CHAPTER 2

Reasonable Alternative Packages

This chapter presents the Reasonable Alternative Packages (RAPs) formulated for the initial evaluation within the Hartford West MIS. The RAPs were intended to present broad themes for future transportation improvement strategies within the corridor. The themes adopted for this round of evaluation included:

- RAP 1- No Build (Existing and Committed);
- RAP 2 - Transportation System Management, Transportation Demand Management, and Transit Operations;
- RAP 3- Freeway Reconstruction and Operations;
- RAP 4- Transit Fixed Guideway - Light Rail, Commuter Rail and Busway;
- RAP 5- Freeway HOV Lane; and
- RAP 6- Freeway Additional General Purpose Lane.

However, due to the complexity of transportation issues within the study area, it is likely that no single package would satisfy all future travel demands. Following this round of evaluations, elements from several of the RAPs were combined to create a hybrid package for further environmental and engineering evaluation.

2.1 RAP 1 – FUTURE NO BUILD (EXISTING AND COMMITTED)

The No Build package (RAP 1) constitutes the base case condition for the evaluation of transportation improvements. No Build generally includes existing and committed projects, along with the normal maintenance and operation of the transportation system over the forecast period. The details of RAP 1 were presented in Technical Report #1, the Preliminary Purpose and Needs Report, which analyzed the future performance of this RAP.

Volume Increase. The increase in the trip ends and thus travel demand from 1995 to 2020 during the A.M. peak hour was approximately 33% and in the P.M. peak hour increase in trip ends was approximately 32%. Trip ends to and from Farmington show a maximum increase of over 45% between 1995 and 2020, and trip ends to and from West Hartford show a minimum increase of approximately 20% between 1995 and 2020.

Intersections. Analysis of the Peak Hour 2020 Levels of Service for the Intersections within the study area indicates that 19 intersections will have a LOS F during the A.M. peak and 24 intersections will have a LOS F during the P.M. peak. This compares to 5 intersections in the 1995 A.M. peak and 9 intersections in the 1995 P.M. peak.

I-84 Westbound. During the A.M. peak, I-84 westbound segments are expected to degrade slightly. Segments with LOS "C" are projected to become LOS "D" and those with "D" are projected to become "E" by 2020). Travel speeds, which are currently between 50 and 52 miles per hour, will be reduced to between 47 and 51 miles per hour.

Performance of the peak direction during the evening P.M. peak is worse than the A.M. peak with a LOS in the "E" range. A comparison of 1995 and 2020 reveals additional degradation. The freeway segments associated with Exits 49 through 46 will routinely fail (i.e., LOS "F") and average speeds reduced to below 25 miles per hour.

I-84 Eastbound. Although the morning A.M. peak eastbound I-84 currently receives LOS "F" on the most easterly segment of the freeway between Exits 46 through 49, the situation by 2020 will become much worse as the LOS "F" segments continue from Exit 39A through 49. Average speeds will drop below twenty miles per hour with volumes exceeding 7,400 on the easterly end of the freeway.

The evening P.M. peak is projected to experience a generally failing Level of Service from Exit 39A through the east end of the corridor. Speeds will drop to twenty miles per hour by 2020.

2.2 RAP 2 - TRANSPORTATION SYSTEM MANAGEMENT, TRANSIT OPERATIONS, & TRANSPORTATION DEMAND MANAGEMENT

Transportation System Management (TSM) is a name given to a broad range of strategy types whose purpose is to get the most out of existing transportation infrastructure without major capital investment. Transit Operations includes methods to improve the ability of existing bus systems in the study corridor to attract riders and meet

mobility needs. Transportation Demand Management (TDM) is a generic term that encompasses a wide range of strategies that have been employed to reduce peak hour vehicular travel and increase overall mobility. A complementary package of TSM, TDM and Transit Operations provides the potential for the most efficient system operation. Technical Report #2 provides background information on TSM, TDM and Transit Operations.

Given the small-scale, localized nature of RAP 2 improvements, a definitive list of improvement sites can not be defined to this stage. Instead, typical locations and improvements have been identified for comparative evaluation. Final improvements may vary from those targeted in this analysis.

TSM, TDM, and Transit Operations strategies can work effectively together to enhance the current effectiveness of the total transportation system. These improvements are usually implemented within the right-of-way and are less capital intensive than other transportation improvement alternatives, but taken in aggregate, the cost associated with RAP 2 would be less than the build alternatives in RAPs 3 through 6. The success of the program especially the TDM segment depends on the voluntary cooperation of the public and private sector.

Safety Enhancements

Safety improvements are an important part of the overall approach to transportation systems management. The top four high accident locations were:

Route 4 approaching the jug handle - The segment of Route 4 west of the jug handle experiences a high percentage of rear end accidents. This is an area in which frequent traffic queuing in the westbound direction occurs due to the geometric constraint of Farmington Center. Sideswipes and turning movement incidents also make up a major portion of the total accidents.

Route 71 south of Corbins Corner - The segment of Route 71 south of Corbins Corner witnesses a high percentage of rear end and turning movement accidents due to the many access points to shopping and restaurants along this road. Driver inattentiveness and sudden stopping to turn may be prime reasons for these types of accidents. One third of all accidents in this area occur at night according to the records. Also, this segment of roadway is responsible for some pedestrian accidents. Since this is a heavy retail and food service orientated area, heavy pedestrian traffic is to be expected. Possible solutions to this problem might involve installing sidewalks and crosswalks, improving lighting, and installing warning signs for both pedestrians and motorists. Another approach to reducing some of these accidents might involve employing access (or curb cut) management techniques. This could involve consolidating some of the many driveways leading to parking lots or adding exclusive left turn lanes for heavily used lots.

