Introduction

The goal of this plan is to implement sustainable solutions to the transportation needs of Wallingford neighborhood. Sustainability is here defined as primarily those transportation initiatives that will ultimately lead to a lower environmental impact, especially in terms of CO2 output. Additional focus is on ways changes in land use, transit, and technology can leverage improvements in livability and social equity.
A sustainable neighborhood must also be a pleasant and vibrant place for people to live. The creation of livable cities is a vital part of any sustainability plan, both for the goal of livability itself, and for the ability for great places to be an inducement to sustainable development. With this in mind, we will strive to make a plan that puts the needs of people first, envisioning a place where walkabilty, safety and the human environment are truly of primary importance.

Wallingford Neighborhood – Background

Annexed to Seattle in 1891 the neighborhood of Wallingford is located on a low hill that overlooks Lake Union to the South, is bounded by Highway 99 to the west and I-5 to the east, and blends into the Greenlake neighborhood in the north. Its location on Lake Union made it accessible by water to early settlers in Seattle, and was likely a settled area long before Europeans arrived. After annexation the neighborhood developed a mix of single family homes, a few minor commercial zones, and medium to heavy industry along the shoreline. A lakeshore railway is a remnant of this industrial legacy, and has since been re-purposed as the Burke-Gilman Trail. The extension of streetcars into the area in the early 19th century brought closer integration to downtown and to surrounding communities of Fremont, Greenlake, and the University District. This extensive streetcar system left its mark on the neighborhood, helping to create a scale and pattern of development that subsequent decades of automobile dependence could not entirely erase.

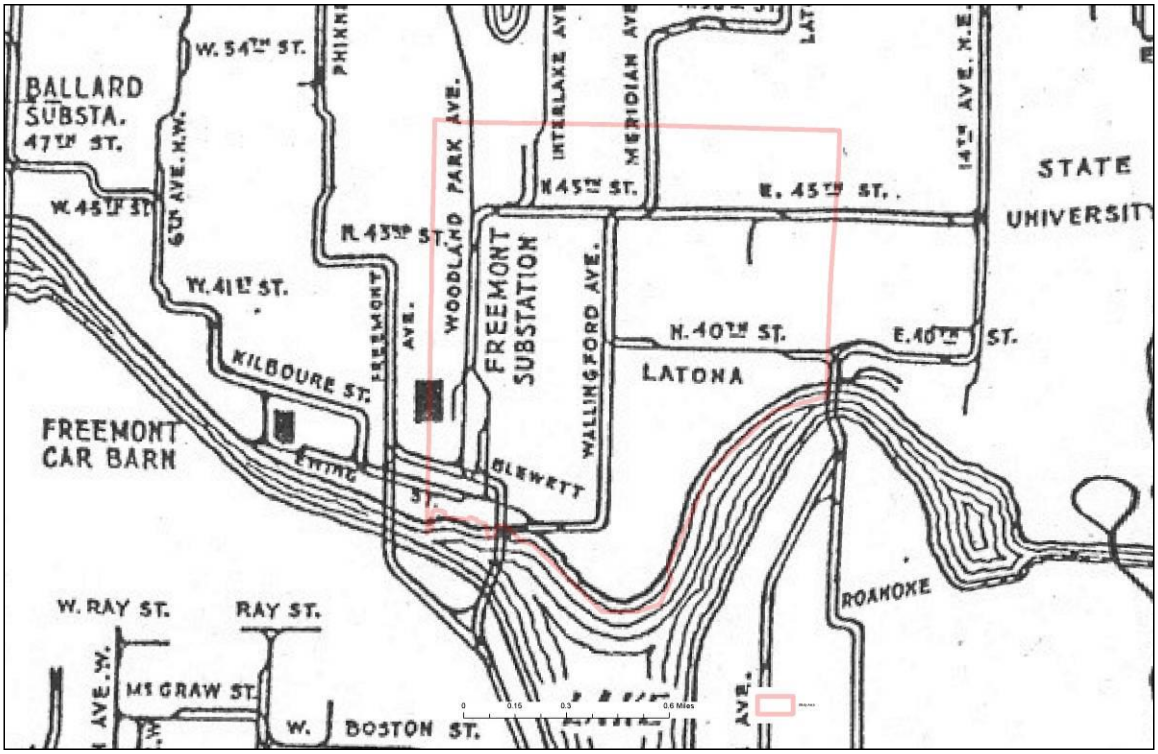

Figure 1--Streetcar Network near Wallingford, 1915

Remnants of the streetcar system can be seen in some of the wide rights-of-way still found in Wallingford and throughout Seattle. As typical of early 20th-Century streetcar suburbs, Wallingford is still made up largely of single family homes, most of them built in the early to mid 1900's.

The rapid growth of Seattle and the region has had substantial impacts on the neighborhood. Two major regional transportation corridors, Highway 99 to the east and I-5 to the west, were constructed in 1936 and 1932, respectively.

Figure 2--Aerial Photo Showing Recently Constructed Highway 99, 1936

The construction of these corridors meant large swathes of housing stock were eliminated outright and non-automotive access to neighboring communities was seriously degraded. Symbolic of this lack of access is the lonely pedestrian bridge crossing Hwy-99 at 43rd street, as well as the unappealing bridges over I-5 at 45th and 50th streets.

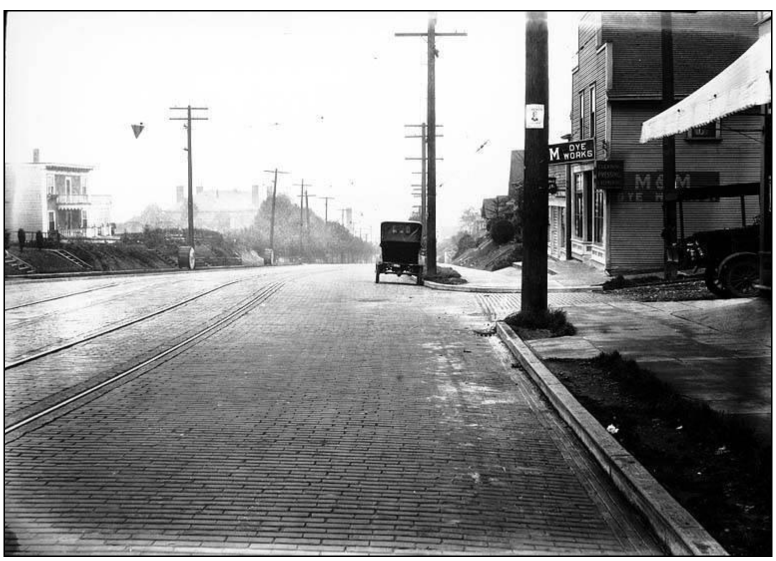

Figure 3—Lovely

A result is that while Wallingford itself remains a fairly attractive neighborhood to pedestrians and bikers, it poses something of an obstacle to through traffic along its east-west axis.

In spite of these obstacles Wallingford's location and geography makes it an important east-west transit corridor in a city that suffers from significant obstacles to movement along that axis. Bordered on the south by Lake Union and on the north by Green Lake, traffic is funneled onto 45th and 50th streets. Large volumes of traffic flow along these arterials during peak times, especially from the Ballard and Green Lake areas.

Figure 4--Lonely

These same lakes that constrict cross-town traffic also serve to shelter the neighborhood from traffic to and from downtown, which is largely contained to I-5 and Highway 99. What results is a somewhat "bi-polar" neighborhood that hosts a great deal of commuter traffic during peak hours, but has in fact a somewhat suburban rhythm in between commutes.

Seattle Neighborhoods Plan-1999

The Wallingford Neighborhood plan developed as a response to Washington Sate's Growth Management Act and represented an attempt to retain the original character of the neighborhood while preparing for significant future growth. Areas designated as the Wallingford Urban Village were rezoned to increase density and create commercial activity within walking distance of neighborhood residents. The transportation component of the plan relied on traffic calming and other modest adjustments to the layout of the main East-West corridors. While this has had little impact on overall congestion, it has made time spent trapped in Wallingford's traffic less stressful. Much of the spirit of community involvement that led to the successful creation of the plan still exists and presents both an opportunity, and potential obstacle, to implementation of further neighborhood development plans.

Wallingford in Context-Neighboring Communities and Connections

This plan focuses both on improvements to transit and land-use within the neighborhood itself, as well as improving connections to neighboring communities to more efficiently serve those transit needs. What follows is a short list of the more significant generators of traffic to, from, and through Wallingford neighborhood along with potential transit options.

- University District - Immediately east of Wallingford across I-5 with three access points at 50th, 45th, and below the Ship Canal bridge (including Burke Gilman trail). This is a very dense neighborhood dominated by the UW with its 29,000 employees[1] and 41,000 students[2], many of whom commute through Wallingford, or even live there. Wallingford and the U-District were once closely connected communities until the construction of I-5 effectively separated them. Reestablishing contact over (or under) I-5 is a clear opportunity to increase the use of alternate modes of transportation - especially for pedestrians and bicyclists.
- Fremont - West of Wallingford separated by Hwy-99 but easily accessible along the shoreline below the highway as well as at 40th street. A well known and much visited neighborhood with good access to Downtown. Hosts a significant IT industry and healthy nightlife. Historically this was Wallingford's connection to downtown via the streetcar system. Renewed interest in streetcars is an opportunity to begin to rebuild some of this highly effective network.

