

**CITY OF POULSBO**  
**TRAFFIC DEMAND MANAGEMENT STUDY**

**FINAL REPORT**

October 8, 2008

*Prepared for:*

**CITY OF POULSBO, WASHINGTON**

*Prepared by:*

**DAVID EVANS AND ASSOCIATES**

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# 1. INTRODUCTION

The 2006 Transportation Plan Update includes recommendations to employ what is known as Travel Demand Management to deal with problems of traffic overloads in the downtown Poulsbo area, in lieu of building more lanes of roadway. What is Travel Demand Management, and why do it? How would it work in Poulsbo?

This report provides an answer to those questions, resulting in an action strategy for Poulsbo to use in the downtown area immediately, and to build upon that strategy for other areas of the city as time goes on.

This introductory chapter defines Travel Demand Management and provides a perspective on it and where it applies in Poulsbo. Additional chapters document the results of technical studies performed by consultant David Evans and Associates, Inc. that have been reviewed by a Stakeholder Committee of citizens selected to assist the City staff and its consultant to develop the final recommendations.

The recommended actions operate in three areas to achieve an integrated result:

- Strategies for traffic management in downtown Poulsbo
- Strategies for increasing transit service and ridership citywide
- Strategies to increase ridesharing and other demand management activities

Each of these areas is addressed by a separate chapter of this report, with standalone recommendations in each case.

## What is Travel Demand Management?

Travel Demand Management, or “TDM”, refers to any combination of actions that reduce, remove, or relocate automobile traffic from locations where it is undesirable to continue building additional capacity for the travel demand. Instead of accommodating all demand for vehicular travel, this demand is shifted to other modes of travel, to other routes or locations, or simply discouraged if not prohibited.

TDM strategies are identified in the Comprehensive Plan Transportation Element (2006 Update) as part of the city’s long range plan for growth. Some of the proposed actions to change the road system are more properly called Transportation System Management, “TSM”. The full scope of the study could be rephrased to include Travel Demand Management AND Transportation System Management, or “TDM/TSM”. In summary:

- Travel **DEMAND** Management means “change the driving habits of people”
- Travel **SYSTEM** Management means “change physical facilities”

TDM and TSM methods are related like the “carrot” and the “stick”. TDM approaches are generally positive techniques (carrots) to encourage people to change their travel habits for personal reasons, to obtain a desired general adjustment of total traffic. A positive approach is usually desirable but requires planning, education, and patience. The TSM approach involves bluntly changing the road system in specific ways, as a negative approach (stick), to obtain desired travel changes by changing the route choices available to drivers.

## What do TDM Strategies Look Like?

Examples of positive TDM actions include:

- Increased transit operations to provide an alternative to automobile travel
- Support for carpooling and vanpooling to reduce commute trips by automobile
- Provision of continuous high-quality pedestrian and bicycle networks through the affected area
- Provision of increased capacity and better continuity on alternative routes
- Coordinated land use policies to encourage mixed use development, transit-oriented development, etc.

## What do TSM Strategies Look Like?

Example of TSM actions include:

- Speed humps, bumps, chicanes, narrow lanes, and other traffic calming devices to discourage through traffic
- All-way stop controls to reduce speeds
- Signal timing strategies that favor certain movements over others
- Parking regulation and pricing
- Tolls

TSM actions overlap with street design techniques sometimes described as traffic calming, road diets, or complete streets, depending on the literature source.

## How Effective are TSM Strategies?

According to the published literature surveying the accumulated experience in various places, some strategies are more effective than others in reducing traffic volumes. **Table 1** briefly summarizes the general characteristics of various potential measures. This table may be used as a general guide to select appropriate actions for particular locations.

## TDM/TSM and Growth Management

Washington's Growth Management Act (GMA) requires cities to establish and maintain level of service (LOS) standards to assure that adequate capacity exists for the travel demand. When capacity increases are not feasible or desirable, the GMA encourages cities to consider TDM strategies to offset the demand instead of serving it. That requires a more sophisticated LOS policy, to make room within the performance standard for alternative strategies that allow toleration of lower service levels under certain conditions.

**Table 1 – Traffic Control Strategies for Downtown Poulsbo**

<b>Strategy</b>	<b>Potential Benefits</b>	<b>Potential Cost</b>	<b>Feasibility / Implementation Issues*</b>
All-Way-Stop Intersections	HIGH – discourage through trips	LOW – installation cost per int'n	Acceptance among local residents affected daily
Speed Limits	HIGH – discourage through trips	LOW – cost of signs	Compliance by all road users
Road Dieting: Narrow Lanes	MEDIUM – slows traffic, helps bicycles	LOW – striping lanes	May not actually divert much traffic, better for slowing traffic and creating parking or bicycle-friendly shoulders
Parking Strategies (angle parking, curb parking, with narrow lanes)	MEDIUM – slows traffic, adds parking supply	LOW – restriping parking spaces and signage	May not divert much traffic, but improves parking and encourages slower speeds
Level Of Service Policy Changes	MEDIUM – removes perceived failures by policy action	LOW – simply a policy decision	Public acceptance of same traffic levels with lower standards
One Way Streets	MEDIUM – reduces congestion and cut-through traffic	LOW – signage and pavement markings	Public acceptance must be developed; adversely affects some local residents and businesses; may increase loop trips
New Streets	LOW – few if any opportunities	HIGH – road construction cost	Right-of-way acquisition, funding of road construction, in already built-up environment
Traffic Calming: Speed Bumps / Humps / Tables	LOW – affects speeds more than volumes	LOW – minor construction costs	Reduces speed but unlikely to reduce volumes; needs community acceptance
Traffic Calming: Intersection Traffic Circles, Diverters, Chicanes, Etc	LOW – affects speeds more than volumes	MEDIUM – minor construction costs	Reduces speed but less certain to reduce volumes; needs local residents' acceptance

Sorted roughly by cost/benefit and feasibility

### What do Other Cities Do?

The list of TDM strategies above is a general summary of what has been done in other places. A visit to the website of progressive cities in Washington would provide a wide range of examples of those concepts. As one specific example, Redmond has recently updated its Transportation Master Plan with a section on Demand Management that includes discussion of various existing and future services and programs including the following types of positive incentives:

- Carpool and Vanpool support programs
- Transit-oriented design of public streets
- Partnering with other agencies to implement multi-modal improvements
- Completion of missing sidewalk and bicycle lane segments on public streets
- Parking management systems in high-demand areas
- Commute Trip Reduction incentives including employer subsidy programs, public information and assistance programs, and interagency coordination
- Development code requirements for multimodal opportunities in commercial developments, such as carpool parking spaces, bicycle lockers and racks, showers and locker rooms, on-site access from transit stops, and internal sidewalks and trails.

- Residential TDM programs to support seamless multi-modal accessibility

Redmond is also reshaping its street system based on a LOS policy that does not attempt to serve all demand by cars, and tolerates more congestion where alternative modes are available.

## What about Poulsbo's Transportation Plan?

Poulsbo's 2006 Transportation Plan Update recognized that in some corridors or subareas, it would not be possible or practical to provide enough capacity to meet the entire forecast travel demand in the 20-year growth forecast. In those cases, the Update recommended the application of TDM strategies. The text in shaded background is extracted from the 2006 report, pages 27ff.

### Apply Transportation Demand Management Strategies

In those situations where it is not physically possible, economically viable, or socially desirable to meet forecast growth by adding new capacity (e.g., new lanes) in the same location where the demand appears, an alternative strategy may be to divert the forecast traffic growth to other possibilities elsewhere. Collectively, such strategies are described as Transportation Demand Management. The concept is to reduce the demand instead of increasing the supply.

Some common examples of TDM are:

- Speed humps, bumps, chicanes, and other traffic calming devices to discourage through traffic
- All-way stop controls to favor local turning movements over through movements
- Signal timing strategies that favor certain movements over others
- Increased transit operations to provide an alternative to automobile travel
- Support for carpooling and vanpooling to reduce commute trips by automobile
- Provision of continuous high-quality pedestrian and bicycle networks through the affected area
- Provision of increased capacity and better continuity on alternative routes

The 2006 Plan indicates that by 2025, 13 roadway segments are forecast to have over-capacity demand that cannot be directly served. Ten of these segments combine to form the following routes to or through the downtown Poulsbo area:

- NW Finn Hill Road, from Olhava Way NW to Viking Way NW
- NW Lindvig Way, from Viking Way NW to Bond Road NE/Front Street NE
- Front Street NE, from Bond Road NE to 4th Avenue NE
- NE Torval Canyon Road and 4th Avenue NE, from Front Street NE to NE Iverson Street

Analysis of these corridors in the Plan concludes as follows:

### Issue: Old Poulsbo Subarea Through-Traffic

Most of the future overloads would occur on roads in the Old Poulsbo Subarea. The forecast travel increases would cause unwelcome degradation of the character of that historic district. The source of the traffic increases is predominantly the growth of residential and commercial activity in the West Poulsbo Subarea, especially along Viking Way NW. This forecast growth inevitably attracts travel between that area and the East Poulsbo Area along SR 305 and east of the highway. The straightest path between those points goes through the Old Poulsbo Subarea.

Widening any roadways in Old Poulsbo, especially Front Street NE, to accommodate through travel would be contrary to the character and continued success of that historic commercial area. Similarly, it

does not appear desirable to carry the excess arterial volumes on other collector streets in the subarea, such as NE Torval Canyon Road, 4th Avenue NE, Jensen Way NE, NE Sunset Street and NE Iverson Street. The imminent expansion of SR 305 will bring some relief to the downtown area, when completed. Methods should be investigated in future years to preserve those gains, by reducing the attractiveness of downtown area streets for through trips. Options to be considered would include:

- Traffic calming techniques such as speed humps or bumps, to deter through traffic from using subarea streets
- All-way stop controls at all intersections on Front Street NE and possibly elsewhere in the downtown area
- Coordination of traffic signal controls on Viking Way NW, NW Lindvig Way, and Bond Road NE to encourage more traffic to bypass the downtown area via those roads instead
- Traffic control strategies east of downtown on NE Iverson Street, NE Lincoln Road, and NE Hostmark Street, to encourage traffic to use SR 305 instead to reach West Poulsbo
- Support expanded service citywide by Kitsap Transit to reduce vehicular traffic everywhere
- Encourage carpooling to/from employment locations by such means as preferential parking and cash subsidies to employees who choose not to drive (and thus, save the employer the cost of a parking space)

#### **Issue: NW Finn Hill Road and NW Lindvig Way Heavy Volumes**

This minor arterial corridor through the West Poulsbo Subarea is inevitably the carrier of much of the traffic growth arising from development in that area. In addition, NW Finn Hill Road connects West Poulsbo directly to SR 3 and to the Olhava retail shopping center. NW Lindvig Way ties West Poulsbo to the eastern majority of the city. Reclassification of these roads would alleviate most of the overload problem on paper, and would in fact bring greater logical consistency to the functional classification plan.

On NW Finn Hill Road in the vicinity of SR 3, operational improvements to the interchange area may be developed, such as adding turn lanes and signal controls, to maximize the operational capacity of that area. Within the interchange area, two additional through lanes should be added to NW Finn Hill Road as well, by 2025. Between SR 3 and Viking Way NW, the route has been fully developed as a 3-lane arterial with sidewalks and bicycle lanes. Adding more through lanes does not appear desirable, although that might need to be reconsidered in the distant future. The forecast demand on 3-lane NW Finn Hill Road, at up to 24,000 ADT, would actually exceed the demand on 5-lane Viking Way NW, at 22,000 ADT. Moreover, the classification of Viking Way NW as a principal arterial appears to be in contradiction to the classification of NW Finn Hill Road as a minor arterial, since the latter serves more long-distance through travel and connects directly to SR 3, the regional freeway.

Reclassifying NW Finn Hill Road as a principal arterial would increase the allowable capacity to the maximum possible for the route, and would suffice for many years. The forecast deficiency would not have to be reevaluated until near the end of the 20-year planning period. To obtain this reclassification, the City will need the support of Kitsap County, Puget Sound Regional Council, and WSDOT. Downgrading Viking Way NW to minor arterial status would be a desirable and logical companion change, and would help to satisfy federal guidelines limiting the amount of allowable principal road miles in an area.

Along with NW Finn Hill Road, the connecting route via NW Lindvig Way and Bond Road NE to SR 305 deserves to be reclassified as a principal arterial. This would be consistent with the strategy mentioned above to encourage use of that route to connect east and west parts of Poulsbo, without going through the downtown area. Signal timing strategies at both ends of NW Lindvig Way to protect the downtown area could be better supported if the route is designated as principal arterial.

Congestion on NW Lindvig Way appears to be inevitable, a reflection of the central place of that road in the Poulsbo traffic network. Future traffic management strategies should focus on optimizing signal timing for through movements, and optimizing the capacity of the corridor by maximizing the available turn pockets and storage lanes at the two intersections at each end.

## 2. TRAFFIC MANAGEMENT FOR DOWNTOWN POULSBO

The goal of this task was to develop a systematic strategy to reduce existing travel on Front Street NE, as well as minimizing future increases. This approach involves Transportation System Management rather than Transportation Demand Management. The study area included all downtown area streets, in addition to the corridors between downtown and the east (NE Hostmark Street, 6th Avenue NE, Fjord Drive) and the west (NW Lindvig Way, NW Finn Hill Road).

The main emphasis was on immediate actions to control traffic flow through downtown Poulsbo by relatively inexpensive means – i.e., using minor revisions to the street system and not large-scale road improvements. A secondary emphasis was placed on long-range system improvement strategies that would increase the attractiveness and utilization of alternative routes around the downtown Poulsbo area.

### Travel Demand on Streets of Downtown Poulsbo

**Figure 1** depicts the near-future traffic volumes that will exist on the streets of Poulsbo within 2-5 years, based on addition of all developments currently in the development review process. The volumes shown are pm peak hour volumes, by direction. Overall, volumes are similar to existing conditions but slightly higher in total trips. The road network includes the recently completed extension of 7th Avenue NE from just north of NE Liberty Road to SR 305, and the completion of ongoing improvements to SR 305.

**Figure 1** shows the two-way total volume as high as 2,400 on SR 305, 2,350 on NW Lindvig Way, and 2,700 on Viking Way NW. All of these routes have 4 through lanes as well as turn lanes. Elsewhere, on 2 and 3 lane roads, the volumes are much smaller. Excluding SR 305, the highest volumes in Poulsbo east of Liberty Bay are found on Front Street NE through downtown Poulsbo. South of NE Torval Canyon Road, the 3-lane section of Front Street NE carries approximately 1,800 two-way peak hour vehicles. At NE Hostmark Street, the volumes are reduced to slightly more than half that, at 1,100 two-way peak hour vehicles. Volumes on NE Hostmark Street continue this volume for the most part to SR 305. However, on a per-lane basis, the volumes on Front Street NE and NE Hostmark Street are similar in density to the volumes on the three larger arterials in Poulsbo.

All other two-lane downtown streets carry much smaller volumes by comparison:

- NE Torval Canyon Road : 360
- 4th Avenue NE (north) : 300
- Jensen Way NE : 300
- NE Sunset Street : 400
- Fjord Drive NE : 280
- 6th Avenue NE : 450

These volumes do not present capacity or congestion issues for vehicular movement, though, some of them are not intended to carry such volumes, due to conflicts with abutting residences, pedestrian activity, etc. NE Torval Canyon Road in particular stands out in this regard.