Route 175 from Route 9 to Route 176 - Route 175 is a principal arterial with two lanes in each direction. The majority of accidents are rear end, but there is also a high percentage of head-on collisions. Since head on accidents tend to be the most severe, this segment of roadway is of concern and necessitates some improvement. Improvements to Route 175 were analyzed in a study by CRCOG.

Interstate 84 from Sigourney St. to High St. - Interstate 84 near downtown Hartford experiences numerous rear end accidents. Naturally, the huge volume of traffic which utilizes this segment of roadway each day is the cause of the high number of accidents. This portion of highway is at breakdown condition during most of the morning and afternoon peak periods, and the frequent stop and go of traffic is responsible for the 48 percent of rear end incidents. But the magnitude of volume is not the only culprit for these accidents. This segment is prone to complex weaving patterns due to the many ramps, some of which are left hand on and off, which compound the traffic flow problem. Some possible solutions to this problem could involve realignment of I-84 or to remove the left hand exits. Another idea is to install overhead variable message signs to alert traffic to peak hour congestion.

Intersection Operational Improvements

Several intersections in the Hartford West study area have been identified as having severe operational deficiencies. These intersection have been analyzed as having a Level of Service F under current conditions and are impeding the overall performance of the transportation system. As part of the TSM strategy each intersection will need to be upgraded to meet acceptable standards for handling traffic. While each intersection will need further analysis some of the potential improvement solutions may include adding exclusive left turn lanes and phases, improving signal timing and coordination, adding lanes, grade separation, updating of signal and improving stripping and signing. The intersections analyzed included:

- Hartford Avenue at New Britain Avenue;
- New Park Avenue at Flatbush;
- Park Road at I-84 Off-Ramp;
- Park Road at I-84 On-Ramp;
- Park Road at So. Main;
- Park Road at Trout Brook;
- Rt. 173 at New Britain Avenue;
- Route 4 at I-84 Ramps (Jug Handle);
- Route 4 at Old Mountain/Talcott Notch; and
- South Main Street at New Britain Avenue.

Other examples of TSM improvements include:

- **Access Control and Management (Curb-cut Control)** – Farmington Ave., New Britain Ave., Park Ave., and Cedar Street;
- **Intersection Widening/Channelization** – Boulevard and Capital Ave.; Farmington Ave. and Sisson Ave., and Farmington Ave. and Trout Brook Dr.;
- **Traffic Signal Systems (Isolated or Corridor Coordination)** – Farmington Ave., New Britain Ave, and Cedar Street;
- **On-Street Parking Regulation** – Farmington Ave., New Britain Ave., and Cedar Street;
- **Spot Widening** – Throughout the Study Area;
- **Goods Movement (Truck) Regulation** – South Road, Route 4, Route 9; and
- **Pedestrian** – Crosswalks, Signal, and Facilities.

Park & Ride Lots

Park and Ride Lots are important elements in transportation system because they provide a convenient location for carpooling, vanpooling, and express and local transit stops. They are important adjuncts to transit and rideshare strategies. While several lots are currently in operation within the Hartford West corridor, opportunities exist for their expansion or construction at new locations. Several of these locations include:

- Plainville - I-84 at Crooked Street (Exit 34);
- Farmington - Additional Parking at Fienemann Road (Exit 37);
- Farmington - Route 6 at I-84 (Exit 38);
- Farmington - Expand parking at Route 4 (Exit 39); and
- West Hartford - I-84 at New Britain Avenue (Exit 40).

Transit Operations

The following are details of transit operations improvements that are included in RAP #2. Route concepts presented here are conceptual in nature oriented toward promoting improved mobility in the corridor via a transit center approach to service design. These services would be overlaid on the existing route structures with details on coordination, schedules and costs to be determined at later phases of this project if necessary.

Express Bus Improvements. New express or limited bus services could be considered:

- **Hartford-New Britain Express** - The transit hubs in downtown Hartford and New Britain would be linked via a Route 9/I-84 Express link that provide attractive mobility between the two largest population concentrations in the study area and allow for connections between the independent Hartford and New Britain transit networks.
- **New Britain-Westfarms - West Hartford Limited** - The transit hubs in New Britain and West Hartford would be linked via a limited service that would operate in express mode along limited access highways but also provide pick up and distribution services near transit hubs.
- **UConn Medical Center Express** - A route connecting the University of Connecticut Health Center with Hartford via Routes 4 and I-84 would link a major employment center with Hartford, and also provide the possibilities of another park/ride facility for Farmington residents to travel to Hartford.

Local Service. Local Transit service could be expanded to include:

- **UConn Medical Center - New Britain**
- **Local Farmington Bus** - A local bus serving the transit hubs at UConn and Westfarms Mall.
- **Newington - West Hartford Service** - A new route operated along the SR 173 corridor.
- **Newington - Westfarms - Farmington Service** - A route from Market Square Newington via Central Connecticut State University, Westfarms Mall, and UConn Medical Center.
- **W-Route Extension** – Extend the W-Route from Hartford to Newington to run to Downtown New Britain via East Street, Allen Street and ML King Street. This would provide access to New Britain from Northwest Newington and Downtown West Hartford.
- **Stanley Street - New Britain Ave Service** - Interline the New Britain Transit Westfarms Service with the Connecticut Transit Q Route service to Westfarms Mall to provide one seat ride for local passengers between the transit dependent neighborhoods in Hartford, Elmwood and New Britain while also provid-

ing an additional local service other than the P Route to provide for travel between Hartford and New Britain.

