting safety requirements — would likely shift investment decisions.

The recent transportation audit in Washington State contains critically important lessons for Hawaii because both states have similarly volcanic mountainous and coastal terrains, similarly environmentally sensitive areas, species and populations, and similar traffic congestion problems. The lessons to Hawaii are tied to the Washington State audit's six recommended actions and principles listed above:

1. Roadway infrastructure is essential to solve traffic congestion. A region simply cannot add population, and the required water, sewer and electrical infrastructure to serve the added population, but no roads. A region that does this is simply trapping itself into perennial economic stagnation and huge economic, societal and environmental costs.
2. Alternative commuting means should be strongly encouraged. Hawaii does not encourage carpools, transit and telecommuting. The 2-person policy for the high occupancy vehicle (HOV) and zipper lanes is an example of this. There is a scarcity of incentives for telecommuting. Many government employee functions can be covered by telecommuting. The successful *TheBus* will be shrunk by *TheRail*.
3. Improvements to traffic signals and few and far between. Signal coordination is major arterials is weak or absent. There are rare occasions when one motorist can go

through five consecutive signals, even along the Nuuanu portion of the Pali Highway which is not interrupted by any significant cross streets.

4. There are few investigations for operational improvements and even fewer implementations of improvements for operational efficiency. Ramp metering has not been given a chance, and solutions to the Middle Street merge have been ignored or dismissed due to secondary and addressable safety concerns.
5. Unlike the City's Alternatives Analysis the AA you are reading now is fully consistent with recommendation number five. This AA provides its readers with exact traffic measures with which one can judge by how much each alternative will reduce traffic congestion. Only selected politicians and planners will say, in a straight face, that the public should pay four or more billion dollars for a transportation "alternative" that will offer practically no reduction in traffic congestion.
6. It is true that every year the Legislature of Hawaii talks a great deal about traffic congestions and in May ends up doing nothing about it. Worse yet, in 2005 they approved a regressive tax for a fixed guideway system that Washington State resoundly defeated as grossly ineffective in addressing congestion and development issues. The HDOT also seems to have a pessimistic view about roadways which basically will shackle Hawaii to the doldrums as economic productivity and appeal to tourists will suffer greatly in the long run. Neither the Legislature nor the state DOT in Hawaii have made a commitment to reducing traffic congestion.

Unfortunately, neither the City nor the State departments of transportation in Hawaii can claim leadership in any aspects of traffic and transportation investment and operations, and their reliance on rail transit as a means for capacity increase and congestion reduction takes them back to the 19th century instead of the 21st. HOT lanes with incentives for hybrid vehicles and fuel-cell fueled buses would have put Hawaii among the frontrunners of U.S. transportation policy. The good news is that Honolulu is only in the Environmental Impact Statement (EIS) phase of its upcoming major transportation investment. There is, thus, hope and opportunity that rail transit will be scrapped and that a 21st century solution will be selected.

1.3. Lessons from Washington, D.C.

It is worth learning from the trials and tribulations of other metropolitan areas and the Metrorail expansion in the nations' capital is a fitting example. Vincent and Roth [3] compared the effectiveness of alternative transit modes to serve the Dulles Corridor, a suburban corridor west of Washington D.C. region that includes the Dulles International Airport. They described the current plan to build a 23-mile extension of the Washington Metrorail system and examined two alternatives to rail: (1) a dedicated busway used to provide bus rapid transit (BRT) service, and (2) a toll-managed facility that would be available for buses at no charge and open to other vehicles on a fee-paying basis (a version of HOT lanes). They concluded that the rail plan is roughly three times more expensive per new transit trip generated than either alternative examined. This finding has significant implications, because it means that funds currently earmarked for rail could be better invested in more productive transit options. Their cost results are summarized below.

Cost Per New Transit Trip Generated			
Dulles Rail Phase I	Dulles Rail Phase I and II	Busway/BRT Option	Express Toll Lane (ETL) Option
$26.41	$33.91	$8.75-$12.19	$8.56-$11.93

A number of lessons can be learned from the Washington D.C. Metrorail extension as discussed below. Bulleted items are from the Vincent and Roth analysis:

- In 1997, the Dulles Corridor Transportation Study recommended extending rail to route 772 in Loudoun County. The estimated cost of this extension was $1.45 billion.

- In 1999, the Supplement to the Dulles Corridor Transportation Study recommended beginning with enhanced express bus services followed by bus rapid transit (BRT) and ultimately rail.

- In April 2000, a process was initiated to obtain federal funding through the federal New Starts program. Four options were included in a Draft Environmental Impact Statement (DEIS): Metrorail, BRT, a combined BRT/Metrorail system, and a phased implementation beginning with BRT and resulting in Metrorail.

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[3] Vincent, W. and G. Roth, Comparison of Bus and Rail Transit Modes for the Dulles Corridor, Paper No. 06-2396, Transportation Research Board, Washington, D.C., 2006.

Lesson 1: The Washington D.C., DEIS includes three alternatives in addition to the base case, whereas the Honolulu DEIS includes only one: rail.

Lesson 2: Seven years later, Washington D.C., has not broken ground. Yet the current city administration claims that it will offer a DEIS in 2008 and expects to break ground in 2009. Honolulu's timetable is not realistic.

- The DEIS included a cost estimate for the Metrorail option of $3.246 billion, more than double the amount cited in the 1997 study.

Lesson 3: City administration's rail cost estimates have been all over the map starting from $2.7 billion when he asked for an increase of the GET from 4% to 5% to $4.6 billion in the City's alternatives analysis. There should be little doubt that if *TheRail* starts in Honolulu, even the minimum operating segment of 20 miles will cost well north of $5 billion. Meanwhile, the reader must be reminded that the Legislature raised GET from 4% to 4.5% only. In other words, the approved GET increase may be suitable for a $2 billion system, including a $750 million federal contribution, same as for the current request by the Washington, D.C. Metro.

- Due to the exceptionally high costs, the FTA demanded that the project be broken into two phases. FTA approved Phase I for preliminary engineering in June 2004. It was estimated that the cost for Phase I would be $1.5 billion and that the New Starts share would be 50%. The Final Environmental Impact Statement (FEIS) was issued in 2004, followed by a record of decision in March 2005. Three months later, in June 2005, the project team estimated that the costs for Phase I could be as high as $2.4 billion, a $900 million increase, unless substantial cuts are made to the project scope.[4]

Lesson 4: The closer a project goes to implementation, the higher the costs become. This is particularly true for rail projects. Note that FTA agreed to finance $750 million for the nation's capital and for the extension of a major existing rail system. City administration started with a

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[4] At the time of the release of this report the Metro's Dulles extension was basically dead:

U.S. Transportation Secretary Mary Peters and Federal Transit Administration chief James S. Simpson stunned Virginia politicians at a meeting on Capitol Hill yesterday when they outlined what Simpson called "an extraordinarily large set of challenges" that disqualifies the project from receiving $900 million in federal money. Without that, the project would die. "The sheer number and magnitude of the current project's technical, financial and institutional risks and uncertainties are unprecedented. I have serious concerns whether it would be appropriate to continue further investment."

SOURCE: Washington Post, Dulles Rail Project All but Dead, January 25, 2008.

promise of $450 million from FTA, then said $750 million, then $1.0 billion and then, $1.2 billion. It makes no sense that the FTA should spend any money for a small but hyperexpensive rail system in the middle of the Pacific Ocean after its painful failure in Puerto Rico. However, U.S. federal transit policy is inconsistent and prone to political pressure, so to some extent "anything goes" including the highly variable and baseless figures announced by Honolulu's city adminstration.

- ❖ The capacity of the full rail line is projected in 2025 to be 8,642 passengers per hour in the peak direction.

Lesson 5: Any three lanes of the H-1 freeway in the rush hour carry this amount of people. Freeway lanes with some high occupancy vehicles (large carpools, vans and buses) have a much higher capacity of passengers and reach hundreds of destinations instead of about 20 stations.

- ❖ We did not include benefits associated with the ability to implement either the busway/BRT or the ETL option sooner than rail. These benefits include the ability to provide commuting and air quality benefits sooner.

Lesson 6: The benefits of non-rail alternatives are significant in Washington, D.C. and will be even larger in Honolulu with its very large *TheBus* and carpooling rates, which are among the highest in the nation.

- ❖ We made no adjustment for the far higher risk associated with rail. Rail requires a significantly greater capital investment than BRT. If it fails, there is no other conceivable use for the project. This risk of failure was recently highlighted by the extension of San Francisco's BART system to San Francisco International Airport, which has attracted less than half of the projected ridership and faces severe service cuts.

Lesson 7: This one is both critical and self-explanatory. *TheRail* is a public investment risk that Oahu has no reason to take and no resources to cover for it in case of failure.

Based on the process so far, it is quite obvious that Honolulu has not learned much from experiences elsewhere. In the 2006 Alternative Analysis (AA), the City and County of Honolulu's Department of Transportation Services evaluated alternatives which would provide congestion relief along the corridor between Kapolei and Downtown Honolulu. The alternatives examined were sufficiently manipulated to conclude by that the Rail Transit Alternative would be the recommended Locally Preferred Alternative (LPA.) The Environmental Impact

Statement (EIS) phase of the federally-mandated NEPA process began in December 2005; the chosen alternative, currently called "a fixed guideway," is being reviewed to determine its potential impacts.

1.4. Honolulu's 2006 Alternatives Analysis

In a letter dated April 10, 2007 to the City and County of Honolulu, the Army Corps of Engineers offered the following comments to the City's AA:

- Existing and modeled traffic data from the 2006 Alternatives Analysis Report suggest the implementation of the LPA will not improve the LOS on most segments of the Interstate H-1 Freeway, including the high-occupancy vehicle and Zipper lanes, within the corridor study area.
- … the stated goal to "improve" existing conditions, or LOS, is somewhat misleading …
- … the inclusion of the verbiage "...to provide high-capacity transit..." is appropriate, but again, caution the use of language that is unduly restrictive.

In other words, the Army Corps understands that the City's AA declares its objective to improve traffic conditions but fails to do so, and its focus is basically to promote a transit system. The Corps cautions the City of its biased study by offering this comment:

- The Council on Environmental Quality regulations requires an EIS objectively and rigorously examines all reasonable alternatives to the proposal. Towards this end, the range of alternatives should include reasonable alternatives that are not within the jurisdiction of FTA and/or DTS, if they exist.

In the November 30, 2006 meeting of the City Council's Transit Advisory Task Force, member Prevedouros highlighted the deficiencies of the AA as follows[5]:

- The Managed Lane Alternative has been engineered to fail. Two expressway lanes were added and the existing zipper lane was subtracted, resulting in an inefficient net effect of adding a single freeway lane during the morning peak hour.
- The alternatives are based on unrealistic forecasts for public transit ridership. The error in the past and current forecasts is at least 21%. In other words, transit trips are forecast to be

[5] Prevedouros, P. D., "Honolulu Needs a Respectable Analysis Report to Help Honolulu Make the Right Decision About Mass Transit," www.hawaiireporter.com/story.aspx?d6581de9-ec07-4d89-bfe4-8ae3e62db404, 2006.

21% too many. The AA forecasts about 294,000 total transit trips per day in 2030. The AA credits rail for an increase of transit trips in the amount of 62,000. However, 21% of 294,000 is 62,000. Therefore, all rail trips are equal to the forecasting error.

- The AA estimates 62,000 rail trips out of over 3 million daily vehicle trips on Oahu, and out of 4 million person trips. Rail will serve between 1% and 2% of daily trips in 2030. The payoff for the cost of rail is extremely poor.
- Despite being engineered to fail in the AA, the 14-mile Managed Lane works almost as good as 20-mile Rail. This means that the expensive rail produces the same benefits as a short, single freeway lane. Again, in comparison, rail's payoff is tiny.
- Ewa Beach, Kapolei, Ko'Olina and Kalaeloa are estimated to change from 298,000 trips in 2005 to 704,000 trips, e.g., 136% growth in 25 years. Such a growth rate is improbable. If only half as much growth occurs, which is still optimistic, then these areas will produce 352,000 fewer trips. All Rail options predict a total of about 294,000 combined bus and rail trips. This means that without inflated forecasts, the Rail option is unsupportable.
- According to the AA, for the entire area between Aiea and Waikiki or Manoa, all Rail alternatives are predicted to provide the same or longer trip times than auto. Rail will provide no relief to traffic congestion. Rail will worsen congestion. Only carefully designed HOT Lanes has the potential to relieve some congestion.
- Honolulu's proposal has no sense of proportion: For example, Phoenix, Arizona with a population that is four times larger than Honolulu's is developing a light rail system with a cost that is less than one quarter the cost of Honolulu's proposed 28 mile heavy rail system.

1.5. The UH Study Group Alternatives Analysis

The City's EIS appears to continue the *shibai* that was the AA by focusing on a Fixed Guideway with alternative rail technologies but no other alternative solutions. Because of the major concerns with the City's Alternatives Analysis, because of Mayor Hannemann's stated preference for the rail alternative, because of the significant drawbacks of rail transit (several of which are summarized in Chapter 3,) and because other intuitive alternatives for congestion relief were designed to fail in the City's AA, the University of Hawaii Congestion Study (UHCS) group made a laborious attempt using detailed microsimulation to provide a fuller list of alternatives and some precise quantification of their effect on traffic congestion. This effort produced a comprehensive, honest and large scale alternatives analysis in which a variety of alternatives were given the opportunity to compete and were judged primarily on the basis of traffic congestion relief, but also on the basis of economic cost and environmental impact.

The objectives of the UHCS were to:

- Use the primary network of Honolulu's major arterials and freeways between Waikele and Waikiki and implement various scenarios for congestion relief.
- Use VISSIM simulation to model Honolulu network during weekday morning peak hour of traffic traveling in the eastbound direction from Kapolei to Moiliili.
- Analyze the impact of each alternative on congestion.
- Determine the most promising scenario which will relieve congestion.

The alternatives investigated included the following:

❖ **Rail** modeled as having a 6.5% or a 3.25% traffic reduction on H-1 Fwy., Kamehameha Hwy., Moanalua Fwy. In our opinion, the 6.5% scenario is highly optimistic and its results are an upper bound of what a highly successful *TheRail* service is likely to do to network traffic congestion.

❖ **Four Underpasses** which provide unimpeded access (i.e., the equivalent of a continuous green light) to heavy movements. The underpasses were: (1) left turn underpass from Nimitz Highway to Alakea Street, (2) Punchbowl through traffic going under Vineyard Blvd., (3) Pali Hwy. through traffic going under Vineyard Blvd., and (4) Kalakaua Ave. through traffic going under Kapiolani Blvd.

❖ **A 2-lane or 3-lane HOT expressway** from the H-1/H-2 merge to Iwilei with a bus ramp to Fort Street Mall and a left turn underpass to Alakea St.

❖ A **combination** of the 2- and 3-lane HOT lanes and the four underpasses.

- **Pearl Harbor Car Ferry** system whereby a large barge transports vehicles across the mouth of Pearl Harbor with a connection to Lagoon Drive through the airport. This system is tailored to Kapolei, Ewa and Ewa Beach areas and was designed with a 500 vehicle per hour capacity.

- **Pearl Harbor Tunnel** is a reversible 2-lane relatively short tunnel under the entrance of Pearl Harbor with cut-and-cover sections through the Honolulu International airport, priority lanes along Lagoon Drive and direct connection to the Nimitz Viaduct.[6]

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[6] Nimitz Viaduct is a 2-lane reversible "flyover" from the Keehi interchange (spaghetti junction) to Iwilei. This project has completed environmental review during the second Gov. Cayetano administration and can be put to bid at any time.

2. Congestion Conditions in Hawaii

UHCS analyzed the conditions of the Primary Oahu Trips using travel time data of various routes taken on Oahu which were collected by Austin, Tsutsumi and Associates in 1997. Table 2.1 summarizes the conditions, based on speed and travel time index (TTI is the ratio of the *Peak Hour Travel Time* over the *Normal Travel Time*) of trips during the morning (AM) and afternoon (PM) peak periods during school and summer seasons. As shown in Table 2.1, the AM Peak Period-School Season has more than 60% of trips at a Poor or Very Poor condition for both the Speed-based and TTI-based criteria. During the AM Peak Period-Summer Season, there is a decrease in Very Poor and Poor trip conditions and an increase in Tolerable trip conditions. For the PM Peak Periods, both seasons have relatively similar conditions, with the majority of trips being of Tolerable condition.

Table 2.1. Primary Oahu Trips Done under Very Poor, Poor and Tolerable Conditions

Morning Peak	School Season AM		Summer Season* AM	
Rating	Speed based	TTI based	Speed based	TTI based
Very Poor	35	41	16	27
Poor	72	36	68	0
Tolerable	10	40	30	87
Total Miles	117	117	114	114
Very Poor	**30%**	**35%**	**14%**	**24%**
Poor	**62%**	**30%**	**60%**	**0%**
Tolerable	**8%**	**34%**	**27%**	**76%**

Afternoon Peak	School Season PM		Summer Season* PM	
Rating	Speed based	TTI based	Speed based	TTI based
Very Poor	24	0	16	0
Poor	44	10	44	10
Tolerable	65	123	75	126
Total Miles	132	132	135	135
Very Poor	**18%**	**0%**	**12%**	**0%**
Poor	**33%**	**7%**	**32%**	**7%**
Tolerable	**49%**	**93%**	**56%**	**93%**

Rating Criteria	Speed	TTI
Very Poor	< 15 mph	≥ 2.0
Poor	15 - 25 mph	1.6 - 1.9
Tolerable	> 25 mph	≤ 1.5

Note: In summer season, some trip lengths are slightly different for some trips, so their total is 114 instead of 117 miles.

One of the UHCS authors made a sample trip from Kapolei to Downtown Honolulu in early August 2007 with only a few schools in session. The travel times were as follows:

Thursday, August 2, 2007	
6:00 AM	Leave Aeloa residential subdivision
6:06	Next to Kunia Road off-ramp
6:07	Enter zipper lane
6:10	Waiawa Road overpass
6:13	Kaonohi Street overpass
6:17	Radford Drive overpass
6:19	Exit zipper at airport viaduct and use regular lanes on Nimitz Highway
6:24	Next to Hilo Hattie's
6:25	Next to Bishop Street

These data indicate that the commute from Kapolei to Honolulu is quite tolerable under off-peak conditions; therefore, commuting would be tolerable if actions are made to mitigate traffic congestion. During the regular School Season, one has to depart at or before 5:30 AM, or after 8 AM for similar travel times. Nevertheless, outside these 2.5 hours on weekdays, travel time from Kapolei to Downtown Honolulu is in the order of about 30 minutes.

In general travel times in Honolulu are relatively short but delays during the peak periods are overlong resulting in unusually high travel time indices. This is evidenced in the results of the Texas Transportation Institute national highway congestion studies.

Table 2.2 shows that Honolulu fares quite well compared to its peers. Delays are relatively low but Honolulu's TTI is very poor. This is the direct result of Honolulu having an insufficient amount of lanes for its population. Honolulu has roughly 1.5 lanes per 1,000 people. San Juan, Puerto Rico has 2.2 lanes per 1,000 people. Most U.S. cities have 3.0 or more lanes per 1,000 people. This supports the idea that Honolulu is "the most lane deficient metropolitan area in the U.S."[7]. Another piece of good news from Table 2.2 is that Honolulu, thanks to its very slow population growth, has among the slower growth rates of congestion among its peers.

Table 2.2. Texas Transportation Institute Mobility Measures for Cities of Medium Population (500,000 to 1 million People)[8]

Comparison of Several Key Mobility Performance Measures
Medium Group – 500,000 to 1 million population urban areas

Urban Area	Delay per Traveler	Travel Time Index	Total Delay	1982 to 2005 Delay per Traveler	1982 to 2005 Total Delay
Jacksonville, FL	H+	H+	H+	F	F+
Nashville-Davidson, TN	H+	0	H+	0	F+
Salt Lake City, UT	0	H	H	0	F+
Raleigh-Durham, NC	H+	H	H+	F+	F+
Richmond, VA	L-	L-	0	S-	S
Louisville, KY-IN	H+	H+	H+	F+	F+
Hartford, CT	L-	L-	L	S	S-
Bridgeport-Stamford, CT-NY	H	H+	H+	F	F+
Charlotte, NC-SC	H+	H+	H+	F+	F+
Austin, TX	H+	H+	H+	F+	F+
Oklahoma City, OK	L-	L-	L	S	S-
Tulsa, OK	L-	L-	L	S-	S-
Tucson, AZ	H+	H+	H+	0	F+
Dayton, OH	L-	L-	L-	S-	S-
Honolulu, HI	**L**	**H+**	**L**	**S-**	**S-**
Birmingham, AL	H+	0	H	F+	F+
El Paso, TX-NM	L	0	L	F	S-
Rochester, NY	L-	L-	L-	S-	S-
Springfield, MA-CT	L-	L-	L-	S-	S-
Omaha, NE-IA	L	0	L	0	S-
Sarasota-Bradenton, FL	L	H	L	S-	S-
Allentown-Bethlehem, PA-NJ	L-	L	L-	S-	S-

Key:
0 – Average congestion levels or average congestion growth
H Higher congestion; **H+** Much higher congestion
L Lower congestion; **L-** Much lower congestion
F Faster congestion growth; **F+** Much faster growth
S Slower congestion growth; **S-** Much slower growth

Table 2.3 provides detailed characteristics for Honolulu and its rank among metropolitan areas in the U.S. Largely for all congestion and network performance measures,

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[7] Prevedouros, P.D., "Why Single Rail Line with 12-15 Stations is Bad Transportation Policy for Oahu," www.hawaiireporter.com/story.aspx?a7a89607-eac3-4bde-bf5d-e5a9ef963e60, 2006.

[8] Texas Transportation Institute, Comparison of Several Key Mobility Performance Measures. Medium Population Group, mobility.tamu.edu/ums/congestion_data/tables/austin.pdf, 2006.

Honolulu has remained relatively steady at rank 55. Its situation was much worse in the past: Honolulu's population was 695,000 in 1994 but that was before the H-3 freeway and the Kalanianaole Hwy. widening projects were delivered. As a result, in 1994, Honolulu's congestion rankings were much worse, in the range between 38th and 44th worse in the nation, as opposed to ranking between 51st and 57th worse in 2005. The figures in Tables 2.2 and 2.3 suggest that in relation to its peers, Honolulu's traffic congestion statistics do not justify multibillion dollar infrastructure with heavy federal subsidies.

Table 2.3. Texas Transportation Institute Mobility Data for Honolulu, Hawaii

Inventory Measures	2005	2004	2003	2002	2001	2000
Urban Area Information						
Population (1000s)	705	700	700	700	700	695
Rank	54	54	54	54	54	52
Urban Area (square miles)	140	140	140	140	140	140
Popn Density (persons/sq mile)	5,036	5,000	5,000	5,000	5,000	4,964
Peak Travelers (1000s)	383	378	376	372	367	359
Freeway						
Daily Vehicle-Miles of Travel (1000s)	6,015	6,000	5,930	5,775	5,740	5,625
Lane Miles	415	415	415	415	410	400
Arterial Streets						
Daily Vehicle-Miles of Travel (1000s)	3,250	3,200	3,175	3,155	3,135	3,115
Lane Miles	505	505	505	505	505	500
Public Transportation						
Annual Psgr-Miles of Travel (millions)	311	287	320	333	371	328
Annual Unlinked Psgr Trips (millions)	69	63	70	75	72	68
Cost Components						
Value of Time ($/hour)	14.60	14.10	13.75	13.45	13.25	12.85
Commercial Cost ($/hour)	77.10	74.60	72.65	71.05	69.95	68.00
Fuel Cost ($/gallon)	2.63	2.38	2.03	1.72	2.00	1.86
System Performance						
Congested Travel (% of peak VMT)	53	50	49	48	48	48
Congested System (% of lane-miles)	48	46	46	46	46	46
Congested Time (number of "Rush Hours")	6.8	6.8	6.6	6.4	6.4	6.6
Annual Increase Needed To Maintain Constant Congestion Level:						
Lane-Miles	11	8	6	2	0	-2
Transit Riders or Carpoolers (millions)	4	3	2	1	0	0
Annual Excess Fuel Consumed						
Total Fuel (1000 gallons)	6,255	5,680	5,466	4,930	5,085	4,966
Rank	53	54	53	56	53	54
Fuel per Peak Traveler (gallons)	16	15	15	13	14	14
Rank	46	48	48	54	52	49
Annual Delay						
Total Delay (1000s of person-hours)	9,342	8,496	8,110	7,252	7,639	7,393
Rank	53	56	56	58	55	56
Delay per Peak Traveler (person-hrs)	24	22	22	20	21	21
Rank	51	52	52	57	54	54
Delay due to Incidents (percent)	53	53	53	52	52	52
Travel Time Index	1.22	1.20	1.19	1.18	1.18	1.18
Rank	32	36	36	37	34	35
Congestion Cost						
Total Cost ($ millions)	166	145	134	116	121	114
Rank	53	56	57	59	55	56
Cost per Peak Traveler ($)	434	383	355	313	330	316
Rank	52	54	54	59	56	57

3. Experiences of Rail Transit in the U.S.

Rail transit may have some significant advantages in (1) very large, very dense, lane-poor and parking-poor older cities such as the millennia old European and Asian cities which developed along ancient foot and chariot paths and are littered with monuments that make right-of-way acquisition impossible, thus necessitating the boring of small tunnels for rail transit, or (2) in overcrowded modern cities with relatively poor populations (a high proportion of auto-less as in developing countries like Brazil and Thailand). Rail transit has a number of substantial disadvantages for modern U.S. cities, a small sample of which is given below.

<u>3.1. U.S. Urban Rail System and Social Welfare</u>

Economists Wiston and Mahashri studied the relationship of 25 U.S. urban rail system and social welfare; they observed that:[9]

- ❖ In 1980 two million Americans got to work by rail transit but in 2006 fewer than one million Americans commuted by rail, in spite of an over 50% increase in the general population, urban jobs and transit coverage.
- ❖ Rail transit's fare-box revenues have consistently failed to cover its operating and capital costs since World War II. Since 1980, annual operating subsidies have climbed from $6 billion to more than $15 billion today.
- ❖ Rail transit's fundamental problem is its failure to attract sufficient number of riders to reduce its high (and increasing) cost.
- ❖ Rail operations are best suited for yesterday's concentrated central city residential developments and employment; they are not suited for today's geographically dispersed residences and jobs.

The most significant conclusion of their detailed analysis which was published in a highly regarded journal was that "with single exception of BART in the San Francisco Bay area, every U.S. transit system actually reduces social welfare. " In plain terms, investment in rail

[9] Wiston, C. and V. Mahashri, "On the Social Desirability of Urban Rail Transit Systems," Journal of Urban Economics, 2006.

transit does not make sense because society spends much more resources in it compared to the benefits that it gets from it.