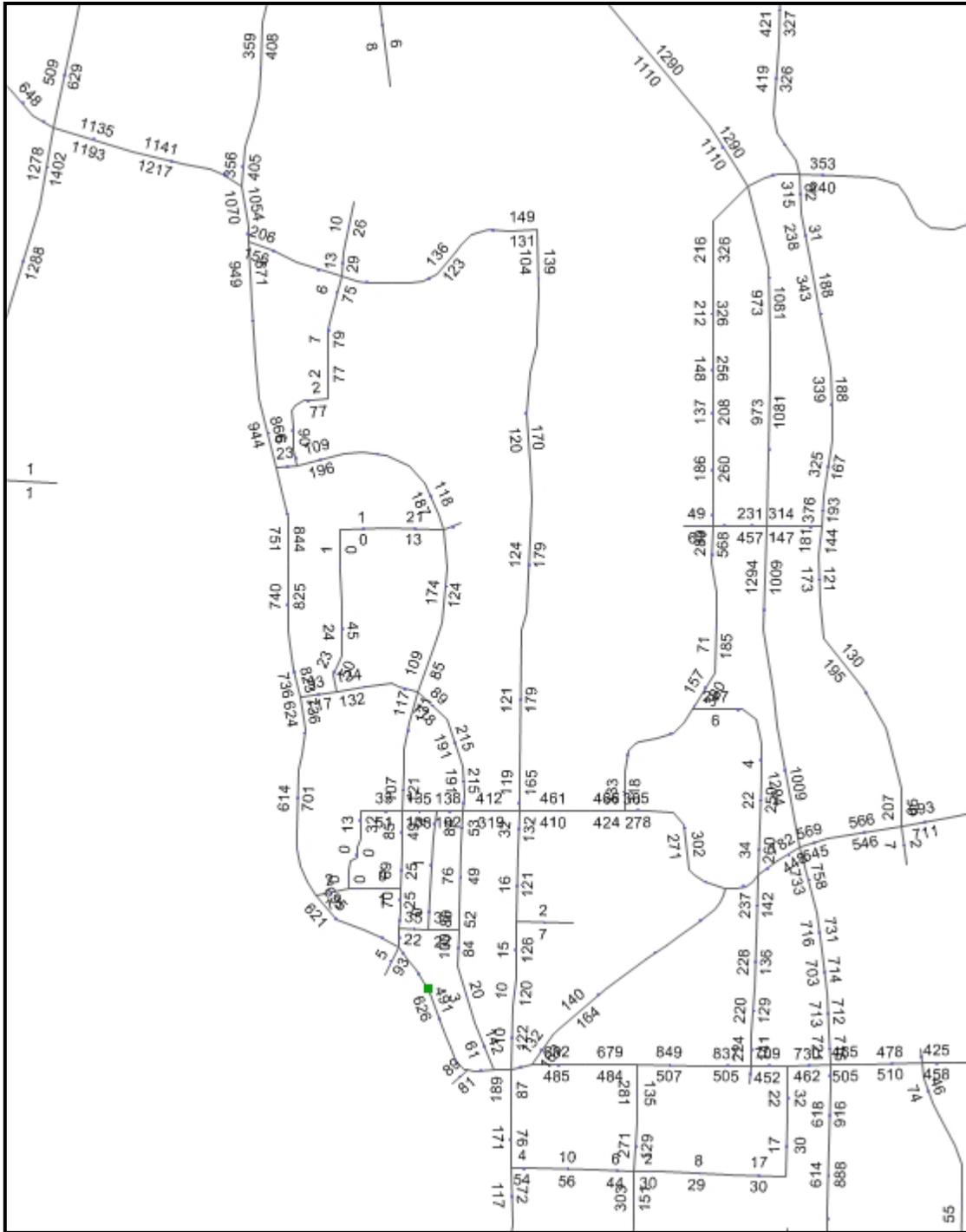


Figure 1 – Total Volumes on Poulso Streets (PM Peak Hour, by Direction)

### Travel through Downtown Poulso

The portion of travel on Front Street NE at NW Lindvig Way that goes through downtown Poulso to SR 305 without stopping is about 40 percent, according to the Poulso Traffic Model. Most of this travel uses Front Street NE and NE Hostmark Street, but a small portion uses the other local streets within the downtown area to reach SR 305 at NE Lincoln Road via NE Iverson Street, or at NE Tollefson Street via Fjord Drive NE, 6th Avenue NE, NE Harrison Street, and NE Haugen Street.

Most of the through travel on Front Street NE comes from areas west and south of Poulsbo in the afternoon peak hour, via either NW Finn Hill Road or Viking Way NW. All such trips pass through NW Lindvig Way en route to Front Street NE.

Travel into Front Street NE from Bond Road NE is all oriented to downtown destinations and does not materially contribute to through trips.

About half of the trips using NE Torval Canyon Road at Front Street NE follow 4th Avenue NE to NE Iverson Street and from there to various commercial destinations in the SR 305 area including 7th Avenue NE.

### **Possible Actions to Reduce Through Travel through Downtown Poulsbo**

Like water, traffic follows the path of least resistance and does not dissipate without explanation. If through trips are diverted away from Front Street NE, they will show up somewhere else. The questions are:

- What does it take to cause diversion to happen?
- Where will diverted trips end up?
- How can unwelcome side effects be avoided on the new routes?

Following are several action strategies suggested by various sources. Each was evaluated to identify their potential benefits for downtown Poulsbo, and to determine if there are unwelcome adverse effects such as travel increases on the roads that were not intended to carry more traffic.

- Slow down traffic on Front Street NE using a series of all-way stops at every intersection
- Slow down traffic on all streets in the downtown area by a system of all-way stops everywhere
- Slow down traffic on Front Street NE by narrowing lanes, and adding curb parking and bicycle lanes where now absent, and adding pedestrian friendly street furniture (a so-called road diet)
- Convert 3rd Avenue NE to one way northbound, as a couplet with Bjermland Place NE southbound
- Convert 6th Avenue NE to one way northbound and Fjord Drive NE to one way southbound
- Reduce through lanes on NW Lindvig Way and modify intersections at Viking Way NW and at Front Street NE & Bond Road NE to discourage travel from Lindvig Way to Front Street NE

Each of these options was evaluated with results discussed next.

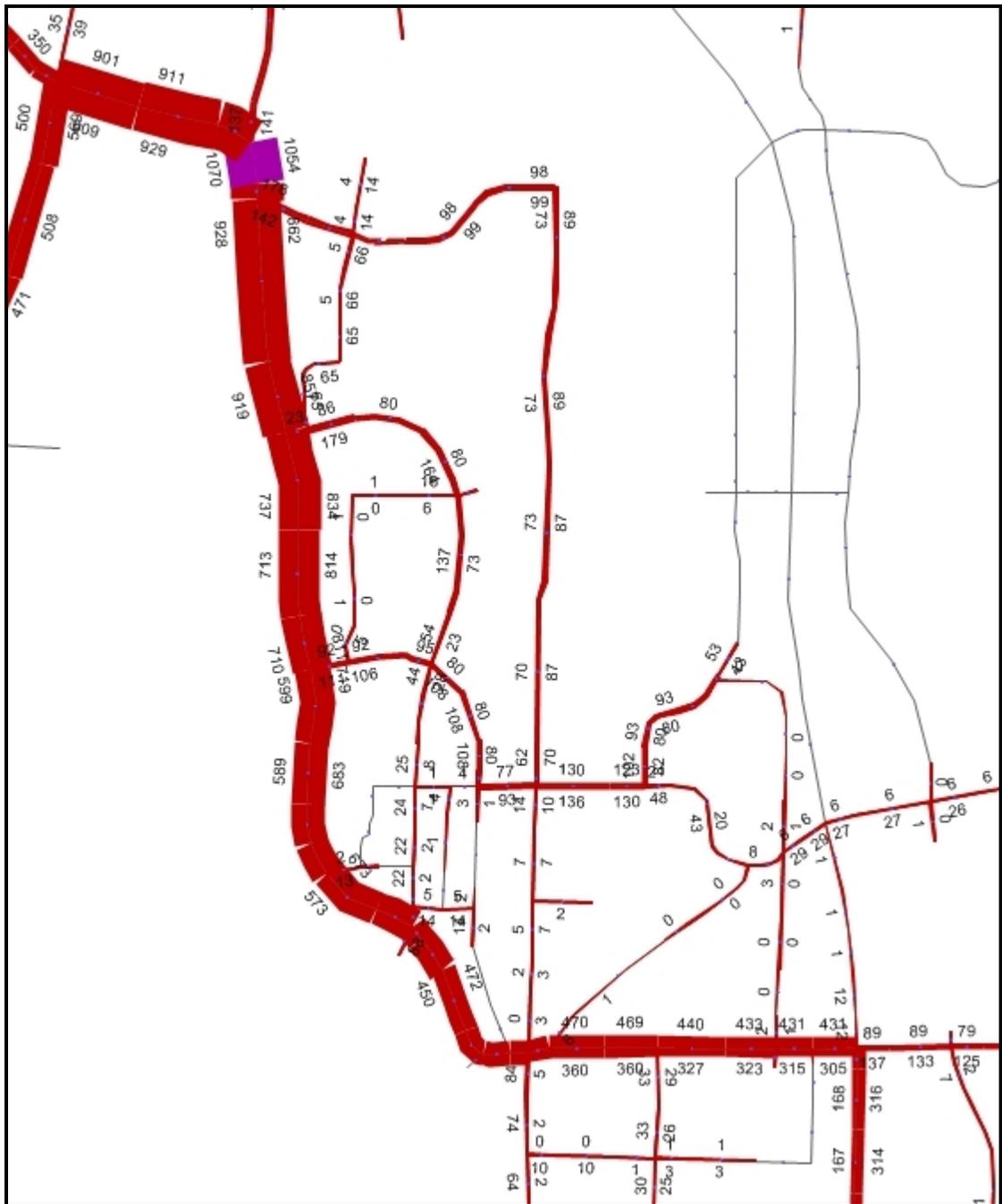


Figure 2 – Users of Front Street NE (South of NW Lindvig Way)

**All-Way Stop Controls**

Adding all-way stop controls at many downtown intersections would tend to reduce through travel speeds and discourage through trips, while adding some inconvenience to local residents, workers, and visitors. Two levels of all-stop revisions were investigated:

- On Front Street NE only, from NE Torval Canyon Road south to NE Hostmark Street, and including NE Hostmark Street intersections at 4th Avenue NE and 6th Avenue NE

- At all downtown intersections, from NE Torval Canyon Road south to 9th Avenue NE at Fjord Drive NE, and from Front Street NE east to 7th Avenue NE

**Front Street NE Only:** Placing all-way stop controls only on Front Street NE would significantly reduce traffic on Front Street NE (see **Figure 3**) and have these additional results:

- Significantly reduce traffic on NE Hostmark Street
- Increase total traffic on NE Torval Canyon Road, 4th Avenue NE, Jensen Way NE, NE Sunset Street, and NE Iverson Street in the north downtown area
- Increase use of Fjord Drive NE and decrease use of 6th Avenue NE, south of downtown
- Slightly increase diversions to SR 305 from SR 3
- Potentially justify signalization at 4th Avenue NE & NE Iverson Street

**All Downtown Streets:** Placing all-way stop controls in the entire downtown would significantly reduce traffic on Front Street NE and NE Hostmark Street (see **Figure 4**) and have other effects similar to the previous case, but also have these additional results:

- Keep traffic increases off of Jensen Way NE and NE Sunset Street
- Further increase total traffic on NE Torval Canyon Road, 4th Avenue NE, and NE Iverson Street
- Further increase use of Fjord Drive NE and decrease use of 6th Avenue NE

In both cases, most of the impacts are desirable, with one exception. The increases on NE Torval Canyon Road and 4th Avenue NE are undesirable, but that route exists as a viable alternative to Front Street NE for some through traffic, even with the deterrent of additional all-way stop controls. Additional countermeasures (e.g., traffic calming tools) will be needed on those roads to prevent overuse of that corridor. NE Torval Canyon Road is not classified to serve through travel, and has many fronting residences, driveways, and narrower road cross-section than other roads.

The Poulsbo Transportation Plan includes a proposed new road parallel to NE Torval Canyon Road but further north, connecting 1<sup>st</sup> Avenue NE and 4th Avenue NE. Given proper design and limitations on connecting driveways, this route could be classified as a collector arterial so as to divert through traffic away from NE Torval Canyon Road. Care should be taken to place controls on abutting developments at the same time, to assure that the through travel can be tolerated.



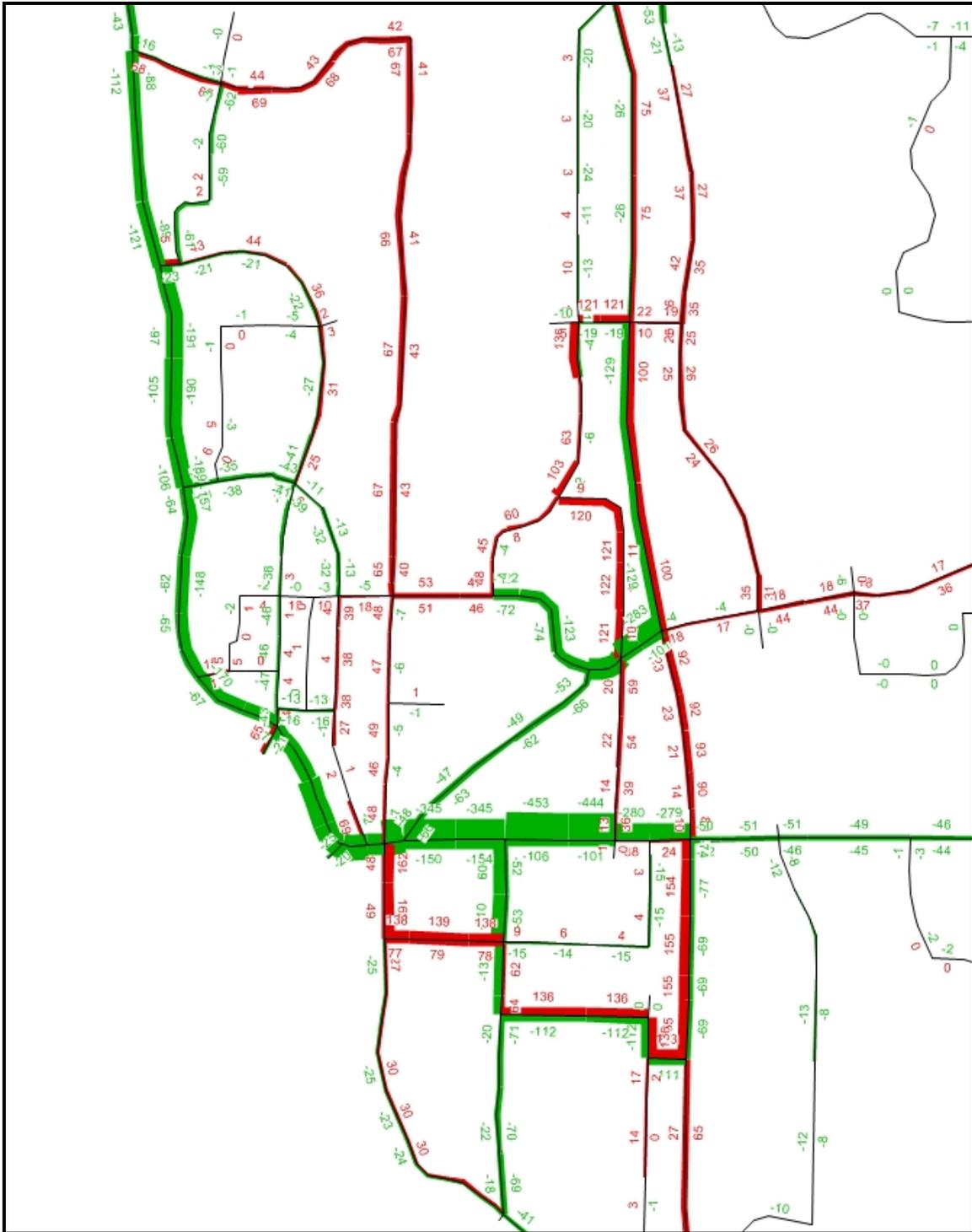


Figure 4 – Volume Changes – All Way Stops in Entire Downtown

### One-Way Street Couplets

The following are potential candidates for revision of the street system in and near downtown Poulsbo to create one-way couplets:

- 3rd Avenue NE and Bjermland Place NE

- 6th Avenue NE and Fjord Drive NE
- Front Street NE and Jensen Way NE

One way streets are able to be used to increase the parking supply by allowing angle parking, in addition to modifying the patterns of traffic flow in the local area by preventing certain directional movements. Right-of-way must be wide enough to maintain a 20-foot wide travel way for fire vehicle purposes, however. Analysis of traffic model results showed the following traffic impacts for these couplet options (see **Figure 5** and **Figure 6**):

**3rd Avenue NE / Bjermland Place NE Couplet.** This one-way pair would

- discourage potential eastbound through trips that would otherwise follow NE Sunset Street to 3rd Avenue NE to NE Hostmark Street
- slightly increase travel on NE Sunset Street and Jensen Way NE
- make better use of existing Bjermland Place NE as a one-way southbound street
- divert some southbound traffic to Front Street NE, Jensen Way NE, and 4th Avenue NE, if implemented as a single traffic revision in isolation

**6th Avenue NE / Fjord Drive NE Couplet.** This one-way pair would

- slightly reduce traffic on Front Street NE
- reduce the use of NE Harrison Street and NE Haugen Street as routes to SR 305
- reduce total traffic on both 6th Avenue NE and Fjord Drive NE
- increase total traffic on NE Hostmark Street
- increase congestion at NE Hostmark Street & SR 305 due to diversions

**Front Street NE / Jensen Way NE Couplet.** This one-way pair would

- greatly reduce traffic on Front Street NE north of Jensen Way NE
- increase travel on Jensen Way NE north of downtown
- divert some travel to NE Torval Canyon Road and 4th Avenue NE and NE Iverson Street

The one-way couplet concepts appear suitable for application either alone or in combination with all-way stop controls elsewhere in downtown Poulsbo. A super-combination of all one-way streets between Front Street NE and 3rd Avenue NE, including Jensen Way NE and Bjermland Place NE, was not tested but should have external similar effects. There are potential adverse effects which must be offset by countermeasures. Some of these are:

- One-way streets reduce accessibility to fronting properties from the excluded direction of travel. Cross-connections at reasonable intervals are essential to minimize out-of-direction travel.
- One-way streets can result in higher speeds. This can be inhibited by all-way stop controls at intersections, or other speed-management designs (see Traffic Calming on page 18).
- Restrictions on circulation in downtown Poulsbo will push some through trips to the NE Torval Canyon Road – 4th Avenue NE route. This can be discouraged by traffic calming modifications to that route, and traffic control changes elsewhere to attract such trips to SR 3 – SR 305, or to NW Lindvig Way – Bond Road NE – SR 305.