- **East Street Extension** - The Dattco East Street Route could be extended via Cedar Street to downtown Newington providing an additional more direct path between the two transit hubs. This crosstown route could be further extended if desired to downtown Wethersfield via a eastward extension on Route 175.
- **E-Route Limited** - Improve the bus travel times by offering "limited" service to some passengers boarding west, north or south of LaSalle Road. The shorter Farmington Ave route variations could make every stop for which there is a demand. However, the longer E route variations, such as Unionville, the Medical Center, and Westfarms Mall would provide "limited" service, making few or no stops between West Hartford center and downtown Hartford.

Transportation Demand Management

In most portions of the Hartford West study area, the existing pattern of land use and the relative availability of parking (in comparison with larger metropolitan areas) favor the use of single-occupant vehicles (SOV's). Even workers within the regional core - Downtown Hartford - utilize an SOV more commonly than any other mode. The 1990 census reports that 70 percent of Hartford workers drove alone, while only 15 percent utilized carpools, or vanpools and ten percent used a bus. The remaining five percent either walked or bicycled to work, or worked at home. For outlying employment centers the proportion of commuters driving alone is even greater, reaching a high of 88 percent in Farmington and 84 percent in Newington. In no other community within the study area, including New Britain, do more than five percent of workers utilize bus service.

Market rate parking costs in Downtown Hartford range from over $100 per month for parking garages in the immediate vicinity of the Civic Center and Constitution Plaza to a low of approximately $40-60 for parking lots in the Asylum Hill and South Green areas depending on location. However, well over half of Downtown employees, including most State of Connecticut employees, have free parking provided to them. In Downtown New Britain, most employers pay for their employees' parking, while visitor parking is provided by the City's extensive inventory of off-street garages. Elsewhere within the study area, almost all employee parking is provided for free. Within West Hartford Center, municipal lots charge for long-term visitor parking, but outside of these very limited instances all of the suburban activity centers offer visitors and employees an abundance of free parking.

TDM Strategies. TDM strategies work most effectively as complements to transit service enhancements. In Technical Report #3, three TDM strategies were tested - Financial Incentives for Transit Use; Parking Pricing; and Congestion Pricing. The Financial Incentives were the most successful in increasing transit ridership. Both Parking Pricing and Congestion Pricing performed about half as well as Financial Incentives.

Based on past regional and nationwide experience, the adoption of a high-profile TDM initiative at an individual employer can result in an increase in use of High Occupancy modes of up to 20 percent. Because HOV travel still represents a minority of travel in most work sites (especially for suburban and non-CBD locations), the total impact on congestion or modal split would be proportionately lower. A voluntary employer-based program implies that participation will be substantially less than 100 percent. Current corporate participation rates (the number of firms participating versus the total number of area businesses) are in the range of one percent of all employers and ten percent of all employees.

For Downtown Hartford work sites an increase of 20 percent in the mode share to ridesharing and transit would actually mean a less than five percent increase in number of people using these modes, and a corresponding (but lower) decrease in vehicular travel due to the fact that most carpools consist of two - the driver plus one passenger, so that vehicle miles of travel decrease by half, not by 100 percent. In suburban locations, where current carpool and transit participation rates are lower, the estimated decrease in vehicular travel would be in the range of two percent.

2.3 RAP 3 - FREEWAY OPERATIONS AND RECONSTRUCTION

Reconstruction improvements will be directed at reconstruction of left entrance and exit ramps, partial interchanges, and locations where auxiliary lanes will relieve spot congestion. RAP 3 also included Intelligent Transportation System (ITS) strategies such Arterial Signal Coordination, Incident Management, and Traffic Operations Centers. These locations include:

- **Route 4, Route 6, and Route 9 interchange areas** - The construction of a collector- distributor road on the south side of I-84 and the elimination of left hand exit and entrance from eastbound I-84 to Route 4 and eastbound Route 4 to I-84.
- **Trout Brook to Kane and Caya Interchanges** - Construction of collector-distributor (C-D) roads on both sides of I-84, and the elimination of left entrance (Trout Brook to I-84 east bound);
- **Prospect and Flatbush Interchanges** - Construction of C-D roads and a diamond interchange at Prospect, elimination of left exit (I-84 westbound to Flatbush), and the construction of eastbound exit and westbound entrance to the Flatbush exit.
- **Sisson Avenue Interchange** - Elimination of left hand eastbound exit and construction of right hand exit.
- **Sigourney Avenue Interchange** - Construction of ramps to and from the west at I-84.
- **Auxiliary Lane in West Hartford** - Construction of auxiliary operational lanes between Exits 40 and 42 in West Hartford.

Intelligent Transportation Systems (ITS)

In the Hartford West corridor, ITS Strategies could consist of Arterial Signal Coordination, Incident Management Techniques, and Traffic Operations Center. RAP 3 includes the following ITS strategies:

Arterial Signal Coordination. This technique will improve travel times on principal arterial streets. Through coordinated traffic signal timing vehicles will maintain a uniform speed and minimize stopping. The result is that motorists will experience fewer delays and reduce auto emissions and energy consumption. To achieve optimal performance on a given arterial street, all signalized intersections must be equipped with sensors, and communications needs to be established between the intersections and a central Traffic Operations Center (TOC), where a computer will use input from the sensors to determine optimal signal timings and offsets for each signalized intersection.

Routes suggested for coordination include the following:

- Farmington Avenue;
- Route 6/Old South Road/New Britain Avenue;
- Fenn Road/West Hill Road/Newington Road;
- Route 175 (Cedar Street);
- Route 176 (Newington's Main Street);
- New Park Avenue/Prospect Avenue; and
- Sedgwick Road/Park Road.