The importance of private mobility for the poor and welfare recipients may be summarized by the following three important findings:[10]

- "In most cases, the shortest distance between a poor person and a job is along a line driven in a car. Prosperity in America has always been strongly related to mobility and poor people work hard for access to opportunities. For both the rural and inner-city poor, access means being able to reach the prosperous suburbs of our booming metropolitan economies, and mobility means having the private automobile necessary for the trip. The most important response to the policy challenge of job access for those leaving welfare is the continued and expanded use of cars by low-income workers." Quoted from Waller and Hughes (1999) from a study by the Progressive Policy Institute.
- "Findings such as these led President Clinton to propose reforms to encourage greater automobile ownership among welfare recipients."
- "Cars are necessary to improve the low-income quality of life because public transport service that would serve the same function does not exist. This is illustrated by a Federal Transit Administration study of Boston, which has one of the best public transport systems in the United States. The study found that only 14% of jobs in the high-growth suburbs of Boston were within one hour's transit ride of inner-city low-income areas."

3.2. Does More Transit Really Relieve Congestion?

According to a study of congestion relief by Cox and O'Toole, "transit has little chance of reducing congestion in U.S. urban areas"[11]. Results from this study show that increasing the transit's market share by 50% would reduce a commuter's travel time by 44 seconds per day, but natural traffic growth in the areas would counteract the reduction. If increasing the market

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[10] Ziv, J.-C. and W. Cox "Megacities and Affuence: Transport & Land Use Considerations,", presentation to the World Conference on Transport Research, Berkeley, www.publicpurpose.com/ut-wctrs2007.pdf, June 2007.

[11] Cox, W. and R. O'Toole "The Contribution of Highways and Transit to Congestion Relief: A Realistic View", Heritage Foundation, http://www.heritage.org/Research/UrbanIssues/bg1721.cfm, 2004.

share by 50% were possible, then funding for transit spending would be raised from $35 billion to over $110 billion per year.

3.3. Misleading Cost Estimates

The issue concerning underestimation of costs for public works projects was researched to determine if this practice is common error or deliberate lying. A significant research results article[12] published in the Journal of the American Planning Association (APA) concluded that:

1. In both the U.S. and Europe, the cost underestimation for rail projects was much higher than for highway projects (i.e., the average cost escalation was 44.7% for rail and 20.4% for road projects).
2. In North America, rail had an average cost escalation of 40.8%, while road projects had a five times smaller escalation of 8.4%.
3. Project costs are usually underestimated in order to get public approval to be constructed, or to be more appealing when competing for federal funds. There is a tendency to hide or leave out certain costs and risks related to the project. (Examples for "missing" rail costs include station security and transit police, parking garages, power plant, etc.) Furthermore, instead of leaving out important factors, certain risks and costs are revealed one at a time to prolong the appearance of a low cost project.
4. It is found with overwhelming statistical significance that the cost estimates used to decide whether such projects should be built are highly and systematically misleading. Underestimation cannot be explained by error and is best explained by strategic misrepresentation, that is, lying."

Dr. Flyveberg's analysis of rail and highway project cost overruns proves that one can catch "strategic misrepresentations" of elected and public officials after the system has been built. However, strategic misrepresentations are hard to prove when the project is in the analysis-and-approvals stage. Mayor Hanneman's stated preference for rail is well known from his campaign and other appearances such as the TV spot urging voters to "re-elect Senator

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[12] Flyvbjerg, Bent, Mette Skamris Holm, Søren Buhl. "Underestimating Costs in Public Works Projects, Error or Lie?", Journal of the American Planning Association, Vol. 68, No. 3, 2002.

Akaka so that he and Senator Inouye will help us get federal funds for the rail we so desperately need."

In addition to the items listed as major shortcomings of the City's AA, one can also detect bias against non-rail alternatives such as the Transportation System Management (TSM or "all bus" alternative) and the high occupancy/toll lanes (HOT lanes) as follows.

The Metrorail extension to Dulles airport in Washington, D.C. has been in design and planning for many years. Currently it is on the brink of losing its federal funding. Of significance is its cost: $244 million per mile.[13] In the Honolulu's AA, the proposed rail costs $240 million per mile.

Conclusion 1: **The cost of rail in Honolulu is about the same as in the mainland.** This is surprising because officials have consistently mentioned that Hawaii construction costs are often double those on the mainland.

Tampa's 3-lane reversible elevated lanes cost $320 million or $32 million per mile. In the City's AA, the proposed 2-lane reversible elevated lanes cost $162 million per mile.

Conclusion 2: **The cost of elevated lanes in Honolulu is about five times the cost in the mainland.**

By comparing conclusions 1 and 2, we reach the final conclusion which agrees with the research by Dr. Flyvberg and his team:

Conclusion 3: **Cost data in the Honolulu AA are "strategically misrepresented" to under-report rail costs and over-report highway and bus lane costs.** In plainer language, lies are used to support *TheRail* alternative.

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[13] Washington Post - August 23, 2007; A18.

3.4. Costs per Person-Mile: Arizona DOT Estimates vs. Honolulu Rail Estimates

In December 2006, Arizona DOT analyzed the costs in cents per person-mile of several urban transportation alternatives. The costs were concluded to be as follows:

- HOT lane 1.2 to 2.7 ¢
- General purpose lane 1.9 to 4.2 ¢
- HOV and bus lane 2.6 to 5.7 ¢
- Exclusive bus lane 6.6 to 14.7 ¢
- Light rail line 16.1 to 35.8 ¢

Notably, for Phoenix, HOT lanes are roughly ten times cheaper per passenger mile than light rail. Furthermore, comparing these costs to the 720-920 cents per passenger mile of Honolulu's rail proposal, makes it clear that a $5 billion rail project is entirely inappropriate for Honolulu[14].

3.5. Sound Transit, Seattle, WA

In 1996, officials affirmed that the construction of Sound Transit would cost $3.9 billion and be completed in 10 years. [15] In 2007, costs skyrocketed to $15 billion with an estimated completion time of 24 years; this only includes Phase I of the proposed light rail deployment. The additional Phase II will cost $20.2 billion and bring the total estimated cost of Sound Transit to $35.2 billion. With an expected 351,000 riders on the rail system, the cost to take one passenger vehicle off the roadway would be roughly $100,000 per person.

Unlike Hawaii, voters in Washington State were called to consider a major transportation funding initiative which relied heavily on local taxes. The lion's share of the funding would go into light rail transportation. The Seattle Times[16] urged voters to defeat Proposition 1 which "would increase the rate of general sales tax to 9.5 cents on a dollar, and on restaurant food to 10 cents. … Most of the increase, five-tenths of a cent, is for Sound Transit's 50 additional miles of light rail, which the people are asked to fund before the first miles even open."

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[14] Kidd, B.D., "Multimodal Optimization of Urban Freeway Corridors," Final Report 582, www.azdot.gov/TPD/ATRC/publications/project_reports/pdf/az582.pdf, November 2006.

[15] Ennis, M., "Sound Transit's rising costs belie logic of light rail", Puget Sound Business Journal, March 23, 2007.

[16] Reject Proposition 1, seattletimes.nwsource.com/html/editorialsopinion/ 2003948183_roadsed14.html.

The same article also informed its readers as follows about light rail: “Consider Portland. That city opened its first light-rail line two decades ago, and has built several of them, all of which replaced bus lines. Overall, Greater Portland is no less car-dependent than Seattle. Its congestion has gotten worse, just as it has here. Many Portlanders are proud of light rail, but the last three times new light-rail plans have been on the ballot in the Portland area, the people rejected them. Maybe they learned something.”

In fall 2007, Washington State voters resoundly defeated Proposition 1. Herein lies a valuable lesson for Honolulu. It was wise that prior attempts for rail in Honolulu have failed. The odds are huge that rail will not work in Honolulu as it has not worked in most places where it has been implemented. This includes places like Portland which are heralded as major successes of light rail by rail proponents. And Seattle where billions of dollars have been sunk into an ineffective black hole. For more documented rail transit failures see section 3.10.

3.6. Rail’s Energy Consumption

Reason Foundation raises an important question relating to the misguided preference of transit instead of autos for environmental reasons:[17] “Over the last several decades, reducing vehicle miles of travel (VMT) has become a core goal of many transportation planners. The original rationale was cleaner air, since in much of the country, tailpipe emissions were the largest contributor to smog. Today, the rationale for VMT reduction is to reduce greenhouse gas emissions. If technology produces vehicles that are cleaner than transit and produced little or no greenhouse gases (GHGs), would they still support VMT reduction?”

“In the U.S., excluding the New York metro area which has an exceptionally high transit mode share compared to anywhere else in the USA, transit elsewhere averages 310 grams per passenger mile, compared with 307 for the average 2006 model car and 328 for the overall car fleet in 2006. The 2007 Toyota Prius hybrid car measures at 147, and a 2008 Peugeot hybrid diesel (so far offered only in Europe) at 101. Both are comparable or better than New York

[17] Poole, R., “What If There Were "Green" Cars? A Litmus Test for Planners”, Surface Transportation Innovations, Issue No. 50, www.reason.org/surfacetransportation50.shtml, December 2007.

metro area transit (140). However, technology is moving toward more efficient and less-GHG-intensive vehicles. So the idea that we should be restricting mobility by VMT reduction mandates in order to "save the planet" from global warming seems to be truly wrong-headed."

Table 3.1 illustrates the energy consumption of light and heavy rail in various cities in the U.S. The table provides the name of the city, agency, the city's population, the system's fare box recovery and the energy consumed per passenger-mile. Among the systems that reported energy data, most perform worse in terms of energy efficiency than cars, that is, they consume more BTUs than cars.[18] It is important to note that over the past 20 years, car energy efficiency in terms of BTU per passenger mile has improved by 19.5%. The energy efficiency for rail is stagnant, but because of its decreasing ridership, rail transit's BTUs per passenger mile worsened by 20.5% in the last 25 years.[19] Importantly, in the next 20 years, hybrid, fuel-cell, ethanol and biodiesel fueled cars will be common, resulting in a substantial reduction in energy consumption and oil dependency for transporting people to their destinations.

"Carbon footprint" is an expression used to represent the environmental pollution impact of a mode, process or activity; it is largely focused on the greenhouse gas carbon dioxide or CO_2. In terms of carbon footprint, Rail modes do far worse than reported in Table 3.1 above because in the supermajority of applications in U.S. rail systems have been unable to reduce traffic congestion. Not only do they not reduce traffic congestion but also they sap the transportation funding resources available in a city to resolve bottlenecks and deploy congestion relief projects. The lack of enough lanes for the demand present leads to giant carbon footprints in U.S. metropolitan areas and rail has a major direct and indirect role in this.

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[18] BTU or British Thermal Unit is used to describe the heat value (energy content) of fuels. This measure is in use mostly in North America. One thousand BTUs per hour is approximately equal to 293 Watts (W).

[19] U.S. Department of Energy, Transportation Energy Data Book, 26e, www-cta.ornl.gov/data/index.shtml, 2007.

Table 3.1 U.S. Light and Heavy Rail Systems that Consume More (Red) or Less (Green) Energy than Cars

ID	Type	City	Agency	Population	Farebox Recovery	BTUs/PM
2099	HR	**Staten Island**	Staten Island Rapid Transit Operating Authority	463,314	16.8%	**8,906**
4034	HR	**Miami**	Miami-Dade Transit	2,379,818	15.9%	**6,641**
5015	HR	**Cleveland**	The Greater Cleveland Regional Transit Authority	1,412,140	18.9%	**6,094**
9154	HR	**Los Angeles**	Los Angeles County Metropolitan Transportation Authority	8,493,281	21.3%	**5,535**
2075	HR	**Lindenwold**	Port Authority Transit Corporation	743,886	53.5%	**5,276**
1003	HR	**Boston**	Massachusetts Bay Transportation Authority	4,510,400	46.5%	**4,121**
3034	HR	**Baltimore**	Maryland Transit Administration	2,077,667	30.9%	**4,070**
3019	HR	**Phila- delphia**	Southeastern Pennsylvania Transportation Authority	3,330,669	52.2%	**3,827**
5066	HR	**Chicago**	Chicago Transit Authority	3,708,773	38.6%	**3,717**
2098	HR	**Jersey City**	Port Authority Trans-Hudson Corporation	2,820,000	45.0%	**3,468**
3030	HR	**Washington**	Washington Metropolitan Area Transit Authority	1,305,693	65.2%	**3,275**
9003	HR	**Oakland**	San Francisco Bay Area Rapid Transit District	833,762	56.6%	**2,314**
2008	HR	**New York**	MTA New York City Transit	8,008,278	68.3%	**2,187**
4022	HR	**Atlanta**	Metropolitan Atlanta Rapid Transit Authority	1,354,871	32.1%	**2,084**

ID	Type	City	Agency	Population	Farebox Recovery	BTUs/PM
3034	LR	**Baltimore**	Maryland Transit Administration	2,077,667	13.1%	**8,380**
3022	LR	**Pittsburgh**	Port Authority of Allegheny County	1,415,244	15.5%	**7,627**
9013	LR	**San Jose**	Santa Clara Valley Transportation Authority	1,759,585	12.2%	**7,055**
0040	LR	**Seattle**	Central Puget Sound Regional Transit Authority	2,653,000	0.0%	**6,761**
2004	LR	**Buffalo**	Niagara Frontier Transportation Authority	1,182,165	21.5%	**6,087**
5015	LR	**Cleveland**	The Greater Cleveland Regional Transit Authority	1,412,140	14.4%	**5,865**
9019	LR	**Sacramento**	Sacramento Regional Transit District	1,035,009	21.2%	**5,653**
2080	LR	**Newark**	New Jersey Transit Corporation	17,799,861	24.0%	**5,170**
3019	LR	**Philadelphia**	Southeastern Pennsylvania Transportation Authority	3,330,669	31.3%	**5,051**
6056	LR	**Dallas**	Dallas Area Rapid Transit	2,250,300	12.2%	**4,627**
8006	LR	**Denver**	Denver Regional Transportation District	2,598,000	30.5%	**4,405**
9015	LR	**San Francisco**	San Francisco Municipal Railway	793,403	21.4%	**4,288**
9154	LR	**Los Angeles**	Los Angeles County Metropolitan Transportation Authority	8,493,281	15.8%	**3,186**
6008	LR	**Houston**	Metropolitan Transit Authority of Harris County, Texas	2,796,994	13.9%	**2,826**
4008	LR	**Charlotte**	Charlotte Area Transit System	681,310	15.7%	**2,823**
7006	LR	**St. Louis**	Bi-State Development Agency	1,006,570	26.0%	**2,617**
1003	LR	**Boston**	Massachusetts Bay Transportation Authority	4,510,400	47.2%	**2,509**
8001	LR	**Salt Lake City**	Utah Transit Authority	1,744,417	32.2%	**2,352**
5027	LR	**Minneapolis**	Metro Transit	1,761,657	42.4%	**2,281**
0008	LR	**Portland**	Tri-County Metropolitan Transportation District of Oregon	1,253,502	34.4%	**2,202**
9054	LR	**San Diego**	San Diego Trolley, Inc.	2,102,396	53.9%	**1,946**

No reported data for systems that are not shown

The obvious observation from Table 3.1 is that most systems are more energy intensive (and thus polluting) than today's cars. Two additional observations are that most systems recover less than half of their operating costs from the fares paid by the riders. The initial construction and the cyclical rehabilitation of the systems are not included in the routine operation and maintenance costs. In short, for many systems, fares cover less than 10% of the costs. A major example of the cyclical rehabilitation of rail systems is in the next section.

3.7. Metro Rail Costs: Cyclical Refurbishment

Unlike the relative simplicity of highways, metro rail (heavy and light rail) is a complex electromechanical system with literally millions of wearing and weathering components, in addition to those destroyed by misuse or vandalism. The following quote from a recent article[20] provides a picture of the huge sums involved in the refurbishment of these systems every 20 to 30 years.

BART train cars and tracks that carry 350,000 people a day are slowly wearing out.

Cables and computers that signal cars to slow down or speed up have a few more years of reliable life.

Wires and circuits that deliver electricity to power the trains are running low on time.

At 35, BART is getting old.

The transit system's board approved on Thursday a 25-year road map that foresees the need to spend $11.4 billion on hardware and equipment but identifies funding sources for only half the money.

Finding the other half -- a $5.8 billion shortfall -- will be a big but necessary task, BART managers and board members said.

Franklin said he is anxious to avoid sharp fare increases to fund improvements, like the steep increases BART imposed in the mid-1990s to fund a $1.5 billion overhaul of train stations, fare gates, escalators and elevators.

The biggest challenge is lining up $5.5 billion to invest in the replacement or modernization of BART's basic equipment, including cars, escalators and car-washing yards.

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[20] Cuff, D., "BART gets rusty: Aging system lacks billions for infrastructure," Contra Costa Times, September 28, 2007.

BART estimates it will need $2.1 billion to replace all 669 trains cars, and $420 million to rehabilitate aging stations, elevators and escalators.

Many of those original cars have run since BART began service in 1972. Although renovated once, those cars are expected to wear out by 2015, transit planners estimate.

The electric train system has 3 million feet of cable to power cars. Much of it is expected to wear out in a decade, BART planners said.

Security concerns about terrorism in the post-Sept. 11, 2001, world have aggravated the funding crunch. BART needs to invest $278 million in safety and security equipment for items such as surveillance cameras, explosives-detection equipment and emergency communication systems, according to the plan. For security reasons, BART does not disclose specifics.

3.8. Commuting in Hawaii

"Commuting in America"[21] reports the nation's trends and patterns of commuting. A summary of this report with a focus on Hawaii's trends is included in Appendix A. Sample highlights include the following:

- Rail transit is found in large, high density areas with a population over 5 million. These are two characteristics Honolulu does not have. Honolulu has a relatively small population, a low population growth, and a low density outside the Chinatown to Waikiki corridor which is roughly five miles long. Oahu has many large communities scattered throughout the island, and large parts of population reside in ridges and valleys all of which are very far from the various proposed rail stations.

- Hawaii is one of three states with a drive alone share of less than 70%. Also, Hawaii as a whole has a high carpooling rate of 19%; all other states range between 9% and 15%. The carpooling rate is even higher for Honolulu. A wise transportation policy would capitalize on already established good travel behavior habits such as bus usage and carpooling. Basing a transportation policy on the wish that "rail will get people out of their cars" is inappropriate and there is no evidence that this politician's wish has worked in the US.

[21] Transportation Research Board, "Commuting in America", National Academy of Sciences, 2006.

- Nationally, transit travel times are about twice that of driving alone. Drivers in Hawaii have a tendency to have multiple stops due to multiple jobs, schools, or activities. Commuting with rail transit makes it difficult to complete multiple trips in a timely manner.

3.9. Learning from Another Island: Tren Urbano in Puerto Rico

There are three populous islands with rail systems: San Juan (Puerto Rico), Singapore and Taipei (Taiwan). It is rather obvious that Honolulu does not compare with the population and density of either Singapore or Taipei.[22] However, it is comparable with Puerto Rico as shown in the comparison table below. San Juan recently deployed a rail line, and it is one of the poorest performing rail systems despite San Juan's very large population, much lower income (which typically translates into a high demand for public transportation) and a much lower level of vehicle ownership. Hard demographic data clearly indicate that the case for rail in Honolulu is much weaker than it is for San Juan.

Island	City	Population Island	Population City	Median Household Income	Motor Vehicles per Capita	City Population Density
Oahu	**Honolulu**	**909,863**	**371,657**	**$54,714**	**1.5**	**4,337**
Puerto Rico	**San Juan**	**3,808,610**	**434,374**	**$17,184**	**0.6**	**3,507**

The construction costs for the 10.7-mile line was $2.25 billion. The official forecast in the Final Environmental Impact Statement, approved by the FTA was $1.25 billion.[23] Slater's careful analysis of Tren Urbano statistics provides the following implication for Honolulu:[24]

[22] **Singapore** has a population of 4.7 million and a density of 16,392 people per square mile. **Taipei** in Taiwan has a population of 2.6 million and a density of 25,031 people per square mile. Rail advocates often refer to the busy and successful systems in London, New York City, Paris and Tokyo among others. The respective densities of these cities are 12,331 for **London**, 27,083 for **New York City**, 52,921 for **Paris** and 35,559 for **Tokyo**. The density in urban **Honolulu** is 4,337 people per square mile. In terms of population, London is the least populous of these four large cities. Entire Oahu has a population eight (8) times smaller than London.

[23] The Americal Public Transit Administration (APTA) refers to the project costing $2.5 billion.

[24] Honolulu Star Bulletin, Gathering Place, Sunday, July 22, 2007.

- Dividing the Tren Urbano's $2.25 billion cost by its 10.7 mile length results in $212 million per mile. Honolulu's Locally Preferred Alternative transit line is scheduled to be 28 miles long. That would suggest that Honolulu's rail construction costs could be $6.0 billion. However, since Honolulu's labor costs are 47% higher than San Juan's, a much higher cost should be expected.

As mentioned earlier, San Juan has many more, and relatively poorer residents that Honolulu, thus ridership in San Juan should be expected to be higher than in Honolulu. However, the first year's average daily ridership on Tren Urbano was 25,000 against the official forecast of 80,000[25].

Curisouly, if one proportions the Puerto Rico forecast of 80,000 trips by the Honolulu and San Juan city populations gets this result: 80,000 * 371,657 / 434,374 = 68,400 riders for Honolulu. The Honolulu Alternatives Analysis estimate for rail riders for the 28 mile line is 128,500 and for the 20 mile line is 95,000. Based on the San Juan experience, *TheRail* trip forecast is entirely unrealistic (but "estimated" to be high enough in order to make *TheRail* eligible for federal subsidy.) Notable, since the late 1980s the same consultant has been predicting a rise in transit trips in the various city attempts to augment its transit service, but *TheBus* service has been declining rather steadily.

There is no reason to expect a performance of rail transit on Oahu island that would be in any way cheaper or better (in terms of ridership) than rail transit on Puerto Rico island. An independent analysis of Tren Urbano is provided in Appendix B.

<u>3.10. Summary</u>

There can be no more effective summary of the disadvantages of urban rail systems than the reports and comparisons coming directly out of the U.S. DOT and the Federal Transit Administration, as summarized below.

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[25] "Urban Train usage could affect funding." San Juan Star, June 12, 2006.

U.S. DOT's Volpe Center researcher Don Pickrell produced a much-cited report[26] (which is also a part in the 2007 FTA report discussed below) on the poor performance of new metro rail systems. Their costs were grossly above the estimates at the time the decision was made to go forward. The ridership numbers were far below projections. None of the 10 federally supported rail projects that were examined by Pickrell achieved their ridership target, and nine of the 10 achieved less than 50%.

In October 2007, the Federal Transit Administration released report titled "Predicted and Actual Impacts of New Starts Projects."[27] A major observation is that there is still a strong pattern of cost overruns, but it is less than for the earlier rail projects documented by Pickrell. The average capital cost of these projects was 121% of what was projected at the time the decision was made to go forward (at the AA/DEIS stage).

Although costs overruns have been reduced, the ridership numbers are dismal.[28] In each case, the researchers compared the actual average weekday boardings in the transit agency's forecast year with the projected boardings for that year which were made at the AA/DEIS decision point. The average for all 19 projects for which data were available is 65%. Only three exceeded their projections (by between 1% and 34%), and the range among those falling short is very wide—from a low of 6% (Jacksonville people mover) to many others in the 40%-60% range, with others in the 70%-80% range. Some rail projects with fairly high percentages achieved them simply by aiming low: BART's Colma extension got 86% of what it projected, but that amounted to only 13,060 weekday boardings, for a very costly heavy-rail line; likewise for Baltimore's heavy-rail Johns Hopkins extension, averaging only 10,128 weekday boardings. For comparison, Honolulu's minimum expectation is for about 90,000 riders.

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[26] Pickrell, D., "A Desire Named Streetcar: Fantasy and Fact in Rail Transit Planning," Journal of the American Planning Association, Vol. 58, No. 2, pp. 158-176, 1992.

[27] Inserted as a 191-page appendix in FTA's "Contractor Performance Assessment Report" dated August 2007.

[28] Reason Foundation, New Report Shows Transit Progress—and Limits, www.reason.org/surfacetransportation48.shtml#feature2, 2007.

4. Tampa REL and Honolulu HOT

4.1. Tampa's Reversible Express Lanes

A unique toll road, Tampa's Crosstown Expressway Reversible Express Lanes (REL) developed, owned and operated by the Tampa-Hillsborough County Expressway Authority opened to motorists in July, 2006[29]. REL is a common sense transportation solution that addresses urban congestion by combining the innovations of concrete segmental bridges, reversible express lanes, cashless open road tolling and full electronic controls. The revolutionary "six lanes in six feet" freeway was constructed within the existing right-of-way of the Lee Roy Selmon Crosstown Expressway. It provides three lanes toward Tampa in the morning peak and three lanes out of Tampa and into the rapidly growing suburb of Brandon in the afternoon peak. During midday, a central segment is closed and the Tampa and Brandon segments operate independently on a direction that optimizes local traffic circulation.

Cars and buses are allowed on the REL. A $1.50 toll is charged in 2007 but entry is unimpeded because tolls are collected electronically via in-vehicle transponders or with license plate recognition. REL provided a spectacular reduction in congestion: Before speeds of 15 mph in the peaks rose to free flow speeds of about 60 mph. For many commuters, this change produced a full hour of round-trip travel time savings. REL was constructed at a record low cost per mile, had minimal environmental impacts, created a minimal disruption to adjacent traffic, and spurred development growth in both Tampa and Brandon. Actual traffic volumes have exceeded forecasts.

Like many urban areas, purchasing the necessary additional land in this corridor for typical highway widening was neither physically nor financially feasible. Consequently, to minimize footprint, most of the project was constructed as a bridge built using only six feet of space within the existing median. This resulted in an aesthetically pleasing structure which also reduced project costs as well as impacts to the community and the environment. The shape of the box that supports the deck and transfers loads to the pier limits the view of the underside of

[29] Prevedouros, P.D. and M. Stone, "Traffic Operations and Structures: Tampa's Reversible Express Lanes, 2008 Almanac of Science and Technology, McGraw Hill, 2008. See Appendix C.

the bridge to only half of the structure, providing light, and limiting the structure's visual impact. The resultant perception is that of an overpass instead of a "double-decker" structure.

Before opening REL, the traffic on the existing 4-lane divided toll facility was at Level of Service (LOS) F[30] during the peak hours of operation. Of the total 115,000 average trips during a weekday, more than 75,000 occurred between I-75 and downtown Tampa on the east end of the highway. The REL is ahead of traffic forecasts. The forecast entries for the first year of operation were 12,500 vehicles per day. In February 2007 REL carried 15,960 vehicles.