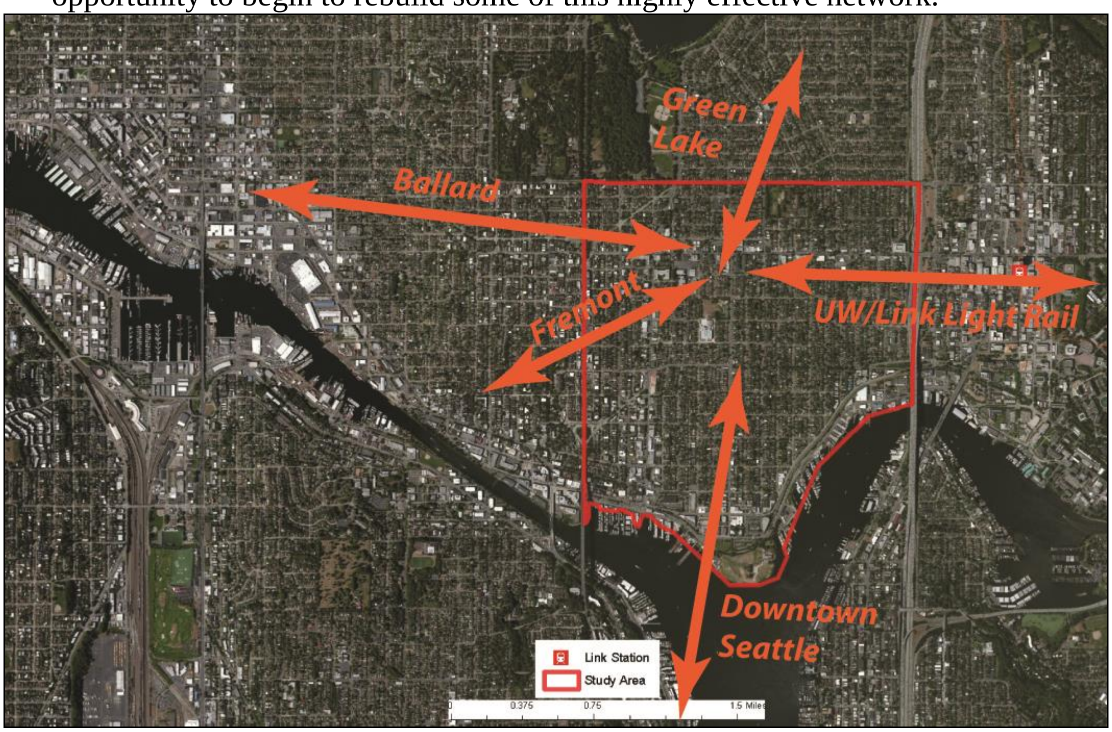

Figure 5--Important Local Neighborhood Connections

[1] University of Washington Fact Book, Autumn Quarter 2010
[2] University of Washington Fact Book, 2011 enrollment

- Ballard - A large mixed residential/industrial/fishing community at the western edge of the city. Has good access both north and south including a direct route to downtown). A significant volume of traffic through Wallingford originates in Ballard, some of which would be alleviated by the extension of light rail from the U-district west to Ballard.
- Green Lake- Popular residential community to the North. Has fairly good access to both Hwy-99 and I-5. Improvements to pedestrian and bicycle access across 45th and 50th would help increase use of those modes to access the University and Fremont neighborhoods.
- Downtown - easy access (under 5 minutes under most circumstances) by either Hwy-99 or I-5 makes Wallingford an ideal residence for downtown workers and a logical place for high-density development. Easy access by automobile poses a challenge to alternate modes of downtown directed traffic which would most effectively overcome by increased parking rates and/or congestion pricing.
- Eastside- Wallingford proximity to the 520 floating bridge (the closest northbound exit on I-5) means that a significant amount of cross lake traffic originates in the Wallingford area, or passes through the neighborhood from communities further west. The establishment of alternate modes across Lake Washington, especially light rail, would significantly reduce automobile traffic through the neighborhood.

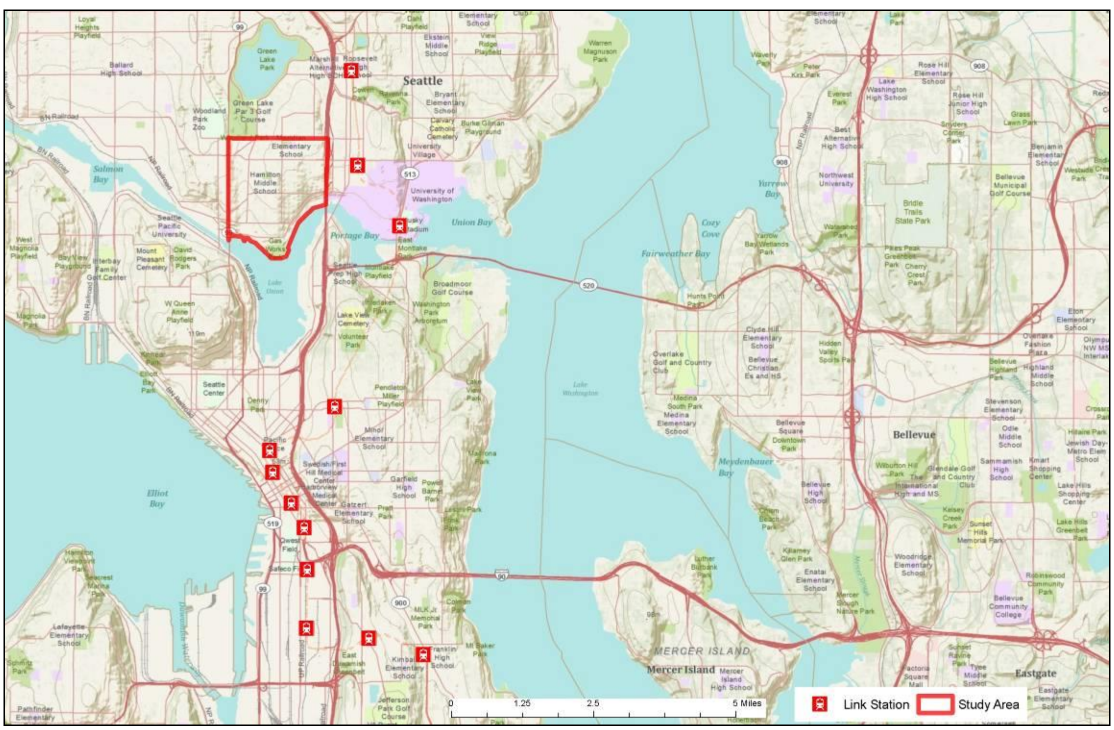

Figure 6--Wallingford in the Regional Context

Land Use

Connecting Land Use to a Transportation Plan

A successful transportation plan must take land use and density into account. Transit-appropriate land use requires population densities in the service area that will ensure the usage of the transportation system. In a 2004 report for the City of Seattle, Nelson\Nygaard Consulting Associates states that "…when residential densities surpass a threshold of approximately 12 – 16 persons per acre…transit ridership approaches a level that would support the levels of service proposed…"[3] The 12-16 persons per acre should be considered the low end of density for an effective transit network, and is considered to have "good levels of transit ridership" in the report. To attain "very good levels of transit ridership", a density level above 20 persons per acre should be in place. These statements are backed up by studies such as one by Kenworthy & Laube, which states that "…higher urban density…is consistently associated with lower levels of car ownership and car use, higher levels of transit use, and lower total costs of operating urban passenger transportation systems"[4].

Goals

According to the 2000 US Census data, the density of Wallingford census tracts is between 12.2 and 18 persons per acre[5]. At this level, the densities in relation to transit service in the Wallingford study area are, according to the Nelson\Nygaard criteria, "good". The goal of the Land Use portion of this project is to create the potential for densities in Wallingford that are "very good" according to the Nelson\Nygaard ranking. The goal for potential density within the study area would therefore be greater than 20 persons per acre. We will attempt to reach this goal through revisions to the zoning within the study area.

Limitations of this Project

This project meant to show what would be an ideal direction for the enhancement of transit and reduction of Single Occupancy Vehicles in Wallingford. Any real plan for zoning changes would involve outreach and consultation with neighborhood residents and business owners. Because of the nature of this final project, local residents were not consulted and neighborhood desires were not taken into account.

Preparing Wallingford Land Use to Enhance Transportation

There are several rules we set up to guide the land-use decisions.

- Tie improvements in transit to neighborhood acceptance of greater density.
    - This is a critical issue. Without greater density, transit cannot be used as effectively.

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[3] City of Seattle, *Seattle Transit Network Development Plan,* Nelson\Nygaard, 2004

[4],J. R. Kenworthy and F.B. Laube. *Patterns of Automobile Dependence in Cities: An International Overview of Key Physical and Economic Dimensions with Some Implications for Urban Policy*. Institute for Science and Technology Policy, Murdoch University, 1999

[5] City of Seattle Strategic Planning Office map, *Population Density by Census Tract*, April 11, 2001.

- Identify corridors within the neighborhood to focus transit improvements.
    - Emphasize multi-use and/or multi-family development along transit corridors--upzone from single family along these corridors.
- Promote land uses that will encourage stronger non-motorized connections across I-5 and Hwy 99, specifically to enhance access to adjacent neighborhoods and institutions (UW).
- Strive to have less than a half-mile between transit lines and any parcel within Wallingford.

Current Zoning and Land Use

The current zoning in Wallingford is dominated by single-family use, with 57% of the zoned area reserved for single-family, detached housing. This puts a strict limit on the potential to create density in the neighborhood. Areas zoned for denser development lie primarily along Stone Way, N 45th Street and N 35th Street. There are small isolated patches of denser zoning throughout the neighborhood, which currently provide opportunities for cafes, small grocery stores and other local businesses.

As mentioned in the *Identifying Corridors* section below, the land use along much of these areas zoned for denser development is currently underutilized. This provides modest opportunities for some transit-oriented development without changes to current zoning.

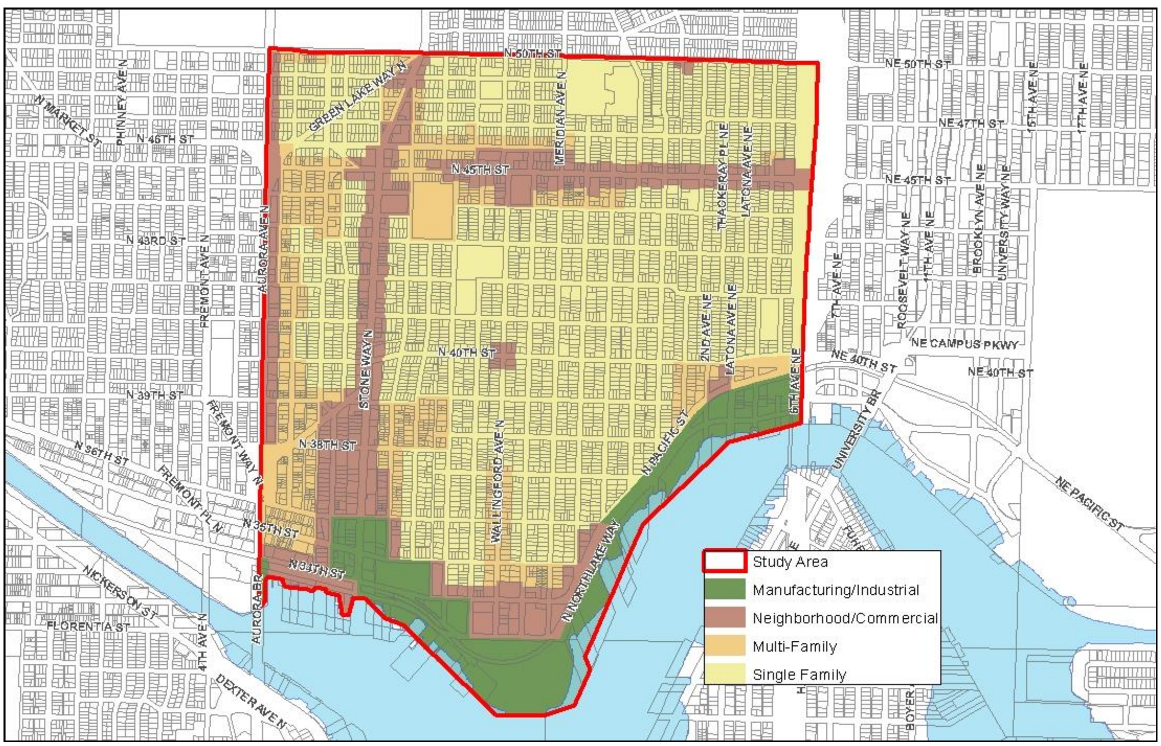

Figure 7--Current Zoning Map

Identifying Corridors

To guide our decisions for zoning revisions, we identified corridors within the study area. These corridors have the potential to host transit improvements, and because we are linking transit improvements to higher density, these areas are where the highest density should occur.