Incident Management. Incident management is the rapid detection and response to any incident with the potential to reduce traffic flow. A common means of incident detection is cellular phone calls from motorists who observe an incident. According to the *ITS Strategic Plan*, this system works well. However, in order to confirm these reports, and help determine the appropriate response, an additional system is proposed. The surveillance of I-84 by a set of Closed Circuit Television (CCTV) cameras would fulfill this function. These cameras would be connected to monitors at a Traffic Operations Center (TOC), where an operator can confirm that an incident has taken place, determine what is needed to clear the incident, and dispatch appropriate personnel and equipment to deal with it. The operator can then use the Advanced Traveler Information Systems to quickly notify motorists of the incident, so that they can choose alternate routes.

Another Incident Management facet recommended by the *ITS Strategic Plan* is the Connecticut Highway Assistance Motorist Patrols, or CHAMP. These are light trucks, staffed by Department of Transportation employees, equipped to handle minor traffic incidents without the dispatch of additional equipment. They can provide a motorist with gasoline, jump start a battery, push a stalled auto out of the traffic stream, or assist in changing a tire. They can remove debris from the right-of-way, and set up signs for accident and detour routes. Additionally, they observe traffic conditions and report to the operators at the TOC. CHAMP patrols already exist on I-95 and on I-91, and the *ITS Strategic Plan* urges their expansion to I-84 in the Hartford area. Nationwide, Highway Service Patrols have proven to be extremely popular in many urban areas, and have proven invaluable in building public support for ITS projects.

Traffic Operations Centers. All of the ITS components described above require control by computers and experienced operators. This is the purpose of a TOC. Currently, two TOCs exist in the Greater Hartford area. A TOC at ConnDOT Headquarters, in Newington, currently controls ITS freeway operations on I-91. This would be the logical place to control the Traveler Information Systems, the Ramp Metering, and the Incident Management surveillance and dispatching. A smaller TOC exists in Downtown Hartford, to control the City of Hartford's computerized traffic signals. This is a possible location for the Arterial Signal Coordination systems. Other options might include use of existing City of West

Hartford traffic engineering facilities, the construction of a new TOC in West Hartford or New Britain, or locating this function in the Newington TOC.

2.4 RAP 4 - FIXED GUIDEWAY TRANSIT

This RAP consists of a variety of different transit related alternatives. The fixed guideway alternatives have been divided into Light Rail, Busway, and Commuter Rail alternatives.

Light Rail technology is an advanced form of the traditional streetcar. Typical LRT systems can include both grade-separated (off-street) and on-street operation. LRT vehicles are powered by electric motors and draw power form electric cable overhead. They are approximately 75-90 feet long (twice the length of a bus) and can run in either single-car or two to four-car (multiple unit) trains.

Busways consist of a designated or grade-separated bus facility. The busway offers greater flexibility than an LRT in that buses can enter and exit the exclusive bus facility from existing bus routes as well as serve station locations. Buses operating on a busway may either be driven by a driver as on-street, o r guided similar to a rail car on steel rails. Guided bus operations allow for buses to operate at higher maximum speeds than may otherwise be desirable with an unguided bus.

The commuter rail mode is distinguished from Light Rail by the greater speed and capacity of the equipment, greater distance between stations, and the orientation of services to park-and-ride or drop-off access versus pedestrian access. In keeping with the overall direction to restrict improvements to existing transportation corridors, the following rights of way were suggested for each alternative:

- **Interstate 84 Right-of-Way** - Light Rail or Busway;
- **New Britain to Hartford Rail Right of Way** - Commuter Rail, Light Rail, or Busway; and
- **Farmington Avenue** - Light Rail or Busway.

Service Objectives. While each of the fixed guideway alternatives is unique, there are similarities in planning and designing these transit services. The following service objectives have been defined:

- Maximize ridership on the fixed guideway line to achieve transit service efficiency and to maximize transit service frequency;
- Eliminate redundant or competitive through bus services in the corridor;
- Provide a reasonable commuter shed for the transit corridor by using feeder bus, park and ride, and pedestrian linkages.

Right-of-Way Width. Twenty-four feet is the normal standard for two straight tracks or for two busway lanes. With a 11' 2" centerline distance between the two tracks, this allows slightly more than two feet nominal clearance between light rail vehicles on the two tracks and between the light rail vehicles and adjacent road traffic (not allowing for vehicle tilt, catenary poles, signal masts, fences, other structures, or roadway traffic overhanging its wheelbase).

Twenty-two feet appears the practical minimum width of a two-track dedicated light rail right-of way. With a 22-foot right of way, these nominal clearances drop below 1.5 feet. Slightly narrower rights-of-way are possible, but probably involve unacceptable and non-cost-effective vehicles. The Washington Boulevard section of the Los Angeles to Long Beach "Blue Line" was the only North American example found less than twenty-four feet wide. The 22-foot trackway was part of a "share the misery" program where traffic lanes and sidewalks were also reduced in width so that 112 feet of total desired width could be squeezed into 100 feet of available right-of-way.

Similar standards seem appropriate for busways. In New Jersey, on the Rt. 495 XBL land widths are sometimes reduced to less than 10 feet nine inches. Safety records are excellent because of the use and training of professional drivers. Similar programs would be important adjuncts to the safe operation of the New Britain-Hartford Busway.

Station Areas and Platforms. Station areas will require wider right-of-way to accommodate stopped and through vehicles as well as the station platform and building. Even with a minimum of two through lanes and two stopping lanes 44 feet to 48 feet would be appropriate. Station platforms increase right-of-way width typically by another ten to fourteen feet. Ten feet is the usual minimum for a center platform serving both tracks. Six feet appears to be the usual minimum for a side platform serving one track. Side platforms serving both tracks add twelve feet to the right of way. The total width needed for a station could be mitigated by staggering the inbound and outbound stations.

An ADA-compliant high center platform also requires that the track be tangent (straight) for fifty feet in both directions beyond the platform. Beyond that, it typically takes another thirty feet for the tracks to move back together.