- One-way travel on Jensen Way NE north of NE Sunset Street is undesirable, because that residential area would be significantly affected by the increased through trips, similar to the issues described for NE Torval Canyon Road.
- One-way travel on Front Street NE through the downtown retail area between Jensen Way NE and NE Hostmark Street would adversely affect access to local businesses from the restricted direction, at least to the extent that on-street parking and pick-up/drop-off activity is important. A one-way loop combining 3rd Avenue NE (northbound) and Front Street NE (southbound) with return connections via NE Moe Street and Jensen Way NE should be carefully reviewed with affected businesses in the downtown area. Return circulation would be greatly improved by adding a public street connection through existing parking areas in the middle of the downtown core, across from the existing connection to the waterfront parking area.

### **Closure of Front Street NE through Downtown Retail Core**

The concept of closing a portion of Front Street NE to create a pedestrian-only environment in the retail core area has been suggested by members of the community. The termini of this closure would presumably be from Jensen Way NE at the north end to Young Street NE at the south end. The consequences of such an action are likely to be:

- Pedestrian circulation within the closed area would be improved, creating a mall-like atmosphere.
- Traffic through downtown Poulsbo would have to be re-routed to alternative streets, such as 3rd Avenue NE, and through the waterfront parking area.
- The route through the waterfront parking area would have to be reconstructed as a city collector street if not a minor arterial, with substantial costs for pavement reconstruction and re-design of the parking lot.
- Parking spaces would be lost in the waterfront park, to make room for a circulation route through the park.
- Parking spaces along the closed section of Front Street NE would be lost.
- Other streets adjacent to the downtown area would receive additional traffic impacts, similar to the diversions described above for one-way couplets. Traffic calming countermeasures would be required to protect NE Torval Canyon Road, 4th Avenue NE, Jensen Way NE, etc., similar to the preceding analysis of all-way stop controls.

These observations do not preclude the idea of a pedestrian-only mall design for Front Street NE, but should be considered in order to recognize the costs as well as the benefits of such an action.

Experiences in other cities provide mixed guidance:

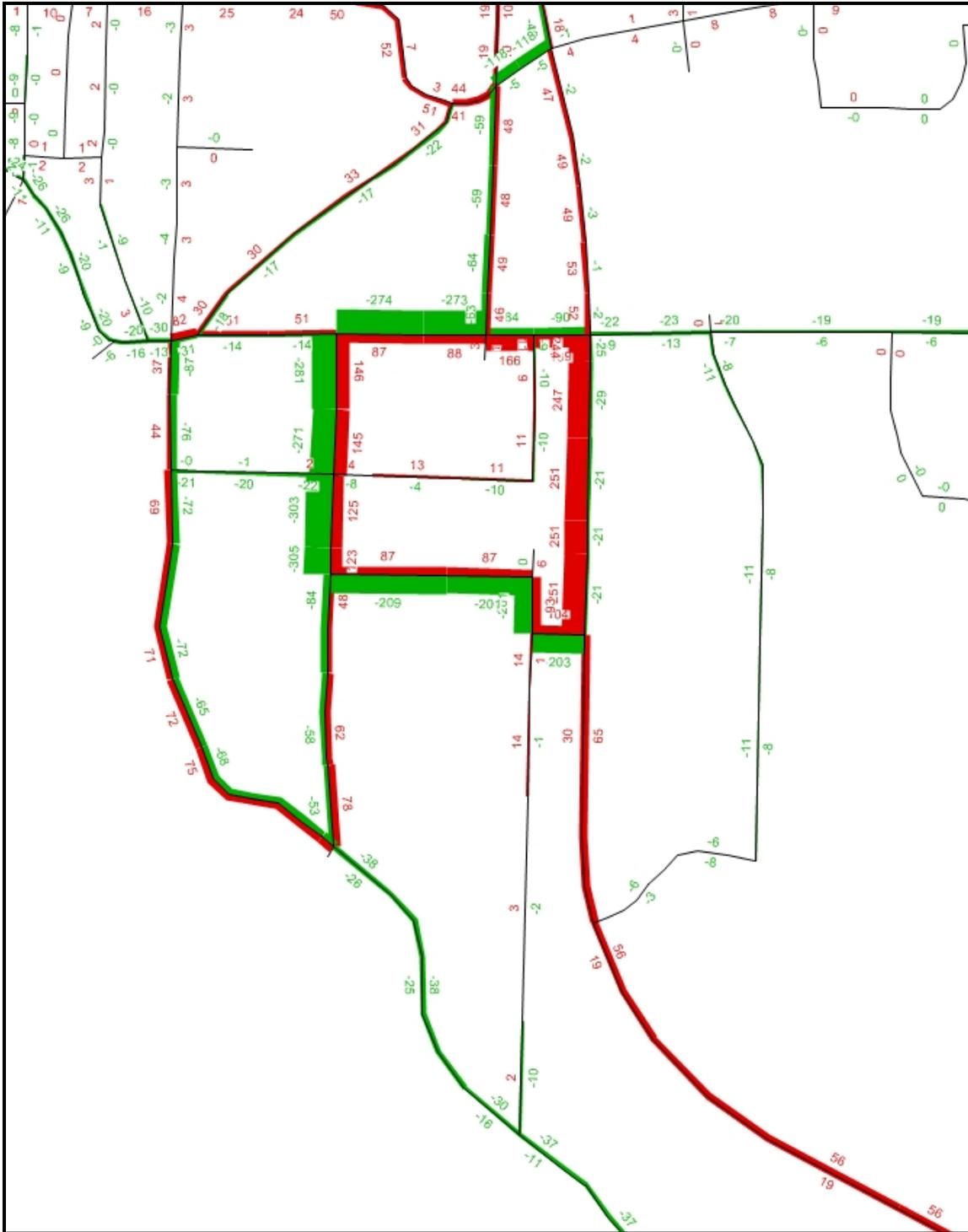
- Some pedestrian mall experiences have been unsuccessful over time in terms of the health of retail business, due to the lack of vehicular access to storefronts. The end result has been that streets are eventually converted back to mixed use including vehicular circulation.
- There is a trend in Europe toward de-regulating traffic, and forcing pedestrians and vehicles to share the road for local circulation. Such changes have been made primarily in designated areas such as small town centers. Rather than assign road space entirely to vehicles or entirely to pedestrians, the new idea is to share that space among all users. Shared-space advocates claim success in some European towns where virtually all signs, markings, and controls have been eliminated. Cars, bicycles, and pedestrians all use the same space. Operating speeds for vehicles are reduced without signs or regulations, because pedestrians and bicycles are freely circulating in the roadway. Safety is reportedly improved, however. Common law prohibitions against doing harm to another appear to be

sufficient to “guide” drivers to adopt appropriate speeds. The psychological aspects are touted as promoting “community” by forcing individuals to interact more through eye contact and coordination of movements around each other.

American experience with these concepts is limited. The concept appears to fly in the face of all experience favoring frequently posted speed controls and maximum signage to instruct drivers. But the traffic engineering literature suggests interest is growing among progressive American cities. It bears noting that in much the same way, traffic calming was originally discounted in America but eventually became an accepted practice.

If Poulsbo were to consider a shared-space experiment, the burden of being an “early innovator” applies. Innovation must proceed carefully and thoughtfully, with the expectation that unforeseen problems will come up and need to be resolved as they occur. Legal aspects of removing customary traffic controls would have to be carefully considered. Public information processes must be well developed. The understanding and support of the affected downtown business community is essential, as well as the general public.





**Figure 6 – Volume Changes – One Way Couplet – 6th Avenue NE and Fjord Drive NE**

### Traffic Calming

Traffic calming devices take many forms, such as speed humps, speed bumps, speed tables, and chokers, diverters, chicanes, partial closures, curb bulb-outs, etc. Traffic calming has evolved into a discipline that primarily seeks to reduce traffic speeds, but not necessarily to change traffic volumes. Therefore, traffic calming in downtown Poulsbo should not be expected to reduce traffic volumes per se, but rather to

reduce speeds so that traffic is more compatible with adjacent land uses and pedestrian activity. The street environment becomes more hospitable to a variety of users instead of just automobiles.

Streets that would be appropriate locations for traffic calming include local access streets that experience speeding problems, as well as some collectors and arterials where speed is not a desired quality. In the downtown Poulsbo area, several locations have present or future potential for traffic calming:

- Speed humps have been installed on NE Torval Canyon Road already, to deter through travel. This has provided limited effectiveness for volumes but greater effectiveness for speed control.
- Front Street NE north of the downtown retail section is a candidate for street design modifications to increase the use of road space for curb parking and bicycle lanes, at the expense of left-turn lanes. This would allow the use of curb bulb-outs to shorten the width of exposed crosswalks as well. The combined effect of these changes would be to reduce speeds entering downtown and slightly diminish traffic volumes.
- 6th Avenue NE could be reduced in width by the use of curb bulb-outs around curb parking, and striping for bicycle lanes. These changes would reduce the “wide-open” appearance of the road and deter high speeds.
- Jensen Way NE south of NE Iverson Street could add curb bulbouts around existing curb parking.

**Figure 7** illustrates a street in British Columbia where the street width was narrowed by the combination of bicycle lanes and a mid-block median island. A raised pedestrian cross-walk is also part of the traffic calming tools applied to this location. Front Street NE south of NE Torval Canyon Road into downtown Poulsbo could be retrofitted with a similar design, also including curb bulb-outs and parallel parking.



**Figure 7 – Example of Mid-Block Median Island (located in British Columbia)**

### **Summary of Effects of Potential Traffic Operations Changes**

The potential to shift traffic demand away from downtown Poulsbo – i.e., toward SR 305, was evaluated by repetitive testing of suggested options using the Poulsbo Traffic Model. The results of this effort produced the following findings:

- Current capacity improvements on SR 305, when completed, will reduce travel on Front Street NE in downtown Poulsbo. This may be occurring already, but should reach maximum effect after all SR305 construction work is finished.
- Speed reductions on Front Street NE in downtown Poulsbo are effective for reducing traffic on that route. One option is to install all-way stop controls at each intersection. Another option is to redesign the street cross-section with narrow travel lanes, and wider bicycle lanes and parking lanes.
- Through traffic diverted from Front Street NE will seek out alternative routes within downtown before shifting to other routes outside of downtown. A complete solution should include countermeasures to minimize increases on: NE Torval Canyon Road, 4th Avenue NE, Jensen Way NE, and NE Sunset Street.
- Traffic restrictions east of downtown Poulsbo need to address several routes as a group, in order to systematically shut off all detour routes that could be exploited by unwanted through traffic: NE Iverson Street, NE Lincoln Road, NE Hostmark Street, Fjord Drive NE, NE Harrison Street, 6th Avenue NE, and NE Haugen Street.

- All traffic to/from the west flows through the single gateway intersection of NW Lindvig Way / Bond Road NE / Front Street NE.
- Decreasing the capacity and/or speed of NW Lindvig Way and/or NW Finn Hill Road slightly reduces through travel on Front Street NE, but the effect would be small compared to direct actions on Front Street NE.
- Capacity increases at the intersection of Viking Way NW and NW Finn Hill Road / NW Lindvig Way would tend to increase through travel on Front Street NE.
- Changing the intersection of NW Lindvig Way / Front Street NE / Bond Road NE to favor Bond Road NE instead of Front Street NE would slightly reduce travel on Front Street NE. Signalization and roundabout conversion are two possible options. The reduction would not be large. Costs would be substantial.
- Increasing capacity and/or speed on Viking Way NW north of NW Lindvig Way has little effect in reducing through travel on Front Street NE. This route is too far out-of-direction to appeal to most trips that go through downtown Poulsbo.
- Increasing capacity and/or speed on Bond Road NE north of NW Lindvig Way has no significant effect in reducing/increasing through travel on Front Street NE. It diverts some through traffic from West Poulsbo over to SR 305 via Bond Road NE, but it adds an equivalent number of new trips into downtown Poulsbo from the area north of the city, away from paths via SR 305.
- One-way street couplets have only small effects on Front Street NE traffic volumes, but serve other local purposes such as increasing the parking supply.
- A network of one-way streets may be most practical for maintaining circulation within downtown, including Front Street NE, Jensen Way NE, Bjermland Place NE, and 3rd Avenue NE, between NE Hostmark Street and NE Sunset Street, but not further north than NE Sunset Street.

## Level of Service Policy

The desire to reduce travel through downtown Poulsbo will eventually collide with the City's LOS policy since the latter implicitly assumes that more capacity is always good, and encourages capacity increases as the solution to traffic problems. If all potential traffic demand should not expect to be accommodated in the downtown area, or if alternative modes are to be encouraged, then the level of service policy should provide support for that solution.

This can be done through changes in the LOS policy specifically for the downtown area or any other area where travel demand must be managed. Existing LOS policy in Poulsbo has two parts: LOS "C" is set as an optional goal to achieve where possible while LOS "E" is set as the minimum requirement for developments to meet as the GMA concurrency standard.

Examples of more sophisticated approaches to the LOS policy include:

- Adopt LOS "F" as the concurrency standard (LOS "F" allows demand to exceed capacity, creating severe congestion) so as to allow development to continue where new lane capacity cannot be added - but elsewhere include an offsetting policy emphasis on transit, ridesharing, and other methods of reducing travel demand, as well.
- Define LOS standards in terms of people-capacity as compared to vehicle-capacity, so as to give credit for an above-average level of transit ridership, walking, bicycling, etc.
- Adjust LOS standards selectively, for areas with highly developed transit service, bicycle lanes, etc. – i.e., LOS "F" where transit service is frequent, but LOS "E" where it is limited, and LOS "D" where it does not exist.

- Adjust LOS standards depending on the type of development so that selected development types (for example, transit-oriented development) have a lower LOS threshold to meet than traditional development.
- Judge the acceptability of new development by the average LOS for many locations, rather than strict compliance with the LOS standard at each location, so as to tolerate congestion at a few places.

Such adjustments to LOS policy represent a different approach to congestion than in the past: congestion will be tolerated in preference to building wider roads, as compared to the traditional approach that congestion was always to be minimized. This change supports the recognition that the vitality of downtown retail and entertainment districts is often associated with high traffic congestion, well-used parking areas, and considerable pedestrian activity, rather than free-flowing streets through a sterile environment.

### **Combination of All-Way Stop Controls and One-Way Streets**

The combined effectiveness of all the preceding options was evaluated with the traffic model. Two one-way couplets were combined with the addition of all-way stop controls throughout downtown Poulsbo, for a maximum test of potential traffic reductions. This combination of actions would have the same impacts in each part of the downtown as would occur with each individual action:

- reduce traffic on Front Street NE and NE Hostmark Street
- slightly reduce traffic on NE Sunset Street and Jensen Way NE
- increase traffic on NE Torval Canyon Road and 4th Avenue NE
- reduce traffic on Fjord Drive NE, 6th Avenue NE, and NE Haugen Street
- increase traffic on SR 305
- potentially require signalization at 4th Avenue NE and NE Iverson Street

This test shows that the one-way couplet options can be combined with the all-way stop options in any combination, without unexpected new consequences.

The recommended approach is therefore to implement all-way stops throughout downtown Poulsbo AND one-way couplets AND also apply road-diet principles to Front Street NE AND utilize traffic calming devices on local streets as need arises. This general concept is subject to detailed refinements in various locations, as the implementation planning goes forward. For example, all-way stop controls are generally recommended, but certain intersections may be excluded after more detailed examination including public review of the plan.

### **Final Recommended Actions**

The consultant and the citizen advisory committee worked together to refine the details of the preceding test cases into a final set of recommended actions. These are recommended for Poulsbo to implement as ways to achieve a reduction in through traffic in downtown Poulsbo, while avoiding adverse effects on adjacent neighborhood streets. **Figure 8** depicts the net traffic impacts of implementing the final set of recommended actions. A series of graphical representations of all recommendations are found at the end of this section.

**1. Define a Downtown Poulsbo Traffic Management Zone (“TMZ”).** (See **Figure 10** and **Figure 11**)

This is the area bounded by waterfront shoreline on the west side, SR 305 on the east side, NW Lindvig Way on the north side, and the southern city limits. Defining this zone as a special area enables the City to apply different level of service policies within that area in the future, utilize traffic impact fee revenues for demand management projects within the defined area in lieu of capacity improvements, and may be used in signs posted on the street system to inform the driving public of the special character of this area.