The current corridors with denser zoning within the study area are North 45th Street, Stone Way North, Aurora Avenue North, and North 35th Street. Each of these corridors is currently underutilized in their current zoning, and has greater potential for density than is currently being filled. Because of their unmet potential for compact development within current zoning restrictions, no upzones are proposed for these corridors.

In considering which additional areas to classify as corridors, we took a look at several criteria, all of which fall into either of two categories, Infrastructure Potential and Importance of Connections:

- Infrastructure Potential
  - Current arterials
  - Width of street
- Importance for Connections
  - Potential connections to destinations
  - Potential connections to other identified corridors
  - Connections to neighborhood hubs
  - Connections to other neighborhoods

Based on these criteria, we identified the following additional corridors within the study area:

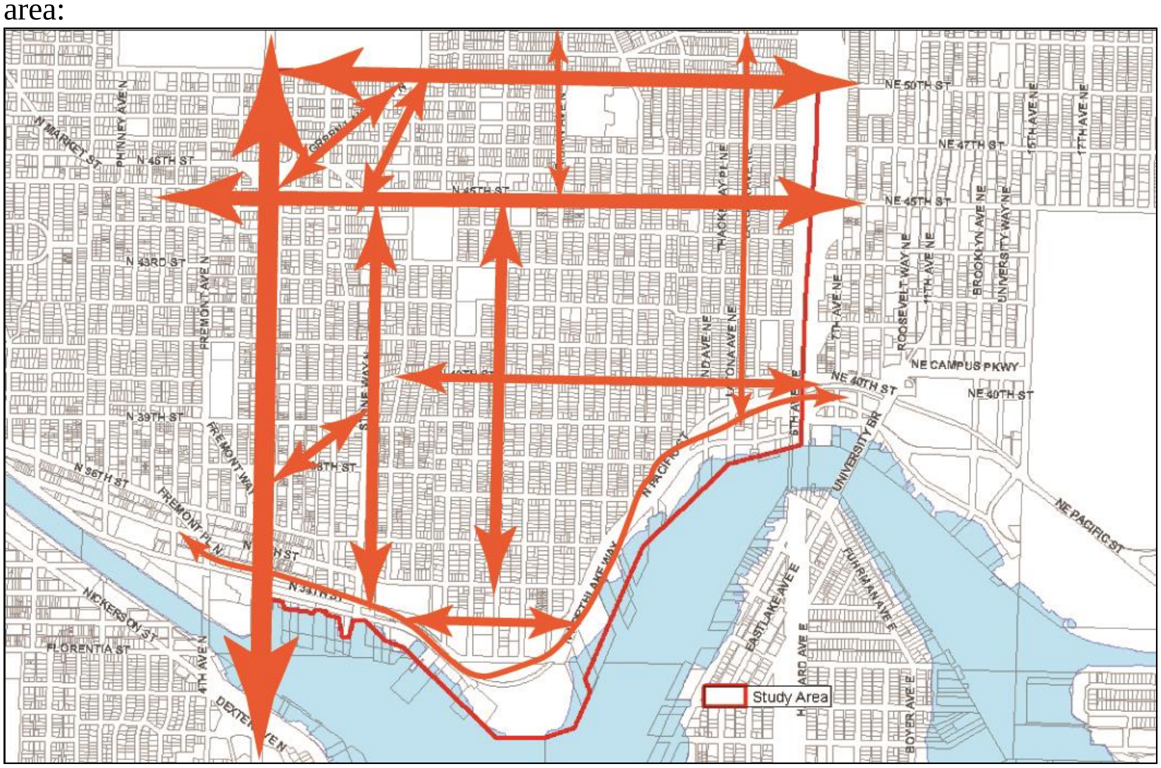

Figure 8--Wallingford Corridors

Each of these corridors will be targeted for greater density, as well as transportation and street improvements.

Proposed Zoning

The proposed changes to the zoning in Wallingford are based upon the identified transit corridors. The zoning along most of these corridors should be changed to Neighborhood Commercial to allow for a higher density of residents as well as opportunities for residents to walk to local amenities such as grocery stores, cafes and restaurants. The zoning surrounding these corridors were re-evaluated according to the following criteria:

- Use zoning to "step down" building heights to help minimize impacts to lower-density zones.
- To keep visual balance along streets, strive to change zoning mid-block, not mid-street.
- Maintain single-family zoning within the neighborhood while allowing greater density and variety of housing types.
- Maintain current zoning where corridors are already zoned for high density.
- Especially at street-level freeway crossings, encourage land uses that create a more pedestrian-friendly environment.

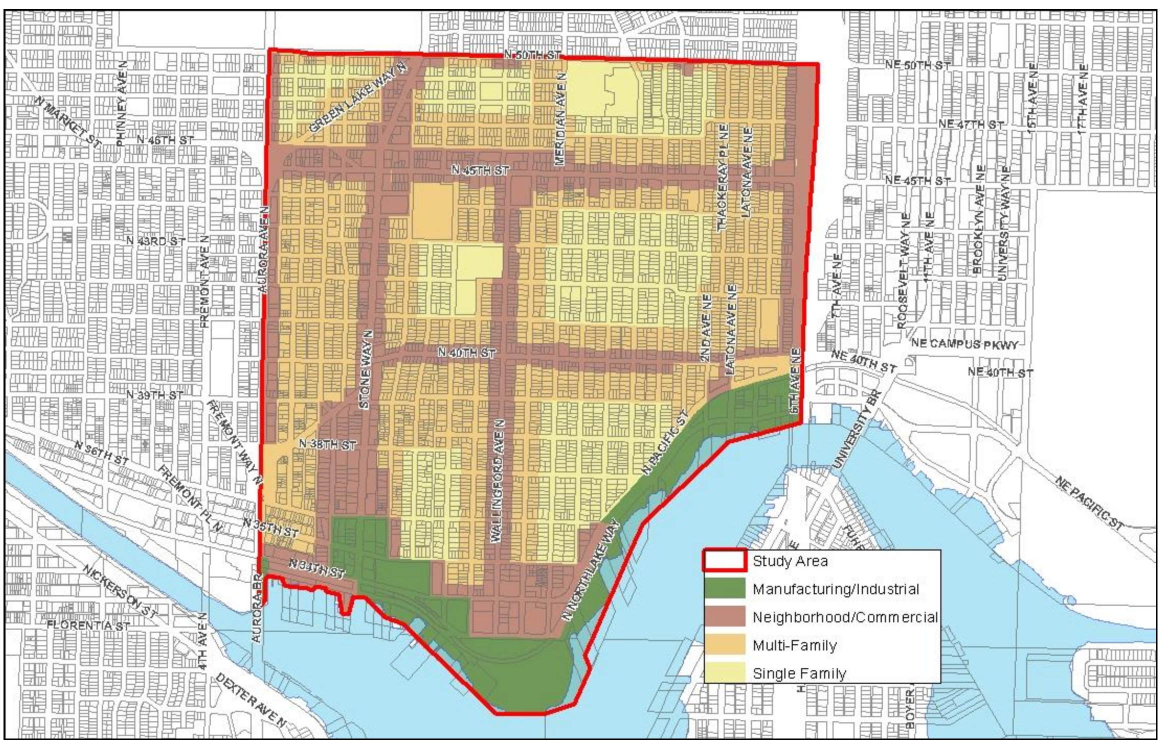

Figure 9--Proposed Zoning Map

Calculating the Changes to Zoning

The proposed zoning decreases the acreage of Single-Family homes from 58% of the study area to 22% of the study area, a decrease of 307 acres. Neighborhood/Commercial zoning increases by 90 acres, from 17% of the study area to 27%. Multi-Family zones increase by 218 acres, from 14% of the study area to nearly 40%. These increases in density limits will help to bring more residents into the neighborhood, increase the people per acre to over 20, and create an environment where transit is more likely to be used regularly.

Zoning Class	**# of Parcels (2010 Configuration)**	**Acres**	**Percent of Acreage**
Manufacturing/Industrial	128	95.91	**11.19%**
Multi-Family	923	121.50	**14.18%**
Neighborhood/Commercial	468	144.71	**16.89%**
Single Family	3061	494.80	**57.74%**
Total	4580	856.92	**100.00%**

Figure 10--Current Zoning—Land Area and Parcels

Zoning Class	**# of Parcels (2010 Configuration)**	**Acres**	**Percent of Acreage**	**Acreage Change**
Manufacturing/Industrial	128	95.91	**11.19%**	**0.00**
Multi-Family	2390	339.05	**39.57%**	**217.55**
Neighborhood/Commercial	1016	234.46	**27.36%**	**89.76**
Single Family	1102	187.50	**21.88%**	**-307.31**
Total	4636	856.92	**100.00%**	0.00

Figure 11—Proposed Zoning—Land Area and Parcels

Creating Pedestrian Connections Across Neighborhood Barriers

There are several points in the study area where pedestrian access to adjacent neighborhoods is discouraged by the presence of significant barriers. In particular, the construction of Aurora Avenue in 1936 and the construction of I-5 in 1962 isolated Wallingford from Fremont and the University District, leaving few access points to either neighborhood. Land use and zoning can be used to enhance these existing connections, and create more pleasant, inviting pedestrian experiences.