REL opened on a limited basis in mid-2006 and fully in January 2007. Since then, it provides motorists trip time savings of up to one hour per day at a cost of $3. Travel time was not only substantially shortened but became reliable due to the safe conditions resulting from the express lane design and the elimination of vehicle conflicts caused by large trucks and numerous entrance and exit ramps. The reduced trip time also is responsible for public transit development of enhanced express bus service from suburban Brandon to downtown Tampa. Within weeks of the initial opening of the REL, public transit ridership was up by over 40% on two express bus routes.

The 3-lane, reversible post-tensioned steel-reinforced concrete segmental bridge was constructed in 9-foot segments at an off-site casting yard, delivered to the Expressway and then assembled in the median of the existing roadway virtually eliminating any impacts to adjacent land uses, the surrounding community or the environment.

The construction started with the installation of piers in the median. Subsequently, a steel truss, designed for REL, was placed between the piers to temporarily support the segments while they were being assembled, allowing much of the work to be performed from above, therefore minimizing impacts to the traffic on the existing Crosstown Expressway lanes below. All segments were match-cast at the casting yard so the on-site assembly was rapid, the resultant geometry flawless and assembly was expedient.

Weighing about 70 tons each, the 59-foot-wide segments were delivered to the Expressway on 13-axle flatbed trucks, also designed for this project. The segments were then

[30] LOS is a grading scheme for representing the quality of traffic operations; it ranges from A (best) to F (worst) -- Highway Capacity Manual, Transportation Research Board, Washington, D.C.

assembled during off-peak times. After the segments were lowered onto the truss, they were pulled together with post-tensioned steel cables inside the bridge.

Concrete segmental bridge construction is most efficient for longer structures and the efficiency increases as the length of the project increases. With more than 3,000 segments, REL took advantage of the cookie-cutter approach to bridge development. The total contract cost for the project was approximately $300 million in year 2004 terms. This includes all of the planning, design, right-of-way, construction, and construction management and inspection for the reversible express lanes and the two gateways. The cost also includes the electronic control and safety systems required to operate the lanes and the new three-story Traffic Management Center.

The actual contract price for the 17.5 lane miles of bridge structure was just over $100 million. At approximately $120 million, the deck cost for the segmental bridge portion of the project was approximately $65 per square foot, far below the average cost for structures in Florida during the past 20 years. The average cost per lane mile for the reversible bridge is approximately $7 million and is among the lowest for bridges constructed in the U.S.

Several of the concepts employed on REL have direct application to other transportation needs throughout the world. The concept of increasing the capacity of transportation corridors through innovative design and maximizing the use of existing public rights-of-way is directly applicable to traffic congestion problems in all urban areas (tolled or not). The tolling technology, payment and enforcement programs are applicable to other express toll lanes, high-occupancy-toll (HOT) lanes and open road tolling facilities everywhere.

4.2. HOT Lanes for Honolulu

HOT expressways are primarily express high-occupancy-vehicle and public transit highways with the ability to zip traffic along at 60 miles per hour by applying a congestion-dependent toll for low occupancy vehicles so that the facility does not get inundated (and jammed) with an amount of traffic that exceeds the capacity of the facility. As a result, buses can travel 10 miles in about 10 minutes. To put this in context, a city bus would be able to travel from the Waikele Shopping Center to Aloha Tower in about 20 minutes at the height of morning rush hour. No other mass transit facility can provide such a high level of service that can actually persuade some motorists to leave their private vehicles at home and choose the express bus. On HOT expressways all buses and vanpools travel free of charge at all times.[31]

A 2- or 3-lane reversible highway can serve several thousand vehicles per hour. For example, a 2-lane facility can serve about 3,000 buses in one hour. But there are no 3,000 buses and large vans in all of Oahu to fill the facility. Therefore, such a highway has a lot of room available to serve low occupancy vehicles. If too many low occupancy vehicles are allowed on it, then the highway will jam, and the speed will be much less than 60 mph. How can this be controlled? With variable tolls that start at $1 for low occupancy vehicles and grow to about $5 at the height of the peak hour. In this way, fewer vehicles enter the HOT highway and its service is maintained at 60 mph. The average toll charge during the morning commute period is expected to be around $3.50 in current values.

In other words, the toll enables the government or other project operator to sell unused space to low occupancy vehicles. Tolls can generate a cash flow to pay for the facility. This type of operation makes these highways appealing to investors because a steady income and a reasonable return for their upfront investment for construction can be made. There are several investment funds worldwide that specialize in tollway and HOT lane development and the U.S. federal government strongly supports PPP, or public-private partnerships. Alternatively, the tolls collected from all-public HOT expressways retire some of the bond debt, and support express bus operations; San Diego does this.

Most people want to have a choice for paying a toll and getting to town in 15 to 20 minutes. Self-employed practitioners would be happy to pay a few dollars of toll and in return get the opportunity to make an extra house call and make extra income. But even those who cannot afford to pay the toll will benefit significantly. For a three lane highway, over 4,000 low occupancy vehicles per hour can use the facility along with city buses, tour buses and vanpools. As a result, over 5,000 vehicles per hour will vacate the H-1 freeway prior to its merge with the

[31] The public, private or joint operator of the HOT lanes has the ability to set the desired level of occupancy. For example, the proposed HOT lanes on Oahu could be the **HI-5 Expressway** on which all vehicles with five or more people in them would travel for free at all times. Technologies for automated vehicle occupancy inspection are available in prototype real world deployments and in consideration for installation on the Capital Beltway HOT lanes and elsewhere in the U.S.

H-2 freeway. Those who stay on the H-1 freeway will enjoy several minutes of savings in peak hour travel time, for free. See Chapter 7 for our travel time estimates.

The Metropolitan Transportation Commission, San Francisco Bay Area has developed a useful Question and Answer web page on HOT lanes. A part of it is provided in Appendix D herein.

The key to the success of a reversible HOT facility is to design proper ramps for it. The figure below shows a design with 10 ramps. The ramps that serve as on-ramps in the morning become off-ramps in the afternoon, as explained later. Let's look at the ramps in Figure 4.1.

Figure 4.1. Ramps of Proposed Reversible HOT Facility in Honolulu.

- Four ramps to provide access to the HOT lanes from the H-1 and H-2 freeways, and the Farrington and Kamehameha highways.

- A ramp to Aiea and Hekaha business area.
- A ramp near Pearl Harbor to serve the strong employment in the area.
- A ramp into Aloha Stadium to serve events and use the mostly empty parking lot as a park-and-ride facility for express buses.
- A connection to H-3 freeway.
- A ramp onto Lagoon Drive to serve the airport and Mapunapuna.
- A ramp onto Waiakamilo Street to serve Kalihi.
- A ramp onto Nimitz Highway, at the point where it widens to four lanes, to serve Honolulu's center and points beyond.

An appropriate termination for buses is a flyover ramp connection to Hotel Street. Thus, an additional major advantage of the proposed HOT lanes is the minimal environmental impact of the project to the residential portion of Honolulu. No massive guideway will mar the city anywhere between Iwilei and Waikiki, as opposed to the proposed rail's major visual and noise impact along the shoreline and Honolulu neighborhoods.

Figure 4.2 demonstrates the flexibility and multiple utility of the reversible facility to handle directional, imbalanced and emergency traffic flows. The HOT expressway can be configured to work in four different ways, depending on traffic loads and traffic management needs. The red direction is Koko Head-bound, and the blue direction is Ewa-bound.

- **Full inbound**, from Waikele to town, during the typical weekday morning travel period.
- **Full outbound**, from town to Waikele, during the typical weekday afternoon travel period.
- **Split inbound**, from Waikele and town to Aloha Stadium and H-3 freeway, before the start of a major event at Aloha Stadium and during most weekends. This configuration also facilitates traffic to windward Oahu in case of a major problem on the Likelike and Pali highways, or other emergency.
- **Split outbound**, from Aloha Stadium and H-3 freeway to Waikele and town, at the end of a major event at Aloha Stadium. This configuration will help relieve the neighborhoods adjacent to Aloha Stadium in half the current time.

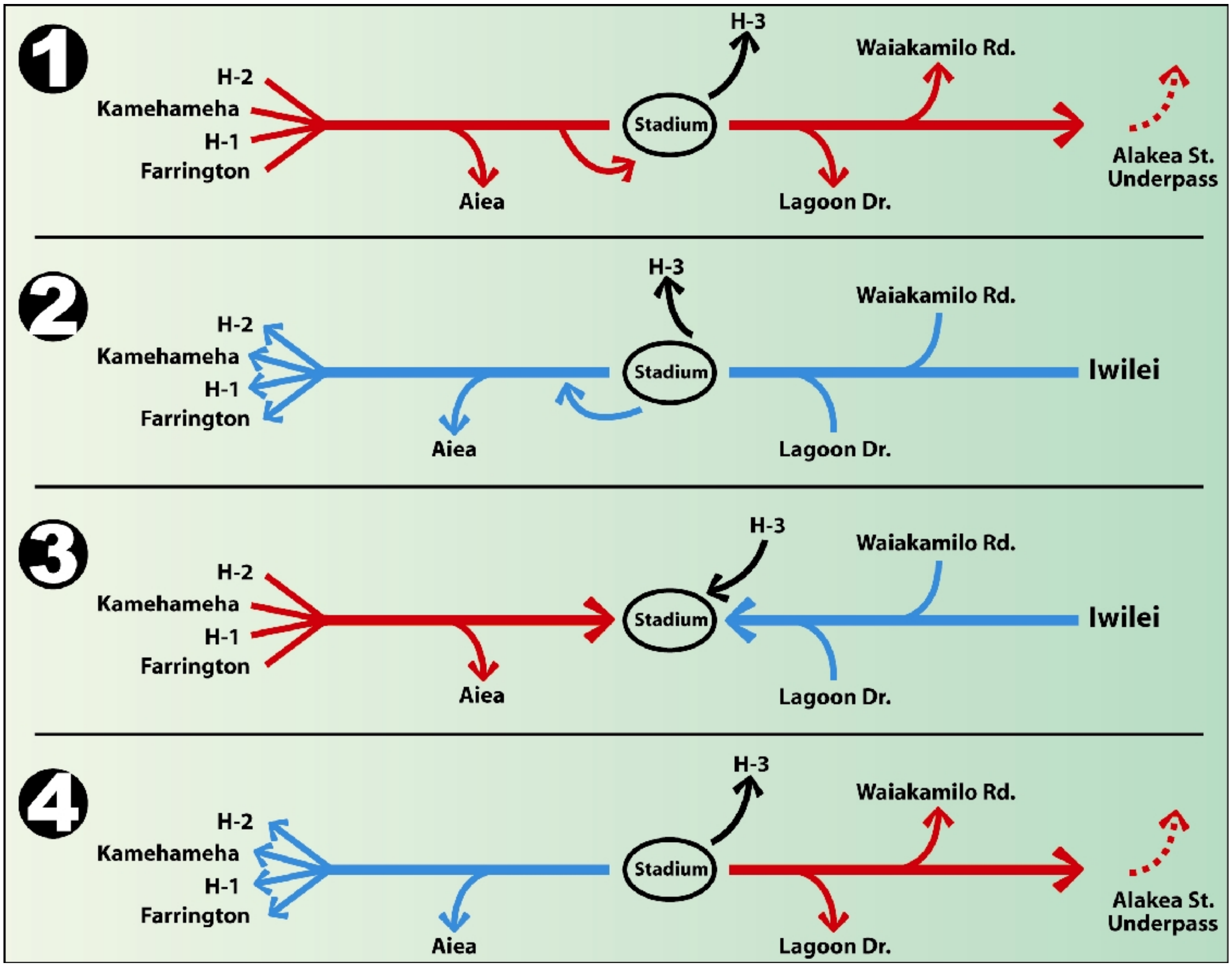

Figure 4.2. HOT Expressway Configuration.

As shown in the preceding section, Tampa's REL has all these features, so the electronics, traffic controls and ramp gates required for these operations are already in practice. A reversible HOT expressway will be a major employer of engineering and computer talent as well as field personnel in order to run efficiently and safely.

In general, HOT lanes are at the forefront of national policy for resolving congestion. Here are some specifics as to where existing and planned HOT lanes are in the nation:

- In addition to **Los Angeles** and **San Diego** HOT lanes, **Washington, D.C.**, metro area includes four new HOT lanes along 15 miles of the Capital Beltway in Virginia, and six new HOT lanes along 18 miles in **Maryland**. An agreement was reached in Virginia for the proposed HOT lanes, expected to be completed in 2013. The 14-mile, 2-lane per direction facility is estimated to cost $1.7 billion. The State will pay $400 million and will have ownership and control of the structure. Two private companies, Fluor Corp. and Transurban, will pay the remaining $1.3 billion and will have control of operations and collection of revenue. [32]

- In **San Francisco**, the Metropolitan Commission's 2030 Plan advocates a HOT network. A massive plan for HOT lane deployment in the entire metropolitan area has been prepared by PB Americas, Inc. It is worth repeating two main points made in this study:[33]
    - Offer congestion insurance. Studies show travelers from all income groups and professions value having a reliable travel option for those times when they most need it.
    - Make HOT lanes and their benefits, including improved reliability and reduced travel time, accessible to all impacted travelers.
- **Houston's** 2025 Regional Transportation Plan plans to expand the existing HOT lanes.
- The **Miami-Dade** 2030 Transportation Plan includes conversion of existing HOV lanes to reversible HOT lanes to provide additional capacity.
- Other areas are applying for grants provided by the U.S. DOT Value Pricing Program including the **Port Authority of New York and New Jersey**; **San Antonio**, **Seattle**, **Atlanta**, and **Portland**.

The proposed design for Honolulu has two more important features:

1. A City Bus only elevated lane from the end of the HOT lanes in Iwilei to Hotel Street bus transit station which provides a full free flow speed travel for buses from the H-1/H-2 merge to the heart of downtown. This is shown in Figure 4.3.
2. A Bus Rapid Transit (BRT) couplet running along King and Beretania Streets with connections to Hotel St. and from there to the HOT lanes. This was proposed in 2002 instead of the ill-conceived BRT plan of the City which was planned to operate on Kapiolani and Ala Moana Boulevards.[34]

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[32] Coombs, J., "Virginia reaches HOT lanes agreement", Washington Business Journal, September 10, 2007.

[33] PB Americas, et al., Bay Area High-Occupancy/Toll (HOT) Network Study, Final Report, www.mtc.ca.gov/ planning/hov/, September 2007.

[34] Prevedouros, P.D., "A Less Expensive and Less Disruptive Bus Rapid Transit System for Honolulu", www.eng.hawaii.edu/~panos/pdp_brt.pdf, November 15, 2002.

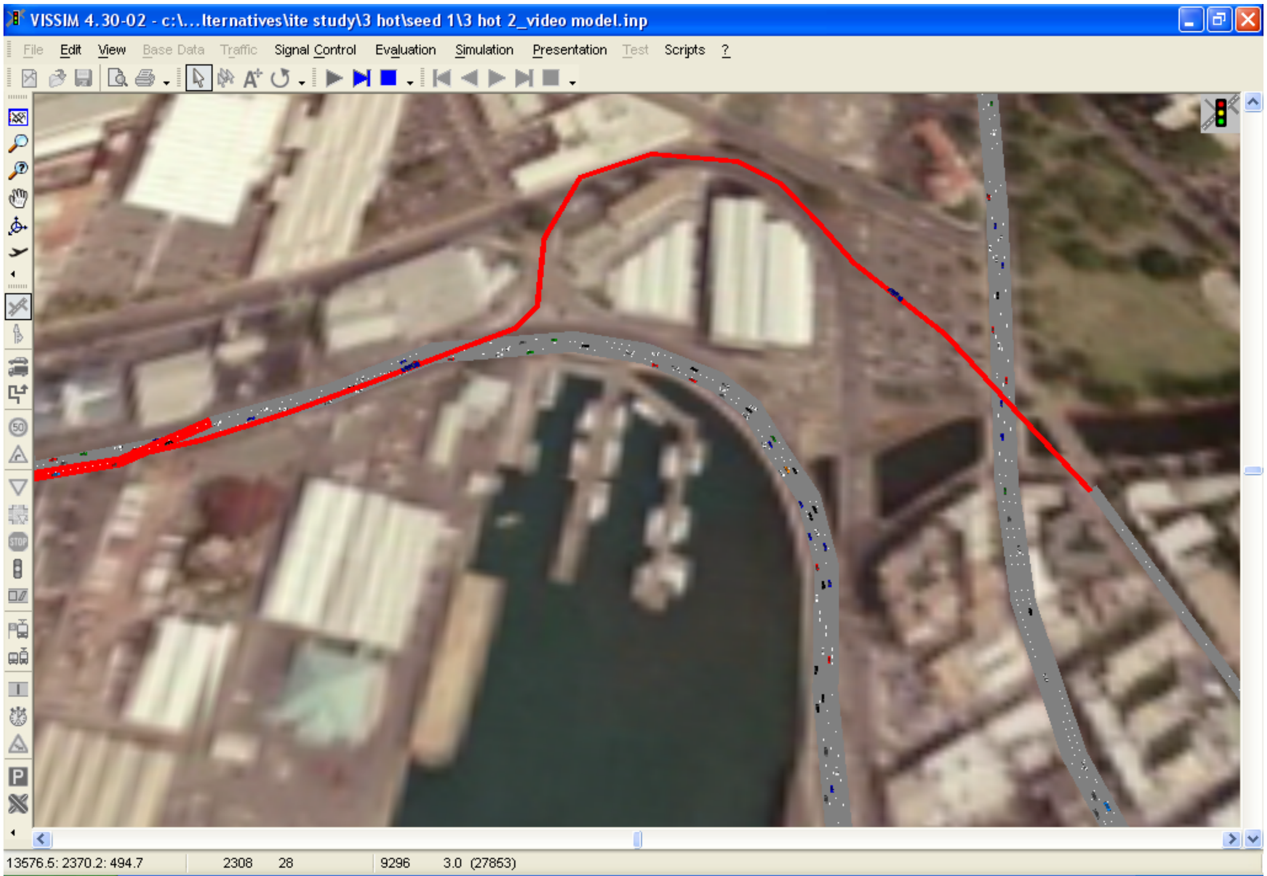

Figure 4.3. Direct connection of HOT lanes (Nimitz Viaduct) to Hotel St. Transit Mall.

The proposed routing connects the UH and downtown Honolulu more efficiently. Instead of a 4.1 mile route through 24 traffic signals from the UH to Tamarind Square via Kapiolani Boulevard, the King/Beretania route is 20% faster (less than 20 minutes) along a 3.4 mile route through 19 traffic signals. Not only will the proposed BRT route be faster, but it will be able to provide the same frequency of service with six instead of seven BRT vehicles; a significant cost savings. As shown in Figure 4.4 below, the HOT-Hotel Street-Transit Mall-BRT integrated system provides a largely congestion free path from Waikele to Moiliili and the University of Hawaii with express buses, at a small fraction of the cost for a similar rail corridor.

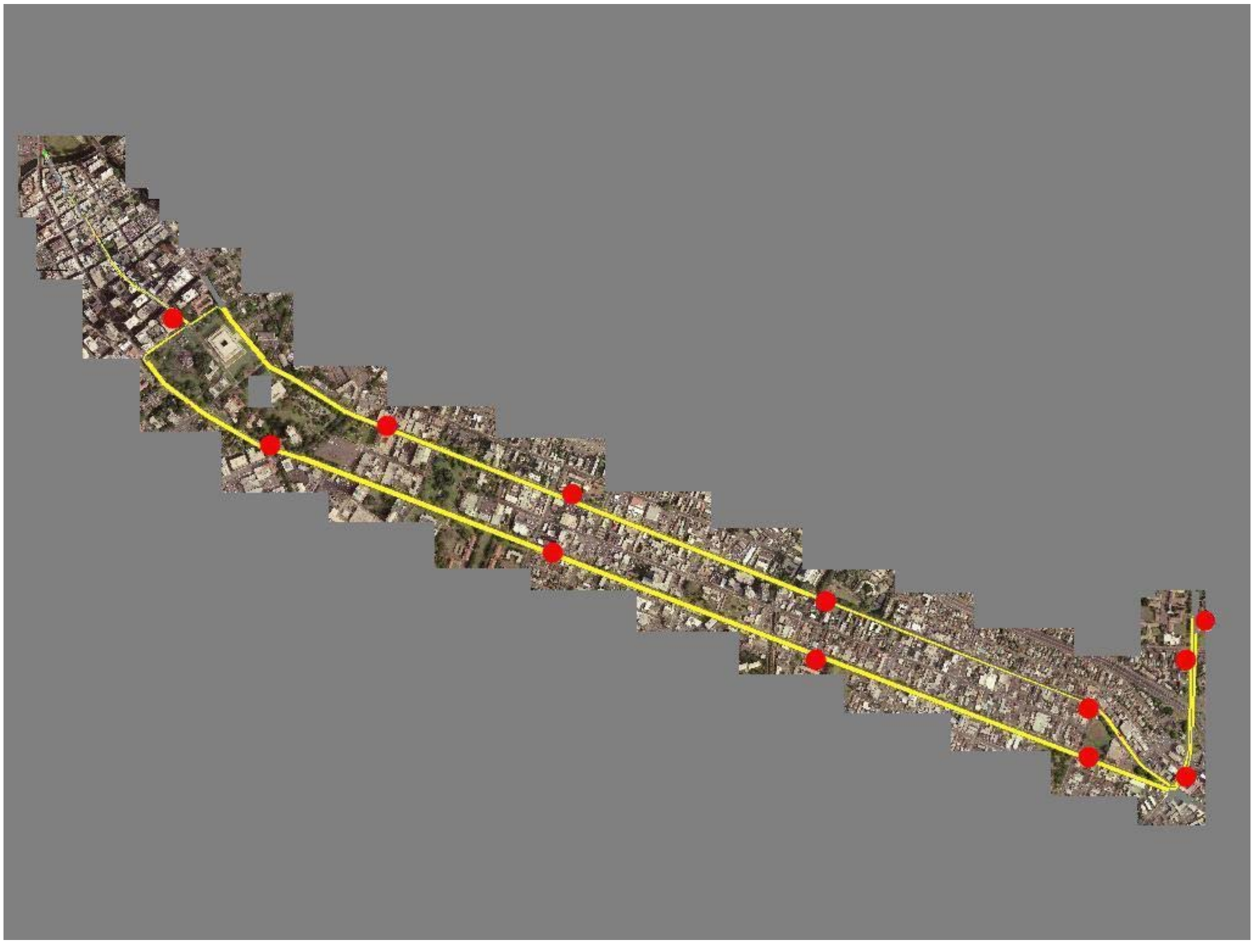

Figure 4.4. BRT on semi-exclusive lanes along King St., Beretania St. and University Ave.

We conclude this section by emphasizing the perfect synergy between HOT lanes and BRT, and by listing a number of advantages of Busways and BRT, as follows:[35]

1. A rubber-tired system can provide express service on exclusive or bus-priority guideways, as well as full or limited stop services on local streets, thus better matching service delivery with demand. Trains are confined to fixed guideways and must stop along these guideways.
2. Bus services can be provided on a competitive basis, which exerts downward pressure on costs and encourages services that meet passenger demand. For example, private

[35] Vincent, W. and G. Roth, "Comparison of Bus and Rail Transit Modes for the Dulles Corridor," Paper No. 06-2396, Transportation Research Board, Washington, D.C., 2006.

tour companies can compete to offer express bus service in commute hours. Rail transit, on the other hand, generally is provided as a government monopoly.

3. Rubber-tired systems can carry more passengers than the proposed rail plan, and all passengers could have a seat. Washington, D.C. Along its current rail lines, Metrorail currently is limited to no more than 20,000 or so passengers per hour in the peak direction, and many of these passengers are standing in very crowded conditions. If each vehicle accommodates 45 seated passengers, a dedicated lane can accommodate 54,000 passengers seated passengers per hour in the peak direction.
4. A rubber-tired system can meet the demand for transit and have significant excess capacity for other purposes. Typical highway lane capacity is roughly 2,000 vehicles per hour. Fewer than 200 45-seat buses per hour can carry the 8,642 passengers forecast for Metrorail. Thus, over 80% of capacity is left over for other purposes, such as emergency vehicles, evacuation, or toll lane operations. This is not possible with rail.

5. Urban Underpasses

Urban underpasses separate the main flows of busy arterial streets without creating an interchange. They have advantages such as ability to fit within existing roadway space, can preserve several turning movements, reduce traffic conflicts as well as conflicts with pedestrians, and have the potential to dramatically reduce delays with no road widening.

Urban underpasses are a fairly rare form of urban traffic control. They provide grade separation between arterials or other similarly busy streets. Most underpasses extant today in historical cities such as London, Paris and Washington, D.C. were installed by design as part of major urban re-organizations. London and Singapore have several post WWII installations of "substandard" underpasses which represent underpasses of limited height clearance. Athens built several full height (standard) underpasses in preparation for the 2004 Athens Olympics.

The expected benefits produced by utilizing an underpass at congested roadways include reduction of travel time, fuel usage and network wide stoppages. The standard height of an underpass is 16 feet; the height of low clearance underpasses is 8 feet. The benefits of the reduced height are more compact size, decreased cost and improved feasibility, particularly for densely developed Asian and European cities as well as Honolulu[36].

In general, underpasses are a "win-win" arrangement for both intersecting streets. The street or movement using the underpass receives in essence a constant green light and its delay is reduced to practically zero. Since a busy movement has been removed from the at-grade part of the intersection, all the rest of the movements receive longer greens resulting in substantially reduced delays. In addition, the conflicts of vehicles with pedestrians at the intersection are reduced substantially.

There are various warrants for the creation of grade separations based on both rail and highway engineering.

[36] Dehnert, G. and Prevedouros, P.D. "Reducing Congestion with Low-Clearance Underpasses at Urban Intersections: Investigation and Case Study." ITE Journal, March 2004, pp. 36-47, 2004.