**2. Place all-way stop controls at selected intersections in the TMZ.** (See **Figure 10** and **Figure 11**)

About 15 intersections are proposed for use of all-way stops to control speeds within the TMZ. A systematic approach for all roads in the area is necessary to avoid unwelcome diversions from controlled streets to uncontrolled streets. Exceptions may be justified based on local details after further analysis.

- The intersection of 4th Avenue NE and NE Iverson Street may be a candidate for signalization in the future. Alternatively, a lower LOS policy could be considered for this intersection to avoid signalization.
- The five-legged intersection at NE Hostmark Street, NE Lincoln Road, 4th Avenue NE, and Fjord Drive NE should be striped and channelized as two separate intersections with all-way stop controls. Additional details of revised markings and controls are available.
- Two intersections would not be changed until the one-way street couplet described below is implemented: at 3<sup>rd</sup> Avenue NE and NE Moe Street, and at Front Street NE and NE Young Street.

**3. Add speed tables at selected locations to discourage cut-through diversions.** (See **Figure 10**)

Following a period of observation of the results of adding stop controls within the TMZ, consider additional speed reduction efforts as needed in various corridors, by placing speed tables at various locations where the distance is long between stopped intersections, and/or where there is a pedestrian cross-walk. Poulsbo already has a few speed tables in operation. Adding generously wide cross-walk markings to the speed tables will further enhance the pedestrian environment.

- Add two speed tables on 4th Avenue NE between NE Iverson Street and NE Arbutus Court, to control speeds in that area, and provide pedestrian crossing.
- Add two speed tables on 4th Avenue NE between NE Hostmark Street and NE Iverson Street, at Viewmont Street NE and the First Lutheran Church parking lot, along with pedestrian crosswalks.
- Add two speed tables on Jensen Way NE (north) at minor intersections, along with pedestrian crosswalks.
- Add four speed tables on Front Street NE (north) at pedestrian crossing locations between major intersections.
- Add three to four speed tables on Front Street NE (south) at pedestrian crossing locations in the downtown core.
- Add a speed table on 6th Avenue NE at a pedestrian crossing location at NE Matson Street.
- Note: The locations of the suggested speed tables are approximate and may be re-located upon actual design.

#### **4. Reconfigure Front Street NE north of downtown Poulsbo as a two-lane street with parallel parking.** (See Figure 10)

This change may be implemented at any time, to develop more curb parking and to enhance the pedestrian environment. Cost will vary depending on the extent of reconstruction.

- All-way stop controls eliminate the need for left-turn lanes at intersections.
- Replace the median turn lane with curb parking, bicycle lanes, or wider sidewalks.

#### **5. Implement one-way street operations on Front Street NE and 3rd Avenue NE through the downtown core.** (See Figure 10)

Changing Front Street and Third Avenue to a one-way pair will reduce traffic conflicts, and may allow creation of additional parking capacity. Third Avenue would need to be reconstructed to handle high volumes, so this phase has a significant cost aspect.

- Front Street NE would operate southbound between Jensen Way NE (south) and Young Street NE.
- 3rd Avenue NE would operate northbound from NE Hostmark Street to NE Iverson Street. For the one-way couple to work, the section of 3<sup>rd</sup> Avenue NE from NE Hostmark Street to NE Moe Street is needed. The second part from NE Moe Street to Hostmark Street is desirable to add on-street parking and to improve pedestrian facilities within limited right-of-way.
- NE Hostmark Street between Young Street NE and 4th Avenue NE would remain a two-way street, in order to preserve access to the waterfront from the east.
- 3rd Avenue NE Extension north of NE Iverson Street to Jensen Way NE would remain as a two-way street.
- Each route would have one travel lane. The space made available can be used to develop additional angle parking or parallel parking as may be recommended in the separate downtown parking study now underway. Sidewalks and bicycle lanes may also be considered.
- Raised speed tables would be added at each crosswalk location.
- Two of the proposed all-way stop intersections would be implemented only with this one-way street conversion: at 3<sup>rd</sup> Avenue NE and NE Moe Street, and at Front Street NE and NE Young Street.

#### **6. Reconfigure the corridor from NW Finn Hill Road to NW Lindvig Way to Bond Road NE to de-emphasize access to downtown Poulsbo.** (See Figure 9)

This change requires significant capital investment preceded by detailed operational planning and design studies. Minor adjustments of existing signal timing plans may be made at any time, however.

- Reconstruct the intersection at NW Lindvig Way and Bond Road NE to favor turns between those roads and disfavor turns to/from Front Street NE.
- Reconstruct the intersection at NW Lindvig Way and Viking Way NW to support turns between NW Finn Hill Road and Viking Way NW and to disfavor movements to/from NW Lindvig Way.
- Define the NW Finn Hill Road corridor including NW Lindvig Way as having reached its “ultimate capacity” with the existing curb-to-curb width between SR 3 and Front Street NE.

- Adopt a lower LOS policy for this corridor to avoid the need for additional capacity improvements in the future, and instead encourage WSDOT to maximize the capacity of SR 305 for through movements as future travel growth materializes.
- Post traffic advisory signs on the approaches, to encourage the driving public to use Viking Way north of Lindvig Road as a route to SR 305, in lieu of Lindvig Way.
- Consider extending the length of the eastbound left-turn lane on Finn Hill Road approaching Viking Way.
- Consider retiming signals at each end of Lindvig Way, as an initial step to encourage use of other routes around downtown Poulsbo.

**7. Consider additional traffic calming measures as need arises, at other locations not discussed here.**

Following the implementation of actions listed above, the City will have gained valuable experience with traffic calming techniques and expected benefits. Additional needs and potential measures may then come into focus for further applications, whether in downtown or elsewhere in Poulsbo.

**8. Consider future changes to the city's LOS policy, to allow additional congestion at locations where capacity improvements are not feasible or not desired.**

Preceding measures should significantly reduce current traffic congestion in the TMZ area. Eventually, however, future growth may lead to renewed congestion where capacity improvements are not practical. If that happens, the City's next step should be to modify the level of service standard within the TMZ.

- Congestion is a useful deterrent factor against unwanted through traffic.
- Many cities have adopted lower LOS standards in downtown areas.
- An easy way to work with the existing policy would be to allow an average LOS throughout the Downtown Poulsbo TMZ. The actual LOS at all intersections, or all road segments, would be averaged and this average would be compared to the existing standard.
- An alternative approach used in some jurisdictions is to allow a limited number of exceptions to the established LOS policy. For example, within the Downtown Poulsbo TMZ, up to 20 percent of monitored intersections and 20 percent of monitored road segments could be allowed to exceed the standard.
- The method of averaging can be defined and implemented in a concurrency ordinance without changing the LOS policy in the comprehensive plan.
- Developments that create LOS deficiencies in the Downtown Poulsbo TMZ may also be allowed to mitigate those impacts by payment of financial support for increased transit service in Poulsbo to reduce their net traffic generation.

**Rough Cost Estimate for Suggested Changes**

To implement the tested TDM/TSM strategies involves various costs, which are roughly estimated as follows. These estimates are subject to refinement and should be used only as planning and programming guidance, and not as refined cost estimates for specific project budgets.

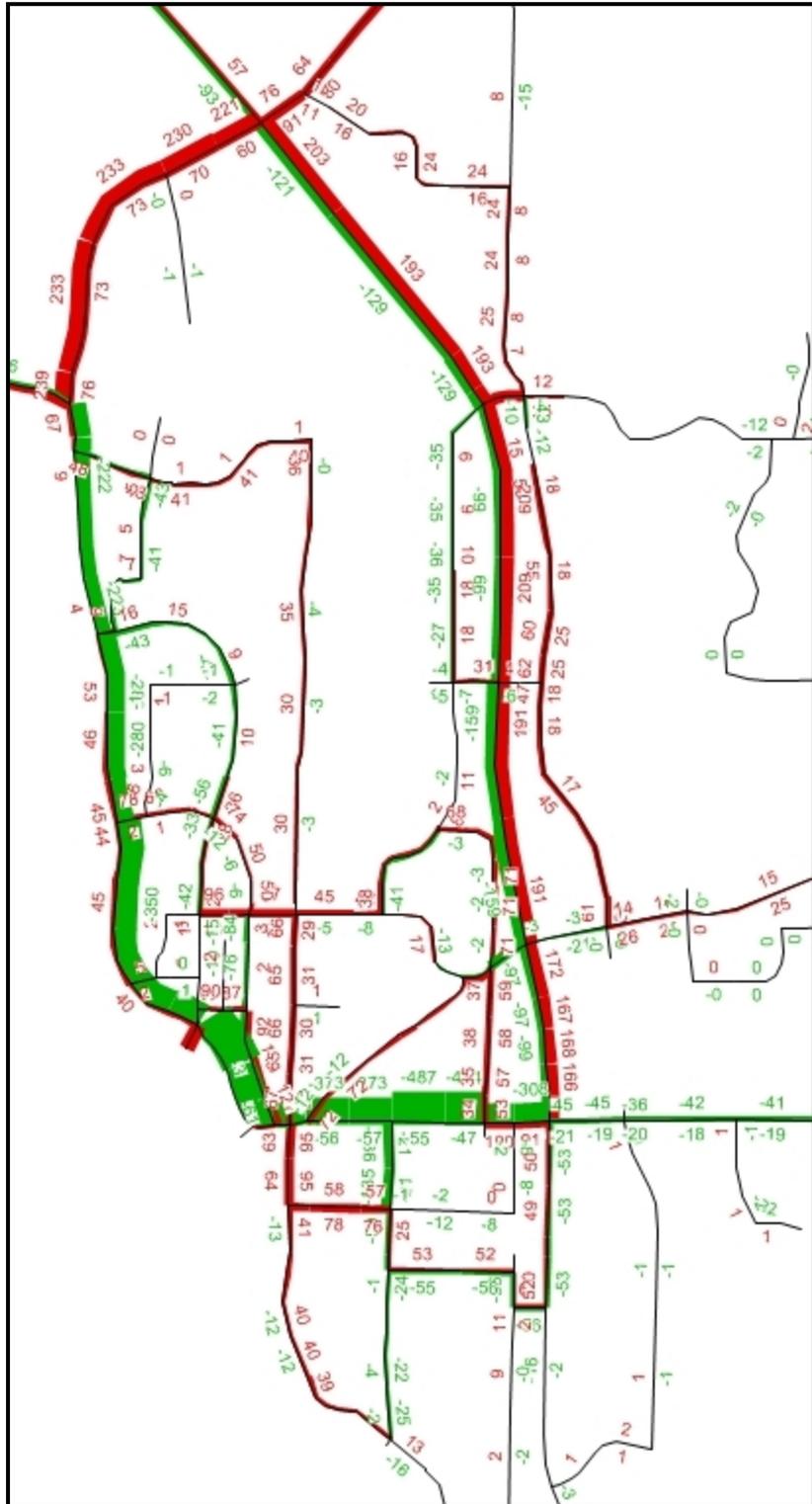


Figure 8 – Volume Changes – Composite of Recommended Actions

Recommendations 1 and 8 above are administrative actions. Cost is minimal and born within existing staff budgets. Allow \$10,000 for external consultant and attorney support as the need arises.

Recommendations 2 and 3 involve a large number of individual small road revision costs ranging from \$1,000 to \$5,000 per site, for as many as 15 all-way-stop intersections and 15 mid-block speed table locations. A lump sum estimate of \$15,000 would cover the costs of adding all-way stop controls. A lump sum estimate of \$85,000 is suggested for the construction work to install speed tables on existing pavement. Recommendation 7 entails similar actions to be defined in the future, The scope and cost is presently unknown.

These estimates do not include reconstruction of streets to add curbs, sidewalks, landscaping, etc., that may be desired for other reasons, such as to reconstruct 3rd Avenue NE to a complete street. Costs of developing new parking supply on streets is not included if construction is involved, but may be included if cost is simply to re-stripe existing pavements.

Recommendation 4 (Front Street NE Reconfiguration) requires a street design study and some reconstruction of the existing street. Construction costs may vary from \$100,000 to \$500,000 depending on design choices. Cost of developing parking spaces on Front Street NE would be included.

Recommendation 5 (One-Way on Front Street NE and Third Avenue NE) also requires a street design study for reconstruction of Third Avenue NE and minor revisions to Front Street NE. Construction costs will vary depending on the extent of reconstruction, and would likely be in the range of \$1 to \$3 million. Parking space improvements would be included.

Recommendation 6 to reconfigure the NW Finn Hill Road – NW Lindvig Way – Bond Road NE corridor requires design study for modified channelization plans. Design and construction costs may vary from \$200,000 to \$500,000, or potentially more.

More detailed cost estimates for construction work can be developed once design options are narrowed.

## **Implementation Process**

The order of actions listed above corresponds to the recommended order of implementation actions. The initial steps are easy to do at low cost, and have high beneficial impacts. Later actions will be significantly more costly.

The success of these recommendations will depend on the acceptance of the residents and businesses in the affected areas. Therefore, the City of Poulsbo should precede each new action with a process for involving the affected public, to explain the intended actions, how the public will be affected, and to describe the expected benefits. A general mailing to all addresses in the affected area is desirable, along with other publicity, followed by one or more public meetings for dialog and feedback. Some adjustment of the scope of efforts may be necessary following public feedback on each proposal, if local reaction is strongly adverse.

Traffic revisions should be accompanied by advance warning signs and temporary pavement parkings to alert the driving public of the changes. Police enforcement will be helpful during the initial period of change.

Once implemented, each change should remain in place for a period of several months, so that the expected traffic changes can stabilize and the local area residents have time to adjust to the local changes and appreciate the long-term benefits. Before-and-after studies of traffic volumes are highly recommended, to provide objective measures of effectiveness.