Feeder and Connecting Bus Services. Each of the potential fixed guideway investments described in the balance of this section include a package of recommended feeder and connecting bus services. In some cases existing bus routes are slightly modified to provide connectivity to the fixed guideway investment. In other cases new bus services are proposed which would be overlaid on existing service. In only a few cases are existing transit services radically altered. In any event, all bus route proposals are oriented toward expanding the range and reach of the proposed fixed guideway investment by improving transit mobility options available for all trips in the corridor.

In later planning stages associated with any fixed guideway transit RAPs more detailed analysis of the feeder and connecting bus network design will be required. This analysis should focus on maximizing transit effectiveness and efficiency but must also evaluate impacts on existing transit riders and other transit constituencies.

RAP 4A-1 Hartford/New Britain Light Rail Transit Line

A rapid transit service using electric light rail technology could be located in the existing rail rights of way linking Hartford with New Britain via Newington. The line would run from downtown New Britain to Union Station. The line would operate in an exclusive right of way with minimal grade crossings allowing for a higher average service velocity. It is possible that the rail line could then run as a street railway from Union Station to the Old State House. Conceptual alignments and station locations are illustrated in Technical Report #2. The proposed alignment conforms to the existing rail corridor. In comparison to the proposed service in RAP 4B, Commuter Rail, the LRT system will have more frequent station stops.

Peak period service velocity for this line would be in the neighborhood of 25 mph. Off peak service velocity could be slightly higher. End to end running time from downtown New Britain to Union Station would average 23 minutes. Running time from Crooked Street in Plainville to Union Station would average 30 minutes. Service frequencies would be approximately 10 minutes or less during the peak and 15 minutes off-peak.

RAP 4A-2 I-84 Median Rapid Transit Line

A rapid transit service using light rail technology with level boarding could be located in I-84 right of way as a grade-separated "high speed" line. The line could run from the I-84 Stack (Exit 39A) to Prospect in the I-84 right of way, then would shift to the rail line where it crosses below near the former Heublein plant on New Park Avenue. The rail line would use the unused western portion of the rail right of way continuing parallel to New Park Avenue and Capitol Avenue to Union Station. The line would operate in an exclusive right of way with minimal grade crossings allowing for a higher average service velocity. It is possible that the rail line could then run as a street railway from Union Station to the Old State House. Conceptual alignments and station locations are illustrated in Technical Report #2. The proposed alignment conforms to the existing rail corridor.

Proposed station spacing in come cases increases to exceed 5000 feet in keeping the rapid design for similar highway median rail lines but is generally less. Peak period service velocity for this line would be in the neighborhood of 25 mph. Off peak service velocity could be slightly higher. End to end running times from the I-84 Stack to Union Station would be approximately 21 minutes. An alternative to a terminal station on the stack is a shared right-of-way loop serving the UConn Medical Center and other employers in this growing part of the region.

RAP 4A-3 Farmington Avenue Light Rail

This light rail line would be located in the median of the Asylum/Farmington Avenue corridor from Old State House in Hartford to La Salle Road in West Hartford-a distance somewhat greater than 3 miles. A possible extension of this segment could run from West Hartford Center to South Road in Farmington just west of the UConn Medical Center.

Proposed station spacing would be generally 2500 feet as per designs of other successful U.S. street railways (e.g. Boston's Green Line). Stations could be more closely spaced where conditions warrant. Stations would be median islands in the roadway. Stations would generally be located mid block to the west of the north/south cross street.

Conceptual alignments and station locations are illustrated in Technical Report #2. The proposed alignment conforms to the existing rail corridor. The two center lanes as shared lanes with general purpose auto traffic. A twelve foot wide center platform location is considered for stations at mid-block.

RAP 4B - Plainville to Hartford Commuter Rail

A commuter rail service using Diesel Multiple Unit (DMU) technology or standard rail cars and diesel locomotive push-pull sets such as the Shoreline East service could be operated in existing rail right of way largely on existing track between Crooked Street in Plainville and Union Station in downtown Hartford. In keeping with commuter rail service designs, station spacing would tend to exceed 10,000 feet between stations. Service would be operated at frequencies of not less than fifteen minutes with off peak service on an hourly (or half-hourly) headway.

Conceptual alignments and station locations are illustrated in Technical Report #2. The proposed alignment conforms to the existing rail corridor. In comparison to the proposed service in RAP 4A-1, New Britain-Hartford LRT, the Commuter Rail system will have less frequent station stops and be able to maintain higher travel speeds.

Service could be operated with traditional diesel locomotive drawn push-pull equipment sets, but the potential also exists to use innovative lower cost rolling stock technology. Many rail transit agencies are currently considering the use of light weight self propelled diesel rail coaches to provide passenger service on lightly used branch lines. Since large portions of the Plainville to Hartford line is only lightly used for freight service, the option arises to employ lighter weight more efficient high performance rolling stock that does not necessarily comply with Federal Railroad Administration standards for joint use with other US standard rail equipment. A range of these self-propelled cars are currently being demonstrated in the North American market.

Using quiet low emissions modern DMU technology it is conceivable that the rail cars could then run as a street railway from Union Station to the Old State House providing improved door step service for many more potential passengers. As noted above, the lightest units do not comply with FRA crash-worthiness regulations and would need to be segregated from other rail traffic (e.g. Amtrak and Guilford Railway System (GRS) trains on the same tracks.) Heavier DMU's and conventional locomotive hauled equipment could share tracks with other heavy trains belonging to Amtrak and freight carriers.