1. The Federal Highway Administration's 2007 Railroad-Highway Grade Crossing Handbook lists the criteria for grade separation at rail—highway intersections. While most of the criteria are only applicable at rail crossings, one is also applicable to street intersections, recommending that grade separations be considered when "vehicle delay exceeds 40 vehicle hours per day." Additionally, it also recommends consideration of grade separation based on economic analysis when "AADT exceeds 50,000 in urban areas or 25,000 in rural areas [or] Vehicle delay exceeds 30 vehicle hours per day."[37]
2. The Policy on Geometric Design of Highways and Streets of the American Association of State Highway and Transportation Officials (AASHTO) lists six warrants for grade separation, one of which is "reduction of bottlenecks or spot congestion" due to the fact that "insufficient capacity at the intersection of heavily traveled routes results in intolerable congestion on one or all approaches."[38]
3. Rymer and Urbanik used TRANSYT-7F and statistical analysis to provide guidance for grade separation at busy urban and rural intersections. They found that large benefits accrue at urban intersections carrying over 60,000 vehicles of average annual daily traffic (AADT). By their calculations, a reduction in at-grade volume from 60,000 ADT to 40,000 AADT will result in a net worth of about $12 million in 1989 dollars.[39]

Several low clearance underpasses can have a large benefit to the traffic congestion on Oahu. The ones in boldface listed below were modeled in our simulations. It is important to state that each of the four chosen locations meet the FHWA, AASHTO, and Rymer and Urbanik criteria shown above.

- **A left turn underpass from Nimitz Highway to Alakea Street.** This can be configured to also connect to Halekauwila St. This underpass provides continuous flow left turns

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[37] Federal Highway Administration, "Guidance on Traffic Control Devices at Highway-Rail Grade Crossings," U.S. DOT, Washington, D.C. http://safety.fhwa.dot.gov/media/twgreport.htm, 2002.

[38] American Association of State Highway and Transportation Officials, "A Policy on Geometric Design of Highways and Streets," 4th Edition. AASHTO, Washington, D.C., 2001.

[39] Rymer, B. and T. Urbanik II, 'Intersection, Diamond and Three-Level Diamond Grade Separation Benefit-Cost Analysis Based on Delay Savings.' Transportation Research Record, No. 1239, pp. 23-29, 1989.

and will replace both of the existing left turns with stoplights. Not only left turn wait time will reduce from a couple of minutes to zero, but also the Ewa-bound traffic on Nimitz Hwy. will have a longer green and lesser congestion. An alternative to this is that Ewa-bound Nimitz Hwy. could go underground starting east of the intersection with Halekauwila St. to west of Alakea St., except for one lane of it which turns right at Alakea St.

- **Punchbowl through traffic going under Vineyard Blvd.** A 2-lane underpass is far superior to existing 4 lanes with stoplights. One lane can continue as a mini-tunnel and surface makai of Beretania St. for larger benefits.

- **Pali Hwy. through traffic going under Vineyard Blvd.** A 3-lane underpass with the middle lane being adjusted to serve morning and afternoon peaks is far superior to the existing 6 lanes with stoplights. Again, one lane can continue as a mini-tunnel and surface makai of Beretania St. for larger benefits.

- Left turn from Ala Moana Blvd. onto Atkinson Dr. A 1-lane underpass will provide a capacity equivalent of over 6 turning lanes with the existing traffic light. An alternative to this is that Ewa-bound Ala Moana Blvd. could go underground.

- **Kalakaua Ave. through traffic going under Kapiolani Blvd.** A 2-lane underpass is far superior to existing 4 lanes with stoplights.

- Kapiolani Blvd. through traffic going under Date St. A 4-lane underpass with the middle lanes being adjusted to serve morning and afternoon peaks will be far superior to the existing 6 lanes with stoplights.

- University Ave. through traffic going under King St. A 2-lane underpass is far superior to existing 4 lanes with stoplights.

❖ South-(makai)-bound Kalihi St. through traffic going under School St. A 2-lane underpass is far superior to existing 3 lanes with stoplights, and will also reduce congestion and delays to the heavy north-bound left turn from Kalihi St. onto School St.

The list above includes critical locations in central Honolulu. However, several other intersections on Oahu qualify for an underpass treatment such as the Castle Junction and Castle Hospital intersection along the Pali Highway. Also the Kalihi Street and School Street intersection along the Likelike Highway is a busy candidate as are most of the intersections along Fort Weaver Road in Ewa.

Most of these short underpasses can be built at a cost between $10 million and $50 million each, and reduce congestion by 25% to 50% at the subject intersection. Their benefit in terms of delay saved (cumulative wasted time valued at minimum wage) will surpass their cost in a time horizon between five and 15 years, depending at intersection-specific volumes, underpass design, and construction cost. The benefits do not account for the resultant friendlier and safer pedestrian environment which is the product of a substantial amount of traffic going under and away from the surface crossings.

Additional student research was conducted with detailed intersection analysis after the conclusion of the network-wide simulations. These included a more refined placement of underpasses based on optimization of traffic performance and feasibility. For example, due to the narrow right of way and curvature it is very difficult to make an underpass of Punchbowl Street under Vineyard Blvd. An underpass for Vineyard Blvd. under Punachbowl St. is easier to construct and provides a superior traffic performance as well.

Base and underpass configurations are depicted in Figures 5.1 through 5.5. All underpasses consisted of one lane per direction except for the one at the Kapiolani/ Date/ Kamoku intersection (Figure 5.5) which has two lanes per direction. The Nimitz/ Alakea/ Halekauwila underpass is a one lane, one way configuration, roughly running from west to east, with a left turn outlet on Alakea St. and a straight termination on Halekauwila St.

Intersection 1 is a set of three signalized intersections, a four-way intersection at Nimitz Highway and Bishop St., three-way intersection at Nimitz Highway and Alakea St. and Nimitz Highway and a two-way intersection at Halekauwila St., all of which are within Honolulu's central business district, directly north from Honolulu Harbor. As currently designed, the primary flow on Nimitz Highway is interrupted at each of these three intersections to allow access to or from the side streets. In the improved model, a single lane is taken from Nimitz Highway before the first intersection and converted into an underpass, with exits on both Alakea and Halekauwila Streets. This configuration eliminates the need for traffic signals at Alakea St. and Halekauwila St. due to the complete elimination of conflicting vehicular movements. At the same time, there are nearby intersections that provide a pedestrian phase for crossing Nimitz Highway.

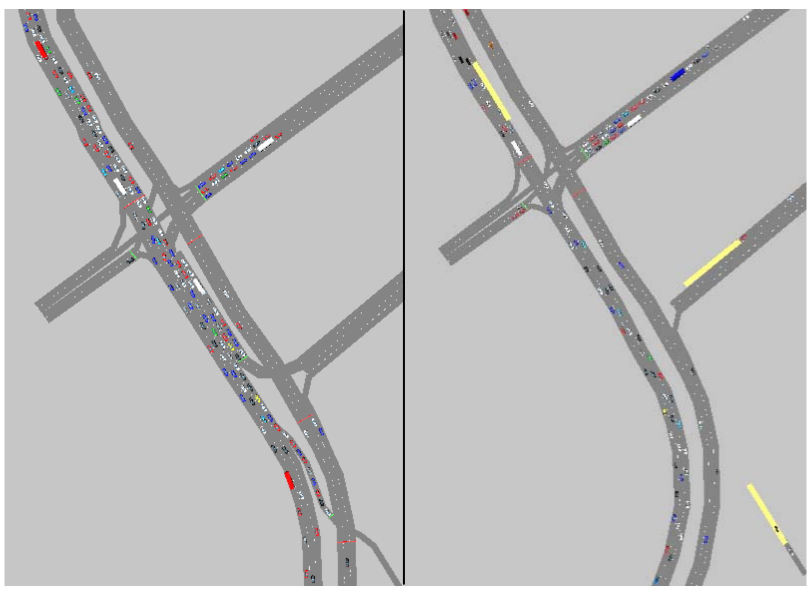

Figure 5.1. Intersections of Nimitz Highway with Bishop, Alakea and Halekauwila Streets.

Intersection 2 is a single four-way signalized intersection of Kapiolani Boulevard and Kalakaua Avenue, and is the state's busiest intersection. Currently, the primary flow of traffic on Kapiolani Blvd. is interrupted by through and turning movements from Kalakaua Ave. In the improved model, a single through lane in each direction is taken from Kalakaua Ave. and converted into an underpass. The cycle and green times are re-estimated (typically both cycle and greens become shorter) for an improved flow in all movements.

Intersection 3 is a single four-way signalized intersection of Vineyard Boulevard and Pali Highway. Currently, the primary flow on the Pali Highway is interrupted by through and turning movements from Vineyard Blvd. In the improved model, a single through lane in each direction is taken from the Pali Highway and converted into an underpass, and the through green time is reduced as part of the signal timings update.

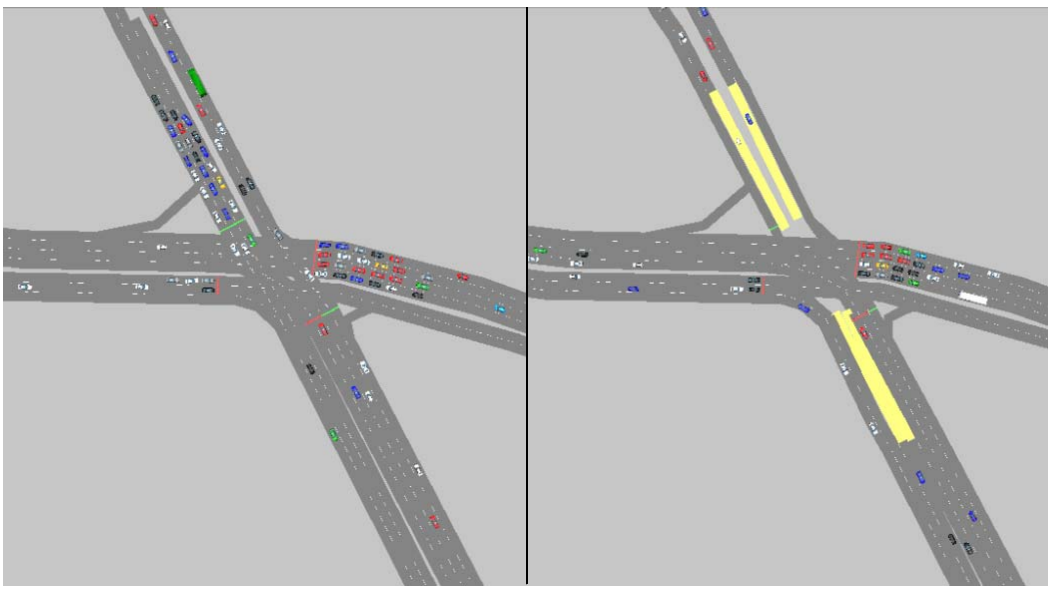

Figure 5.2. Intersection of Kapiolani Boulevard and Kalakaua Avenue.

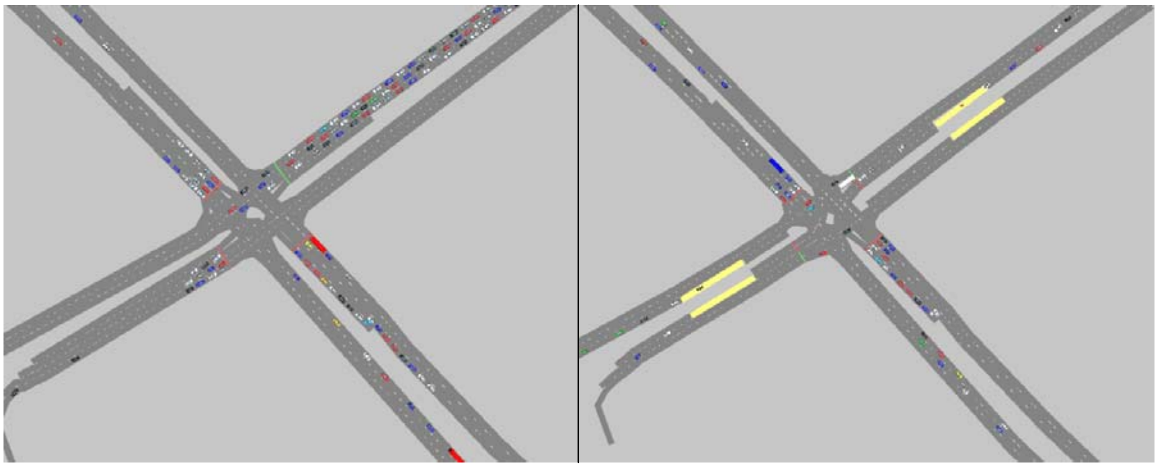

Figure 5.3. Intersection of Vineyard Boulevard and Pali Highway.

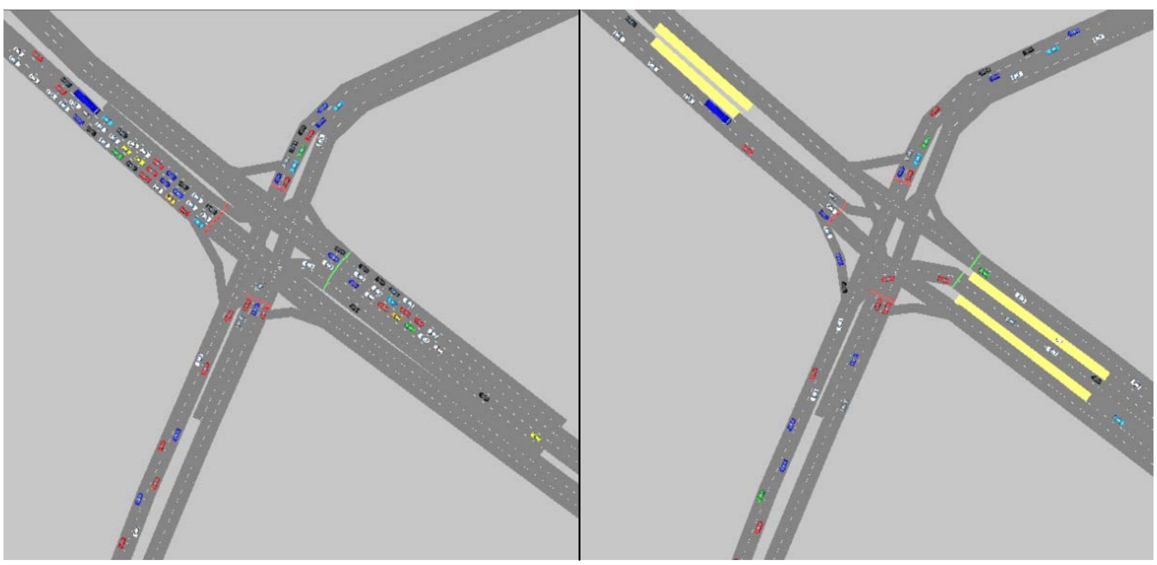

Figure 5.4. Intersection of Vineyard Boulevard and Punchbowl Street.

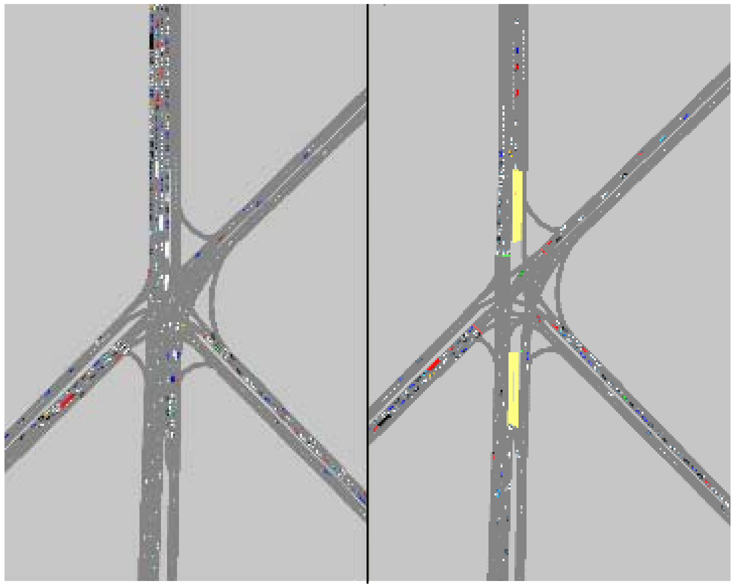

Figure 5.5. Intersection of Kapiolani Boulevard with Date and Kamoku Streets.

Intersection 4 is a single four-way signalized intersection of Vineyard Boulevard and Punchbowl Street. Currently, the primary flow on Vineyard Boulevard is interrupted by through and turning movements from Punchbowl Street. In the improved model, a single through lane in each direction is taken from Vineyard Blvd. and converted into an underpass, and the signal timings are updated. An earlier solution had the underpass located on Punchbowl St. but curvature and limited right of way on the north approach rendered this underpass largely infeasible. The modified solution is better in terms of flow as well as circulation because traffic on the Vineyard Blvd. approaches where the underpass terminates do not generate queues that could block the underpass.

Intersection 5 is a six-way signalized intersection of Date Street, Kapiolani Boulevard and Kamoku Street. Currently, the primary flow on Kapiolani Boulevard is interrupted by through and turning movements from the other two streets. In the improved model, a single through lane in each direction is taken from Kapiolani Boulevard and converted into an underpass, and the signal times are updated. This intersection operates with long queues in the peak hours, despite of the fact that no left turns are permitted from Kapiolani Blvd. to any of the other streets. This queuing is clearly depicted on the left simulation image capture (base) in Figure 5.5.

Table 5.1. Evaluation of Base and Underpass Delay and Level of Service

	Base Delay (sec/veh)					Underpass Delay (sec/veh)				
Intersection -->	**1**	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**
Benefitted movement	178.8	25.3	78.8	26.0	62.0	1.0	1.2	0.5	0.4	0.9
Remainder (surface)*							11.9	3.4	3.9	8.6
All other movements	34.6	17.6	53.3	46.0	74.9	20.9	9.5	30.2	23.0	72.7
Whole intersection	54.3	22.8	63.5	38.4	69.3	18.6	7.0	17.3	14.2	41.5

	Base LOS					Underpass				
	1	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**
Benefitted movement	F	C	F	D	F	A	A	A	A	A
Remainder (surface)*	-	-	-	-	-	n.a.	B	A	A	B
All other movements	D	C	E	E	F	C	B	D	C	F
Whole intersection	E	C	F	D	F	C	B	C	B	E

Total peak hour interection volume					Portion of the total volume on the benefited movement				
7201	5933	4441	4790	5156	10%	30%	40%	40%	40%

Table 5.1 summarizes intersection delay and LOS results for the Base and Underpass options at each if the five intersections. Under “benefited movements” are the delays and LOS of the movements which were replaced with underpasses. Under “remainder” are the delays and LOS of the vehicles on the benefited movement which were unable to travel through the underpass. In all cases these were modeled to be 10% of the total volume along the benefited volume, a conservative assumption, given that the proportion of heavy vehicles in Honolulu urban traffic rarely exceeds 5%. Many of the heavy vehicles are low enough in height to utilize the underpass (such as all city buses and courier trucks.) Under “all other movements” are the delays on movements unaffected by the underpass, and under “whole intersection” is the weighted average of all delays in the intersection, and its corresponding LOS. There is no remainder for Intersection 1 because the underpass is the only roadway after the improvement.

The results display substantial improvements in all categories. The largest improvement, as expected, is for the benefited movement which typically improves from LOS F to LOS A. In all cases, intersection LOS improves by at least one level; for example, intersection 3 LOS improves from F to C, which reflects a “day and night” difference in peak hour traffic operations.

6. Analysis Tool, Network and Alternatives

This section presents a brief justification of the engineering tool used for traffic analyses, describes the road network modeled in the computer and defines the alternatives we modeled.

Environmental impact assessments accepted by counties in Hawaii typically employ the Highway Capacity Manual (HCM[40]) method, which is an inappropriate methodology for large projects with pervasive, network or corridor-wide impacts. The HCM clearly makes the case that it is not appropriate to use it in large and congested networks. The HCM states that:

- "the HCM methods are generally not appropriate...for the evaluation of queues that are building over both time and space." HCM, page 9-1.
- "Certain freeway traffic conditions cannot easily be analyzed by the methodology. Multiple overlapping bottlenecks are an example. Therefore, other tools may be more appropriate." HCM chapter on computer simulation, page 22-1.

The best and common practice in Traffic Engineering in the U.S. is to study transit and traffic systems in final stages of design and evaluation with a detailed microsimulation tool. There is one half dozen powerful and detailed programs available for use in the US. Vissim [41] is one of the most accomplished traffic simulators and it was chosen for use in this project. A recent survey in the Urban Transportation Monitor shows the pervasive use of Vissim in 13 of the 20 summarized large traffic microsimulation projects and Table 6.1 shows that our study of Honolulu with Vissim compares quite impressively with those done by major consultancies and universities in the mainland.

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[40] Transportation Research Board, Special Report 209: Highway Capacity Manual 2000e. Transportation Research Board, National Research Council, Washington, D.C., 2001.

[41] PTV America, Vissim, version 4.30-02, Corvallis, Oregon, 2007.

Table 6.1. Comparison of Large Microsimulation Studies in the U.S.

Traffic Simulation Project	Gateway Program	VISSIM East Link Light Rail Study	SR-500/St. Johns Interchange	Downtown Lexington (KY) Transportation Analysis	I-285 Strategic Implementation Plan	I-405 GEC	QEW Express Lane Closure Evaluation	GTA East HOV Network Study	Incident Management for Safe, Secure, and Productive Transportation Systems	Lincoln Tunnel Corridor/Toll Plaza Simulation	UHCS_AA
Location of project: metropolitan area	Greater Vancouver, British Columbia	Seattle metro	Portland OR/Vancouver WA	Lexington, Kentucky	Atlanta, GA	East of Seattle	n/a	Greater Toronto Area	Capital District of NY	New York/New Jersey Metro Area	Honolulu
Size of project:											
freeway miles simulated	50	10	0	0	63	35+	14	100	~80	3	17
HOV/HOT miles included in freeway miles	35	3	0	0	0-63	~20	0	100	0	3	18
number of interchanges simulated	25+	6	1	0	47	24	7	65	15-20	6	12
arterial miles smulated	75+	0	20	50	20	0	0	0	~120	6	24
number of intersections simulated	120	0	42	130	205	0	0	0	265	9	10
Software used	PARAMICS	VISSIM	SYNCHRO/ SIMTRAFFIC	TRANSMODELER	VISSIM	VISSIM	VISSIM	VISSIM	TRANSMODELLER	VISSIM	VISSIM
Who performed project	Delcan Corporation	CH2M HILL	WSDOT Southwest Region Traffic Office	ENTRAN, PLC	PBS&JU	I-405 Project Team	McCormick Rankin Corporation for the Ontario Ministry of Transportation	McCormick Rankin Corporation for the Ontario Ministry of Transportation	Rensselaer Polytechnical Institute for NYSDOT	URS Corporation	University of Hawaii Congestion Study Group
Project time frame	on-going (2007)	2007	2007	2004-2006	2006-2007	Ongoing	2004	2005-2008	2006-2007	2004	2007
Project duration	24+mos	12mos	3mos	15 mos	30mos	Started in 2004	10mos	~30mos	12mos	16mos	10mos
Project's objectives	Develop a proven conceptual design for three independent but related road corridors.	Analyze bus and light rail, freight, HOV, and general purpose traffic travel times, freeway queuing and congestion patterns if light rail transit is added.	Determine the traffic impacts of diverted trips on adjacent intersections during the construction of a proposed interchange.	Evaluate the operational impacts of converting Lexington's downtown one-way streets to two-way operation.	Evaluate various corridor-wide transportation alternatives and localized operational improvements on the I-295 Corridor.	Determine best use of funds - applications of managed lanes.	Assess feasibility of closing the express lanes during weekend for highway rehabilitation.	Assess utilization and priorities for HOV lane implementation.	Suggest new procedures for traffic and incident management, evaluate ITS and determine best locations for sensors.	Evaluation of existing and future operations for the toll plaza of the Lincoln Tunnel.	Study the effects of alternatives on traffic network performance in Honolulu.
Number of alternatives	100+	5 alternatives in 2 peak periods	3	5	13	10+	7	25+	6	12	9

Traffic Simulation Project	I-270/I-70/Mo 370 simulation	I-495 HOT Lanes	Transit Priority Preliminary Design (Phase I)	Cleveland Innerbelt Project	I-70/71 Columbus Soputh Innerbelt Study	West Edmonton Traffic Study	Edmonton North Ring Road	Caltrans Traffic Management System master plan - I-405/I-5 study	I-880 Corridor Microsimulation Traffic Model	SR-41 Corridor Simulation Study
Location of project: metropolitan area	N/A	Washington DC	Winnipeg	Cleveland, Ohio	Columbus, Ohio	N/A	N/A	Orange County, California	SF/Oakland Bay Area	Fresno, CA
Size of project:										
freeway miles simulated	15	18	0	14	11	2	28	30	34	21
HOV/HOT miles included in freeway miles	0	12	0	0	0	0		N/A	20	20
number of interchanges simulated	10	14	1	24	17	2	16	11	30	12
arterial miles smulated	10	10	12.7	12	5	18	67	36	45	30
number of intersections simulated	50	33	39	63	58	39	63	38	200	187
Software used	VISSIM	VISSIM	VISSIM	VISSIM	VISSIM	VISSIM	VISSIM	PARAMICS	PARAMICS	PARAMICS
Who performed project	Crawford Bunte Brammeier	HNTB Corporation	MRC	Ohio DOT	Ohio DOT	City of Edmonton	WAIS Engineering Ltd	California PATH	Braidwood Associates with CCIT/UC Irvine/SMG support	CALTRANS Dist. 6 Planning and University of Minnesota
Project time frame	2006	Ongoing	Winter 2007	1999-2007	2002-2007	2003	2007	2003	2007	2007
Project duration	15mos	16mos	2mos	96+mos	66+mos	12mos	20	5mos	ongoing	30mos
Project's objectives	Develop microsimulation modeling framework.	Complete operation analysis of existing, future no-build and future with HOT lanes to include in two Interchange Justification Reports.	Evaluate a number of transit priority measures for the corridor.	Intelligent renewal of the transportation infrastructure within the corridor.	Alternatives Analysis/Major Investment Study.	Develop medium term operation improvements.	Long term interchange operational review.	Quantify the benefits from various ITS elements, arterial management, and adaptive ramp metering	Development of a Corridor System Management Plans.	Develop a template for corridor management.
Number of alternatives	4	10	8	44	5	4	6	8	12	5

SOURCE: Large Microsimulation projects, Urban Transportation Monitor, Vol. 21, No. 19, October 26, 2007, pp.8-16.

6.1. Network

A large part of the primary freeway and arterial network in Honolulu between the H-1/H-2 freeway merge and Kalakaua Ave./ Punahou St. was modeled in Vissim, along with several intersections. Figures 6.1 and 6.2 depict the roadways in the system. Due to the size and effort involved, only east-bound traffic was modeled based on the demand levels reported in Table 3-12 of the City's alternatives analysis. Opposing movements were modeled at intersections. At some intersections, left turn movements were not modeled but the left turn greens were retained in the signal cycle to accurately depict queues for the heavy through movements. Because of these simplifications, the congestion metrics generated are lower than in reality, so the estimated improvements for each alternative are a reasonable lower bound of traffic performance expectations.