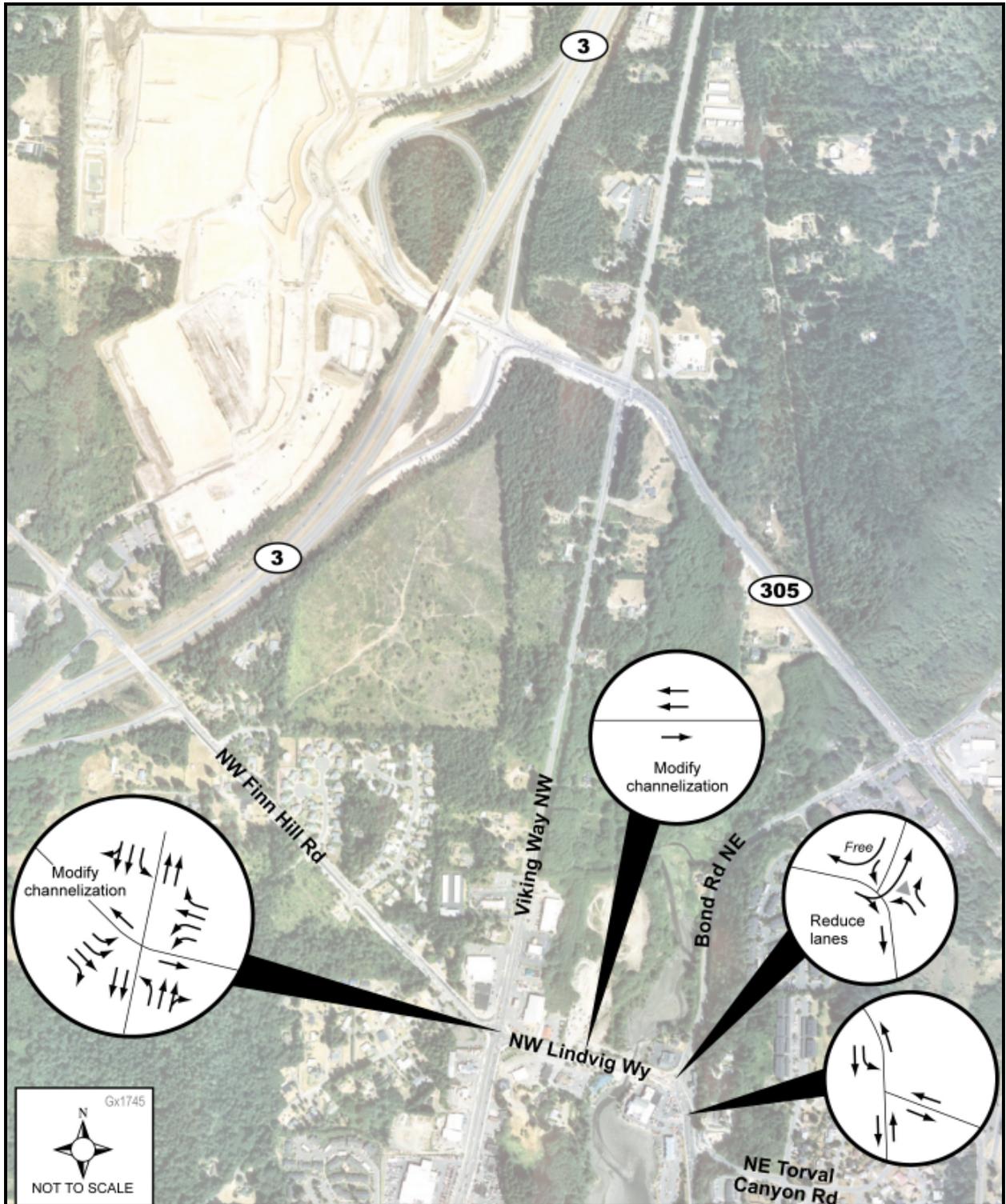


Figure 9 – NW Lindvig Way, NE Torval Canyon Road, and Bond Road NE Details

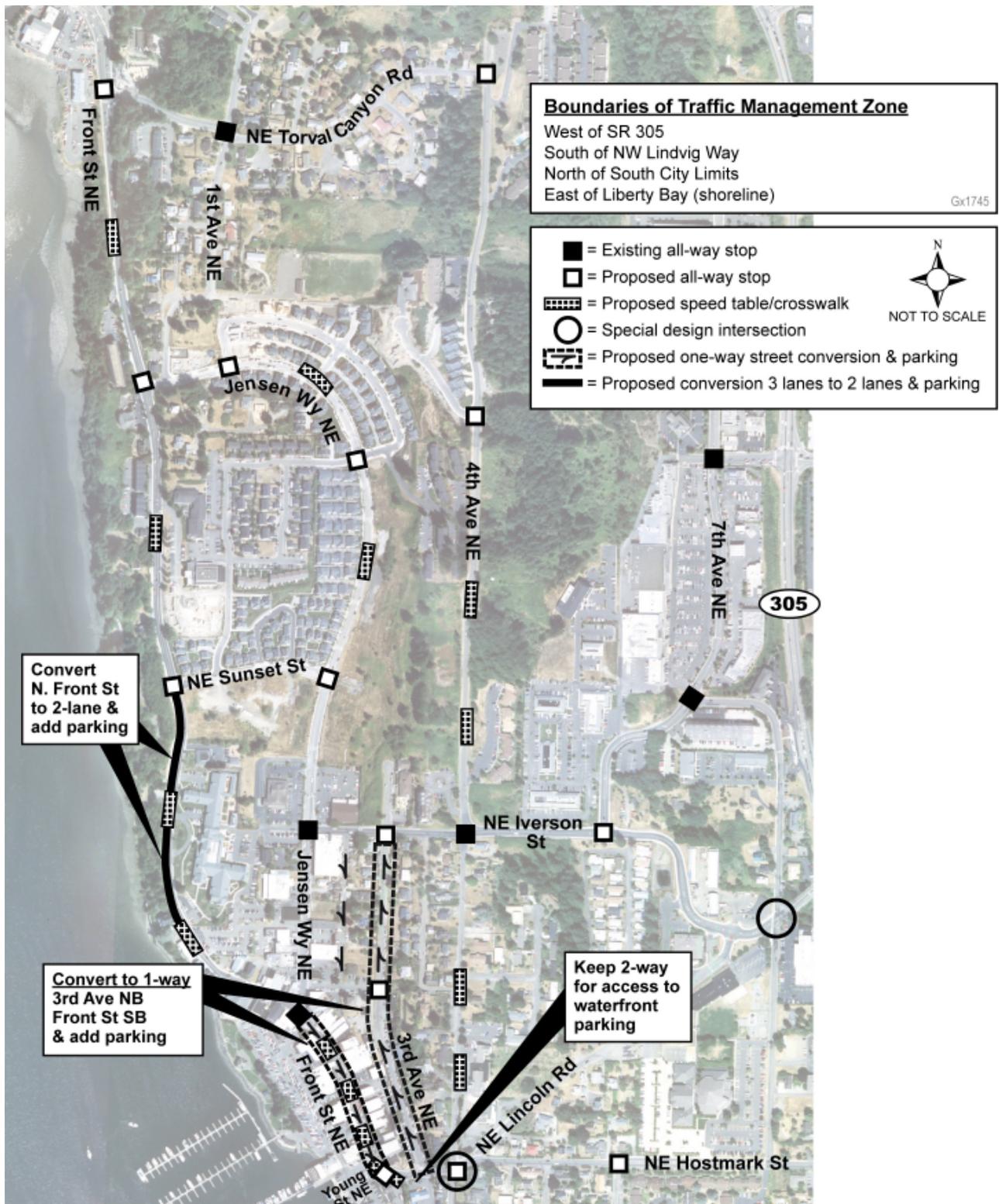
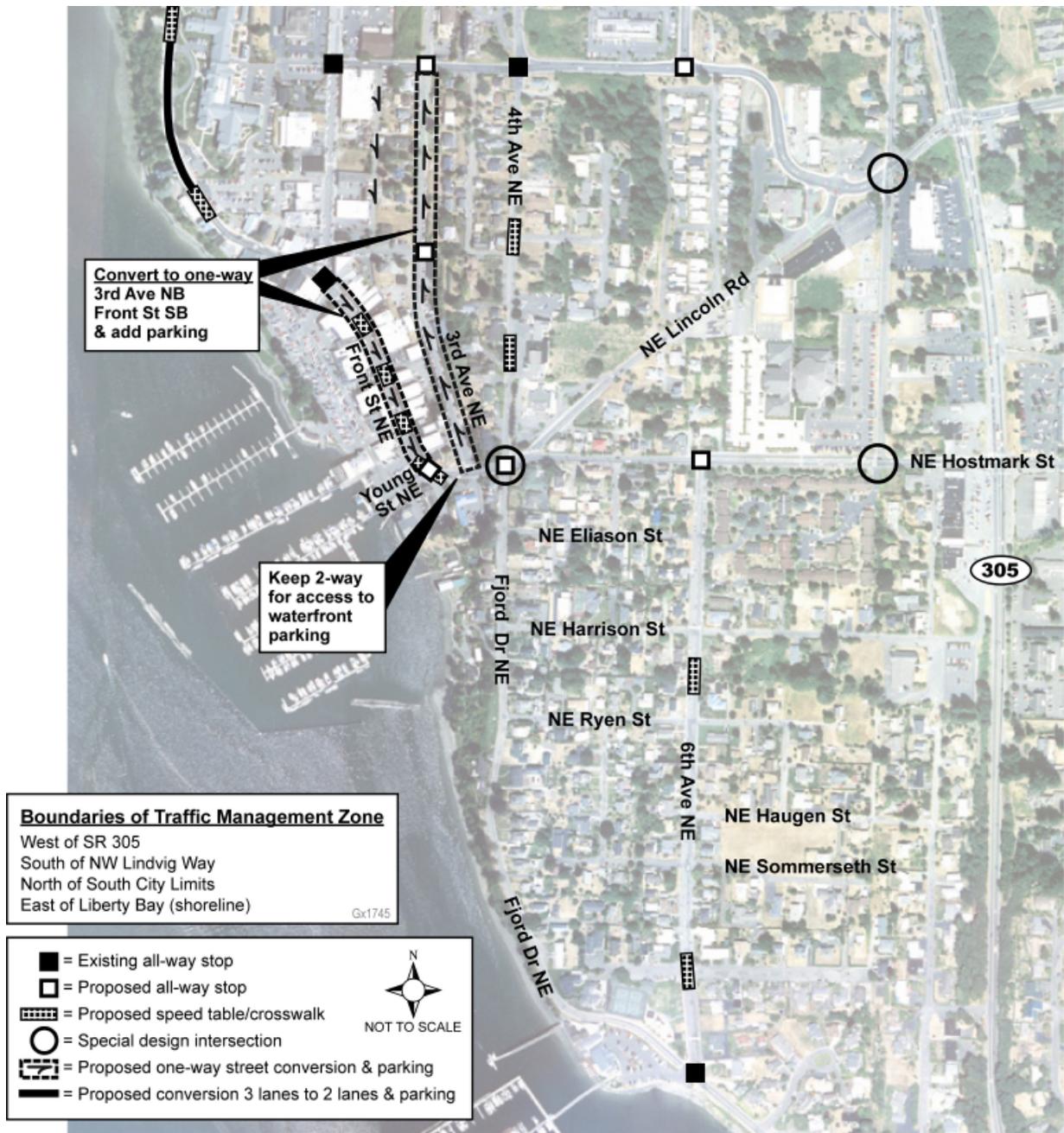


Figure 10 – Northern Downtown Poulsbo All-Way Stop and One-Way Road Combinations



**Figure 11 – Southern Downtown Poulsbo All-Way Stop and One-Way Road Combinations**

### 3. Transit-Related Strategies

#### Existing Transit Service

The existing transit service for the City of Poulsbo (City) consists of six separate routes, four of which serve other cities as well, and two being circulator routes within Poulsbo. The locations in Poulsbo that each route serves can be observed on **Figure 12**. **Table 2** displays all six routes, sorted by the number of riders, based on Kitsap Transit website information.

**Table 2 – Current Operations**

Route	Weekday Rides	Annual Rides	Service Area
90	1,108	270,000	Poulsbo - Bainbridge
32	256	70,000	Silverdale - Poulsbo
33	169	32,000	Silverdale - Poulsbo - Bainbridge, peak hours only
92	110	18,000	Poulsbo - Suquamish - Kingston
43	62	22,000	Olympic College - Front St - PTC - Central Market
41	46	11,000	PTC - Ridgewood - NKHS

PTC = Poulsbo Transfer Center  
 NKHS = North Kitsap High School

It can be seen that the Poulsbo circulator routes (41 and 43) are operating at very poor efficiency. The routes run in circular patterns as opposed to two-way patterns, and therefore do not provide flexibility when the rider is required to travel in the opposite direction. Also, a majority of their time is spent operating during non-peak hours to serve the small population of transit-dependent citizens (students, elderly, unemployed, etc.), which results in low revenues. In addition, the routes have a frequency of one hour and end their service each weekday at 4:30 PM – before the end of the business day. When all of these limitations are combined into one service (as they currently are), the service performs poorly. In contrast, the routes that focus on commuters, and only operate during peak hours of travel, perform well above average. This goes along with the idea that vanpools and worker/driver buses are very efficient in their peak-hour-only style of operations (see details for these programs on page 40).

After determining that several routes within Poulsbo are performing poorly, the generated revenues associated with each route can be used to gain a better understanding of their operating efficiencies. The estimated revenue generated for each Poulsbo route is shown in **Table 3**.

**Table 3 – Transit Revenues**

Route	Annual Rides	Revenues* at \$1.50 Fare
90	270,000	\$180,000
32	70,000	\$105,000
33	32,000	\$48,000
43	22,000	\$33,000
92	18,000	\$27,000
41	11,000	\$16,500

\* Estimated from rides and fares, not actual financial accounts.

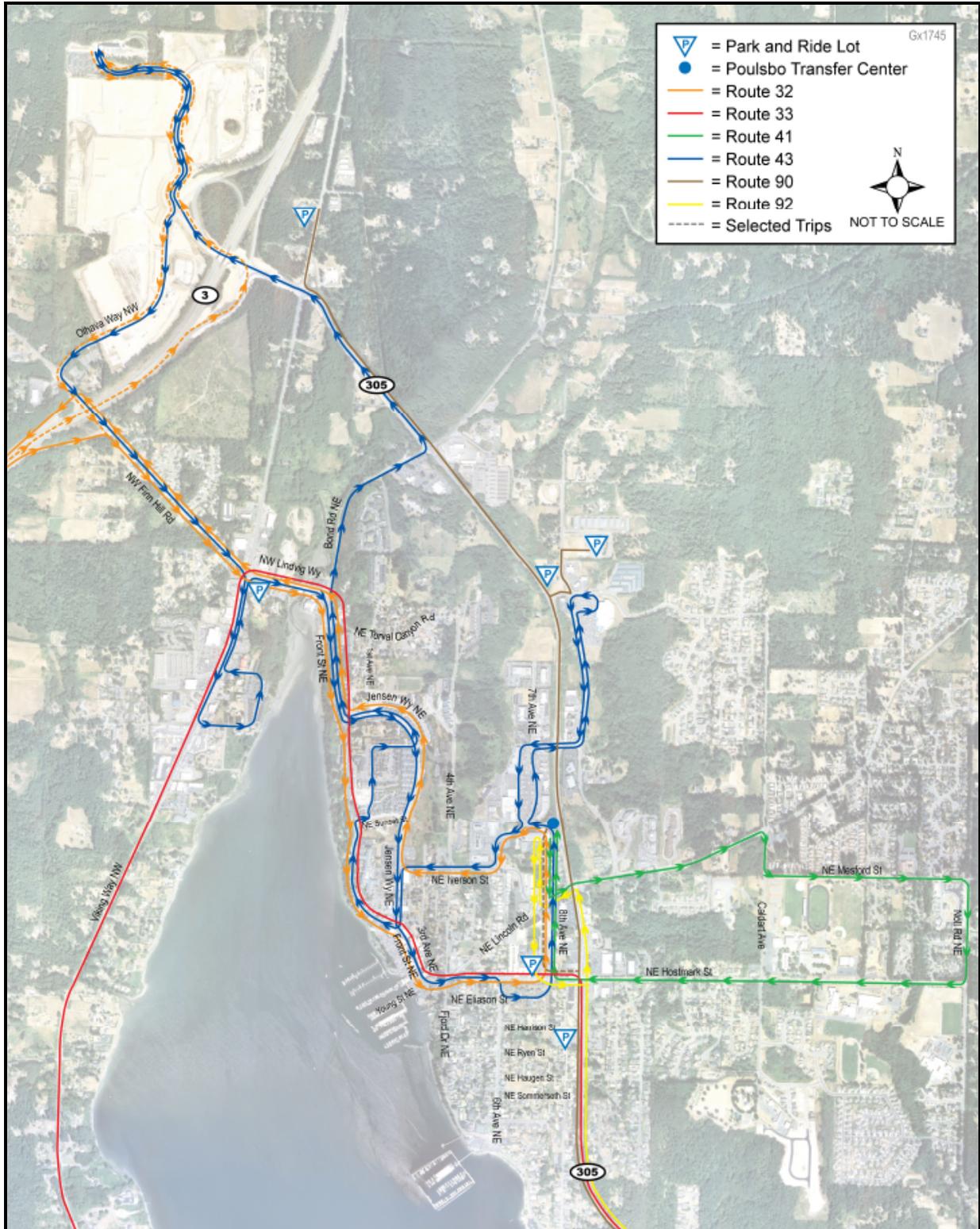
**Table 4** provides approximate annual costs of operating buses. These values are calculated using the assumption that it costs an average \$100 per hour to operate a bus, provided by Kitsap Transit. When compared to the transit revenues found in **Table 3**, it is clear that revenues from fares fail to provide a

significant portion of the buses' operating costs. Generally, transit systems aim to recover approximately 25% of their costs from fares. In contrast, Poulsbo's fares restore only about 10% of the costs.

**Table 4 – Transit Operating Costs**

<b>Scenario</b>	<b>Days/Year</b>	<b>Cost/Hour</b>	<b>Annual Cost</b>
1 bus, 12 hour days	365	\$100	\$438,000
1 bus, 8 hour days	260	\$100	\$208,000
2 buses, 12 hour days	365	\$100	\$876,000
2 buses, 8 hour days	260	\$100	\$416,000

In summary, most of the ridership in Poulsbo occurs on the routes to/from the Bainbridge Island ferry terminal, service from Poulsbo to areas west (Silverdale, Bremerton, and Bangor) is limited, and Poulsbo circulator routes are performing poorly. The key problems appear as a result of budget limitations: one-hour frequencies, circular routes instead of two-way routes, and service that does not match the commuters' work days (circulator service ends at 4:30 PM). However, the problems associated with budget limitations cannot be remedied through collected fares, as Poulsbo fare revenues provide much less than is needed. Therefore, alternative methods of financing would need to be sought by the City if future transit service is to be significantly improved.



**Figure 12 – Current Transit Routes in Poulsbo**

## Potential Transit Demand

The potential transit demand in Poulsbo is difficult to forecast without any assumptions about the amount of funding provided for transit. Increased funding would enable increased service which would in turn generate increased ridership, within reasonable limits. To gain a better idea of potential transit demand, the projected vehicular trip growth in Poulsbo over time was considered, based on the Poulsbo Traffic Model. **Table 5** provides the estimated amount of trip growth for each subarea of Poulsbo, between the years 2003 and 2025. Each subarea of Poulsbo, except for the Old Poulsbo area, is projected to have at least roughly 50% growth. The greatest increase of 194% occurring in West Poulsbo presents a potential market to improve the transit connections of that area with the central Poulsbo area. Overall, the 2025 total trips in Poulsbo are close to double that of the total trips in 2003. This suggests that the transit ridership will double as well over the same time period, with the existing level of transit service. With increased transit funding and expanded service, a greater market share for transit is possible.