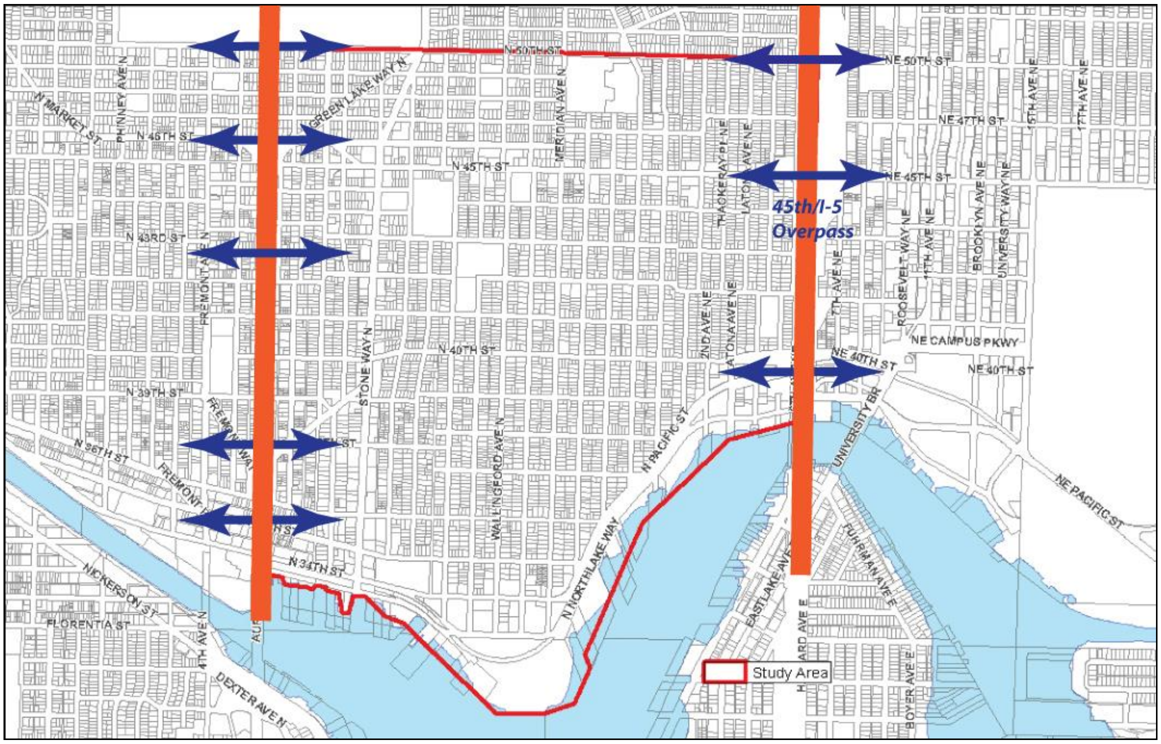

Figure 12--Pedestrian Barriers and Crossings

For all these connections, a major issue to overcome is the desirability of passage. This desirability consists of several components: distance, the pleasantness or disagreeableness of the distance traveled, and the destination.

A general set of rules that we can then apply to create better pedestrian crossings is:

- Reduce the width of the barrier
    - Encourage development at both ends of the crossing.
- Create destinations at each end of the crossing
    - These destinations can be both a perception of destination, such as an archway that welcomes you to the neighborhood, or a real destination, such as a restaurant or cluster of businesses.
- Make the walk through the barrier more pleasant
    - This could be accomplished with landscaping or complete streets.
- If possible, eliminate the barrier
    - This doesn't necessarily mean the removal of the barrier, but creating an environment past the barrier that makes the barrier irrelevant.

For this study, we've chosen the 45th Street overpass across I-5 as an example of how connections across the freeways can be improved. This crossing was chosen due to its importance as a pedestrian connection to the University District, the University of Washington and the future Brooklyn station of Link Light Rail. In addition, the 43rd Street Greenway will feed into this crossing, making it the single most important freeway crossing in Wallingford.

Figure 13--45th Street Overpass, Current Condition

This I-5 crossing presents a challenge to pedestrian travel, and interrupts a street with great pedestrian potential. On the south side, a pedestrian will cross streets, walk over a major freeway, pass dead zones and parking lots until they finally encounter any sort of destination, 1,200 feet later. This is a huge disincentive to walking from Wallingford to the University District. The need for improvements is great. With these issues in mind, here are some ways to fix it:

- There is a significant amount of unused land on the east side of the 45th Street Overpass. These fenced-off areas are rights-of-way administered by WSDOT, and are frequently trash-filled and used as campsites by the homeless. The City of Seattle should be encouraged to work with WSDOT to allow for commercial development of these properties to shorten the distance between used properties at the I-5 crossing. (Reduce the width of the barrier)
- The zoning of these parcels should allow for buildings as high as 85', and specify street-level retail. This will create greater incentive for development and create a destination for pedestrians crossing I-5. (Create a destination)
- The following changes would make the passage more pleasant:
    - Pedestrian barrier along the street
        - This would create a safer environment for pedestrians, and eliminate the danger of puddle splashes from street vehicles.
    - Wind/rain shelter for the length of the bridge
        - The bridge is extremely exposed in bad weather. This would create a walkable environment in the rain.
- The following changes would eliminate the barrier:

- Allow the widening of the bridge to accommodate buildings to house small businesses along the length of the span. Think of a modern *Ponte Vecchio* that connects two vital neighborhoods.
- Additional changes to make to the streetscape:
  - Where street traffic exits or enters freeway on or off-ramps, decrease the radius of the corners to slow down turning auto traffic.
  - Move the crosswalk crossing 45th St at 7th Ave out of the middle of the intersection to connect the SE and NE corners. A pedestrian island should be created at the midpoint of this crossing.

Figure 14--45th Street Overpass with Improvements

These improvements will create a much more pedestrian-friendly environment by slowing down traffic, creating a greater sense of enclosure, establishing a solid destination on the University side, and reducing the distance traveled across an area exposed to the weather.

Transportation Plan

Current Transportation Infrastructure

Wallingford’s transit options are currently bus only. Because of its geography, it doesn’t find itself as an origin or destination point of these bus routes, but instead a midway point that bus routes pass through. For east/ west travel, Wallingford is served by Metro 44, 30, and 31. For north/south travel, Metro 26 and 16 travel through the heart of Wallingford, with Metro 358 on its western border, and Sound Transit 510 and 511express buses making a stop on its eastern border.

Bus Routes

- *Route 44*
  The 44 is a familiar site to those traveling through Wallingford's busiest district along NE 45th St. It is a vital east/west link in the system connecting several high population areas. It is an electric trolley bus beginning in the western end of Ballard traveling through upper Fremont/lower Phinney neighborhoods before traveling through Wallingford on its way to the University District and ultimately ending and the University of Washington Medical Center (UWMC). Congestion along the 45th street corridor, especially at the gateways to Wallingford at Hwy 99 and I-5, often causes delays. Scheduled service is rather frequent, with 15 minute or less intervals during peak times.
- *Route 30*
  The 30 connects Wallingford to Seattle Center in Lower Queen Anne, Westlake Ave, and Fremont to the southwest, and the University District and northern reaches to the east and northeast. It only runs every half hour at peak times, and only hourly at off-peak.
- *Route 31*
  The 31 connects Wallingford to Fremont, Seattle Pacific University, and Magnolia to the west, and the University District to the east. It only runs every half hour at peak times, only hourly at off-peak, and does not run at night.
- *Route 16*
  The 16 connects Wallingford to Green Lake and Northgate to the north, and lower Queen and downtown to the south, ultimately ending at the Washington State Ferry dock. It's a rather long and winding route that can often lead to delays and long ride times. Segments of the route parallel old street car lines.
- *Route 26*
  The 26 is the primary route for residents of Wallingford commuting south to downtown. The route does a circle through Wallingford and Green Lake—much of it through more of the single-family housing neighborhoods—connecting the neighborhoods south to Fremont and downtown. There is also an express version of the route with fewer stops running at peak hours.
- *Route 358*
  The 358 is an express route traveling down Aurora Ave from Shoreline at the King/Snohomish County Line to downtown Seattle making limited stops along Aurora Ave on Wallingford's western boundary. It runs on frequent service (every 10 minutes or less during peak) providing a useful connection to residents of Wallingford's western edge.
- *Sound Transit Routes 510 and 511*
  The 510 and 511 are express routes to downtown coming from Everett and Lynnwood respectively that make a stop off at NE 45th St and I-5. The stop is often underutilized and is visually uninviting. Connections from these routes into Wallingford could be improved so that take transit into areas east and west of it could be more enticing for commuters from that direction, eliminating some drive-through traffic into the area from that direction.

Bus route performance indicators

Route	Peak: Rides per platform hour	Peak: Passenger miles per platform mile	Off-Peak: Rides per platform hour	Off-Peak: Passenger miles per platform mile	Night: Rides per platform hour	Night: Passenger miles per platform mile
44	52.4	15.9	46	15.2	30.8	70.2
30	38.1	11.5	28.2	8.7	21.3	6
31	34.5	8.1	23.3	5.7	n/a	n/a
16	36	12.3	33.7	12	17.3	6.8
26	59.3	11.5	52.4	13.4	29.3	6.2
358	418	18.8	50	20.5	33.3	15.4

Figure 15—Ridership performance of Metro routes running through Wallingford

Rides per platform hour is a measure of the number of people who board a transit vehicle relative to the total number of hours that a vehicle operates (from leaving the base until it returns). Passenger miles per platform mile is a measure of the total miles riders travel on a route relative to the total miles that a vehicle operates (from leaving the base until it returns). Blocks shaded in green are in the top 25% of route productivity in the system, while blocks shaded in gray represent routes in the bottom 25% of productivity.

The strong ridership numbers of the 44 contrasted with the weak numbers of the 30 and 31 suggest the possibility for consolidation of the routes through Wallingford into a more frequent, single route. Ridership on the 26 is strong although it's closely parallel running partner the 16 is middle of the road. This suggests the possibility for a better, more frequent combination of the two to capture both sets of riders. The robust numbers of the 358 support the expansion of improved service on this corridor, and illustrates the usefulness of making sure connections from Wallingford are provided.