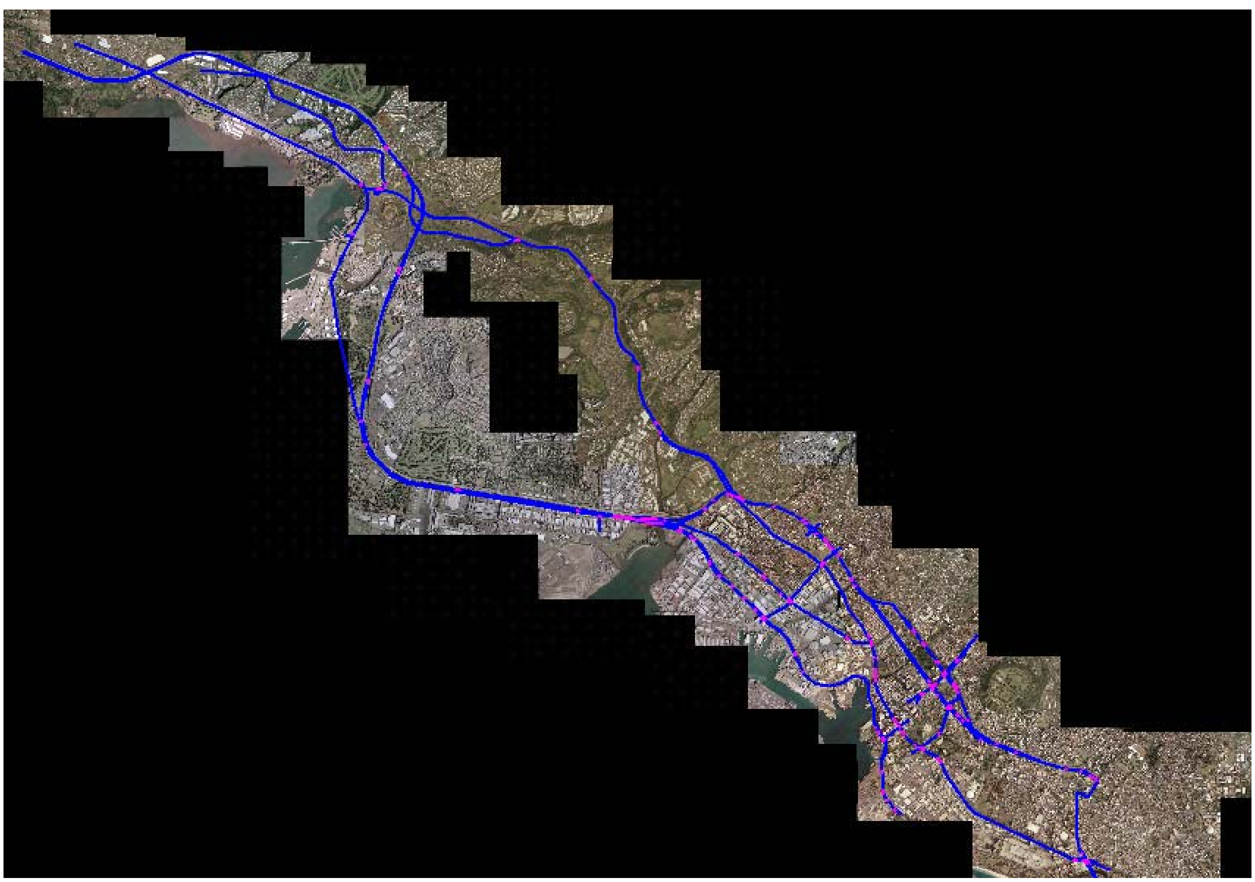

Figure 6.1. Vissim links and connectors for Honolulu's primary morning commute network.

This is the largest traffic microsimulation network ever created and analyzed in Hawaii. The following roadways were represented in our simulation network:

- Kamehameha Hwy. from Waimano Home Rd. to North Nimitz Hwy.
- North Nimitz Hwy. from Kamehameha Hwy. to Helkauwila St.
- Moanalua Rd. from Kaahumanu St. to Moanalua Fwy.
- Moanalua Fwy. from Moanalua Rd. to the H-1 (Middle St.) merge.
- H-1 Fwy. from H1/H2 merge to McCully St..
- Likelike Hwy./Kalihi St. interchange.
- Lunalilo St. on-ramp.
- Kamehameha Hwy. off-ramp.
- Punchbowl St. from H-1 Fwy. off-ramp to Queen St.
- Lagoon Dr.
- Vineyard Blvd.
- Waiakamilo Rd. from Nimitz Hwy. to H-1 Fwy.
- Alakea St. from Nimitz Hwy to Hotel St.
- Maunakea St. from Nimitz Hwy. to Hotel St.
- North King St. from Moanalua Fwy. to South King St.
- South King St. from North King St. to Kapiolani Blvd.
- Kapiolani Blvd. from South King St. to McCully St.
- Kalakaua Ave. from South Beretania St. to McCully St.
- South Beretania St. from Punahou St. to Kalakaua Ave.
- Punahou from H-1 to South Beretania St.
- Dillingham Blvd. from H-1 off-ramp to North King St.
- Pali Hwy. from Pauoa Rd. to Bishop St./Fort Street Mall fork.
- Bishop St./Fort Street Mall from fork to South Beretania St.

6.2. Simulated Alternatives

The transportation alternatives investigated with traffic simulation included the following:

- **Rail** was modeled as having a 6.5% or a 3.25% traffic reduction on H-1 Fwy., Kamehameha Hwy., Moanalua Fwy. In our opinion, the 6.5% scenario is highly optimistic and its results are an upper bound of what a highly successful *TheRail* service is likely to do to network traffic congestion.

- **Four Underpasses** which provide unimpeded access (i.e., the equivalent of a continuous green light) to heavy movements. The underpasses were: (1) left turn underpass from Nimitz Highway to Alakea Street, (2) Punchbowl through traffic going under Vineyard Blvd., (3) Pali Hwy. through traffic going under Vineyard Blvd., and (4) Kalakaua Ave. through traffic going under Kapiolani Blvd. These were explained in Chapter 5.

- **A 2-lane or 3-lane HOT expressway** from the H-1/H-2 merge to Iwilei with a bus ramp to Fort Street Mall and a left turn underpass to Alakea St. The basic design was explained in Chapter 4.

- A **combination** of the 2- and 3-lane HOT lanes and the four underpasses.

- **Pearl Harbor Car Ferry** system whereby two large barges carry vehicles across the mouth of Pearl Harbor with a connection to Lagoon Drive through the airport. This system is tailored to Kapolei, Ewa and Ewa Beach areas and was designed with a 500 vehicle per hour capacity. Figure 6.2 shows the jagged route through existing roads that the traffic on the ferry would follow. It must be noted that most of the roadways showing inside the Hickam AFB and Honolulu International Airport are currently off-limits to general traffic. Special arrangements and security measures as well as short underpasses will be required for this route to open to general traffic.

- **Pearl Harbor Tunnel** is a reversible 2-lane relatively short tunnel under the entrance of Pearl Harbor with cut-and-cover sections through the Honolulu International airport, priority lanes along Lagoon Drive and a direct connection to the Nimitz Viaduct.[42] Compared to the jagged ferry route, this option provides a much straighter alignment, as shown in Figure 6.3, and most of it could be made with a cut-and-cover tunnel design that opens up the opportunity for use by the general public without raising security risks for the Air Force Base or the Airport. While a tunnel near Pearl Harbor and the Honolulu International Airport sounds like a technical and institutional impossibility to some, it is appropriate technology that is safe to deploy near sensitive military and aviation infrastructure. A comparable case in point which could be used as a guide in the detailed design of this alternative is the Monitor-Merrimac Memorial Bridge-Tunnel [43] deployed by the Virginia DOT as shown in Figure 6.4. The MMMBT is near U.S. Marines, Naval and other large military installations and airfields along environmentally sensitive shores of the Virginia coastline.

- ***TheBoat*** was included in the comparisons but it was not included in simulations because its ridership does not provide any estimable relief from traffic congestion.

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[42] Nimitz Viaduct is a 2-lane reversible "flyover" from the Keehi interchange (spaghetti junction) to Iwilei. This project has completed environmental review during the second Governor Cayetano administration and can be put to bid at any time.

[43] Completed in April 1992, I-664 includes the 4.6-mile Monitor-Merrimac Memorial Bridge-Tunnel (MMMBT) which cost $400 million to build, and includes a four-lane 4,800 feet long tunnel, two portal islands, and 3.2 miles of twin trestle: www.roadstothefuture.com/I664_VA_MMMBT.html.

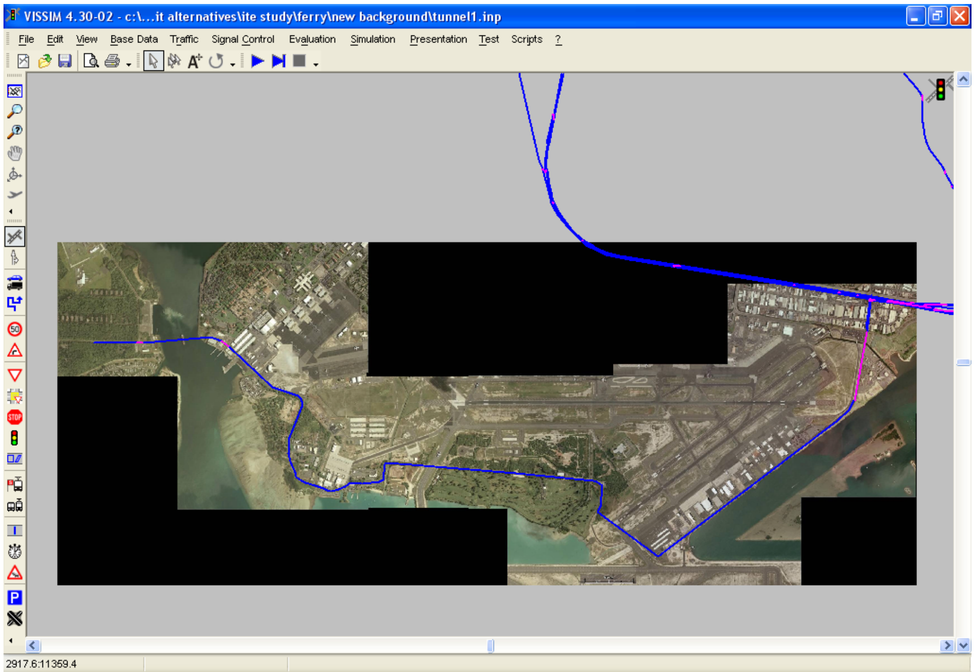

Figure 6.2. Route for Ewa plains ferry service to Nimitz Hwy. via Lagoon Drive.

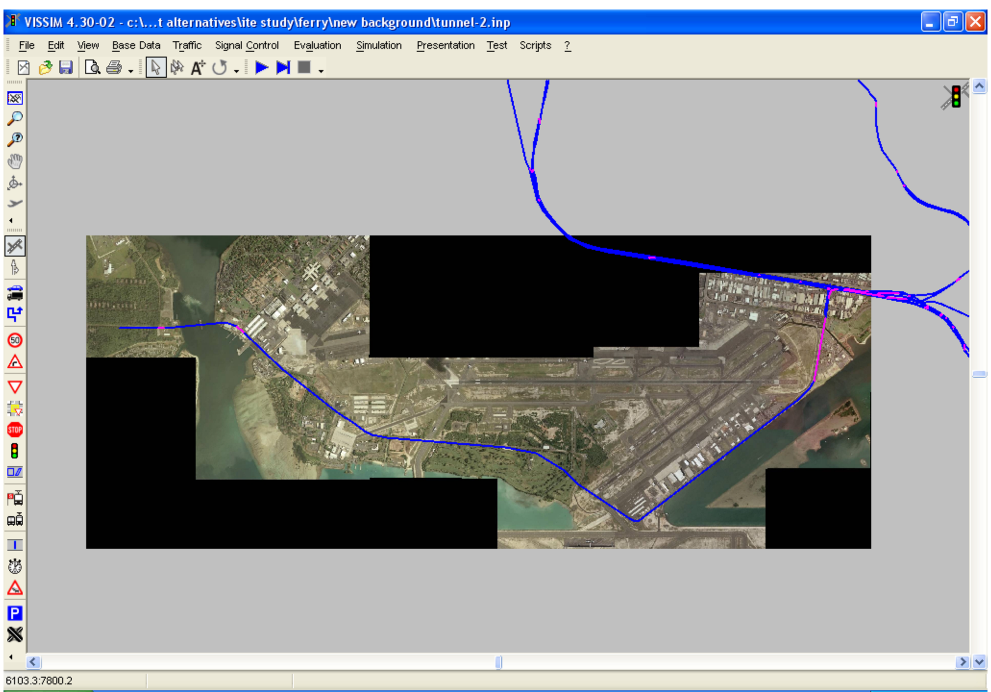

Figure 6.3. Route for Ewa plains tunnel to Nimitz Hwy. via Lagoon Drive.

Figure 6.4. Monitor-Merrimac Memorial Bridge-Tunnel (I-664), looking north. Starting at the left edge of the photo is the Newport News U.S. Marines Terminal.

7. Traffic Analysis Results

Any transportation alternative that involves several hundred million dollars in infrastructure costs has to provide a substantial congestion relief in order to be deemed cost-effective and appropriate for public financing. To this end, Table 7.1 below summarizes specific simulation travel time results for six alternatives. The results represent a typical morning peak hour with clear weather and no traffic incidents along the streets in the model.

Table 7.1.Travel Time Estimates for Six Alternatives

H-1/H-2 Merge to Aloha Tower, Alakea Street			
Scenario	**Mode of Transportation**	**Time (minutes)**	**% Change from existing**
Existing conditions (H1/H2 merge to downtown)	Bus on H-1, Nimitz	**35.6**	none; this is the base case
	Car on H-1, Nimitz	**34.0**	
Rail: 6.5% traffic reduction (H-1, Kam., Moanalua)	Car on H-1, Nimitz	**33.0**	**-3%**
	Rail passenger	**41.4**	**16%**
Rail: 3.25% traffic reduction (H-1, Kam., Moanalua)	Car on H-1, Nimitz	**33.7**	**-1%**
	Rail passenger	**41.4**	**16%**
2-lane HOT (H1/H2 merge to Iwilei)	Bus on HOT lanes	**12.7**	**-64%**
	Car on H-1, Nimitz	**22.1**	**-35%**
3-lane HOT (H1/H2 merge to Iwilei)	Bus on HOT lanes	**11.8**	**-67%**
	Car on H-1, Nimitz	**21.5**	**-37%**

Ewa to Aloha Tower, Alakea Street			
Scenario	**Mode of Transportation**	**Time (minutes)**	**% Improvement from existing**
Existing conditions (Ewa to downtown)	Car on H-1, Nimitz	**65.0**	none; this is the base case
Ferry	Car on Ferry, Lagoon Dr., Nimitz	**36.6**	**-44%**
	Car on H-1, Nimitz	**62.9**	**-3%**
Tunnel	Car through tunnel, Lagoon Dr., Nimitz Viaduct	**10.6**	**-84%**
	Car on H-1, Nimitz	**40.3**	**-38%**

The top part of the table utilizes a base case network roughly from Waikele to Moiliili, and the second part utilizes a base case network between Ewa and Moiliili. This is because later in our analysis process it was decided to explore two additional alternatives: a ferry across the mouth of the Pearl Harbor, and a tunnel under the mouth of Pearl Harbor, thus the network was expanded in the western edge from Waikele to Ewa. Due to time limitations, it was not possible to re-run all the previous alternatives utilizing the expanded network. However, the results shown in Table 7.1 in terms of "% Change" are comparable. The scenarios are discussed below.

The first scenario depicts a car and a bus on the existing network traveling along the H-1 freeway between the H-1/H-2 merge and Aloha Tower/Alakea Street in downtown Honolulu. This is the base case and shows that a car can do this in 34 minutes, and an express bus in a little less than 36 minutes, on the average. This is the base case for travel times during the peak hour, under normal conditions in the current (2006-2008) time frame.

Then we take the optimistic case of *TheRail* removing 6.5% of cars from H-1 and Moanalua freeways and from Kamehameha Hwy. The result is that Car travel time will reduce from 34 to 33 minutes, a reduction of 3%. Typically changes under 5% are not noticeable in a traffic network. An interesting observation here is that for this trip, the rail passenger will need 41 minutes, 8.4 minutes longer than a car using the congested H-1 freeway. A more realistic scenario is that *TheRail* will remove about 3% of cars on the three major roadways mentioned above. In this case, *TheRail* does not improve travel times at all.

The next alterative is that of a 2-lane HOT lane expressway. An express bus on it will make this trip in 12.7 minutes or 64% faster than today. A car that did not pay a toll but did the trip on the free route along H-1 freeway and Nimitz Hwy. will make the trip in 22.1 minutes or 35% faster than today.

The 3-lane HOT lane expressway scenario shows that travel time improvement would be even higher. Good reasons for building a 3-lane reversible expressway instead of a 2-lane one are that capacity is 50% more at a cost that is about 15% more and a 3-lane facility would be more able to aid in evacuations and emergencies, as well as provide a dedicated bus lane, should this become a necessity or financing requirement. One of the three town-bound lanes terminates on Waiakamilo Street in Kalihi. Only two lanes continue to terminate onto Nimitz Hwy. and one of them continues as a viaduct to Hotel Street, for *TheBus* use only.

The bottom of Table 7.1 presents results of scenarios with an expanded network that includes the Ewa and Ewa Beach communities and represents a route along these streets: Fort Weaver at Geiger Road-North Road-Iroquois Drive-Barracks Road-18th Street-G Avenue-Dock-*Short Trip on the Car Ferry*-Dock-Vickers Avenue-Fort Kam Road-Mamala Bay Drive-runway underpass-Lagoon Drive-Nimitz Viaduct. The tunnel route follows a similar but smoother alignment (as in Figure 6.3). In the case of the reversible tunnel, all sections through Honolulu International Airport are cut and cover tunnels and connect to a mini tunnel under the L22-R4 runway.

The travel times indicate that the commute trips from Ewa to downtown are very long. If a quick ferry (barge) service is provided, then the travel time from Ewa to downtown can be reduced to about 37 minutes, or by 44%. This is feasible for up to 500 vehicles per hour, with two or three large barges. A tunnel that connects directly to Lagoon Drive will provide a rather grand travel time reduction from 65 minutes to 11 minutes. This should come as no surprise because the length of this trip becomes 23% shorter: 13.6 instead of 17.7 miles (Ewa to Iwilei), and made at free flow speeds for the entire length of it. The toll tunnel has the potential to remove a substantial amount of traffic from Ft. Weaver Road and the H-1 Fwy., therefore, the trip along those free routes is also expected to be reduced significantly, to about 40.3 minutes.

Table 7.1 above provided a sample of travel times for a specific trip length between the H-1/H-2 freeway merge and Alakea St. in downtown Honolulu. However, in addition to travel times, (1) there are other important measures of performance such as average speed, number of stoppages and network throughput, and (2) there is a whole street network between Waikele and Moiliili, not just three main freeways or highways. The results for the full network are shown below in Table 7.2. The list of roadways in the simulations was provided earlier in this section.

The table is color coded, so it is best viewed in color. For each measure of performance provided, there are four ranges or potential results as shown in the key to colors:

- ❖ The alternative produces an insignificant or counterproductive change; in beige color.

- ❖ The alternative produces some change but it is too small to make a perceptible difference; in green color.
- ❖ The alternative produces a large, productive change and is likely a partial solution to congestion problems; blue color.
- ❖ The alternative produces a very large, productive change and is likely a major solution to congestion problems; yellow color.

The measures are presented in terms of change from the base case. Average network speed will increase for all alternatives, but gains less than 10% are largely imperceptible. Average stopped delay is a typical traffic engineering measure and represents the difference between normal free-flow travel and congested travel. In order to make a perceptible difference, effective solutions should reduce delay by 10% or more. The third measure, "number of vehicles that completed their travel" during the one peak hour of simulation is a measure of network throughput. None of the infrastructure scenarios analyzed is massive enough to produce very large improvements in throughput, but underpasses and HOT lanes can deliver a double digit improvement in throughput. Total network wide travel time shows the overall improvement in congestion. Several alternatives will provide a substantial congestion relief.

Even under optimistic assumptions, rail fails to produce results that would make it at least a small solution to congestion. It is interesting that the network wide impacts of a massive $5 billion rail line are basically the same as the traffic benefits of four underpasses costing around $50 million to build. In contrast, the HOT lanes combined with four underpasses will provide a substantial relief from congestion resulting in network-wide travel times being reduced by about one third.

The ferry option does not have significant network impacts but it provides substantial relief for 500 vehicles per hour from Ewa and Ewa Beach to Lagoon Drive. It is therefore highly advisable that the ineffective, unreliable and expensive *TheBoat* be replaced by *TheFerry*. From a network performance standpoint the tunnel will offer a substantial relief to traffic congestion. Concerns about feasibility and costs are discussed later herein.

Table 7.2.Change over Existing Conditions by each Examined Alternative (Full Network)

	AVERAGE SPEED	AVERAGE STOPPED DELAY PER VEHICLE	NUMBER OF VEHICLES THAT COMPLETED TRAVEL	TOTAL TRAVEL TIME
Rail: 6.5% traffic reduction on H-1, Kamehameha, Moanalua	7%	-10%	1%	-9%
Rail: 3.25% traffic reduction on H-1, Kamehameha, Moanalua	5%	-5%	1%	-6%
Four Underpasses [(a)]	5%	-27%	3%	-5%
2-lane HOT [(b)]	24%	-27%	13%	-24%
2-lane HOT and Four Underpasses	28%	-40%	14%	-26%
3-lane HOT	30%	-34%	15%	-32%
3-lane HOT and Four Underpasses	32%	-46%	15%	-34%
Ferry (500 vehicles/hour) through Airport to Lagoon Drive [(c)]	2%	-2%	0%	-1%
Pearl Harbor Tunnel through Airport to Nimitz Viaduct [(d)]	16%	-29%	9%	-15%

KEY
insignificant change
small change; likely not worth the cost
large change; a likely solution
very large improvement

NOTES

a) Four underpasses: (1) Vineyard/Punchbowl, (2) Vineyard/Pali, (3) Nimitz to Alakea left turn, (4) Kalakaua/Kapiolani

b) All HOT lanes start near the H-1/H-2 merge and terminate at Iwilei near Hilo Hattie's; they include an elevated lane to Hotel St. (buses only) and underpasses (3) from the list above.

c) Short passage across the Pearl Harbor entrance channel with two highly maneuverable barges carrying 50 cars each and taking 12 minutes including load/unload.

d) Underwater tunnel in lieu of the barges, cut-and-cover tunnel through HIA, widened Lagoon Drive and 2-lane on-ramp to HDOT Nimitz Viaduct (2 reversible lanes from Keehi to Iwilei.)

Table 7.3. Comparison of Selected Transportation Alternatives

	TheRail	TheBoat	HOT lanes	Toll Tunnel
COST				
Capital Cost (Billion)	$5-6	Lease (in O&M)	$0.90	$3-5
Likely Local Tax Burden to Build It	$5,000,000,000	Lease (in O&M)	$400,000,000	$1,250,000,000
Tax Burden per Oahu Resident	$5,523	$6	$442	$1,381
Annual O&M Cost	$64,400,000	$6,000,000	$11,500,000	$14,300,000
Fare or Toll	$2 / Person	$2 / Person	$1-$3 / Car	$2-$6 / Car
GET Increase	Yes, from 4.1% to 4.7%	None	None	None
Property Tax Increase	40%	No	No	No
Likely Peak Hour, Peak Direction People Moved*	1,500	120	7,540	3,910
20 Year Cost per Peak Hour Commuter	**$4,192,000**	**$1,000,000**	**$83,554**	**$392,839**
Year Fully Completed (20 miles of Rail)	2018+	2007	2015	2016
Crime: Needs Transit Police	Yes	No	No	No
Uses U.S. Technology / Know How to Maintain	No/No	Yes/Yes	Yes/Yes	Yes/Yes
Funding Eligibility FHWA - FTA - PPP	No-25%-No	No-25%-No	80%-10%-50%	80%-No-50%
CONSTRUCTION				
Large Parking Lots	4 Planned Need More	Yes, 2	No	No
New Electric Power Plant	Yes	No	No	No
Stations	21-29	2	No Need	No Need
Overall Investment and Construction Risk, 10 is best	4.2	10	6.8	2.1

	TheRail	TheBoat	HOT lanes	Toll Tunnel
PERFORMANCE				
Average Speed	25 mph	20 mph	60 mph	50 mph
Kapolei to Downtown (minutes, approx.)	65	80	25	15
Waikele to Waikiki Corridor Travel Time Reduction	**-6%**	**0%**	**-34%**	**-15%**
Slow Downs or Shut Downs	Power Failure, Mech. Failure, Suicide, Strike, Crime	Mech. Failure, Strike, Crime	Very Few Crashes on Freeflow Lanes without Trucks	Very Few Crashes on Freeflow Lanes without Trucks
SERVICE TO COMMUNITY				
Affects *TheBus*	Very Negative	Mostly Neutral	Very Positive	Somewhat Positive
Support Express Routes	No	No	Yes	Yes
Serves Public Buses, Tour Buses, and Vanpools	No	No	Yes, Free	Yes
Helps Business, Tourism and Economy	No	No	Yes	Yes
Good Option for Unemployed, Seniors, Disabled	No	No	Yes	Yes
Connects to King / Beretania Bus Rapid Transit to UH?	Transfer	Transfer	Express, Direct	Express, Direct
Emergency Response	No	No	Fast and Wide-spread	Fast but Limited
OTHER CHARACTERISTICS				
Noise Pollution	Steel Wheels on Steel Rails	No Impact	Very Little Noise	Most Quiet Highway Option
Carbon Footprint (Pollution)	Very High Because Roadways Remain Clogged	Relatively Huge Consumption per Passenger Mile	Lowest Because It Resolves Congestion	Second Lowest; It Resolves Some Congestion
Future Solar, Hydrogen, Battery Technologies	Old, Fixed Technology	Old, Fixed Technology	Markets and People Adapt	Markets and People Adapt

(*) TheRail and *TheBoat* number of people include those who were drivers. Those who switched to rail from vanpools and *TheBus* are not counted because they were not significant contributors to traffic congestion.

(**) All figures in approximate year 2005 to 2007 time frame.