**Table 5 – Trip Generation Growth in Areas of Poulsbo**

Subarea	2003 Average Daily Total Trips	2025 Average Daily Total Trips	Growth (Trips)	Growth (%)
West Poulsbo	3,432	10,093	6,661	194
Old Poulsbo	2,496	2,753	257	10
Highway Commercial	2,611	4,076	1,465	56
Northeast	1,249	1,855	606	49
Southeast	922	1,444	522	57
<b>Totals</b>	<b>10,710</b>	<b>20,220</b>	<b>9,510</b>	<b>89</b>

The trip generation growth from **Table 5**, when used to estimate transit demand, should only be used as a general guide to likely market trends. Many factors are associated with the fluctuation of transit demand and should be considered if more in-depth analysis is pursued. Several of these significant factors are: the amount of funding provided to transit programs, rising fuel prices, economic concerns, environmental concerns, and increased traffic congestion.

As the purpose of this entire traffic demand management study is to reduce trips through downtown Poulsbo, this transit analysis is focused on how to strategically increase the ridership in such directions that it would also reduce the number of trips through downtown. Two major markets that have potential for doing so are:

- Between east Poulsbo and employment areas to the west located in Bangor, Bremerton, etc.
- Between the city and county populations west of downtown Poulsbo to the Bainbridge Island ferry terminal.

### Conclusions:

- Internal circulation transit within Poulsbo could be expanded for better coverage and increased frequency. This would probably result in an increase in users; however, it will provide little benefit to reducing downtown traffic congestion as this market is quite small.
- An increase in service for the main commuter markets of Kitsap County employers to the west and the Bainbridge Island Ferry Terminal to the east is likely to perform well in terms of reducing peak-hour traffic through downtown.
- **Table 4** outlines that for every bus placed into full-time service, the average annual operating cost is roughly \$400,000. With an increase in the frequency of service, the cost goes up accordingly. Fare revenues on Poulsbo routes generate about 10% of the operating costs, which is well below

the system-wide standard of 25% for Kitsap Transit. This causes funding to play an even larger role than normal for Poulsbo.

- Worker/driver bus routes may be a viable option to provide service to major employers west of Poulsbo. These routes would operate only one way during the peak hours of commuting, while not operating during the non-peak hours. This would minimize operating costs. Details on worker/driver buses can be found in the next chapter.
- Ridesharing-related opportunities, separate from bus transit, are also available for implementation within Poulsbo. See the next chapter on “Ridesharing and Other TDM/TSM Activities” on page 39 for further information.

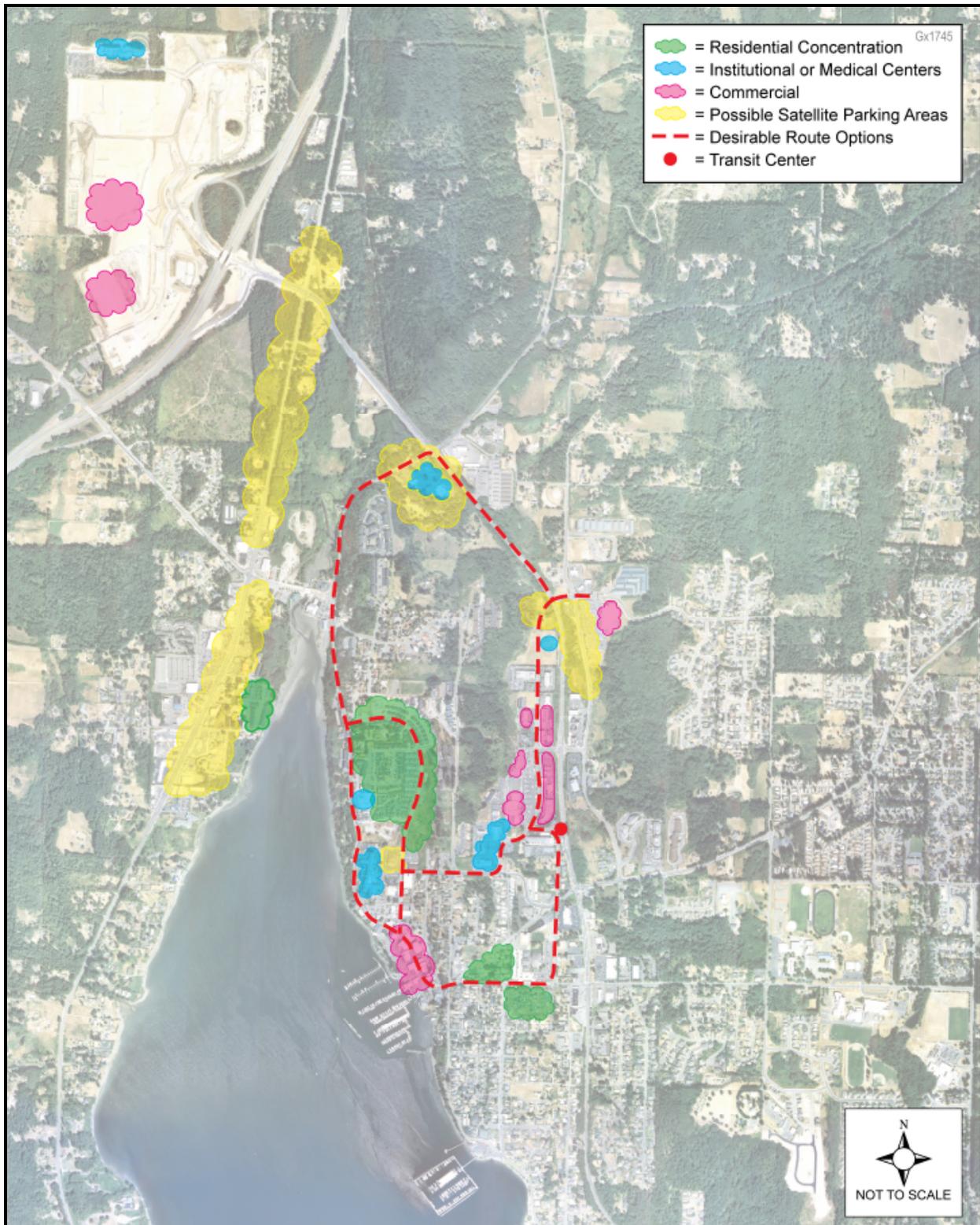
## Suggested Transit Improvements

Kitsap County states in its *2007-2013 Transit Development Plan* under “Section VI: Proposed Action Strategies, 2008 – 2013” that it has interest in developing improved downtown transit circulation routes in Poulsbo (among other cities) as the first step toward integrating service to better conform with the City’s land-use goals. While Kitsap Transit definitely has an interest in improving its service, the budget needed remains an open question.

Kitsap Transit hosted an open house with the public in September 2008 in Poulsbo, to discuss potential improvements to its service. Even with the current underperforming/failing routes in Poulsbo (as observed in **Table 2**), Kitsap Transit learned that there was much resistance to changing the routes. In particular, Route 32 could benefit greatly by redoing its timing and omitting certain travel locations. The public was generally supportive of the idea to redo the timing of the route, but were not very supportive to make any changes to its traveled path. This is an understandable response, given that the majority of the participants of the open house were current users of Kitsap Transit, and any changes suggested would affect them the greatest. It should also be considered that the potential new users that would benefit from possible changes were most likely absent at the open house, as they are not users of Kitsap Transit just yet and would not have been as likely to be aware of or attend the open house.

Overall, there was support for both keeping the current routes and changing the current routes – with no clear direction as to what would serve the public the best. However, there was clear support for transit service operating in several areas of Poulsbo. These include the Poulsbo Medical Center, North Kitsap High School to Downtown Poulsbo, and North Kitsap High School to Olympic College. North Kitsap High School to Olympic College was mentioned specifically, as the current timing of this route often requires a Running Start student to wait 40 minutes after class before catching a bus back to the high school.

A map of Poulsbo is displayed in **Figure 13** that highlights certain areas that may be of interest when revising current routes and planning new routes. The map also outlines roads that would serve as desirable route options. These concepts are just ideas at this point. Kitsap Transit would need to undertake a considerable amount of route planning to finalize any new route. These concepts are tentative and subject to change.



**Figure 13 – Possible Locations for Route Changes**

## Shuttle Bus Concepts for Downtown Poulsbo

There is interest in Poulsbo to introduce transit operations in the style of shuttle buses. Two different ideas of shuttles appear to be potentially viable:

- Link downtown Poulsbo to the highway commercial corridor with the shuttle ending at Central Market (10th Avenue NE/NE Forest Rock Lane). This connection exists with Route 43; however, its hourly frequency does not stimulate high ridership. Possible reasons were discussed under “Existing Transit Service.”
- Employer shuttles used in combination with new satellite parking lots. The current Parking Study for Poulsbo has determined several locations in the city where new satellite parking lots could be located. When used in combination with shuttles, employees would be provided with an alternate method of transportation – which would possibly increase use among the other alternate methods of transportation. The Parking Study suggests the possibility of: introducing paid short-term parking along the waterfront to help relocate commuters to satellite parking lots and to allow customers/tourists to take advantage of the parking spaces; using the parking lots of First Lutheran Church, Bank of America, and the old City Hall (long-term plan) as satellite parking lots; and considering the feasibility of a parking garage (distant long-term plan). Benefits of these possibilities are: increased tourism, parking lots located along current bus routes, and increased use of public transit. The key to implementing this shuttle idea is to first find and develop the satellite parking lots, and then increase the available shuttle service.

These two ideas may be combined with careful planning; however, funding is likely to be the most challenging part of the solution.

Possible Actions:

- Increase the frequency of Route 43, although, only within the downtown Poulsbo to Central Market portion of the loop. This would generate a greater transit presence.
- Adjust the route, if necessary, to directly serve the new on-street parking that may occur as discussed in Chapter 2.
- Consider state grant opportunities to defray the costs, as commuter trips may be removed from the roadway. (See TRPP in the CTR section on page 39.)
- Investigate economic development funding options for satellite parking acquisition.
- To reinforce tourist usage, create a Scandinavian theme for the shuttle buses. This would give the impression that the service would benefit the tourists as well as the citizens. An inexpensive method to create such a theme is to use a graphical “wrap” that forms around the outside of the bus. Examples of wraps are the large ads that encompass the entire shells of buses. However, if the wraps are used, the bus may not be able to be used for other routes in the community.

## City Sponsorship of Transit Improvements

A recurring theme within this report is that there is limited funding available for Kitsap Transit to expand upon its current service. This is not a unique circumstance happening in Kitsap County. Most transit systems have to deal with such issues. As with most transit systems, Kitsap Transit aims to recover approximately 25% of its operating costs from fares, with the remaining amount generated from fixed taxpayer subsidies of sales tax and property tax, along with general fund sources.

In Poulsbo, the situation is less encouraging. Fares generate approximately 10% of the operating costs, producing a large void in funding. That void is being met through current financing from Kitsap Transit. However, if any improvements or expansion upon the current transit service in Poulsbo is desired beyond

the normal funding capability of Kitsap Transit, the City may need to partner with Kitsap Transit in locating additional funding sources. For example, if Poulsbo funded a large part or all of the first year of service for a new route or shuttle service, and that new service performed well enough, Kitsap Transit would then consider running that service on their own after the first year.

In essence, the City needs to identify new financial mechanisms in order to realize a significant increase in transit service. Following are examples of potential financial partners:

- City general funds
- Downtown businesses
- Economic development grants
- Trip Reduction Performance Program grants (see the CTR section in chapter 4)
- Other grants
- Addition of satellite parking costs to the TIP as part of TDM strategy to reduce trips from downtown (an eligible mitigation cost under SEPA and GMA)
- Downtown developers who contribute to financing transit operations as substitute mitigation for traffic impacts (an eligible mitigation cost under SEPA)

## Programmatic Cost Estimates

**Cost of transit development:** For preliminary planning of transit development, it is adequate to use the rough value of \$100/hour/bus for operating costs, as seen in **Table 4**. This value of \$100/hour/bus provides an operating cost of roughly \$400,000 per year, for each additional full-time bus. For any given number of new buses, multiply by this rough annual cost.

**Cost of parking lot development:** Parking lot development for satellite parking outside of downtown Poulsbo has three major cost components: land acquisition, surface paving, and environmental mitigation costs. The pavement cost is most predictable while the other two costs are quite variable and depend on the locations. Typical costs for new parking spaces vary from \$5,000 to \$10,000 per space, as surface parking. Parking structures are much more costly, in the range of \$20,000 per stall.

## Recommended Actions

The City of Poulsbo can take the following steps to increase transit ridership in downtown Poulsbo:

- Work with Kitsap Transit to modify route alignments for existing circulation routes in downtown Poulsbo, to better connect potential transit trip generators discussed above, especially future satellite parking areas.
- Encourage Kitsap Transit to increase the frequency of service on downtown routes, with two-way operation of routes in place of existing one-way loops. Additional service requires additional funds.
- Work with Kitsap Transit to locate additional park-and-ride locations for the successful routes to Bainbridge Island Ferry Terminal, especially at sites west of downtown Poulsbo.
- Allow or require developments in downtown Poulsbo to mitigate some or all of their new traffic impacts by financially supporting increased transit operations in downtown Poulsbo, as a transportation demand management action encouraged in the Growth Management Act.
- Add satellite parking lot acquisition and construction to the scope of the Transportation Demand Management project in the current Six-Year Transportation Improvement Program.

## 4. Ridesharing and Other TDM/TSM Activities

In addition to transit, there are many ridesharing-related activities and programs which may also help reduce downtown traffic. When both transit and ridesharing are used in conjunction with one another, total results are increased. The following information contains details about ridesharing-related activities and how they relate with the City of Poulsbo.

### Existing Ridesharing-Related Activities

**Vanpools:** Current vanpool participation is reportedly doing very well in the Poulsbo area. However, there is still an availability of unused vans and seating on vans in use that could be utilized. Details of this program and potential actions to improve it are found on page 41.

**RideshareOnline.org:** Current rideshare interest has been very good in the Poulsbo area. With the current state of the economy, greater numbers of people are signing up. Details of this program and potential actions to improve it are found on page 43.

### Potential Ridesharing-Related Activities

**Commute Trip Reduction (CTR):** CTR is a Washington State program designed to reduce the output of greenhouse gases caused by commuting through the promotion of the use of alternative means of transportation. Poulsbo has currently not implemented the CTR program due to the small size of existing employers.

The CTR Law affects Washington State's nine most populated counties, which include Kitsap County. However, employers are only required to participate in the program if they employ 100 or more people that arrive at work between the hours of 6 and 9 AM. Poulsbo does not have any places of employment that fulfill these requirements; therefore, no place of employment in Poulsbo is required to participate. Even though the requirement does not apply, the City has the option of promoting similar CTR guidelines with the smaller employers found in Poulsbo. The CTR program has proven to be very successful in many other communities by reducing the amount of single-occupancy vehicles on the road by encouraging people to ride the bus, vanpool, carpool, walk, bike, work from home, or compress their workweek. The CTR program works in conjunction with any mode of transportation other than a single-occupancy vehicle, therefore, it is a program that can be easily adopted throughout a broad base of employers.

Benefits of supporting a CTR type of program include the following:

- The City will experience a reduction of vehicular traffic on the road system, while at the same time promoting alternative means of transportation.
- Employers will see reduced demand for parking, which can be a costly investment.
- Employees' expenses to commute to work is reduced.
- Greenhouse gas emissions are reduced, which are a major contributor to global warming.

The idea behind the CTR program is that the employer offers incentives and rewards to those that commute to work via means other than a single-occupancy vehicle. These incentives and rewards may be money, gift cards, physical items, etc. Some examples include the employer offering incentives to the employee for each CTR trip to/from the workplace, or employers offering a reward for those employees that travel 60% or more out of each week by means of CTR. These are just two examples of the limitless number of ways to support commuting that reduces car trips.

For the City to promote their own type of CTR program throughout Poulsbo and raise awareness of such an idea, they may consider helping the businesses offer these types of incentives through monetary support. Some grant money is available that would help the City run such a program - for example, the Trip Reduction Performance Program (TRPP).

The TRPP is a program designed to encourage entrepreneurs, private companies, transit systems, cities, non-profit organizations, developers, and property managers to provide services to employees that result in fewer vehicle trips arriving at worksites. They provide funds every two years to these types groups based on how they intend to reduce vehicle trips. To apply to be a part of the TRPP, the City would need to write a work plan describing their method to reduce vehicular trips and how many trips they expect to reduce. If their request is approved, the City would receive 50% of their expected costs at the beginning as a 'start-up' contribution. At the end of the two-year period, the TRPP would run a performance measure survey to determine if the goals of reduced trips were met or not, and by what percentage they were met. If the City's results of the program are found to be anywhere between 50% and 120% of the original goals, the City would receive that percentage of funds originally planned, minus the initial 50% start-up contribution that was already provided. Any program with results below 50% of the original goal will be able to keep their initial 50% start-up contribution. Any program with results above 120% of the original goal will be provided 120% of the funds originally planned, minus the initial 50% 'start-up' contribution that was already provided. Therefore, bonuses are available to those programs that perform above expectations.