Bike/Pedestrian Routes

- *45th Street Pedestrian Zone* - This commercial zone through Wallingford provides the main pedestrian thoroughfare through Wallingford. Changes in land use to parcels of it providing development more appealing to pedestrian traffic (i.e., fewer auto body shops, more cafes) will increase its allure.
- *Burke-Gilman Trail* – Along Lake Union, the southern boundary of Wallingford, likes this trail reserved for non-motorized travel connecting to Fremont and Ballard to the west, and to the University District and beyond to the east.
- *Sharrows* – 45th St and Stone Way have shoulders marked with "sharrows"—markers indicating shared use of the road for cyclists. Stone Way also has a dedicated bike path at the intersection of 40th to aid in safer crossing.
- *43rd St. Greenway* – SDOT is working on the installation of a greenway running down 44th and 43rd Streets that will act as an urban trail for cyclists. Traffic calming and parking limitations will be put in place to create a better environment. A median island and Stone Way and 43rd is proposed to provide a safer transition onto Stone Way, and the on towards Fremont.

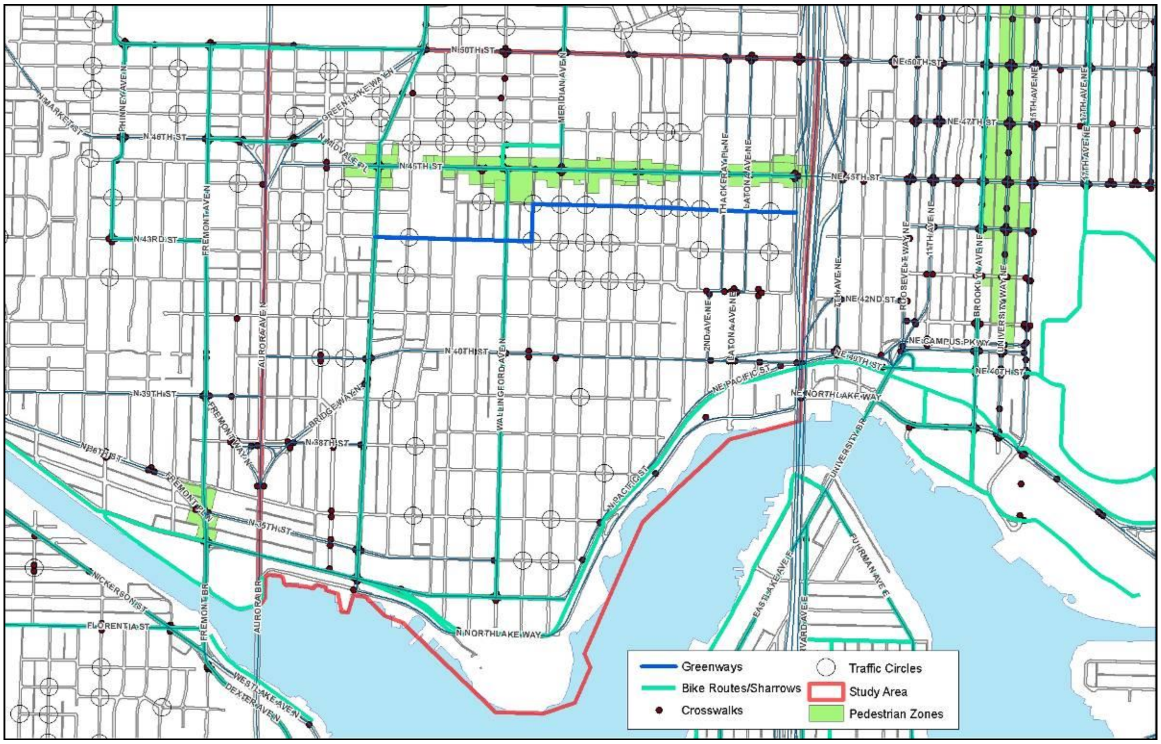

Figure 16--Current Bike Routes and Pedestrian Zones

Phased Implementation of Plan

Phase I (5 years)

Revised Zoning Plan

The first changes that must happen before transit improvements are implemented are the revisions to neighborhood zoning. This will help to ensure that there is a necessary level of density to support the transit plan. For the details of the zoning plan, see the Land Use section above.

Enhanced Bus Service

Because of Wallingford being sandwiched between high traffic areas of Fremont and Ballard to the west, and the University District to the east, it is important to focus attention on improving east/west transit service through the neighborhood. The first step to this will be splitting the 44 into two routes—a local version of the 44 and a new Metro Rapid Ride route—Line G.

Rapid Ride G

In October, 2010 King County Metro began service on its first "Rapid Ride" Line running from Federal Way to SeaTac Airport (Line A) and began service on a second (Line B) from Redmond to Bellevue in October, 2011, with more planned Lines on the way. The buses are new hybrid electrics recognizable by their distinct red and yellow coloring. With Metro's success in obtaining state and federal funding for these lines, and overall infrastructure already in place, it makes financial sense to begin improvements on this corridor with this system. Through July 2011, Metro had received a total of $82 million in federal and state grant funding for Rapid Ride buses and infrastructure.[6] Additional matching funding could possibly be acquired from large institutions and employers along the route who stand to benefit from better service (UW, Getty Images, Adobe, etc.).

Rapid ride stations differ from standard Metro buses and operate more like a fixed-station rail line. The buses sit lower to the ground and arrive at a raised curb stop so that steps aren't needed, and the front entrance has a quicker access accessible ramp. Passengers pre-pay at the platform enabling boarding and departure from all three doors. Bus stops are larger, more visible, well lit, and have security cameras for added safety. Additionally, the have boards showing arrival times for the next bus tracked by an automated vehicle location system, as well as larger route maps, making the stops much more user-friendly to those not as familiar with transit. Rather than a fixed printed schedule, the routes run on 10 minute or less headways during peak, and 15 minute headways during off-peak.

To help with faster travel times, street improvements are added such as larger curb bulbs and priority signals for queue bumps. The buses can also communicate with traffic signals to help with traffic flow.

The G Line route will divert south through Fremont instead of continuing along Market and NW 46th. This serves to help avoid the 99 interchange which often has congestion problems, but also to make the service available to the downtown Fremont area with its growing population and numerous transit connections. Additionally, the route will travel Stone Way, a corridor designated for further density in the land use plan. The new routing also provides connections to upcoming Rapid Ride D (Ballard to Lower Queen Anne and downtown), E Line (Aurora corridor), and ST510 and 511 express buses. It also will connect to the future Sound Transit Link station in the University District.

[6] King County, http://www.kingcounty.gov/transportation/kcdot/MetroTransit/TransitNow.aspx, December 7, 2011

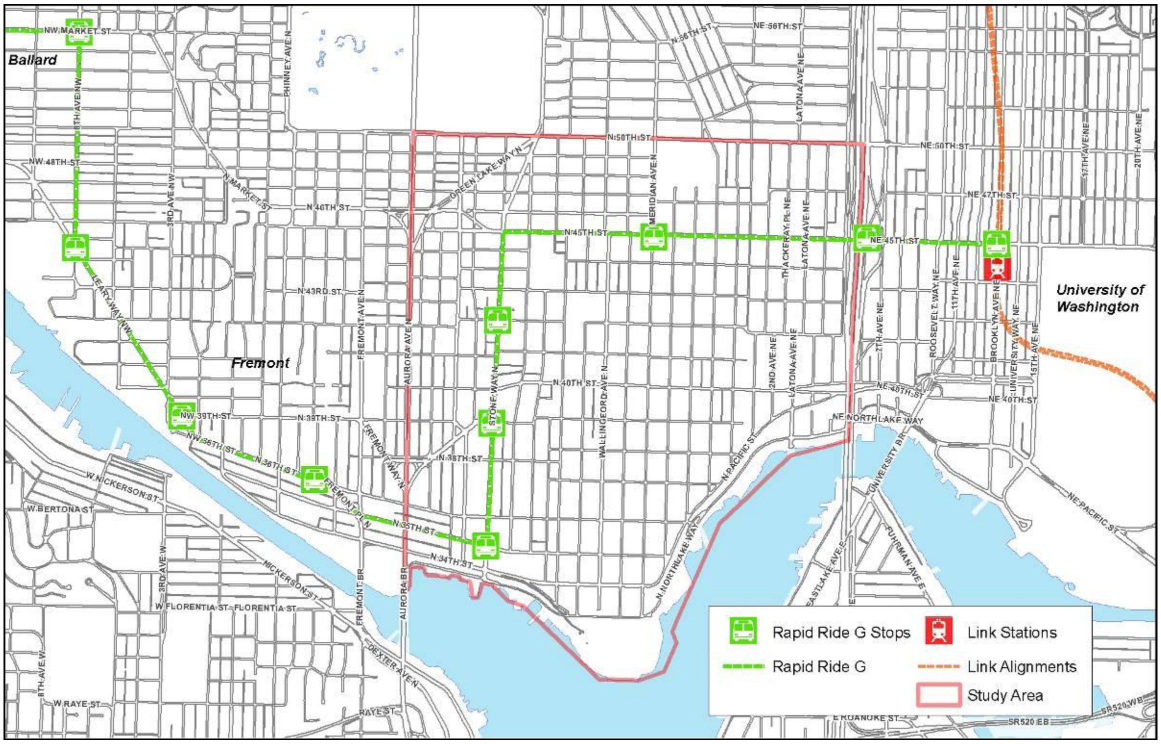

Figure 17—Rapid Ride G Route

Aside from new Rapid Ride stations, street changes to facilitate the route will include reduced street parking to accommodate a transit lane and priority signal in the Fremont & 35th, Stone Way, and NE 45th St stops. Opposition to removed parking may create the need to replace the lost parking spots with a city run parking facility to offset. Any parking would only be offset with the same number of spaces lost, and it would be recommended to include electric charging stations in these facilities to accommodate this growing technological need.

Route 44

Supplementing Line G, route 44 would remain in service running on reduced intervals, around 20 minutes at peak times and 30 minutes in off peak. The route would be necessary to serve the NW Market/N46th corridor, and also to provide night service. Given the existing electric trolley wires on the route, it makes most sense to leave the 44 on its current route.