There are many parameters of significance in addition to travel time and traffic performance of the alternatives. These are summarized in Table 7.3 for three main competing alternatives *TheRail*, HOT lanes, and the tunnel; for additional perspective, *TheBoat* has been included. The later does not compete directly with the other infrastructure-intensive alternatives because it operates with just two boats and there are no plans to make it a high frequency, high capacity waterborne transit service. Table 7.3 has five main sections: Costs, Construction, Performance, Service to the Community and Other Characteristics of the compared alternatives.

Capital Cost is listed in billions. The city's 2006 estimate for the 20 mile (short) rail line is $3.6 billion and $4.6 billion for the 28 mile line, but based on national experience of average cost overruns (which are in the order of 20%), the likely cost is between five and six billion dollars, which does not include but a few parking lots, no transit police and no power plant.[44] *TheBoat* is operated on a lease basis and has no fixed capital cost. A 15-mile 3-lane HOT lane reversible expressway with the structural design features of the Tampa Leroy Selmon Expressway is expected to cost 900 million dollars based on Tampa costs updated for 2007 construction prices and nearly doubled to account for Hawaii construction costs. For the amount indicated, one can quite possibly build the concrete segments off-island and ship them to Honolulu. Tunnel costs are much harder to estimate, although an underwater tunnel built in the US in 1992 cost under

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[44] "Last month the USDOT released a new report covering those projects built between 1990 and 2003, which showed that of the 21 projects covered, the best performer, San Jose, was 28% under forecast and the worst, Portland, was 72% over, for an average of 21% over forecast.

More important than averages is the distribution of the various error rates. For example, if the resulting costs of the 21 projects were between ± 10% of the forecasts it would be a reasonable indication to our policy makers of the likely accuracy of the Honolulu projections.

However, that is not the case here. These 21 projects' costs relative to forecasts errors were evenly distributed over a wide range of 72% over to 28% under forecasts. If we were to apply that range of error to the $4.6 billion projection, it would result in a spread of $3.3 billion to $7.9 billion.

Each of these 21 capital cost projections was thought at the time to be reasonable by both the transit agency and its consultant who produced them. Just as our City Transportation Department and its consultants, Parsons Brinckerhoff, also believe their current cost projections are reasonable. In addition, the US DOT Federal Transit Administration's in-house analysts and outside consultants also examined each of these 21 capital cost projections in great detail and thought them all reasonable.

The forecast errors have not improved. The errors of the last three rail lines built were as follows: (1) San Francisco BART Airport Extension heavy rail had a 21% overrun, (2) Minneapolis Hiawatha light rail had a 49% overrun, and (3) San Juan, Puerto Rico heavy rail had a 113% overrun."
Source: Slater, C. "Rail Transit Not Worth The Big Financial Risk," The Honolulu Advertiser, October 26, 2007.

$400 million.[45] Coincidentally, the tunnel referenced below is also adjacent to a major U.S. Marines and Naval station, therefore allegations that tunnels cannot be built near military facilities are unfounded. For this tunnel to work well, there has to be a connection through the Honolulu International airport, in the form of a cut and cover or largely covered highway to allay fears of potential terrorist acts against passenger aircraft. This project is likely to cost up to 10 times as much as the elevated expressway, on a per mile basis. Both the tunnel and the HOT lanes alternatives share the same reversible segment called the Nimitz Viaduct.

Likely Local Tax Burden to Build It is the cost that Oahu residents have to pay after likely federal subsidies have been subtracted. About one billion dollars of subsidies have been assumed for *TheRail*, which is a highly optimistic amount. FHWA and FTA sources or earmarks can provide at least half a billion dollars for HOT lanes. This level of subsidy could also be attained from a private partner. HOT lanes is the only project that can be built with private investors and local taxes thereby avoiding extensive federal subsidy requirements which prolong project delivery from about seven years to over ten years. Over two billion dollars of subsidies are assumed for the tunnel, an amount that is not likely to be obtained. Due to the relatively high risk of tunneling and the interference of the project with Pearl Harbor and HIA, substantial private participation is much less likely compared to the HOT lanes. No private participation has ever been a part of metrorail development projects because all systems, without exception, generate heavy operating losses. Las Vegas Monorail was built with private funds and it is a case study of huge capital losses, technical failures and low ridership.

The reader should not be confused by Transit Oriented Developments (TOD) and similar “development” propaganda which in reality is a tool for providing tax subsidies and similar taxpayer financed breaks to developers to develop land near rail stations. All TODs built without sufficient parking have failed. TODs succeed only when a sufficient roadway and parking infrastructure is provided to them. The “cake” in TODs is roads, cars and parking; rail is only a sliver of “icing.” In other words, TODs are normal land developments, but devised in a way so that subsidies and incentives can be provided for developers by the typically unaware taxpayer. A more appropriate explanation for the acronym TOD is Taxes Offered to Developers.

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[45] Monitor-Merrimac Memorial Bridge-Tunnel (I-664) in Virginia, shown in Figure 6.4.

This is in large part the explanation of the strong support of Oahu developers, realtors and financiers (banks, etc.) for *TheRail*. A handful of politicians who are vocal supporters of *TheRail* are also employees of those land owners and developers.

Tax Burden per Oahu Resident is the cost that each resident on Oahu, regardless of age, will pay to have these projects built. The Tax Foundation of Hawaii often uses a "family of four" to make the figures more representative of the burden per household. Therefore, a family of four will pay a one time amount of $22,000 to have a 20 mile, 21 station rail system built, $1,700 to have a 15-mile reversible HOT expressway built, and about $5,600 to have a reversible toll tunnel built. *TheBoat* operates on an annual lease and the cost per Oahu family is $24 per year assuming that for subsequent years local taxes will pay five million dollars for its operation and federal taxes will pay one million. There is no guarantee that there will be any future operational subsidies past the first year for *TheBoat*, which received a five million dollar earmark for a one year experimental launch.

Annual Operational and Maintenance (O&M) Cost are significant for all alternatives. A large O&M budget is critical for *TheRail*, which, like *TheBus*, requires a large staff around the clock in order to operate. In contrast, virtually nobody is required for the hundreds of miles of freeways, highways and arterial streets on Oahu for at least one half of every day. Notably, the annual cost for operating *TheBus* is in the order of $170 million per year.

Fare or Toll specifies the likely charge in today's value of money. A substantial toll would be required for the tunnel option. Maximum toll for HOT lanes is likely $3.50 at 2007 prices. Buses and vanpools go free on HOT lanes at all times. Due to its high cost, the tunnel will not be able to offer "free rides" to over 250 high occupancy vehicles per hour.

A general excise tax (GET) increase has been enacted for a fixed guideway project. Effective GET increased from 4.17% to 4.72%. However, this increase is not enough. Prior to the passage of the GET increase bill, *TheRail* cost estimate was $2.7 billion and the GET increase request was from 4% to 5%. *TheRail* cost is now about double its original estimate and the Legislature has approved only a 0.5 point increase on the GET, which leaves a gap that needs to be covered by a 40% estimated increase in **Property Tax** on Oahu, or at least a full point increase on the GET.

Likely **Peak Hour, Peak Direction People Moved** is significant because Honolulu has a transportation capacity problem. If a train departs on an optimistic schedule every three minutes, there will be 20 trains per hour carrying a maximum (sardine packed load) of 20 trains times 300 passengers equals 6,000 passengers per hour, most of them standees. But sardine loads are observed only in multimillion city populations and on Oahu many of the passengers will switch from *TheBus* and some carpools and vanpools. Optimistically, *TheRail* will remove at most 1,500 drivers and their cars from the corridor. *TheBoat* is not a sustainable alternative, but in a best case scenario it may remove at most 120 drivers from the corridor. HOT lanes, even in a 2-lane configuration has a capacity of well over 2,000 vehicles per hour per lane of which at least 50 will be loaded express buses and 200 will be 5+ people vanpools, for an average occupancy per vehicle of well over 2 resulting in a people moving capacity of 8,000 people in the peak hour, all of them sitting comfortably. A larger number of buses can be routed, as demand increases, with an attainable people moving capacity of well over 10,000 people per hour. In other words, with an extensive bus service, a mere two (2) HOT lanes can provide double the peak capacity of *TheRail*. HOT lanes are superior in both theoretical capacity and actual people moved. Due to its cost and limited geographic coverage, the tunnel alternative is expected to serve about 4,000 people in the peak hour.

Twenty Year Cost per Peak Hour Commuter is a critical measure that lets the reader compare long term effectiveness. Using this cost-effectiveness criterion is easy to show the fallacy of providing alternatives such as *TheBoat*, which cost the taxpayers one million dollars to remove one driver from the road. *TheRail* is even worse. Notably, the 20-year figure (which includes installation, operation and maintenance costs) does not include the necessary refurbishment of *TheRail*, which typically runs in the billions every 20 to 30 years; see section 3.7. The Operating and Maintenance cost shown for highway alternatives includes repaving and tunnel cleaning. Except for natural disasters and other calamities, highways do not need any refurbishment as long as maintenance cycles are observed.

Year Fully Completed is an estimate of the year when the alternative will be open for public use. Without exception all estimates (except for *TheBoat*) are highly optimistic but were stated as such to be relatively compatible with city administration's target for year 2018 operational rail (20 miles of *TheRail*). In real terms, this target is virtually impossible to attain.[46] There is a notable exception: With local funds and a public-private partnership, it is realistic to expect that HOT lanes can be delivered by 2015 if this option receives strong bipartisan political support. This may also include a Bus Rapid Transit connector along King St. and Beretania St. linking express buses from HOT lanes to UH via the Hotel St. transit station.

Crime: Needs **Transit Police** applies only to *TheRail*. Typically train systems and stations are attractive to undesirable elements of the society and are effective conduits for drug trafficking, as Portland light rail and many other systems have demonstrated. There are virtually no rail systems in the nation without Transit Police. However, transit police was not budgeted for in the City's AA costs. Also park-and-ride lot security is not budgeted for. Park and ride transit areas are attractive to thieves and require surveillance and security.

Uses U.S. Technology / Know How to Maintain refers to the little known fact that the U.S. has no passenger rail technology. Virtually a passenger rail technology is imported, primarily from Germany, France, or Italy in Europe, and Japan or Korea in Asia. All technologies for running trains are strictly proprietary and guarded. Competitive contracting for a rail system is very difficult and the final system is a sole-source purchase with a long maintenance contract. Unlike highways, tunnels and boats of which Oahu has many, an unfamiliar rail system will pose extensive (which means both difficult and expensive) maintenance issues.

Funding Eligibility describes the ability of an alternative to receive Federal Highway Administration (FHWA), or Federal Transit Administration (FTA) or Public-Private Partnership (PPP) Financing. Due to its low cost, superior performance, and ability to charge a reasonable toll, HOT lanes have the advantage of being eligible for all three types of financing. A toll

[46] In 1996, officials affirmed that the construction of Sound Transit would cost $3.9 billion and be completed in 10 years. In 2007, costs skyrocketed to $15 billion with an estimated completion time of 24 years. In 2008, twelve years after 1996, Seattle has no functioning rail system.

tunnel will require an unusually strong local political commitment in order to attract some PPP interest. FTA funding for New Starts is limited to $500 million but city administration has claimed that $1.2 Billion should be expected for the full alignment. As of this writing, the Hawaii Congressional delegation has not asserted that such an amount is attainable. It is worth noting that the Washington, D.C. metrorail extension to Dulles airport which has half the cost of *TheRail* has serious trouble in receiving FTA subsidy.[47] Another salient fact is that due to pervasive federal budget issues, Congress has enacted a number of transportation funding rescissions.[48]

The next section in Table 7.3 assesses potential construction issues for the alternatives. *TheRail* plan includes four **parking lots** but many more are needed to facilitate connections with cars. The rail line is largely surrounded by medium and low density suburbia, therefore, expecting people to make connections by *TheBus* is highly optimistic. It has been shown that *TheBus*-*TheBoat* connections are problematic. In contrast, no parking is required for the reversible expressway or tunnel options. These facilities will simply take the same downtown workers to their same parking lots but 30 to 60 minutes quicker during the peak hour. There is a lot of space for additional parking lots in the fringes of downtown Honolulu (e.g., one block east of Punchbowl Street), but only if and when Honolulu develops thousands of new jobs, would more parking and cars come to the city center.

A new **electric power plant** will be needed due to the substantial draw of electricity for the long rail line which will also be subject to large parasitic losses. HECO plants cannot provide sufficient electricity to *TheRail* during the evening peak period.

TheRail is planned with 21 stations, all of which will have the equivalent height of a four story building and must be Americans with Disability Act (ADA) compliant. The Ala Moana Shopping Center station will have an elevation of over 80 ft. in order to clear the Nordstrom department store. This increases size and necessitates the continuous use of escalators and

[47] Washington Post - August 23, 2007; A18.

[48] AASHTO Journal, "A rescission of $3 billion from the unobligated balances of apportionments is included in the compromise bill," November 9, 2007.

elevators. Contrary to the prevailing rhetoric, it is improbable that bikes, surfboards and other large objects will be allowed onboard *TheRail* for safety reasons. Station supervisors will be needed to enforce such limitations. *TheBoat* does not have proper stations to protect people from the elements, but, as mentioned earlier, from all perspectives this "transportation alternative" is not viable.

Thirty engineers completed a survey developed using an NCHRP[49] survey instrument to assess project development risk and an Overall Investment and Construction Risk was developed with zero being worst possible risk and 10 being least risky. Obviously *TheBoat* is a relatively tiny transportation service based on proven technology (e.g., passenger boat for transportation or sightseeing) and therefore it received an essentially risk free score. All other alternatives involve investments in the billions and are subject to substantial environmental impacts and ridership concerns. As expected, developing a tried-and-true and relatively inexpensive HOT lane project is much less risky that developing a small rail system or an undersea tunnel.

Performance is an important feature of any transportation alternative and chief characteristic is the provision of a competitive, convenient and reliable transportation service. Competitiveness typically refers to **average normal speed** between major origins and destinations (e.g., from the H-1/H-2 merge to downtown). All HOT facilities in the nation are operated on a congestion pricing principle that varies the toll so low occupancy vehicles cannot enter a facility "in droves" and allow it to get congested. HOT lane speeds are typically between 65 and 70 miles per hour with a practical average for buses and vanpools of about 60 mph. At that rate, 15 miles are covered in 15 minutes as opposed to 60 minutes on a stop-and-go freeway. Although typical metrorail strains can attain 50 mph speeds, their slow acceleration and deceleration as well as mandatory 15 to 45 second stops at stations reduce their average speed to under 25 mph. As a result, when it comes to **travel times**, the illustrated times between Kapolei and downtown are short for both the HOT lanes and the tunnel but they are long and uncompetitive for *TheBoat* and *TheRail*. The same reason why commuters do not stampede to *TheBoat* will apply to *TheRail*. Modern people, particularly suburbanites with young children

[49] National Cooperative Research Program, Estimating Toll Road Demand and Revenue, Synthesis 364, TRB, Washington, D.C., 2006.

live complex, rushed lives. An elevator that stops at every stop in a 21 story building is infuriating. A similar feeling cripples the attractiveness of *TheRail* which, combined with its limited geographic coverage vis-à-vis the multitude of people's destinations, makes fixed rail an alternative that is not suitable to people's lifestyles.

It must be repeated that the City's own Alternatives Analysis Table 3-11 (AA, page 3-11) includes travel time estimates for year 2030 with *TheRail*. It is shown that travel by auto is equal, faster or much faster than *TheRail* for all year 2030 trips between:

- Aiea (Pearlridge) and Downtown
- Downtown and Ala Moana Center
- Downtown and Manoa
- Airport and Waikiki

For trips between Aiea and either Waikiki or Manoa, all Rail alternatives will provide trip times that are the same as or longer than trips by auto. The travel times by auto reflect 2030 traffic congestion conditions without rail. What is also important is that in the current plan, *TheRail* does not serve UH-Manoa or Waikiki, therefore those trips require additional transfers and connections and their travel times will be much longer than those stated in the Alternatives Analysis.

As mentioned earlier in this chapter, detailed traffic microsimulations have allowed us to estimate the congestion reduction offered by each alternative by estimating a **Waikele to Waikiki Corridor Travel Time Reduction** for all vehicles in the main Honolulu network in our analysis. The congestion benefit is 0% for *TheBoat* (it has an imperceptible benefit), 6% (at best) for *TheRail*, 15% for the tunnel and 34% for a 2-lane HOT lane reversible expressway.

Some refer to *TheRail* as offering a reliable service, but ignore **Slow Downs or Shut Downs**. HOT lanes are not subject to congestion and due to its relatively high toll, the tunnel also is not expected to be congested. Thus, for many years into the future, both highway alternatives will provide reliable and uncongested flow. We are all aware of the effect of crashes and stalls on highways and their potential for generating congestion. However, on free-flowing freeways without trucks (neither HOT lanes nor the tunnel will allow trucks, except for ambulances and fire trucks) the accident rate is very low, practically bordering with zero. For example, despite the presence of many heavy trucks, the uncongested H-3 freeway is virtually accident free.

On the other hand, crime, suicides, mechanical, electrical and electronic malfunctions are a daily occurrence on busy rail systems. When one's commuter environment includes among other things bad smells, pushing, rushing, cursing and groping as it is the norm in New York City, London, Paris and other busy systems, nagging malfunctions and late trains do not register let alone make anyone's news list, as opposed to an overturned SUV on the FDR in Manhattan with TV helicopters rushing to cover the action. Some may think that "transit strike" is a made up issue. An Internet search reveals 2.6 million hits. Transit strikes are predictable events and so are freeway closures for maintenance, etc. A "freeway closure" Internet search reveals 0.6 million hits. These are not scientific indicators, so the readers should draw their own conclusions.

Each of the examined alternatives has vastly different impacts on the community. Only a handful of them are presented in this study. A common occurrence with the creation of new rail systems is the **reduction of bus service**. This is planned and expected for *TheBus*. Los Angeles minorities sued the city and won a restoration of bus service after it was reduced in favor of an ineffective rail line. *TheBus* will become a feeder service to *TheRail*. Express Bus service will suffer as roadway congestion worsens with *TheRail* since it is unable to provide congestion relief. Due to budget issues faced by all cities operating rail systems, express bus service may be deleted altogether as a cost-cutting measure.

On the other hand, free-flowing expressways make **Express Buses** highly competitive and economical to run since a Kapolei to downtown round trip can be concluded in less that one hour instead of more than two hours with or without *TheRail*. With HOT lanes, the same number of buses and drivers can provide twice the service. This doubles the benefits because both speed and frequency improve for *TheBus*, making it even more competitive to the automobile. These advantages combined with a lesser need for transfers and the ability of *TheBus* to provide sidewalk service at the origin (e.g., Kapolei) and destination (e.g., downtown) for the same fare as *TheRail* make *TheBus* much more attractive than *TheRail*. Most HOT lane developments in the nation report strong partnerships with municipal bus operators. The effect of the tunnel route on *TheBus* will be less positive chiefly because the route affects fewer residential communities (Kapolei, Ewa and Ewa Beach) as opposed to all the communities strung along the H-1 freeway corridor from Kapolei to Kalihi. Also a PPP-based tunnel development will likely charge buses a substantial fee per passage in the order of $20 to $50, based on similar toll facilities in Europe.

TheRail and *TheBoat* make no contribution to **tour bus operations, vanpools and the transportation of freight, supplies and mail**. Not only do they not resolve congestion but they also will consume most of Oahu's transportation taxes leaving little funds for highway and bottleneck improvement. Cities like Chicago, Portland and Vancouver are often mentioned for their "successful" rail systems, but at the same time they have among the worst traffic congestion and pavement conditions. *TheRail* should be expected to have significant negative implications to the Ko'Olina and Disney resorts, the Campbell Industrial Park, Barbers Point Harbor as well as the entire leeward Oahu since highway congestion will be far worse with it in 2030 making all these places hard to access, therefore undesirable for commerce, businesses, tourists and residents alike. There are no major congestion relief projects planned for the corridor between Waikele and downtown given that neither the City nor the State are actively pursuing the HOT lanes or the tunnel options.

Both *TheRail* and *TheBoat* require transfers to other modes. As such, they are least convenient for **elderly, disabled and handicapped people**. Also significant research conducted by Dr. Evelyn Bloomenberg (Professor of Urban Planning, UCLA) and Sandra Rosenbloom (Professor of Urban Planning, University of Arizona) have conducted major pieces of investigative research that has proven that by far the automobile is the best tool for getting people out of welfare. It enables them to seek both help and job opportunities. Bus systems came as a distant second. Rail systems were deemed to be useless in this regard.

In 2002 the City pursued an ill-conceived **Bus Rapid Transit** system (BRT) that took lanes away from Kapiolani and Ala Moana Boulevards resulting in unfathomable urban congestion levels (e.g., peak period lanes to town on both these arterials would have been reduced from the existing seven to four, a 43% reduction in traffic capacity in a lane-deficient city). However, BRT can succeed and offer a valuable service to residents by running along King and Beretania Streets with minimal impacts to through traffic lanes. A proposal[50] drafted in 2002 is still viable, but has never been considered by City consultants. Given that there will be a direct free-flow link between the HOT lanes and Hotel Street transit mall, which in turn is directly connected with the King and Beretania couplet, there can be express buses that offer a direct, fast connection from Kapolei, Waipahu and Waikele on one end to Lower Makiki, Moiliili and UH-Manoa on the other end (see Figure 4.4.)

Both *TheRail* and *TheBoat* provide no functionality for **emergency services and evacuations**. In fact it is typical that in regional emergencies these services are shut down and locked (e.g., impending hurricane, extended power outage, etc.) On the other hand, reversible expressway facilities shine in cases of Emergency Response because within 30 minutes they can be configured to respond to a regional threat, such as evacuating Aiea and Pearl City due to a nuclear or other contamination threat in Pearl Harbor. As shown in Figure 4.2, a reversible expressway can evacuate a fully occupied Aloha Stadium in under one hour and in all three directions (to town, to Ewa and to Kaneohe.)

Other important characteristics include **visual impact**, **noise**, carbon footprint (which is a common current expression for **air pollution**), and ability to take advantage of less polluting and fossil energy demanding **future technologies** such as solar, hydrogen, battery technologies. Visual blight is hard to quantify and was not included in the table, however, it is worth repeating that the Ala Moana Shopping Center station will have an elevation of over 80 ft. in order to clear the Nordstrom department store. Most stations will be massive and will have a major aesthetic and view-plane impact. *TheBoat* has no impact in this respect and the tunnel option has the least visual impact among the three remaining options. The HOT lanes will be wider than *TheRail* guideway, but HOT lanes have four urban ramps and no stations, and their visual impact if designed like Tampa's, will be small. The HOT structure will not affect Honolulu residential areas. On the other hand, *TheRail*'s 4-story high and wide stations will

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[50] Prevedouros, P.D., "A Less Expensive and Less Disruptive Bus Rapid Transit System for Honolulu", www.eng.hawaii.edu/~panos/pdp_brt.pdf, November 15, 2002,

obstruct all views to Aloha Tower and will provide major visual obstructions at 20 or more locations. A large part of the guideway will affect residential areas from Kalihi to Moiliili.

The **noise levels** of steel-wheel on steel-rails will be high and so will be the rumbling noise from a heavy rail system on a concrete structure, passing every three minutes in peak periods. In comparison, a pedestrian at the lower level of the roadway of Tampa's reversible lanes cannot tell that there is traffic on the elevated lanes as all noise is deflected upwards by the design. About one third of the tunnel alternative will be covered, resulting in the least noise emissions among the three land-based alternatives.

TheRail will result in the highest **pollution** because it is dependent on fossil fuel conversion to electricity in order to operate. *TheRail* draws similar amounts of energy in the 15 hours per day that it will run near empty as during the 2 to 4 hours per day that it may run with a large passenger load. In contrast to *TheRail*'s continuous energy draw and pollution generation, cars consume energy and create pollution only during the time they are operated, which is under two hours a day for most private vehicles. Unfortunately, the worst part of *TheRail* is that it will not relieve congestion, thus current pollution levels will worsen and the concomitant energy and pollution issues will be enlarged. On a per-passenger basis *TheBoat* has a huge carbon footprint, which is inherent in this mode of transportation. Based on national statistics, ferries have the worst record in terms of energy consumed per passenger mile, for urban transportation. HOT lanes will provide the best relief in congestion and trips on the HOT lanes will be fast and efficient, thereby resulting in the lowest carbon footprint for the examined network. The tunnel option will be roughly half as good as HOT lanes, but substantially better than *TheRail*.

Markets, people and manufacturers adapt, in respect to **new technologies**, energy depletion and global warming. In contrast, *TheRail* is a 19th century technology that with the exception of some electronics and modernized interiors has not improved much in the last 50 years. *TheRail* will not enable Oahu to take advantage of large expected improvements in technology. In year 2030 Oahu will have a rail system which will look and function like a typical 1980s metrorail system. In contrast, in 2030 the presently advanced, quiet and economical

Toyota Prius will be a relic. The reader can imagine what a technological relic *TheRail* will be in 2030. Even a nuclear power plant (a virtual impossibility for Oahu) will not be able to make *TheRail* a modern, clean and efficient system in 2030 and beyond.

It is apparent that HOT Lanes, a mass transit version of Managed Lanes, clearly wins in an objective alternatives analysis. The only drawback of this proposal is the introduction of variable tolls on a facility that can be open for use by private vehicles. As researchers from the University of California systems have put it: "It is almost universally acknowledged among transportation experts that <u>congestion pricing is the best way, and perhaps the only way, to significantly reduce urban traffic congestion</u>. Politically, however, congestion pricing has always been a tough sell. Most drivers don't want to pay for roads that are currently free, and most elected officials—aware that drivers are voters—don't support congestion pricing.

A major reason for the hesitance in the introduction of tolls and of variable tolls is that there is always substantial support for the status quo and lukewarm support for new concepts such as HOT lanes. However, the rapidly increasing deployments of HOT lanes nationwide should provide a strong impetus for Hawaii to develop a toll enabling legislation (the County of Honolulu already has toll enabling ordinance) and proceed with the development of new HOT lanes.

To this end, a recent survey conducted in Seattle, Washington provides strong evidence that the public is ready for congestion priced projects.[51] WA-DOT plans two large toll projects, an expressway and a bridge, but has no desire to build them as taxpayer financed projects and instead it will build them as tolled projects:

The survey introduced the idea of a variable toll, also described as "congestion pricing." Although only 28% had ever heard the term before, after a careful explanation, 75% strongly or somewhat supported the idea, and 63% supported that form of tolling for the new 520 bridge. They also could see the logic of putting such a toll on both Lake Washington bridges (I-90 as well as 520), to even out the traffic flows.

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[51] Poole, R., Seattle Area Ready for Road Pricing?, Surface Transportation Innovations, No. 52, Feb. 2008.