As mentioned previously, the TRPP decides how they will best distribute their funds every two years. The application process to become a part of the program will start as early as January 2009, and the members selected to participate in the program will possibly be announced by the end of March 2009. The next two years of the program will commence on July 1, 2009. If interested, the City should contact the TRPP Program Manager, Hiep Tran, at 360.705.7806.

**Guaranteed Ride Home Program:** This program aims to eliminate the worries of traveling to work without your personal vehicle, and during the day experiencing a change of plans that would leave you stranded without a ride home. The Poulsbo area does not have a Guaranteed Ride Home program.

Through alleviating the worry of being stranded at work without a ride home, the Guaranteed Ride Home program provides peace of mind to commuters, which results in a further reduction of vehicles on the roadway. There are many causes of being stranded at work, some of which may be that you or a family member became ill, your carpool partner had to leave early, your supervisor asked you to work late, etc.

Currently Kitsap Transit supports the Guaranteed Ride Home program with an agreement with the local taxi companies to pay the taxi fare to send a person home. For the City to help support the Guaranteed Ride Home program, they could raise awareness of the service within the community and amongst employers, as well as provide financial support to Kitsap Transit.

Just like the CTR program, the Guaranteed Ride Home program works in conjunction with all other alternative modes of transportation.

**Worker/Driver Buses:** Worker/driver buses could be considered a cross between transit buses and vanpools. They incorporate the large capacity of transit buses with the single vehicular trip associated with vanpools. Worker/driver buses are currently not operating to or from Poulsbo.

The idea behind worker/driver buses is similar to vanpools, except that they supply a much larger demand (seating for up to 45 passengers), and the driver of the worker/driver bus is a regular commuter and an employee of Kitsap Transit; therefore, the driver gets paid roughly \$15 per hour for their time spent commuting to work.

For Poulsbo to incorporate worker/driver buses within the city, the City would need to demonstrate a large employment center that would fill the demand needed for the buses. If the demand is there, Kitsap

Transit would be willing to support this program in Poulsbo, depending on their budget. A possible area to search for demand would be Poulsbo commuters traveling to employers to the west.

If the worker/driver bus is not plausible, the next option to consider would be vanpools, as they range in size from 8 to 15 passengers.

**Vanpools:** Vanpools are very well-used in the Poulsbo area, although, there are still extra vans available. These extra vans provide an opportunity for the City to promote greater use of vanpools.

Vanpools consist of 8-, 12-, and 15-passenger vans which provide commuters an alternative to buses. The service matches up fellow commuters that have similar routes of travel. Each day the van completes one trip to work and one trip to the commuters' homes. Often times, the participants in one vanpool are all from a common place of employment, making the process convenient. One of these commuters becomes the designated voluntary driver for the group.

To begin a vanpool group and have it considered viable, there must be enough demand from half the capacity of a certain van plus one person. For example, to begin a vanpool group in a 12-passenger van, it would require the demand from half of 12 plus one – which is 7 people. Therefore, it is possible that there is an amount of demand in Poulsbo that is not being met by vanpools as it does not meet the demand requirements.

When the demand falls short of the requirements, the City has several options to help. These options could be enacted separately or in combination with one another.

The first option is for Poulsbo to publicize and advertise vanpools to get the word out to those that are not informed of the program.

The second option is for Poulsbo to provide an incentive to commuters to ride vanpools by designating popular and convenient parking locations for vanpools only. Kitsap Transit would be able to help such a program by providing the needed placards at the parking locations.

The third option would be for the City to work with Kitsap Transit to temporarily cover the costs of the unmet demand. The thought behind this idea is that it would provide a jumpstart to a vanpool group that is just below its demand requirements in hopes that it would soon reach the demand. Kitsap Transit stated that Poulsbo would pay for the 'lost fares' below the "half plus one" demand requirement. Kitsap Transit would allow Poulsbo to operate a new vanpool group in such a way for two months before the demand requirements would be enforced. The fares that would need to be covered are variable depending on the average trip length of the vanpool and the size of the van. This option brings forward the question of whether or not it is worth the risk to pay for up to two months of a fare and in return possibly receive a new vanpool group that will take multiple vehicles off of Poulsbo's streets.

Incentives for Poulsbo to promote the use of vanpools include the following:

- There are no operator salaries to pay, as the drivers are voluntary commuters. This is a significant point of difference compared to transit buses and worker/driver buses.
- The service runs only once during the morning commute and once during the afternoon commute, thereby eliminating the operating costs of running a bus during the non-peak hour times of the day when the service is not as well utilized.

**SCOOT:** SCOOT (Smart Commuter Option of Today) is a program run by Kitsap Transit to provide commuters that use alternative modes of transportation with a vehicle free of charge to perform daily errands when needed. The SCOOT program does not currently operate in Poulsbo.

The goal of this program is to reduce the number of single-occupancy vehicles that are brought to work based on the sole need to accomplish personal errands during the workday, such as doctor appointments. As this program is geared toward commuters with safe driving records, it requires users to apply before

using the service. In addition, any use of the cars requires 24 hours notice. Only commuters that do not drive to work in their own car are allowed to use this free service.

Kitsap Transit has their SCOOT program operating in five locations in Kitsap County, none of which are in Poulsbo. These five locations were chosen because they have CTR-qualified employment centers in close proximity, which provides a large density of car-free commuters to take advantage of the service. As mentioned previously, Poulsbo does not have any CTR-qualified employment centers; therefore, Kitsap Transit does consider Poulsbo to have an immediate demand for such a program.

Even though Kitsap Transit will not place a SCOOT car in service in a non-CTR area, they are willing to help out by way of other means. This provides Poulsbo with the option to start a similar SCOOT program on its own, invest in a car, and pay for the associated expenses. If Poulsbo were to choose this option, Kitsap Transit would provide Poulsbo access to their computer software online reservation system for use with their ‘customers.’

If Poulsbo went ahead and pursued this program, which then ended up performing well and was met with high demand, Kitsap Transit would then be willing to help out financially in the future.

**Zipcar:** Similar to the SCOOT idea, a Zipcar is a community vehicle used when ‘needed’, however, this private for-profit program allows anyone to participate and is not free to the user. Zipcars are currently not available in Poulsbo, as the company is first targeting large metropolitan areas and universities.

Zipcar (formerly Flexcar) is a company that offers vehicles for rental on short time intervals. They scatter the cars around neighborhoods that are densely populated, have low car ownership rates, and have high costs of parking. It is this criterion which is considered when expanding into new markets. In the near future, the ideal markets for Zipcar mainly consist of the major metropolitan areas and universities. When expanding to universities, Zipcar considers that expansion to be a remote location as it is away from its hub of metropolitan centers. If Poulsbo were considered as a possible location of expansion for Zipcar, it would best fit the description of a remote location.

If Poulsbo were interested in attracting Zipcar to the area, they would need to first seek a University Partnership. Even though Poulsbo is not within the immediate future plans of Zipcar, the company is open to the idea that an expansion would work. To pursue this opportunity, Poulsbo would have to provide Zipcar with a scope that demonstrates a need for the cars, risk sharing, and dedicated staff.

The ‘need for the cars’ portion would contain detailed information of the area’s population density, car ownership rates, and costs of parking.

The ‘risk sharing’ portion would provide information regarding Zipcar’s revenue guarantee. As Zipcar is a private for-profit company, they expect each car to make a profit. The revenue guarantee would be an agreement with Zipcar guaranteeing that each car would receive a certain amount of revenue – with the difference being subsidized by the third party that had an interest in the vehicles.

As Poulsbo would be considered a remote location, the City should be able to provide a dedicated staff member to maintain the Zipcar vehicles. This information would provide the ‘dedicated staff’ portion of the scope.

When Zipcar expands to remote locations, they prefer to place between 30 and 40 vehicles in close proximity.

Overall, Poulsbo is not in the near future for Zipcar as the company is focusing on major metropolitan centers and universities first. However, if interest is high enough and quality data is shown which would support the idea of Zipcar expansion into Poulsbo, the possibility is there. For Poulsbo, this is probably the riskiest option available, because the reduction of traffic would not be as significant as other alternatives, as Zipcars do not necessarily replace single-occupancy vehicles.

**RideshareOnline.org:** RideshareOnline.org is a service provided to create carpools by matching commuters together with other commuters that have similar routes and similar time schedules. Poulsbo is currently included in RideshareOnline.org.

This service is meant more for matching interests than providing a physical service, and as such, Poulsbo is limited in its ways of providing support. One option available for Poulsbo to improve this service is to increase awareness of RideshareOnline.org by promoting this program. This option is an inexpensive way to increase the use of alternative methods of transportation in Poulsbo.

**Kitsap Transit:** Kitsap Transit is willing to visit Poulsbo and put on a free ‘Transit Fair’ to inform the public of the many options of transportation available to them. This Transit Fair would serve many purposes, from informing the public of what is available – to having the public inform Kitsap Transit of their wishes. This would be a beneficial session for everyone involved.

## **Recommended Actions**

The City of Poulsbo can take the following steps to increase ridesharing activities to benefit downtown Poulsbo:

- Work with RidesharOnline.org to obtain and distribute publicity information to all Poulsbo residents concerning the availability of carpool and vanpool opportunities for commuters.
- Work with Kitsap Transit to obtain and distribute publicity information to all Poulsbo residents concerning the availability of existing vanpools for commuting to jobs in west Kitsap County.
- Work with Kitsap Transit to explore the possibility of developing a worker-driver bus route between Poulsbo residences and a major employer in west Kitsap County.

# APPENDIX A – TRAFFIC CALMING MEASURES

(Source: ITE.org)

A series of fact sheets providing an overview of several traffic calming measures are included in this appendix. Photographs of typical applications as well as plan-view sketches adapted from the Boulder, Colorado *Neighborhood Traffic Mitigation Program Toolkit* are included.

Four types of measures are summarized:

**Vertical deflections**, **horizontal shifts**, and **roadway narrowing** are intended to reduce speed and enhance the street environment for non-motorists.

**Closures** (diagonal diverters, half closures, full closures, and median barriers) are intended to reduce cut-through traffic by obstructing traffic movements in one or more directions.

## Vertical Deflections



Speed Hump



Speed Table



Raised Intersection

## Horizontal Shifts



Neighborhood Traffic Circle



Chicane

### Roadway Narrowing



Choker

### Closures



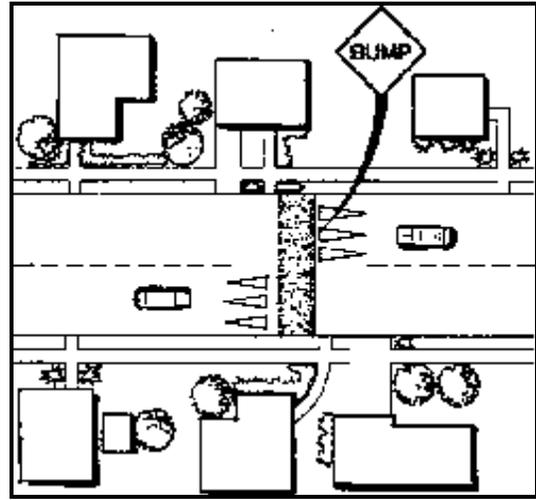
Closure



Center Island Narrowing

The information provided above has been obtained from the research and experience of transportation engineering and planning professionals. The information is intended for informational purposes only and does not include ITE or FHWA recommendations on the best course of action.

## Traffic Calming Measures – Speed Hump



### Description:

- rounded raised areas of pavement typically 12 to 14 feet in length
- often placed in a series (typically spaced 300 to 600 feet apart)
- sometimes called road humps or undulations

### Applications:

- residential streets
- not typically used on major roads, bus routes, or primary emergency response routes
- mid-block placement, not at an intersection
- not on grades greater than 8 percent
- work well with curb extensions

### Design/Installation Issues:

- typically 12 to 14 feet in length; other lengths (10, 22, and 30 feet) reported in practice in the U.S.
- speed hump shapes include parabolic, circular, and sinusoidal
- hump heights range between 3 and 4 inches with trend toward 3 - 3 ½ inches maximum
- difficult to construct precisely; may need to specify a construction tolerance (e.g.  $\pm 1/8$  inch) on height
- often have signage (advance warning sign before first hump in series and warning sign or object marker at hump)
- typically have pavement marking (zigzag, shark's tooth, chevron, zebra)
- taper edge near curb to allow gap for drainage
- some have speed advisories
- bicyclists prefer that it not cover or cross a bike lane

**Potential Impacts:**

- no effect on non-emergency access
- speeds determined by height and spacing; speeds between humps have been observed to be reduced between 20 and 25 percent on average
- based on a limited sample of sites, typical crossing speeds (85th percentile) of 19 mph have been measured for 3½ inch high, 12 foot humps and of 21 mph for 3 inch high, 14 foot humps; speeds have been observed to rise to 27 mph within 200 feet downstream
- speeds typically increase approximately 0.5 mph midway between humps for each 100 feet of separation
- studies indicate that traffic volumes have been reduced on average by 18 percent depending on alternative routes available
- studies indicate that collisions have been reduced on average by 13 percent on treated streets (not adjusted for traffic diversion)
- most communities limit height to 3-3½ inches, partly because of harsh ride over 4-inch high humps
- possible increase in traffic noise from braking and acceleration of vehicles, particularly buses and trucks

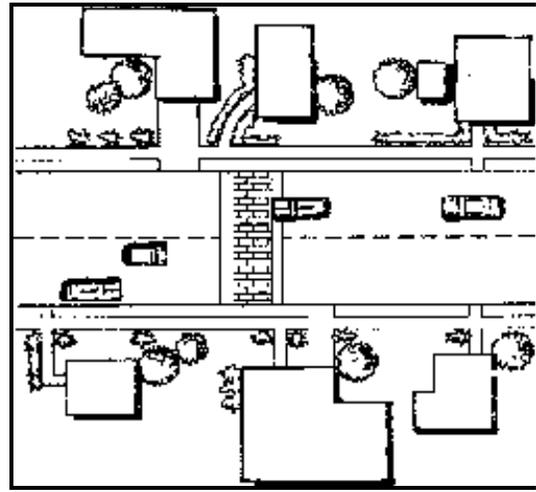
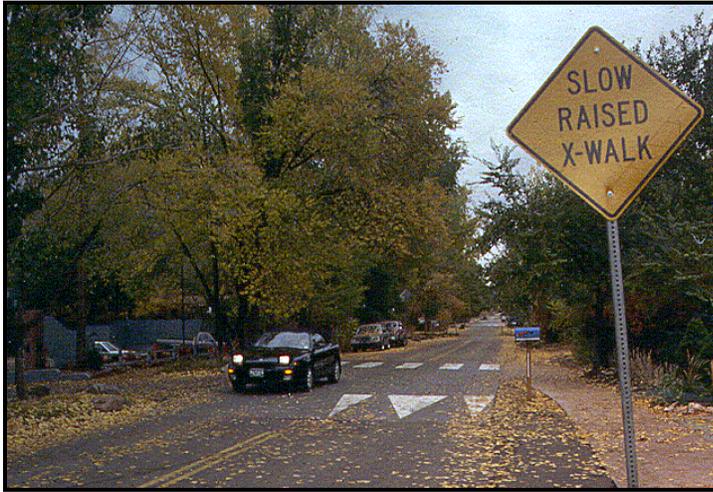
**Emergency Response Issues:**

- Concern over jarring of emergency rescue vehicles
- Approximate delay of between 3 and 5 seconds per hump for fire trucks and up to 10 seconds for ambulance with patient

**Typical Cost:**

- Approximately \$2,000 (1997 dollars)

## Traffic Calming Measures – Speed Table



### Description:

- long raised speed humps with a flat section in the middle and ramps on the ends; sometimes constructed with brick or other textured materials on the flat section
- sometimes called flat top speed humps, trapezoidal humps, speed platforms, raised crosswalks, or raised crossings

### Applications:

- local and collector streets
- main roads through small communities
- typically long enough for the entire wheelbase of a passenger car to rest on top
- work well in combination with textured crosswalks, curb extensions, and curb radius reductions
- can include a crosswalk

### Design/Installation Issues:

- typically 22 feet in the direction of travel with 6 foot ramps on each end and a 10 foot flat section in the middle; other lengths (32 and 48 feet) reported in U.S. practice
- most common height is between 3 and 4 inches (and reported as high as 6 inches)
- ramps are typically 6 feet long (reported up to 10 feet long) and are either parabolic or linear
- careful design is needed for drainage