Routes 30 and 31

Metro's 2012 proposed changes have the 30 being replaced by a new route 32, and route changes to the 31.[7]

[7] King County Metro, http://metro.kingcounty.gov/have-a-say/get-in-the-know/projects/route-information.html , December 7, 2011

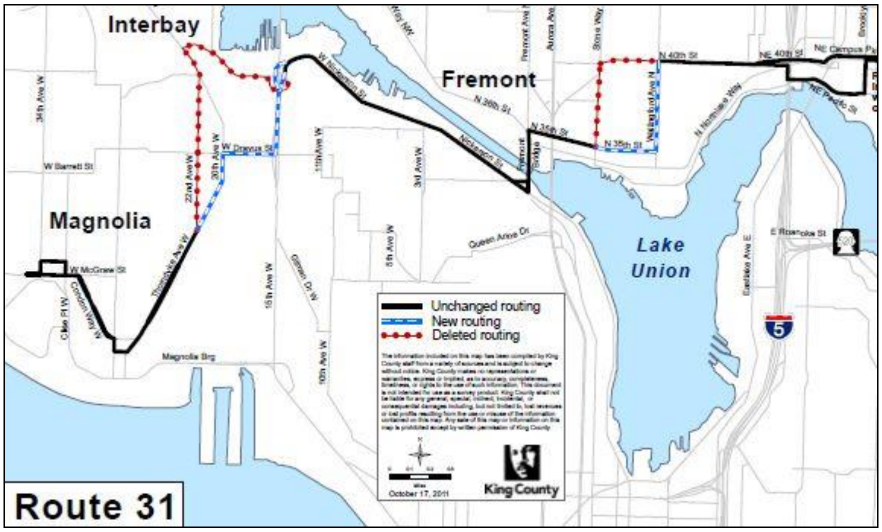

Figure 18—Proposed Route 31 changes

Figure 19—Proposed Route 32 changes

Both lines will provide greater accessibility and would be great additions. However, as proposed both will intersect right at the Fremont G Line stop if needed for cost savings the 31 and 32 could instead turn around in Fremont and passengers can transfer to G Line for quick service onward to the University District.

Route 16

Maintain current service relatively unchanged for the five year plan.

Route 26

Metro's proposed 2012 changes have the non-express routes of the 26 terminating in the University District rather than downtown.[8] Given the strong performance of the route, 26 service should be kept intact during initial 5 year timeframe. If savings are needed, it would be preferred to make cuts to 30/32 or 31 and preserve the 26.

Rapid Ride E Line

Metro is replacing the 358 with the E Line in 2012. Fast, frequent service will be of improvement to Wallingford residents near Aurora. Rapid Ride stops buses should serve as a safety improvement and reduce barriers to attracting riders. E Line will be accessible from Stone Way & NE 45th G Line stop, to a short walk to 46th & Aurora. Improve connection by investing in lighting and safety improvements to stairwell climbing to bus stop. Further improve accessibility to this route by installing a stop at 41st and Aurora by pedestrian overpass. Cycle and pedestrian improvements can be made to connect this to the proposed 43rd St greenway.

ST 510 and 511

Investments should be made in the north and southbound bus shelters of this area to be more visible and safer to take advantage of the G Line connection.

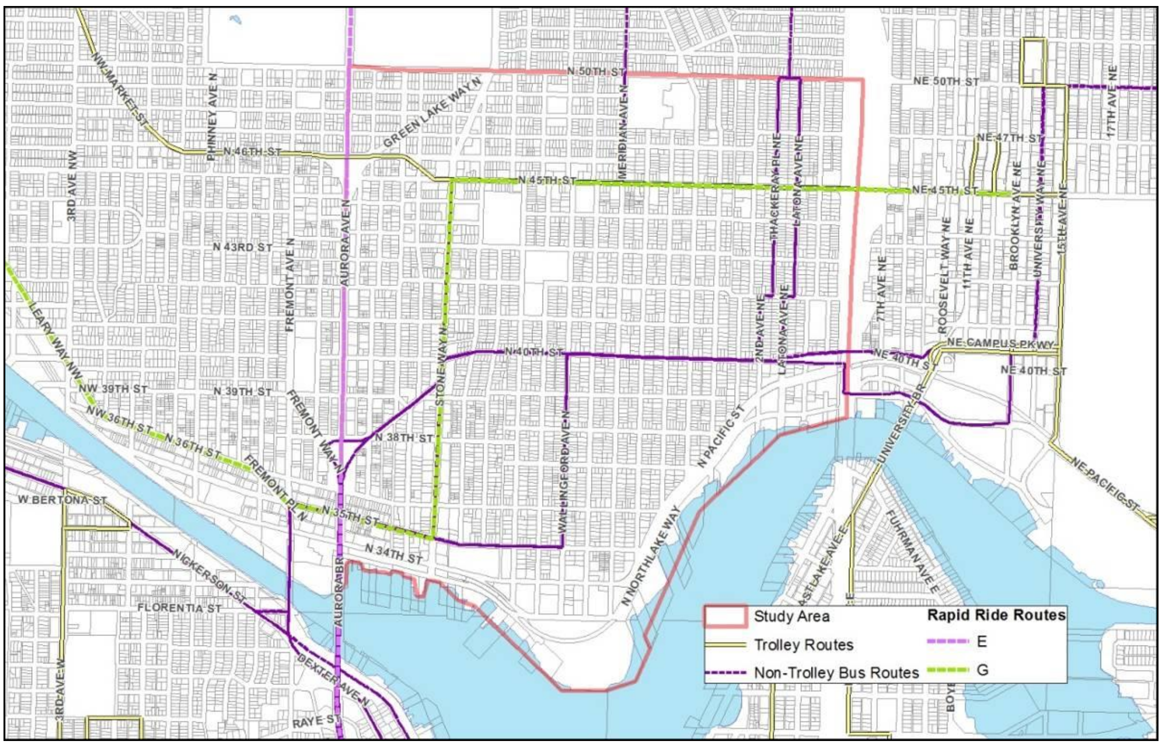

Figure 20--Phase I Showing Transit Lines

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[8] ibid

Phase II (10 years)

Wallingford /Green Lake spur of Seattle Streetcar

With a better east/west connection now in place with G Line and a connection in place to the newly opened Link station to the east, the next phase will be to extend the Seattle Streetcar north from downtown through Fremont and north through Wallingford and Green Lake. The route will be very similar to its predecessor a century before, heading north through Fremont, then up Wallingford Ave to Meridian. With frequent service that will no longer be burdened by vehicle traffic on the street, the 16 and 26 routes can be phased out as this line runs right in the middle of the two. The Fremont to downtown link also eliminates the need for route 30 or 32, creating further savings in operation costs.
In the long-term view, running a streetcar instead of the buses will attract more riders, collect more at the fare box, and have lower operating costs. As Kenworthy and Laube state "looking just within the US cities sample at those with and without rail systems, it is found that those with rail systems have some 117 annual transit trips per capital, while those that have only buses have 30 trips per capita".[9] Investing in a fixed guideway type of transit such as a streetcar also conveys a better sense of permanence and confidence in area homeowners and businesses. This confidence can help justify the capital investments. Collected studies by the Victoria Transport Policy Institute find that proximity to transit often increases property values enough to offset some or all of transit system capital costs.[10]

[9] J. R. Kenworthy and F.B. Laube. *Patterns of Automobile Dependence in Cities: An International Overview of Key Physical and Economic Dimensions with Some Implications for Urban Policy*. Institute for Science and Technology Policy, Murdoch University, 1999

[10] J.L Smith and T.A Girhing with T. Litman, *Financing Transit Systems Through Value Capture An Annotated Bibliography,* November 24, 2011

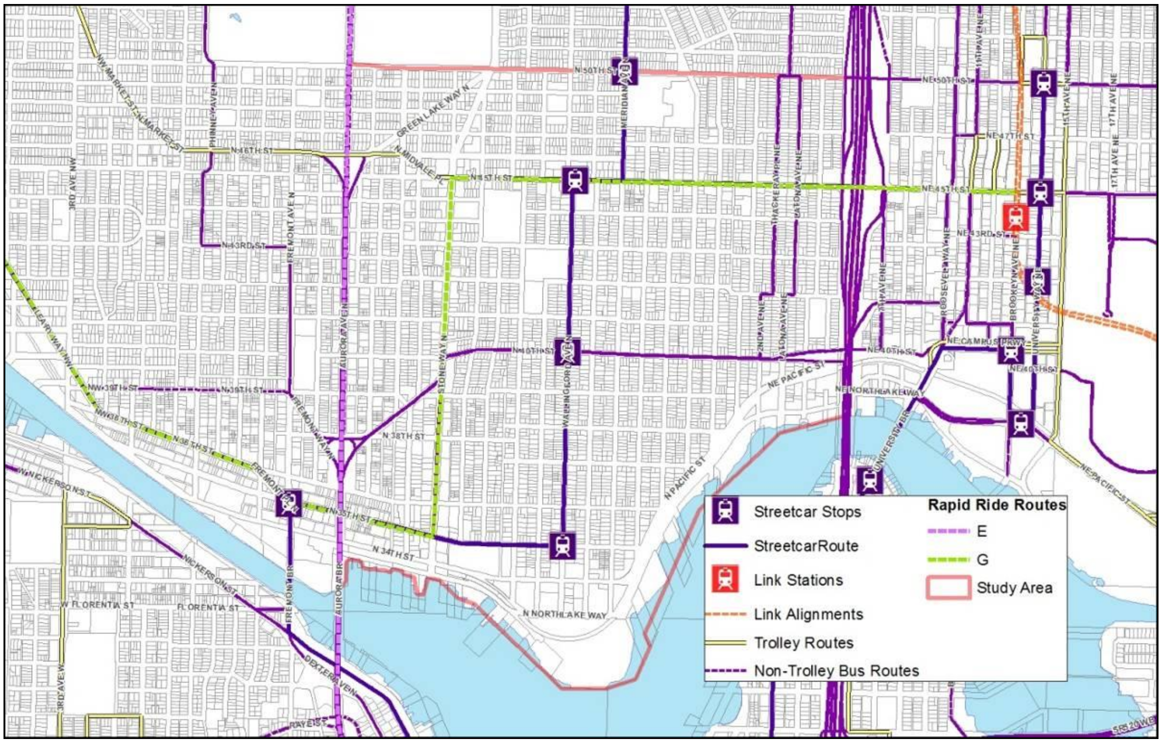


Figure 21--Phase II Showing Transit Lines

Phase III (20 years)

After 10 years Wallingford now has good north/south connections in place with the street car running to downtown, and further connections available by connecting to Sound Transit Link in the University District via G Line to the east, as well as the E line on Aurora. Given growing population densities in not only Wallingford but as well as surrounding neighborhoods, an even better east/west transit option is the next step. The solution will be to add a subway spur from Link extending from the Brooklyn Station west through Wallingford, Fremont, and out to Ballard. Upon completion of the line, Wallingford, with the combination of the streetcar and this subway line, will have rapid transit access both east/west and north/south. The G Line can then be phased out, as the subway will replicate most of the route, and the streetcar will fill in any gaps. The 44 will stay in place providing local service on the surface streets.