The survey tested a number of different arguments for variable tolling. Out of 10 such arguments, the four most persuasive were:

- ❖ It is popular with people, regardless of income, as found in San Diego (**76%**)
- ❖ It reduces congestion, by shifting some trips to other times or other modes (**73%**)
- ❖ It encourages non-commuters to travel at off-peak times (**70%**)
- ❖ It reduces fuel consumption and vehicle emissions (**70%**)

8. Summary

8.1. Conclusions

The only reason that rail appears to be the solution is only because a handful of elected officials say so. The previous city administration wanted rail; they analyzed and rejected rail as a solution. One administration and five years earlier, the former DTS director endorsed Bus Transit over Rail Transit, as follows:

> "Previous proposals for a grade-separated rail transit system in Honolulu deeply divided the community and would have required massive capital investments.
>
> "It is increasingly clear that our best path to better mobility on Oahu is to improve our highway infrastructure as much as we can and build on our very successful bus service to improve and expand public transit.
>
> "With cutting edge technologies and innovative operational systems, we can make big improvements at an affordable cost."
>
> Cheryl Soon, DTS Director, City & County of Honolulu, Oahu Trans 2K, Progress Report 3, 2000

A study done by Texas Transportation Institute for the Maryland Chamber of Commerce[52] highlights the huge difference between investment in roadways and in passenger rail. Roadways provide a large net economic benefit. Rail does not. The FTA requires that each daily trip removed from traffic cost less that $25 in tax subsidy. The average 10 mile trip on highways costs under 50 cents in taxes. Honolulu's rail ridership forecasts, with sufficient manipulation, will provide rail transit trips costing in the neighborhood of $25 to qualify the proposed system for federal funding. However, investment in *TheRail* is unwise and in fact irresponsible for current and future generations of Oahu taxpayers.

[52] Texas Transportation Institute, "Investing in Maryland's Transportation Infrastructure: The Costs and Benefits to Workforce and Family," Report for Maryland Chamber of Commerce, September 2007.

The increased general excise tax combined with the future tax increases to sustain *TheRail* and the worsening traffic congestion will generate a strong and perennial loss to Oahu's economy. Government policies are driving up cost of living, driving out families, jeopardizing business survival. A limited, underpaid, overtaxed, overworked and under-qualified labor force is detrimental to businesses. This, in turn, will cause a prolonged economic recession with no hope for recovery from huge military projects or tourist growth.

A reversible HOT lane expressway from Waikele to Iwilei, combined with a handful of underpasses, traffic signal upgrades and optimization, and a Bus Rapid Transit that runs along King and Beretania Streets are the main ingredients to providing the solution to both congestion and mobility issues on Oahu at a cost that the local tax base can afford. In turn these will improve development opportunities, quality of life and social welfare. As President John F. Kennedy said "*It is not the wealth of a nation that builds roads, but the roads that build the wealth of a nation.*"

8.2. History Repeating Itself

Excerpts from *An Evaluation of the Honolulu Rapid Transit Development Project's Alternative Analysis and Draft Environmental Impact Statement*. [53]

- "A rapid transit system will not be likely to improve [traffic congestion], and such improvements should not be a major selling point for the system."
- "... it is debatable whether any noticeable impact will occur on highway facilities ..."
- "... estimates of fuel, pollution, and time savings on highway facilities are generally paper exercises that seldom occur in the real world."
- "The Final Environmental Impact Statement should more clearly state that the primary benefit of rapid transit will be to substantially increase mobility for transit-dependent commuters."

[53] Hawaii Office of State Planning and University of Hawaii. May 1990.

- "...the primary benefit of rapid transit is not the reduction of automobile congestion. Rapid transit's primary benefit should be to substantially increase mobility for transit-dependent commuters."
- "...it appears that relatively few public benefits of any regional significance will result from any of the fixed guideway alternatives."
- "...it would be highly misleading to measure the success or failure of the proposed transit system solely on the basis of its ability to reduce auto congestion. To the extent that it increases the travel speed of current bus riders, who are slowed down by roadway congestion, this would be a benefit even if congestion levels on roadways did not fall at all. At least bus riders, who are not at all responsible for creating the congestion problem on the roads, would be less likely to suffer from it."
- "The only really effective way to reduce auto congestion is by raising the price of auto use ... and by giving traffic priority to buses and high occupancy vehicles."
- "In order to increase transit's mode splits to the 20-30% range, a level that would begin to yield quite noticeable and important social and environmental benefits, some combination of the following initiatives would likely need to be introduced: increased fuel taxes and registration fees; elimination of free or heavily subsidized parking; introduction of an auto-restricted zone in the core area (such as practiced in Singapore); creation of HOV-lanes and contra-flow lanes that give buses operating on surface streets substantial speed advantages..."
- "Perhaps what is most surprising, and to some extent alarming, about the alternatives presented is that few real choices are offered."
- "...we think that the TSM alternative has not been adequately defined in the AA/DEIS."
- "The TSM option appears "born to lose," as most TSM options are in alternatives analyses."
- "The range of alternatives considered in the AA/DEIS was disappointingly narrow and might have included other options."
- "In particular, what is lacking is a serious investigation of several viable dedicated busway options."
- "Where the current set of alternatives really fall short is in ignoring various busway configurations as a fundamental option to rail transit."

- "Quite aside from the neglect of low cost TSM alternatives, there is no exploration of the possibility of investing more in HOV lanes for buses and carpools, as an intermediate level of investment between the No-Build alternative and the rail alternatives."
- "The additional riders that might be drawn to busways (by virtue of the superior quality of service offered buy buses feeding directly into neighborhoods) might more than make up any higher costs (if indeed cost estimates are accurate). If presented in terms of a more traditional benefit-cost framework, it is likely that busways would compare far more favorably with fixed guideway rail options."
- "The real advantage of busways...is that they reduce...transferring, the Achilles heel of mass transit in many modern, low-density metropolises like Honolulu."
- "This criticism [of the City's TSM alternative], I believe, is less a reflection on the work of the consultants and more an outcome of pressures exerted by various political and special interest groups."
- "It seems totally inconsistent for the State to countenance increasing Hawaii's most regressive and most heavily used tax, the general excise and use tax, in order to finance the construction of a rail transit system, while at the same time the State and City continue to subsidize downtown parking *for their own employees.*"
- "...decibel levels may be noticeably higher to occupants of tall buildings adjacent to and above the aerial guideways ... Street canyons, such as found in Waikiki, can intensify noise through ricocheting and megaphone effects."

The main conclusions of the 1990 distinguished panel of experts[54] were that: (1) Rail will have no noticeable impact on traffic congestion. (2) The alternatives considered were totally inadequate and should have included busways and high quality transit options. (3) The lack of

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[54] Dr. Penelope Canan, Professor of Sociology at the University of Denver and faculty director of the University's International Institute for Environment & Enterprise.

Dr. Moshe Ben-Akiva, Turner Professor of Civil Engineering at MIT.

Dr. Robert Cervero, Professor of Urban and Regional Planning at the University of California, Berkeley, and a member of the Editorial Board, Journal of the American Planning Association.

Dr. G. Scott Rutherford, is Professor of Civil and Environmental Engineering at the University of Washington and Director of its Transportation Engineering Graduate Studies Program.

Dr. Donald Shoup, Professor and Chair of Urban Planning at University of California, Los Angeles and is also Director, of UCLA's Institute of Transportation Studies.

Dr. John R. Pucher, Professor of Urban Planning at the Blaustein School of Planning and Public Policy at Rutgers University.

these alternatives is the outcome of political and special interest group pressure. (4) The ridership projections are flawed due to faulty modeling and wrongly assuming that transit ridership increases with population and employment.

In 2006 the main author of this report and several other critics reviewed the City's Alternatives Analysis and independently found similar flaws, only in 2006 the flaws were more egregious. Long time residents of Oahu may observe that although the world is changing, nothing has changed in the cyclical attempts of special interests to introduce heavy rail on Oahu: Predictably biased studies, with predictable recommendations offering the wrong conclusions and solutions are done every 10 of 15 years. As a result, traffic congestion worsens, quality of life diminishes and the appeal of Oahu to tourists and visitors worsens while tens of millions of dollars are expended in useless non-solutions.[55]

[55] A cynical but shrewd observer mentioned that "the solution" is irrelevant. All that matters is "the process." The process of going through the motions of pretending to solve a problem by proposing a hyper-expensive solution. The process, in return, provides strong election and re-election opportunities to its advocate politicians, and millions of dollars to those involved with the studies, lobbying and paperwork, who, in turn, support the politicians and officials who advocate "the solution."

9. Questions

The City's Environmental Impact Statement must provide clear and precise answers to a number of questions. In addition to those routinely examined in an EIS, we developed several important ones that should be answered.

- When the large railcars arrive at Barbers Point how will they get to the rail yard which is adjacent to the Leeward Community College campus near the merge of the H-1 and H-2 freeways? The rail cars are too big, heavy and tall for trucks to carry on the freeway and under freeway overpasses from Barber's Point. Figure 9.1 shows the dimensions and weight of a typical heavy rail car. This rail car cannot be transported on Oahu highways. Others may look more modern (and cost much more than this $1.2 million sample) but they are not much smaller.
- *TheRail* requires a new power plant. Who will pay for it? Where will it be loctated?
- How long will HEI take to build a new power plant? How much will a new power plant cost? What kind of fuel will it use?
- *TheRail* will be a new Transportation Division in the city's transportation department. Early estimates ask for 40 staff to quickly grow to 400 plus. What is the full staffing needed for a 20 and 28 mile rail line?
- How many transit police will be required? At what cost?
- Will the proposed route sit in the flood areas predicted by Global Warming prognosticators?
- If rail is the selected technology, what effect will it have on U.S. trade deficit?
- What negative economic impact is the GET surcharge having on our economy, with it taking about $100 million per year out of residents' wallets?
- What is the economic consequence of only being able to find jobs along the rail line because traffic is projected to be so congested everywhere else?
- What will be the cost to the rest of Oahu residents that will be stuck in more congested traffic?
- What types of subsidies will be required to support the projected TODs?
- What specific monetary commitments in terms of actual land gifts and actual dollars have real estate developers, shopping centers, banks and others have made to the City? If *TheRail*

is such a good idea for private interests, where are the millions of dollars in private enterprise contributions and cost-sharing?

- ❖ What communities will be affected by the noise levels and what will be the consequences to public health and land values?
- ❖ How will future traffic be impacted due to rail using the majority of Oahu's transportation taxes and funds to build traditional road infrastructure?
- ❖ What is *TheRail*'s long-term cost including the mandatory refurbishment of most of its systems after 20 to 30 years? Since the GET sunsets, how will this be covered?

R-142A "Millennium" specifications

Car builder	Kawasaki Rail Car Company in Kobe, Japan and Yonkers, NY	
Car body	stainless steel	
Unit numbers	7211-7730	
Fleet of	520 cars	
Car dimensions	51 ft 4 in long 8 ft 7 $^{3}/_{16}$ in wide 11 ft 10 $^{5}/_{8}$ in high	15.65 m long 2.621 m wide 3.623 m high
Track, standard gauge	4 ft 8 $^{1}/_{2}$ in	1.435 m
Doorway width (side—clear opening)	4 ft 6 in	1.37 m
Wheel diameter	34 inches	864 mm
Propulsion system	Bombardier propulsion system, 3-Phase AC Traction Motors Model 1508C	
Power (per motor)	150 horsepower	112 kW
Brakes	Dynamic braking propulsion system; WABCO friction braking system	
Average car weight (empty)	*A-car (with cab) :* 73,159 lb *B-car (without cab):* 67,630 lb	33,184 kg 30,676 kg
Maximum speed	55 mph	90km/h
Total seated passengers	*A car (cab car):* 34 *B car (no cab):* 40	
Total standees	*A car (cab car):* 142 *B car (no cab):* 148	
Full capacity totals	*A car (cab car):* 176 passengers *B car (no cab):* 188 passengers	
Air conditioning system	Two roof-mounted HVAC units each car.	
Price per car (new)	US$1,215,466.66	

Figure 9.1. Sample rail car characteristics of the New York City metro system.

10. References

American Association of State Highway and Transportation Officials, "A Policy on Geometric Design of Highways and Streets," 4th Edition. AASHTO, Washington, D.C., 2001.

Coombs, J., "Virginia reaches HOT lanes agreement", Washington Business Journal, September 10, 2007.

Cox, W. and R. O'Toole "The Contribution of Highways and Transit to Congestion Relief: A Realistic View", Heritage Foundation, www.heritage.org/Research/UrbanIssues/bg1721.cfm, 2004.

Cuff, D., "BART gets rusty: Aging system lacks billions for infrastructure," Contra Costa Times, September 28, 2007.

Dehnert, G. and Prevedouros, P.D. "Reducing Congestion with Low-Clearance Underpasses at Urban Intersections: Investigation and Case Study." ITE Journal, March 2004, pp. 36-47, 2004.

Federal Highway Administration, "Guidance on Traffic Control Devices at Highway-Rail Grade Crossings," U.S. DOT, Washington, D.C. http://safety.fhwa.dot.gov/media/twgreport.htm, 2002.

Flyvbjerg, Bent, Mette Skamris Holm, Søren Buhl. "Underestimating Costs in Public Works Projects, Error or Lie?", Journal of the American Planning Association, Vol. 68, No. 3, 2002.

Kidd, B.D., "Multimodal Optimization of Urban Freeway Corridors," Final Report 582, www.azdot.gov/TPD/ATRC/publications/project_reports/pdf/az582.pdf, November 2006.

National Cooperative Research Program, Estimating Toll Road Demand and Revenue, Synthesis 364, TRB, Washington, D.C., 2006.

PB Americas, et al., Bay Area High-Occupancy/Toll (HOT) Network Study, Final Report, www.mtc.ca.gov/ planning/hov/, September 2007.

Pickrell, D., "A Desire Named Streetcar: Fantasy and Fact in Rail Transit Planning," Journal of the American Planning Association, Vol. 58, No. 2, pp. 158-176, 1992.

Poole, R., "What If There Were "Green" Cars? A Litmus Test for Planners", Surface Transportation Innovations, Issue No. 50, www.reason.org/surfacetransportation50.shtml, December 2007.

Prevedouros, P. D., "Honolulu Needs a Respectable Analysis Report to Help Honolulu Make the Right Decision About Mass Transit," www.hawaiireporter.com/story.aspx?d6581de9-ec07-4d89-bfe4-8ae3e62db404, 2006.

Prevedouros, P.D. and M. Stone, "Traffic Operations and Structures: Tampa's Reversible Express Lanes, 2008 Almanac of Science and Technology, McGraw Hill, 2008.

Prevedouros, P.D., "A Less Expensive and Less Disruptive Bus Rapid Transit System for Honolulu", www.eng.hawaii.edu/~panos/pdp_brt.pdf, November 15, 2002.

Prevedouros, P.D., "Why Single Rail Line with 12-15 Stations is Bad Transportation Policy for Oahu," www.hawaiireporter.com/story.aspx?a7a89607-eac3-4bde-bf5d-e5a9ef963e60, 2006.

PTV America, Vissim, version 4.30-02, Corvallis, Oregon, 2007.

Reason Foundation, New Report Shows Transit Progress—and Limits, www.reason.org/surfacetransportation48.shtml#feature2, 2007.

Rymer, B. and T. Urbanik II, 'Intersection, Diamond and Three-Level Diamond Grade Separation Benefit-Cost Analysis Based on Delay Savings.' Transportation Research Record, No. 1239, pp. 23-29, 1989.

Texas Transportation Institute, "Investing in Maryland's Transportation Infrastructure: The Costs and Benefits to Workforce and Family," Report for Maryland Chamber of Commerce, September 2007.

Texas Transportation Institute, Comparison of Several Key Mobility Performance Measures. Medium Population Group, mobility.tamu.edu/ums/congestion_data/tables/austin.pdf, 2006.

Transportation Research Board, "Commuting in America", National Academy of Sciences, 2006.

Transportation Research Board, Special Report 209: Highway Capacity Manual 2000e, National Research Council, Washington, D.C., 2001.

U.S. Department of Energy, Transportation Energy Data Book, 26e, www-cta.ornl.gov/data/index.shtml, 2007.

Vincent, W. and G. Roth, Comparison of Bus and Rail Transit Modes for the Dulles Corridor, Paper No. 06-2396, Transportation Research Board, Washington, D.C., 2006.

Washington State DOT, Managing and Reducing Congestion in Puget Sound, Performance Audit Report, http://www.sao.wa.gov/reports/auditreports/auditreportfiles/ar1000006.pdf, 2007.

Wiston, C. and V. Mahashri, "On the Social Desirability of Urban Rail Transit Systems," Journal of Urban Economics, 2006.

Ziv, J.-C. and W. Cox "Megacities and Affuence: Transport and Land Use Considerations," World Conference on Transport Research, Berkeley, CA, www.publicpurpose.com/ut-wctrs2007.pdf, June 2007.

Appendix A

Commuting in America: Hawaii Edition

A Summary Report Based on

Commuting in America III

The Third National Report on Commuting Patterns and Trends

Transportation Research Board—U.S. Academy of Sciences

Commuting in America is the definitive report produced roughly in the middle of each decade to help transportation professionals and policy makers understand the demographic, social and lifestyle forces that shape the demand and choices for transportation in the United States.

All exhibits and text in *italics* are taken directly from the report. My commentary appears in plain font as in this sentence. This 2006 report provides useful guidance for Oahu's major decision to develop transportation infrastructure costing billions of dollars.

The purpose of my commentary is to provide an insight into the trends in commuters' needs, wants, and likely choices for transportation, anticipated for the next decade, caused in large part by the baby boomers' reaching the final stages of their work life. I hope that you will find this 7-page summary useful. The 172 page report is available at TRB.org.

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November 28, 2006

Commuting in America III provides a snapshot view of commuting patterns and trends derived principally from an analysis of the 2000 decennial U.S. Census and will be a valuable resource for those interested in public policy, planning, research, and education. This is the third report in this series authored by Alan E. Pisarski, transportation consultant, over the last 20 years.

So many of the major forces of change in the past have diminished: the explosive growth of drivers' licenses and vehicle ownership, the rise of female participation in the workforce, the suburban boom, and the boom in baby boomer workers themselves are all behind us. Watching the final stages of the baby boomers' work life and the rise of the new populations that will replace them should be equally fascinating.

The summary is grouped in four sections: (1) Demographics. (2) Travel choices or modes of travel. (3) Congestion. (4) Infrastructure decision making. Throughout the text, SOV is single occupant vehicle.

DEMOGRAPHICS

The modal usage of the worker population over age 55 shows that as the older worker ages, there is a significant shift away from the SOV (from about 80% to 68%), slight gains in carpooling, and major shifts to walking and working at home. Bus travel gains somewhat as workers age and other transit modes tend toward minor losses in shares.

In general, as people transition to advanced age, they increasingly depend on buses to take them to their activities. Rail transit goes to dozens of places whereas buses go to several hundred places. Rail transit requires transfers and long cumulative wait times, whereas an express bus can travel for 10 miles or more without making any stops. In the recent Honolulu city administration's rail transit poll, only 33% of current *TheBus* riders support rail transit.

One of the main themes of this report has been the aging of the baby boomer workforce. We are now seeing the leading edge of the baby boomer generation approaching age 60, and some early indicators of more extensive changes to come are becoming visible. What we are seeing could be summarized quickly as: more workers working after 65; more older workers working limited hours; more older workers shifting away from the private vehicle; and more older workers shifting to working at home and walking, with mixed effects on transit (gains in buses but losses in rail).

The question remains whether significant numbers of baby boomers will tire of crabgrass and home care and opt for a more clustered-living lifestyle with less vehicle dependence and fewer household care concerns. There are immense governmental pressures trying to create these patterns. [The "Smart Growth" doctrine.] *The net effects* [of Smart Growth] *over time would be likely to be minor with increases in density in the suburbs in some areas and declines in central city densities acting to balance out.*

Very few things are as central to how people live, or how they choose to live, as the residential density at which they live. In America, affluence has always been associated with declining density of living and increased ownership of land, including multiple homes. At the same time, the desire for walking and "walkability" is very real and I would expect it to grow (but as noted in Commuting in America II, don't be shocked if people drive to where they want to walk!)

TRAVEL CHOICES

The distribution of the fleet by trip purpose clearly indicates that the automobile is used less for work than it is for other travel purposes. The van is also less used, but pickups are used in greater proportion.

The average age of vehicles has been climbing for years and now is reaching close to 9 years. One of the dramatic changes in American technology in the latter part of the past century was the engineering of vehicles that last longer. This has made serviceable vehicles available to lower income populations.

Over its 40-year span, the baby boom generation's coming of age and entry into the workforce, accompanied by the surge of women into the workforce, has been fundamentally served by the private vehicle.

Transit: Of the 13 states that posted gains [in ridership], *only Nevada gained more than 1 percentage point. Driving alone remains the lowest in travel time of the major modes. Commuter rail is the longest. Average transit travel times remain roughly double that of driving alone.*

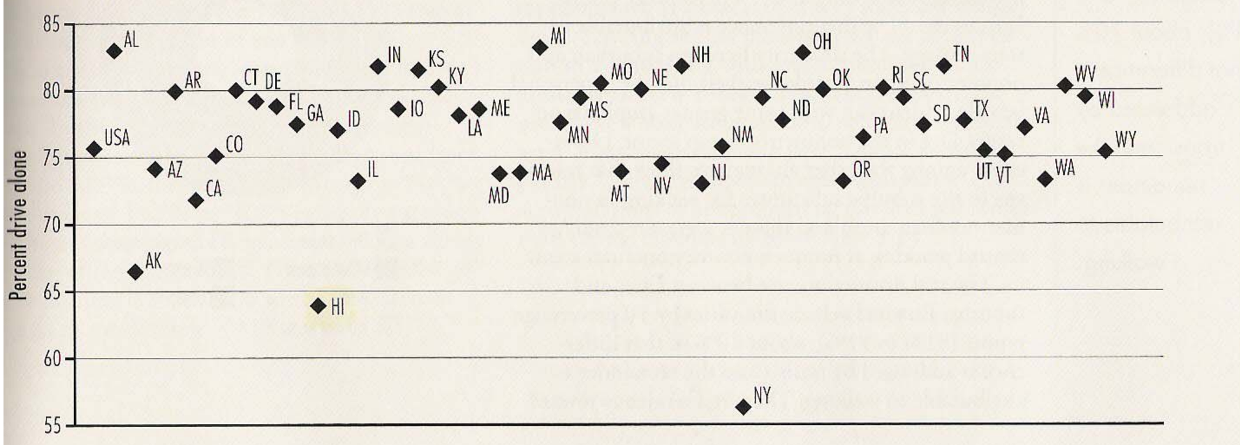
Only under very special circumstances is transit travel time competitive with travel time by auto. Honolulu's Alternatives Analysis report shows that trips by rail between Aiea and Manoa will be of longer duration than the same trips by auto, in 2030 ("Rail" travel times vs. "No Build" auto travel times in the AA report, Table 3-11.) In an increasingly multi-tasking society, this time savings and the inherent flexibility of private vehicles make them both invaluable as well as essential for daily living. Those who do not understand this either live in the past or are eager to recreate a socialist utopia: fixed, "canned sardines," government-controlled travel versus flexible, independent, autonomous travel. All developed countries went through a phase of poverty that necessitated mass transit (from horse-drawn trams to double-decker commuter trains.) Those times are in the past for Hawaii and the U.S.

Transit is more prevalent in densely populated areas, such as in downtowns and along the well-served transit corridors of the 12 mega-metropolitan areas with population over 5 million. … Overall, almost 73% of national transit usage occurred in areas over 5 million in 2000. With the recent additions of Miami, Atlanta, and Houston, transit's share would decline.

Transit includes all forms of public transportation. The point is clear that transit is less able to serve populations in smaller and horizontally developed urban areas. West of Salt Lake, Honolulu is largely suburbia with large rural patches. Even bus service is marginally efficient in these conditions. Here's how Hawaii did in terms of means used for trips:

Driving alone: States below 70% are New York, Hawaii and Alaska
Carpooling: All states Except Hawaii (19%) are between 9% and 15% share.

FIGURE 3-34 Drive Alone Shares by State, 2000



Note: States appear in alphabetical order.

It is clear that we have the <u>second lowest drive-alone rate in the country and the highest carpooling rate</u> (**Figure 3-34**). To succeed, Oahu's future infrastructure choices must understand why these travel choices occur and how to foster them.

CONGESTION

Many of the congestion problems we face are a product of vehicle breakdowns, construction and repair activities on the roadway, weather, and poor signal timing, all of which have ameliorative solutions that do not involve building new facilities.

I have repeatedly cited poor traffic signal timing, incompetent crash clearance, and a lack of responsive traffic rerouting during special events, evacuations, disasters, etc., in interviews, letters to the editor, and other venues for over a decade. Honolulu has accomplished very little in this regard. (See ITS below.)

Congestion, while growing, is still a relatively small part of work travel. Many workers suggest that they enjoy their work travel.

Indeed, many people make the best out of their commute because it presents an opportunity to be alone, to enjoy music, to catch up to the news or listen to a book tape. Others enjoy some quality family time and passengers enjoy some more sleep. Stop-and-go traffic is certainly a major annoyance, but compared to rail transit, traffic congestion is usually more tolerable compared with multiple transfers, standing and waiting, lack of seats in peak commute times, smelly surroundings, and exposure to pick-pocketing, groping, and other crimes.

Will ITS [Intelligent Transportation Systems] ***technologies begin to assert an influence on travel times or other factors of commuting?***

Recent studies have shown that many of the tools developed have a very positive influence at relatively low cost. Focusing on just four of the myriad technologies available (freeway entrance ramp metering, freeway incident management, traffic signal coordination, and arterial street access management), their research indicates that the present level of utilization of these technologies provided 336 million hours of delay reduction and $5.6 billion in congestion savings in 2003 for the 85 areas that they monitor. In the future, demonstrating effective use of existing capacity will be seen as a critical predicate to justifying investment in any form of new capacity.

The public should look forward to the Federal Highway and Transit agencies requiring proof that traffic and transit operations are reasonably optimized before approving any capital intensive traffic or transit projects. Traffic operations in Honolulu are far from being at an optimum level.

INFRASTRUCTURE DECISION MAKING

Will the value of time in an affluent society be the major force guiding decisions?

Seeking to juggle multiple tasks and household roles has created tremendous pressures to get things done on the way to something else. During the energy crisis of the 1970s this was driven by the need to conserve fuel; today it is driven by the need to conserve time. This has probably been the central factor in the growth of the SOV versus carpooling and other alternatives – the speed and flexibility of operating alone in a vehicle has strong appeal in an environment that values the ability to multitask.