Taking advantage of the high speed Amtrak track between Newington and Hartford and the longer station spacing, the commuter service would operate at an average velocity in excess of 30 mph. Running time from Crooked Street to Union Station using diesel locomotive hauled equipment would be approximately 25 minutes. DMU service velocities would be somewhat faster with even more attractive travel times.

RAP 4C-1 – New Britain - Hartford Busway Alignment and Stations

The busway would follow the same alignment as the RAP 4A-1 and 4B light rail and commuter alternatives. It would pass through the communities of New Britain, Newington, West Hartford and Hartford. The busway would use the same stations as the light rail alternative between New Britain and Hartford.

- Downtown New Britain;
- South Main Street;
- East Street;
- Cedar Street;
- Willard Avenue;
- Elmwood;
- Oakwood Avenue;
- New Park Avenue at I-84;
- Park Street;
- Aetna;
- State Armory; and
- Union Station.

Bus routes will be able to enter and exit the busway at intermediate locations. The busway will also serve activity centers in the New Park Avenue corridor in Hartford, the Elmwood community in West Hartford, the future business center anticipated at the junction of Route 9 and Route 175, and Central Connecticut State University located in New Britain. While final location studies will be necessary, access points will be located at:

- New Britain – Downtown (End Point);
- East Street;
- Willard Avenue;
- Oakwood Avenue;
- New Park Avenue;
- State Armory; and
- Union Station (End Point).

Connecting bus routes and van services will link passengers with off-line destinations at station locations. Bus terminal access in New Britain would include a direct connection to the limited-access Route 72 freeway, while in Downtown Hartford buses would leave the busway between Broad and Church streets and circulate through the CBD to Main Street. Park-and-ride lots would offer further flexibility in meeting passenger needs.

Major Differences Between Busway and Rail Alternatives. The bus services that would be operated with this alternative would be similar to those be provided with light rail or commuter rail. However, there would be four major exceptions:

1. The first is obvious - buses, rather than light rail or commuter rail, would provide the trunk service along the railroad right-of-way between Plainville and downtown Hartford.
2. By definition, rail services are restricted to the rail right-of-way. Buses, however, would not be restricted to the rail right-of-way. As a result, many of the routes that would act as feeder services for light rail or commuter rail could be through-routed with the busway services to provide one-seat service to downtown Hartford and intermediate stations.
3. The frequency of service offered by the busway would be much more attractive than light rail or commuter rail. Using 40 foot buses with 40 seats, trunk line service would have to be provided every 3 minutes to carry the demand indicated in the initial RAP 4A-1 and 4B forecasts. (The services described below would provide that level of service.)
4. The western terminus of the busway would be downtown New Britain because the rail right of way west of downtown New Britain has insufficient width to accommodate continued rail freight traffic and a busway, and because congestion on Route 72 is not great enough to warrant a separated guideway. From New Britain to Newington Junction, the right of way is generally wide enough to allow for the development of a two lane busway parallel to the existing active tracks.

Because the busway alternative would provide more direct services and more frequent services at comparable speeds, it is likely that this alternative could attract higher ridership than the rail alternatives.

RAP 4C-2 – I-84 Median Busway Alignment and Stations

The busway would follow a similar alignment as the RAP 4A-2 light rail alternative, except that the Stack terminal would be replaced by a new terminal at the Exit 39/Route 4 interchange. It would pass through the communities of Farmington, West Hartford and Hartford.

2.5 RAP 5 - ADDITIONAL LANE - HIGH OCCUPANCY VEHICLE (HOV)

The High Occupancy Vehicle (HOV) system (RAP 5) proposed for the Hartford West corridor would operate similarly to those in the Capitol Region on Interstate 91 and Interstate 84 east of the Connecticut River. Access to the interstate would be provided at designated on-ramps, and would be open for use by vehicles with two or more occupants (HOV 2+). In addition to HOV 2+ automobile traffic, the HOV lane would also enable express buses to enhance travel time and build ridership. Another key element in building use of the lane is the implementation of park and ride lots. While they may be open for general carpooling and ridesharing operations, these lots are also frequently served by express and local transit service.

The improvement would consist of a twelve foot HOV lane, a four foot shoulder separation, and a ten foot inside shoulder. The proposed alignment for the HOV lane is illustrated in Technical Report #2. At the east end of the corridor right-of-way restrictions may require that shoulders and separations be reduced to minimize or eliminate impacts on adjoining property.

In addition an alternative exists for access to the downtown area. It would be possible to use the busway proposal from RAP 4A-2 from Prospect Ave. to Union Station for circulation downtown. The geometrics of the bus way are too tight to allow general purpose HOV 2+ traffic to use as an access path. However, transit buses could effectively use this as an alternative path.

Express Bus Routes. The bus routes that will use the proposed High Occupancy Vehicle (HOV) lane for I-84, extending from Exit 39A to downtown Hartford are discussed in this section. Express buses will enter and exit the HOV lane at Exit 39A, "The Stack", Exit 40, Westfarms Mall, Exit 41, South Main Street, Exit 42, Trout Brook, and Exit 45, Flatbush Avenue. The bus services that will use the HOV lane include both existing express routes and several new "limited" routes designed to take advantage of the time savings possible with faster bus travel speeds on the HOV lane.

2.6 RAP 6 - ADDITIONAL LANE - GENERAL PURPOSE

RAP 6 is similar in geometric configuration to the RAP 5 HOV improvement. The improvement would consist of a twelve foot lane in each direction and a twelve foot inside shoulder. Every effort would be made to achieve and maintain a twelve foot outside shoulders for safety reasons. The proposed alignment for RAP 6 is illustrated in Technical Report #2. At the east end of the corridor right-of-way restrictions may require that inside and out-

side shoulders be reduced to minimize or eliminate impacts on adjoining property.