Potentially, the Ballard/University District subway could be extended across Lake Washington to directly serve commuters to the Eastside.

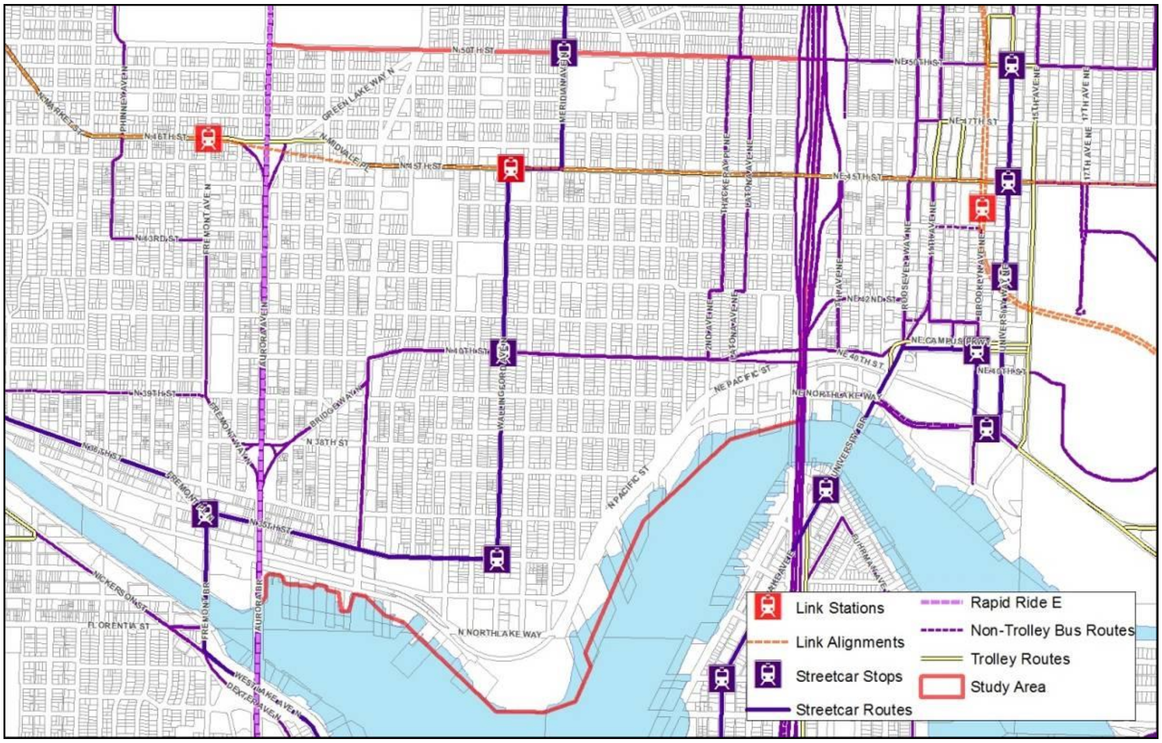


Figure 22--Phase III Showing Transit Lines

The following tables show the area that would be served by the rail transit modes. At Phase 3, a combined 55% of the study area would be within ½ mile of the proposed U-District—Ballard Link Subway.

FREQUENCY	Zoning Type	Distance From Station	Acres	% of Area
27	Multi-Family	Within 1/4 Mile	62.08	7.28%
34	Neighborhood/Commercial	Within 1/4 Mile	46.07	5.40%
12	Single Family	Within 1/4 Mile	41.70	4.89%
51	Multi-Family	Between 1/4 Mile & 1/2 Mile	144.58	16.96%
49	Neighborhood/Commercial	Between 1/4 Mile & 1/2 Mile	96.63	11.34%
21	Single Family	Between 1/4 Mile & 1/2 Mile	81.56	9.57%
	Subtotal Within 1/2 Mile		**472.61**	**55.44%**
36	Manufacturing/Industrial	Over 1/2 Mile	95.91	11.25%
30	Multi-Family	Over 1/2 Mile	127.91	15.01%
47	Neighborhood/Commercial	Over 1/2 Mile	91.77	10.77%
10	Single Family	Over 1/2 Mile	64.25	7.54%
	Subtotal Over 1/2 Mile		**379.83**	**44.56%**

Figure 23--Summary of Distances to Link Stations

Because of the routing, the Wallingford/Green Lake streetcar serves a much higher percentage of the study area. Fully 97% of the area of Wallingford is within ½ mile of a streetcar stop[11]. Approximately 48% of the neighborhood area is within a quarter mile of a streetcar stop.

FREQUENCY	Zoning Type	Distance From Station	Acres	% of Area
19	Manufacturing/Industrial	Within 1/4 Mile	44.97	5.28%
46	Multi-Family	Within 1/4 Mile	153.65	18.02%
54	Neighborhood/Commercial	Within 1/4 Mile	105.27	12.35%
15	Single Family	Within 1/4 Mile	105.85	12.42%
17	Manufacturing/Industrial	Between 1/4 Mile & 1/2 Mile	50.93	5.98%
52	Multi-Family	Between 1/4 Mile & 1/2 Mile	172.66	20.25%
67	Neighborhood/Commercial	Between 1/4 Mile & 1/2 Mile	118.78	13.93%
23	Single Family	Between 1/4 Mile & 1/2 Mile	78.85	9.25%
	Subtotal Within 1/2 Mile		**830.97**	**97.48%**
10	Multi-Family	Over 1/2 Mile	8.27	0.97%
9	Neighborhood/Commercial	Over 1/2 Mile	10.41	1.22%
5	Single Family	Over 1/2 Mile	2.80	0.33%
	Subtotal Over 1/2 Mile		**21.47**	**2.52%**

Figure 24--Summary of Distances to Streetcar Stops

[11] This does not take into account any barriers that may be between origin and streetcar stop destination.

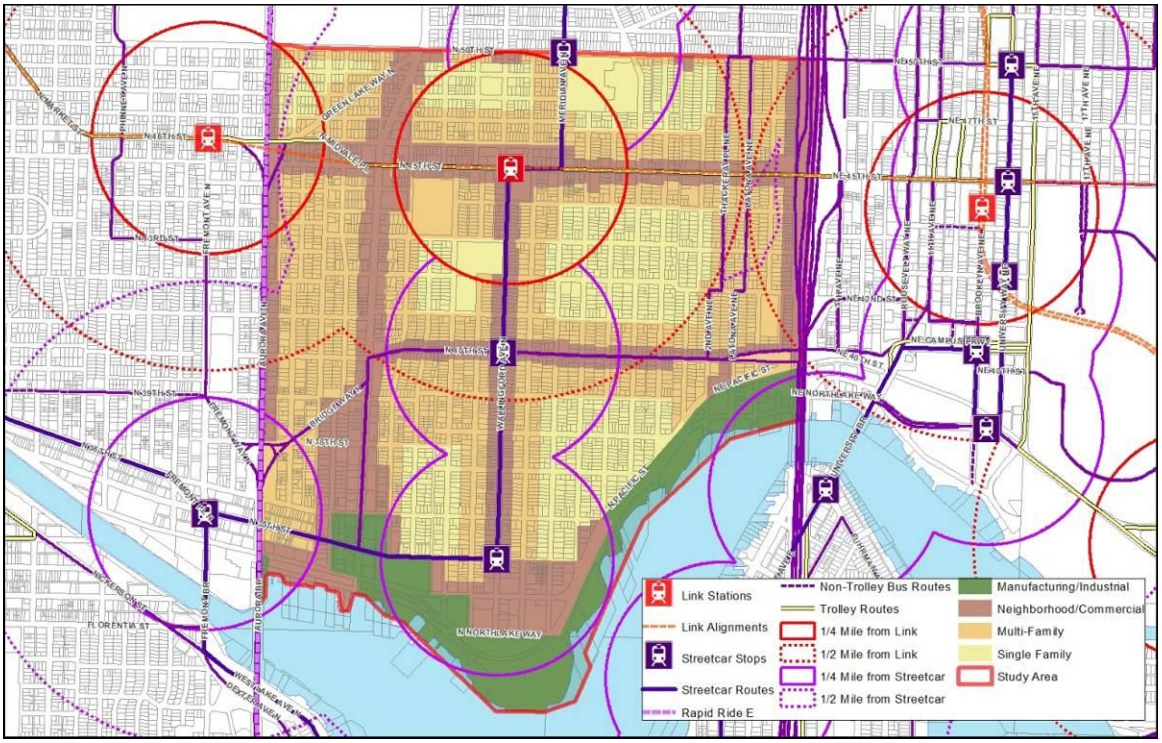


Figure 25--Phase III Showing Transit Lines, Service Buffers and Zoning

Automated Roadway Section

Overview

The plan includes a more speculative component exploring the possibility that technological changes may provide new transit opportunities at the extreme of the planning horizon 20 years out. Recent innovations in communication and sensor technology suggest that the technical challenges of mitigating the shortcomings of human drivers may be overcome. This process will likely result in vehicles equipped with a significant capacity for autonomous control. For the purpose of this proposal a limited accommodation is made for this developing technology.

The primary goal of such a system is to alleviate traffic congestion along major east-west corridors by facilitating cross town trough traffic. Possible knock-on effects include;

- improved traffic flow on traditional lanes
- decreased stop-start traffic and reduced idling
- Improved pedestrian safety with fewer vehicles moving from arterial to side streets to avoid congestion
- reduced parking requirements
- improved transit access and personal mobility for elderly and disabled individuals

Proposal Details

The proposal reserves the center (turn) lane of 50th street for intermittent use by automated traffic. Special signaling will alert traffic (and pedestrians) to vacate the center lane (and complete left turns) well in advance of automated traffic. Traffic at intersections along the route would be stopped in all directions and in a sequence allowing uninterrupted passage of vehicles at a steady speed of @ 30 mph along a route stretching from the UW to Ballard neighborhood in the west. The lane would be reserved for automated traffic for 45 seconds (including a 10 second warning period) every five minutes. Vehicles would travel in groups of three tightly spaced vehicles with three vehicle lengths between groups. Aggregation and disaggregation of vehicle groups would take place opportunistically as there would be no physical barrier between traditional and automated lanes. The lanes themselves, especially at intersections, would be heavily invested with sensors and the capacity to communicate directly with vehicles.