There is another part of this: as incomes rise, the value of time increases. That means that many people, if not most, will have increasing values of time that they apply to their transportation decisions. Hence, the same system next year will be less acceptable to users than it is today because their value of time increases even if the system does not change.

We are hoping for ever increasing affluence in Hawaii since, in terms of purchasing parity, average incomes are relatively low. Any and all increases in affluence will move commuters from mass to individual means of transportation, regardless of what social planners wish. The preceding text from *Communing in America III* also explains the skyrocketing acceptance for toll or variable pricing highways in the U.S. and worldwide.

Time is money. For most people, some of their trips are worth a lot, so a few dollars in tolls for free flow travel are well spent. Variable pricing HOT highways in California enjoy an unprecedented 70% approval rate. In contrast, all three recent Honolulu polls indicated that at most 45% support rail, and in some Council districts, the majority of citizens are unaware of the heavy new taxation that will pay for it. Also most people are not aware of the 24 mph average speed of rapid rail.

Will the role of the work trip decline, grow, or evolve?

The work trip is no longer the dominant factor in local metropolitan and rural travel that it was in past years. Yes, the work trip is now festooned with associated and integrated trips in what has become a well-known phenomenon called the "work trip chain" – dropping off things in the morning and picking them up on the way home – all of this tightly tied to the continuing pressures of time on the average worker. Trips to the gym and market, drop-offs/pickups, etc. – are as likely to start from work as home in many households. Thus, for the majority of adults who work, the workplace location is a major force in the stimulus for travel, the direction, location, and time of travel and – often – the mode of travel as well.

Currently people make a chain of trips and not the old fashioned commute to work. (Rail systems were designed to serve the home-work-home commute, which is now nearly extinct.) Therefore, in a chain of daily trips, if even one trip has to be made by car, then it is likely that the car will be chosen to do all of the day's trips. People are rational decision makers when it comes to running their daily routine. They may like to use rail transit, but their daily chores preclude them from doing so.

The proof for this is in the report's data. The table below shows that regular transit users use transit only 69.4% of the time; they use other modes the rest of the time. In contrast, drive-alone commuters drive alone 90% of the time and drive with another

Is the Usual Mode the Actual Mode?

Usual Mode	On Travel Day (%)					
	Drove SOV	Drove with Others	Took Transit	Walked	Biked	Gave No Report/Other
Drive alone	90.0	9.3	0.2	0.3	0.1	0.2
Carpool	22.2	74.8	1.0	1.4	0.4	0.3
Take transit	7.8	9.7	69.4	10.1	0.5	2.5
Walk	8.1	9.2	2.6	79.5	0.2	0.4
Bike	6.7	8.4	1.7	6.1	77.1	0.0

person 9.3% of the time. Carpoolers carpool 74.8% of the time and drive alone 22.2% of the time. Even walkers and bikers are more consistent in their choice of transportation mode than are transit users.

Table 3-14 shows that on average, out of 1,000 commuters, fewer than 200 of them use subway or similar metro rail systems (2%). These percentages include New York City which skews statistics in favor of transit. Note that Honolulu already has very high carpooling and bus usage percentages, roughly twice those of mainland U.S. There is little room for a rail system to attract commuters. At best, it will siphon passengers from Oahu's successful *TheBus*.

TABLE 3-14 Modal Usage by Age and Gender

Mode	Total	Male	Female
		Percent	
Drive alone	75.73	76.17	75.22
Carpool	12.18	12.21	12.15
2-person	9.43	9.31	9.57
3-person	1.68	1.68	1.69
4-person+	1.07	1.22	0.89
Transit	4.55	4.11	5.07
Bus	2.51	2.10	2.98
Streetcar	0.05	0.05	0.05
Subway	1.45	1.36	1.56
Railroad	0.51	0.57	0.45
Ferry	0.04	0.04	0.03
Taxi	0.16	0.14	0.18
Motorcycle	0.12	0.20	0.02
Bike	0.38	0.57	0.16
Walk	2.93	2.90	2.96
Work at home	3.27	2.88	3.72
Other	0.69	0.83	0.53
	100%		

Honolulu is a small metro area compared to the 50 largest metro areas in the nation, as shown in **Table 2-16** on page 7. About half of these metro areas do not have rail systems. It would seem logical that several much larger metro areas will have priority over Honolulu for developing expensive rail infrastructure.

Indeed some are developing <u>light rail urban</u> systems. Honolulu is planning a <u>heavy rail suburban</u> system. For example, Phoenix, Arizona with a population that is four times larger than Honolulu's is developing a light rail system with a cost that is less than one quarter the cost of Honolulu's proposed 28 mile heavy rail system. Compared to fast growing metro area like Atlanta, Las Vegas and Phoenix, Honolulu's population growth was tiny—under 5% between 1990 and 2000

Proving to Oahu's residents and to the nation that Honolulu's proposed heavy rail system is necessary, cost-effective, and with a total cost that is in line with Honolulu's size will be a very tall order for Council Members and for Hawaii's Congressional Delegation.

In addition to high cost, Honolulu's proposed rail transit system does not fit its people's commuting patterns,[56] transportation needs,[57] chosen lifestyle[58] and the state's plans for

[56] Hawaii has the highest proportion of carpoolers, and second lowest proportion of SOV commuters in the nation.

alternative energy sources.[59] At the same time a reversible high occupancy/toll (HOT) expressway fits well. It is a proven solution for congestion relief, a reward for carpoolers, a great stimulator for bus usage, a tool for multi-work and activity multitasking residents and visitors, and it supports a market for locally produced alternative fuels.

BLE 2-16 Metropolitan Areas with Population Over 1 Million

ulation Rank	Metro Area	April 1, 1990 (Millions)	April 1, 2000 (Millions)	Change (Millions)	Change (%)	Population Rank	Metro Area	April 1, 1990 (Millions)	April 1, 2000 (Millions)	Change (Millions)	Change (%)
1	New York	19.55	21.20	1.65	8.44	26	Milwaukee	1.61	1.69	0.08	5.13
2	Los Angeles	14.53	16.37	1.84	12.68	27	Orlando	1.22	1.64	0.42	34.27
3	Chicago	8.24	9.16	0.92	11.14	28	Indianapolis	1.38	1.61	0.23	16.44
4	Washington, D.C.-Baltimore	6.73	7.61	0.88	13.10	29	San Antonio	1.32	1.59	0.27	20.20
5	San Francisco	6.25	7.04	0.79	12.57	30	Norfolk	1.44	1.57	0.13	8.75
6	Philadelphia	5.89	6.19	0.30	5.01	31	Las Vegas	0.85	1.56	0.71	83.33
7	Detroit	5.46	5.82	0.36	6.67	32	Columbus	1.35	1.54	0.19	14.47
8	Boston	5.19	5.46	0.27	5.19	33	Charlotte	1.16	1.50	0.34	29.02
9	Dallas-Fort Worth	4.04	5.22	1.18	29.34	34	New Orleans	1.29	1.34	0.05	4.08
10	Houston	3.73	4.67	0.94	25.15	35	Salt Lake City	1.07	1.33	0.26	24.41
11	Atlanta	2.96	4.11	1.15	38.93	36	Greensboro	1.05	1.25	0.20	19.16
12	Miami	3.19	3.88	0.68	21.42	37	Austin	0.85	1.25	0.40	47.69
13	Seattle	2.97	3.55	0.58	19.68	38	Nashville	0.99	1.23	0.25	25.00
14	Phoenix	2.24	3.25	1.01	45.27	39	Providence	1.13	1.19	0.05	4.78
15	Minneapolis-St. Paul	2.54	2.97	0.43	16.94	40	Raleigh	0.86	1.19	0.33	38.85
16	Cleveland	2.86	2.95	0.09	3.01	41	Hartford	1.16	1.18	0.03	2.21
17	San Diego	2.50	2.81	0.32	12.64	42	Buffalo	1.19	1.17	−0.02	−1.61
18	St. Louis	2.49	2.60	0.11	4.46	43	Memphis	1.01	1.14	0.13	12.74
19	Denver	1.98	2.58	0.60	30.37	44	West Palm Beach	0.86	1.13	0.27	31.00
20	Tampa	2.07	2.40	0.33	15.86	45	Jacksonville	0.91	1.10	0.19	21.37
21	Pittsburgh	2.39	2.36	−0.04	−1.51	46	Rochester	1.06	1.10	0.04	3.36
22	Portland	1.79	2.27	0.47	26.30	47	Grand Rapids	0.94	1.09	0.15	16.06
23	Cincinnati	1.82	1.98	0.16	8.89	48	Oklahoma City	0.96	1.08	0.12	12.99
24	Sacramento	1.48	1.80	0.32	21.32	49	Louisville	0.95	1.03	0.08	8.09
25	Kansas City	1.58	1.78	0.19	12.20	50	Richmond	0.87	1.00	0.13	15.12

: Full length names for the above metropolitan areas can be found in Appendix 4.

The entire island will barely reach one million population by 2030. The central City of Honolulu (Red Hill to Hawaii Kai) is small in population and population growth.

Municipality	State	**2000 Population**	2000 Land Area in Square Miles	Population per Square Mile	1990 Population	1990 Land Area in Square Miles	Population per Square Mile	Change in Population
City & County of Honolulu	Hawaii	**876,156**	600.0	1,460	836,231	600.0	1,394	4.8%
Honolulu CDP	Hawaii	**371,657**	102.2	3,637	365,272	102.2	3,574	1.7%

Source: Calculated from US Census Bureau data. (demographia.com)

57 Oahu residents have multiple jobs, or both school and job duties, and an active lifestyle.

58 Relative to population, there is a large variety of activities, most of them year-round scattered throughout Oahu.

59 Ethanol production from agricultural crops and expanded bio-diesel production to provide fuel for vehicles.

Appendix B

Lessons for Hawaii from Puerto Rico[60]

The Honolulu City Council is determined to spend billions of dollars on a ridiculous rail-transit line in Oahu. State Representative Marilyn Lee happened to visit Puerto Rico and came back gushing about that island's new *Tren Urbano* in Honolulu's leading paper."There are many similarities between Hawaii and Puerto Rico," says Representative Lee. "We must proceed with our scheduled plan to build transit — our sister island state has shown it can succeed."

San Juan's Tren Urbano. (Wikipedia photo.)

There are so many fallacies in Representative Lee's column that it is hard to know where to begin. Needless to say, Puerto Rico is not a state. Further, Honolulu rail proponents have a nasty habitat of calling rail transit "transit," implying that Honolulu doesn't have mass transit because it doesn't have rail transit.

In fact, there **are** lessons that Hawaii can learn from Puerto Rico, just not the ones that the apparently innumerate Representative Lee learned. As Honolulu rail skeptic Cliff Slater[61] has noted, far from showing that rail transit can succeed, the *Tren Urbano* is just one more rail disaster.

Start with the cost. It was supposed to cost $766 million to build. After more than a decade of planning and construction, it ended up costing $2.25 billion. Even after adjusting for inflation, Northeastern University researchers found, that was a 113% cost overrun.

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60 Source: http://www.ti.org/antiplanner/?p=229.

61 http://www.honolulutraffic.com/TrenUrbano.pdf

Next, look at ridership. Representative Lee admitted that "ridership is lower than projected." And how. The Tren Urbano was projected to carry 80,000 people per day. In its first year, it carried less than 25,000 people a day.

In 2005, the Puerto Rican Transportation Authority spent $43 million operating the *Tren Urbano* and collected slightly less than $600,000 in fares. Granted, 2005 was the first year of operation, but even in the first year you expect farebox recovery to be a little more than 1.4%. The agency collected far more from its bus riders, on whom it spent far less.

Puerto Rico was lucky: most of the cost of building the *Tren Urbano* was paid by U.S. taxpayers. Honolulu plans to impose most of the cost of its rail line on its own residents.

If Hawaiians want to look at a successful transit system in Puerto Rico, skip the *Tren Urbano* and look for the *públicos*, or public cars, that range up to 17-passenger vans. These are sometimes described as shared taxis and the operate a lot like airport shuttles in other U.S. cities. *Públicos* have fixed routes, but they will deviate from those routes for an extra charge.

In 2005, the *públicos* carried more than 20 times as many passengers (and passenger miles) as the *Tren Urbano*. The *público*'s farebox recovery rate? An amazing (for American transit) 98%. That's because they are really a form of private transit that is regulated by the local Department of Transportation.

While Honolulu might benefit from something like *públicos*, it already has (despite the claims of the rail nuts) one of the most heavily used mass transit systems in the U.S. It carries nearly 4% of urban travel, more than all other major urban areas except New York, San Francisco, and Washington. It also carries 8.7% of commuters, more than Portland, San Diego, or many other regions with supposedly successful rail transit systems.

Plus Honolulu has numerous private bus operators and a competitive taxi system that caters to tourists and really is very close to the *públicos* in many ways. But Honolulu's transit agency does everything it can to hamper its competition, such as forbidding private buses from taking tourists to popular beaches served by the public bus system.

The only reason Honolulu needs a rail transit line is so local politicians can award fat contracts to rail contractors and engineering firms. For transit riders and auto drivers, rail transit can only be bad news, draining away funds from transport systems that really work to feed the egos of local officials.

It is too bad that so many urban planners have jumped on the rail transit bandwagon. To justify their support of rail construction, they have to twist the data, bend their ethics, and betray the taxpayers they are supposed to serve. That's just one more reason to be an antiplanner.

Randall O'Toole
August 29, 2007

Appendix C

Traffic Operations and Structures: Tampa's Reversible Express Lanes[62]

Project Overview
A most unique toll road, Tampa's Crosstown Expressway Reversible Express Lanes (REL) developed, owned and operated by Tampa-Hillsborough County Expressway Authority opened to motorists in July, 2006. REL is a common sense transportation solution that addresses urban congestion by combining the innovations of concrete segmental bridges, reversible express lanes, cashless open road tolling and full electronic controls. The revolutionary "six lanes in six feet" freeway was constructed within the existing right-of-way of the Lee Roy Selmon Crosstown Expressway. It provides three lanes toward Tampa in the morning peak and three lanes out of Tampa and into the rapidly growing suburb of Brandon in the afternoon peak. During midday, a central segment is closed and the Tampa and Brandon segments operate independently on a direction that optimizes local traffic circulation. Cars and buses are allowed on the REL. A $1.50 toll is charged in 2007 but entry is unimpeded because tolls are collected electronically via in-vehicle transponders or with license plate recognition. REL provided a spectacular reduction in congestion (before speeds of 15 mph in the peaks rose to free flow speeds of about 60 mph) which translates to a full hour of round-trip travel time savings for many commuters. REL was constructed at a record low cost per mile, had minimal environmental impacts, created a minimal disruption to adjacent traffic, and spurred development growth in both Tampa and Brandon. Actual traffic volumes have exceeded forecasts.

The growth of traffic from 13.1 million tolling transaction in 1982 to 30.2 million transactions in 2002 resulted in severe congestion for thousands of daily Crosstown Expressway commuters. The Authority's solution to relieve peak-hour congestion was to build 10 miles of reversible express toll lanes between Interstate 75 and downtown Tampa. Like many urban areas, purchasing the necessary additional land in this corridor for typical highway widening was neither physically nor financially feasible. Consequently, to minimize footprint, most of the project was constructed as a bridge built using only six feet of space within the existing median. This resulted in an aesthetically pleasing structure which also reduced project costs as well as impacts to the community and the environment. The shape of the box that supports the deck and transfers loads to the pier limits the view of the underside of the bridge to only half of the structure, providing light, and limiting the structure's visual impact. The resultant perception is that of an overpass instead of a "double-decker" structure.

Technological innovations include cashless 3-lane wide open road tolling at free flow speeds supplemented by a unique approach to video toll collection for motorists without transponders and a centralized Traffic Management Center with state-of-the-art software to control the reversible lane operations and provide multiple safeguards to preclude vehicles entering in the wrong direction.

The Expressway is a classic commuter toll road, with directional percentage splits of more than 75/25 during the peak hours. In the morning, more than 75% of the traffic is Tampa bound; the

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[62] Panos D. Prevedouros, PhD and Martin Stone, PhD, AICP. Selected to appear in the 2008 McGraw-Hill Almanac of Engineering and Technology. (One of only three entries in the field of civil engineering.)

reverse is true in the afternoon. Almost 80% of all of the daily traffic occurs during the morning and afternoon commuting peak periods.

Terminal Gateways

The Brandon and Downtown gateways to REL were planned by pro-actively engaging the public into the design of both gateways. This resulted in highly positive community acceptance and support at both ends of the project.

In addition to their value as transportation projects, these gateways were major investments in urban architecture, landscaping and public facilities that have been a catalyst for new private investment. They are a case study on the integration of major highway infrastructure into existing communities. They are also a case study of flexible traffic operations since REL is able to operate in six modes: All east-bound, all west-bound, and four combinations of directional operation of the Brandon and Tampa gateways.

The Brandon Parkway end of REL includes scenic landscaping, a winding off-road recreational trail for walking and cycling and numerous sites for resting, relaxing, and enjoying the environment. The Parkway has become the prime location for construction of over $100 million of new restaurants, shopping, residential and private leisure activities. The Brandon Parkway functions as a set of internal circulation roads. During off-peak travel periods, the Parkway facilitates local trips to shopping areas, public services and restaurants.

In downtown Tampa, REL descends to Meridian Street. It transformed a former narrow two-lane street through an aging industrial district into a modern 6-lane urban thoroughfare. Representing a $50 million investment in downtown Tampa, the gateway includes custom designed urban architecture and it offers a visually exciting and pedestrian friendly environment which became the primary catalyst for almost $1 billion of new residential and commercial development.

Traffic Improvement

Before opening REL, the traffic on the existing 4-lane divided toll facility was at Level of Service (LOS) F[63] during the peak hours of operation. Of the total 115,000 average trips during a weekday, more than 75,000 occurred between I-75 and downtown Tampa on the east end of the highway. The trip time from the east averaged between 30 and 40 minutes in the morning commute.

REL opened on a limited basis in mid-2006 and fully in January 2007. Since then, it provides motorists a trip time of 10 minutes or less for their morning and afternoon commute into and out of Tampa. The 10-minute-or-less trip yields time savings of 20-30 minutes for each of the peak-hour directions, thus delivering a time savings of up to one hour per day at a cost of $3.

Travel time was not only substantially shortened but became reliable due to the safe conditions resulting from the express lane design and the elimination of vehicle conflicts caused by large trucks and numerous entrance and exit ramps. The reduced trip time also is responsible for public transit development of enhanced express bus service from suburban Brandon to downtown Tampa. Within weeks of the initial opening of the REL, public transit ridership was up by over 40% on two express bus routes.

[63] LOS is a grading scheme for representing the quality of traffic operations; it ranges from A (best) to F (worst.)

It is also noteworthy that the REL is ahead of traffic forecasts. The forecast number of entries for the first year of operation was 12,500 vehicles per day. In February 2007 REL carried 15,960 vehicles.

Figure C1. A single gantry facilitates tolling both directions of REL.

Figure C2. The segmental yard cast-matching technique was responsible for excellent on-site fit and large economies in construction.

Tolling System Innovations

REL is the first transportation project in Florida to employ a totally cashless toll collection method known as Open Road Tolling and it is the first implementation of free-flow tolling in a configuration wider than two lanes for the SUNPASS™ statewide electronic toll collection system. In addition, video toll collection is added to ensure open-access to all users, with or without a transponder.

The Toll-by-Plate program creates a unique Video Toll Account (VTA) for occasional users who may call a special toll-free number in advance of using the REL, or up to 72 hours after use, to register for a VTA. By providing their license plate number and a credit card, motorists may register for either a limited time use of the facility or for an on-going VTA. The VTA, which requires a minimum $5 balance, is essentially a prepaid license plate account for those who use it infrequently.

The toll system has been made more customer friendly by changing the overall philosophy of identifying violators. Under normal business practices for electronic tolls in the US, violators are normally identified as those vehicles without a transponder or an ETC account. By providing multiple payment options, motorists can enter and pay later. A violation is registered only when "failure-to-pay" occurs. Not only is this a more user-friendly approach to toll collection, but it results in the reduction of mistaken violations and the increase in net revenues for the agency, while allowing the organization to focus their violation enforcement resources on those who intentionally and repeatedly refuse to pay tolls.

Construction and Cost

The 3-lane, reversible post-tensioned steel-reinforced concrete segmental bridge was constructed in 9-foot segments at an off-site casting yard, delivered to the Expressway and then assembled in the median of the existing roadway virtually eliminating any impacts to adjacent land uses, the surrounding community or the environment.

The construction started with the installation of piers in the median. Subsequently, a steel truss, designed for REL, was placed between the piers to temporarily support the segments while they were being assembled, allowing much of the work to be performed from above, therefore minimizing impacts to the traffic on the existing Crosstown Expressway lanes below. All segments were match-cast at the casting yard so the on-site assembly was rapid, the resultant geometry flawless and assembly was expedient.

Weighing about 70 tons each, the 59-foot-wide segments were delivered to the Expressway on 13-axle flatbed trucks, also designed for this project. The segments were then assembled during off-peak times. After the segments were lowered onto the truss, they were pulled together with post-tensioned steel cables inside the bridge.

Concrete segmental bridge construction is most efficient for longer structures and the efficiency increases as the length of the project increases. With more than 3,000 segments, REL took advantage of the cookie-cutter approach to bridge development. The total contract cost for the project was approximately $300 million in year 2004 terms. This includes all of the planning, design, right-of-way, construction, and construction management and inspection for the reversible express lanes and the two gateways. The cost also includes the electronic control and safety systems required to operate the lanes and the new three-story Traffic Management Center.

The actual contract price for the 17.5 lane miles of bridge structure was just over $100 million. At approximately $120 million, the deck cost for the segmental bridge portion of the project was approximately $65 per square foot, far below the average cost for structures in Florida during the past 20 years. The average cost per lane mile for the reversible bridge is approximately $7 million and is among the lowest for bridges constructed in the U.S.

Most of the funding for REL was provided with revenue bonds. One of the most interesting financing components was a unique loan from the State of Florida. In 1999, based on an endorsement from the Florida Transportation Commission who called the REL project "…a unique demonstration of innovative ideas, new technology and the beneficial impact of transportation on economic development and urban revitalization," the State loaned the Expressway Authority $25 million in order to accelerate construction.

Worldwide Applicability

Several of the concepts employed on REL have direct application to other transportation needs throughout the world. The concept of increasing the capacity of transportation corridors through innovative design and maximizing the use of existing public rights-of-way is directly applicable to traffic congestion problems in all urban areas (tolled or not). The tolling technology, payment and enforcement programs are applicable to other express toll lanes, high-occupancy-toll (HOT) lanes and open road tolling facilities everywhere.

Appendix D

High-Occupancy-Vehicle (HOV)

and High-Occupancy/Toll (HOT) Lanes

Frequently Asked Questions[64]

What is a HOT lane?
A HOT lane is a designated lane motorists driving alone can use if they pay a toll, allowing them to avoid traffic delays in the adjacent regular lanes. HOT lanes usually are combined with High Occupancy Vehicle (HOV or carpool) lanes that have enough capacity to handle more vehicles. Toll-paying drivers and toll-free carpools/vanpools share the lane, increasing the number of total vehicles using the HOV/HOT lane.

Why Consider HOT lanes?
The appeal of this concept is three-fold:
It expands mobility options in congested urban areas by providing an opportunity for reliable travel times for HOT lane users;
It generates a new source of revenue which can be used to pay for transportation improvements, including enhanced transit service; and
It improves the efficiency of HOV facilities.
Why the need for a HOT Network in the Bay Area?
There are several gaps in the region's current HOV lane system. Filling these gaps would create a seamless network of unobstructed lanes to provide a faster commute for travelers who use them. MTC's 25-year Regional Transportation Plan indicates that these gaps cannot be filled with traditional existing revenues.

What is the time frame for implementing the Bay Area HOT Network?
Implementation of the network would begin within the next five to 10 years; new federal and state legislation would be required. State legislation enacted in 2004 allows HOT lane demonstration projects to be constructed in two corridors in Alameda County and two in Santa Clara County. The first demonstration project to open will be on I-680 over the Sunol Grade. Work is just getting underway to develop demonstration HOT lanes in the I-580 corridor in Alameda County and in the SR 85 and US 101 corridors in Santa Clara County.

Are HOT lanes a new concept?
No. HOT lanes have proved successful in California on State Route 91 in Orange County and on Interstate 15 in San Diego, as well as on Interstate 10 in Houston, Texas. New HOT lanes opened recently in Minneapolis and Denver.

How does a HOT lane work?
Motorists usually enter and exit the lane at specific locations. An electronic reader identifies the vehicle from an in-vehicle transponder (FasTrak) and deducts the toll from a prepaid account.

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[64] http://www.mtc.ca.gov/planning/hov/faq.htm

How much does it cost to use HOT lanes?
Toll rates vary based on demand, and be can adjusted to maintain optimal traffic flow. As an example, tolls to use San Diego's eight-mile FasTrak express lanes generally vary from 75 cents to $4.00 (or 12 cents to 50 cents per mile) on a typical day.

What is the HOT lane revenue used for?
HOT lane revenue can be used to help pay off bonds issued to finance construction, provide for maintenance, operations and enforcement of the lanes, and to fund new or enhanced transit service.

Don't HOT lanes discourage ridesharing and transit use?
No. Drivers still will have a financial incentive to carpool in the express lanes. For example, carpooling in the Interstate 15 corridor in San Diego has increased 80% since 1996 when the conversion of HOV lanes to HOT lanes took place. Also, HOT lanes have the potential to improve transit travel times by ensuring access to relatively free-flowing travel lanes for commuter bus service, especially during rush hour.

I've heard HOT lanes referred to as "Lexus lanes" – don't they just benefit the rich?
A study done by Cal Poly San Luis Obispo of the State Route 91 HOT Lanes in Southern California found that "although roughly one-quarter of the motorists in the toll lanes at any given time are in the high income bracket, data demonstrate that the majority are low and middle-income motorists. The benefits of the HOT lane are enjoyed widely at all income levels."

The study also found that HOT lane use was more closely tied to current travel conditions and trip needs than income. HOT lanes really are a form of "congestion insurance" for any traveler willing to pay the toll - whether it is a businessperson late for a meeting or a parent racing to pick up a child at day care.

For more information on HOT lanes see:

- San Diego, CA – I 15: http://www.sandag.org/index.asp?classid=29&fuseaction=home.classhome
- Orange County, CA – State Route 91: http://www.91expresslanes.com/
- Minneapolis, MN — I-394 MNPass Lanes: http://www.mnpass.org/
- HOT Networks: A Plan for Congestion Relief and Better Transit (Reason Foundation): http://www.rppi.org/ps305.pdf
- FHWA Value Pricing Pilot Program: http://www.ops.fhwa.dot.gov/tolling_pricing/value_pricing/