The improvements proposed for this alternative would include the elimination of left entrance and exit ramps as proposed in RAP 3 Freeway reconstruction. While the additional Interstate capacity would relieve traffic pressure on parallel arterials, it would still be important to coordinate ITS and arterial signal systems to assure optimum operation.

The Connecticut Department of Transportation (ConnDOT) and the Capitol Regional Council of Governments (CRCOG) agreed to drop further consideration of RAP 6 after publication of Technical Report #2. In the body of this chapter, as a point of comparison, selected elements associated with RAP 6 are presented to facilitate comparative analysis of the RAPs and their transportation components that remain in consideration.

2.7 ASSESSMENT OF REASONABLE ALTERNATIVE PACKAGES

This Section presents the results of evaluations conducted for highway-related and transit-related Reasonable Alternative Packages (RAPs). Taken in conjunction with the impact evaluations contained in Chapter 3, these results present a profile of potential success in meeting the Goals and Objectives developed to guide investment decisions in the corridor.

Transit-Related Performance Measures

New Service Transit Users. There are several ways to measure the relative success of transit related RAPs. In terms of riders that will use transit services, routes structured to take advantage of busways in the New Britain and I-84 corridor attract more daily riders, 13,290 and 11,540, respectively, than other RAPs (Table 2.1). In reality many users of the new route structure would not necessarily use the busway to downtown, but because buses circulate on streets, riders would use the buses as tradition local bus service. This tendency is illustrated in that ridership on existing bus routes for the New Britain busway dips from 19,870 in the 2020 Base Case to 15,400 for RAP 4C-1.

After the busways, the Light Rail to New Britain will attract the most service oriented riders. Fourth in rank is the New Britain Commuter Rail service, and fifth, Light Rail in the Interstate 84 corridor. The strategy least effective in attracting new riders is bus routes implemented to support RAP 5, I-84 HOV Lane. This is probably because of the competitive travel times and attractiveness of shared ride auto trips.

Total Transit Riders/New Transit Riders. Total transit trips in the corridor (and therefore new transit riders) are a good measure of RAP effectiveness. The New Britain - Hartford Busway ranks first in this category handling a total of 28,690 transit riders - 8,820 riders above the 2020 Base Case number. Light Rail in the I-84 corridor, either terminating at Route 9 or at Fienemann Road, ranks second in Total Transit Riders at 27,520 and 27,480, respectively. The only other RAP with more than 27,000 daily riders is the New Britain Light Rail service.

With the exception of the HOV alternative, all RAPs outperform the transit service alternatives proposed for RAP 2. Implementation of the transit service will nearly return the 2020 Base Case ridership to the current 1995 ridership levels. Clearly, some of the RAP 2 service proposals could generally be implemented without large capital investments.

Peak Period Transit Ridership. Transit ridership during peak periods will do the most to reduce roadway congestion within the Hartford West corridor by diverting person trips from drive alone to transit based modes. The highest level of peak hour transit ridership will be achieved by the New Britain - Hartford Busway service, RAP 4C-1 (Table 2.2). The second ranked service will be the I-84 Busway followed closely by the I-84 and New Britain Light Rail alternatives. The relative ranking for New Service ridership is similar. As noted for daily ridership, New Bus Routes and New Britain Service are grouped together under one category.

Impact on Mode Share Transit-Related RAPs. Of the transit-related RAPs, only the Busway alternatives reduce the Drive Alone Mode share to less than 70% at 69.1% and 69.37%. In all cases Shared Ride mode share is also reduced below the 2020 Base Case level of 8.6%. In the busway alternatives in both the New Britain and I-84 corridors, buses operate in local service on state and town roads as well as in express service on the busway alternative. As such buses riders are able to take advantage of new bus routes for local bus trips as well as for trips to and from downtown. Of the alternatives, only the New Britain Light Rail service and Farmington Avenue Light Rail have the impact of reducing bus mode share below the 2020 Base Case level.

Table 2.2

PEAK PERIOD COMPARISON OF TRANSIT-RELATED RAPS

Hartford West MIS

Passenger Trips Base Case/RAP	Existing Bus Routes	New Bus Routes	New Service	Total Transit	New Riders
2020 Base Case	7,360			7,360	
RAP 2 - Transit Operations	7,330	550	-	7,880	520
RAP 4A-1 - New Britain LIght Rail	7,400	500	2,300	10,200	2,840
RAP 4A-2 - I-84 Light Rail	7,960	340	1,940	10,240	2,880
RAP 4A-3 - Farmington Ave. Light Rail	6,240	2,040	1,410	9,690	2,330
RAP 4A-4 - I-84 Light Rail Extended	7,820	650	1,870	10,340	2,980
RAP 4B - New Britain Commuter Rail	7,400	500	2,200	10,100	2,740
RAP 4C-1 - New Britain-Hartford Busway	4,940	-	6,690	11,630	4,270
RAP 4C-2 - I-84 Busway	6,090	-	4,290	10,380	3,020
RAP 5 - I-84 HOV Lane	7,220	-	120	7,340	(20)

Source: Hartford West MIS Technical Report #3

Highway Performance Measures

Table 2.3 presents the results of the Highway Performance analysis for all RAPs both transit and highway related. During the AM Peak Period, the greatest reduction in VMT is achieved by RAP 4C-1, New Britain-Hartford. Both RAP 3, Freeway Reconstruction, and RAP 5, HOV Lane, experience an increase in VMT because of the increase in operating speed over the set one hour evaluation period.

The performance of the RAP 2 package includes implementation of all strategies including TSM, TDM, and Transit Operations. Overall vehicle trips are reduced 1.3% during the AM peak period and 4.7% in the PM period. Speeds increase on both the freeway and arterial roadways as traffic demand during the peak period is reduced. It is important to remember that transportation demand management (TDM) strategies such as parking pricing, congestion pricing, and transit incentives depend on voluntary participation that may not be politically attractive.