Automated Traffic Capacity Calculation: Theoretical Load Capacity

Assumptions

- 35 second passing times with 10 second warning period
- Automated traffic on 5 minute intervals
- 3 vehicle platoons, minimal spacing inside platoons (@12”)
- Average Speed 30mph

- Platoon Spacing 3 vehicle lengths

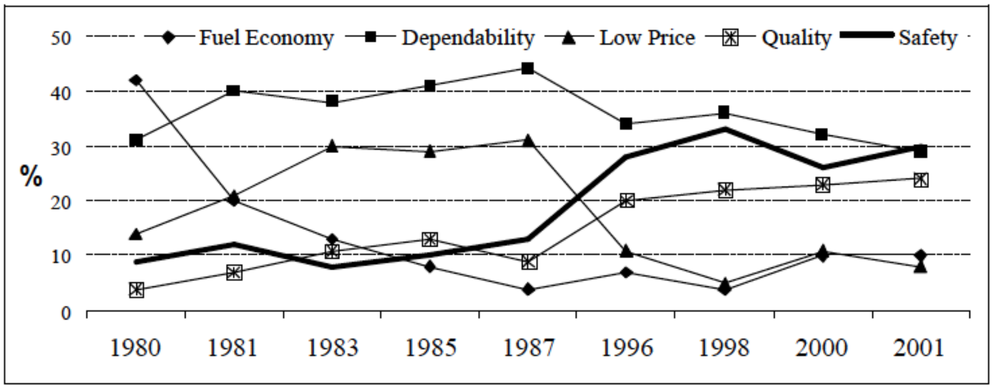
Calculations

- platoon length = platoon(ave car length x 3) + spacing(ave car length x 3)= 90ft (@15' car length)
- Distance covered at 30mph per second= (30mi (158,400 ft) /60min/60sec) = @45'/sec
- Total Linear Measurement of Platoons in Transit during available transit time= 35sec x 45'/sec=1,600'
- Total Number of vehicles in transit during available transit period= (1,600'/90ft per platoon) x 3 per platoon -%20 innefficiency= @45 vehicle capacity per transit period
- Total hourly capacity of Lane = 12 transit periods x 45 vehicles= 540 per hour (lane in use 15% of available time)
- 30 mph Automated Lane 24 hr capacity = 13,000 (one way)
- 45th street traffic (one way)=11,000
- 50th (one way)=12,600
- 55 mph Automated Lane 24 hr capacity = 23,000 (one way)
- 55 mph lane uninterrupted 24hr capacity = 153,000 (one way)
- hwy 99 at 45th (one way) = 19,000
- I-5 at 45th (one way includes express) = @150,000

Adoption of Intelligent transportation systems

Predicting technological change is problematic under any circumstances, and doing so for a technology so fraught with cultural, legal, and economic implications even more so. There are however some historical precedents which may provide some grounding for this speculation. The increasingly accepted use of active safety systems is reminiscent of the process that saw the adoption of more passive systems such as airbags and ABS. While not commonplace such systems - lane departure warnings, collisions alerts, even direct accident avoidance - are finding their way into an increasing number of luxury and even mid-price vehicles. The steadily increasing consumer focus on safety as an important consideration when buying a vehicle is likely to drive further developments of this type.

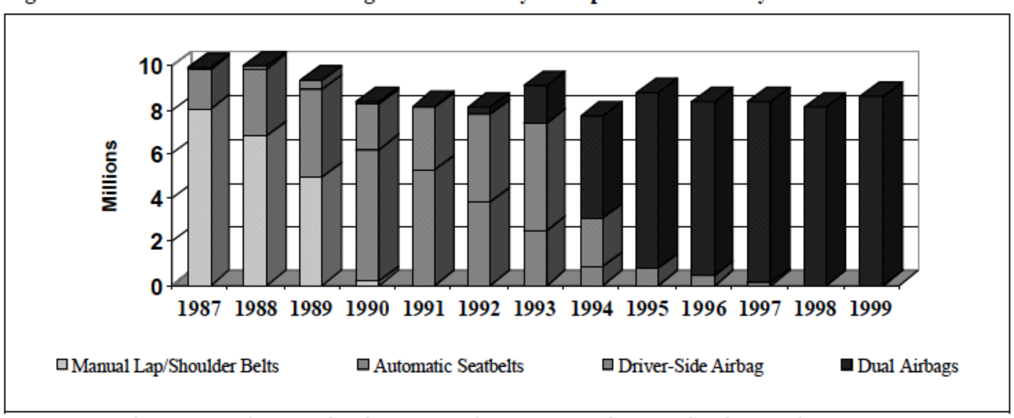
Figure 2-2 History of Consumer Valuation of Vehicle Attributes



Sources: For 1980s: J. D. Power (data based on new car buyers). For 1996+: Opinion Research Corporation International (ORCI) for National Renewable Energy Laboratory (NREL), Studies # 707089, 709318, & 710288.

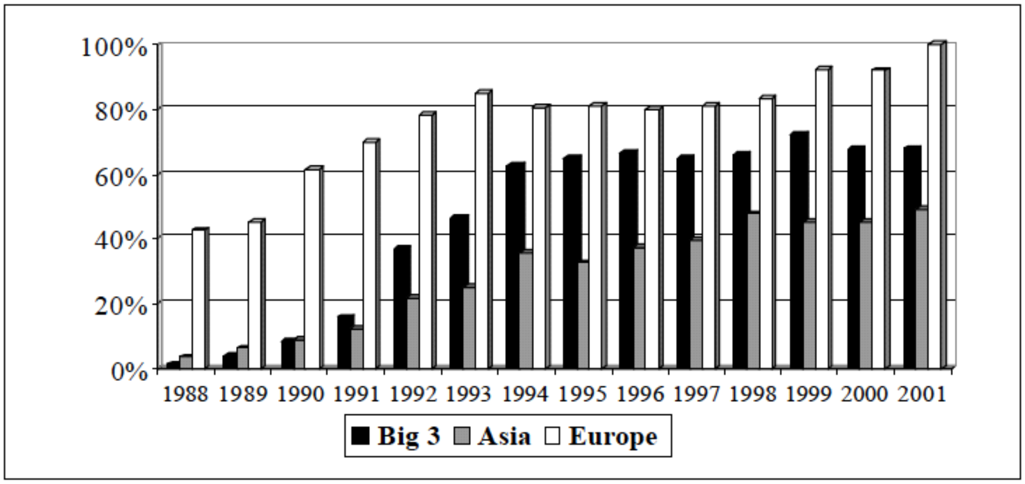
Braking technologies in particular bear a resemblance to active safety features in that they assume control of the vehicle's braking function, reducing the driver's autonomy to a significant degree. ABS and airbags saw rapid adoption after a long period of technological maturity and minimal implementation. In both cases reluctance by manufacturers was finally overcome by legislation mandating the deployment of the safety features, usually after lobbying by the insurance industry.

Figure 2-1 Annual U.S. New Passenger Car Sales by Occupant Restraint System



Source: Ward's Automotive Yearbook, Automotive News Market Databook – Various Years

Figure 3-14 Anti-Lock Braking System Installation Rates on Cars Sold in the U.S.



Source: Ward's Automotive Yearbook (Various Years)

The speed at which more active safety technologies are implemented, especially those that are capable of assuming complete control of the vehicle, is impossible to predict. It is important to keep in mind that airbags and anti-lock brakes provided only marginal reductions in accident and injury rates. Active safety systems, on the other hand, have the potential to *substantially* reduce the number of casualties on the road. If that potential can be confirmed in the performance of the limited number of luxury vehicles being equipped with the technology, then pressure to expand their use is likely to be significant. The cost of implementing active systems, based as they are on presently available technology, also falls within the model of previous safety technologies.

For the purpose of calculating the potential benefits of an automated system we assume that a mandate of autonomous capability for safety reasons is at least ten years away. Vehicles equipped to take full control in emergency situations would be, for all intent and purpose, capable of autonomous operation during routine operation. If after 2025 all new vehicles are so equipped, and assuming an annual vehicle replacement rate of 5%, it is unlikely that the number of potentially autonomous vehicles would exceed 30% by 3030.

CO2 Impact Calculation

The impact on CO2 emissions stems mainly from the greater efficiency of vehicles moving non-stop through the neighborhood. This should be fairly significant for two reasons - less energy expended during acceleration and an overall reduction in ride duration. The later is significant because cross-town traffic presently moves at an average of 15mph - half of the projected steady speed of the autonomous lane.

Overall CO2 efficiency depends on the number of vehicles both equipped and inclined to use the automated lane for cross-town traffic. Assigning a 30% greater efficiency to automated traffic and assuming no more than 50% of properly equipped vehicle (@15%) make use of the lane, an approximate reduction of 5% in overall automotive CO2 might be expected.

Conclusion—Automated Roadways

What is the relation does this proposal have to sustainability in general and sustainable transportation in particular? It is clear that most of the problems we address when we attempt to achieve sustainability stem directly or indirectly from our reliance on automobiles for transportation. Our goal is often to reduce this reliance by making automobile use inconvenient or expensive, creating greater opportunities for public transportation, or to decrease the need for cars by adopting policies that encourage compact development and transit-oriented land use. Is there a place for automobiles within this sustainable framework? Cars do increase personal mobility, and will always be convenient and suitable for many uses. Will they be replaced, or could they be reformed?

Google Car....or Masdar?

Summary

In this paper, we have emphasized the need to address issues of zoning and land use simultaneously with improvements to transportation systems. To ensure the success of transportation systems, there needs to be a sufficient density in terms of people per acre. We lay out a plan where the potential for density is increased before creating new transportation systems, which will help to ensure a successful implementation of sustainable transit.

Only after the potential for greater density is created through zoning revisions do we lay out our plan for sustainable transit. We do this by increasing the opportunities for walking connections within the neighborhood and to adjacent districts, implementation of Bus Rapid Transit, creation of a streetcar spur connecting the neighborhood to downtown, and finally, the creation of a new LRT subway that connects Ballard and Wallingford to the LRT line currently under construction in the University District. The prospect of a smart lane for automated roadways was also considered to be a possibility, depending on technical advancements in this field.

We believe that this is a realistic plan, although in the real world the time frame may extend past the 20 years allotted in this assignment. Seattle is a young city, and will have both opportunity and need for greater density and urban transportation solutions. We view this plan as a way for Wallingford to age both gracefully and sustainably.