### Potential Impacts:

- no effect on access
- speeds are reduced, but usually to a higher crossing speed than at speed humps (typically between 25 and 27 miles per hour)
- traffic volumes have been reduced on average by 12 percent depending on alternative routes available
- collisions have been reduced on average by 45 percent on treated streets (not adjusted for traffic diversion)

- reported to increase pedestrian visibility and likelihood that driver yields to pedestrian

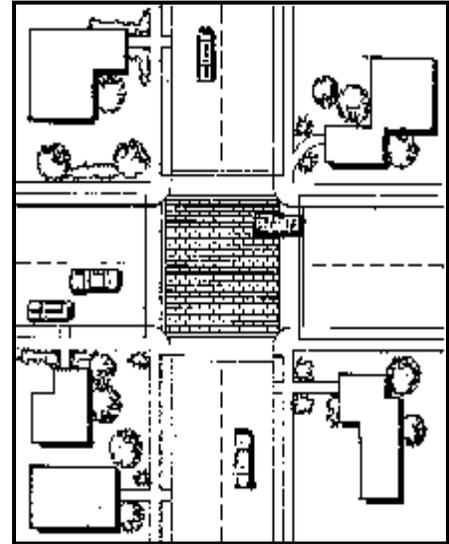
**Emergency Response Issues:**

- typically preferred by fire departments over 12 to 14-foot speed humps
- generally less than 3 seconds of delay per hump for fire trucks

**Typical Cost:**

- approximately \$2,500 (in 1997 dollars) for asphalt tables; higher for brickwork, stamped asphalt, concrete ramps and other enhancements sometimes used at pedestrian crossings

## Traffic Calming Measures – Raised Intersection



### Description:

- flat raised areas covering entire intersections, with ramps on all approaches and often with brick or other textured materials on the flat section and ramps
- sometimes called raised junctions, intersection humps, or plateaus

### Applications:

- work well with curb extensions and textured crosswalks
- often part of an area wide traffic calming scheme involving both intersecting streets
- in densely developed urban areas where loss of parking would be unacceptable

### Design/Installation Issues:

- typically rise to sidewalk level
- may require bollards to define edge of roadway
- Canadian installations typically have gentle 1:40 slopes on ramps
- storm drainage modifications are necessary

### Potential Impacts:

- reduction in through movement speeds at intersection
- reduction in mid-block speeds typically less than 10 percent
- no effect on access
- make entire intersections more pedestrian-friendly
- no data available on volume or safety impacts

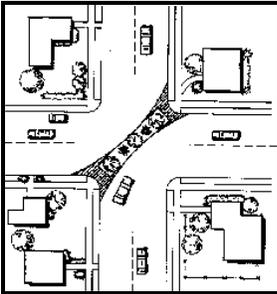
### Emergency Response Issues:

- slows emergency vehicles to approximately 15 miles per hour

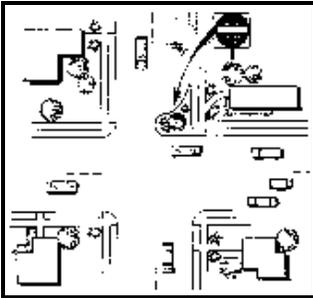
**Typical Cost:**

- reported costs range between \$15,000 and \$50,000 (1997 dollars)

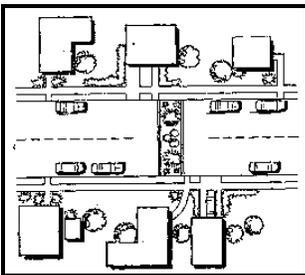
## Traffic Calming Measures – Closure



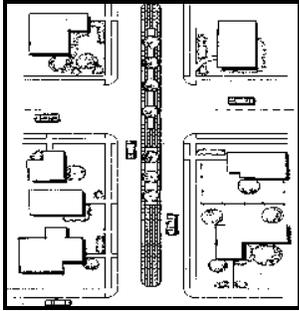
**Diagonal diverters** are barriers placed diagonally across an intersection, blocking through movement; they are sometimes called full diverters or diagonal road closures



**Half closures** are barriers that block travel in one direction for a short distance on otherwise two-way streets; they are sometimes called partial closures, entrance barriers, or one-way closures (when two half-closures are placed across from one another at an intersection, the result is a semi-diverter)



**Full-street closures** are barriers placed across a street to completely close the street to through-traffic, usually leaving only sidewalks open; they are sometimes called cul-de-sacs or dead-ends



**Median barriers** are raised islands in the centerline of a street and continuing through an intersection that block the left turn movement from all intersection approaches and the through movement at the cross street

#### **Applications:**

- closures are typically applied only after other measures have failed or have been determined to be inappropriate
- for all types of closures, provisions are available to make diverters passable for pedestrians and bicyclists
- often used in sets to make travel through neighborhoods more circuitous - typically staggered internally in a neighborhood, which leaves through movement possible but less attractive than alternative (external) routes
- closures have been used as a crime prevention tool

#### **Design/Installation Issues:**

- there may be legal issues associated with closing a public street
- can be placed at an intersection or mid-block
- barriers may consist of landscaped islands, walls, gates, side-by-side bollards, or any other obstruction that leaves an opening smaller than the width of a passenger car

#### **Potential Impacts:**

- concern over effects on emergency response, street network connectivity and capacity, and parallel local streets that carry diverted traffic
- may divert significant traffic volumes
- no significant effect on vehicle speeds beyond the closed block

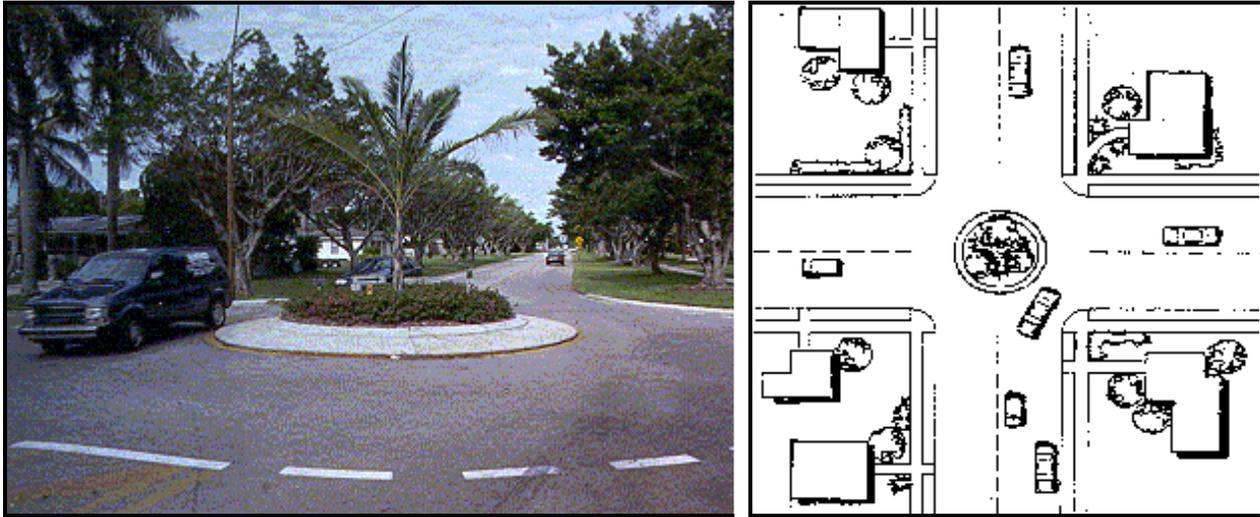
#### **Emergency Response Issues:**

- half closures allow a higher degree of emergency vehicle access than full closures or diagonal diverters
- all three types of closures can be designed to allow emergency vehicle access

#### **Typical Cost:**

- costs range between \$2,000 for a simple half-closure and \$35,000 for highly-landscaped diagonal diverter

## Traffic Calming Measures – Neighborhood Traffic Circle



### Description:

- raised islands, placed in intersections, around which traffic circulates
- motorists yield to motorists already in the intersection
- require drivers to slow to a speed that allows them to comfortably maneuver around them
- sometimes called intersection islands
- different from roundabouts

### Applications:

- intersections of local or collector streets
- one lane each direction entering intersection
- not typically used at intersections with high volume of large trucks and buses turning left

### Design/Installation Issues:

- typically circular in shape, though not always
- usually landscaped in their center islands, though not always
- often controlled by YIELD signs on all approaches, but many different signage approaches have been used
- key design features are the offset distance (distance between projection of street curb and center island), lane width for circling the circle, the circle diameter, and height of mountable outer ring for large vehicles such as school buses and trash trucks

### Potential Impacts:

- no effect on access
- reduction in mid-block speed of about 10 percent; area of influence tends to be a couple hundred feet upstream and downstream of intersection
- only minimal diversion of traffic

- intersection collisions have been reduced on average by 70 percent and overall collisions by 28 percent
- can result in bicycle/auto conflicts at intersections because of narrowed travel lane

**Emergency Response Issues:**

- emergency vehicles typically slow to approximately 13 mph; approximate delay of between 5 and 8 seconds per circle for fire trucks
- fire trucks can maneuver around traffic circles at slow speeds provided vehicles are not parked near the circle

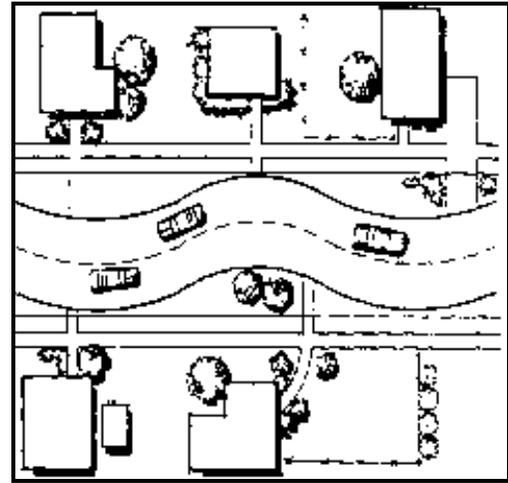
**Other/Special Considerations:**

- large vehicles may need to turn left in front of the circle (which could be unsafe at higher volumes); legislation may be required to legally permit this movement
- quality of landscaping and its maintenance are key issues
- landscaping needs to be designed to allow adequate sight distance
- care must be taken to avoid routing vehicles through unmarked crosswalks on side-street approach

**Typical Cost:**

- approximately \$3,500 to \$15,000 (1997 dollars)

## Traffic Calming Measures – Chicane



### Description:

- a series of narrowings or curb extensions that alternate from one side of the street to the other forming S-shaped curves
- also called deviations, serpentes, reversing curves, twists, and staggerings

### Applications:

- appropriate for mid-block locations only
- most effective with equivalent volumes on both approaches
- typically, is a series of at least three curb extensions
- can use on-street parking to create chicane

### Design/Installation Issues:

- unless well-designed, chicanes may still permit speeding by drivers cutting straight paths across the center line
- European manuals recommend shifts in alignment of at least one lane width, deflection angles of at least 45 degrees, and center islands to prevent drivers from taking a straight "racing line" through the feature

### Potential Impacts:

- no effect on access
- limited data available on their effect on speed, volume, and collisions
- street sweeping may need to be done manually
- can impact parking and driveway access
- provides opportunity for landscaping

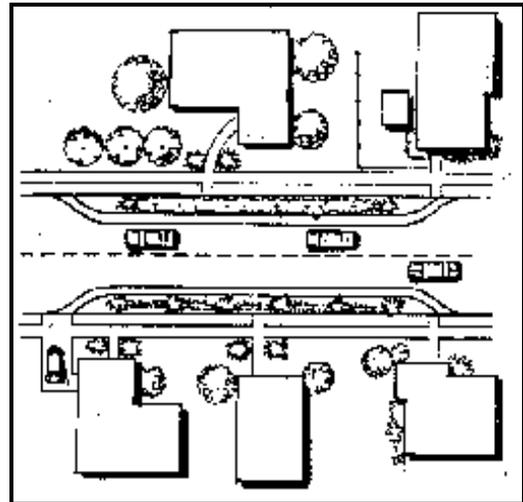
### Emergency Response Issues:

- limited data available on their effect on delay to emergency response
- emergency response typically prefer two-lane chicanes to speed humps

**Typical Cost:**

- reported costs range between \$5,000 and \$15,000 (1997 dollars)

## Traffic Calming Measures – Choker



### Description:

- curb extensions at mid-block or intersection corners that narrow a street by extending the sidewalk or widening the planting strip
- can leave the cross section with two narrow lanes or with a single lane
- at mid-block, sometimes called parallel chokers, angled chokers, twisted chokers, angle points, pinch points, or mid-block narrowings
- at intersections, sometimes called neckdowns, bulbouts, knuckles, or corner bulges
- if marked as a crosswalk, they are also called safe crosses

### Applications:

- local and collector streets
- pedestrian crossings
- main roads through small communities
- work well with speed humps, speed tables, raised intersections, textured crosswalks, curb radius reductions, and raised median islands

### Design/Installation Issues:

- some applications use an island which allows drainage and bicyclists to continue between the choker and the original curb line
- typically designed to narrow road to 20 feet for two-way traffic; typically avoid the use of widths between 13 and 17 feet
- adequate drainage is a key consideration
- provides opportunity for landscaping
- vertical delineators, bollards or object markers are often used to make visible to snowplow operators

### Potential Impacts:

- can impact parking and driveway access

- reduces pedestrian crossing width and increases visibility of pedestrian
- speeds have typically been reduced on average by 4 percent for two-lane chokers and 14 percent for one lane chokers
- minor decrease in traffic for two-lane and 20 percent reduction for one-lane chokers
- collision data not available
- bicyclists prefer not to have the travel way narrowed into path of motor vehicles

**Emergency Response Issues:**

- preferred by many fire department/emergency response agencies to most other traffic calming measures

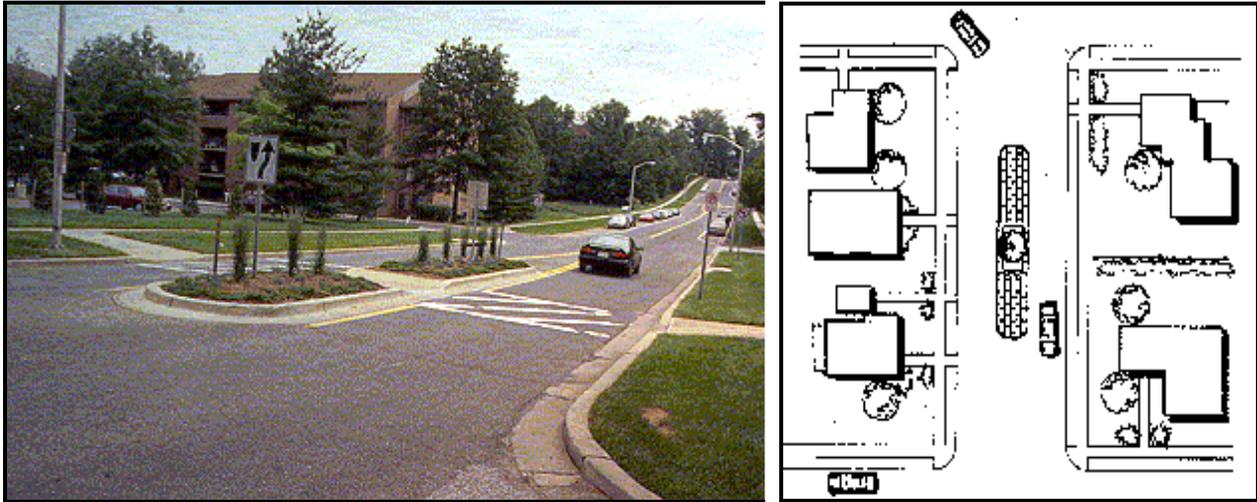
**Other/Special Considerations:**

- one-lane chokers rely on regulatory signs and driver courtesy to work

**Typical Cost:**

- approximately \$7,000 to \$10,000 (1997 dollars)

## Traffic Calming Measures – Center Island Narrowing



### Description:

- raised islands located along the centerline of a street that narrow the travel lanes at that location
- sometimes called mid-block medians, median slow points, or median chokers

### Applications:

- are often nicely landscaped to provide visual amenity and neighborhood identity
- can help pedestrianize streets by providing a mid-point refuge for pedestrian crossings
- sometimes used on wide streets to narrow travel lanes
- work well when combined with crosswalks

### Potential Impacts:

- may reduce parking and driveway access
- reduces pedestrian crossing width
- may visually enhance the street through landscaping but may also limit visibility of pedestrian crossings
- bicyclists prefer not to have the travel way narrowed into path of motor vehicles
- collision, speed and volume data are not available

### Emergency Response Issues:

- preferred by fire department/emergency response agencies to most other traffic calming measures

### Typical Cost:

- reported costs range between \$5,000 and \$15,000 (1997 dollars)