During the PM Peak period, the greatest reduction in VMT was also achieved by the New Britain - Hartford Busway at 5.2%. The second largest reduction in system wide VMT was achieved by the New Britain Commuter Rail, RAP 4B at 4.4 %. The I-84 Busway follows closely behind with a 4.3 % reduction.

The largest percentage increase in AM average vehicle speed was achieved by RAP 3, Freeway Reconstruction. Of the transit-related alternatives, the best results were achieved by the I-84 Light Rail and New Britain Light Rail with 9.4 % and 8.5%, respectively. Trends are similar for PM average vehicle travel speeds with the best improvement achievement of a 4.9% increase in speed. The second ranked improvement is the I-84 Busway with a 3.1 % increase in average speed.

Because freeway speeds increase, vehicle trips may be attracted from arterial roads with slower overall speeds. As such VMT on freeways may in some cases increase even though overall demand for vehicle trips will decrease. Of all alternatives, RAP 3, Freeway Reconstruction, will achieve an increase in speeds of 19.1 % and 34.4 % for the AM and PM Peak Periods, respectively. RAP 4C-1, New Britain - Hartford Busway, results in the greatest increase for AM average speed, and RAP 4C-2, I-84 Busway, results in the greatest increase for PM speeds.

Arterial Roadway Performance. Concerning highway performance measures on arterial roadways, the New Britain corridor alternatives perform similarly with reductions in VMT during both the AM and PM peak periods of about 4.0 %. The alternatives in the I-84 corridor perform somewhat less well for arterial VMT reduction. Speed increases are similar under each of the transit-related alternatives.

The most congested roadways are those that experience a volume capacity ratio greater than 1. As noted in Table 2.4, the New Britain Commuter Rail achieved the greatest reduction in arterial congestion eliminating 6.35 miles of arterial with V/C ratio greater than 1 during the AM peak hour. Following in second place is New Britain - Hartford Busway, reducing arterial roadway mileage by 4.95. The I-84 Light Rail alternative results in 3.03 fewer miles of highly congested roadway.

During the PM Peak Period, the I-84 Busway achieves the greatest reduction in congested mileage with 5.21 miles eliminated. New Britain Commuter Rail strategies result in a reduction of 4.99 miles of arterial with a V/C ratio greater than 1. RAP 3, Freeway Reconstruction, also has a favorable impact eliminating 4.5 miles of congested roadway.

Capital Construction Cost

Of the Transit Related RAPs evaluated, the least expensive alternative is the New Britain Busway at $75.3 million followed closely by Farmington Avenue Light Rail at $97.1 million (Table 2.5). The New Britain Commuter Rail is estimated to cost $98.3 million to implement.

The Transit-related RAPs will include not only the construction of roadbed, tracks, pavement, and stations, but also the acquisition of light rail vehicles, commuter rail vehicles, or buses, and the construction of maintenance and storage facilities and yards. These costs vary dramatically. The transit vehicle and facility capital costs are in Table 2.6.

The most expensive overall RAP would be reconstruction of the freeway at $527.3 million. The most expensive element of this plan would be the reconstruction of the downtown segment of I-84 due to the extensive structure work that would be a key element. Reconstruction of Flatbush, Prospect, and Sisson interchanges would be the second most expensive at $102.4 million.

Transit Operating Costs

The transit services associated with RAPs 2, 4, and 5 would operate as described in Technical Report #2, "Preliminary Screening and Scoping Report." For weekdays, peak and off-peak service levels were defined for all of the services associated with each RAP in terms of average headways. For the span of service, an 18 hour service day was assumed for major services, from approximately 6:00 am until midnight. Most other routes (for example, feeder routes) would operate for shorter spans, generally corresponding to the span of service for similar current services.

Frequent peak period service would be provided during a two hour AM peak and a two hour PM peak, with less frequent service being provided in the off-peak, which is the remainder of the day. For weekends and holidays, specific service plans were not developed. Instead, it was assumed that similar services would be provided, but less frequently and over a shorter span of service. At the present time, in terms of vehicle service hours, Saturday service levels in the Hartford West corridor are approximately 47 percent of weekday levels, and Sunday service levels only 9 percent of weekday levels.

By RAP, total annual operating cost estimates are summarized in Table 2.7. These costs are for operations within the corridor only and do not include other region wide costs. The highest annual operating cost would be experienced by New Britain Light Rail (RAP 4A-1) at $22.3 million.

Fare to Operating Cost Ratio - Within the Hartford West corridor, it is estimated that in the Base Case (No-Build) Scenario farebox revenues would cover approximately 37 percent of the operating costs for the bus services (Table 2.8). Under the build alternatives, the coverage ratio will vary from a low of 26 percent for the Farmington Ave. Light Rail to 39 percent for New Britain Commuter Rail. These estimates may change in a subsequent study will refine bus routing options and new service operations plans and costs. However, the positive performance of the Commuter Rail and Busway alternatives suggests that transit operations may be affordable.

Transit Subsidies - Comparing Operating Cost and Annual Fare receipts within the Hartford West corridor, the largest total subsidy will be necessary for the Farmington Ave. Light Rail and the New Britain Light Rail with $16.2 million and $16.0 million, respectively (Table 2.9). This compares to a base case projected subsidy of $7.7 million for corridor transit operations. In the base case, subsidies per rider are projected at $1.33, and RAP 2 TSM/TDM/Transit Operations will experience $1.44 per rider. Of the Build alternatives, the New Britain - Hartford Busway and I-84 Busway will experience subsidies of $1.60 and $1.53 per rider, respectively.